Essays on Integrating Families and Demographics into Macroeconomics

by

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Dedication

To my wife, Nicole.

Without her endless love and encouragement, I couldn't have accomplished what I have.

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Abstract

In this dissertation, I integrate families and demographic structure into macroeconomics and use these methods to study family policies and intergenerational mobility.

The first chapter develops a heterogeneous-agent overlapping generations model to study the macroeconomic consequences of family policies. The model integrates the quantity-quality trade-off, a multi-period demographic structure, and childcare choices. I calibrate the model to U.S. data and validate the magnitude of the model's predictions using the Alaska Permanent Fund Dividend (APFD). In counterfactuals, I find that raising aggregate fertility to the replacement level requires a $30,000 cash reward to childbirth, but such a policy reduces average human capital and intergenerational mobility. Nevertheless, average well-being rises by 1.6% in the long run as the old-age dependency ratio drops, requiring lower taxes to sustain retirement benefits. Compared with cash rewards, in-kind benefits are less cost-effective in raising fertility but have other advantages: subsidized childcare encourages parents to work, while expansions of public education improve children's human capital and intergenerational mobility.

The second chapter explores the role of unintended fertility in perpetuating intergenerational persistence of socioeconomic status. Nearly 40% of births in the United States are unintended, and this phenomenon is disproportionately common among Black Americans and women with lower education. Given that being born to unprepared parents significantly affects children's outcomes, could family planning access affect intergenerational persistence of economic status? We extend the standard Becker–Tomes model by incorporating an endogenous family planning choice. When the model is calibrated to match observed patterns of unintended fertility, we find that intergenerational mobility is significantly lower than that in the standard model. In a policy counterfactual where states improve access to family planning services for the poor, intergenerational mobility improves by 0.3 standard deviations on average. When we calibrate the model to match unintended birth rates by race, we find that differences in family planning access alone can account for 20% of the racial gap in upward mobility.

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Chapter 1

The Macroeconomic Consequences of Family Policies

1.1 Introduction

During the past decades, family policies have become increasingly important in developed economies. They are social programs and laws designed to promote and enhance family formation, reproduction, and child-rearing. These programs include both in-cash benefits (e.g., baby bonuses and child tax benefits) and in-kind ones (e.g., subsidized childcare, public pre-K).

At the aggregate level, family policies are one of the key policy instruments to address population aging, which poses a threat to the sustainability of the public pension system (Bongaarts 2004). At the household level, policymakers and economists believe that family policies are effective instruments to improve children's outcomes and boost social mobility.[1] From an economic point of view, family policies are deployed to redistribute resources across households and to address, albeit indirectly, inefficiencies arising from imperfect capital markets and fiscal externalities of childbearing (Schoonbroodt & Tertilt 2014). Since the 1980s, government expenditures on family policies have been growing steadily among OECD countries, exceeding 2% of GDP on average.

Despite the importance and wide implementation of large-scale family policies, little is known

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[1] For instance, see The White House (2021), Schanzenbach et al. (2021), and Pulliam & Reeves (2021).

about their macroeconomic implications. Are family policies cost-effective in achieving stated macro-level goals of raising fertility, reducing the fiscal burden of the government, and improving social welfare? On a more micro level, do generous child benefits improve an average child's outcome and raise social mobility? Given that changes in demographic structure take decades to realize, what do we know about the long-term effects versus outcomes in transition? With a variety of available policy instruments, how should policymakers choose among them, especially between in-cash and in-kind benefits? These questions are central to understanding and designing the consequences of family policies.

In this paper, I develop a unified framework to study these questions. The proposed model integrates four ingredients that are crucial for analyzing family policies: endogenous fertility and child investments, heterogeneity across parents, a multi-period life cycle with pension, and childcare choices. These ingredients matter because they facilitate the analysis of the key mechanisms of family policies.

To be more specific, first, the model allows households to choose both the quantity and quality of children. From a policy perspective, both the quantity and quality margins are important because they correspond to the two main goals of family policies – raising fertility and improving children's outcomes, respectively. Moreover, the two margins are closely linked by the *quantity-quality trade-off* à la Becker & Lewis (1973).

Second, heterogeneities across parents affect the consequences of family policies through *composition effects*. As we see in the model and data, heterogeneous parents respond differently in their fertility and child quality decisions to a given policy regime. Some parents increase fertility more than others, meaning that their children comprise a larger share of the population in the future. Because parents and children tend to have similar traits (e.g., human capital) due to intergenerational linkages, aggregate variables depend more on the traits of parents with stronger fertility responses. Therefore, even when policies raise individual child's human capital, the effects on aggregate human capital could still be negative.

Third, while most models on family policies consider agents that live for two periods and/or abstract away from the pension system (e.g., Liao 2013; Kim et al. 2021), this paper explicitly models a multi-period life cycle with a pay-as-you-go (PAYG) system of Social Security. Beyond making the model more realistic, this ingredient allows me to quantify the *demographic structure effect* of family policies: following an increase in the population growth rate, the burden of pension payments is relieved, but public expenditures for children rise. In fact, this effect is one of the original goals that governments have in mind when they implement family policies.

Last, unlike most models with endogenous fertility where each child costs a fixed amount of time (Jones et al. 2008), I consider *endogenous childcare choices* where parents can choose to either take care of children by themselves or utilize market childcare services. Besides allowing the model to generate childcare utilization patterns in the data that are otherwise hard to explain, this ingredient allows the model to inform one of the most important discussions about family policies in practice: should the government use in-cash policies (e.g., baby bonuses or child allowances) or in-kind ones (e.g., subsidized childcare vouchers)?

Besides identifying these mechanisms theoretically, I discipline the model's quantitative predictions by connecting it to data in two ways. First, I calibrate the model to match the U.S. economy in 2010 and identify the key parameters that governs the magnitude of fertility responses to financial incentives, i.e., *fertility elasticities*. Specifically, fertility elasticities are most affected by two key parameters in the model: the elasticity of intergenerational substitution (EGS) and the productivity of investment goods in children's human capital formation.[2] Because EGS governs how the marginal benefits of having children varies with parents' human capital, I identify it using the income-fertility profile. As the productivity parameter dictates the benefit-cost ratio of education intervention programs, I calibrate it to match the investment returns estimated by García et al. (2020) using data from a randomized trial.

Furthermore, I show that the model's predictions are consistent with the effects of the Alaska Permanent Fund Dividend (APFD), a universal basic income policy that implicitly encourage parents to have more children. Using difference-in-differences methods, I find that the APFD increases the completed fertility rate in Alaska by 0.17 children per women and the effect is larger among women with lower education. The policy also lowers the overall college enrollment. Besides the

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

APFD, I find that quasi-experimental evidence from several other family policies also corroborates the magnitude of the calibrated fertility elasticities in the model.[3] These external validation exercises lends extra credibility for me to use the model to conduct policy counterfactuals.

The policy counterfactual analyses reveal four main findings. First, a baby bonus (cash reward for childbirth) of $30,000 boosts the average fertility rate in the U.S. from 1.9 children per woman to 2.1 children per woman, the replacement level.[4] The amount of this transfer is similar to 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. I find that parents with lower human capital respond more strongly to the baby bonus, raising fertility by a greater proportion. Such a child benefit, however, is not effective in raising child human capital or social mobility. Under the calibrated EGS, parents optimally reduce child education investments by an average of 4% due to the quantity-quality trade-off, and this reduction is larger among low-income parents. The heterogeneous reductions in education investments, coupled with composition effects due to differential fertility responses, lower average human capital by 2% and intergenerational income mobility by 1.6% in the long-run steady-state equilibrium.

Second, despite reductions in average human capital and social mobility, long-run average welfare rises by 1.6% in consumption equivalents under the $30,000 baby bonus.[5] The key to this result is that as the old-age dependency ratio falls following an increase in fertility, the government is able to reduce tax rates while still balancing the fiscal budget due to a smaller burden of pension payments. This is a novel result showing that despite the negative human capital effects, family policies could improve social welfare through interactions with the pension system.

Third, the welfare consequences for existing agents can be very different from those in transition or in the long-run steady state. During the first few decades of transition, the government will need to finance both direct policy expenses and higher child-related public expenditures as children make

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[3] Additional validation exercises include comparisons with the Australian baby bonus, the Spanish child benefits, and the Maternal Capital in Russia. See Appendix 1.D for details.

[4] I use the replacement fertility as a benchmark policy goal since it is "widely considered among policy makers and the public as the desirable level of long term fertility" (Striessnig & Lutz 2013). Section 1.6 discusses whether this goal is optimal in itself from a welfare point of view.

[5] Long-run welfare is defined as the average utility of a new-born under the veil of ignorance. See Section 1.6 for further discussion.

up a larger proportion of the population. While the old-age dependency ratio falls gradually, the total dependency ratio overshoots in the first few decades before converging to its long-run level. If the government, for example, chooses to balance the budget from period to period using changes in the consumption tax, most households in the current economy will bear higher tax burdens. These additional expenditures in transition are quantitatively significant. Therefore, policy discussions should not only focus on the long-run gains in alleviating pension liabilities, but should also devote more attention to the financing challenges and distributional consequences along the transition path.

Last, I compare baby bonuses with subsidized childcare and expanded public education funding. I find that these in-kind policies are less cost-effective in raising fertility than the cash rewards but offer other advantages. In particular, subsidized childcare encourages parents to work in the labor market because it substitutes home production of childcare with market childcare services. The resulting increase in working hours, especially among parents with low human capital, reduces wage inequality. Among all policy instruments studied in this paper, public education most effectively improves children's outcomes and boosts social mobility. However, it also has the smallest effect on fertility.

Related Literature

This paper is most related to the literature that use structural models to analyze the aggregate impacts of family and child-related policies. The closest papers are Liao (2013) and Kim et al. (2021). They both examine the aggregate impacts of policies that restrict or subsidize fertility, calibrating models to match China or South Korea. My paper builds on their work by considering a model with multi-period life cycle and the interaction between family policies and the pension system. These ingredients are important in understanding the quantitative implications of family policies on tax and welfare in counterfactuals. Another set of papers focus on the role of family policies in relaxing borrowing constraints and encouraging labor supply (e.g., Daruich 2018 and Guner et al. 2020). This paper complements their work by showing that fertility response to incentives is an essential part of the analysis due to mechanisms discussed above.

This paper is also related to a macroeconomic literature with endogenous fertility choices. Notable examples include Barro & Becker (1989), Greenwood et al. (2003), Doepke (2004), Erosa et al. (2010), Manuelli & Seshadri (2009), Daruich & Kozlowski (2020), Córdoba et al. (2019), Jones (2020), and Cavalcanti et al. (2021) among many others. Each of these papers shares some ingredients in common with the framework here, but they all answer different research questions. This paper contributes to the literature by providing a unified framework tailored to analyze family policies and generate policy predictions. Furthermore, it uses the APFD to provide novel empirical evidence on fertility elasticity, a key object disciplining the quantitative strength of mechanisms related to endogenous fertility in this class of models.

In addition, this paper is related to the empirical studies on the fertility effects of family policies (e.g., Milligan 2005; Haan & Wrohlich (2011), Drago et al. 2011; González 2013; Laroque & Salanié 2014; Gaitz & Schurer 2017). My paper complements this literature in two ways. First, I provide a structural framework to interpret the regression results and conduct policy counterfactuals. Second, the model allows me to study the policy effects in the long run and in transition: children affected by these policies age and become parents in their own right, changing the distribution of the underlying population of interest.

Finally, the paper contributes to a growing literature evaluating the impacts of transfers to parents on children's lifetime outcomes (Dahl & Lochner (2012), Daruich (2018), Abbott et al. (2019), Mullins (2019), and García et al. (2020)). The conventional wisdom in the literature is that transfers to families have positive impacts on children being affected, including improving health and education attainment and reducing criminal behavior (Schanzenbach et al. 2021). This paper differs by considering endogenous fertility responses. I show that under empirically plausible fertility elasticities, introducing the "extensive margin" of endogenous fertility reverses the policy effects on average outcome of children and intergenerational mobility.

The rest of the paper is organized as follows. In Section 1.2, I present the quantitative model. Section 1.3 describes the calibration of the model in detail. I conduct validation exercises in Section 1.4. Section 1.5 presents the main policy counterfactual results of the paper. Section 1.6 discusses optimal policy design and Section 1.7 concludes.

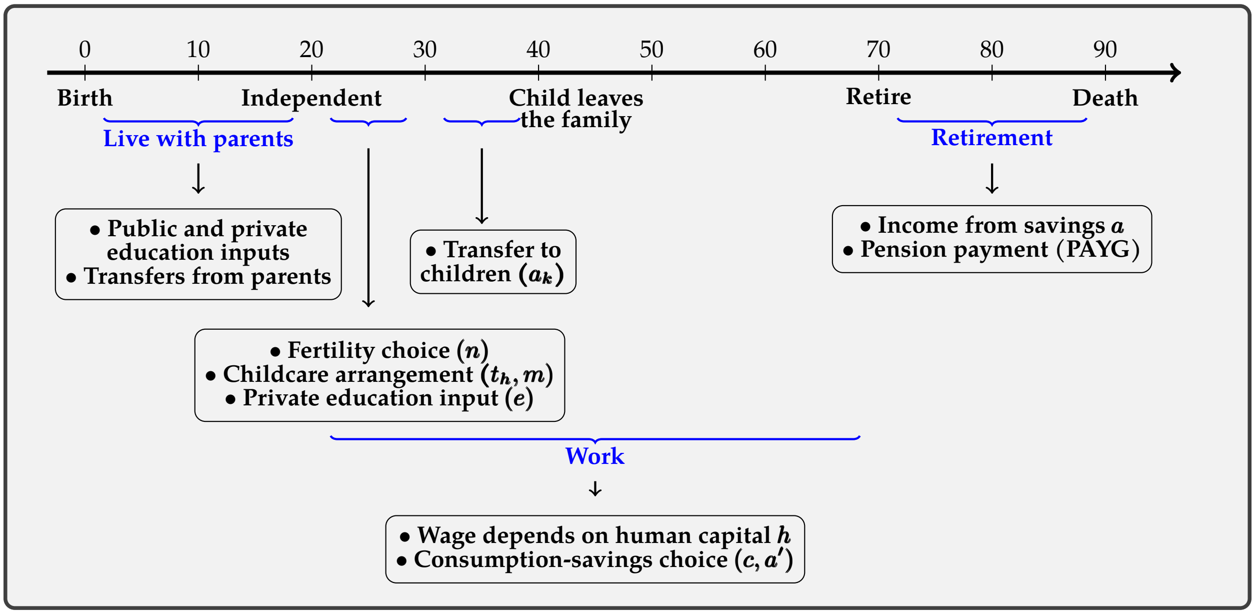
1.2 Model

I study a general-equilibrium overlapping generations (GE-OLG) economy. Households make choices over consumption and saving, child quality and quantity, and childcare. Representative firms hire labor and borrow capital from households. The government finances public education, pension payments, and other (exogenous) spending using distortionary taxes.

1.2.1 Household

Consider overlapping generations of households that live up to 90 years.[6] I split the life cycle into 9 periods indexed by $j \in \{0, 1, 2, \ldots, 8\}$, each representing 10 years. Period j therefore reflects age $j \times 10$ through $(j+1) \times 10$.

Figure 1.1: Model's Life Cycle



The life cycle of each agent in the model is presented in Figure 1.1. Children live with their parents from age 0 to 20, during which time they make no choices and receive human capital investments from both public and private sources. Children also receive inter vivos transfers from

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[6] In this paper, I model unitary/collective decision-making within families and abstract away from intra-household bargaining. Hereafter, I use agents, households, and adults interchangeably.

parents when they become independent and form families in their 20s. Households choose fertility, childcare arrangements, and private child human capital investments from age 20 to 30.[7] Between ages 30 and 40, parents determine the amount of inter vivos transfers that their children would receive at the beginning of the next period.

People work from age 20 to 70, and their earnings depend on the amount of efficiency units, i.e., human capital, supplied to the market. Human capital for working adults evolves over time following an age-dependent learning-by-doing process:

$$h_{j+1} = L_j(h_j, t_w, z_{j+1}), \tag{1.1}$$

where z_{j+1} is an idiosyncratic, uninsurable shock to human capital that occurs at the beginning of period $j+1$; h_j is the amount of human capital at period j; and t_w is the time worked in period j. Agents have unit time endowment and supply labor inelastically, with the exception of period 2 where they trade off providing childcare at home against supplying labor in the market.[8]

Agents retire at the end of period 6 (age 60 to 70). Retired adults receive income from savings and pension payments for the remainder of their lives. Households make consumption-savings choices in each period and face an age-specific survival rate δ_j.

At the beginning of period 2 (age 20 to 30), the state variables for young adults are the human capital level h and assets a. Both h and a are endogenously determined in equilibrium by the young adults' parents during previous periods. Agents choose consumption c, savings a', fertility n, total time spent providing at-home childcare t_h, amount of market childcare purchased for each child m, and private education investment for each child e.[9] Parents' value $V_2(\cdot)$ is composed of flow utility from consumption $u(c/\Lambda(n))$ and the discounted continuation value $\beta V_3(\cdot)$. Consumption

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[7] In Appendix 1.A.3, I argue that the main results of this paper are robust to allowing for endogenous timing of childbirth where parents can also give birth in their 30s.

[8] I have experimented with adding endogenous labor supply with leisure in the utility function. Quantitative results remain largely unchanged, but computation time is significantly increased, especially for the transition path. Therefore, I omit labor supply in the baseline model.

[9] Following Barro & Becker (1989), de La Croix & Doepke (2003), and most subsequent work, the fertility choice n is continuous in the model. An alternative approach is to use discrete fertility and add states or idiosyncratic shocks (e.g., Daruich & Kozlowski 2020). Since the model is calibrated to match aggregate moments on income-fertility relationship, the second approach yields similar results once the additional state space are integrated over.

expenditure c is divided by equivalence scale $\Lambda(n)$.[10] Their maximization problem is given by

$$V_2(h,a) = \max_{c,a',n,t_h,m,e\geq 0} u(c/\Lambda(n)) + \beta \mathbb{E} V_3(h',a',n,\mathbb{E}h_k)$$

subject to

$$n\cdot\chi = \left(t_h^{\upsilon/\iota} + (n\cdot(m+\mathcal{S}))^{\upsilon}\right)^{1/\upsilon}, \qquad \text{[time cost]}$$

$$y = wh\cdot(1-t_h), \qquad \text{[labor income]}$$

$$(1+\tau_c)(c+p_m\cdot n\cdot m + e\cdot n) + a' = (1+r)a + y - \mathcal{T}(y,a,n) + \mathcal{B}\cdot n, \qquad \text{[BC]}$$

$$h' = L_2(h, 1-t_h, z'), \text{ and} \qquad \text{[learning OTJ]}$$

$$h_k = G(h,\mathcal{E},e,\epsilon). \qquad \text{[skill formation]}$$

To raise n children, parents need to produce $n\cdot\chi$ amount of childcare (in time units). Parents could satisfy this need either by spending their own time at home (t_h) or by purchasing market childcare services m. The government chooses to provide in-kind childcare $\mathcal{S}\in[0,\chi]$ free of charge to parents. These two forms of childcare are combined in a constant-elasticity-of-substitution (CES) production function where υ governs the elasticity of substitution. Household production of childcare enjoys an economy of scale with parameter $\iota\in(0,1)$. This captures the fact that taking care of two children at home simultaneously costs less than two times the hours needed to take care of a single child (Folbre 2008).

The opportunity cost of home production of childcare t_h is hours spent in the labor market.

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[10] As defined by Browning et al. (2013), "An equivalence scale is traditionally defined as the expenditures of the household divided by the expenditures of a single person that enjoys the same 'standard of living' as the household. Just as a true cost of living price index measures the ratio of costs of attaining the same utility level under different price regimes, equivalence scales are supposed to measure the ratio of costs of attaining the same utility level under different household compositions."

The household's labor income y is the product of the market wage w, human capital h, and time worked $(1 - t_h)$. Total resources available to the parents consist of risk-free assets a multiplied by the gross interest rate $(1 + r)$, labor income y, net taxes paid $\mathcal{T}(y, a, n)$, and the total amount of baby bonuses received $\mathcal{B} \cdot n$ where $\mathcal{B}$ is chosen by the government. The household divides resources into savings a' and different expenditures, including consumption c, total spending on market childcare $p_m \cdot n \cdot m$, and private education expenditures $e \cdot n$. I use p_m to denote the price of market childcare relative to consumption goods.[11] All expenditures are subject to a proportional consumption tax τ_c.

The child human capital production function $G(h, \mathcal{E}, e, \epsilon)$ combines parents' human capital h, public education $\mathcal{E}$, private investment e, and idiosyncratic ability shocks ϵ which are unknown to the parents. To keep the model tractable, I make a simplifying assumption that parental investments in child human capital take place when children are between age 0 and 10 while public education $\mathcal{E}$ affects children throughout age 0 to 20. The function $G(\cdot)$ captures the overall human capital production function that spans age 0 to 20 without explicitly modeling several stages of production. Moreover, to the extent that the bulk of childcare needs $n \cdot \chi$ are non-educational (i.e., preparing food or changing diapers), childcare arrangements do not affect child human capital directly in the model.[12] Parents can invest in their children's human capital through monetary investments e. As the government chooses public education expenditures $\mathcal{E}$, the model could replicate the public provision of high-quality childcare or pre-K by adopting high $\mathcal{S}$ and $\mathcal{E}$ at the same time.

In the economy, households face an inter-temporal borrowing constraint $a' \geq 0$ that is standard in the class of Aiyagari-Bewley-Huggett models. Moreover, parents cannot invest negative amounts of resources in children's education, i.e., $e \geq 0$. As a result, public investment $\mathcal{E}$ serves as a lower

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[11] In the model, the supply of childcare services is perfectly elastic at baseline price p_m. Since each period represents ten years, adjustments of capital and labor in and out of the childcare industry equate childcare prices to long-run marginal costs so long as the industry is perfectly competitive. In the short run, of course, relative prices of childcare may change in response to family policies.

[12] As Guryan et al. (2008) have noted, educational childcare time accounts for at most one quarter of the time that parents spend with their children. Furthermore, Bernal & Keane (2011) find that among single mothers, the use of formal center-based childcare, resembling m in the model, do not affect children's cognitive achievements. In a recent paper, Chaparro et al. (2020) develop a model of childcare with both quality and quantity aspects of maternal and non-maternal care. In their model, effects on child human capital are proportional to both care quality and time "exposed" to each type of care, but they do not explicitly consider non-educational time spent with children. The model in this paper separates the essence of childcare into non-education chores χ and endogenous education investments e, which includes the premium paid to obtain high-quality childcare services.

bound of the total education investment received by each child.[13]

Parents' maximization problem from age 30 to 40 is given by

$$V_3(h, a, n, \mathbb{E}h_k) = \max_{c,a',a_k \geq 0} u(c/\Lambda(n)) + \beta \mathbb{E}V_4(h', a') + v(n, \mathbb{E}h_k, a_k)$$

subject to

$$y = wh,$$

$$(1 + \tau_c)c + a' + n \cdot a_k = (1 + r)a + y - \mathcal{T}(y, a, n), \text{ and} \tag{1.2}$$

$$h' = L_3(h, 1, z'),$$

where parents choose consumption, savings, and the amount of transfers to be received by each child at the beginning of the next period (a_k).[14] Parents face intergenerational borrowing constraints so that they are not allowed to make negative transfers to children, i.e., $a_k \geq 0$. I use $v(n, \mathbb{E}h_k, a_k)$ to denote parents' preferences over child quantity, child human capital, and inter vivos transfers. I discuss the parametric form of $v(\cdot)$ in detail in Section 1.3.1.

For $j \in \{4, 5, 6\}$, households solve a simple consumption-savings problem with idiosyncratic shocks to human capital. The maximization problem is given by

$$V_j(h, a) = \max_{c,a' \geq 0} u(c/\Lambda(0)) + \beta \delta_j \mathbb{E}V_{j+1}(h', a') \qquad j \in \{4, 5, 6\}$$

subject to

$$(1 + \tau_c)c + a' = (1 + r)a + y - \mathcal{T}(y, a, 0) \text{ and}$$

$$h' = L_j(h, 1, z).$$

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[13] As public education funding depends on local taxation (Kotera & Seshadri 2017), one might worry that the amount of education resources received by each child is not uniformly $\mathcal{E}$. The child human capital production function $G(\cdot)$ allows for this possibility through its dependency on parents' human capital h. In other words, $\partial G(\cdot)/\partial h$ captures not only the genetic transmission of ability but also ability transmitted via other channels such as residential segregation.

[14] I discuss the robustness of the main results when I add end-of-life bequests to the model in Appendix 1.A.4.

Finally, retired agents solve

$$V_j(h,a) = \max_{c,a' \geq 0} u(c/\Lambda(0)) + \beta\delta_j V_{j+1}(h,a') \qquad j \in \{7,8\}$$

$$(1+\tau_c)c + a' = (1+r)a + \pi \cdot wh - \mathcal{T}(0,a,0) \text{ and}$$

$$V_9(\cdot) \equiv 0,$$

where household income is composed of risk-free assets and pension payments $\pi \cdot wh$, and where π denotes the pension replacement rate.[15]

1.2.2 Firms

There is a representative firm in the economy that hires labor and borrows capital from households to produce final goods with Cobb-Douglas technology

$$Y = AK^{\alpha}H^{1-\alpha}. \tag{1.3}$$

In Equation (1.3), K is aggregate capital used in production and H is total efficiency units employed. Without loss of generality, we normalize total factor productivity A to one.[16]

Physical capital depreciates at rate δ_K after use. With competitive factor markets, the equilibrium wage and risk-free interest rate are given by

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

1.2.3 Government

The government collects revenues from taxing labor income, capital income, and household expenditures (including spending on market childcare and children's education). Government

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[15] For simplicity, I assume that pension payments are not subject to labor income taxes.

[16] I abstract away from population externalities that could affect aggregate production such as pollution (Bohn & Stuart 2015) and idea creation (Jones 2020). This choice is made since (1) the literature on the measurement of population externalities is still developing, and (2) the results will change in expected ways once positive/negative externalities are incorporated.

expenditures include public education, family policies, pension payments, and other policy-invariant expenditures, denoted Ω, that depends on the mass of adults. The government balances the budget from period to period.[17]

I use $\{\mu_j\}_{j=0}^{8}$ to denote the distribution of households across the state space and $\{\omega_j\}_{j=0}^{8}$ to denote the fraction of each age group in the population, with the total mass normalized to one at each date. The government budget is given by

$$\begin{aligned}\underbrace{\left(\sum_{j=2}^{6}\omega_j\int\mathcal{T}(y_j^*,a_j^*,n_j^*)\,d\mu_j\right)}_{\text{labor and capital income taxes}}+\tau_c\underbrace{\left(\sum_{j=2}^{8}\omega_j\int c_j^*\,d\mu_j+\omega_2\int n^*\cdot(p_m\cdot m^*+e^*)\,d\mu_2\right)}_{\text{consumption taxes}}&=\underbrace{\underbrace{(\omega_0+\omega_1)}_{\text{mass of children}}\cdot\mathcal{E}}_{\text{public education expenditures}}\\ \underbrace{+\,\pi\cdot\left(\sum_{j=7}^{8}\omega_j\int wh\,d\mu_j\right)}_{\text{pension payments}}+\underbrace{\omega_2\left(\underbrace{\int n^*\cdot\mathcal{B}\,d\mu_2}_{\text{baby bonus}}+\underbrace{\int(1+\tau_c)\cdot n^*\cdot p_m\cdot\mathcal{S}\,d\mu_2}_{\text{subsidized childcare}}\right)}_{\text{family policy expenditures}}&+\underbrace{\sum_{j=2}^{8}\omega_j\cdot\Omega}_{\text{other spending}}\,.\end{aligned}\tag{1.4}$$

1.2.4 Equilibrium

I use t to denote time. The equilibrium of the economy is defined as a tuple composed of:

- decision rules $\{c_t^*, a_t'^*, n_t^*, m_t^*, t_{h,t}^*, e_t^*, a_{k,t}^*\}_{t=0}^{\infty}$,
- prices[18] $\{w_t^*, r_t^*\}_{t=0}^{\infty}$,
- government policies $\{\mathcal{T}_t(\cdot), \tau_{c,t}, \mathcal{B}_t, \mathcal{S}_t, \mathcal{E}_t\}_{t=0}^{\infty}$, and
- distribution of agents $\{\{\mu_{j,t}\}_{j=0}^{8}, \{\omega_{j,t}\}_{j=0}^{8}\}_{t=0}^{\infty}$,

such that households maximize utility subject to idiosyncratic shocks, prices clear labor and capital markets, the government balances the budget in each period, and the distribution of agents evolves following the dynamics shaped by household decision rules, exogenous human capital shocks z, and the ability shock for children ϵ.

