# Building Future Generations: The Macroeconomic Consequences of Family Policies

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# Motivation

## Family Policies

- Policies that support childbearing and child-rearing (e.g., baby bonus, subsidized childcare, child tax benefits...)
- Key instruments to achieve two sets of policy goals:
  1. Raise aggregate fertility rate to combat population aging
  2. Support families to improve children's outcomes and social mobility
- Increasing popularity & large in scale ($> 2\%$ of GDP in OECD countries) ► plot

**Question: What are the macroeconomic consequences of family policies?**

1. Effectiveness in achieving stated policy goals
2. Short-run versus long-run effects, and transition
3. Compare in-cash versus in-kind family policies

# This Paper

**A quantitative heterogeneous-agent GE-OLG model that integrates:**

- Rich life cycle with childhood, working age, and retirement
- Fertility choices **(quantity)** and investment per child **(quality)**
- Childcare choices (home care & market childcare)

**Model encompasses three key mechanisms of family policies:**

1. Child quantity-quality trade-off a lá Becker and Lewis (1973)
2. Composition effects: heterogeneous fertility responses across families
3. Demographic structure effects: changing age distribution over time

**Parameters affect elasticities of quantity and quality responses to policies:**

- Disciplined by matching cross-sectional U.S. data and RCT evidence
- Validated using the Alaska Permanent Fund Dividend and other existing policies

# Preview of Key Results

1. Raising aggregate fertility from 1.9 to 2.1 children per women requires a $30,000 cash reward to childbirth
2. This policy lowers both average child human capital and intergenerational income mobility by 2%
3. Average welfare rises by 1.6% (c.e.) in the long-run as taxes fall by 0.9%. But the government needs to finance higher child-related expenditures in transition
4. Subsidized childcare and public education are less cost-effective in raising fertility than cash benefits, but offer other advantages

# Contribution

### Fertility and Family Policies

- **Empirical:** Milligan (2005), Laroque and Salanié (2008), Drago et al. (2011), Luci-Greulich and Thévenon (2013), González (2013), Raute (2019)...
- **Structural:** Liao (2013), **Kim, Tertilt and Yum (2021)**
- **Contribution: (1) Considering rich life cycle significantly changes policy predictions on taxes and welfare (2) Adding childcare choices distinguishes in-cash & in-kind policies**

### Income transfers, Children's Outcomes, and Social Mobility

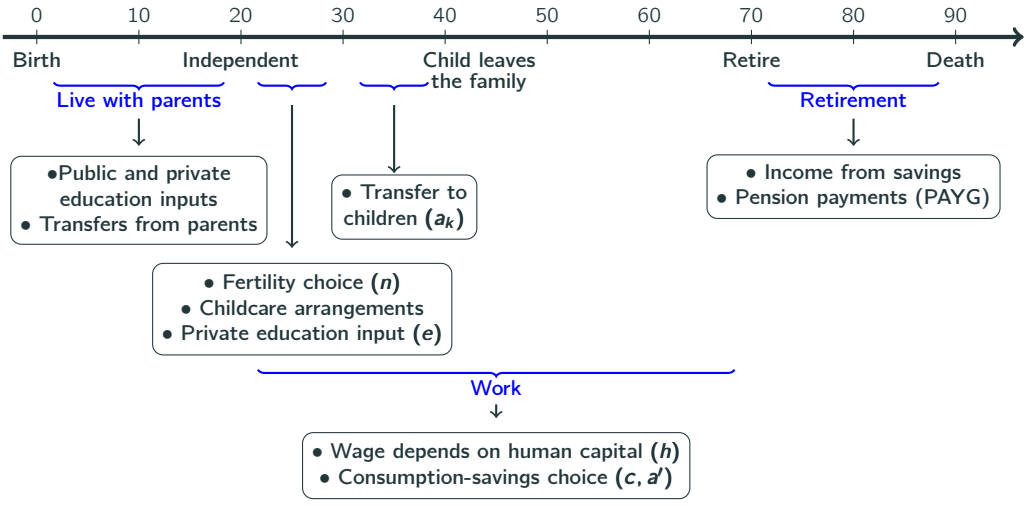
- Benabou (2002), Heckman and Mosso (2014), Bastian and Michelmore (2018), **Daruich (2019)**, Abbott, Gallipoli, Meghir and Violante (2019), Mullins (2019), **Guner, Kaygusuz and Ventura (2020)**...
- **Contribution: (1) Introducing endogenous fertility reverses policy predictions on children's outcomes and mobility (2) Modeling demographic structure distinguishes short-run & long-run effects**

# Outline

1. Model
   - Setup and the maximization problem of parents
   - Mechanisms of family policies
2. Calibration (2010 USA)
   - Key parameters that affect quantity/quality elasticities
3. Validation – the Alaska Permanent Fund Dividend (APFD)
4. Counterfactual – Steady-State & Transition
5. Compare In-Cash vs In-Kind Benefits

# Model

# Model: Life Cycle



# Fertility, Childcare and Skill Formation


$$V_2(h,a) = \max_{c,a',n,e,t_h,m\geq 0} \quad u(c/\Lambda(n)) + \underbrace{\beta \mathbb{E} V_3(h',a',n,\mathbb{E}h_k)}_{\text{includes utility of having children}}$$

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

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

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

$$\underbrace{h'}_{\text{parent's h.c.}} = L_2(h,1-t_h,z') \qquad \underbrace{h_k}_{\text{child's h.c.}} = G(h,\mathcal{E},e,\epsilon) \qquad \text{[technology]}$$

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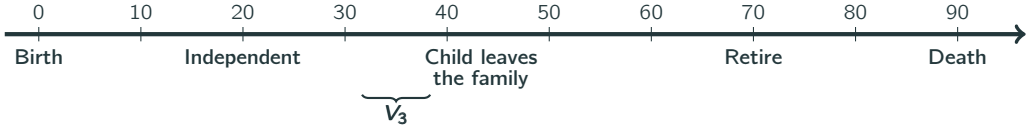
| | | |
|---|---|---|
| $h$ : parents' skills | $a$ : assets | $n$ : fertility (continuous) |
| $t_h$ : total home care | $m$ : market care | $e$ : private educ. input |
| $\chi$ : care time per child | $p_m$ : market care price | $\Lambda(n)$ : equivalence scale |
| $\mathcal{S}$ : childcare subsidy | $\mathcal{B}$ : baby bonus | $\mathcal{E}$ : public education |

