The Macroeconomic Consequences of Family Policies

Anson Linshuo Zhou
University of Wisconsin-Madison

July 2, 2021

Motivation: Dual Role of Family Policies

Family policies: a class of policies that promote childbearing and childrearing

Motivation: Dual Role of Family Policies

Family policies: a class of policies that promote childbearing and childrearing

Encourage Childbirth to Combat Population Aging

- Prevalent in OECD countries with low fertility (**>2% of GDP**)

► trend

Motivation: Dual Role of Family Policies

Family policies: a class of policies that promote childbearing and childrearing

Encourage Childbirth to Combat Population Aging

- Prevalent in OECD countries with low fertility (**>2% of GDP**) ► trend
- Baby bonus in Australia 2004 ($\approx$ \$2,100). Treasurer Peter Costello: “One (baby) for the Mum, one for the Dad, and one for the country"

Motivation: Dual Role of Family Policies

Family policies: a class of policies that promote childbearing and childrearing

Encourage Childbirth to Combat Population Aging

- Prevalent in OECD countries with low fertility (**>2% of GDP**) ► trend
- Baby bonus in Australia 2004 ($\approx$ \$2,100). Treasurer Peter Costello: “One (baby) for the Mum, one for the Dad, and one for the country"
- Increasingly relevant for the U.S. as Census data sends warning signals

Motivation: Dual Role of Family Policies

Family policies: a class of policies that promote childbearing and childrearing

Encourage Childbirth to Combat Population Aging

- Prevalent in OECD countries with low fertility (**>2% of GDP**) ► trend
- Baby bonus in Australia 2004 ($\approx$ \$2,100). Treasurer Peter Costello: "One (baby) for the Mum, one for the Dad, and one for the country"
- Increasingly relevant for the U.S. as Census data sends warning signals
- Popular and large in scale $\longrightarrow$ cost-effectiveness and aggregate impacts?

Motivation: Dual Role of Family Policies

Family policies: a class of policies that promote childbearing and childrearing

Encourage Childbirth to Combat Population Aging

- Prevalent in OECD countries with low fertility (**>2% of GDP**) ► trend
- Baby bonus in Australia 2004 ($\approx$ \$2,100). Treasurer Peter Costello: "One (baby) for the Mum, one for the Dad, and one for the country"
- Increasingly relevant for the U.S. as Census data sends warning signals
- Popular and large in scale $\longrightarrow$ cost-effectiveness and aggregate impacts?

Boost Child Outcomes and Social Mobility

- Goals of **\$3k+ Child Tax Credit**, **\$1.8 trillion American Families Plan** - "an investment in our kids, our families, and our economic future"

Motivation: Dual Role of Family Policies

Family policies: a class of policies that promote childbearing and childrearing

Encourage Childbirth to Combat Population Aging

- Prevalent in OECD countries with low fertility (**>2% of GDP**) ► trend
- Baby bonus in Australia 2004 ($\approx$ \$2,100). Treasurer Peter Costello: "One (baby) for the Mum, one for the Dad, and one for the country"
- Increasingly relevant for the U.S. as Census data sends warning signals
- Popular and large in scale $\longrightarrow$ cost-effectiveness and aggregate impacts?

Boost Child Outcomes and Social Mobility

- Goals of **\$3k+ Child Tax Credit**, **\$1.8 trillion American Families Plan** - "an investment in our kids, our families, and our economic future"
- Effective in achieving stated policy goals?

This Paper

What are the macroeconomic consequences of large-scale family policies?

- Suppose the government gives parents a baby bonus
  1. Will it improve children's outcomes and boost social mobility?
  2. How will it affect population growth, output and social welfare?

This Paper

What are the macroeconomic consequences of large-scale family policies?

- Suppose the government gives parents a baby bonus
  1. Will it improve children's outcomes and boost social mobility?
  2. How will it affect population growth, output and social welfare?

- A quantitative GE-OLG model:

$$\textbf{Endogeneous Fertility} \quad + \quad \underbrace{\textbf{Endogenous Intergenerational Linkages}}_{\text{child human capital formation + inter-vivos transfers}}$$

This Paper

What are the macroeconomic consequences of large-scale family policies?

- Suppose the government gives parents a baby bonus
  1. Will it improve children's outcomes and boost social mobility?
  2. How will it affect population growth, output and social welfare?