The evolution of the human capital distribution from parents to children is given by

$$\mu_2'(h)=\frac{1}{N}\iint n^*(x)\mathbb{1}_{h_k^*(x,\epsilon)<h}\,d\mathcal{Q}(\epsilon)\,d\mu_2(x),\tag{1.5}$$

---

[17] I discuss the possibility of allowing for government borrowing in Appendix 1.A.6.

[18] Recall that the relative price of childcare p_m is exogenous in the model.

where $\mathcal{Q}$ denotes the distribution of the child ability shock ϵ. Variable $h_k^*(x, \epsilon)$ is the human capital of a child whose ability shock is ϵ and parents' human capital is x. N is the aggregate fertility rate in the economy defined as:

$$N = \int n^*(x)\, d\mu_2(x). \tag{1.6}$$

In a stationary equilibrium of the economy, decision rules, prices, and distributions are unchanged over time. The size of the population, however, could vary over time as the aggregate fertility rate is not necessarily at the replacement level. Under mild conditions that are satisfied by the model, a stationary distribution exists and is unique (see Mode 1971; Chu 1990).

1.2.5 Welfare

To facilitate comparisons between different government policies, I define social welfare in the long run $(\mathcal{W})$ as the *average value* of households at the beginning of their life cycle:

$$\mathcal{W} = \int V_2\, d\mu_2, \tag{1.7}$$

where both V_2 and μ_2 are endogenous equilibrium objects. The welfare metric $\mathcal{W}$ measures the expected utility of a newborn child under the veil of ignorance by summing up the discounted utility flow from later life periods. When making welfare comparisons, I convert the changes in $\mathcal{W}$ into percentage changes in consumption equivalents. Since the welfare metric $\mathcal{W}$ does not reflect the policy effects for households who are *already alive* when the policy is enacted, or for those who will be born in the *transition phase*, I also assess how these people are affected by family policies in Section 1.5.3.

In the model, government policies have the potential to improve the well-being of agents for two reasons. First, childbearing and child-rearing carry fiscal externalities as parents do not internalize the effects of having an additional child or investing in child human capital on the future tax base and government revenues. Atomic parents take the age structure $\{\omega_j\}_{j=0}^{8}$, distribution $\{\mu_j\}_{j=0}^{8}$, and tax rates as given, but these objects will change when a mass of parents adjust their decisions on fertility and education investments. Following this line of logic, Schoonbroodt & Tertilt (2014) argue that due to parents' lack of property rights over children's future output, the equilibrium level of fertility is too low relative to the planner's solution. Different from Schoonbroodt & Tertilt (2014), in a model with heterogeneous agents and public transfers (i.e., taxes, education, and pension), the equilibrium fertility could be either too high or too low depending on parental characteristics.[19]

Second, parents face both inter-temporal and intergenerational borrowing constraints due to imperfections in capital markets. Parents cannot borrow against their children's future income or their own future income to finance current expenditures. Government policies can overcome these inefficiencies by providing in-cash or in-kind transfers (Daruich 2018; Abbott et al. 2019).

1.2.6 Discussion of Mechanisms

In this section, I discuss the mechanisms through which family policies affect the economy. In particular, I highlight how the features of this model (namely, fertility and child quality choice, endogenous demographic structure, and childcare arrangements) make the model's predictions on the overall impacts of family policies distinct from those in standard models.

Quantity-Quality Trade-Off

Consider the effect of an increase in the baby bonus $\mathcal{B}$ on private education investment into child human capital formation e, which determines children's expected human capital $\mathbb{E}h_k$.[20] The first-order condition of e is given by

$$\underbrace{MU_c \cdot n}_{\text{marginal costs of } e} \quad = \quad \underbrace{\frac{\partial v(n, \mathbb{E}h_k, a_k)}{\partial \mathbb{E}h_k} \times \frac{\partial \mathbb{E}h_k}{\partial e}}_{\text{marginal benefits of } e}. \qquad \text{FOC } [e]$$

When fertility is exogenous, i.e., n is fixed, the increase in $\mathcal{B}$ is an *income transfer*, which implies that e rises unambiguously due to income effects. As the marginal utility of consumption MU_c decreases, e needs to increase to keep the first-order condition satisfied.

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[19] The policy implications of this observation, however, are less straightforward than one might think. Due to intergenerational persistence of human capital, a tempting conclusion is that the policymaker should restrict fertility among the poor (Chu & Koo 1990). Setting aside the rampant ethical concerns over such a policy, I show that this argument is not valid in Sections 1.5.1 and 1.6.3.

[20] The same argument applies to inter vivos transfers a_k.

When fertility is endogenous, however, the increase in $\mathcal{B}$ is a *price change*. The direction in which e changes is ambiguous. As fertility n rises due to more generous child benefits,[21] it affects the first-order condition in three ways. First, it interacts with e in parents' preferences $v(\cdot)$. If quality and quantity are complements, parents demand higher e *ceteris paribus*, and vice versa.[22] Second, rising quantity could potentially offset the income effect since higher n raises the marginal utility of consumption via the change in the equivalence scale $\Lambda(n)$. Last, the marginal cost of e rises because it is proportional to fertility n due to their interaction in parents' budget constraint (see Equation (1.2)).[23] Considering endogenous fertility allows for the possibility that e - hence children's human capital h_k - could fall when family policies become more generous. In Section 1.5.1, I show that both indeed fall in the calibrated model.

Composition Effects

Because parents differ by human capital h and asset holdings a, they respond differently to the same baby bonus $\mathcal{B}$ or subsidized childcare $\mathcal{S}$.[24] With an endogenous quantity-quality trade-off, children from families with stronger fertility responses account for a larger fraction of the future population. Combined with the intergenerational transmission of traits, differential fertility responses results in *composition effects* whereby aggregate variables gravitate towards those of the households with the largest fertility responses.

For example, consider the average human capital of children in the economy

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

---

[21] This holds if child quantity is not a Giffen good. See McDonald (2006) and Stone (2020) for supporting evidence.

[22] Whether child quantity and quality are complements or substitutes remains an open question in the literature. Standard Barro-Becker models usually assume they are complements (e.g., Córdoba et al. 2016; Daruich & Kozlowski 2020). On the other hand, there are also models using separable preferences (e.g., de La Croix & Doepke 2003; Bar et al. 2018), or quality and quantity being substitutes (Jones & Schoonbroodt 2010).

[23] Becker & Lewis (1973) named this last effect the quantity-quality trade-off. In this paper, I abuse this term slightly to denote the overall effect of an increase in fertility on child quality. Using twin births as instruments, some recent papers (e.g., Black et al. 2005 and Angrist et al. 2010) find little evidence of such a trade-off. A recent study by Mogstad & Wiswall (2016), however, overturns that conclusion by relaxing the linear specification constraint. They find evidence of a trade-off between quality and quantity for larger families and complementarities in small families.

[24] See Drago et al. 2011 and Table 1.3 for empirical evidence.

where N is the aggregate fertility rate defined in Equation (1.6). Family policies change fertility weights $n^*(h,a)/N$ across households. As a result, even when $h_k^*(h,a,\cdot)$ stays unchanged, $\overline{h}_k$ converges towards families with rising fertility weights.

From a theoretical perspective, composition effects generate an interesting scenario where aggregate human capital decreases even if policy effects on individual children's human capital are positive. Empirically speaking, composition effects are shown to be important for the evolution of aggregate variables such as economic growth (de La Croix & Doepke 2003) and public opinion on family values (Vogl & Freese 2020).

Demographic Structure Effects

With endogenous fertility, family policies change the population growth rate, and, as a result, the demographic structure $\{\omega_j\}_{j=0}^{8}$. This has profound implications for the government budget constraint (1.4) because demographic structure determines how each source of revenue or expenditure is weighted.

Most macroeconomic structural models with endogenous fertility assume two-period-lived agents. From the government budget perspective, an increase in the population growth rate leads to an unambiguous increase in the fiscal burden in this class of models since there are fewer tax-paying adults to finance public education expenditures for children. Therefore, tax rates need to rise to balance the budget. Most developed countries that actually adopt family policies, however, have another story in mind where tax rates should be *lower* instead of higher in the long run. The key missing piece in this analysis is the presence of retired households receiving pension payments.

By considering a rich life cycle with childhood, working-age, and retirement in the model, higher fertility rates reduce the old-age dependency ratio. Therefore, the model allows for the possibility that the government may *reduce tax rates* in the long run after family policies are adopted. I denote the effects of family policies through changes in the mass of each age group as *demographic structure effects*.

Childcare Choices

Consider a comparison between two family policies, a baby bonus $\mathcal{B}$ and subsidized childcare $\mathcal{S}$. In standard macroeconomic models with endogenous fertility, each child costs a fixed amount of time for parents.[25] Since subsidized childcare reduces time costs, total income in this class of models is given by

$$y = wh\,\underbrace{(1-(\chi-\mathcal{S})}_{\text{hours worked}} \cdot n) + n \cdot \mathcal{B}.$$

For parents with human capital h, a baby bonus $\mathcal{B}$ can be replicated by subsidized childcare with $\mathcal{S} = \frac{\mathcal{B}}{wh}$ in these models. Therefore, parents should be indifferent between in-cash and in-kind child benefits of the same face value. They are also expected to react to each policy in the same way in terms of labor supply and child-related decisions.

These predictions from traditional models are not supported by empirical evidence which indicate that parents react differently to in-cash versus in-kind benefits. Upon receiving a baby bonus, parents do not increase their labor supply but rather choose to stay at home and use less market childcare (González 2013). In contrast, upon receiving subsidized childcare, parents increase their labor supply drastically and substitute home care for (subsidized) market care (Milligan 2005). Last, use of market childcare is increasing in maternal education.[26] Models without childcare arrangements are unable to account for this pattern.

In this model, considering parents' childcare arrangements provides an explanation for patterns observed in the data and offers a natural way to compare family policies of different kinds. With market childcare, a substitute for home care, available at a uniform price, richer parents use more market childcare services than poorer ones. A government-offered childcare subsidy $\mathcal{S}$ will therefore be equivalent to a baby bonus $\mathcal{B}$ of the same face value for parents with high human capital who are already spending more than $\mathcal{S}$ on market childcare – subsidized childcare simply reduces their out-of-pocket expenditures. On the other hand, parents with low human capital who receive a

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[25] Modeling child costs as time costs rather than goods costs is crucial for explaining the negative income-fertility relationship (Jones et al. 2008). See the discussion in Doepke & Tertilt (2016). A notable exception that considers the use of market childcare is Bar et al. (2018). Those authors show that the adoption of market childcare services and rising income inequality explain the recent rise in fertility among high-income married women in the U.S.

[26] See Figure 1.5 for evidence. Also see Bar et al. (2018) and Chaparro et al. (2020).

childcare subsidy $\mathcal{S}$ would rather have an in-cash transfer $\mathcal{B}$ of the same face value since they prefer spending the money on consumption or education. As a result, subsidized childcare $\mathcal{S}$ is "binding" for low-human capital parents in the sense that the in-kind policy pushes them into the labor market if they want to take up the benefits. Their welfare improvements will be smaller than if they were offered a baby bonus $\mathcal{B}$ of the same face value. As they work more, however, these parents accumulate more human capital through learning-by-doing, and the economy sees a reduction in the life-cycle wage inequality across parents.

1.2.7 Summary of Mechanisms

As discussed above, the framework contains a unique mix of modeling ingredients. Therefore, the model explains more observed data patterns (e.g., childcare usage) relative to standard macroeconomic models with endogenous fertility. It also speaks to several important mechanisms through which family policies affect the economy.

The quantitative magnitude of these mechanisms depends crucially on the fertility responses to family policies (the fertility elasticities). For instance, if child quantity is fixed, then family policies will have (1) a simple income effect on children's outcomes, (2) no composition effects, and (3) no demographic structure effects. In Section 1.3, fertility elasticities across households are disciplined by the calibrated model parameters. In Section 1.4, I show that the model predictions on fertility responses are consistent with existing empirical evidence.

1.3 Calibration

In this section, I discuss the parameterization, calibration procedures, and the model fit. Following the literature, I choose some parameters exogenously, most of which either have standard values or have observable counterparts. The other 14 parameters (listed in Table 1.2) are calibrated inside the model by matching steady-state moments to the United States in 2010.

1.3.1 Preferences over Quantity and Quality

Parents' preference over child quantity and quality is given by

$$v(n, \mathbb{E}h_k, a_k) = \underbrace{\Psi(n)}_{\text{child discounting}} \cdot \underbrace{(\theta \cdot u(\mathbb{E}h_k) + \nu \cdot u(a_k))}_{\text{utility from quality}}, \tag{1.8}$$

$$\Psi(n) = 1 - \exp(-\psi n), \text{ and} \tag{1.9}$$

$$u(x) = \frac{x^{1-\gamma}}{1-\gamma}, \quad \gamma \in (0,1), \quad x \in \{\mathbb{E}h_k, a_k, c\}. \tag{1.10}$$

where parents value child quality weighted by the child discounting function $\Psi(n)$ (c.f., Barro & Becker 1989; de La Croix & Doepke 2003; Kim et al. 2021). The utility function of child quality and consumption is governed by parameter γ, which determines the elasticity of intergenerational substitution (EGS), i.e., $1/\gamma$, defined in Córdoba et al. 2016 and Córdoba & Ripoll (2019).[27] I use $\theta \cdot u(\mathbb{E}(h_k)) + \nu \cdot u(a_k)$ as a first-order approximation to general preferences over child quality and transfers. In Appendix 1.A.2, I argue that results in this paper are robust to other common specifications used in the literature, including separable preferences (de La Croix & Doepke 2003), quality and quantity being substitutes (Jones & Schoonbroodt 2010), and dynastic altruism (Daruich & Kozlowski 2020).

I calibrate parameters $\theta = 2.85$ and $\nu = 0.29$ to match the average human capital investment as a share of income and average inter vivos transfers of \$48,381 in 2000 dollars (Daruich 2018).[28] I calibrate $\psi = 2.3$ to match the average fertility calculated using the CPS Fertility Supplement data from 2008 to 2014.

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[27] Since the EGS is designed to match interactions across generations, its magnitude and interpretations are different from that of the elasticity of intertemporal substitution (EIS) used to capture risk-aversion in business cycle models. More specifically, when utilities from consumption and child quality are separable, it is common to assume that EIS and EGS are the same to ensure the existence of long-run steady states (see Barro & Becker 1989; Soares 2005). For recent work modeling EGS and EIS jointly with non-separable utilities, see Córdoba & Ripoll (2019).

[28] Daruich (2018) uses the PSID and the CEX to estimate that average expenditures on each child below age 12 include 18 hours of "quality" hours per week and \$1,966 (in 2000 dollars) spent on childcare and education investments. These two expenditures combined amount to 13.4% of median family income. The calibration targets this moment by computing average education investments e plus expenditures on market childcare services m. These moments are also similar to those reported in Lee & Seshadri (2019).

Figure 1.2: Identification of γ

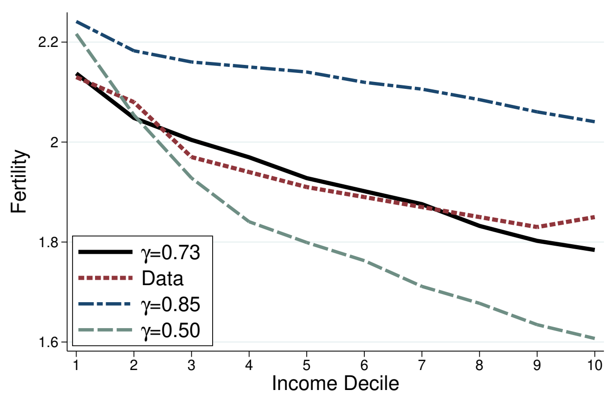
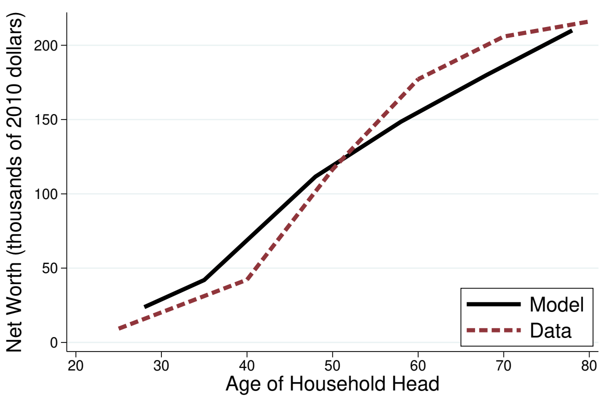


Figure 1.3: Non-Targeted - Net Worth by Age



Notes: Figure 1.2 plots the relationship between family income and fertility in the model under different γ. Fertility rates by income are calculated using the number of live births ever had for married women between 40 and 55 years old in the CPS Fertility Supplement data from 2008 to 2014.

— Figure 1.3 plots the median net worth by age in the model and in the data. Median net worth in the model is calculated using net asset position a integrated over the equilibrium distribution of households by age. In the data, median net worth by age of the household head is collected from the Federal Reserve System estimated using the Survey of Consumer Finances (SCF).

Conditional on $\{\theta, \nu, \psi\}$ and other parameters of the model, γ is governs the fertility elasticity. Higher γ leads to a faster decay of the marginal utility from $\{\mathbb{E}h_k, a_k, c\}$. Hence when the "price" of child falls, parents have larger fertility responses to balance the first-order-condition.[29] The same logic provides the identification of γ following Córdoba et al. (2016): controlling for other parameters, higher γ implies a faster decay in the marginal utility of consumption as parents get richer, which makes having children more valuable for them as an "extensive margin" of adjustment. As a result, higher γ leads to a flatter income-fertility profile. Figure 1.2 shows a numerical illustration of the identification. I choose $\gamma = 0.73$ such that the model best fits the observed relationship between fertility and income.[30]

Even though γ is restricted to be between $(0, 1)$, the model generates a surprisingly good fit to the data in terms of life-cycle asset accumulation. Figure 1.3 shows the median net worth profile from the model and from the Survey of Consumer Finances (SCF). The model generates a non-targeted life-cycle profile of net worth similar to the data both in trend and in levels.

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[29] The illustrative model in Appendix 1.E.2 highlights this logic. Soares (2005) uses a similar argument in discussing fertility responses to changes in adult longevity and child mortality.

[30] See Appendix 1.A.5 for discussion and tests of robustness to alternative measures of fertility.

1.3.2 Child's Human Capital Production

I parameterize the child human capital production function as

$$h_k = G(h, \mathcal{E}, e, \epsilon) = \underbrace{Z}_{\text{scalar}} \cdot \underbrace{\epsilon}_{\text{shock}} \cdot \underbrace{h^{\rho}}_{\text{spillover}} \cdot \left(\underbrace{\mathcal{E}^{\xi}}_{\text{public education}} + \underbrace{e^{\xi}}_{\text{private input}} \right)^{\kappa/\xi}, \qquad (1.11)$$

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

Parameter Z is a scaling parameter that governs the overall scale of the economy. I choose $Z = 2.5$ to normalize the median income of families in the model to one, corresponding to the Census-estimated household median income of $49,445. Parameter σ_ϵ governs the dispersion of idiosyncratic shocks to children's ability. I pick $\sigma_\epsilon = 0.58$ to match the dispersion of earnings for young households.[31] I calibrate $\rho = 0.30$ to match the rank-rank intergenerational mobility estimated by Chetty et al. (2014). Figure 1.4 shows that the model generates a good fit both in absolute upward mobility and relative mobility.

I denote ξ as the elasticity of substitution between public and private education inputs. $\xi = 0.9$ is calibrated to match the relationship between education spending and household income using data from the Consumer Expenditure Survey (CEX) which includes tuition, test preparation, tutoring, books, and supplies. Public education $\mathcal{E}$ in the baseline economy is chosen to match the $12,000 annual expenditure per student reported by the National Center of Education Statistics (NCES). This value translates to 0.16 under the normalization of median income to be 1.

The last parameter to be calibrated is κ. It governs the productivity of education investments. I identify γ using RCT evidence from 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) estimate that children's lifetime labor income increases by 1.3 dollars in net present value for every dollar invested. I take this moment on benefit-cost ratio and compute the model counterpart. More specifically, I apply the same policy in

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[31] I calibrate σ_ϵ to match the Gini coefficient of income among married households age 23 to 29 in the CPS-ASEC data (2008-2014).

the model by expanding existing public education $\mathcal{E}$ by \$17,000 (in 2010 dollars) for five years. The policy targets children with parents at the 10th percentile of earnings. Moreover, the counterfactual is evaluated at a small scale so that prices and taxes remain unchanged. I calibrate $\kappa = 0.13$ by matching the benefit-cost ratio in the model to that in García et al. (2020).

1.3.3 Costs of Children and Childcare

The household equivalence scale $\Lambda(n)$ is taken from the OECD standard:

$$\Lambda(n) = 1.7 + 0.5 \cdot n,$$

where n is the number of children residing with the family.[32]

Recall that the childcare requirement, i.e., time cost of children, is given by

$$n \cdot \chi = \left(t_h^{\upsilon/\iota} + (n \cdot (m + \mathcal{S}))^{\upsilon}\right)^{1/\upsilon}.$$

I choose $\chi = 0.18$ following estimates by Folbre (2008) (Table 6.2), calculated using data from the American Time Use Survey (ATUS).[33] I calibrate the economies of scale in providing childcare at home $\iota = 0.7$ to match the estimates by Folbre (2008) (Table 6.4).[34] The parameter governing the elasticity of substitution between home care and market care υ is calibrated to be 0.38 to match the average expenditure on childcare as a fraction of total family income using estimates from Herbst (2018).[35] Last, I choose the price of full-time market care for a child aged 0 to 10, p_m, to be \$6,860 per year in 2010 following the statistic reported by the National Association of Child Care Resource

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[32] The base level $\Lambda(0)$ is 1.7 since I model the decision of married households.

[33] Folbre (2008) documents that an average child in a two-parent household spends about 22 hours per week in active non-parental care, and 23 hours per week in active parental care (adjusting for presence of both parents). Therefore, I calculate χ, the total active care required by one child as a fraction of parents' total time endowment, as $\chi = (22 + 23)/((24 - 6.5) \cdot 7 \cdot 2) \approx 0.18$ assuming 6.5 hours of sleep for each parent (Richter et al. (2019)).

[34] Folbre (2008) reports that for two-parent families, the active parental time per child is 1.5 times higher in one-child families than that of two-child families.

[35] Herbst (2018) uses Wave 8 of the 2008 SIPP panel, which covers winter and spring of 2011. The results show that average childcare expenditures in the whole sample are \$134.44 per week in 2013 dollars, which translates to 16% of the median household income. The calibration targets this moment by computing the average share of income spent on market childcare services, measured by $n \cdot m \cdot (1 + \tau_c)$ integrated over the equilibrium distribution.

Figure 1.4: Model Matches Mobility

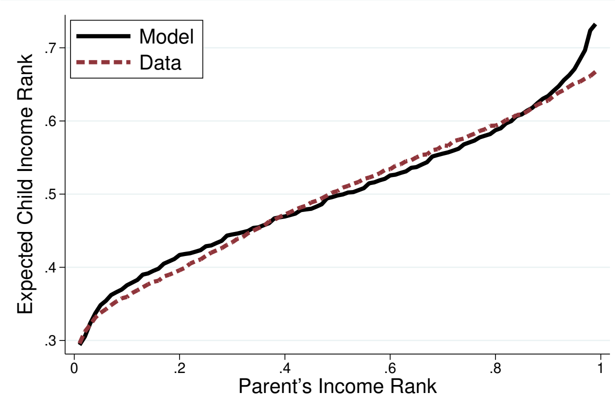
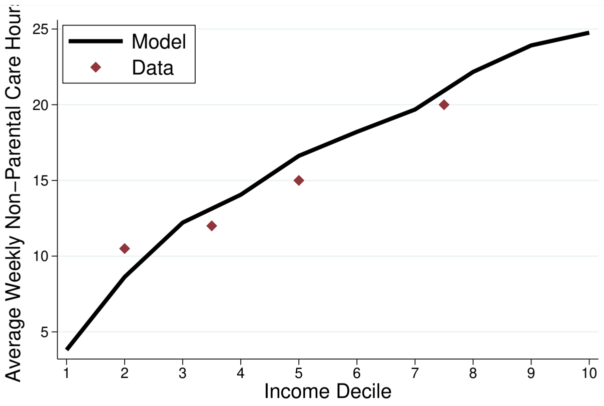


Figure 1.5: Non-Targeted: Childcare Usage



Notes: Figure 1.4 plots the relationship between parents' income rank and children's expected income rank in the calibrated model and that estimated by Chetty et al. (2014).
— Figure 1.5 plots the average weekly non-parental care received by children aged 0-2 conditional on parents' income decile. The data estimate is obtained using the public-use file of the National Survey of Early Care and Education (NSECE) wave 2012 by Flood et al. (2021). They calculate the average weekly non-parental care hours in the data by maternal education categorized into "less than high school", "high school", "some college", and "bachelor's degree and above". I map the education category into income deciles using median income by education and income distribution estimated from the Current Population Survey (CPS).

& Referral Agencies (NACCRRA 2011).[36] Figure 1.5 shows that the model generates the pattern of childcare usage by parent income decile that fits the data from the National Survey of Early Care and Education (NSECE), a non-targeted moment.

1.3.4 Other Parameters

Human capital of adults evolves with age according to

$$h_{j+1} = L_j(h_j, t_w, z') = \exp(z') \left[h_j + \zeta_j (h_j \cdot t_w)^{\eta}\right] \text{ and } \tag{1.12}$$

$$\log(z) \sim \mathcal{N}(\mu_z, \sigma_z).$$

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[36] The average annual costs of full-time childcare across all U.S. states are $9,303 (infant), $7,377 (4-year-old), and $4,753 (school-age) for child care centers; family child care, on the other hand, costs $6,926 (infant), $6,131 (4-year-old), and $4,405 (school-age) (NACCRRA 2011 Appendix 1). I take an age-weighted average of these costs to calculate full-time childcare costs for children aged 0 to 10.

I calibrate $\eta = 1.22$ to match the heterogeneous growth rate of income by initial income decile (see Figure 1.6).[37] Parameters $\{\zeta_j\}_{j=2}^{5}$ and $\sigma_z = 0.38$ are calibrated to match the life-cycle profile of average household income and its dispersion.[38]. I choose $\mu_z = -0.23$ exogenously so that human capital depreciates at an annual rate of 2%.

Following Heathcote et al. (2017), I parameterize income taxes as

$$\mathcal{T}(y, a, n) = y \cdot (1 - \tau_y^n y^{-\lambda_y^n}) + \tau_a r a, \tag{1.13}$$

where $\{\tau_y^n, \lambda_y^n\}$ denote the level and progressivity of taxes depending on the number of children residing in the household while τ_a denotes the linear capital income taxes. I obtain $\{\tau_y^n, \lambda_y^n\}$ using simulated data from TAXSIM provided by the NBER (see Figure 1.7) and use linear interpolation to calculate $\{\tau_y^n, \lambda_y^n\}$ when n is not an integer. Having an additional child significantly reduces the tax burden faced by households through various programs such as the Earned Income Tax Credit (EITC), Dependent Care Tax Credit (DCTC), and the Child Tax Credit (CTC). The tax system is progressive, with lower-income households receiving subsidies. As household income grows, labor income taxes converge to 40%. Following McDaniel (2007) and Daruich & Fernández (2020), I choose capital income tax $\tau_a = 0.27$ and consumption taxes $\tau_c = 0.07$. The pension replacement rate π is set to 40%.

In the production function of the representative firm, I choose the capital share α to be 0.33 following the standard in the literature and set the capital depreciation rate δ_k at 4% per year. Last, I choose the annual discount rate $\beta = 0.98$ and calculate the age-specific mortality rate $\{\delta_j\}_{j=0}^{8}$ using the actuarial life table from the Social Security Administration.

Table 1.1 summarizes the model parametrization, and Table 1.2 contains the list of identifying moments and the model fit. As all the moments affect all the parameters, it is difficult to pinpoint which moment is identifying a certain parameter. Nevertheless, Table 1.4 in Appendix 1.A displays

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[37] This model reproduces the well-documented hump-shaped life-cycle earnings profile as well as a Gini coefficient of human capital that is increasing in age (Huggett et al. 2006). These two facts are reconciled by considering a profile of learning ability $\{\zeta_j\}_{j=2}^{5}$ that is decreasing in age and the self-production of human capital with $\eta > 1$.

[38] I calculate average income by age and the Gini coefficient of income by age using data from married households in the CPS-ASEC data (2008-2014). I have experimented with panel methods à la Huggett et al. (2011) and the results are quantitatively similar.