# Parent-to-Child Transfer




$$V_3(h, a, n, \mathbb{E}h_k) = \max_{c,a',a_k \geq 0} \; u(c/\Lambda(n)) + \beta \mathbb{E} V_4(h', a') + \underbrace{v(n, \mathbb{E}h_k, a_k)}_{\text{utility from quantity and quality}}$$

$$y = wh$$

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

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

---

Child quantity ($n$) interacts with child quality ($\mathbb{E}h_k, a_k$) in two ways:

1. [BC]: higher $n$ raises marginal costs of ($\mathbb{E}h_k, a_k$) a lá Becker and Lewis (1973)
2. Preferences: complements or substitutes – calibrated to match data

► later periods

## Quantity-quality Trade-off

- Consider increase in $\mathcal{B}$ on private educational input $e$ (and hence $h_k$):

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

- When $n$ is fixed, $\mathcal{B} \uparrow$ (income effect), $MU_c \downarrow \Longrightarrow e \uparrow$
- When $n$ is endogenous, $\mathcal{B} \uparrow$ ("price" change), $n \uparrow \Longrightarrow e$ could fall (quantitative prediction depends on elasticities)

## Composition Effects

- Average child human capital:

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

- Family policies change the fertility weights, i.e. composition of parents

# Firms, Government, and Demographic Structure Effects

- Representative firm with Cobb-Douglas production function: $Y = AK^{\alpha}H^{1-\alpha}$
- Denote age structure as $\{\omega_j\}_{j=0}^{8}$ (with $\sum_{j=0}^{8}\omega_j = 1$) and the distribution of households across state space as $\{\mu_j\}_{j=0}^{8}$
- Government fiscal budget:

$$\underbrace{\left(\sum_{j=2}^{6}\omega_j \int \mathcal{T}(y_j^*, a_j^*, n_j^*)\, d\mu_j\right)}_{\text{income taxes / transfers}} + \tau_c \underbrace{\left(\sum_{j=2}^{8}\omega_j \int c_j^*\, d\mu_j + \omega_2 \int n^*(p_m m^* + e^*)\, d\mu_2\right)}_{\text{consumption taxes}} =$$

$$\underbrace{(\omega_0+\omega_1)}_{\text{mass of children}}\ \underbrace{\mathcal{E}}_{\text{public education}} + \underbrace{\omega_2\left(\underbrace{\int n^*\mathcal{B}\, d\mu_2}_{\text{baby bonus}} + \underbrace{\int (1+\tau_c)n^* p_m \mathcal{S}\, d\mu_2}_{\text{subsidized childcare}}\right)}_{\text{family policy expenditures}} + \underbrace{\pi\left(\sum_{j=7}^{8}\omega_j \int wh\, d\mu_j\right)}_{\text{pension payments}} + \underbrace{\sum_{j=2}^{8}\omega_j}_{\text{mass of adults}}\ \underbrace{\mathcal{X}}_{\text{exo.}}$$

- **Demographic Structure Effects**: Family policies change $\{\omega_j\}_{j=0}^{8}$. Effects on fiscal burden depends on relative costs of retired agents versus children

► stationary equilibrium ► childcare channel

# Calibration

# Model Parameters

**Table 1:** Model Parameters

| | Interpretation | Value | Source |
|---|---|---|---|
| | **Preferences** | | |
| $\beta$ | discount rate (annual) | 0.98 | standard |
| $\gamma$ | elasticity of substitution | 0.73 | CPS |
| $\psi$ | fertility preference | 2.30 | CPS |
| $\theta$ | human capital preference | 2.85 | PSID |
| $\nu$ | transfer preference | 0.29 | PSID |
| | **Childcare arrangement** | | |
| $\chi$ | childcare cost | 0.18 | ATUS |
| $\iota$ | economies of scale at home | 0.7 | ATUS |
| $\upsilon$ | substitutability of care | 0.38 | SIPP |
| $p_m$ | price of full-time care | \$6,860 | NACCRRA |
| | **Taxes and pension** | | |
| $\tau_y^n, \lambda_y^n$ | tax levels and progressivity | misc. | TAXSIM |
| $\tau_c$ | consumption tax | 0.07 | McDaniel (2007) |
| $\tau_a$ | capital income tax | 0.27 | McDaniel (2007) |
| $\pi$ | pension replacement rate | 0.40 | OECD Database |

| | Interpretation | Value | Source |
|---|---|---|---|
| | **Child human capital production** | | |
| $Z$ | normalizing scalar | 2.50 | median income =1 |
| $\sigma_\epsilon$ | ability shock dispersion | 0.58 | PSID |
| $\rho$ | intergenerational spillover | 0.30 | Chetty et al. (2014) |
| $\xi$ | substitution of education | 0.9 | CEX |
| $\mathcal{E}$ | public education | \$12,000 | NCES |
| $\kappa$ | input productivity | 0.13 | Gárcia et al. (2020) |
| | **Adults' human capital evolution** | | |
| $\eta$ | learning curvature | 1.22 | PSID |
| $\{\zeta\}_{j=2}^5$ | learning level | misc. | PSID |
| $\mu_z$ | skill depreciation | -0.23 | PSID |
| $\sigma_z$ | shock dispersion | 0.38 | PSID |
| | **Firm production function** | | |
| $A$ | total factor productivity | 1 | normalization |
| $\alpha$ | capital share | 0.33 | standard |
| $\delta_k$ | capital depreciation (annual) | 0.04 | standard |

- 14 parameters are calibrated within the model

► moment fit ► sensitivity

► childcare ► adult skill ► firm and gov.