- A quantitative GE-OLG model:

$$\textbf{Endogeneous Fertility} \quad + \quad \underbrace{\textbf{Endogenous Intergenerational Linkages}}_{\text{child human capital formation + inter-vivos transfers}}$$

- Previous studies and policy recommendations: family policies as transfers to existing child $\rightarrow$ quality margin
- This paper: family policies change the "price" of child $\rightarrow$ **add quantity margin**

Overview of Channels

- Considering **endogenous fertility** incorporates key policy channels:

Overview of Channels

- Considering **endogenous fertility** incorporates key policy channels:
  1. **Quality/quantity trade-off**: higher fertility raises the marginal cost of child quality (Becker and Lewis 1973)

Overview of Channels

- Considering **endogenous fertility** incorporates key policy channels:
  1. **Quality/quantity trade-off**: higher fertility raises the marginal cost of child quality (Becker and Lewis 1973)
  2. **Composition effects**: families that increase fertility more gain representation in future economies

Overview of Channels

- Considering **endogenous fertility** incorporates key policy channels:
  1. **Quality/quantity trade-off**: higher fertility raises the marginal cost of child quality (Becker and Lewis 1973)
  2. **Composition effects**: families that increase fertility more gain representation in future economies
  3. **Demographic structure effects**: changes in age distribution affects pension, child expenditures, and taxes

Overview of Channels

- Considering **endogenous fertility** incorporates key policy channels:
  1. **Quality/quantity trade-off**: higher fertility raises the marginal cost of child quality (Becker and Lewis 1973)
  2. **Composition effects**: families that increase fertility more gain representation in future economies
  3. **Demographic structure effects**: changes in age distribution affects pension, child expenditures, and taxes
- **Fertility elasticities**, i.e. magnitude of fertility responses to financial incentives
  1. Disciplined by parameters that are calibrated within the model
  2. Validated externally using policy - Alaska Permanent Fund Dividend

Preview of Key Results

Consider a $31k baby bonus:

(1) $\approx$ expansion of CTC from 2010-2021 in NPV

(2) offsets the average cost of raising one child by 19% (USDA)

Preview of Key Results

Consider a $31k baby bonus:

(1) $\approx$ expansion of CTC from 2010-2021 in NPV

(2) offsets the average cost of raising one child by 19% (USDA)

1. Average fertility increases by 10% (1.9$\rightarrow$2.1) while average private education investment **reduces** by 8%

Preview of Key Results

Consider a $31k baby bonus:

(1) $\approx$ expansion of CTC from 2010-2021 in NPV

(2) offsets the average cost of raising one child by 19% (USDA)

1. Average fertility increases by 10% (1.9$\rightarrow$2.1) while average private education investment **reduces** by 8%
2. Average human capital falls by 1.5%. Social mobility falls by 1.6%

Preview of Key Results

Consider a $31k baby bonus:

(1) $\approx$ expansion of CTC from 2010-2021 in NPV
(2) offsets the average cost of raising one child by 19% (USDA)

1. Average fertility increases by 10% (1.9$\rightarrow$2.1) while average private education investment **reduces** by 8%
2. Average human capital falls by 1.5%. Social mobility falls by 1.6%
3. Long-run welfare[1] **rises by 2.2%** with reduced taxes. Government needs to raise taxes initially along the transition path

[1] Average utility of new-borns under the veil of ignorance

Preview of Key Results

Consider a $31k baby bonus:

(1) $\approx$ expansion of CTC from 2010-2021 in NPV
(2) offsets the average cost of raising one child by 19% (USDA)

1. Average fertility increases by 10% (1.9$\rightarrow$2.1) while average private education investment **reduces** by 8%
2. Average human capital falls by 1.5%. Social mobility falls by 1.6%
3. Long-run welfare[1] **rises by 2.2%** with reduced taxes. Government needs to raise taxes initially along the transition path

Compare different policies: baby bonus, childcare subsidy, and education

- **Education expenditures** are more effective than family policies in improving child outcomes and social mobility with mild effects on fertility

[1] Average utility of new-borns under the veil of ignorance

Related Literature

Education Policies, Income transfers, and Mobility

- Benabou (2002), **de la Croix and Doepke (2003)**, Heckman and Mosso (2014), Bastian and Michelmore (2018), **Daruich (2019)**, Abbott, Gallipoli, Meghir and Violante (2019), Mullins (2019), **Guner, Kaygusuz and Ventura (2020)**...
- **Contribution: Considering fertility responses could reverse policy effects on child human capital and social mobility**

Family Policies, Fertility and Child Outcomes

- **Empirical:** Milligan (2005), Laroque and Salanié (2008), Drago et al. (2011), Luci-Greulich and Thévenon (2013), González (2013), Raute (2019)...
- **Structural:** Fan and Stark (2008), Liao (2013), **Tertilt, Kim and Yum (2021)**
- **Contribution: Propose and calibrate a quantitative model that is suitable for analyzing large-scale policies beyond fertility effects**

Outline

1. **Model: Role of endogenous fertility**
2. **Calibration (2010 USA)**
3. **Validation**
4. **Counterfactual Results**
5. **Conclusion**

Model

Model: Timeline

- Model Period = 10 Years

Key Elements:

- Endogenous Fertility
- Endogenous Child Link

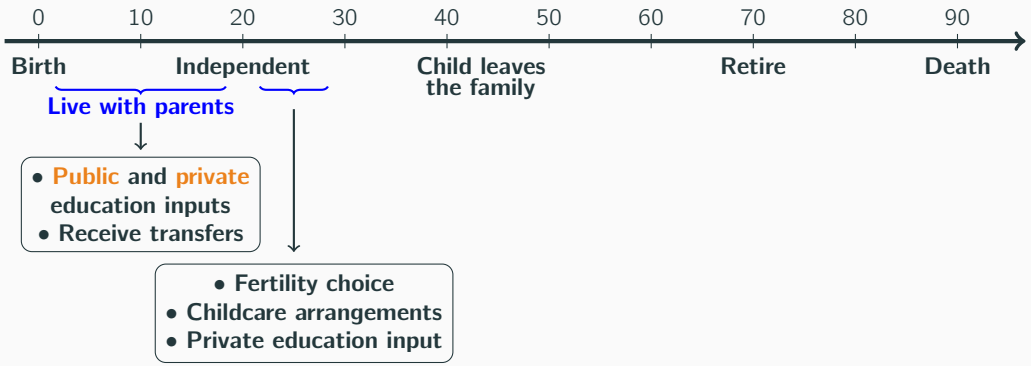
Model: Timeline

- Model Period = 10 Years

Key Elements:

- Endogenous Fertility
- Endogenous Child Link

Model: Timeline

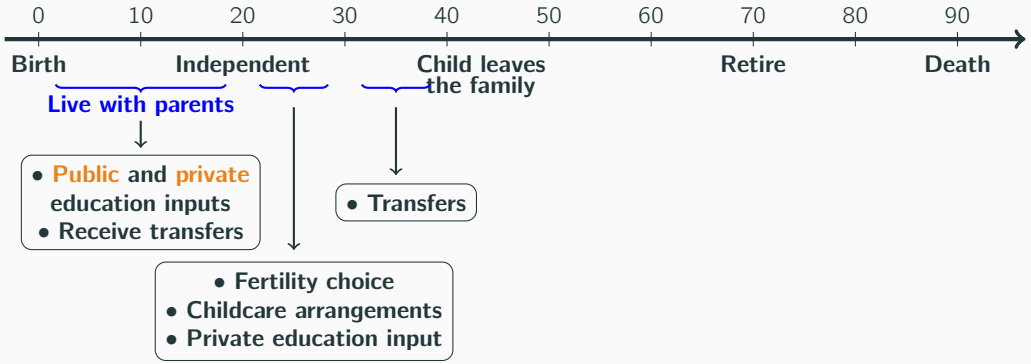


- Model Period = 10 Years

Key Elements:

- Endogenous Fertility
- Endogenous Child Link

Model: Timeline

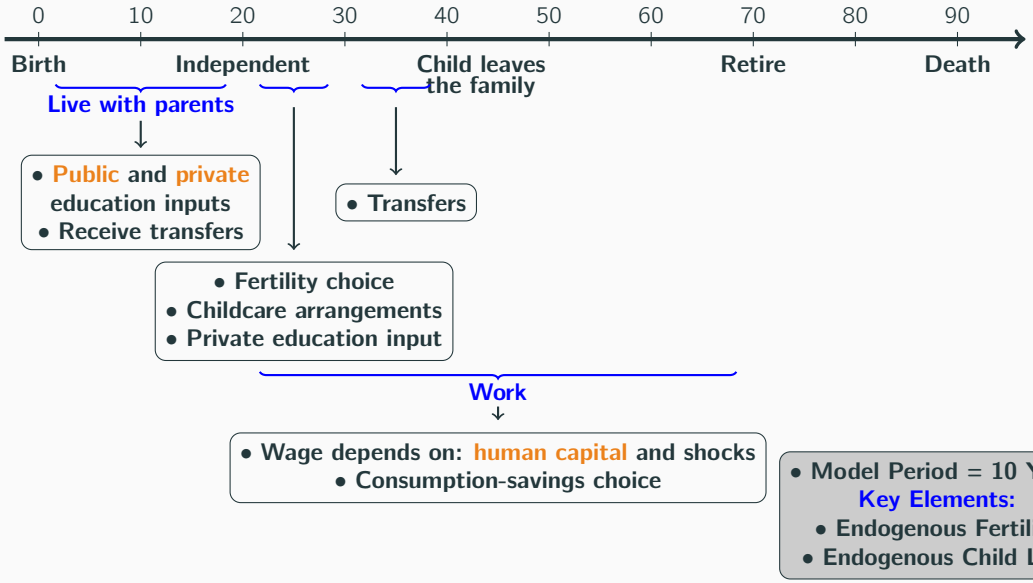


- Model Period = 10 Years

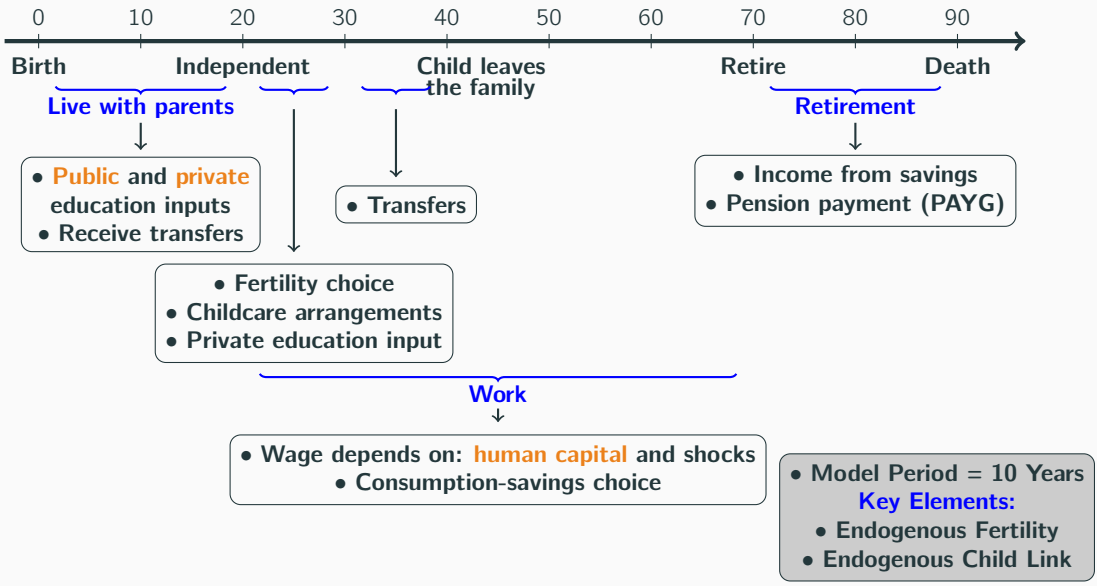
Key Elements:

- Endogenous Fertility
- Endogenous Child Link

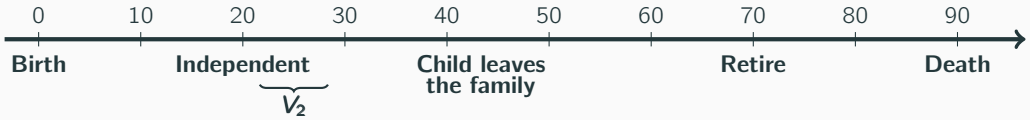
Model: Timeline



Model: Timeline



Fertility, Childcare and Skill Formation



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

---

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

Fertility, Childcare and Skill Formation

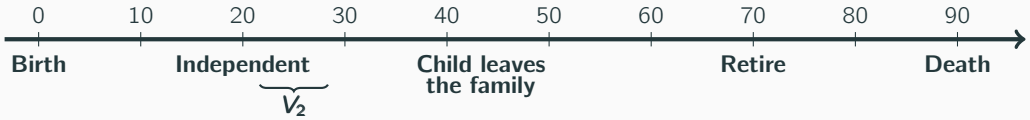
$$V_2(h,a) = \max_{c,a',n,e,t_h,m\geq 0} u(c/\Lambda(n)) + \beta \mathbb{E} V_3(h', a', n, \mathbb{E}h_k)$$

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

---

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

Fertility, Childcare and Skill Formation



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

$$n \cdot \chi = \left({t_h}^{\upsilon/\iota} + (n \cdot m)^{\upsilon} \right)^{1/\upsilon} \quad \textbf{[time cost]}$$

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

---

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

Fertility, Childcare and Skill Formation

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

$$n \cdot \chi = \left({t_h}^{\upsilon/\iota} + (n \cdot m)^{\upsilon} \right)^{1/\upsilon} \quad \textbf{[time cost]}$$

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

$$(1+\tau_c)(c + mp_m(1-\mathcal{S})n + e \cdot n) + a' = (1+r)a + y - \mathcal{T}(y,a,n) + \mathcal{B} \cdot n \quad \textbf{[BC]}$$

---

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

Fertility, Childcare and Skill Formation

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

$$n \cdot \chi = \left({t_h}^{\upsilon/\iota} + (n \cdot m)^{\upsilon} \right)^{1/\upsilon} \quad \textbf{[time cost]}$$

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

$$(1+\tau_c)(c + mp_m(1-\mathcal{S})n + e \cdot n) + a' = (1+r)a + y - \mathcal{T}(y,a,n) + \mathcal{B} \cdot n \quad \textbf{[BC]}$$

$$h' = L(h, 1 - t_h, z') \qquad h_k = G(h, \mathcal{E}, e, \epsilon) \quad \textbf{[technology]}$$

---

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

Fertility, Childcare and Skill Formation

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

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

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

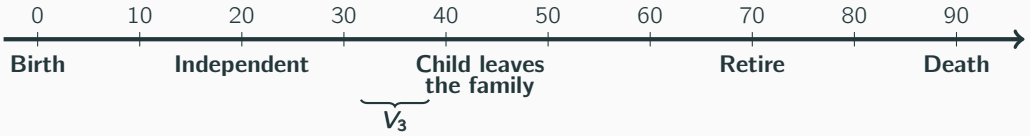
$$(1+\tau_c)(c + mp_m(1-\mathcal{S})n + e \cdot n) + a' = (1+r)a + y - \mathcal{T}(y,a,n) + \mathcal{B} \cdot n \qquad \textbf{[BC]}$$

$$h' = L(h, 1 - t_h, z') \qquad h_k = G(h, \mathcal{E}, e, \epsilon) \qquad \textbf{[technology]}$$