Figure 1.6: Income Growth By Initial Decile

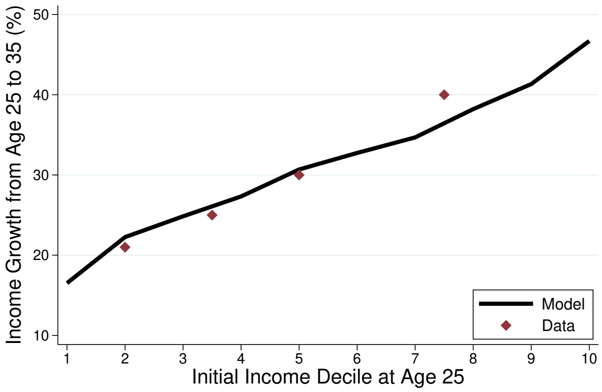
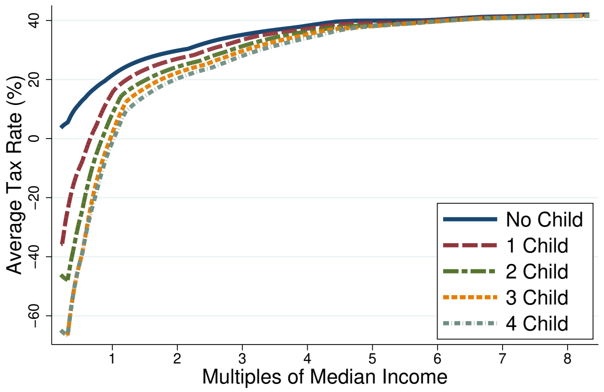


Figure 1.7: Labor Income Taxes



Notes: Figure 1.6 plots the growth rate of average income from age 25 to 35, depending on the initial income decile at age 25. For married households in the CPS-ASEC data (2008-2014), I calculate the growth rate of average household income by four education categories: “less than high school”, “high school”, “some college”, and “bachelor’s degree and above”. The initial income decile of each education category is calculated using the income distribution at age 25.
— Figure 1.7 plots average tax rates depending on household income and number of dependent children residing with the family calculated TAXSIM.

the sensitivity of model parameters to change in moments. Table 1.5 in Appendix 1.A displays the elasticity of moments to model parameters to illustrate the identification argument.

1.4 Validation

In this section, I discuss the main external validation of the fertility and education responses to financial incentives. The purpose of the validation exercises is to lend extra credibility to the quantitative predictions of the model before evaluating policy counterfactual. In Appendix 1.D, I provide further confirmation of the model’s predictions using evidence from the Australian baby bonus, the Spanish child benefits, and the Maternal Capital in Russia.

The main validation exercise exploits empirical evidence from the Alaska Permanent Fund Dividends (APFD). The dividend was officially established in 1982 after the discovery of petroleum increased state revenues. Every year, it gives uniform transfers to all residents regardless of income, employment or age. In particular, the program allows a parent, guardian, or other authorized representative to claim a dividend on behalf of a child, while Alaska law imposes no requirements whatsoever on how parents use a child’s dividend. As a result, the policy has pro-natal effects even

Table 1.1: Calibrated Parameters

	Interpretation	Value	Source
	Preferences		
β	discount rate (annual)	0.98	standard
γ	elasticity of substitution	0.73	CPS
ψ	fertility preference	2.30	CPS
θ	quality preference	2.85	PSID
ν	transfer preference	0.29	PSID
	Childcare arrangement		
χ	childcare cost	0.18	ATUS
ι	economies of scale at home	0.7	ATUS
υ	substitutability of care	0.38	SIPP
p_m	price of full-time care	\$6,860	NACCRRA (2011)
	Taxes and pension		
τ_y^n, λ_y^n	tax levels and progressivity	misc.	TAXSIM
τ_c	consumption tax	0.07	McDaniel (2007)
τ_a	capital income tax	0.27	McDaniel (2007)
π	pension replacement rate	0.40	OECD Database

	Interpretation	Value	Source
	Child human capital production		
Z	normalizing scalar	2.50	median income =1
σ_ϵ	ability shock dispersion	0.58	PSID
ρ	intergenerational spillover	0.30	Chetty et al. (2014)
ξ	substitution of education	0.9	CEX
$\mathcal{E}$	public education	\$12,000	NCES
κ	input productivity	0.13	García et al. (2020)
	Adults' human capital evolution		
η	learning curvature	1.22	PSID
$\{\zeta\}_{j=2}^{5}$	learning level	misc.	PSID
μ_z	skill depreciation	-0.23	PSID
σ_z	shock dispersion	0.38	PSID
	Firm production function		
A	total factor productivity	1	normalization
α	capital share	0.33	standard
δ_k	capital depreciation (annual)	0.04	standard

Notes: This table displays the list of parameters used in the model. Parameters in red are calibrated within the model while those in black are chosen exogenously.

Table 1.2: Identifying Moments and Model Fit

Parameter	Interpretation	Moment	Data	Model
γ	elasticity of substitution	fertility differential	0.12	0.12
ψ	fertility preference	average fertility	1.92	1.92
θ	human capital preference	average investment as % of income	13.4	13.5
ν	transfer preference	average transfer	\$48,381	\$48,400
ι	economies of scale at home	childcare time by # children	1.5	1.5
υ	substitutability of care	average care spending as % of income	16	16
Z	normalizing scalar	median income = 1	N/A	N/A
σ_ϵ	ability shock dispersion	Gini of earnings at $j = 2$	0.29	0.29
ρ	intergenerational spillover	intergenerational elasticity of earnings	0.34	0.33
ξ	substitution of education	investment by parents' education	misc.	misc.
κ	input productivity	return on per dollar investment (NPV)	\$1.3	\$1.29
η	learning curvature	income growth by initial decile	0.1	0.09
$\{\zeta\}_{j=2}^{5}$	learning level	income growth by age	misc.	misc.
σ_z	shock dispersion	Gini of earnings at $j = 6$	0.39	0.39

Notes: This table displays the list of parameters, identifying moments, and the model fit. See text for more discussion on the source of each moment.

though it is not explicitly advertised as a family policy that encourages fertility.

The APFD is an ideal policy environment to validate fertility elasticities in the model for three reasons. First, compared with other family policies which are usually less than a few thousand dollars in net present value per child (McDonald 2006; Luci-Greulich & Thévenon (2013)), the net present value that parents could receive and use with an additional child under the APFD is almost \$20,000.[39] With sizable benefits, it is more likely that the APFD would have meaningful and observable impacts on people's behavior, especially when it comes to the important and irreversible decision of having a child. Second, unlike family policies which are typically means-tested or depend on birth order, the APFD has a simple implementation, with more than 91% of the state population filing for the application historically. In contrast, the Census Bureau estimates that the national participation rate of the Earned Income Tax Credit (EITC) is lower than 80%. Moreover, the APFD mimics a universal basic income for parents plus a fully refundable Child Tax Credit (CTC) for children without income requirements. Given that the APFD is not advertised as a policy

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[39] I calculated the average payment to be around \$1,500 per year. Since the amount of the dividend is tied to the performance of the overall stock market, future payment uncertainties might affect people's responses. Given that childbirth is an irreversible decision, I argue that a mean-preserving spread of the dividend payment would reduce households' fertility responses. Therefore, since the model generates fertility elasticities that are consistent with people's choices under uncertainty, the results on child benefits without uncertainty is likely conservative.

that aims to encourage childbirth, its effects on fertility provide a conservative benchmark for family policies that are explicitly pro-natal, and thus may change parents' behaviors through preferences or information. Last, Cowan & Douds (2021) find that the migration effect, also known as "population magnets effect," of the APFD was not large empirically, with net migration rates around one-tenth of a percent in the sample period.

To implement the APFD in the model, I implement the APFD by transferring \$1,500 (annually) to every household member, including both parents and children. Parents will receive this transfer (for themselves) every period until they die. They are also entitled to receive the children's share of dividends before their children become independent. I normalize the amount of the transfer by median household income in Alaska relative to the total U.S. I conduct the policy experiment in the partial equilibrium without changing prices and distribution. The model predicts that the completed fertility rate, i.e., the total number of children that parents end up having, increases by 0.16 compared with the scenario without the AFPD.[40] The model also predicts heterogeneous fertility responses across households. Since parents are entitled to claim children's dividends and these dividends are uniform in size, the model predicts that parents with lower human capital will have a larger increase in fertility.

Using the CPS Fertility Supplement data from 1982 to 2018, I collect micro-level data on the completed fertility rate, i.e., the total number of live births ever had, among women aged 40 to 55.[41] I divide the Alaskan sample into three groups based on the survey years. The "not treated" group contains the data prior to year 1987, as these women had already passed their childbearing years when the APFD was enacted. The "partially treated" group contains the sample from 1987 to 2005 because the APFD affected some, but not all, of their childbearing years. Last, the "fully treated" group contains the observations from 2006 to 2018 since these women fully took the policy into account when making fertility choices. Women in other states are in the control group.

To estimate the policy effects on the completed fertility rate, I use a difference-in-differences strategy by regressing the completed fertility rates on state fixed effects, year fixed effects, and

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[40] I derive this result by calculating the difference in the aggregate fertility rate between the new stationary equilibrium and the baseline economy without the APFD. Results from the transition path (see Figure 1.11A) indicate that the policy effect on fertility is almost unchanged if I use short-run effects in the transition phase instead of long-run ones.

[41] Figure 1.14 displays the time series of the completed fertility rate in Alaska and the rest of the U.S.

treatment dummies:

$$\text{fertility} = \beta_0 + \beta_1 T_1 + \boldsymbol{\beta_2} T_2 + \text{State FE} + \text{Year FE} + \epsilon, \tag{1.14}$$

where T_1 is a dummy variable for being in the "partially treated" group, and T_2 is a dummy variable for being in the "fully treated" group. The standard errors are clustered at the state level. Since the model prediction concerns the long-run impacts of policies, coefficient β_2 is the one of interest. To explore heterogeneous treatment effects, I also estimate the specification in Equation (1.14) separately for women with or without high education, which is defined as having at least one year of college experience.[42] Table 1.3 reports the regression results.

Table 1.3: Effects of the APFD on the Completed Fertility Rates

	(1) Full Sample	(2) Low Educ.	(3) High Educ.	Model Predictions Average	Model Predictions Low Educ.	Model Predictions High Educ.
β_1	0.098	0.216	0.074			
	(0.027)	(0.036)	(0.021)			
β_2	0.172	0.296	0.105	0.16	0.31	0.09
	(0.032)	(0.041)	(0.025)			
# Obs.	146,804	69,511	77,293			

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 (1.14) 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 (30th percentile of human capital), and women with high education (70th percentile of human capital).

Column (1) of Table 1.3 shows that the estimated effects of the APFD on the completed fertility rates is $\hat{\beta}_2 = 0.172$ children per woman with a 95% confidence interval of $(0.109, 0.235)$.[43] The model-predicted policy effects of 0.16 children per woman is within this range. Results on $\hat{\beta}_2$ from columns (2) and (3) also confirms the model's prediction on heterogeneous treatment effects: women without high education responds more strongly to the APFD.[44] Quantitatively, these estimates are

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[42] Figure 1.15 displays the time series of the completed fertility rate by state of residence and education.

[43] This finding echos the results in Yonzan et al. (2020). Using synthetic control methods on Natality files, they conclude that the total fertility rate in Alaska increases by 13.1% due to the AFPD.

[44] This finding echos the results in Cowan & Douds (2021). They find larger increases in fertility among Alaska natives and women without a high school degree.

consistent with the model predictions for women with low and high education (mapped to the 30^{th} and 70^{th} percentiles of human capital).

Furthermore, the model predicts that following an increase in fertility, children will have lower human capital on average due to the quantity-quality trade-off. To assess the plausibility of this prediction, I inspect the education attainment of individuals of 25- to 30-years old in Alaska and other states by birth cohort. Figure 1.16 shows that while Alaska has been following the national trend in college enrollment before the APFD, children born after the APFD have significantly lower college attainment, consistent with the model's predictions.

1.5 Counterfactuals

In this section, I use the model to evaluate family policies of different sizes in a general equilibrium where population distribution adjusts. I 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).[45] The simplicity in policy structure facilitates better exposition of the model mechanisms. Second, such cash rewards have already been widely adopted in the developed world (see Drago et al. 2011; González 2013). I discuss the long-run implications of baby bonuses in Section 1.5.1 where the government balances the budget by adjusting consumption taxes.[46] The outcome variables of interest consists of fertility, human capital, average income, intergenerational mobility (measured by the inverse of IGE),[47] and social welfare. In Section 1.5.2, I compare the baby bonus with subsidized childcare and public education expenditures. Last, I study the transition path of the baby bonus and its distributional effects across generations in Section 1.5.3.

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[45] 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 usually 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 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.

[46] I discuss the robustness of the results to alternative funding methods in Appendix 1.A.6.

[47] Intergenerational Elasticity of Earnings (IGE) is calculated by simulating parent-child pairs and evaluating the correlation between their earnings at $j = 2$.

1.5.1 Baby Bonus: Long-run Implications

This section evaluates baby bonuses of different sizes ranging from \$0 to \$50,000 in 2010 dollars. I compute the long-run macroeconomic implications of these policies by comparing the long-run steady state of the economy with the benchmark economy where the baby bonus is zero.

Figures 1.8A and 1.8B show the fertility effects and the direct fiscal costs of baby bonuses. To reach the replacement fertility level (2.1 children per family on average), the model predicts that it would require a baby bonus of \$30,000, or approximately 1.6% of GDP in the new steady-state economy. This amount is similar to the increase in the maximum benefit of the Child Tax Credit (CTC) from 2010 to 2021 in net present value, taking the American Rescue Plan Act of 2021 into account. It offsets 19% of the average cost of raising one child as estimated by the USDA. These results confirm the common perception by demographers that using financial incentives to raise fertility is not "cheap." Under realistic magnitudes of fertility elasticities and reasonable policy scales, the effects of financial incentives provided by the government are small relative to historical changes in preferences, social norms, contraceptive technologies, and perhaps most important of all, changes in the skill premium. These results, however, suggest that using cash transfers to prevent further crashes in fertility, or even to raise the fertility rate, is feasible in practice.

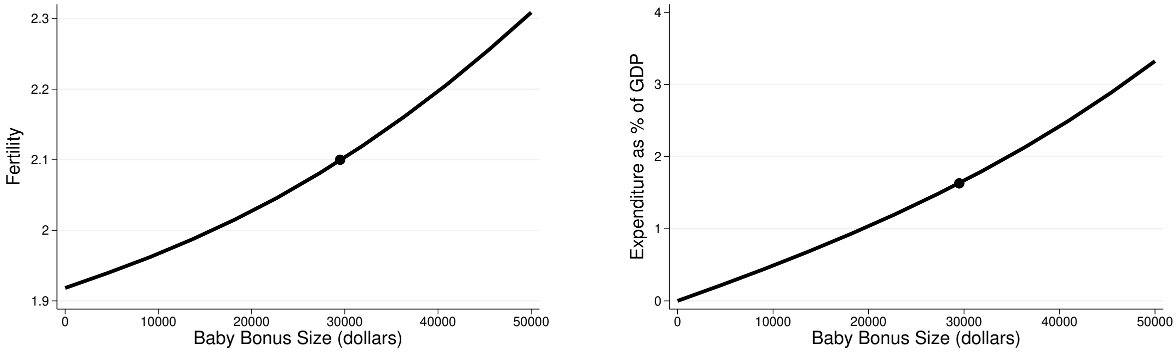
Figure 1.8C shows that parents in the lower half of the human capital distribution (low h) have larger fertility responses to baby bonuses than the ones with higher human capital (high h). This is intuitive since the same level of $\mathcal{B}$ translates into a larger proportional change in the "shadow price" of children, which is composed of the opportunity costs of time wh and private education investments $e^*(h)$. This prediction is also consistent with the estimated fertility effects of APFD presented in Table 1.3.

Figure 1.8D shows the quantity-quality trade-off channel discussed in Section 1.2.6. Baby bonuses reward parents for higher fertility, and parents respond by having more children, but they reduce private investment in children's education. Average e falls by 4% when fertility reaches the replacement rate. Further, due to their larger fertility responses, parents with lower human capital reduce investment in their children's education by more than parents with high human

Figure 1.8: Long-Run Effects of Baby Bonuses

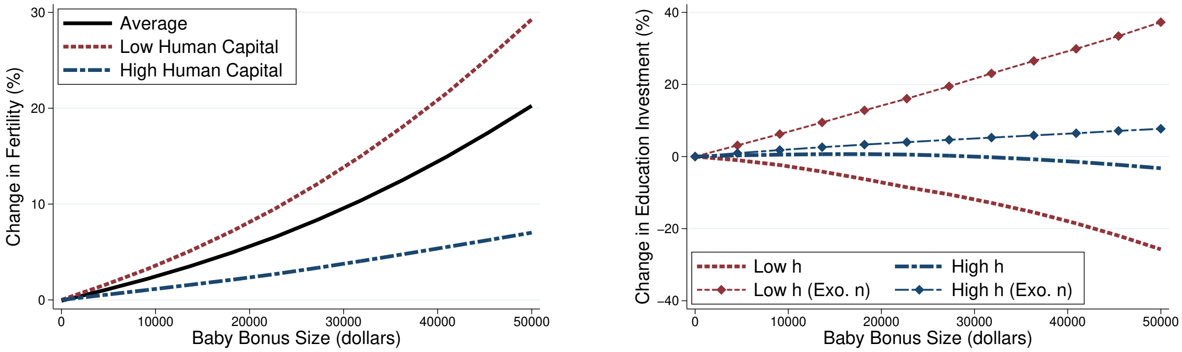
(A) Effects on Fertility

(B) Expenditure Share as % of GDP



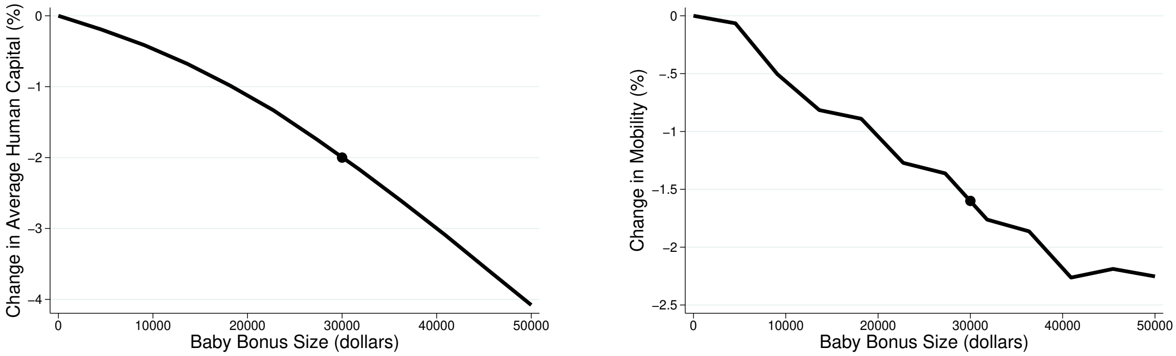
(C) Heterogeneous Fertility Response

(D) Heterogeneous Private Input Response



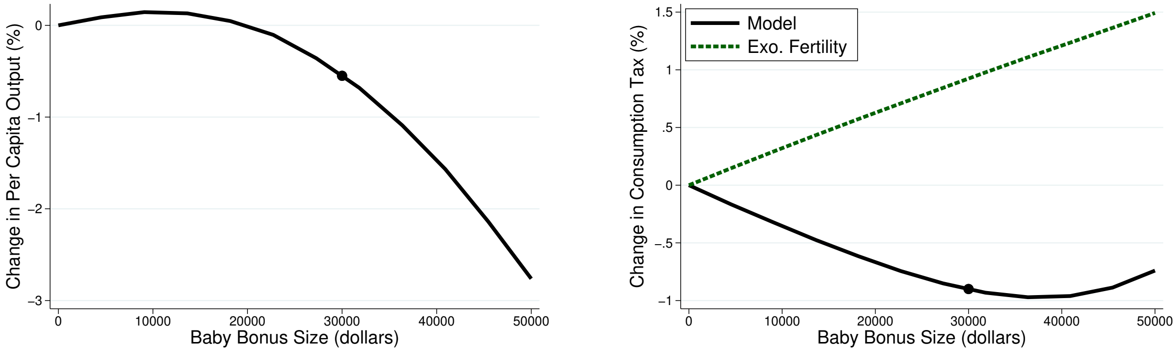
(E) Average Human Capital

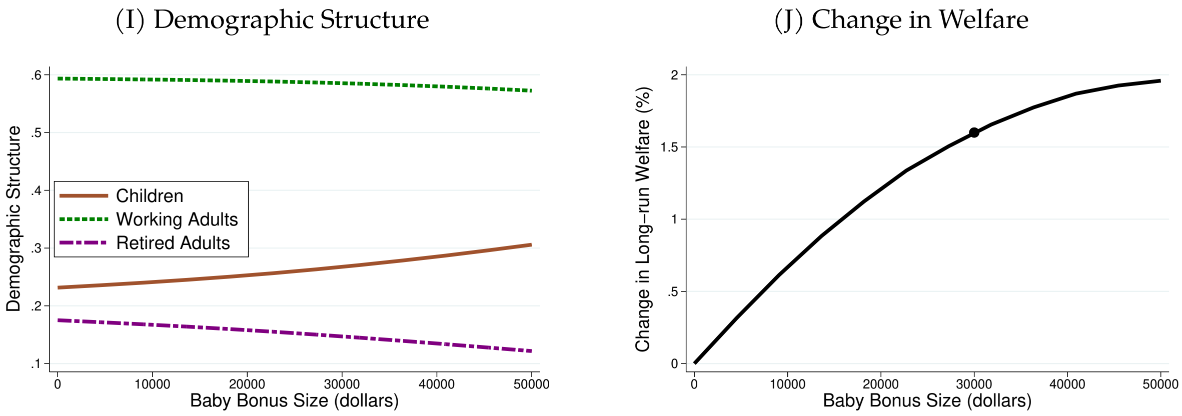
(F) Intergenerational Mobility



(G) Per Capita Output

(H) Change in Consumption Tax




(I) Demographic Structure

(J) Change in Welfare

Notes: These figures plot macroeconomic impacts of baby bonuses of different sizes by comparing long-run steady-states under policies with the baseline steady-state economy. In Figure 1.8D and 1.8C, I plot the average responses as well as heterogeneous responses by parents' human capital levels.

capital. Figure 1.8D also displays the model predictions when fertility is exogenous.[48] In that case, parents spend more on e when they receive the baby bonus as an *income transfer*, with larger increases among parents with low human capital. As can be seen, implications of family policies are qualitatively different with endogenous fertility.

Due to intergenerational transmission of human capital, heterogeneous responses in fertility induce gravitation of aggregate variables towards low-income families. Composition effects, in addition to the reductions in private investment per child, lead to a reduction of the average human capital by 2% under a \$30,000 baby bonus (see Figure 1.8E).[49] As the decrease in education investments is larger among low-income households, Figure 1.8F shows that the \$30,000 baby bonus also reduces intergenerational mobility by 1.6% rather than boosting it as policymakers have hoped. Due to the quantity-quality trade-off mechanism, the negative policy effects on social mobility would be even stronger if the baby bonus is exclusively given to low-income households.

Figure 1.8G shows that per capita output declines by 0.6% at $\mathcal{B} = \$30,000$. Nevertheless, Figure 1.8H indicates that in the long-run steady-state, the government is able to reduce the consumption tax by 0.9%. This is a result of several forces shaping the government budget constraint in Equation

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[48] To compute this, I do not allow parents to make endogenous fertility choices and assign the number of children that corresponds to the level observed in the data (see Figure 1.2). Parents still make private education investments and transfer choices as in the baseline model.

[49] The 2% reduction in average human capital is smaller than that of the private investment (-4%) because public education investment $\mathcal{E}$ is unchanged.

(1.4). First, the change in human capital distribution affects tax revenues. Second, as the share of children increases, the government needs to allocate more resources to public education. Further, as the share of retired households decreases (see Figure 1.8I), the government is less burdened by pension payments. This result stands in contrast with predictions under exogenous fertility (dashed line in Figure 1.8H) or those from models with endogenous fertility, but agents only live for two periods.

Figure 1.8J plots the welfare effects in consumption equivalents.[50] I find that the average utility of new-borns under the veil of ignorance increases by 1.6% in the long-run economy when aggregate fertility reaches the replacement level. Quantitatively, the reduction of consumption taxes by 0.9% explains more than half of the welfare improvements. The rest of the welfare gain is explained by (1) higher fertility, (2) insurance benefits *ex ante*, and (3) changes in the distribution of agents.

1.5.2 Comparing Policies: Subsidized Childcare and Education Expenditures

In this section, I highlight results from policy comparisons. For more details on subsidized childcare and public education expenditures, see Appendices 1.C.1 and 1.C.2.

Compared with baby bonuses, subsidized childcare is less cost-effective in raising fertility. While it takes a baby bonus equal to 1.6% of GDP to boost aggregate fertility to the replacement level, the government needs to spend 2.5% of GDP if it uses subsidized childcare to achieve the same goal (see Figure 1.9A). This result is consistent with evidence from historical policies (Luci-Greulich & Thévenon 2013; Stone 2020). It is also intuitive; compared with cash benefits, subsidized childcare offers fewer benefits per child (in consumption equivalents) to parents with low human capital (see Figure 1.10A) given that they would prefer to spend the money elsewhere.

Different from baby bonuses, subsidized childcare encourages the combination of childbearing and working, especially among parents with low human capital.[51] This in turn fosters adults'

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[50] Consumption equivalents measure the percentage changes of consumption in the original economy that would make households indifferent between the original allocation and that with the policy.

[51] Hours worked among parents with low human capital fall after the implementation of a baby bonus for two reasons. First, these parents are most responsive in fertility, which drives up the total childcare time. Second, due to increasing economies of scale in home production of childcare, the increase in fertility decreases the relative price of home versus market childcare. See González (2013) for empirical evidence of these predictions. As discussed in Section 1.2.6, hours worked among parents with low human capital increase under subsidized childcare as the policy "pushes" them from

human capital accumulation via on-the-job learning. As a result, subsidized childcare leads to more equitable income growth across agents with different initial human capital (see Figure 1.10B) and reduces life-cycle wage inequality.[52]

The fertility effects of public education expenditures are an order of magnitude smaller than those from baby bonuses for two reasons. First, public education expenditures only indirectly affect quantity choices through changes in child quality. Second, in the long run, education expenditures increase the share of parents with higher human capital, who have a fewer children. Thus, the government should not expect to use education expenditures as an effective pro-natal policy instrument. While a $30,000 baby bonus boosts aggregate fertility from 1.92 to 2.1 (the replacement level), an education expansion of the same size only raises aggregate fertility by 0.011 (see Figure 1.9A).

Similar to baby bonuses, private investments in children's education also fall under public education expansion, but for a different reason. Parents spend less on children's education under an expansion of public education expenditure due to crowding-out effects. This is because public and private monetary inputs into child human capital formation are substitutes.

Despite mild fertility effects, expanding public education is the most effective policy among those evaluated at raising social mobility and improving children's outcomes. Figure 1.9B indicates that different from baby bonus or subsidized childcare, an expansion of public education that is 1.5% of GDP raises intergenerational mobility by 5.2%.[53] This effect will be larger if the public education expenditure is targeted at low-income households.

1.5.3 Baby Bonus: Transition Path

In this section, I discuss the transition path results following the implementation of a $30,000 baby bonus that leads to the replacement level fertility rate in the long run. The policy is enacted

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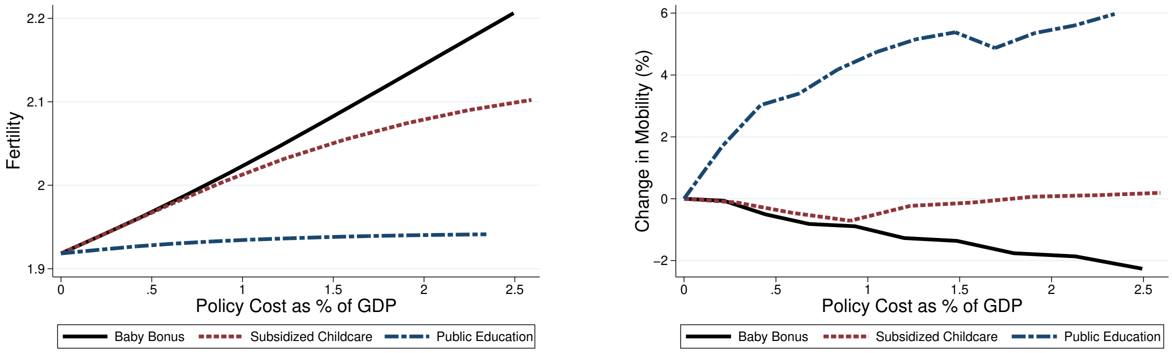
home production of childcare to market work if they want to benefit from the in-kind transfers.

[52] The quantitative effects on wage inequality are nevertheless mild, as most of the gap is driven by differences in initial human capital rather than hours worked.

[53] These values are considerably smaller than the projected policy effects by Daruich (2018) for two reasons. First, Daruich (2018) does not consider the existence of public education expenditures in the benchmark economy. As a result, additional public education expenditures have significantly higher marginal effects on child human capital. Second, Daruich (2018) does not consider endogenous fertility which dampens the policy effects on child quality through the quantity-quality trade-off.