**Utility from child quantity and quality:**

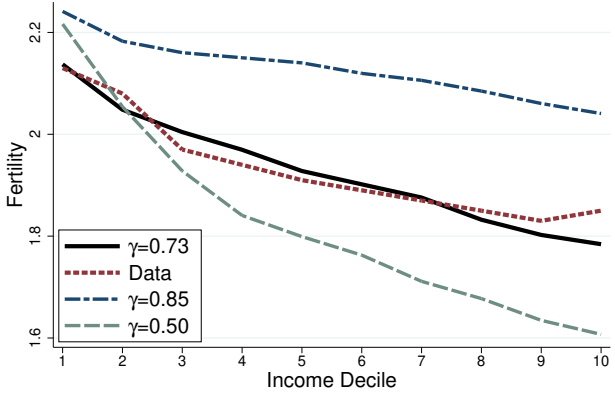
$$v(n, \mathbb{E}h_k, a_k) = \underbrace{\Psi(n)}_{\text{child discounting}} \cdot \underbrace{(\theta \cdot u(\mathbb{E}h_k) + \nu \cdot u(a_k))}_{\text{utility from child quality}}$$

$$\underbrace{\Psi(n) = 1 - \exp(-\psi n)}_{\text{increasing \& concave in } n} \qquad u(x) = \frac{x^{1-\gamma}}{1-\gamma} \qquad \gamma \in (0,1) \quad x \in \{\mathbb{E}h_k, a_k, c\}$$

- Results robust to dynastic altruism and separable preferences
- $\{\psi, \theta, \nu\}$ matches aggregate fertility and average spendings on quality
- $\gamma$ - elasticity of intergenerational substitution (EGS) (Córdoba and Ripoll 2019)
- Conditional on other parameters, **$\gamma$ determines fertility elasticity**. Higher $\gamma \implies$ smaller fertility responses, larger quality responses (c.f. Soares 2005)
  ► intuition
- High $\gamma$ could overturn the quantity-quality trade-off in budget constraint

# Identification of $\gamma$

- $\gamma$ identified by **fertility-income profile** (Córdoba, Ripoll and Liu 2016). Higher $\gamma \Longrightarrow$ Higher MRS of quantity for quality $\Longrightarrow$ flatter profile




- Calibrated $\gamma$ generates a realistic life-cycle profile of net worth

►net worth

# Children's Human Capital Production Function

- **Children's human capital production function**:

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

$$\log(\epsilon) \sim \mathcal{N}\left( -\frac{\sigma_\epsilon^2}{2}, \sigma_\epsilon^2 \right)$$

- Highlight of parameters:
  - $\rho = 0.3$ - rank-rank mobility (Chetty, Hendren, Kline and Saez 2014)
  - $\mathcal{E} = 0.16$ - \$12k per pupil per year (NCES)
  - $\kappa$ governs the elasticity of children's human capital to monetary investments. **$\kappa = 0.13$ - RCT evidence** from García, Heckman, Leaf and Prados (2020)

► mobiltiy fit ► RCT

# Validation

# Does the model generate responses that match empirical estimates?

External validation using **Alaska Permanent Fund Dividends (APFD)**

- Established in 1982 after discovery of the petroleum. Equal transfer to **all residents** regardless of income, employment or age
- **Pronatal effects**: allows parent to claim dividend on behalf of a child with no requirements on how parents use a child's dividend
- Ideal setting to test fertility responses:
  1. Large in scale ($\approx$ \$1.5k per year) relative to other family policies
  2. Simple implementation that is not income- or work-tested
- Re-calibrate, then implement APFD in the model: universal basic income (UBI) to parents and children by \$1.5k

# Difference-in-Difference Analysis

- CPS June Fertility Supplement 1982-2018, Alaskan women aged 40-55, divided into "not treated", "partially treated" ($T_1 = 1$), and "fully treated" ($T_2 = 1$)
- Estimate on full sample, and subsamples by education (at least 1 year of college)

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

- Regression results confirm model predictions on fertility effects:

| | (1) | (2) | (3) | Model Predictions | | |
|---|---|---|---|---|---|---|
| | Full Sample | Low Educ. | High Educ. | Average | Low Educ. | High Educ. |
| $\boldsymbol{\beta_2}$ | **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 | | | |

► plot ► Australia ► Spain

# Counterfactual

# Main Counterfactual

- Evaluate **baby bonuses** $\mathcal{B}$ of different sizes:
  - (1) actual policy (2) effectively a refundable CTC delivered in lump-sum
  - Timing: unexpected and permanent policy change at beginning of period
  - Source of funds: $\tau_c$ balances budget each period
- Consider two (pragmatic) welfare measures in consumption equivalents:
  1. Long-run average welfare $\mathcal{W} = \int V_2 \, d\mu_2$ – expected utility of a newborn under the Rawlsian veil of ignorance
  2. Welfare of existing households and those born in transition
- Roadmap of results:
  - Long-run effects
  - Transition and distributional effects across generations
- Policy comparisons: subsidized childcare $\mathcal{S}$ and public education $\mathcal{E}$

► role of gov.

# Fertility Effects of Cash Rewards to Childbirth

**Figure 1:** Effects on aggregate fertility

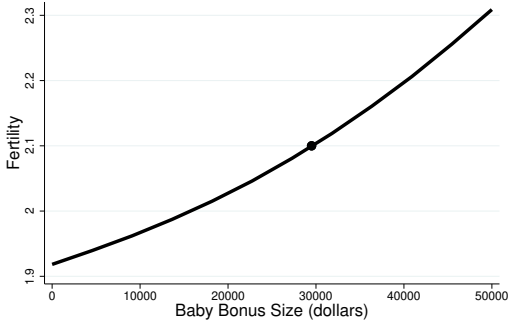
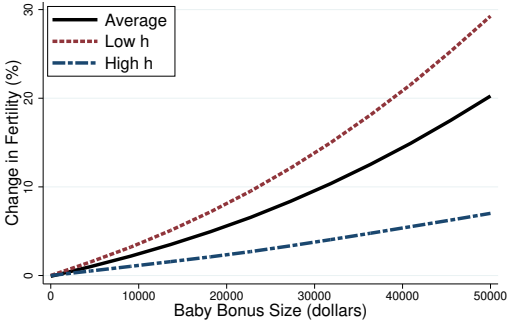



**Figure 2:** Heterogeneous fertility response




- $\mathcal{B}$ **=\$30k** raises aggregate fertility rate to the replacement level
  - Similar to changes in the CTC from 2010 to 2021, including ARPA (in NPV)
  - 1.8% of GDP in the new equilibrium
- Parents with lower human capital respond more in fertility – larger proportional change in the shadow price of child ($e^*(h)$ and $wh$)