Two simplifying modeling assumptions:

1. $G(h, \mathcal{E}, e, \epsilon)$ captures the overall skill formation of children from age 0 to 20
2. Time cost χ is non-educational. High-quality public childcare can be implemented by raising $\mathcal{S}$ and $\mathcal{E}$ jointly in the model

Parent-to-Child Transfer



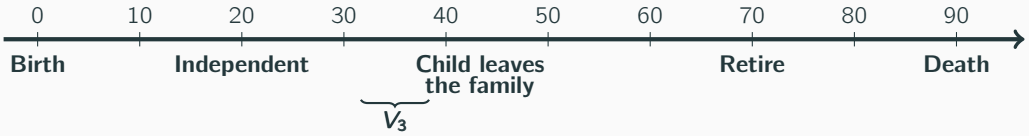
$$V_3(h, a, n, \mathbb{E}h_k) = \max_{c, a', a_k \geq 0} u(c/\Lambda(n)) + \beta \mathbb{E} V_4(h', a') + \underbrace{v(n, \mathbb{E}h_k, a_k)}_{\text{utility from quantity and quality}}$$

$$y = wh \cdot 1$$

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

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

Parent-to-Child Transfer



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

$$y = wh \cdot 1$$

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

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

- First-order conditions for child "quality" choices e and a_k:

$$\frac{\partial v(n, \mathbb{E}h_k, a_k)}{\partial \mathbb{E}h_k} \cdot \frac{\partial \mathbb{E}h_k}{\partial e} = \lambda_2 \cdot (1 + \tau_c) \cdot n \qquad \textbf{FOC } [e]$$

$$\frac{\partial v(n, \mathbb{E}h_k, a_k)}{\partial a_k} = \lambda_3 \cdot n \qquad \textbf{FOC } [a_k]$$

where marginal costs are proportional to n

► later periods

Fertility Elasticity - Quality/Quantity Trade-off

Consider the effect of an increase in baby bonus $\mathcal{B}$ on transfers a_k (fixing e for now)

Fertility Elasticity - Quality/Quantity Trade-off

Consider the effect of an increase in baby bonus $\mathcal{B}$ on transfers a_k (fixing e for now)

When fertility elasticity $\frac{dn^*}{d\mathcal{B}} = 0$, i.e. exogenous fertility

- Increase in $\mathcal{B}$ is an income transfer, $\boldsymbol{a_k}$ **rises unambiguously**:

$$\underbrace{\lambda_3 \downarrow}_{\text{income effect on } MU_c} \cdot n \quad \Rightarrow \quad \frac{v(n, \mathbb{E}h_k, a_k \uparrow)}{\partial a_k} \qquad \textbf{FOC } [\boldsymbol{a_k}]$$

Fertility Elasticity - Quality/Quantity Trade-off

Consider the effect of an increase in baby bonus $\mathcal{B}$ on transfers a_k (fixing e for now)

When fertility elasticity $\frac{dn^*}{d\mathcal{B}} = 0$, i.e. exogenous fertility

- Increase in $\mathcal{B}$ is an income transfer, a_k **rises unambiguously**:

$$\underbrace{\lambda_3 \downarrow}_{\text{income effect on } MU_c} \cdot n \quad \Rightarrow \quad \frac{v(n, \mathbb{E}h_k, a_k \uparrow)}{\partial a_k} \qquad \textbf{FOC } [a_k]$$

When fertility elasticity $\frac{dn^*}{d\mathcal{B}} \neq 0$, i.e. endogenous fertility

- Increase in $\mathcal{B}$ is a price change, n rises $\Longrightarrow$ **effects on a_k is ambiguous**:

$$\underbrace{\lambda_3?}_{\text{change in } MU_c \text{ as } n\uparrow} \cdot \underbrace{n \uparrow}_{\text{fertility response}} = \underbrace{\frac{\partial v(n \uparrow, \mathbb{E}h_k, a_k?)}{\partial a_k}}_{\text{interaction in preferences}} \qquad \textbf{FOC } [a_k]$$

- a_k could fall when child benefits are more generous - **quality/quantity trade-off**

Heterogeneous Fertility Elasticities - Composition Effects

- Heterogeneous fertility elasticities: size of transfer relative to income differs
- Families that increase fertility more gain representation
- Intergenerational persistence of $h \Longrightarrow$ **composition effects** on aggregate h.c.