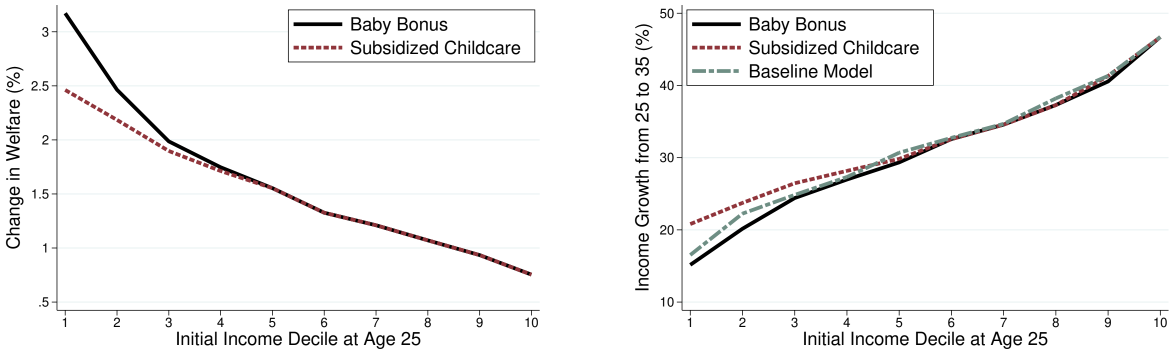
Figure 1.9: Compare Policies: Effects on Fertility and Mobility


(A) Effects on Fertility

(B) Effects on Mobility

Notes: This figure compares baby bonus $\mathcal{B}$ with subsidized childcare $\mathcal{S}$ and public education $\mathcal{E}$ on the basis of effects on fertility and intergenerational mobility.

Figure 1.10: Baby Bonuses and Subsidized Childcare: Effects on Welfare and Income Growth


(A) Effects on Welfare

(B) Effects on Income Growth

Notes: This figure compares baby bonus $\mathcal{B}$ with subsidized childcare $\mathcal{S}$. The direct expenditure on each policy is 1.6% of GDP in the long-run steady-state.

unexpectedly at period $t = 1$ and stays in place for all subsequent periods. The government changes consumption taxes along the transition path to balance the budget in each ten-year period.[54]

Figure 1.11A shows that the policy effects on fertility are immediate and persistent. Figure 1.11B indicates that the old-age dependency ratio starts to decline in period 6, given that past fertility rates predetermine the ratio of the retired to working-age population in the short run. The total dependency ratio, however, increases immediately after the policy is adopted due to a large increase in the number of children born due to the baby bonus.

As a result of this increase in the total dependency ratio, the government needs to finance additional expenditures in the first few periods. Such expenditures include education and transfers to parents with children through the tax system. These "induced" expenditures make the overall costs of family policies much larger than the direct expenditures.[55]

In the baseline model, the government balances the budget period by period using consumption taxes. As a result, Figure 1.11C shows that consumption taxes rise at first before falling in the long run. Hence, welfare changes of new-born agents in transition are positive but significantly smaller than those in the long-run steady state (see Figure 1.11D). Most existing agents in the economy at $t = 1$ do not benefit from the baby bonus, but they are still required to pay higher consumption taxes, leaving them worse off.

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 usually much higher than the policy expenditure itself, 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

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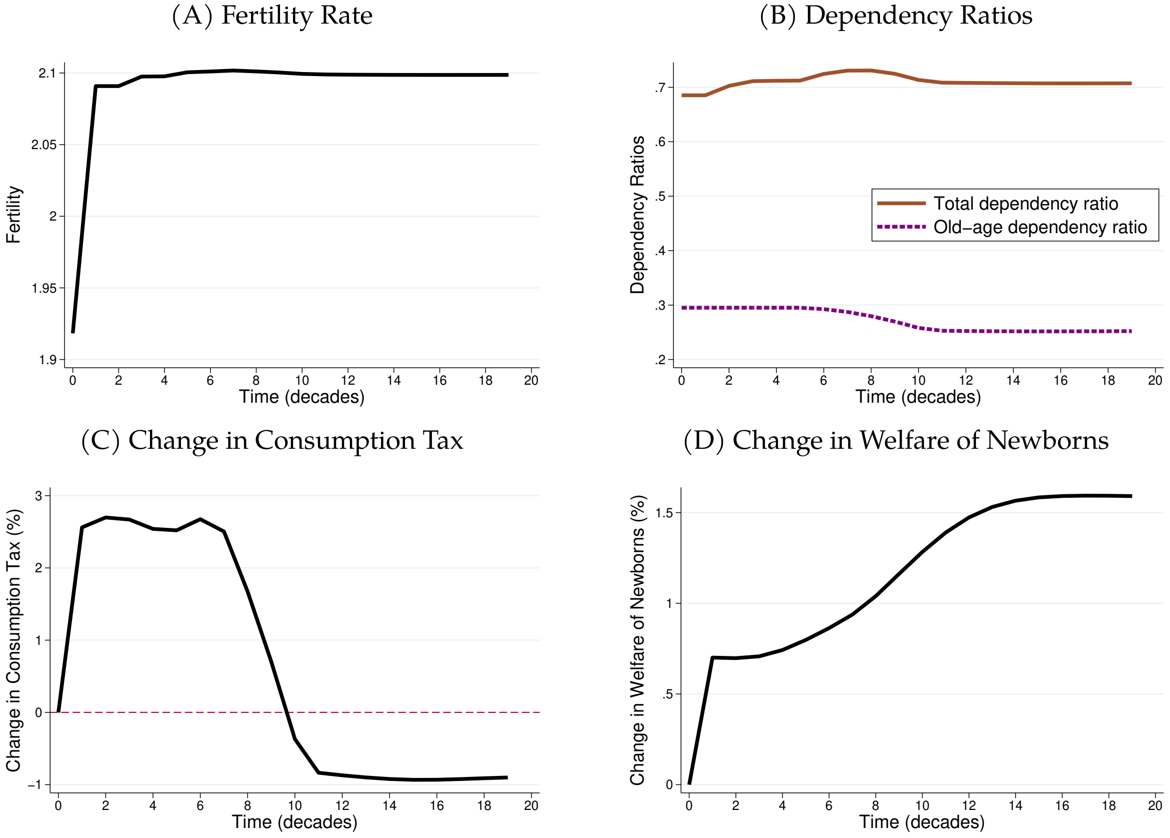
[54] I discuss an alternative way of using government borrowings to fund fiscal expenditures in Appendix 1.A.6. Furthermore, finding the optimal transition is interesting but rarely implemented in quantitative models since the dimensionality of policy instruments is immense. One notable exception is Bakış et al. (2015) where they compute the optimal path of taxes along the transition path in a stylized Aiyagari-Bewley-Huggett model. This would be interesting in my richer model but is beyond the scope of this paper.

[55] For example, while the direct cost of a \$30,000 baby bonus is 1.6% of GDP, the government needs to raise consumption taxes by 2.6% for the first seven decades of the transition.

Figure 1.11: Transition Path of a $31,000 Baby Bonus


(A) Fertility Rate

(B) Dependency Ratios

(C) Change in Consumption Tax

(D) Change in Welfare of Newborns

Notes: These figures plot the evolution of aggregate variables under a baby bonus of $31,000. Each period represents 10 years. The policy is enacted at period 1.

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).

1.6 Optimal Policy

In this section, I study the optimal baby bonus to address the externalities of childbearing and inefficiencies caused by borrowing constraints. I begin with a discussion of welfare criteria under heterogeneous agents and endogenous fertility. Then, I show optimal policy results and propose principles for designing family policies in general.

1.6.1 Welfare Criteria

Welfare criteria in models with endogenous fertility are complicated both conceptually and philosophically. Unlike standard comparisons between allocations where the set of agents is fixed, in this context there will be agents born in one economy but not in the other. As a result, the standard Pareto principle cannot be used to conduct welfare analysis in this context. The field of population ethics is devoted to understanding and resolving this question.[56]

As the debate on welfare criteria is far from being settled, I adopt two definitions in studying the optimal policy. The first criterion is the *long-run average welfare* $\mathcal{W}$ used in previous sections. It 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.[57] I decompose this into welfare changes for existing parents ($j = 2$) who receive the baby bonus and for other households ($j > 2$) who are not direct beneficiaries of the policy. The latter criterion has two features. First, it is forward-looking, as it incorporates tax changes in later periods that affect these households' utility. Second, with this criterion, the unique solution to the planning problem corresponds to the notion of $\mathcal{A}$-efficiency defined in Golosov et al. (2007) which focuses on the welfare of those already alive.

Rather than computing the unconstrained optimum, I follow the Ramsey tradition and allow the government/planner to use only a certain policy instrument (a baby bonus) that is uniform across households and birth order. As in previous sections, I consider the scenario where the government adopts the baby bonus at the beginning of time period $t = 1$. The policy change is permanent and financed by consumption tax changes. I use $\mathcal{B}^*_{lr}$ to denote the optimal baby bonus that maximizes

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[56] For instance, Parfit (1984) derives the famous "repugnant conclusion" showing that under a set of intuitively appealing assumptions, one can prove "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 & Doepke (2021) consider the optimal welfare from a soul's perspective where one needs to consider both the utility of being born and the average "waiting time" for incarnation.

[57] Following standard practice in quantitative macroeconomic literature, I use equal weights as a benchmark. Another approach is to use the Negishi weights, which put a greater weight on households with higher human capital and initial assets. This would eliminate the redistributive benefits of baby bonuses. See Kim et al. (2021) for an example.

average utility in the long run, and I use $\mathcal{B}^*_{sr}$ to denote the optimal baby bonus that maximizes the average utility of existing households when the policy is adopted.

1.6.2 Optimal Policy Results

Figure 1.12 shows the changes in welfare under different baby bonuses for two welfare criteria. From a long-run perspective, the optimal baby bonus is $\mathcal{B}^*_{lr} = \$60,000$. $\mathcal{B}^*_{lr}$ boosts aggregate fertility to 2.4 children per woman, raises long-run welfare by 2%, and costs around 4.1% of GDP.

The baby bonus that maximizes the welfare of the median voter among existing households, however, is $\mathcal{B}^*_{sr} = \$0$. Current parents who receive the baby bonus prefer larger $\mathcal{B}$ for two reasons. First, despite the higher taxes in transition, these households are subsidized by older households $(j > 2)$ on net. Second, the baby bonus redistributes towards poorer parents, which improves average welfare. Older households in the economy, however, oppose the baby bonus because they do not benefit from the bonus but still pay higher taxes for the remainder of their lives. If each household has the same voting power, then $\mathcal{B}^*_{sr} = \$0$ is the most likely outcome from a political perspective. As discussed in Section 1.5.3, this observation explains the observed puzzle where many countries with extremely low fertility rates fail to implement large-scale family policies despite knowing the dire consequences in the long run. Even when they do implement these policies, governments often renege on the promises due to fiscal pressures. For example, the Australian baby bonus was significantly downsized in 2014.

1.6.3 Discussion

Even though this paper restricts the study of optimal policy to choosing the optimal level of a baby bonus, it highlights the major trade-offs in policy design that are broadly applicable to other instruments and goals.[58] On the one hand, subsidizing childbirth among parents with low human capital leads to larger fertility changes per dollar spent on family policies. This in turn leads to larger welfare improvements due to changes in the demographic structure. On the other

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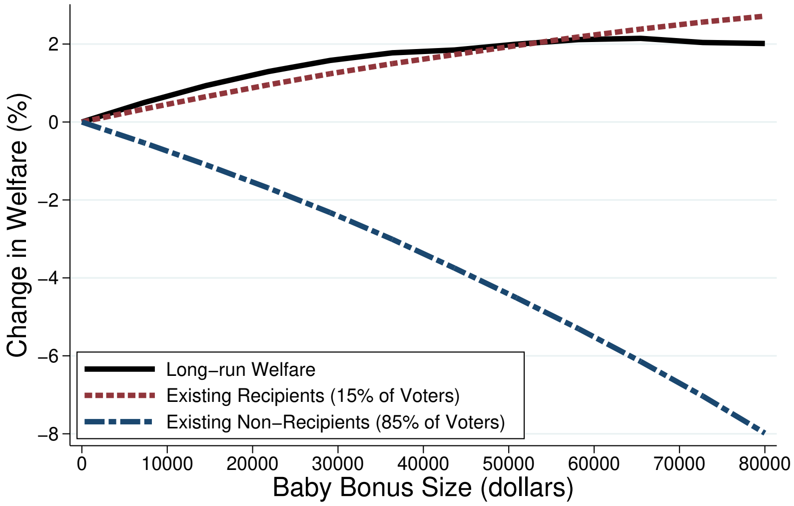
[58] For instance, it is straightforward to incorporate subsidized childcare and public education expenditures, shown in Appendices 1.C.1 and 1.C.2. Instead of choosing a permanent policy change to the baby bonus, one could also conduct dynamic optimal policy design where the size of the bonus varies over time.

Figure 1.12: Optimal Baby Bonus by Welfare Measure



Notes: This figure plots the changes in welfare under baby bonuses of different sizes. I consider two welfare criteria: (1) average utility of a new-born child in the long run and (2) average utility of existing households when the policy is enacted, decomposed into agents who receive the baby bonus and agents who do not receive it.

hand, subsidizing childbirth among parents with high human capital improves the equilibrium human capital distribution via intergenerational transmission of skills, thereby raising welfare due to composition effects. At the aggregate level, the government balances population growth, average human capital, and distortions through the taxation by weighing the quantity-quality trade-off, composition effects, demographic structure effects, and changes in childcare arrangements.

With countervailing forces present in the unified model, the first-order stochastic dominance (FSD) in equilibrium human capital distribution is neither necessary nor sufficient for choosing better policies. 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*. Thus, 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 & Koo

1990).[59] These parents, with higher fertility responses to per dollar benefit, could be key to solving population aging problems.

1.7 Conclusion

Facing aging populations, family policies have been widely pursued to encourage childbirth. On the other hand, evidence of the effects of transfers to parents on children's outcomes lead policymakers and economists alike to believe that family policies are good instruments 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 overlapping generations model. Relative to previous studies on family policies, this paper is the first to combine the quantity-quality trade-off, an endogenous demographic structure, and childcare choices in a quantitative structural framework.

In the calibrated model, I find that when governments design family policies that reward having more children, parents respond by increasing child quantity but optimally reduce child quality. Compared with education subsidies, child benefits are not ideal instruments if the government aims to raise child human capital or boost social mobility. However, the pro-natal effect of family policies could lead to long-run welfare gains: lower old-age dependency ratio allows the government to cut taxes. I also show that the long-run gains in welfare require a transition path where the government needs to finance higher child-related expenditures during the first few decades. Depending on how the government decides to finance these higher costs, the welfare of existing households could fall.

The tractability of the model allows for several extensions and applications, which are left for future research. First, one can calibrate the model to match the institutional details of other countries and conduct policy counterfactuals on a case-by-case basis. Moreover, it would be interesting to consider the optimal policy design with additional or jointly-used policy instruments under different welfare criteria. For instance, when the government uses a baby bonus to raise fertility, it could expand public education at the same time to offset the reduction in private education investments

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[59] Córdoba & Liu (2016) make a complementary argument invoking the Lucas' Critique by showing that family policies have direct effects on households' utility.

due to the child quantity-quality trade-off.

Chapter 1 Appendices

1.A Robustness

1.A.1 More on Calibration

Table 1.4: Sensitivity of Model Parameters to Moments

	γ	ψ	θ	ν	υ	σ_ϵ	ρ	ξ	κ	η	σ_z
n Gap	-0.50	-0.28	**-0.52**	-0.41	0.00	0.00	-0.03	0.03	0.03	-0.01	-0.03
TFR	0.56	-0.56	**1.60**	1.06	0.12	-0.07	-0.01	0.02	0.09	-0.04	0.04
e	0.46	0.49	**1.14**	0.34	-0.47	0.05	-0.08	0.28	-0.07	0.01	-0.02
a_k	-0.03	-0.06	-0.04	**0.75**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m	-0.41	-0.35	-0.31	-0.29	**1.05**	-0.11	-0.08	0.07	0.13	-0.05	0.03
Gini_2	0.02	0.37	1.00	-0.39	-0.48	**1.37**	0.71	-0.61	-2.49	1.19	0.95
IGE	-0.27	-0.24	-0.71	-0.26	-0.23	-0.03	**1.20**	-0.29	-0.37	0.20	0.27
e_{low}	-0.07	-0.08	**-0.19**	-0.05	-0.01	0.00	0.02	-0.15	0.00	0.01	0.01
B/C Ratio	0.31	-0.12	-0.61	0.30	0.25	-0.11	-0.36	0.26	**1.75**	-0.22	-0.30
h Profile	-0.11	0.06	0.22	-0.31	-0.32	0.10	0.28	-0.19	**-1.05**	0.50	-0.05
Gini_6	-0.03	0.06	0.20	-0.05	-0.09	0.03	0.02	-0.06	**-0.40**	0.19	0.36

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 1.2 for definitions of parameters and identifying moments.

Table 1.5: Elasticity of Target Moments to Parameters

	n Gap	TFR	e	a_k	m	Gini_2	IGE	e_{low}	B/C Ratio	h Profile	Gini_6
γ	-2.10	0.38	-3.50	-1.36	-1.73	0.00	-0.26	**-7.58**	0.04	0.07	0.20
ψ	-0.67	-0.96	2.36	0.73	1.21	-0.03	0.15	**4.81**	-0.01	-0.08	-0.10
θ	0.63	0.19	1.90	-0.14	0.89	0.02	0.12	**4.03**	-0.02	-0.01	-0.19
ν	-0.09	-0.05	0.16	**1.33**	0.08	0.00	0.01	0.34	0.00	-0.01	-0.04
υ	-0.92	-0.12	0.02	0.07	**0.99**	0.08	0.00	0.10	-0.02	0.00	-0.38
σ_ϵ	0.76	0.05	-0.29	0.03	-0.32	0.85	-0.19	**-1.36**	0.03	-1.08	-2.13
ρ	-0.10	-0.02	0.90	0.02	0.52	0.06	**0.93**	0.45	-0.02	-0.17	-0.92
ξ	0.61	0.09	-1.96	-0.06	-0.98	0.01	0.05	**-11.08**	0.11	0.03	0.32
κ	0.65	-0.06	1.93	0.06	0.84	0.06	0.30	**4.74**	0.74	-0.04	0.20
η	0.19	-0.09	1.00	0.61	0.89	-0.03	0.06	1.87	1.59	**2.14**	1.60
η_z	-0.02	0.03	-0.49	-0.24	-0.31	0.01	0.16	-1.17	-0.01	-1.05	**2.50**

Notes: This table displays the elasticity of model moments with respect to changes in model parameters. Each cell shows the percentage change of the value of model moment (column) when the corresponding parameter (row) changes by one percent. Bold entries report maximum (of absolute value) by row, highlighting the moment that is most sensitive to parameter changes. See Table 1.2 for definitions of parameters and identifying moments.

1.A.2 Alternative Preferences

There are alternative ways to model parents' preferences over child quantity and quality. I argue that the modeling choice in Section 1.3.1 results in a conservative benchmark relative to other parameterizations.

Separable preferences between quality and quantity (see de La Croix & Doepke 2003; Bar et al. 2018; Vogl 2016) is a commonly-used assumption where

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

Compared with our benchmark case where quality and quantity are complements, parents will raise fertility and reduce child quality even more strongly when the government rewards childbirth. This is because the interaction in preferences $v(n, \mathbb{E}h_k, a_k)$ is not present when quantity and quality are separable. I show this result with closed-form solutions in Appendix 1.E.1. For the same reason, if quantity and quality are substitutes, the results in this paper will be conservative (Jones & Schoonbroodt 2010).

Another way of modeling parents' preferences is with dynastic altruism (see Córdoba et al. 2016; Daruich & Kozlowski 2020) where

$$v(n, \mathbb{E}h_k, a_k) = \Psi(n) V_2(\mathbb{E}h_k, a_k).$$

This formulation is similar to the one used in this paper with the exception that utilities from child quality are pinned down recursively. Dynastic altruism is appealing aesthetically but faces unresolved challenges in fitting observed transfers between parents and children (see Altonji et al. 1997; Barczyk & Kredler 2020). Paternalistic motives are often added to improve data fit (e.g., Abbott et al. 2019). I argue that the results will also be stronger under dynastic altruism: parents endogenize the fact that returns to child quality become lower when the government creates a "social safety net" for children with low human capital by providing generous family benefits. As a result, parents would further increase child quantity and reduce quality investments. For instance, Daruich & Fernández (2020) argue that universal basic income reduces the human capital of future generations due to this mechanism.

1.A.3 Endogenous Timing of Childbirth

In the baseline model, I abstract away from birth timing by assuming that parents only make fertility choices from age 20 to 30. In reality, parents can decide when to give birth, and family policies could affect that decision. This is known as the *tempo effects* of family policies.[60]

I argue that adding endogenous timing will make my baseline results stronger. As the model matches effects on the completed fertility rate (known as the *quantum effects*) in the validation exercise, policy effects on the total fertility rate (quantum plus tempo) will be larger. Suppose that in addition to increasing the number of children, some parents shift birth from their 30s to their 20s in response to a baby bonus. This shift in birth timing will likely be detrimental to child human capital for two reasons. First, early birth reduces the spillover that the children could receive because parents' human capital grows rapidly from age 20 to 40. Second, family policies of realistic sizes fall short of offsetting the income differences of parents between early and late births. Hence, these children are born into households with fewer resources on average, which would also reduce child human capital as investment falls. As a result, family policies will have a larger observed fertility impact on the economy with endogenous timing of birth, but the outcomes of children will be even worse.

1.A.4 Bequests

The model restricts the set of timings that parents could make transfers to children to $j = 3$. I make this simplifying assumption to keep the model tractable – if parents can leave end-of-life bequests to their children, then children need to keep track of parents' state space, including human capital and assets.

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[60] An unresolved question is whether changes in timing are due to the relaxation of parents' constraints (e.g., down payments to buy a larger house) or the lack of commitment to policies by the government. Historically, governments often renege on family policies as fiscal conditions change. The significant downsizing of the Australian baby bonus in 2014 is one good example. This uncertainty creates an incentive for parents to shift birth timing while benefits are still in effect.

I argue that this simplification does not significantly affect my model results. Because the key mechanisms of the model (i.e., quantity-quality trade-off and childcare choices) occur in period $j \in \{2, 3\}$, the possibility of receiving a bequest at $j \in \{5, 6\}$ does not matter for households' choices if they cannot borrow against it due to life-cycle credit constraints. In the calibrated model, most households, especially those with low human capital who are most responsive to family policies, hold few assets in the beginning of their life cycles despite receiving the inter vivos transfers from their parents (see Figure 1.3).

1.A.5 Alternative Measure of Fertility

As the baseline model focuses on the total number of children that parents decide to have, the most appropriate measure of fertility in this context is the completed fertility rate (CFR), measured using data on either "children ever born" in Census data (dropped after 1990) or "live births ever had" in the CPS June Fertility Supplement. As discussed in Section 1.4, the CFR has the advantage of being invariant to shifts in birth timing due to policy changes. For these reasons, in Figure 1.5.2 and the calibration, I use the CFR by household income decile, calculated using the sample of married women age 40-55 in the 2008-2014 CPS Fertility Supplement.[61]

One disadvantage of using the CFR is that these women made their fertility decisions prior to 2010 where they may have faced different trade-offs. The total fertility rate (TFR) is an alternative measure that is more responsive to contemporaneous situations, calculated by summing the age-specific birth rates of all women alive in a given year. This measure is simple to compute and widely used in the literature (Kremer & Chen 2002).

TFR *by income decile*, however, is less straightforward to compute than CFR by income decile. First, one does not want to assign income ranks that mix young women with older women due to life-cycle changes in the earnings profile. Second, given that the appropriate measure of income

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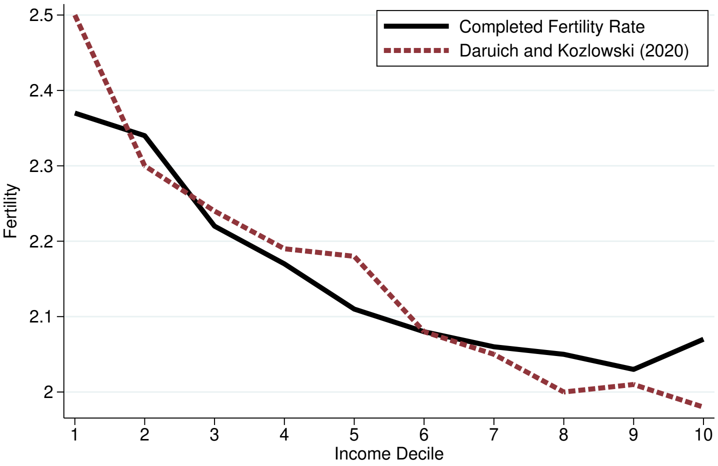
[61] In a steady-state economy, fertility choices across cohorts are stationary, and hence the CFR coincides with the total fertility rate (TFR). For this reason, I normalize the CFR target in the calibration of ψ to match the total fertility rate in 2010, which was 1.92 children per woman. Model results are quantitatively similar if I omit this step. I have also experimented with a version of the model where a fraction of adults remain single and (exogenously) childless, meaning that the CFR in the economy is a weighted average between single adults without children and married households whose within-group CFR is higher than 1.92. The overall results are again similar.

is total family income, one would not want to mix married women with single women. Daruich & Kozlowski (2020) provide a recent estimate of TFR by income decile using data from the 2000 Census. They restrict the sample to married women between ages 15-49 who are either themselves household heads or spouses of the household head. Income deciles are assigned by comparing the total family income of each woman with other observations in the same age group. To alleviate selection bias into marriage for younger age groups, they also drop age-income groups with a small number of observations. For each income decile, they calculate the TFR by adding up the age-specific fertility rates in that decile. Figure 1.13 shows that their result is quantitatively similar to the CFR estimates used in the calibration.

Figure 1.13: Fertility Rate by Income Decile



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

1.A.6 Government Borrowing

In the baseline policy counterfactual and the optimal policy analysis, the government changes consumption taxes τ_c to balance the budget in every period. This assumption is made primarily for computational reasons.

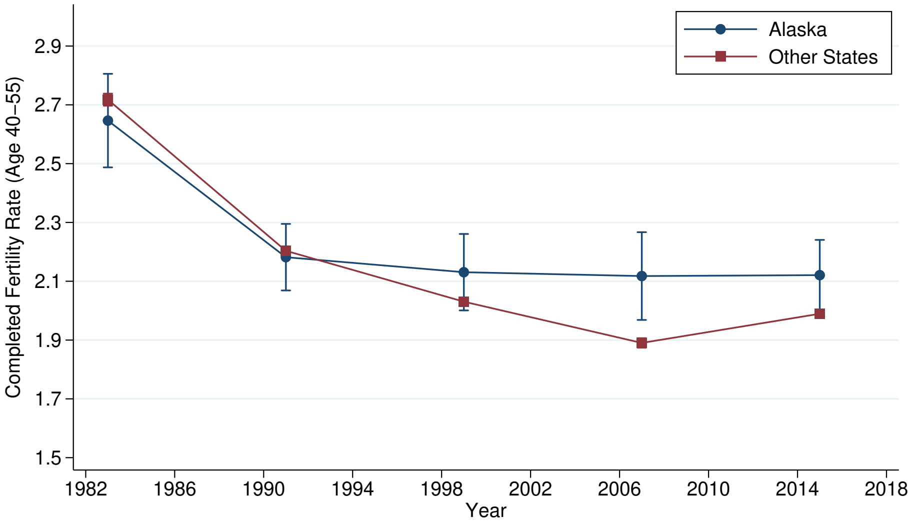
I argue that many results are unlikely to change when the government can borrow from domestic or international lenders. In particular, all of the main policy mechanisms (i.e., quantity-quality trade-off, composition effects, changes in demographic structure, and adjustments in childcare arrangements) are independent of whether or not the government is allowed to borrow. As a result, I expect the model predictions on fertility, human capital, output, and mobility to be unchanged in a model with government borrowing.

Welfare implications, however, will likely change depending on how government expenditures are funded. For example, since the $30,000 baby bonus generates welfare improvements for all agents in the long run, it is natural for the government to shift the fiscal burden to these beneficiaries via borrowing instead of asking existing elderly households to fund additional expenditures from which they derive little benefit (see Figure 1.12). If the government chooses to do so, then the welfare effect in the long-run economy will be smaller, while the effect on existing agents will be less negative. Such a policy change is also more likely to gain sufficient political support for implementation as it does not directly hurt existing agents who have voting power. On the other hand, if the government issues debt to finance large-scale family policies, the overall borrowing cost for the government could increase in general equilibrium if lenders require higher compensation for a larger debt-to-GDP ratio. This might crowd out other government borrowing that benefits existing households. As a result, whether current agents prefer government borrowing or changes in taxation also depends on the opportunity costs of family policies.