# Effects on $e$ and Average Human Capital

**Figure 3:** Average private input $e$

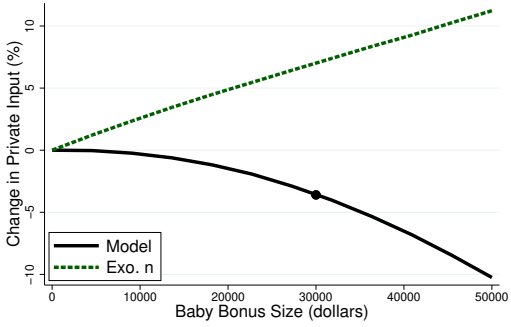
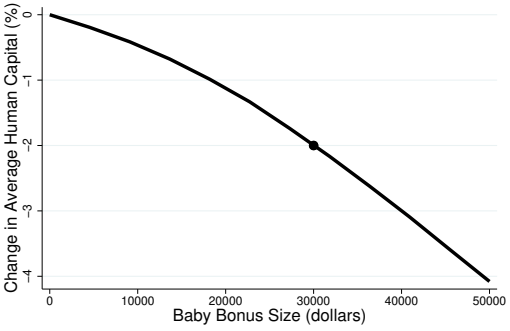



**Figure 4:** Average human capital




- Average private input ($e$) **falls by 4%** – **quantity-quality trade-off**
- Average human capital **falls by 2%** – **composition effects** and reduced $e$

► Australia

# Average Human Capital and Intergenerational Mobility

**Figure 5:** Heterogeneous response in $e$

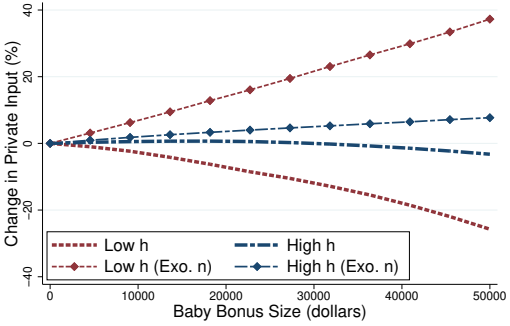
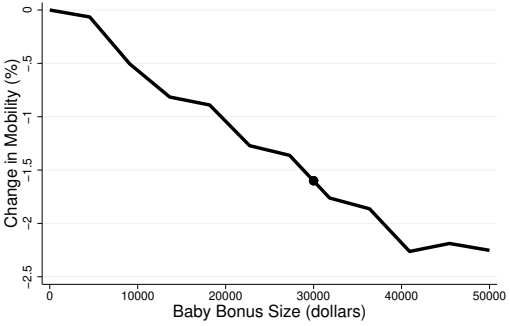



**Figure 6:** Intergenerational mobility




- Larger reductions in $e$ among parents with low $h$ as their $n$ increases more
- Intergenerational mobility **decreases by 1.8%**
- Results will be **stronger** when baby bonus is targeted at low-income households

# Output and Tax

**Figure 7:** Per capita output

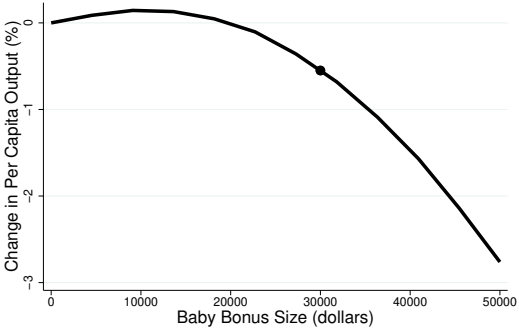
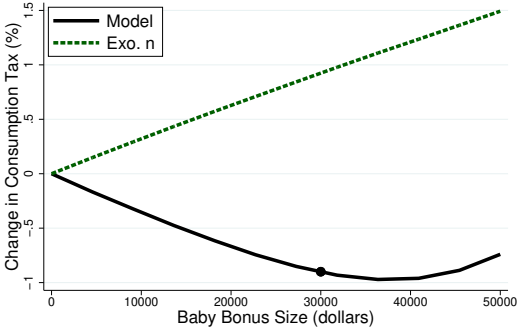



**Figure 8:** Change in consumption tax

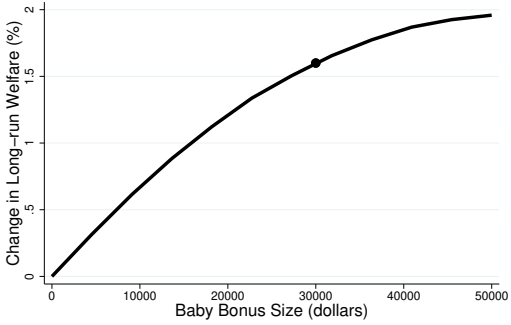



- Per capita output **falls by 0.6%**
- **Demographic structure effects**: consumption taxes **reduces by 0.9%**

► age structure

# Welfare Effects

**Figure 9:** Change in welfare




- Long-run welfare $\mathcal{W}$ rises by 1.6% (c.e.), more than half due to lower $\tau_c$ (0.9%)

# Transition Path of $\mathcal{B} = \$30,000$ - Replacement Fertility

**Figure 10:** Change in dependency ratios

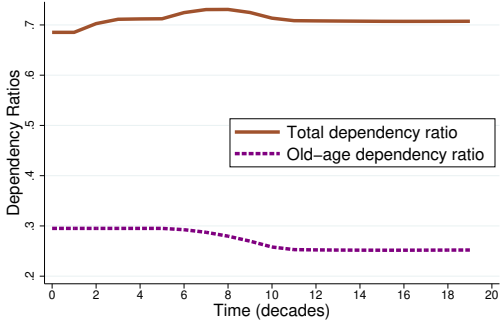
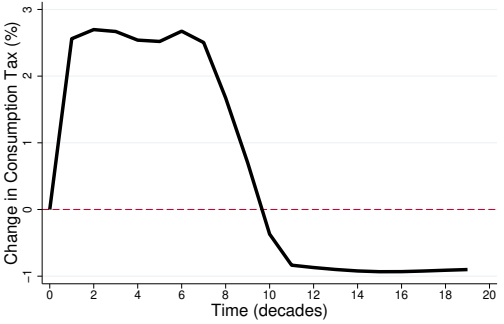



**Figure 11:** Change in consumption tax




- Higher child-related government expenditures in the first few decades beyond the direct policy costs ($\mathcal{E}$ and $\mathcal{T}(n, \cdot)$)
- With $\tau_c$ changing to balance the budget, welfare effects for: ► plot
  - Newborns in transition – positive but smaller than 1.6% (c.e.)
  - Existing baby bonus recipients (15% of voters): +1.4% (c.e.), existing non-recipients (85% of voters): -2.4% (c.e.)