Heterogeneous Fertility Elasticities - Composition Effects

- Heterogeneous fertility elasticities: size of transfer relative to income differs
- Families that increase fertility more gain representation
- Intergenerational persistence of $h \Longrightarrow$ **composition effects** on aggregate h.c.
- **Insight**: Even when policy effects on each child's human capital is positive, overall impact on aggregate human capital could still be negative

Firms and the Government

- Representative firm with Cobb-Douglas production function:

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

Firms and the Government

- 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 distribution of households across state space as $\{\mu_j\}_{j=0}^{8}$. **Government fiscal budget**:

$$\underbrace{\left(\sum_{j=2}^{6}\omega_j \int \mathcal{T}(y_j^*, a_j^*, n_j^*)\, d\mu_j\right)}_{\text{labor and capital income taxes}} + \underbrace{\left(\sum_{j=2}^{8}\omega_j \int \tau_c c_j^*\, d\mu_j\right)}_{\text{consumption tax}} = \underbrace{\left(\sum_{j=7}^{8}\omega_j \int w\pi h\, d\mu_j\right)}_{\text{pension payments}}$$

$$+\underbrace{(\omega_0+\omega_1)\cdot\mathcal{E}}_{\text{public education}} + \omega_2\left(\underbrace{\int n^*\cdot\mathcal{B}\, d\mu_2}_{\text{baby bonus}} + \underbrace{\int (1+\tau_c)m^* n^* p_m\cdot\mathcal{S}\, d\mu_2}_{\text{subsidized childcare}}\right) + \underbrace{\mathcal{X}}_{\text{other spendings}}$$

Firms and the Government

- 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 distribution of households across state space as $\{\mu_j\}_{j=0}^{8}$. **Government fiscal budget**:

$$\underbrace{\left(\sum_{j=2}^{6}\omega_j \int \mathcal{T}(y_j^*, a_j^*, n_j^*)\, d\mu_j\right)}_{\text{labor and capital income taxes}} + \underbrace{\left(\sum_{j=2}^{8}\omega_j \int \tau_c c_j^*\, d\mu_j\right)}_{\text{consumption tax}} = \underbrace{\left(\sum_{j=7}^{8}\omega_j \int w\pi h\, d\mu_j\right)}_{\text{pension payments}}$$

$$+\underbrace{(\omega_0+\omega_1)\cdot\mathcal{E}}_{\text{public education}} + \omega_2\left(\underbrace{\int n^*\cdot\mathcal{B}\, d\mu_2}_{\text{baby bonus}} + \underbrace{\int (1+\tau_c)m^* n^* p_m\cdot\mathcal{S}\, d\mu_2}_{\text{subsidized childcare}}\right) + \underbrace{\mathcal{X}}_{\text{other spendings}}$$

- **Demographic Structure Effects**: Fertility responses change $\{\omega_j\}_{j=0}^{8}$. Key motivation for family policies, absent in models with exogenous fertility

► stationary equilibrium

Why may family policies improve welfare?

Long-run welfare[2]: **average value** of newborn under the veil of ignorance:

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

Welfare of current households $\longrightarrow$ transition path results

[2] See Parfit (1984) - "repugnant conclusion", Golosov, Jones and Tertilt (2007) - "$\mathcal{A}, \mathcal{P}$-efficiency", and de la Croix and Doepke (2021) - "soul incarnation" for more discussions of welfare with endogenous fertility

Why may family policies improve welfare?

Long-run welfare[2]: **average value** of newborn under the veil of ignorance:

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

Welfare of current households $\longrightarrow$ transition path results

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 ...)

[2]See Parfit (1984) - "repugnant conclusion", Golosov, Jones and Tertilt (2007) - "$\mathcal{A}, \mathcal{P}$-efficiency", and de la Croix and Doepke (2021) - "soul incarnation" for more discussions of welfare with endogenous fertility

Calibration

Model Parameters

Table 1: Model Parameters

	Interpretation	Value	Source
	Preferences		
β	discount rate	0.98[10]	standard
γ	elasticity of substitution	0.61	CPS
ψ	fertility preference	1.93	CPS
θ	quality preference	2.1	PSID
ν	transfer preference	0.36	PSID
	Childcare arrangement		
χ	childcare cost	0.18	Folbre (2008)
ι	economies of scale at home	0.7	Folbre (2008)
υ	substitutability of care	0.5	SIPP
p_m	price of full-time care	0.13	NACCRRA
	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	2.57	median income =1
σ_ϵ	ability shock dispersion	0.45	PSID
ρ	intergenerational spillover	0.28	Chetty et al. (2014)
ξ	substitution of education	0.9	ATUS
$\mathcal{E}$	public education	0.15	NCES
κ	input productivity	0.17	García et al. (2020)
	Adult human capital evolution		
η	learning curvature	0.61	PSID
ζ	learning level	0.72	PSID
μ_z	skill depreciation	-0.23	PSID
σ_z	shock dispersion	0.42	PSID
	Firm production function		
A	total factor productivity	1	normalization
α	capital share	0.33	standard
δ_k	capital depreciation	0.04[10]	standard

- 13 parameters are calibrated within the model using SMM
- Model matches salient features of fertility, childcare, parental investment, transfers, child skill formation, and lifecycle earnings profile

► child costs ► skill formation ► adult skill ► firm and gov.