Despite the intuitive appeal of using government deficits to finance large-scale family policies that benefit future generations, family policies are often financed by adjusting fiscal revenues and expenditures in current policy proposals. For example, the American Families Plan vows to increase the tax rates among the very rich, while the Family Security Act proposed by Senator Romney would reform and consolidate outmoded federal programs. I leave the normative implications of such financing choices for future research.

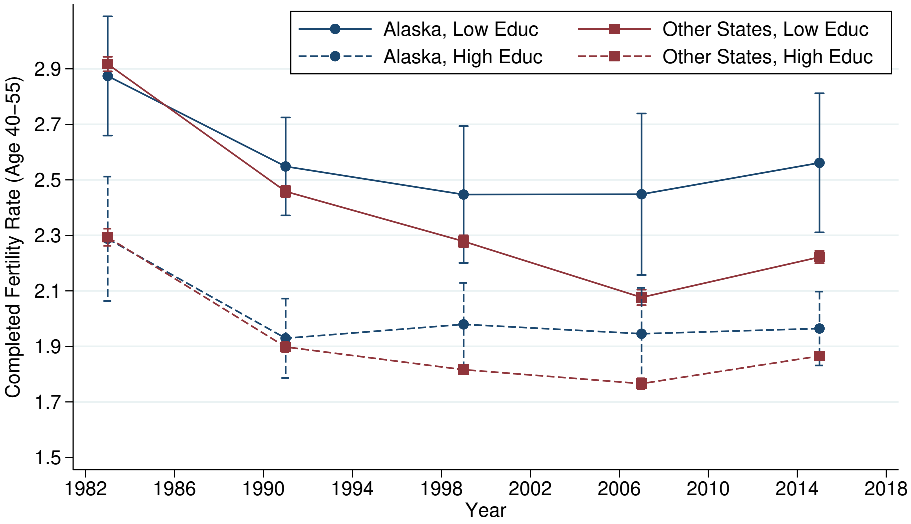
1.B Additional Figures on the APFD

Figure 1.14: APFD and Completed Fertility Rate



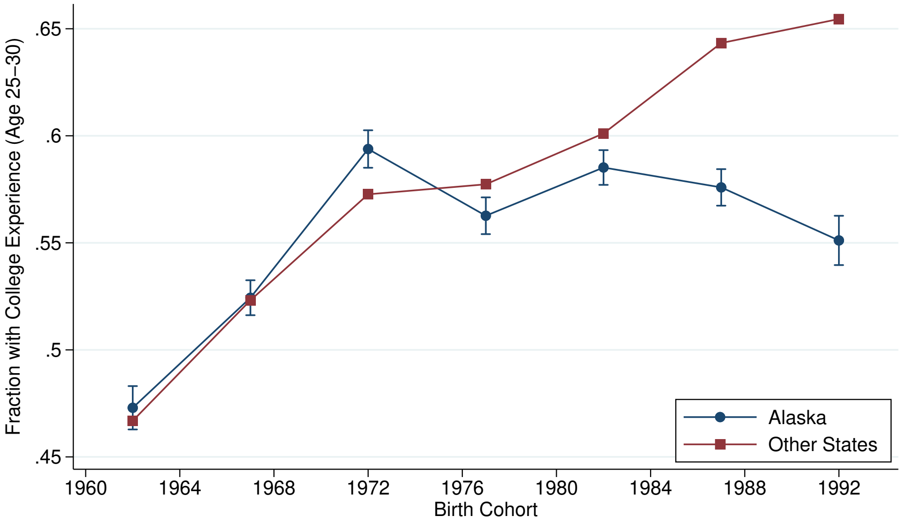
Notes: This figure plots the average completed fertility rates for women aged 40-55 by state of residence from 1982 to 2018 using data from the CPS Fertility Supplement combined into 8-year bins. Bars around sample means show 90% confidence intervals.

Figure 1.15: APFD and Completed Fertility Rate by Education



Notes: This figure plots the average completed fertility rates for women aged 40-55 by state of residence and education from 1982 to 2018 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.

Figure 1.16: APFD and Completed Fertility Rate by Education



Notes: This figure plots the fraction of 25- to 30-year-olds with at least one year of college experience by birth cohort by state of residence using data from the CPS combined into 5-year bins. Bars around sample means show 90% confidence intervals.

1.C Additional Results

1.C.1 Public Childcare

In this section, I evaluate childcare subsidies where the government offers $\mathcal{S} \in [0, 0.9 \cdot \chi]$ market childcare services for all families, equivalent to 0 to 36 hours of public childcare per week.

I find that subsidized childcare raises fertility, but at a higher cost than baby bonuses. The government needs to provide 25 hours of subsidized childcare to raise the aggregate fertility rate to 2.1. This would cost almost 2.5% of aggregate GDP in the long-run steady-state economy, which is 0.8 percentage point higher than a baby bonus that achieves the same fertility goal.

Figure 1.17D shows that similar to the baby bonus counterfactual, parents reduce private education investments due to the quantity-quality trade-off. Figure 1.17C shows that fertility responses are higher among low-income parents. Due to reductions in private investment and composition effects, average human capital in the economy decreases (see Figure 1.17E). The overall effects on intergenerational mobility are small (see Figure 1.17F).[62]

Figure 1.17G shows that output per capita increases with subsidized childcare. Compared with the baby bonus, the output changes are larger for three reasons. First, composition effects are milder because the fertility differentials between parents with low and high human capital are smaller than those under the baby bonus (see Figure 1.17C). Second, the childcare subsidy raises the labor supply by replacing home care with subsidized market childcare. Finally, the increased working time during age 20-30 translates to high human capital for adults in later periods due to learning-by-doing in the labor market. Relative to the original steady-state, Figure 1.17I shows that the government can reduce consumption taxes by 0.6%. Long-run welfare could be raised by 2.5% when aggregate fertility is around the replacement level.

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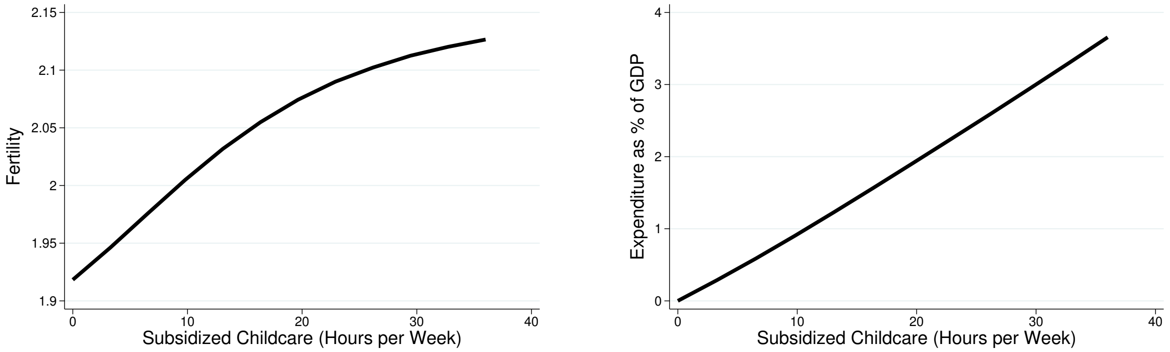
[62] The effects on mobility are not monotonic because besides changing child human capital, subsidized childcare also changes hours worked, affecting household earnings.

Figure 1.17: Long-Run Effects of Childcare Subsidies

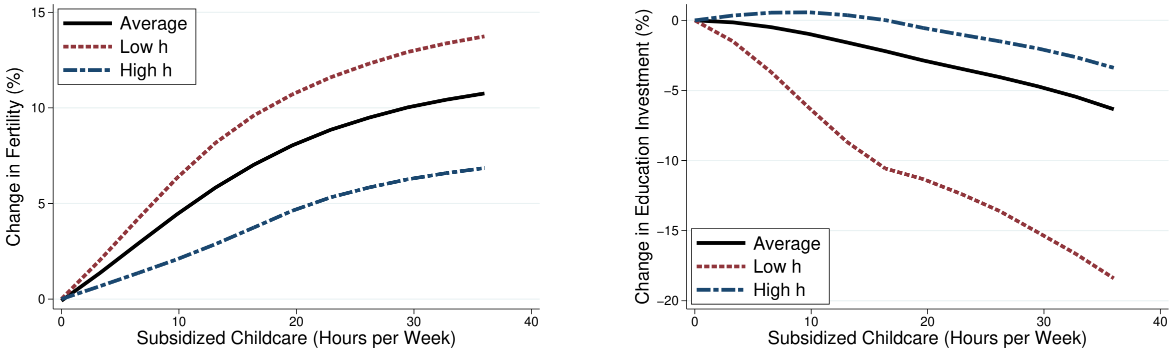


(A) Effects on Fertility

(B) Expenditure Share as % of GDP

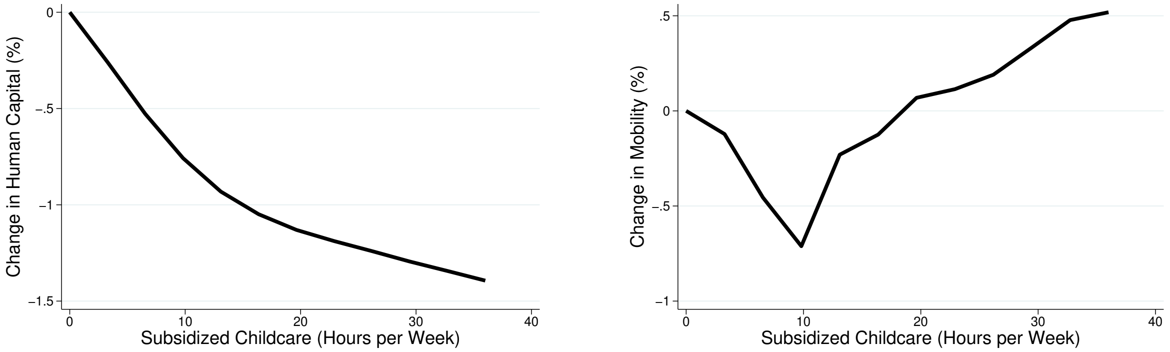
(C) Heterogeneous Fertility Response

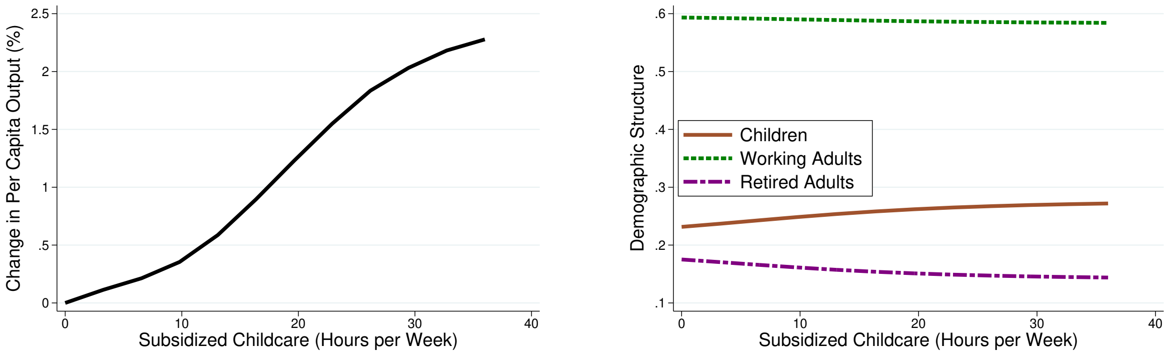
(D) Heterogeneous Private Input Response



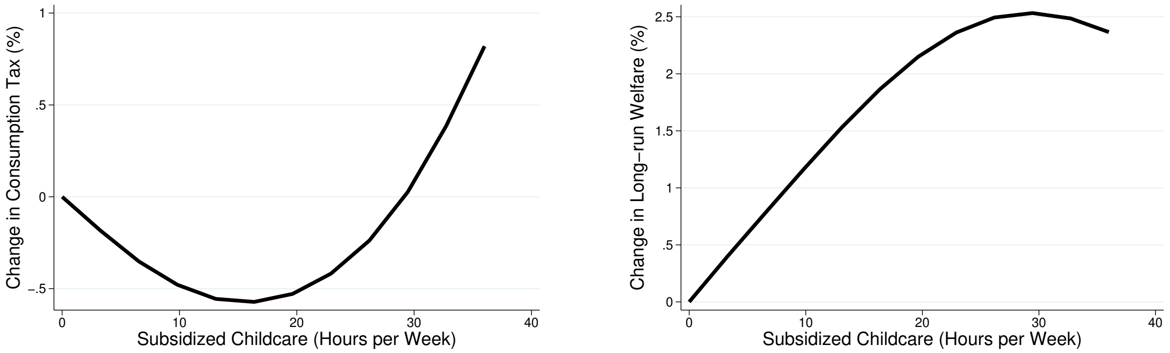
(E) Average Human Capital

(F) Intergenerational Mobility




(G) Per Capita Output

(H) Demographic Structure


(I) Change in Consumption Tax

(J) Change in Welfare

Notes: These figures plot macroeconomic impacts of childcare subsidies of by comparing long-run steady-states under different policies to the baseline steady-state economy.

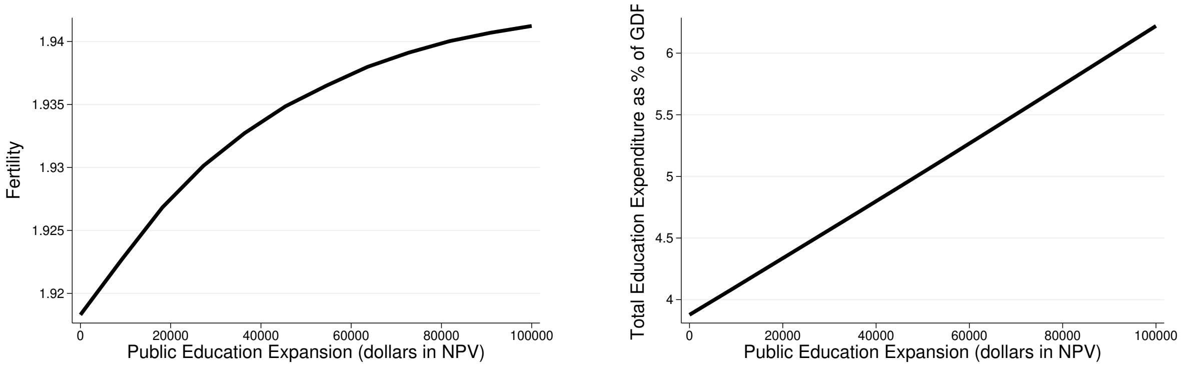
1.C.2 Public Education

In this section, I evaluate expansions of public education expenditures from the current level of \$12,000 per student per year. The size of the increment varies between \$0 and \$100,000 in net present value. Figure 1.18A shows that the effect on fertility is positive: as public education raises children's human capital, they become more desirable to parents. The magnitude of the fertility effect here is much smaller than that of family policies. Compared with a \$30,000 baby bonus that raises fertility by 0.2 children per woman, an education expansion with costs being the same share of GDP only raises fertility by 0.011. The government should therefore not expect to use education policies to raise aggregate fertility to the replacement level.

Figure 1.18C shows that the fertility response is larger for households with higher human capital. An increase in public education expenditure also crowds out private input (see Figure 1.18D). Due to strong crowding-out effects, average human capital only increases by 2.5% when the education expansion exceeds \$80,000 in net present value. It is costly to raise average human capital in the economy using uniform policies in general equilibrium because (1) crowding-out effects are strong and (2) investments face decreasing marginal returns as $\mathcal{E}$ is already \$12,000 per year in the baseline economy.

Expanding public education, however, most effectively raises social mobility. As the expansion exceeds \$60,000 in net present value, intergenerational mobility rises by almost 5.2%. If the policy targets lower-income households, one can expect larger effects on mobility. Due to increased human capital, public education expansion of \$60,000 raises output by 2.3%. The government needs to increase the consumption tax by 0.75% to finance such expenditures. Figure 1.18J shows that welfare could be increased by up to 2.5%.

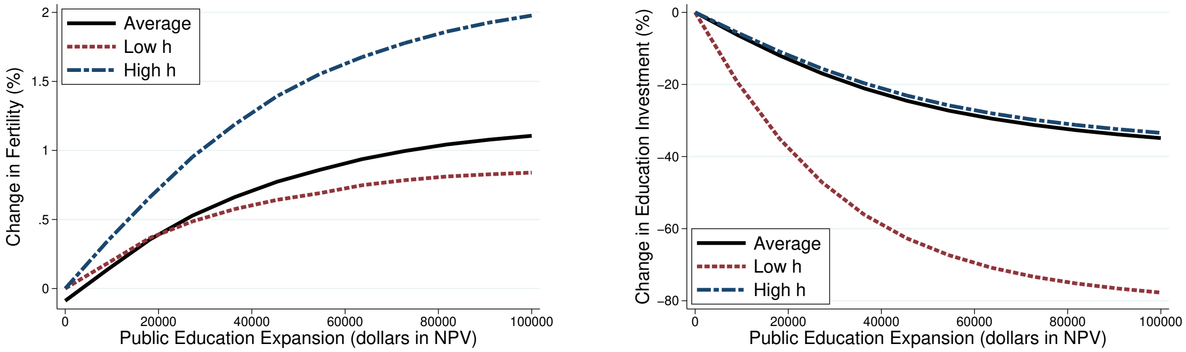
Figure 1.18: Long-Run Effects of Public Education Expansions


(A) Effects on Fertility

(B) Total Education Expenditure Share as % of GDP

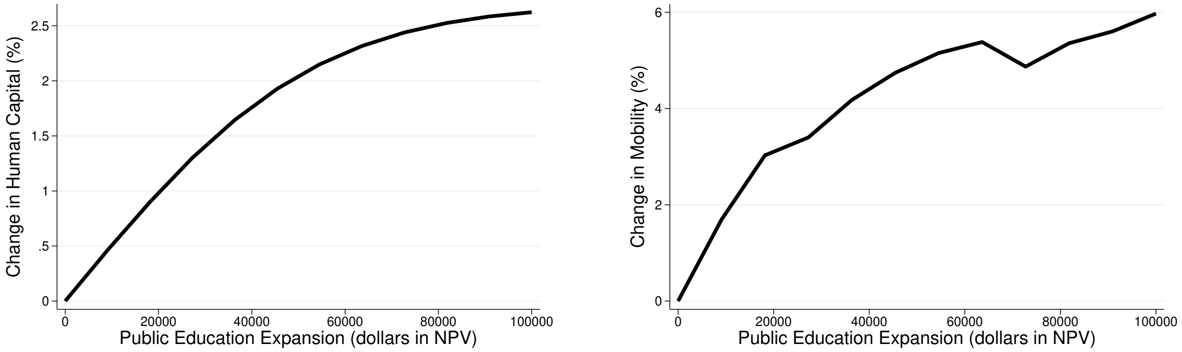
(C) Heterogeneous Fertility Response

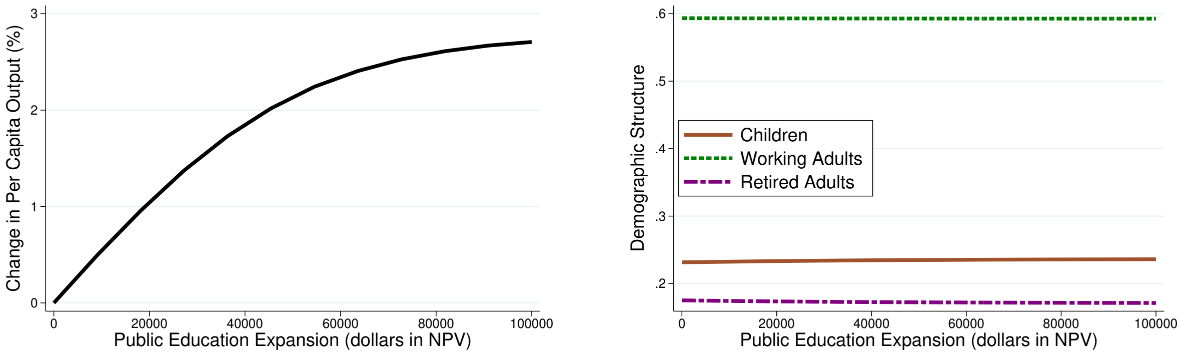
(D) Heterogeneous Private Input Response



(E) Average Human Capital

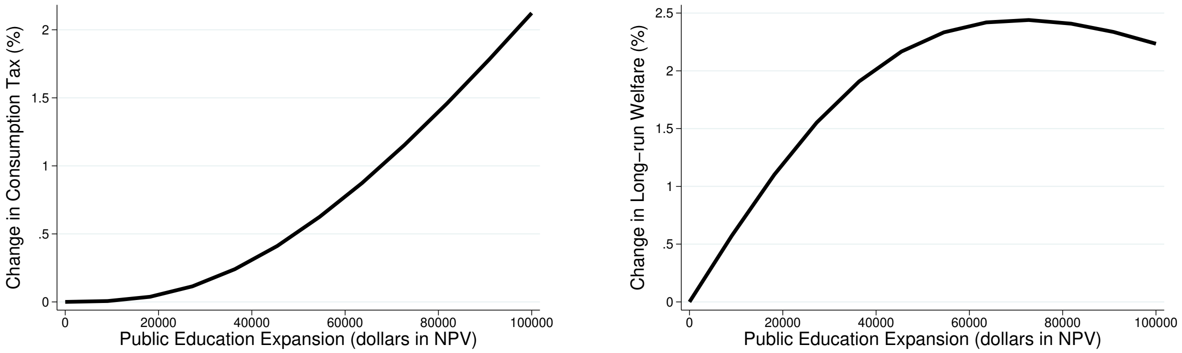
(F) Intergenerational Mobility





(G) Per Capita Output

(H) Demographic Structure



(I) Change in Consumption Tax

(J) Change in Welfare

Notes: These figures plot macroeconomic impacts of expansions of public education expenditures by comparing long-run steady-states under policies to the baseline steady-state economy.

1.D Additional Validating Evidence

1.D.1 Australian Baby Bonus

This section compares the implications of the calibrated model with the empirical evidence from a recently adopted baby bonus in Australia.

The Australian government announced the introduction of a universal cash payment, i.e., a baby bonus, in its federal budget on May 12, 2004. It was designed to be a non-means-tested and non-taxable lump-sum payment of AU$3,000 to encourage childbirth. The transfer would be paid to parents following the birth or the adoption of a child up to 2 years of age after July 1, 2004. Such payments were independent of family income, maternal employment status, or the number of existing children in the household. The payment amount was equivalent to 4 times the weekly average earnings in Australia, or $2,800 in 2010 U.S. dollars.

Drago et al. (2011) conduct a comprehensive analysis of the fertility effects of the Australian baby bonus using household panel data ($N = 14,932$) from the Household, Income and Labour Dynamics in Australia Survey (HILDA) and a simultaneous equations approach. They first estimate the effect of the baby bonus on households' birth intentions in a linear regression, which, in turn, predicts actual births in a binomial probit regression. They exploit the panel structure of the data to test and correct for announcement effects, compression/tempo effects, and delayed effects. Regression results show that the baby bonus has significant and positive impacts on fertility. Moreover, the fertility responses are concentrated among low-income women.[63] Risse (2010) reports similar findings on women's birth intentions.

When I compare these empirical studies to the model, both the finding on the overall fertility effect and the heterogeneities across households are consistent with predictions in Section 1.5.1. Drago et al. (2011) estimate that the marginal cost to the government of an additional birth is at least A$126,000, roughly 4 times the GDP per capita in 2004 Australia dollars. The calibrated model generates a quantitatively similar conclusion where the marginal costs for an additional birth using

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[63] This finding is different from that of Milligan (2005) where the author evaluates a child benefit in Quebec and finds larger responses among parents with higher incomes. Drago et al. (2011) propose that the difference could be due to the fact that the Quebec baby bonus was significantly more generous for high-parity births. Milligan (2005) discusses some other possible explanations such as unobserved heterogeneities that are systematically related to income.

a US baby bonuses in 2010 are around 3.5 times the GDP per capita.[64]

Gaitz & Schurer (2017) evaluate the effect of the Australian baby bonus on child human capital accumulation using high-quality panel data from the Kindergarten cohort (K-cohort) of the Longitudinal Study of Australian Children (LSAC). They find that the baby bonus, despite being significant in size, is not effective in boosting learning, socio-emotional or physical health outcomes of the average pre-school child. This finding is consistent with results in Section 1.5.1 where parents optimally reduce private education investments due to the quantity-quality trade-off.

1.D.2 Spanish Child Benefits

In this section, I provide additional evidence of the fertility effects of child benefits using a universal child benefits policy in Spain.

The Spanish government announced the new child benefit on July 3, 2007. The benefit was a one-time payment of €2,500 to the mother immediately following a child's birth on and after July 1, 2007. Since the cash benefit was universal and independent of the recipient's characteristics, it was essentially a universal baby bonus (c.f., the Australian baby bonus, and $\mathcal{B}$ in the model). The size of the payment is 4.5 times the monthly gross minimum wage for a full-time worker or $3,500 in 2010 U.S. dollars.

González (2013) studies the effect of the Spanish child benefit on fertility and mothers' labor supply using monthly vital statistics, monthly abortion statistics, and the 2008 Household Budget Survey ($N = 958$). In the paper, fertility effects are assessed by inspecting the time series of births and abortions, while effects on the labor supply are estimated using a regression-discontinuity design by comparing households who gave birth right before and right after the cutoff date. González (2013) finds that the fertility effects are positive and significant, with the policy increasing the total fertility rate by 6%. Around 80% of this increase is due to increased conception while the remaining 20% is due to reductions in abortion. The result suggests that (in Spain) the marginal cost of an additional birth using baby bonuses is 3.6 times the GDP per capita.[65] The model counterpart to

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[64] To provide additional corroborative evidence, leveraging a large-scale subsidy called Maternity Capital, Sorvachev & Yakovlev (2019) find that the costs of an additional birth in Russia is approximately $50,000, around 3.5 times the GDP per capita of Russia in 2011.

[65] Summarizing historical studies with both short-run and long-run effects on fertility, Stone (2020) show that one can

this statistic is 3.5.

González (2013) also finds that the baby bonus reduced mothers' labor force participation. The calibrated model produces this effect via two channels. First, as the baby bonus raises fertility, parents need to generate more childcare services, increasing their time at home ceteris paribus. Second, higher fertility reduces the relative cost of home versus market care due to economies of scale in home production of childcare ($\iota < 1$). Therefore, the model predicts that parents optimally change their childcare arrangements so that their children spend less time in market care. González (2013) confirms this prediction by showing that Spanish parents reduce enrollment in formal childcare after the baby bonus.

1.D.3 Russian Maternal Capital

In this section, I provide additional evidence of the fertility effects of child benefits using a series of subsidies, called Maternity Capital, in Russia.

The Russian government introduced a sizable conditional child-subsidy program (called Maternity Capital) to address the decade-long decrease in fertility and depopulation. The program was implemented in two waves. In the first wave in 2007, the federal Maternity Capital program, a family that already had at least one child and gave birth to another became eligible for a one-time subsidy of approximately $10,000 U.S. dollars. This figure was larger than the country's average 18-month wage or the sum of the minimum wage over a 10-year period. At the end of 2011, Russian regional governments introduced regional Maternity Capital programs that gave additional money on the top of the federal subsidy to all families with newborn children.

Using a regression-discontinuity design surrounding the program announcement date, Sorvachev & Yakovlev (2019) find that the program have significantly increased fertility both in the short-run and in the long-run. They estimate that the cost for an additional birth is around $50,000, approximately 3.5 times the GDP per capita of Russia in 2011. Moreover, they find that the treatment effect is heterogeneous: while all educational groups are affected by the program, the increase in fertility is higher among low-educated mothers. In another work, Slonimczyk & Yurko (2014) build

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multiply the policy effects on total fertility rates by 1/3 to derive a crude estimate of the effects on completed fertility rates.

and estimate a structural dynamic programming model of fertility and labor force participation to evaluate the policy effects. They find that the program increased long-run fertility by about 0.15 children per women. This estimate suggest that the cost for an additional birth is around 4.6 times the GDP per capita, slightly higher than that in Sorvachev & Yakovlev (2019). They also find that the program "seems to have more stronly affected relatively underprivileged women".

Subject to the caveat of not re-calibrating the model to match institutional details in Russia, these findings in both papers are consistent with the model's prediction. In particular, the model predicts that an additional birth requires a payment that is 3.5 times the national GDP per capita. Moreover, fertility responses are larger among parents with lower human capital (see Section 1.5.1).

1.E Illustrative Models

1.E.1 Simple Model of Quantity-Quality Trade-Off

In this section, I show the quantity-quality trade-off mechanism with closed-form solutions in a model that is adapted from de La Croix & Doepke (2003).