# Highlights of Policy Comparisons

**Figure 12:** Effects on Fertility

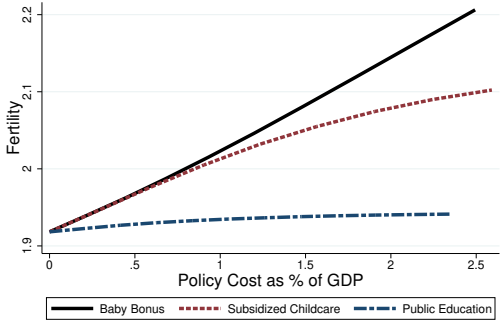
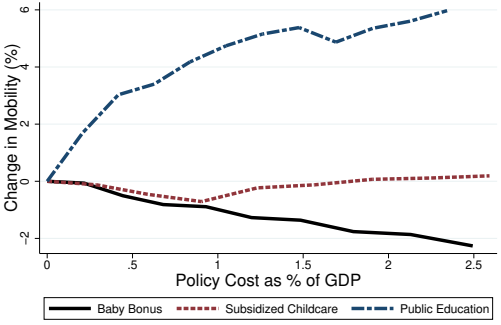



**Figure 13:** Effects on Mobility




- $\mathcal{S}$ and $\mathcal{E}$ are less cost-effective in raising fertility
- Higher $\mathcal{E} \Rightarrow$ children are more desirable and parents are more educated in the long-run
- $\mathcal{E}$ is most effective in improving mobility

► more on $\mathcal{S}$

# Future Work

1. Alternative policies:
   - Joint usage of several policy instruments
   - Dependency on income, work, or expenditures
   - Gradual introduction of policies over time
2. Alternative ways of funding the policies:
   - Capital and labor taxes – implications for distortions and redistribution across households
   - Government deficits – implications for redistribution across generations
3. Alternative sources of inefficiencies of fertility choices:
   - Ideas creation (Jones, 2020)
   - Pollution (Bohn and Stuart, 2015)
   - Firm dynamics (Hopenhayn et al., 2018)
4. Endogenize childcare price – supply and demand of caregivers

# Conclusion

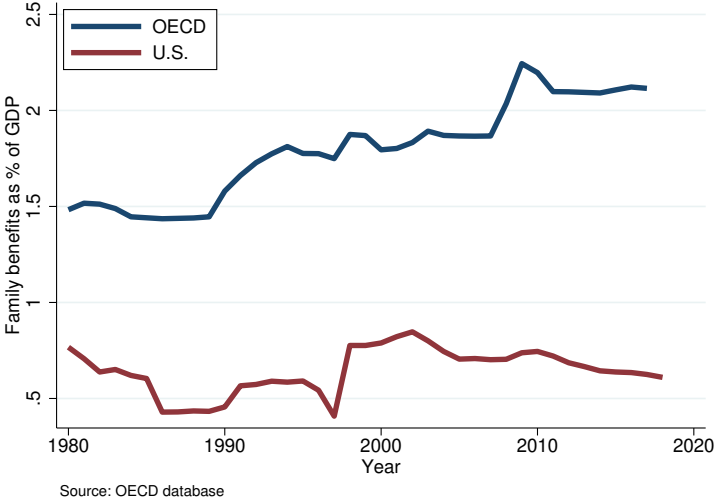
## What I do:

- Develop a quantitative GE-OLG model to study the macroeconomic consequences of family policies
- Calibrate the model to match U.S. data and validate using empirical evidence
- Flexible framework that can be used in many other contexts

### What I find:

1. $30k cash benefit at birth raises fertility to the replacement level, but reduces average human capital and social mobility by 2%
2. Long-run welfare rises by 1.6%, largely due to demographic structure changes
3. Government needs to finance higher child-related expenditures in transition
4. In-kind policies have smaller fertility effects, but offer other advantages

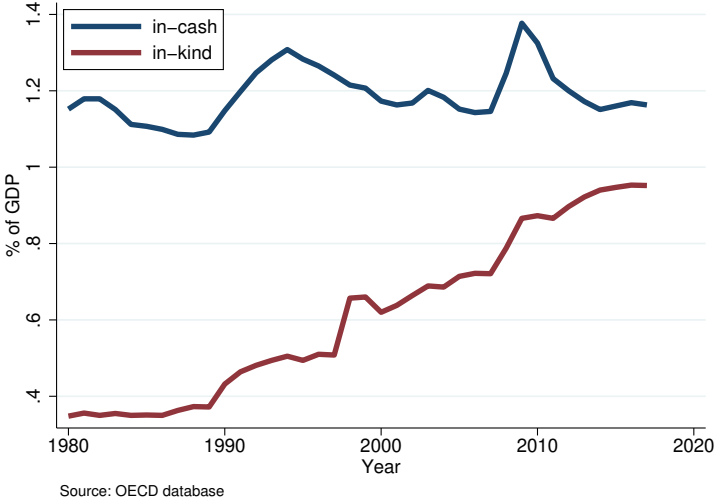
# Time Trend of Public Expenditures on Child Benefits




Source: OECD database

► back to intro

# Expenditure Breakdown




Source: OECD database

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# Working Without Children and Retirement

- For households working without children, $j \in \{4, 5, 6\}$:

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

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

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

- For retired households, $j \in \{7, 8\}$:

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

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

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

where $\pi$ is pension replacement rate

► back to transfer

# Stationary Equilibrium

- Invariant distribution: Demographic structure $\{\omega_j\}_{j=0}^{8}$ and distribution of agents over states $\{\mu_j\}_{j=0}^{8}$ are invariant over time periods
- Households optimize utility and firms maximize profits
- Prices clear markets
- Government balances budget in period to period
- Externalities/incompleteness that government could address:
  1. **Fiscal externalities of childbearing and childrearing**
     - Private returns $\neq$ social returns (i.e. $\{\omega_j\}_{j=0}^{8}$ and $\{\mu_j\}_{j=0}^{8}$)
  2. **Borrowing constraints** (Daruich 2019, Abbott et al. 2019 . . . )