Utility from child quantity and quality[3]

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

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

[3] Results robust to separable preferences and dynastic altruism

Utility from child quantity and quality[3]

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

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

- $\{\psi, \theta, \nu\}$ matches aggregate fertility and average spendings on quality

[3] Results robust to separable preferences and dynastic altruism

Utility from child quantity and quality[3]

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

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

- $\{\psi, \theta, \nu\}$ matches aggregate fertility and average spendings on quality
- γ - elasticity of intergenerational substitution (EGS) (Córdoba and Ripoll 2019)

[3]Results robust to separable preferences and dynastic altruism

Utility from child quantity and quality[3]

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

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

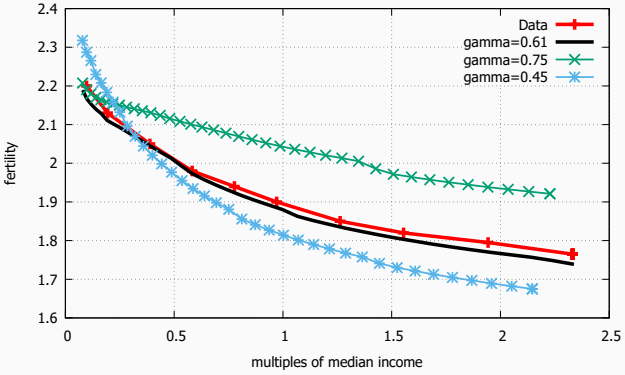
- $\{\psi, \theta, \nu\}$ matches aggregate fertility and average spendings on quality
- γ - elasticity of intergenerational substitution (EGS) (Córdoba and Ripoll 2019)
- Conditional on other parameters, **γ determines fertility elasticity**. Higher $\gamma \Longrightarrow$ smaller fertility responses

► intuition

[3] Results robust to separable preferences and dynastic altruism

Identification of γ

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



Validation

Does the model generate responses that match empirical estimates?

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

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.

Does the model generate responses that match empirical estimates?

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

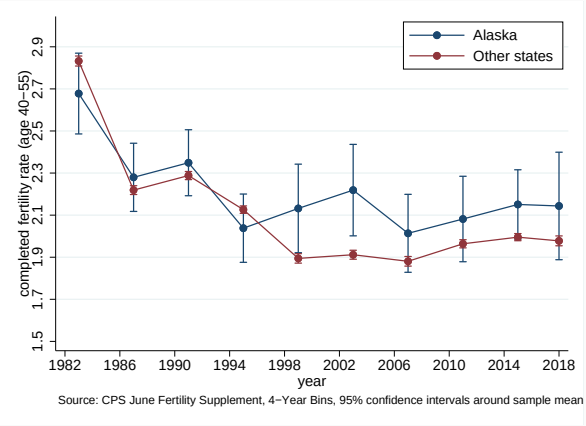
- Established in 1982 after discovery of the petroleum. Equal transfer to **all residents** regardless of income, employment or age
- **Pronatal effects**: allows parent to claim dividend on behalf of a child with no requirements on how parents use a child's dividend.
- Ideal policy variation to test fertility responses:
  1. Similar institution and cultural background
  2. Large in scale ($\approx$ \$1.5k per year) relative to other family policies

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 policy variation to test fertility responses:
  1. Similar institution and cultural background
  2. Large in scale ($\approx$ \$1.5k per year) relative to other family policies
- Apply same policy in the model: universal basic income (UBI) to parents and children by \$1.5k. Model predictions are consistent with empirical evidence:
  1. Completed fertility rises by **4.2%** ($\approx$ Kelly, Timilsina and Yonzan 2020)
  2. Larger responses from households with lower human capital (Cowan and Douds 2020)
  3. Positive but small effects on education investments

Evidence from Completed Fertility Rates



- Changes in completed fertility rate alleviates worries about effects on birth timing
- Model-predicted 4.2% (0.1) increase is consistent with average differences between Alaska and the other states

► by education ► Australia ► Spain ► Cherokee

Counterfactual Results

Baby Bonus Counterfactuals

Evaluate baby bonus $\mathcal{B}$ of different scale

- **Budget balance**: consumption tax adjusts to balance budget each period
- **General equilibrium**: wage, interest rates, and population distributions adjust

Baby Bonus Counterfactuals

Evaluate baby bonus $\mathcal{B}$ of different scale

- **Budget balance**: consumption tax adjusts to balance budget each period
- **General equilibrium**: wage, interest rates, and population distributions adjust

Outcomes of Interest

- Aggregate fertility, average human capital, per capita income, consumption taxes and intergenerational income mobility (IGE^{-1})
- Social welfare in consumption equivalence (changes)

Baby Bonus Counterfactuals

Evaluate baby bonus $\mathcal{B}$ of different scale

- **Budget balance**: consumption tax adjusts to balance budget each period
- **General equilibrium**: wage, interest rates, and population distributions adjust

Outcomes of Interest

- Aggregate fertility, average human capital, per capita income, consumption taxes and intergenerational income mobility (IGE^{-1})
- Social welfare in consumption equivalence (changes)

Outline

- **Long-run effects**
- **Transition phase**
- Childcare subsidies and education expenditures if time permits