Agents in the economy live for two periods, child and adult. Adult parents solve the problem:

$$\max_{c,n,e} \quad \log(c) + \theta \log(n \cdot h_k)$$

subject to

$$c + n \cdot e = 1 - n \cdot \chi, \text{ and}$$

$$h_k = e^{\gamma}, \quad \gamma \in (0,1).$$

where c is consumption, n is fertility, h_k is human capital of children, e is private investment,[66] and χ is fixed cost per child.

When fertility is exogenous, i.e., n is given, parents maximize over c and e. The optimal investment is given by

$$e^* = \frac{\theta\gamma}{1+\theta\gamma} \times \frac{1-n\chi}{n}.$$

When the child cost χ decreases, e^* increases due to the income effect.

When fertility is endogenous, parents maximize over c, e, and n. The optimal fertility and investment decisions are given by

$$n^* = \frac{1}{\chi} \cdot \frac{\theta(1-\gamma)}{1+\theta}, \quad \text{and} \quad e^* = \frac{\gamma\chi}{1-\gamma}.$$

When the cost of a child χ decreases, n^* increases while e^* decreases. The intuition for this result is simple. Parents increase fertility due to the substitution effect. The increase in n^*, in turn, raises the

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[66] In de La Croix & Doepke (2003), children receive human capital endowments. This generates non-homotheticity over child quality for heterogeneous parents with different human capital and leads to a negative income-fertility relationship. I abstract away from steady-state heterogeneity across households in this simple model for clearer exposition of intuition in comparative statics, but all arguments carry through when human capital endowments are allowed.

shadow price of investment e^* due to the interaction between n and e in the budget constraint. As a result, the optimal investment e^* falls.

Compared with the benchmark model where n and h_k are complements in parents' preferences, reductions in e^* in response to a change in χ are higher in this simple model. This is because the marginal utility in child quality h_k is independent of fertility n.

1.E.2 Simple Model of Fertility Elasticity

In this section, I build a simple model to illustrate the relationship between the parameter γ, which determines the intergenerational elasticity of substitution (EGS), i.e., $1/\gamma$, and the magnitude of fertility responses to family policies.

Consider a simplified problem for parents with very low income so that child quality is generated by public investments alone:

$$\max_{c,n} \quad u(c) + \Psi(n)u(\mathcal{E})$$

$$\text{subject to} \qquad c + n \cdot \chi = 1.$$

The first-order condition for n is therefore:

$$\underbrace{\Psi'(n) \cdot u(\mathcal{E})}_{\text{MB of } n} = \underbrace{u'(c) \cdot \chi}_{\text{MC of } n}.$$

By substituting in $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, I have

$$\Psi'(n) \cdot u(\mathcal{E}) = c^{-\gamma} \cdot \chi.$$

When the "price" of child χ falls, both n and c will rise. A higher γ results in a faster decay of the marginal utility change from rising consumption. To balance the first-order condition, the rise in n on the left-hand-side needs to be larger. In other words, higher γ leads to a greater elasticity of n with respect to changes in χ.

This argument holds equally for $\{\mathbb{E}h_k, a_k\}$ in the main model because they are also evaluated by parents through utility function $u(\cdot)$. Soares (2005) uses a similar argument in the context of mortality reductions of children.

Chapter 2

Intergenerational Mobility Begins Before Birth

with **Ananth Seshadri**

2.1 Introduction

If the United States has a civic religion, it is that each individual should have the opportunity to achieve the American Dream. Enhancing socioeconomic mobility is often regarded as an important policy goal and has always been a central issue in public policy discussions and academic research. Significant research efforts have been directed towards documenting patterns of intergenerational mobility (Chetty et al. 2014) and studying the mechanisms behind the observed degrees of intergenerational persistence (Lee & Seshadri 2019).

Most analyses of intergenerational mobility focus on the structural forces after childbirth, such as credit constraints (Heckman & Mosso 2014, Daruich 2018) or neighborhood effects (Chetty & Hendren 2018), while assuming that the childbirth itself is exogenous or controlled with perfection. Relatively little attention has been paid to the frictions that determine the conditions into which the children are born and the aggregate implications of government policies aimed at mitigating these frictions.

In this paper, we first discuss several motivating facts which suggest that intergenerational mobility begins before childbirth. We use data from the National Survey of Family Growth (NSFG) to show that the fertility process is far from being frictionless or exogenous, contrary to what is commonly assumed in the literature. Overall, nearly half of all pregnancies and 40% of all live births are unintended where the respondents think the conception was either "too soon, mistimed" or "unwanted." The phenomenon is much more common among Black Americans and women with low socioeconomic status. Given that unintended fertility has a detrimental effect on both the mother and the child (Logan et al. 2007, Bailey 2013), we argue that the presence of family planning adoption amplifies the degree of intergenerational persistence that would otherwise prevail had mothers been able to control their fertility freely. Using restricted-access data from Pregnancy Risk Assessment Monitoring System (PRAMS), we also provide suggestive evidence supporting this inquiry by showing that the level of unintended fertility is highly correlated with measures of intergenerational mobility at the state level after controlling for various correlates discussed in the literature.

We then extend the standard Becker-Tomes model by incorporating endogenous adoption of family planning services to understand unintended fertility and to quantify its effect on intergenerational mobility. Differences in career costs of children, life-cycle income profile, and family planning costs by education all contribute to the disparities in family planning adoption, birth timing, and unintended fertility rates. We show that compared with the standard Becker-Tomes framework, the model with family planning generates lower social mobility.

To study policy counterfactuals, we calibrate the model to match intergenerational mobility and profiles of unintended fertility across states. State-level parameters map closely to factors that are good predictors of mobility (e.g., residential segregation) as well as indices reflecting costs of family planning services. In policy counterfactuals, we reduce the cost of family planning among the poor to the lowest level across all states. We find that absolute upward mobility rises, on average, by 0.3 standard deviations across states.

We also use the calibrated model to shed light on how much of the racial gap in absolute upward mobility can be explained by differences in family planning costs. When we calibrate the model to match differences in unintended fertility by race, we find that Black women face much higher costs of family planning than white women with similar incomes. If the government reduces family planning costs among Black Americans to match that of the whites, the racial gap in upward mobility can be eliminated by 20%. At the same time, the racial income gap could be reduced by 25% in the long-run steady-state, and more than half of this gain can be achieved in one generation.

The rest of the paper is organized as follows. In Section 2.2, we discuss the motivating facts on unintended fertility, family planning adoption, and intergenerational mobility. Section 2.3 presents the model and calibration. Section 2.4 contains the key results of the paper. Section 2.5 concludes.

2.2 Motivating Facts

In this section, we present several facts, some of which are stylized and extensively studied in the literature of family planning and unintended fertility.[1] Here, we provide a brief overview of these facts and make a connection to intergenerational mobility.

2.2.1 Unintended Fertility

We use data from the National Survey of Family Growth (NSFG) to characterize some stylized facts about unintended fertility in the United States.

NSFG is administered by the U.S. National Center for Health Statistics starting from 1973, designed to be nationally representative of women 15-44 years of age in the civilian, non-institutionalized population of the United States. It gathers information on pregnancy and births, marriage and cohabitation, infertility, use of contraception, family life, and general and reproductive health. We use the 2015-2017 sample, where the dataset contains 5,554 women, 9,553 recorded pregnancies, and 6,693 live births.

The interview question of particular interest here concerns fertility intention. Respondents were asked about their wantedness for each pregnancy. The answer is one of “later, overdue”, “right time”, “too soon, mistimed”, “didn’t care, indifferent”, “unwanted”, or “don’t know, not sure”.

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[1] For instance, see Brown et al. (1995), Rosenzweig & Wolpin (1993), and Kost & Henshaw (2014).

A pregnancy is categorized as "unintended" if it is either "too soon, mistimed" or "unwanted." Information on fertility intention is highly valuable to modeling fertility choice because childbirth that would be otherwise interpreted as "chosen" from a revealed preference point of view could actually be the result of contraceptive failure, misinformation, or lack of access to family planning services. We restrict the sample to pregnancies that end up in live births and view the adoption of abortion procedures as another form of family planning for simplicity. We categorize a live birth to be unintended if the corresponding pregnancy is reported to be unintended by the mother.

Figure 2.1 displays unintended birth rates by education and race. The figure conveys three stark observations. First, the overall level of unintended fertility rate is high. Finer & Zolna (2016) report that in 2011, nearly half (45%) of the 6.1 million pregnancies in the United States were unintended. In NSFG data, the percentage of unintended births is 42%. This implies that a significant portion of childbirth would have been delayed or avoided had the mothers utilized family planning better. Second, the unintended fertility rate declines sharply with education. While 45% of the births are unintended for women with high school degrees and below, only 22% are unintended for women with a college degree and above. Lastly, unintended birth rates are much higher among Black Americans than among whites. Even conditional on education, Black women are almost 20% more likely to report having unintended birth than white women.

2.2.2 Frictions and Sources of Disparities in Family Planning

Since the invention of modern contraceptive technologies, especially the oral birth control pill, women have been empowered with a highly effective tool to conduct family planning (Bailey 2010).[2] Therefore, it might first come as a surprise to observe the high level of unintended birth rates presented in Figure 2.1. In this section, we use NSFG and the National Longitudinal Survey of Youth 1979 (NLSY79) to present patterns of family planning adoption and discuss some of the relevant factors.[3] This would help us to have a deeper understanding of the frictions that women

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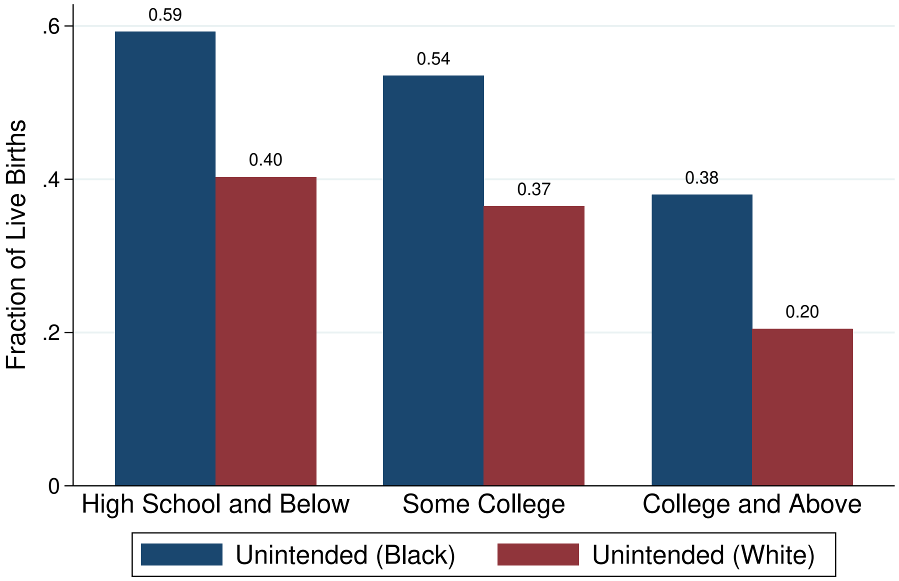
[2] In recent years, abortion pills, approved by the United States Food and Drug Association (FDA) in 2000, also provide an additional instrument to women with unintended pregnancy.

[3] Women could report unintended fertility with and without consistent use of family planning. On the one hand, there are women who suffer from contraceptive failures despite consistent efforts. On the other hand, there are also women who did not consistently use contraceptives or abortion for various reasons but actually wanted to delay or avoid the

Figure 2.1: Unintended Birth Rate by Education and Race



Notes: This figure plots the fraction of live births that are unintended by mother's education and race using data from NSFG wave 2015-2017.

face in family planning and also provide policymakers with a gateway to reduce unintended birth and increase social mobility.

Figure 2.2 shows the fraction of sexually active women who have consistently adopted contraceptives in the year before the interview *conditional on* indicating that they do not want any child in the future using data from the NSFG Female Respondent File. Like Figure 2.1, the statistics on contraceptive use reveal three observations. First, despite not wanting to have any more children, the level of consistent family planning adoption is far below 100%. Second, contraceptive use increases with education. This increase is more pronounced among White women but not statistically significant among Black Americans (see Table 2.1). Third, conditional on education, Black women use contraceptives less consistently than white women. This could be potentially due to the more widespread belief among Black Americans that the government encourages contraceptive use to limit minority populations (Rocca & Harper 2012). We also observe similar patterns when we investigate whether the respondent had used any contraceptive methods between pregnancy

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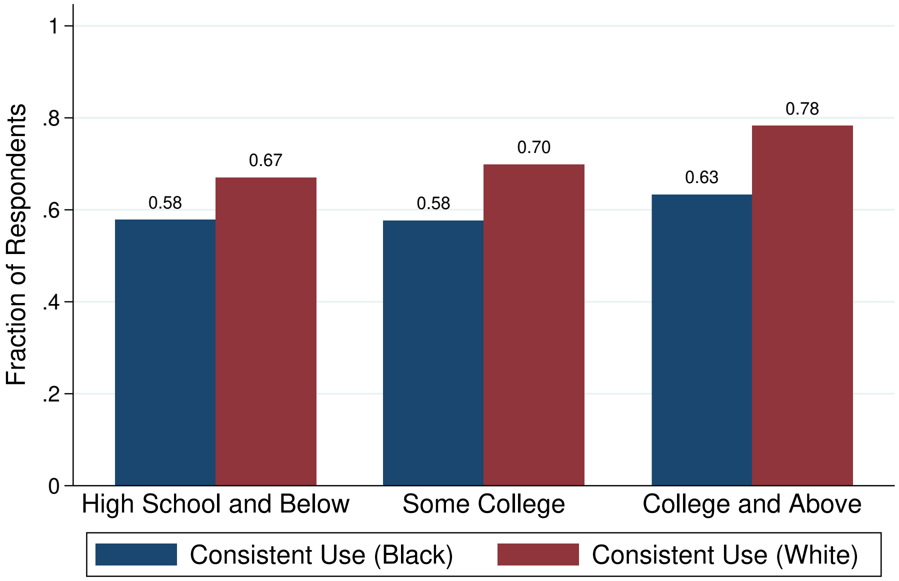
birth ex post. Quantitatively, the latter group accounts for the vast majority of unintended fertility: Finer & Zolna (2016) documents that 32% of women who used contraceptives inconsistently account for 95% of unintended pregnancies.

intervals (or since the first intercourse) conditional on the following pregnancy was unintended.

Given that abortion is a measure that women can use to terminate unintended pregnancies, we also investigate the fraction of unintended pregnancies that were carried to term by education and race.[4] Figure 2.3 shows that unintended pregnancies are less likely going to result in live birth among women with higher education. Regression results in Table 2.1 indicate that conditional on education, the racial differences here are less pronounced.

Figure 2.2: Consistent Contraceptive Use by Education and Race



Notes: This figure plots the fraction of sexually active women that consistently use contraceptives in the year prior to the interview date by education and race using data from NSFG wave 2015-2017. We restrict the sample to the respondents who reported not wanting to have any more children in the future.

The statistics above show that the adoption of family planning services is far from perfect or frictionless. Taking both contraception and abortion adoptions into account, there are large disparities by education and race. Here, we briefly discuss the potential sources of family planning costs using NSFG and NLSY79.[5]

First of all, misinformation among women at risk of unintended pregnancy is quite common. In

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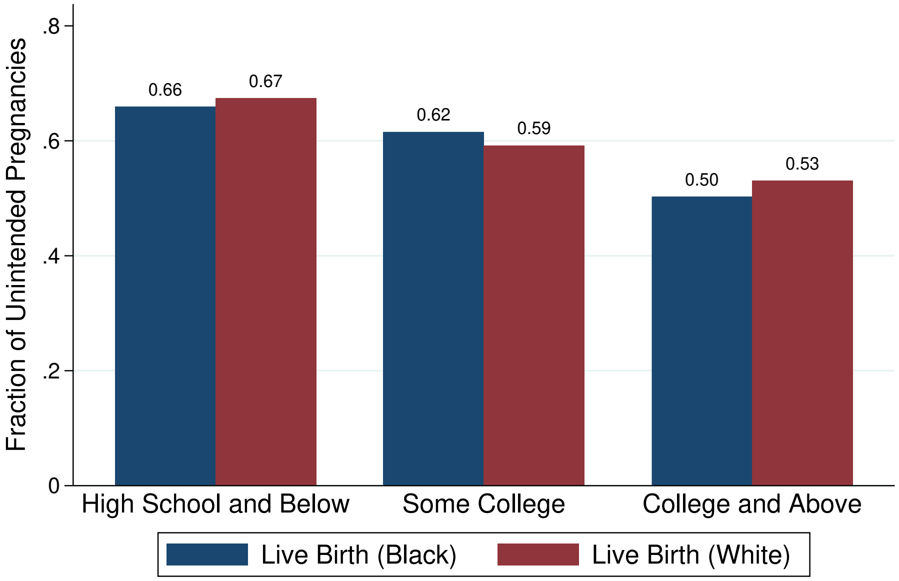
[4] We do not examine reported abortions directly because it is subject to severe underreporting in NSFG data (Fu et al. 1998).

[5] See Brown et al. (1995) and Dehlendorf et al. (2010) for a more comprehensive treatment of factors determining contraceptive use.

Figure 2.3: Fraction of Unintended Pregnancies That Were Carried to Term



Notes: This figure plots the fraction of unintended pregnancies that were carried to term by education and race using data from NSFG wave 2015-2017.

Table 2.1: Family Planning Utilization by Education and Race

	Consistent Use		$P(\text{Carry to Term}\mid\text{Unintended})$	
	Coefficient	Std. Err.	Coefficient	Std. Err.
Black-Some College	-0.001	0.084	-0.044	0.039
Black-College	0.055	0.102	-0.157**	0.066
White-High School	0.092	0.061	0.015	0.031
White-Some College	0.121*	0.063	-0.067*	0.036
White-College	0.205***	0.058	-0.129***	0.044
N. of Observation	1515		4231	

* $p<0.1$, * $p<0.05$, *** $p<0.01$

Notes: This table displays the coefficients and standard errors of regressing consistent contraceptive use and the fraction of unintended pregnancies carried to term on education and race dummies.

a nationally representative survey conducted by the Guttmacher Institute for the National Campaign to Prevent Teen and Unplanned Pregnancy, 44 percent of young women agreed or strongly agreed with the statement "It doesn't matter whether you use birth control or not; when it is your time to get pregnant it will happen" (Sawhill et al. 2010). The survey also found that among unmarried adults aged 18-29, about six in ten said they know "little" or "nothing" about birth control pills, and three in ten said they know "little" or "nothing" about condoms. Using data from the National Survey of Family Growth (NSFG) and National Fertility Survey (NFS), Rosenzweig & Schultz (1989) uncover that more educated couples have a wider knowledge and are more efficient in using contraceptive methods. Shartzer et al. (2016) documents high degrees of misinformation towards highly effective long-acting, reversible contraceptive methods (LARC) such as IUDs and implants, and the knowledge gap is larger among non-white, non-Hispanic women with low income. We provide additional evidence using the response to a survey question in NLSY79 where respondents were asked whether they had ever attended a sex education course, and if so, whether the course taught the effects of contraception and where to get contraceptives. The first row in Table 2.2 shows that not all respondents have ever attended a sex education course, and there is a gap of 10 percentage points between respondents with and without a college degree. The next three rows indicate that the content of sex education courses is similar conditional on being taught.

Table 2.2: Sex Education Ever Received

	without college	college
ever have a sex education course	0.549	0.657
course teaches effects of contraception	0.700	0.703
course teaches types of contraception	0.793	0.799
course teaches where to get contraception	0.654	0.649

Notes: This table displays the fraction of women respondents in NLSY79 who had ever attended a sexual education course, and if so, whether the course taught the effects of contraception and where to get contraceptives.

Another contributing factor to family planning costs is disagreements between partners. Partners could have different bargaining power, fertility intention, or preferences over the usage of family planning. These could result in moral hazards in family planning use (Ashraf et al. 2014) and affect aggregate fertility (Doepke & Kindermann 2019). In NSFG, respondents were also asked about their partners' intentions about each pregnancy. Table 2.3 presents the degree of (dis)agreements between partners by the education of female respondents. As can be seen, women with high school education or below report a higher incidence of pregnancies where both parties do not want the child (0.325 versus 0.204). Moreover, they are also more likely to indicate that they do not want the child themselves, yet their partners do (0.196 versus 0.110). Similarly, Table 2.4 shows that Black women report higher incidences of pregnancies where both parties do not want the child than white women (0.278 versus 0.190). Black women are also much more likely to indicate that they do not want the child themselves, yet their partners do (0.212 versus 0.103). These disagreements between fertility intentions could lead to higher costs to adopt contraception consistently for women with disadvantaged backgrounds through coercion or conflict within the relationship.

Table 2.3: Fertility Intentions of Both Parties, by Respondents' Education

		high school		college	
		partner wants the child		partner wants the child	
		Yes	No	Yes	No
respondent	Yes	0.412	0.067	0.630	0.056
wants the child	No	0.196	0.325	0.110	0.204

Notes: This table displays the fertility intentions of female respondents and their partners in NSFG by the respondents' education.

Table 2.4: Fertility Intentions of Both Parties, by Respondents' Race

		Black		White	
		partner wants the child		partner wants the child	
		Yes	No	Yes	No
respondent	Yes	0.431	0.079	0.640	0.066
wants the child	No	0.212	0.278	0.103	0.190

Notes: This table displays the fertility intentions of female respondents and their partners in NSFG by the respondents' race.

The financial costs of contraceptives and abortion also play an important role. For instance, the National Campaign to Prevent Teen and Unplanned Pregnancy found that 17 percent of men and women aged eighteen to twenty-nine agree with the statement: "I/my partner would use better methods, but they cost too much" (Sawhill et al. 2010). Using a randomized control trial, Bailey et al. (2021) find that women's choices of LARC are highly sensitive to price, with the take-up elasticity ranging from -2.3 to -3.4.

In addition, Dehlendorf et al. (2010) discussed that access to family planning services and high-quality treatments from healthcare providers are important factors contributing to disparities in unintended fertility. Disadvantaged women are disproportionately uninsured in the United States (Ebrahim et al. 2009). Women with no insurance coverage are 30% less likely to use prescription contraception (Culwell & Feinglass 2007). Religion also plays a role in the provision of family planning services. For instance, Hill et al. (2019) showed that Catholic hospitals reduce the per bed rates of tubal ligation by 31%, which could increase the risk of unintended pregnancies.

Last, legal restrictions and state funding have a huge impact on family planning and abortion access. For instance, White et al. (2015) document that legislation changes in Texas resulted in a 25% closure of family planning clinics and 54% fewer clients served than that in previous periods. In the next section, we provide further discussions of the literature studying the effects of legislation and government programs.

This paper's goal is not to analyze the exact source and decompose the magnitude of those frictions discussed above. But the analyses clearly indicate that the cost of family planning could be sizable depending on an individual's education, race, and income. Moreover, these costs extend beyond the financial burden. Therefore, even though reducing out-of-pocket costs is an integral part of the solution to unintended fertility (Bailey et al. (2021)), policymakers can do more to improve access among disadvantaged women, such as providing more sex education.

2.2.3 Consequences of Unintended Fertility

An important link between unintended fertility and intergenerational mobility is that the unpreparedness of mothers results in worse outcomes for the children. If unintended fertility only leads to a utility loss for mothers without affecting their children's human capital, heterogeneous exposures to unintended fertility do not necessarily lead to more persistence in economic status across generations. Yet if self-reported unintendedness reflects lack of financial resources, instability of the family structure, or other disadvantages when the child is young, improving family planning access would have profound implications on child outcomes and social mobility.

There is a large body of work investigating the consequence of unintended fertility on both mothers and children. We broadly categorize them into "direct" evidence and "indirect" evidence.

The "direct" evidence literature uses individual-level data from those children who were reported to be unintended by their mothers. They are compared with children who have similar family backgrounds but are not unintended. Brown et al. (1995) presents evidence showing that unintended children are at greater risk of being born at low birth weight, being abused, and of not receiving sufficient resources for health development. Mothers of unintended children are also at greater risk of depression, self-abuse, and suffering from a dissolution of relationships with their partners. Baydar (1995) uses National Longitude Survey of Youth data to show that unintended children have lower test scores and a less positive relationship with their mothers. Miller (2009) shows that giving birth to the first child one year earlier, potentially due to mistimed pregnancies, results in a significant decrease in the child's future test scores that is equivalent to 10 percent of the gap between children of college graduates and those of high school dropouts. In a comprehensive survey of the recent literature, Logan et al. (2007) concludes that "Overall, unintendedness seems to be most clearly associated with poor physical health, poor mental health, a close mother-child relationship, and poorer educational outcomes."

The "indirect" evidence literature uses historical events or policies that improved access to family planning services (e.g., expanded access to the Pill, Title X, and the War on Poverty) and compares mothers/children who were affected (treated) versus those who were not. Goldin & Katz (2002) and Bailey (2006) show that the legalization of the Pill and abortion in the 1960s and 1970s have resulted in women delaying births, getting more education, and earning more. Pop-Eleches (2006) finds that children born after a ban on abortions in Romania had worse educational and labor market achievements as adults after controlling for composition effects. Ananat & Hungerman (2012) show that access to oral contraceptives has negligible long-term effects on fertility. But better access increases the share of children with college-educated mothers and decreases the share with divorced mothers. Bailey (2013) finds suggestive evidence that individuals' access to contraceptives increased their children's college completion, labor force participation, wages, and family incomes decades later. Bailey et al. (2019) use the county-level introduction of U.S. family planning programs between 1964 and 1973. They find that children born after the programs had high family incomes, and the direct "resource effect", rather than changes in the composition of mothers, accounts for roughly two-thirds of these gains.

2.2.4 State-Level Correlations

In the previous section, we presented micro-level observations on unintended fertility and family planning adoption. A natural question is whether these effects are visible at a more aggregate level. For instance, do places that have higher unintended birth rates have worse child outcomes and lower mobility? In this section, we present suggestive evidence supporting this conjecture by combining intergenerational mobility measures from Chetty et al. (2014) and restricted-access data on unintended fertility from PRAMS.

We construct state-level mobility measures by aggregating commuting-zone (CZ) level estimates in Chetty et al. (2014) using population weights. Figure 2.4 illustrates the empirical content of these two measures. The horizontal axis plots parent income rank in the national distribution, while the vertical axis plots the corresponding average children's income rank in the national distribution. Absolute upward mobility (AM) measures the average income rank of the children whose parents' income rank is at the 25th percentile. Relative mobility (RM) measures the slope of the rank-rank relationship. Higher AM and lower RM means *larger* intergenerational mobility.

We use restricted-access data from PRAMS to calculate unintended birth rates (by education) at the state level. Besides uncovering the correlation between unintended fertility and mobility in this section, these statistics also help us identify state-specific parameters and conduct policy counterfactuals in Section 2.4. PRAMS is a surveillance project of the Centers for Disease Control and Prevention (CDC) and state health departments that collects state-specific, population-based data on maternal attitudes and experiences before, during, and shortly after birth. We use the data from 2008 to 2017 covering all contiguous United States that participate in PRAMS.[6] Unfortunately,

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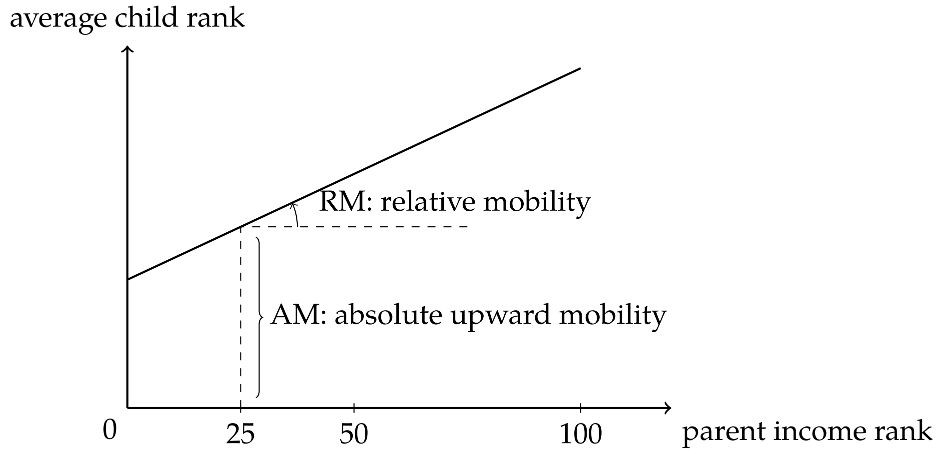
[6] We are extrapolating the level of unintended fertility rates in the 1980s, i.e., where children observed in Chetty et al. (2014) are born, using data from later years due to data limitations. We argue that this would not greatly harm our results for two reasons. First, with available data from 1990 to 2017, we find that unintended fertility rates are persistent across time at the state level. Second, the rank of unintended fertility rate across states is highly stable.