► back to eqm. ► back to counterfactual

# Endogenous Childcare Arrangements

- Standard models where a child costs fixed amount of time, total income $y$:

$$y = wh\underbrace{\left(1 - \underbrace{(\chi - \mathcal{S})}_{\text{time cost}} \cdot n\right)}_{\text{labor supply}} + n \cdot \mathcal{B}$$

  which implies $\mathcal{S}$ is equivalent to a baby bonus $\frac{\mathcal{B}}{wh}$

- Empirical evidence indicates the opposite:
  - Subsidized childcare: labor supply ↑ market care enrollment ↑ (Baker et al. 2008)
  - Baby bonus: labor supply ↓ market care enrollment ↓ (González 2013)
- **Endogenous childcare arrangements**: (in-kind) subsidized childcare induces more labor supply from parents with $m^*(h, a) \leq \mathcal{S}$
- Affects inequalities in wage growth since $h_{j+1} = L_j(\cdot, t_w)$

► back to model ► back to result

# Model Fit

| Parameter | Interpretation | Moment | Data | Model |
|---|---|---|---|---|
| $\gamma$ | elasticity of substitution | fertility differential | 0.12 | 0.12 |
| $\psi$ | fertility preference | average fertility | 1.92 | 1.92 |
| $\theta$ | human capital preference | average investment as % of income | 13.4 | 13.5 |
| $\nu$ | transfer preference | average transfer | \$48,381 | \$48,400 |
| $\iota$ | economies of scale at home | childcare time by # children | 1.5 | 1.5 |
| $\upsilon$ | substitutability of care | average care spending as % of income | 16 | 16 |
| $Z$ | normalizing scalar | median income = 1 | N/A | N/A |
| $\sigma_\epsilon$ | ability shock dispersion | Gini of earnings at $j = 2$ | 0.29 | 0.29 |
| $\rho$ | intergenerational spillover | intergenerational elasticity of earnings | 0.34 | 0.33 |
| $\xi$ | substitution of education | investment by parents' education | misc. | misc. |
| $\kappa$ | input productivity | return on per dollar investment (NPV) | \$1.3 | \$1.29 |
| $\eta$ | learning curvature | income growth by initial decile | 0.1 | 0.09 |
| $\{\zeta\}_{j=2}^{5}$ | learning level | income growth by age | misc. | misc. |
| $\sigma_z$ | shock dispersion | Gini of earnings at $j = 6$ | 0.39 | 0.39 |

► sensitivity ► back

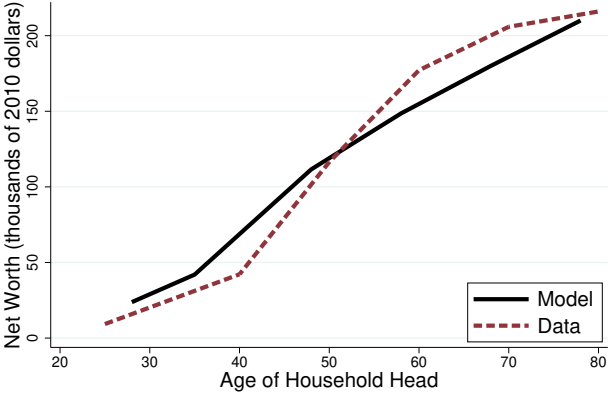
# Sensitivity of Parameters to Moments

| | $\gamma$ | $\psi$ | $\theta$ | $\nu$ | $\upsilon$ | $\sigma_\epsilon$ | $\rho$ | $\xi$ | $\eta$ | $\sigma_z$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $n$ Gap | -0.51 | -0.28 | **-0.53** | -0.40 | -0.01 | 0.00 | -0.02 | 0.02 | -0.01 | -0.02 |
| TFR | 0.56 | -0.56 | **1.67** | 1.05 | 0.11 | -0.07 | 0.00 | 0.01 | -0.04 | 0.05 |
| $e$ | 0.47 | 0.48 | **1.12** | 0.35 | -0.45 | 0.04 | -0.10 | 0.30 | 0.00 | -0.04 |
| $a_k$ | -0.02 | -0.06 | -0.04 | **0.75** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $m$ | -0.43 | -0.33 | -0.28 | -0.29 | **1.02** | -0.10 | -0.06 | 0.05 | -0.03 | 0.06 |
| $\text{Gini}_2$ | 0.47 | 0.20 | 0.14 | 0.02 | -0.12 | **1.21** | 0.19 | -0.23 | 0.88 | 0.53 |
| IGE | -0.20 | -0.27 | -0.83 | -0.19 | -0.18 | -0.05 | **1.13** | -0.23 | 0.16 | 0.21 |
| $e_{\text{low}}$ | -0.07 | -0.08 | **-0.19** | -0.05 | -0.01 | 0.00 | 0.02 | -0.15 | 0.01 | 0.01 |
| $h$ Profile | 0.08 | -0.01 | -0.14 | -0.14 | -0.17 | 0.03 | 0.07 | -0.03 | **0.37** | -0.23 |
| $\text{Gini}_6$ | 0.04 | 0.03 | 0.06 | 0.02 | -0.03 | 0.01 | -0.06 | 0.00 | 0.14 | **0.29** |

- Sensitivity "$\Lambda$" defined in Andrews, Gentzkow, and Shapiro (2017)
- Bold entries (row max): most sensitive parameter to moment changes

► back

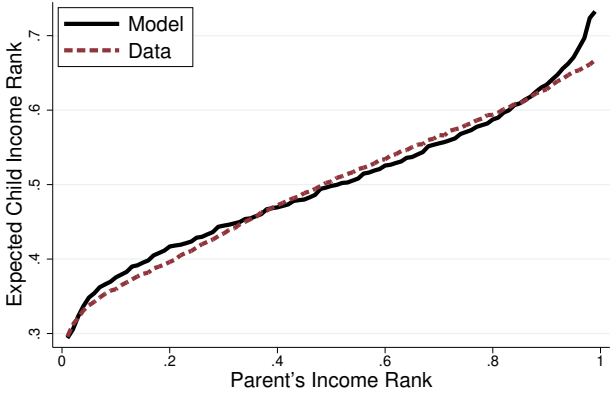
# Net Worth by Age: Model and Data




- Net worth by age of household head from SCF summary tables

►back

# Intergenerational Mobility: Model vs Data




- Rank-rank slope = 0.34 (Chetty, Hendren, Kline and Saez 2014)

► back

# Child's Skill Production Function Cont'd

Use **RCT evidence** to estimate the productivity of inputs $\kappa$:

$$h_k = Z \cdot \epsilon \cdot h^\rho \left(\mathcal{E}^\xi + e^\xi\right)^{\kappa/\xi}$$

- García, Heckman, Leaf and Prados (2020)
  - Two US early childhood development programs (ABC, CARE) in 1970s
  - Cost $\approx$ \$13.5k per year for five years - total \$67.5k per child
  - Followed up into adulthood and observe education/income
  - For every dollar invested, children's lifetime labor income increases by **\$1.3**
- Apply similar policy in the model: expand existing $\mathcal{E}$ by \$67.5k
  - **Small scale**: prices and taxes remain unchanged
  - **Target**: children of parents at 10th percentile of earnings
- Comparing labor income changes with program costs gives $\kappa = 0.13$

► back

# Costs of Child and Childcare

- OECD equivalence scale:

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

- **Childcare arrangements**:

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

  Set $\chi = 0.18$ (Folbre 2008). Returns to scale within family calibrated to be $\iota = 0.7$

- Elasticity of substitution: $\upsilon = 0.38$ - average share of income spent on childcare by education (SIPP) (Herbst 2018)

- **Price of full-time childcare**: $p_m = \$6,860$ per year for child aged 0-10 (The National Association of Child Care Resource & Referral Agencies 2011)

► back

# Fertility Response

- Consider simplified problem for low-$h$ parents, i.e. quality margin not operative

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

$$c + n \cdot \chi = 1$$

- First-order condition for $n$:

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

- Plug in $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, we have

$$\Psi'(n) = (1-\gamma) \cdot \chi \cdot \frac{\lambda}{\mathcal{E}^{1-\gamma}} \Longrightarrow \boldsymbol{\Delta\Psi'(n) \propto (1-\gamma) \cdot \Delta\chi}$$

Conditional on other parameters, higher $\gamma \Longrightarrow$ smaller $n$ response

► back

# Skill Evolution for Adults

- **Human capital of working adults** evolves:

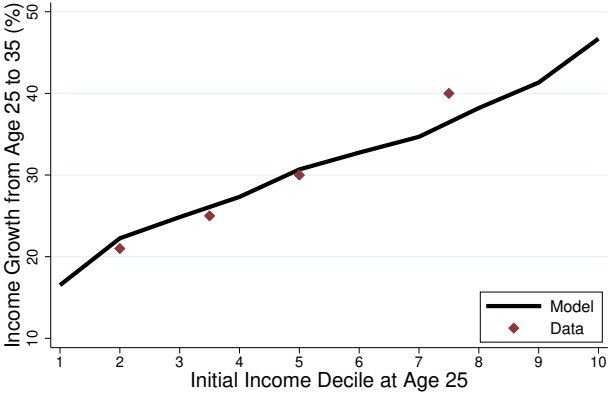
$$h_{j+1} = L_j(h_j, t_w, z') = \exp(z')\left[h_j + \zeta_j(h_j \cdot t_w)^{\eta}\right]$$

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

- $\{\zeta_j\}_{j=2}^{5}$ - age-earnings profile (CPS)
- $\eta = 1.22$ - inequality in wage growth (CPS)
- $\mu_z = -0.23$ - 2% skill depreciation
- $\sigma_z = 0.38$ - life-cycle Gini coefficient of earnings (Huggett, Ventura and Yaron 2011)

► fit ► back

# Inequality in Wage Growth: Model vs Data




- Growth rate of average income from age 25 to 35 by education in CPS-ASEC data (2008-2014)

► back

# Other Parameters

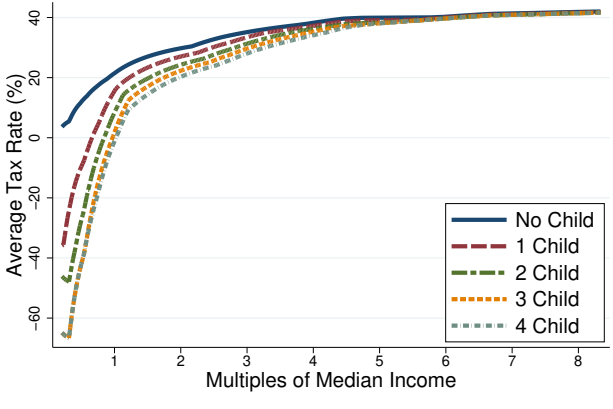
- **Firms' production function**: capital share $\alpha = 0.33$ and $4\%$ capital depreciation
- **Government taxes**
  - **Income taxes**:

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

    where $\{\tau_y^n, \lambda_y^n\}_{n=0}^6$ estimated using TAXSIM
  - **Tax rates** from McDaniel (2014): $\tau_c = 0.07$ and $\tau_a = 0.27$
  - **Pension replacement rate**: $\pi = 40\%$

► tax ► back

# Income Taxes: Model vs Data




- Child tax benefits (reduction in tax rates) are larger for low-income households

► back

# APFD and Completed Fertility Rate

**Figure 14:** Completed Fertility Rate (CFR)

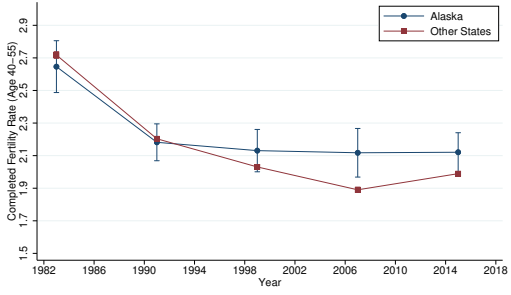
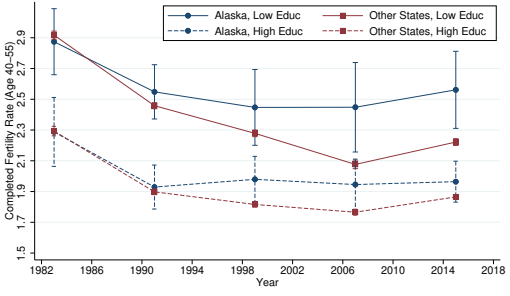