Figure 2.4: Measuring mobility

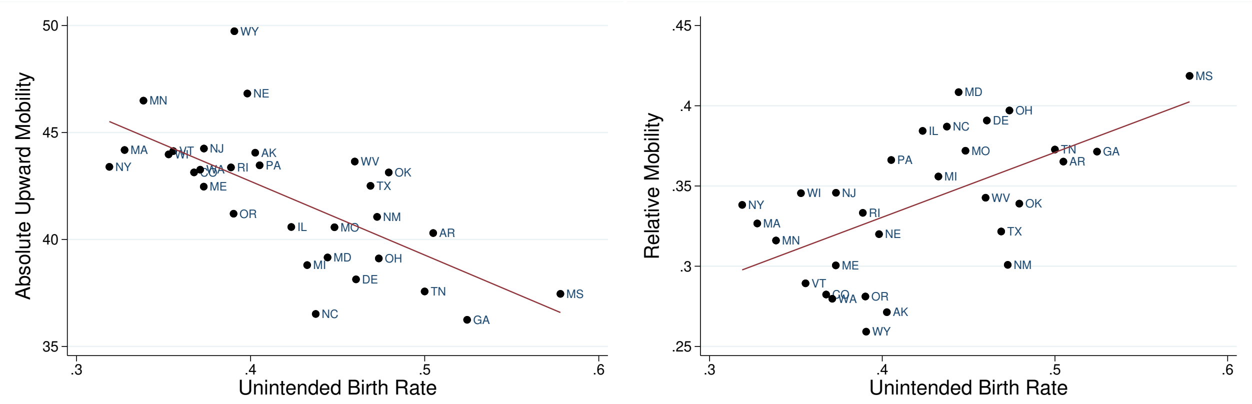


Notes: This figure illustrates the definition of absolute upward mobility (AM) and relative mobility (RM).

we can not go to more granular levels such as county or commuting-zone. The sample contains around 600,000 pregnancies.

Figures 2.5A and 2.5B plots AM and RM against unintended birth rates across states. We find that states with higher unintended birth rates have lower AM and higher RM. Both figures show that the level of unintended fertility is negatively correlated with intergenerational mobility.

Figure 2.5: Correlation Between Intergenerational Mobility and Unintended Birth Rate



(A) AM and Unintended Birth Rate

(B) RM and Unintended Birth Rate

Notes: This figure plots measures of intergenerational mobility (AM and RM) against unintended fertility rate by state.

We further investigate the predictive power of unintended birth rates on AM and RM after controlling for the six factors that are the strongest predictors of mobility in Table VI of Chetty et al. (2014). These factors are:

- (Fraction short commute) The share of workers that commute to work in less than 15 minutes calculated using data for the 2000 Census. Chetty et al. (2014) uses it as a proxy for income segregation with higher "fraction short commute" indicating lower segregation.
- (Gini bottom 99%) The Gini coefficient minus the top 1% income share within each CZ, computed using the distribution of parent family.
- (High school drop-out rate) Residual from a regression of the fraction of children who drop out of high school in the CZ, estimated using data from the NCES Common Core of Data for the 2000-2001 school year, on mean household income in 2000. We aggregate it to the state level.
- (Social Capital Index) Standardized index of social capital constructed by Rupasingha & Goetz (2008). It measures the strength of local norms and networks that facilitate collective action and efficient "round-about" means of production.
- (Fraction single mothers) The fraction of children being raised by single mothers in each state, measured using 2000 Census data.
- (Fraction Black) The fraction of Black population, measured using 2000 Census data.

Table 2.5 reports the ordinary least squares (OLS) results by regressing AM and RM on the six controls and unintended birth rate. All dependent and independent variables are normalized to have a unit standard deviation so that we can interpret the coefficients as responses in mobility to a one-unit deviation in controls.

The first two columns replicate the regression specification in Table IV of Chetty et al. (2014). Because we only have observations for 28 states, some of the coefficients are not statistically significant. But the correlation between these controls and mobility is in line with the commuting-zone level results. Columns (3) and (4) add unintended birth rates as an additional predictor. As can be

Table 2.5: Correlates of Intergenerational Mobility

	(1) AM	(2) RM	(3) AM	(4) RM	(5) AM	(6) RM
Fraction short commute	0.197	-0.186	0.461***	-0.343*	0.443*	-0.334*
Gini bottom 99%	-0.199	0.507*	0.236	0.248	0.122	0.304
High school drop-out rate	0.061	-0.029	0.018	-0.003	0.036	-0.012
Social capital index	0.014	0.684***	0.068	0.652***	0.059	0.656***
Fraction single mothers	-0.202	0.095	-0.242	0.118		
Fraction Black	-0.367	0.697***	-0.093	0.535***	-0.227	0.600***
Unintended birth rate			-0.591***	0.351*	-0.571***	0.342*
Adjusted R^2	0.556	0.747	0.678	0.785	0.666	0.789
N. of Observation	28	28	28	28	28	28

Standardized beta coefficients. * p<0.1, * p<0.05, *** p<0.01

Notes: This table displays the coefficients of regressing measures of intergenerational mobility on common correlates in the literature and unintended birth rates. Both dependent and independent variables are normalized to have mean zero and unit standard deviation.

seen, unintended birth rates are highly correlated with mobility even after controlling for the six factors. A one standard deviation increase in unintended birth rate is correlated with a 0.59 standard deviation drop in AM and a 0.35 standard deviation increase in RM. The last two columns drop fraction of single moms, and the predictive power of the unintended birth rate remains significant.

Table 2.5 displays two findings. First, unintended birth rates have a high predictive power of intergenerational mobility. Adding it to the regression increases the adjusted R^2 for AM (RM) by around 0.12 (0.04). Second, the correlation between intergenerational mobility and unintended birth rates is economically significant and is larger than almost all other correlates.

The observations above suggest that family planning adoption and unintended fertility play a role in determining intergenerational mobility. Moreover, reducing family planning costs may be an effective way in to boost mobility. There are, however, two challenges in using historical policy variations to directly assess such a hypothesis. First, there is a lack of high-quality panel data that measures mobility at a granular level to exploit policy variations. Second, policies have dynamic effects because children being affected will become better parents when they grow up (Daruich 2018). As a result, short-run policy evaluations are likely going to understate long-run effects.

Therefore, in the next section, we develop and calibrate a structural model with three goals in mind. First, we use it to understand trade-offs in family planning adoption. Second, we use the calibrated model to examine the implications of individual's family planning adoption choices for intergenerational mobility. Last, we use the framework to conduct two policy counterfactuals.

2.3 Model

In this section, we first present the basic Becker-Tomes model to highlight sources of intergenerational persistence of income in a canonical setting without family planning. Then, we extent this canonical framework by incorporating endogenous family planning decisions.

2.3.1 Basic Becker-Tomes Model

Consider a two-period overlapping generation model where individual first lives as a child (period 0) and become a parent after one period (period 1).[7] Children live with their parents and do not make any choices until they become parents themselves. Parents are heterogeneous by lifetime income h, they choose consumption c and investments into child's human capital e to maximize

$$\max_{c,e\geq 0} \log(c) + \theta \log(\mathbb{E}_\epsilon h'),$$

where θ governs parent's altruism towards children's income. The budget constraint is given by

$$c + e = h.$$

The model imposes an *intergenerational borrowing constraint* that prevents the parent from using the child's future income to finance the parent's consumption or the child's education.

Child human capital production function is assumed to take the form

$$h' = Z \cdot \epsilon \cdot h^\rho \cdot e^\gamma. \tag{2.1}$$

In (2.1), h' denotes children's income when they becomes a parent; Z is a scaling parameter; ϵ is an idiosyncratic shock that is assumed to take lognormal distribution: $\log(\epsilon) \sim \mathcal{N}(-\sigma_\epsilon^2/2, \sigma_\epsilon^2)$; ρ is a

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[7] Here, we assume that each family is composed of one parent and one child for simplicity.

parameter governing the direct transmission of economic status from parent to children, and γ is the productivity of child investments.[8]

The introduction of parental human capital in the human capital production captures many benefits accruing to a child by virtue of being attached to a more educated parent. This broad view of the intergenerational spillover should be kept in mind when interpreting our results. First, higher human capital parents are better able to transmit learning to their child. A parent with higher human capital could provide better neighborhoods and surroundings which would augment his child's human capital. Another interpretation is that the parental human capital reflects an inherited component of innate ability.

After solving the maximization problem, the parent's optimal child investment is given by

$$e^* = \frac{\theta\gamma}{1+\theta\gamma} \cdot h,$$

which means that the expected child human capital $\mathbb{E}_\epsilon h'$ can be written as:

$$\mathbb{E}_\epsilon h' = Z \cdot \left(\frac{\theta\gamma}{1+\theta\gamma}\right)^{\gamma} \cdot h^{\rho+\gamma}. \tag{2.2}$$

Therefore, when we calculate the intergenerational elasticity of earnings (ige) in this basic Becker-Tomes model, we have:

$$\text{ige}_{bt} \equiv \frac{d\log \mathbb{E}_\epsilon h'}{d\log h} = \rho + \gamma. \tag{2.3}$$

Parameter ρ governs the "better parent" effect (Lefgren et al. 2012) because it captures the direct influence of parents' human capital on that of their children. Parameter γ governs the "richer parent" effect since it reflects the productivity of additional investments due to greater financial resources.

After the dispersion of idiosyncratic shock σ_ϵ is chosen, there is a one-to-one mapping between

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[8] Instead of direct transmission through h^ρ, another formulation of the Becker-Tomes model (see Solon 2014) interprets ϵ as innate ability and assumes it is persistent across generations following: $\epsilon_i = \delta + \rho\epsilon_{i-1} + v_i$ with white noise v_i. As a result, one needs to correct for the serial correlation in ability ϵ when estimating the intergenerational persistence of income and will obtain $\text{ige}_{bt} = \frac{\rho+\gamma}{1+\rho\gamma}$. Here, we do not need to make the adjustment given the assumption that ϵ is white noise and the direct transmission acts through the term h^ρ.

ige and intergenerational mobility measured in AM or RM. With $\rho + \gamma < 1$, we can characterize the stationary distribution of income in this economy in closed form:

$$\log(h) \sim \mathcal{N}\left(\frac{\log(\overline{Z}) - \sigma^2/2}{1-(\rho+\gamma)}, \frac{\sigma_\epsilon^2}{2(1-(\rho+\gamma)^2)}\right),$$

where $\overline{Z} = Z \cdot \left(\frac{\theta\gamma}{1+\theta\gamma}\right)^\gamma$.

2.3.2 Incorporating Family Planning Adoption

Consider an extension of the standard Becker-Tomes model where adult individuals make dynamic decisions in two sub-periods which we denote using period 1 (early 20s) and period 2 (late 20s). We will make the assumption that individuals have one child over their lifetime, but whether the birth occurs in period 1 or period 2 depends on the family planning choice made by the agents.[9] Before period 1 starts, agents choose units of family planning adoption κ which determines $p(\kappa)$, the probability of having the child in period 1. Function $p(\kappa)$ is the technology that transforms family planning adoption κ into birth probabilities. With probability $1 - p(\kappa)$, the birth will take place in period 2. We assume that each agent receives an idiosyncratic taste shock for early birth ι with distribution $F(\iota)$. We will present the determination of κ after discussing the agent's consumption and education investment choices.

Agents receive income h in period 1, i.e., when agents first enter the labor market. If the birth does not occur in period 1, agents will receive $(1 + \lambda(h)) \cdot h$ in period 2 where $\lambda(h)$ denotes income growth, or age effects, from the early 20s to 30s. We assume that $\lambda(h)$ is exogenous and depends on h to capture observed differences in the age-income profile by education. Here, $\lambda(h)$ is a reduced-form way of modeling heterogeneities in income growth across initial human capital without micro-founding it by invoking the human capital accumulation or marriage process. On the other hand, if the birth occurs in period 1, agents suffer a human capital loss and receive $(1 - \delta(h))(1 + \lambda(h)) \cdot h$.

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[9] By assuming that agents only have one child, we abstract away from unwanted births and focusing on mistimed ones. We make this assumption for simplicity of exposition. This assumption is likely going to make our results a lower bound because unwanted fertility has larger negative impacts on a child's human capital than mistimed ones (Finer & Kost 2011). Moreover, mistimed births also account for the majority of unintended fertility in the data. Last, Ananat & Hungerman (2012) show that increased access to family planning has negligible effects on fertility rates in the long run.

We also allow the career costs of children $\delta(h)$ to differ by education following evidence from Miller (2011) and Adda et al. (2017). This feature captures the observation that losses of human capital (or experience) due to childbearing differ by occupation and mother's education.

Besides the intergenerational borrowing constraints as in the standard Becker-Tomes model, we assume that there is also an *inter-temporal borrowing constraint* that prevents agents from borrowing from the income in period 2 to finance expenditures in period 1.[10] Therefore, birth timing would affect children's human capital because agents are restricted to using resources on hand to finance both consumption and child investments.

Consumption-Investment Problem

If the childbirth occurs in period 1, the individual's maximization problem is given by:

$$\begin{aligned} V_1(h) \equiv \max_{c_1,c_2,e\geq 0} & \log(c_1) + \log(c_2) + \theta \log(\mathbb{E}_\epsilon h') \\ \text{subject to} \quad & c_1 + e = h, \\ & c_2 = \underbrace{(1-\delta(h))}_{\text{human capital loss}} \underbrace{(1+\lambda(h))}_{\text{age effects}} \cdot h, \text{ and} \\ & h' = Z \cdot \epsilon \cdot h^\rho \cdot e^\gamma, \end{aligned} \tag{V1}$$

where c_1 and c_2 denote consumption in period 1 and 2 respectively. Other variables follow the definition in the standard Becker-Tomes model. We use V_1 to denote the maximized utility (value) of this problem.

If the childbirth occurs in period 2, the individual's maximization problem is given by:

$$\begin{aligned} V_2(h) \equiv \max_{c_1,c_2,e\geq 0} & \log(c_1) + \log(c_2) + \theta \log(\mathbb{E}_\epsilon h') \\ \text{subject to} \quad & c_1 = h, \\ & c_2 + e = (1+\lambda(h)) \cdot h, \text{ and} \\ & h' = \underbrace{(1+\omega)}_{\text{direct boost}} \cdot Z \cdot \epsilon \cdot h^\rho \cdot e^\gamma. \end{aligned} \tag{V2}$$

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[10] See Daruich (2018) and Caucutt & Lochner (2020) for the implications of such constraints on children.

We allow for the possibility that children born in period 2 receive a direct boost to their human capital governed by the parameter ω. This captures the effects of birth timing on children's human capital beyond the investment channel, such as the presence of father, a more stable family structure, or more emotional maturity (Aizer et al. 2020). We use V_2 to denote the maximized utility (value) of this problem.

The optimal child investments, depending on the birth timing, are given by

$$e_1^*(h) = \frac{\theta\gamma}{1+\theta\gamma} \cdot h, \qquad \text{less than} \qquad e_2^*(h) = \frac{\theta\gamma}{1+\theta\gamma}(1+\lambda(h))h.$$

We define $\Delta(h)$ as the difference between $V_2(h)$ and $V_1(h)$:

$$\Delta(h) \equiv V_2(h) - V_1(h) = \underbrace{-\log(1-\delta(h))}_{\text{career costs}} + \underbrace{\theta}_{\text{altruism}} \left(\underbrace{\gamma \log(1+\lambda(h))}_{\text{higher investment}} + \underbrace{\log(1+\omega)}_{\text{direct boost}} \right) > 0. \tag{2.4}$$

Note that $\Delta(h)$ summarizes the marginal benefits of family planning for parents with human capital h. The first term in (2.4) is the career costs of giving birth in period 1 on parent's consumption. The second and third terms represent the effects on children's human capital which is valued by the parent with the altruistic parameter θ. Given that $\Delta(h) > 0$, if a woman does not have a strong enough taste shock ι for having a child in period 1, she would prefer to delay the birth to period 2 because it is good both for her own career and also for the child's human capital development.

As both income growth $\lambda(h)$ and career costs of children $\delta(h)$ are increasing in education h (Miller 2011, Adda et al. 2017), we can show that $\Delta(h)$ is also increasing in h. In other words, women with higher education have more to gain from delayed birth (Kearney & Levine 2012). This gives a demand-side explanation to the observed positive correlation between family planning adoption and education.

For parents with human capital h, the model also gives a formula for the effects of birth delay on child human capital. If we use $h_1'(h)$ and $h_2'(h)$ to denote the human capital conditional birth timing and parent's human capital h, we have

$$\log\left(\frac{\mathbb{E}_\epsilon h_2'(h)}{\mathbb{E}_\epsilon h_1'(h)}\right) = \underbrace{\log(1+\omega)}_{\text{direct boost}} + \underbrace{\gamma\log(1+\lambda(h))}_{\text{higher investment}}. \tag{2.5}$$

This equation will be used later to calibrate the direct boost parameter ω.

Family-Planning Problem

With $V_1(h)$ and $V_2(h)$ defined, now we present the family planning problem. Before period 1 starts, agents observe their idiosyncratic taste for early birth ι and solve

$$\max_{\kappa\geq 0} p(\kappa)(V_1(h)+\iota) + (1-p(\kappa))V_2(h) - \chi(h)\cdot\kappa. \tag{2.6}$$

We assume that each unit of family planning adoption leads to a utility cost of $\chi(h)$. The utility costs encapsulate possible frictions such as misinformation, disagreement between partners, and access to family planning services. With ample evidence presented in Section 2.2.2, we allow the cost $\chi(h)$ to be different by adult's human capital. In the calibration section, we will discuss how the data allow us to identify $\chi(h)$.

The first-order condition compares the marginal benefits and the marginal costs of family planning adoption:

$$\underbrace{-p'(\kappa)\cdot(\Delta(h)-\iota)}_{\text{marginal benefits}} \leq \underbrace{\chi(h)}_{\text{marginal costs}},$$

which gives the optimal level of family planning:

$$\kappa^*(h,\iota) = \begin{cases} 0 & \iota \geq \Delta(h) \\ p'^{-1}\left(\frac{\chi(h)}{\iota-\Delta(h)}\right) & \iota < \Delta(h) \end{cases}. \tag{2.7}$$

Lastly, we define unintended fertility in a way that is most consistent with the definition of mistimed ones in the NSFG survey questionnaire.[11] Individuals compare the utility of having a

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[11] This model interprets family planning and unintended fertility within a rational agent's framework. We are aware

birth in period 1 and period 2. If she would prefer the births to occur in period 2 and yet the birth realized in period 1, we would categorize that as unintended births. We define unintended fertility rate by human capital of parents as

$$\eta(h) \equiv \int \underbrace{p(\kappa^*(h,\iota)}_{\text{births in period 1}} \cdot \underbrace{\mathbb{1}(\Delta(h) > \iota)}_{\text{prefers to delay}} \, dF(\iota). \tag{2.8}$$

In the model, there are three channels why observed family planning adoption $\kappa^*(h, \cdot)$ is increasing in h, and also why unintended fertility rate $\eta(h)$ is decreasing in h:

1. Income growth rate $\lambda(h)$ is increasing in education h. This gives agents with high h more gains to postpone birth to period 2 so that they could invest more in their children.
2. Career costs of children $\delta(h)$ are higher for more educated women. This makes it more costly for highly-educated women to have early births, hence prompting them to adopt family planning more consistently.
3. Costs of family planning $\chi(h)$ are decreasing in education h. This captures various "supply-side" reasons such as misinformation and insurance coverage.

Discussion of Modeling Assumptions

Before we proceed to the implications of family plannings on intergenerational mobility, some discussions of the modeling assumptions are in order.

First, the unit of κ is not relevant in the interpretation of the model because agents are simply choosing the probability of early birth subject to utility costs whereas κ is an intermediate variable in this mapping.

Second, similar to Choi (2017) and Filote et al. (2019), we assume that family planning κ carries utility cost instead of financial costs given that past research suggests that financial barriers play a relatively small role in explaining why people are not using contraceptives consistently (see Sawhill et al. 2010 and Frost et al. 2008). Nevertheless, more recent evidence reveals that financial costs

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that there are alternative interpretations that might lead to different policy recommendations (Rosenzweig & Wolpin 1993, Santelli et al. 2003). For more recent development, see Aiken et al. (2016).

could matter for individual's adoption of more effective contraceptive methods (Bailey et al. 2021). In this model, introducing financial costs will strengthen our conclusion because it interacts with agents' borrowing constraints, leaving more room for policy intervention.

Third, we abstract away from modeling different contraceptive measures defined by varying efficacy rate, upfront costs, and variable costs (see Michael & Willis 1976). From a modeling point of view, $\chi(h)$ can be viewed as the lower envelope of the costs after choosing the optimal method of family planning. Introducing fixed costs of family planning into the model raises the fraction of agents choosing $\kappa^* = 0$. Therefore, it is largely captured by the mean value of the idiosyncratic taste for early birth ι.

Last, we assume that agents have the same preferences towards their children but face different costs in labor market (Adda et al. 2017) and family planning (see Section 2.2.2). As a result, differences in unintended fertility across education and race are attributed to heterogeneous family planning benefits $\Delta(h)$ and costs $\chi(h)$. In this paper, we quantify the role of $\chi(h)$ in shaping intergenerational mobility, but remain silent on the exact composition of $\chi(h)$ and how the government could reduce it in the most cost-effectively way.[12]

Intergenerational Mobility in the Family-Planning Model

Define $\overline{p}(h)$ as the fraction of mothers giving birth in period 1 by human capital h,

$$\overline{p}(h) = \int p(\kappa^*(h, \iota)\, dF(\iota).$$

In the economy with family planning adoption, we can write expected child human capital $\mathbb{E}_\epsilon h'$ as

$$\mathbb{E}_\epsilon h' = Z \cdot h^\rho \underbrace{\left(\overline{p}(h)(e_1^*(h))^\gamma + (1-\overline{p}(h))(1+\omega)(e_2^*(h))^\gamma\right)}_{\text{average investment}}.$$

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[12] We thank Martha Bailey for pointing us to a large and burgeoning literature that seeks to understand the determinants of differences in contraceptive use and non-marital childbearing between Black and White Americans. For example, see Guzzo & Hayford (2012), Barber et al. (2015), and Kusunoki et al. (2016). Whether the racial gap in family planning should be closed and, if so, how to close is an ongoing and hotly debated question.

Plugging in $e_1^*(h)$ and $e_2^*(h)$, we obtain

$$\mathbb{E}_\epsilon h' = \underbrace{Z \cdot \left(\frac{\theta\gamma}{1+\theta\gamma}\right)^{\gamma} \cdot h^{\rho+\gamma}}_{\text{standard Becker-Tomes}} \cdot \underbrace{\left(\overline{p}(h) + (1-\overline{p}(h))(1+\omega)(1+\lambda(h))^{\gamma}\right)}_{\text{family planning effect}}. \tag{2.9}$$

If we compare it with Equation (2.2), we find that it contains an additional term that summarizes the effects of family planning adoption on intergenerational mobility. Note that if this additional term is increasing in h, then when we try to find intergenerational elasticity of earnings with family planning, ige$_{fp}$, by computing $\frac{d\log(\mathbb{E}_\epsilon h')}{d\log h}$, we would get an answer that is higher than ige$_{bt} = \rho+\gamma$. Conditional on ρ, γ and σ_ϵ, the presence of family planning adoption propagates the intergenerational persistence of income through its heterogeneous effects on child human capital across parents.

It is important to note here that it is the *differences* in income growth, career costs of children, and costs of family planning across parents that are causing the additional source of intergenerational persistence. If $\lambda(h), \delta(h)$ and $\chi(h)$ are all positive but constant in h, then conditional on ι, agents will make the same family planning choices, and it leads to the same social mobility as in the standard Becker-Tomes model. This is intuitive because the notion of mobility and inequality is inherently about differences, not levels. Therefore while reducing levels of family planning costs $\chi(h)$ equally for everyone could increase aggregate output and boost growth (Cavalcanti et al. 2020), the government needs to reduce the *gaps* in family planning costs if the goal is to increase mobility.

2.3.3 Quantifying the Model

This section discusses how we use data to inform model parameters and how our results will be affected under alternative calibration.

Calibration

First, we set $\theta = 0.3$ exogenously following Lee & Seshadri (2019). Then, we can back out $\gamma = 0.16$ because in the model, $\frac{\theta\gamma}{1+\theta\gamma}$ gives to the fraction of household income that is spent on children's education.[13] We calibrate parameters $Z = 1.85$ so that the median income in the economy is normalized to one. Parameters $\sigma_\epsilon = 0.7$ and $\rho = 0.15$ are calibrated to match the Gini coefficient of income Gini $= 0.42$ and rank-rank mobility RM $= 0.34$ respectively. Note that to rationalize the same degree of inequality and mobility, the family planning model requires smaller σ_ϵ and ρ than the standard Becker-Tomes model. This is an intuitive result – as we have shown in Equation (2.9), the family planning model features higher intergenerational persistence holding the levels of ρ and κ unchanged. This higher intergenerational persistence, in turn, supports a thicker right-tail of the income distribution in the steady-state.

The additional parameters in the family planning model include the profile of income growth $\lambda(\cdot)$, career costs of children $\delta(\cdot)$, costs of family planning $\chi(\cdot)$, the technology $p(\cdot)$ that transforms family planning adoption to the probability of birth in period 1, the direct boost to child human capital ω, and the distribution that governs taste shock for early birth $F(\iota)$. We discuss the calibration strategy for these parameters in turn.

First of all, we use period 1 to denote the first six years that individuals enter the labor market after completing education, while period 2 stands for the rest of their fertile years. We assume the gap between births in period 1 and period 2 to be four years, which is the average year that respondents say their pregnancies are mistimed (too soon) in NSFG.

We parameterize $\lambda(\cdot), \delta(\cdot), \chi(\cdot)$ as:

$$x(h) = x_b + (x_a - x_b) \cdot \frac{2\exp(-x_c \cdot h)}{1 + \exp(-x_c \cdot h)}, \qquad x \in \{\lambda, \delta, \chi\}. \tag{2.10}$$

so that the function $x(h)$ is governed by three parameters $\{x_a, x_b, x_c\}$ where $\lim_{h \to 0} x(h) = x_a$, $\lim_{h \to \infty} x(h) = x_b$, and x_c governs the curvature.

Because we do not observe the profile of income growth, career costs of children, or family planning costs by continuous levels of h, we calibrate $\{x_a, x_b, x_c\}, x \in \{\lambda, \delta, \chi\}$ to match empirical moments by mothers' education (high school and below, some college, and college and above), which are in turn mapped into income ranks using the Current Population Survey (CPS) data. In

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[13] We follow the procedures described in Section III.B of Lee & Seshadri (2019) to calculate this moment in the data using PSID data. Daruich (2018) gives similar estimates.

particular, we calibrate $\{\lambda_a, \lambda_b, \lambda_c\}$ to match income growth by education calculated using data from the CPS 2010-2019.[14] Parameters $\{\delta_a, \delta_b, \delta_c\}$ are calibrated to match the effects of fertility delays on earnings estimated by Miller (2011).

We assume the technology that maps family planning adoption κ to the probability of early birth takes the functional form

$$p(\kappa) = p_b + (p_a - p_b) \cdot \frac{2\exp(-p_c \cdot \kappa)}{1 + \exp(-p_c \cdot \kappa)}. \tag{2.11}$$

We exogenously choose $p_a = 1$ and $p_b = 0$ so that if the agent does not adopt any family planning, having a child in period 1 is a certain event, and if the agent adopts an infinite amount of family planning, having a child in period 1 can be entirely prevented. We can normalize $p_c \equiv 1$ so that the scale of family planning adoption κ is pinned down by parameters in $\chi(h)$. As the costs of family planning $\chi(h)$ directly affects family planning use $\kappa^*(h)$ and hence the profile of unintended fertility by parents' human capital $\eta(h)$, we calibrate $\{\chi_a, \chi_b, \chi_c\}$ to match the level of unintended birth rates by education calculated using NSFG data. Figure 2.6 shows the costs of family planning by agent's human capital – the horizontal axis plots the probability of birth in the first period $p(\kappa)$ while the vertical axis plots the utility costs of $\chi(h) \cdot \kappa$ in consumption equivalents. While the magnitude of family planning costs in this paper is estimated using data on unintended fertility, it is comparable to the estimates in other structural models that use pregnancy rates or family planning adoption. For instance, Filote et al. (2019) estimates that the costs of reducing $p(\kappa)$ to 20% is 11.4% in consumption equivalents; Choi (2017) estimates such costs to be around 14% for single women without college education.[15] The corresponding statistic in this paper for an agent with median human capital is 12%.