**Figure 15:** CFR by Education




► back to validation

# Australian Baby Bonus

- **A$3,000 baby bonus**[1] to every child born on or after July 1st 2004
- Risse (2010) and Drago et al. (2011) find:
  - Significant fertility responses and evidence for long-term/quantum effects
  - Baby bonus needed for additional birth around A$126,000 $\approx 4\times$GDPPC
  - Larger fertility responses from low-income households
- Gaitz and Schurer (2017) finds that the baby bonus was **ineffective** in boosting learning, socio-emotional or physical health outcomes of pre-school children
- Results from baby bonus counterfactual are consistent with above findings:
  - Significant fertility effects that are larger among low-income households
  - Baby bonus needed for additional birth = $3.5\times$GDPPC
  - Child human capital reduces due to quantity-quality trade-off

► back to validation ► back to results

[1] More details: (1) Announced on Mar 12th 2004, (2) universal coverage, lump-sum payment, (3) Equivalent to 4 times average weekly earnings, (4) Equivalent to $2,800 in 2010 USD.

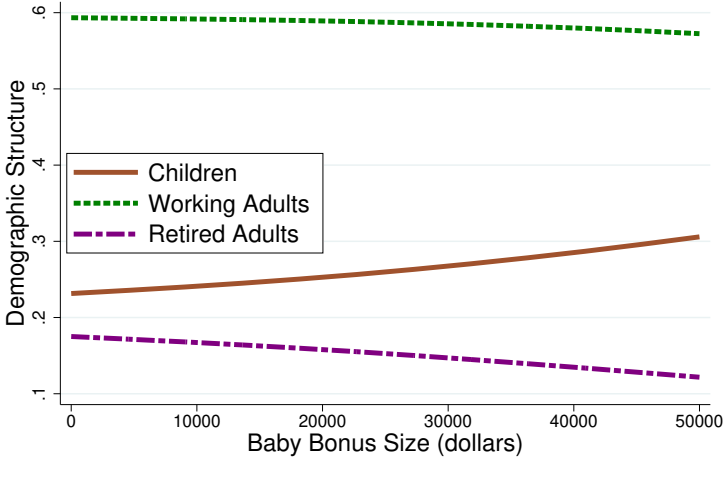
# Spanish Baby Bonus

- **€$2,500 baby bonus**[2] to every child born on or after July 1st 2007
- González (2013) finds:
  - Total fertility rate increased
  - Mothers reduced labor supply
  - Fewer children were enrolled in formal childcare
- Results from model are consistent with above findings:
  - Baby bonus needed for additional birth / GDPPC = 3.6 (data) vs 3.5 (model)
  - Parents reduce labor supply as fertility raises $\rightarrow$ more childcare needs
  - Parents demand less market care as relative costs of home care falls due to economies of scale in home production of childcare

► back to validation

[2] More details: (1) Announced on July 3rd 2007, (2) universal coverage, lump-sum payment, (3) Equivalent to 4.5 times the monly gross minimum wage for full-time worker, (4) Equivalent to $3,500 in 2010 USD.

# Change in Demographic Structure




► back to results

# Distributional Welfare Consequences

**Figure 16:** Newborns in Transition

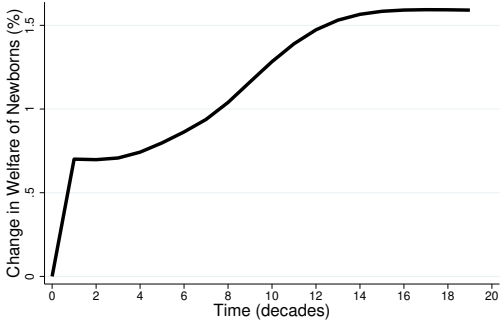
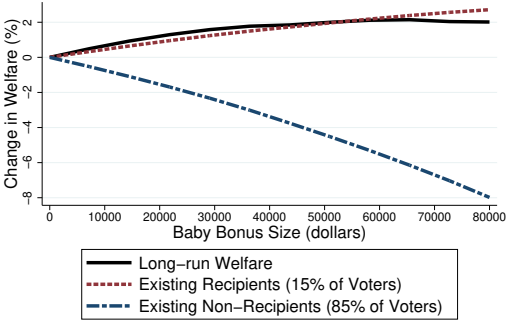



**Figure 17:** Long-run and Existing Households




► back

# Baby Bonus versus Subsidized Childcare

**Figure 18:** Effects on Income Growth

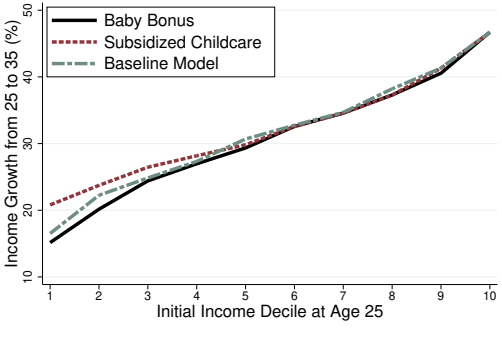
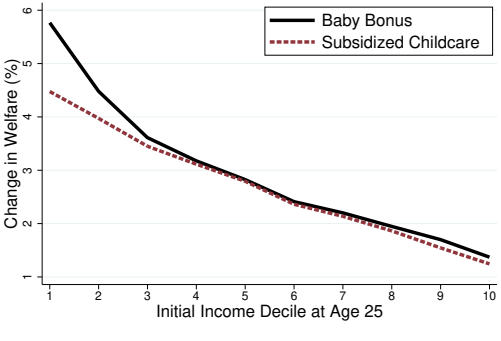



**Figure 19:** Effects on Welfare




- Subsidized childcare reduces inequality in income growth
- Low-income households prefers cash transfers of the same face value

► intuition ► back