We use Equation (2.5) and the estimates from Miller (2009) to calibrate ω. Using biological fertility shocks as instruments, Miller (2009) estimates that a year of motherhood delay leads to an improvement of test scores that is equivalent to 10 percent of the test score differences between

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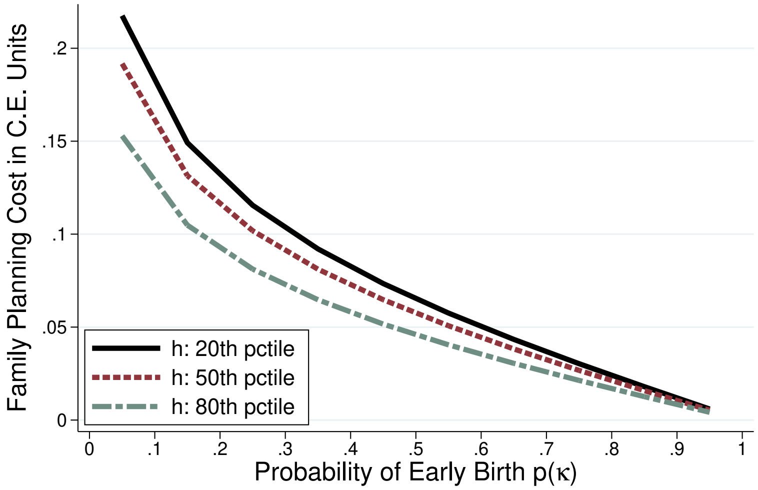
[14] We calibrate $\lambda(h)$ within the model because the observed growth in earnings are net of the effects of childbirth, and hence the career costs of children $\delta(h)$.

[15] Authors' own calculations based on parameter estimates reported in Filote et al. (2019) and Choi (2017).

Figure 2.6: Utility Cost of Family Planning by h



Notes: This figure plots the utility costs of reducing the probability of birth in the first period by agent's human capital percentile in the population.

children of college graduates and those of high school drop-outs. Assuming that gaps in test scores reflect differences in human capital, we calibrate ω using an iteration procedure. We first guess ω_0, then calibrate the model and compute the human capital differences between children of college graduates and those of high school drop-outs. Then, we multiply this difference by 10 percent and compute ω_1 by deducting $\gamma \log(1 + \lambda(\overline{h}))$ following Equation (2.5). We iterate until ω_0 and ω_1 are sufficiently close.

Last, we assume that the distribution of idiosyncratic taste for early birth ι is normally distributed with mean μ_ι and standard deviation σ_ι. We calibrate $\{\mu_\iota, \sigma_\iota\}$ to match the share of women having their first child in period 1 (i.e., six years into the labor market) by education.

To sum up, Table 2.6 presents the model parameters and Figure 2.7 shows the fit to data.

Discussion of Parameters and Moments

Before we proceed to the results, we briefly discuss the parameters and moments that matter most for the model mechanism and counterfactual results.

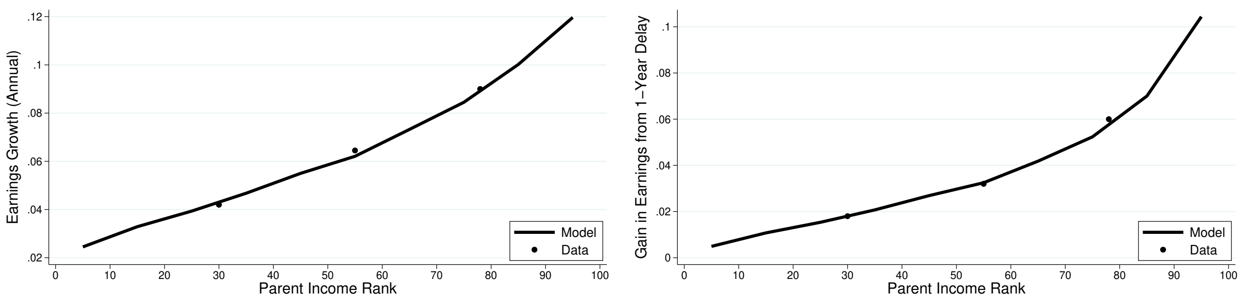
Equation (2.9) shows that comparing with the standard Becker-Tomes model, the mechanism of this model is summarized by the "family planning effect", i.e., $(\overline{p}(h) + (1 - \overline{p}(h))(1 + \omega)(1 + \lambda(h))^\gamma)$.

Table 2.6: Family Planning Model Parameters

	Value	Source		Value	Source		Value	Source
Costs of family planning			Career costs of children			Other Parameters		
χ_a	0.068	NSFG	δ_a	-0.005	Miller (2011)	Z	1.85	normalization
χ_b	0.03	NSFG	δ_b	0.17	Miller (2011)	σ_ϵ	0.70	Census
χ_c	0.9	NSFG	δ_c	0.40	Miller (2011)	ρ	0.15	Chetty et al. (2014)
						θ	0.30	Lee & Seshadri (2019)
Income growth			Taste shock distribution			γ	0.16	Lee & Seshadri (2019)
λ_a	0.01	CPS	μ_ι	0.045	NSFG	ω	0.05	Miller (2009)
λ_b	0.13	CPS	σ_ι	0.04	NSFG			
λ_c	0.88	CPS						

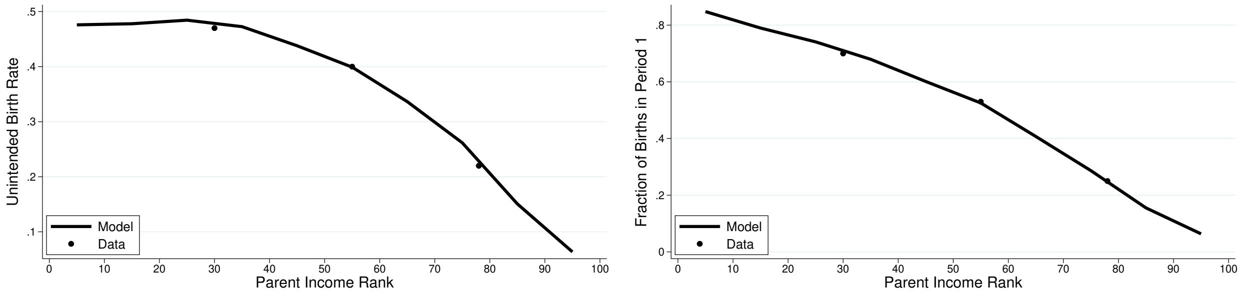
Notes: This table displays the parameters in the family planning model and sources of targeted moments.

Figure 2.7: Calibration of The Family Planning Model



(A) Income Growth by Education

(B) Career Costs of Children by Education



(C) Unintended Birth Rate by Education

(D) Fraction of Early Births by Education

Notes: This figure plots the fit of the family planning model to the moments in data.

The magnitude of this effect depends on the fraction of early birth $\overline{p}(h)$ and the effects of birth timing on children's human capital $(1+\omega)(1+\lambda(h))^\gamma$, both of which are measured in the data. While $\overline{p}(h)$ is measured quite precisely using NSFG, the empirical evidence on the magnitude of $(1+\omega)(1+\lambda(h))^\gamma$ is relatively scant in the literature. We rely on the estimates from Miller (2009), but we note that the quantitative strength of the mechanism will be stronger (weaker) if this estimate is larger (smaller).

On the other hand, even though we do not calibrate the altruism parameter θ inside the model, its value is not critical to the counterfactual results because Equation (2.9) shows that it is not a part of the family planning effect.[16]

2.4 Results

This section presents the main results of the paper. We first quantify the role that endogenous family planning decisions play in shaping intergenerational mobility. Then, we present results from two policy counterfactuals.

2.4.1 Intergenerational Mobility with Family Planning

We use the calibrated model to evaluate Equation 2.9 which indicates that intergenerational persistence is higher with family planning. We use the model parameters displayed in Table 2.6 and shut down family planning decisions in the model so that parents across h have the same timing of birth.

Figure 2.8 displays the comparison results. As can be seen, intergenerational persistence is significantly higher in the model with family planning. The difference in RM when we include family planning is more than two times the standard deviation of RM across states in the data.

As discussed in previous sections, the propagation mechanism in the family-planning model originates from *differences* in income growth $\lambda(h)$, career costs of children $\delta(h)$ and costs of family planning $\chi(h)$. We decompose the increase in intergenerational persistence in Figure 2.8 into these three sources. We start from the family planning model and set $\lambda(h), \delta(h)$ and $\chi(h)$ to be at its population average. When there are no heterogeneities across h, the family planning model collapses to the standard Becker-Tomes framework. By equalizing $\delta(h)$, $\lambda(h)$ and $\chi(h)$ one step at a time, we

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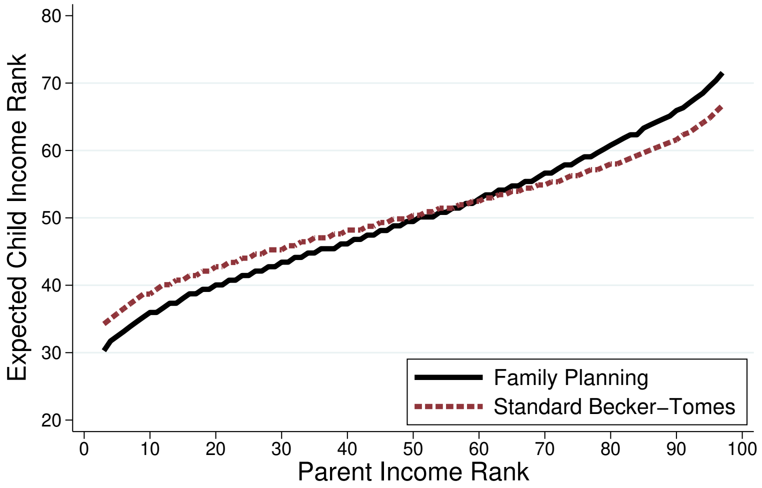
[16] Calibrating θ within the context of this model is difficult unless we directly observe the marginal benefits of family planning $\Delta(h)$ in the data. If we can only observe birth timing, then an increase in θ is largely offset by a reduction in family planning costs $\chi(\cdot)$ in the calibration. In particular, when we experiment with a larger or smaller value of θ and re-calibrate the model, the main results in the policy counterfactuals remain largely unchanged.

Figure 2.8: Intergenerational Mobility with Family Planning



Notes: This figure plots the rank-rank relationship between parents' and children's income with and without family planning.

record the contribution of each element.[17]

Table 2.7: Decomposition of Additional Persistence

	RM	AM
family-planning model	0.341	41.7
- heterogeneous $\lambda(h)$	-0.011	+0.3
- heterogeneous $\delta(h)$	-0.067	+1.9
- heterogeneous $\chi(h)$	-0.014	+0.4
= standard Becker-Tomes	0.249	44.3

Notes: This table displays the decomposition results of the additional intergenerational persistence into heterogeneous $\lambda(h)$, $\delta(h)$ and $\chi(h)$.

Table 2.7 presents the decomposition results. Three factors all contribute to the additional persistence relative to the standard Becker-Tomes model, with heterogeneous career costs of children having the largest impacts. The results indicate that gaps in family planning and unintended fertility reflect not only discrepancies in family planning costs $\chi(h)$, i.e., supply-side factors, but also different returns to family planning adoption due to lifetime income growth $\lambda(h)$ and career costs of children $\delta(h)$, i.e., demand-side factors. Quantitatively, demand-side explanations play the most significant

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[17] Our results do not vary much when we experiment with other orders of decomposition.

role, echoing the findings in Kearney & Levine (2012).

2.4.2 Counterfactual 1: Reducing Costs among Low-Income Women

In the first policy counterfactual, we study the changes in intergenerational mobility after we reduce family planning costs among the poor in different states.

Before conducting the policy counterfactual, we re-calibrate the family-planning model to match moments state by state. More specifically, for each U.S. state i, we calibrate $\{Z^i, \rho^i, \sigma_\epsilon^i, \chi_a^i, \chi_b^i, \chi_c^i\}$ to match $\{\mathrm{AM}^i, \mathrm{RM}^i, \mathrm{Gini}^i\}$ and the unintended fertility profile by education in state i.[18] This calibration is similar to an accounting exercise given that we are attributing differences across states to fundamentals in the model, including costs of family planning. Allowing these parameters, especially ρ, to vary across states is necessary to explain geographical differences in mobility.

Figure 2.9 plots correlations between the calibrated state-specific parameters with control variables in Chetty et al. (2014) and information on public provision of family planning services obtained from the Guttmacher Institute. In Figure 2.9A, we show that states with higher residential segregation, measured by "fraction short commute" in Chetty et al. (2014), have higher direct intergenerational persistence ρ. Figure 2.9B shows that in states where the model predicts to have higher costs of family planning services among the poor, χ_a^i, we observe a smaller fraction of likely family planning needs that are met by publicly funded centers.

In the counterfactual, we hold $\{Z^i, \rho^i, \sigma_\epsilon^i, \chi_b^i, \chi_c^i\}$ unchanged for each state, and reduce the family planning costs χ_a^i to the minimum level across all states,[19]. In other words, we set

$$\chi_a^i = \min_j \chi_a^j, \qquad \text{for all } i.$$

As the calibrated χ_a^j is the lowest in New York, the counterfactual is essentially granting low-income women in other states the same degree of family planning costs as that in New York. To illustrate,

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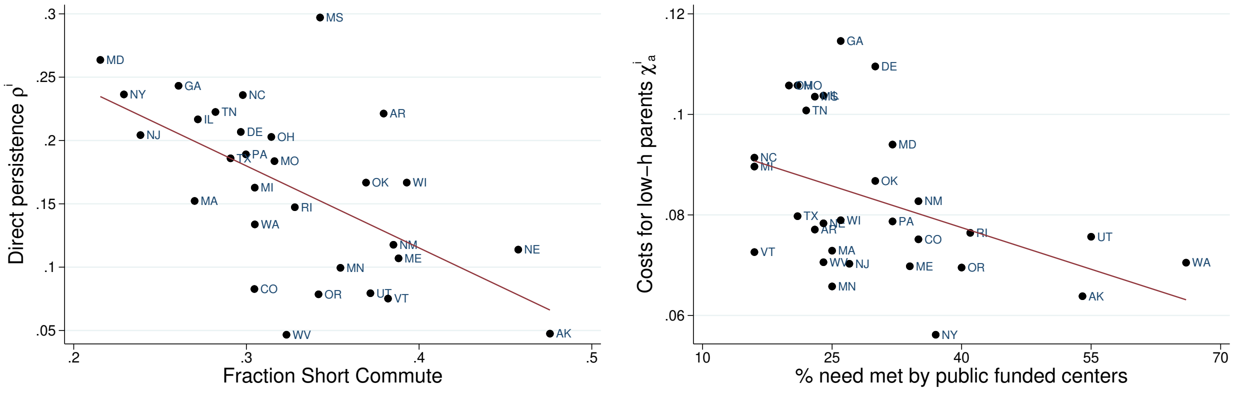
[18] For each state i, we compute its stationary distribution $G^i(h)$ and obtain $\{\mathrm{AM}_i, \mathrm{RM}_i\}$ by plotting the rank-rank relationship between parents' and children's income rank against the invariant national income distribution $G^*(h)$.

[19] In practice, reducing family planning costs χ_a^i amounts to addressing various frictions discussed in Section 2.2. For instance, the government could encourage the use of family planning via mass media campaigns, reduce misinformation through sex education programs, and extend accessible family planning services to all women of childbearing age regardless of her insurance status (e.g., expanding eligibility and coverage of Medicaid and Title X).

Figure 2.9: Correlates with State-specific Parameters



(A) ρ^i and Segregation

(B) χ_a^i and "Family Planning Deserts"

Notes: This figure plots the correlation between state-specific model parameters and other state characteristics.

consider the cost of reducing the probability of childbirth in period 1 (early 20s) to 0.3 depending on the agent's human capital for those residing in Georgia.[20] Figure 2.10 shows that before the policy counterfactual, the cost (in consumption equivalents) among low-income women is more than 9%, whereas the cost after implementing the policy counterfactual is almost halved.

Figure 2.11 and 2.12 plot the changes for each state under the policy counterfactual. Figure 2.11 shows that every state (except New York) sees an increase in absolute upward mobility, with the average being 0.27 standard deviations. Figure 2.12 shows that every state also has a decrease in relative mobility that is 0.16 standard deviations on average. These improvements are larger in states with high initial (calibrated) family planning costs, such as Delaware, Missouri, Ohio, and Georgia. After normalization, these results imply that a one-standard-deviation reduction in unintended fertility through changes in costs causes a 0.15 (0.08) standard deviation change in AM (RM). If we compare these results to the correlations presented in Table 2.5, we find that almost a quarter of the raw correlations in the data is *causal* from the point of view of the model.

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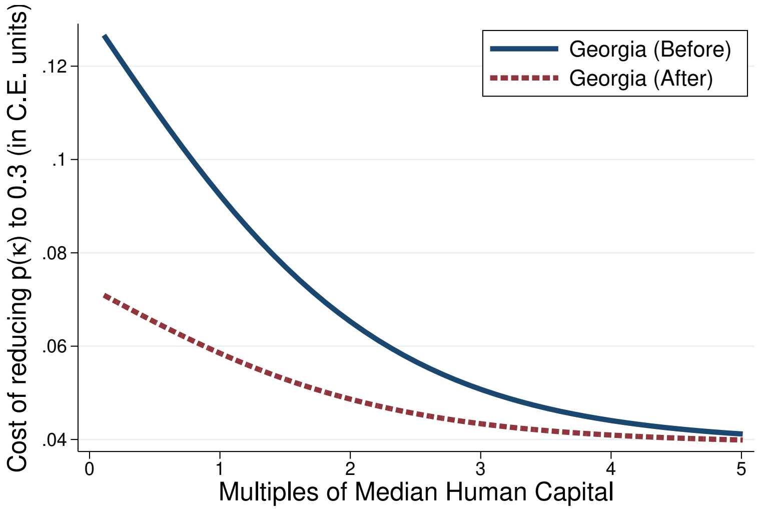
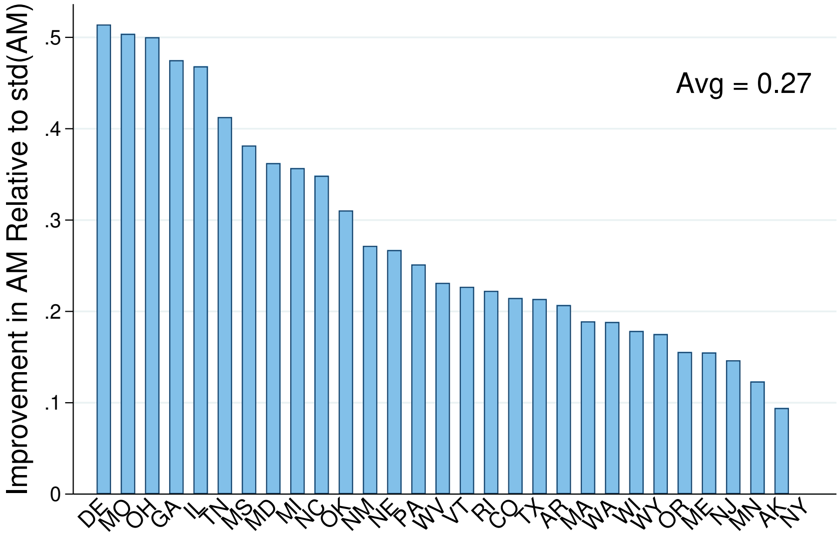
[20] 0.3 equals to the probability of childbirth in period 1 among women with a college education and above.

Figure 2.10: Family Planning Costs, Before and After



Notes: This figure plots the cost of reducing the probability of childbirth in period 1 to 0.3 depending on the agent's human capital for those residing in Georgia, before and after implementing the policy counterfactual. Recall that $h = 1$ denotes the median level of human capital in the population.

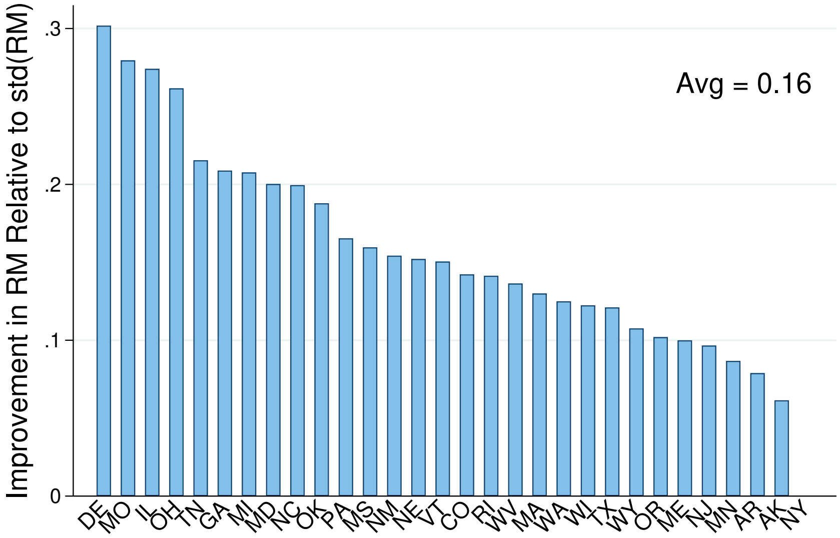
Figure 2.11: Improvement (increase) in AM under Counterfactual 1



2.4.3 Counterfactual 2: Reducing Costs among Black Americans

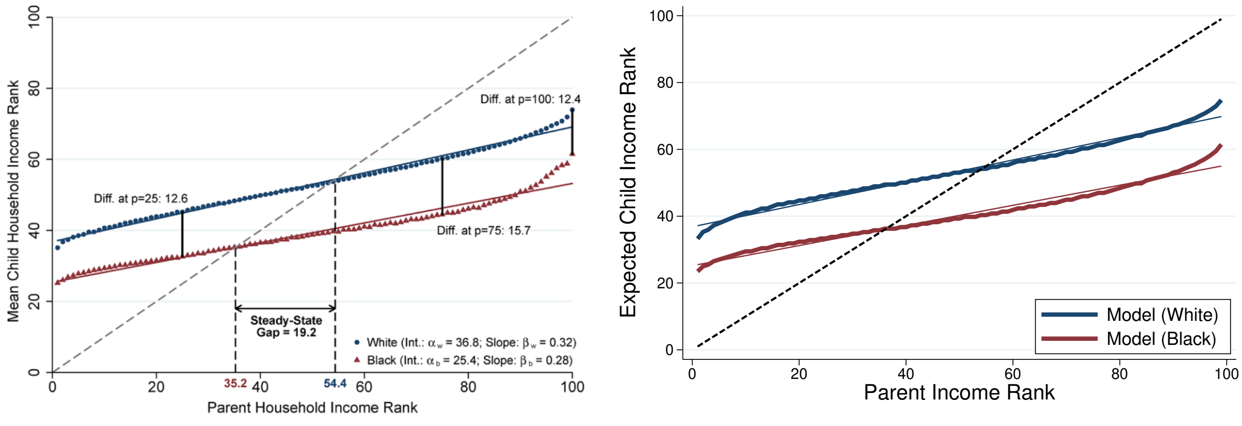
Using anonymized longitudinal data covering nearly the entire U.S. population from 1989 to 2015, Chetty et al. (2020) uncover the large Black-White gap in absolute upward mobility. Under

Figure 2.12: Improvement (decrease) in RM under Counterfactual 1



the assumption that rates of mobility remain constant across generations, the observed Black-White income gap is due almost entirely to differences in average child income rank *conditional on* parent income rank. Figure 2.13A displays their main finding where conditional on parent household income rank, the average child income rank of white families is roughly 12.5 points higher than the average child rank of Black families.

Figure 2.13: Black-White Gap in Absolute Upward Mobility, Data and Model


(A) Racial Gap in Chetty et al. (2020)

(B) Racial Gap in the Model

Notes: This figure plots the Black-White gap in absolute upward mobility in Chetty et al. (2020) and in the calibrated model.

We use our model of intergenerational mobility with family planning to shed light on how much of the Black-White mobility gap can be explained by different costs of family planning services. Racial gaps in family planning costs could play a role in explaining the mobility gap because Figure 2.1 shows that the unintended fertility rate is much higher among Black women conditional on education. Potential factors contributing to disparities in family planning costs by race include, but are not limited to, geographical locations of abortion clinics, misconceptions, and supply-side distortions (Dehlendorf et al. 2010).

We calibrate the model to match race-specific moments. In particular, we calibrate $\{\lambda_a^i, \lambda_b^i, \lambda_c^i\}$ where $i \in \{\text{Black}, \text{White}\}$ to match income growth by education and race in the Current Population Survey data. We also calibrate $\{\chi_a^i, \chi_b^i, \chi_c^i\}$ to match the unintended birth rates by education and race presented in Figure 2.1. Lastly, we allow Z to be different by race to generate the observed gaps in absolute upward mobility in Figure 2.13A.[21] Figure 2.13B presents the fit of the model.

In the policy counterfactual, we set $\{\chi_a^{\text{Black}}, \chi_b^{\text{Black}}, \chi_c^{\text{Black}}\}$ to the level of $\{\chi_a^{\text{White}}, \chi_b^{\text{White}}, \chi_c^{\text{White}}\}$.[22] This amounts to a more-than-half reduction in family planning costs across all education levels for Black women. Figure 2.14 plots the results from the counterfactual: equating family planning costs across races shifts up the expected child income rank among Black Americans by an average of 2.5. This eliminates 20% of the Black-White gap in absolute upward mobility. The remaining gap is largely due to differences in Z^i which captures other frictions such as labor market discrimination and residential segregation.[23]

Figure 2.14 also indicates that the racial income gap (in ranks) reduces by 25% in long-run steady-states from 19.2 to 14.4 (comparing intersections with the 45-degree line). By fixing parents' human capital distribution at the original steady-state, we find that more than half of this reduction

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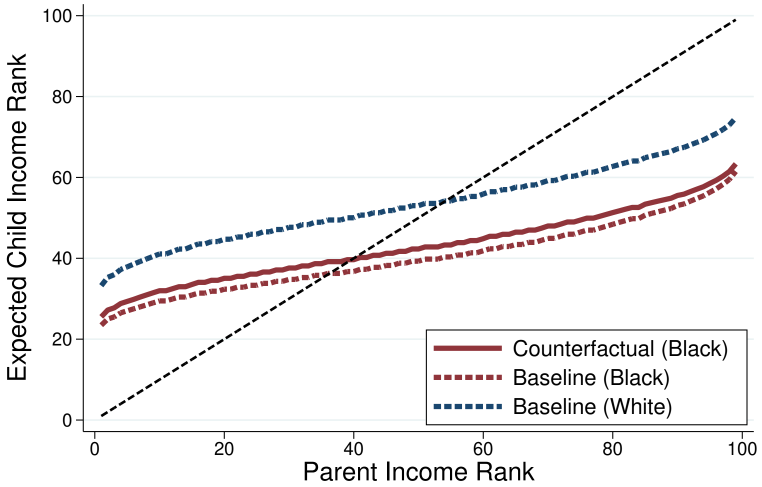
[21] Given that RM and the Gini coefficient are similar across races, allowing ρ and σ_ϵ to be race-specific yield similar results. We assume that other parameters in Table 2.6 are the same across Blacks and Whites.

[22] The exact policy prescription to achieve this goal is complicated and sensitive, and deserves further research. For instance, Bailey et al. (2021) documents that non-Hispanic Black women is the only group that exhibits small responses to vouchers that subsidize the use of LARCs. The counterfactual results in this paper provide an estimate of the potential gains once such improvements are made.

[23] In a recent paper, Gayle et al. (2015) find that the racial differences in the marriage matching patterns lead to racial differences in the time allocation of parent(s) and explain a large fraction of the black-white achievement gaps. Their findings are related to the results from this model even though we do not consider marriage explicitly. In our framework, racial gaps in parental human capital and family planning costs result in a larger fraction of early birth among Black Americans. Besides receiving lower financial investments, these children do not enjoy the direct boost ω, which could reflect the consequences of the absence of fathers.

Figure 2.14: Changes in Mobility When Family Planning Costs are Equalized Across Races



Notes: This figure plots the counterfactual rank-rank relationship between parents' and children's income by race.

in racial inequality can be achieved within one generation.

2.5 Conclusion

Nearly 40% of all live births in the United States are unintended. This phenomenon is disproportionately common among women with low socioeconomic status. Given that being born to unprepared parents significantly affects children's development of human capital, a natural hypothesis is that differences in family planning costs affect intergenerational persistence of economic status and income inequality.

We extend the standard Becker-Tomes model of intergenerational mobility with endogenous family planning adoption. When the model is calibrated to match observed patterns of unintended fertility, we show that social mobility is significantly lower than that in the standard model. We attribute this reduction to gaps in income growth, career costs of children, and costs of adopting family planning services across education. A decomposition exercise shows that the heterogeneous career costs of children play the primary role, but the other two factors are also quantitatively important.

In the policy counterfactual where each U.S. state reduces costs of family planning services among the poor, intergenerational mobility (AM) could be improved by 0.3 standard deviations on average. When we calibrate the model to match unintended fertility by race, we find that equating racial gaps in family planning costs can close 20% of the Black-White gap in upward mobility documented by Chetty et al. (2020). This policy also eliminates 25% of the Black-White income gap in the long run. More than half of this improvement can be achieved within one generation.

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