Fertility Effects

Figure 1: Effects on aggregate fertility

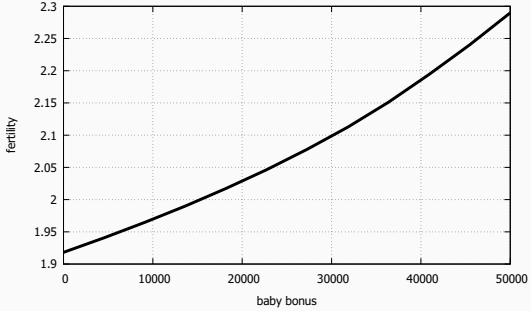
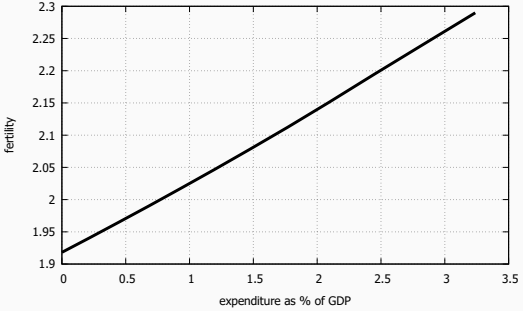


Figure 2: Expenditure share



- Baby bonus needs to be at least **$31k** to raise aggregate fertility rate to **replacement level** (2.1, commonly stated long-run policy goal). The policy costs around **1.7%** of GDP in the new equilibrium

Fertility Effects

Figure 1: Effects on aggregate fertility

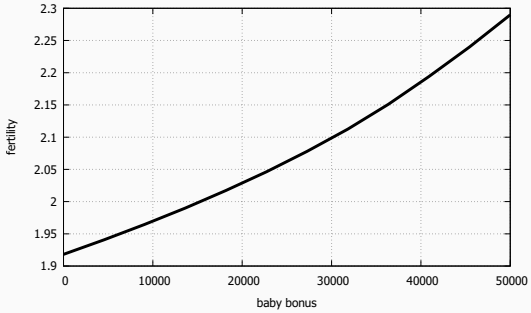
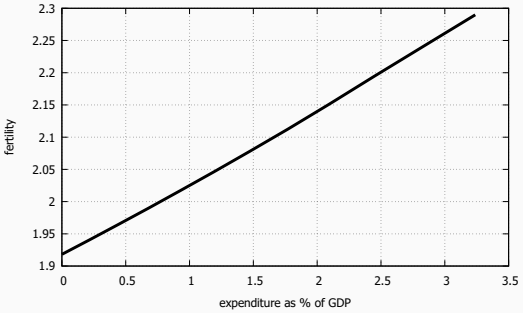


Figure 2: Expenditure share



- Baby bonus needs to be at least **$31k** to raise aggregate fertility rate to **replacement level** (2.1, commonly stated long-run policy goal). The policy costs around **1.7%** of GDP in the new equilibrium
- Consider $\mathcal{B} = \$31\text{k}$ as the benchmark policy ($\approx$ expansion of CTC from 2010-2021 in NPV)

Model Channels

Figure 3: Average private investment

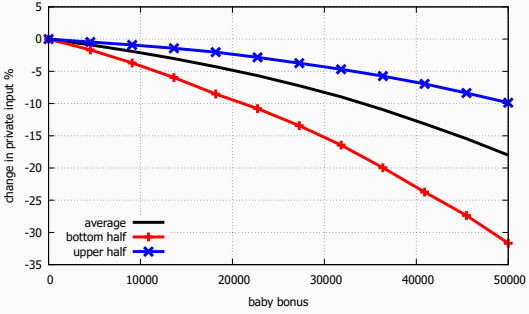
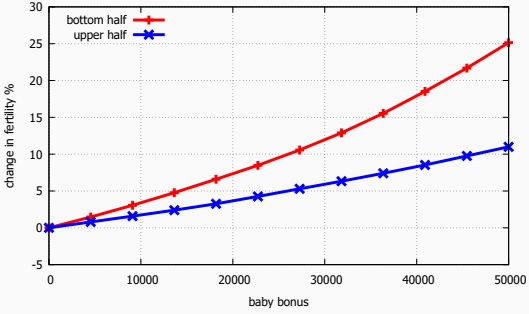


Figure 4: Heterogeneous fertility response



- **Quality/quantity trade-off**: Parents **reduce** private investments by 8%

Model Channels

Figure 3: Average private investment

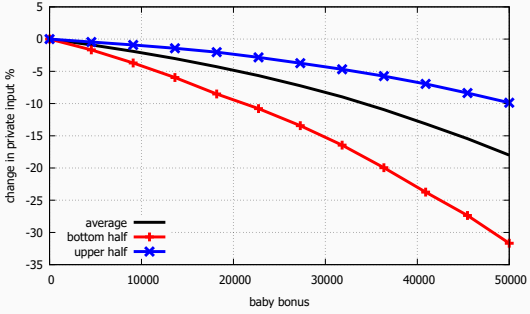
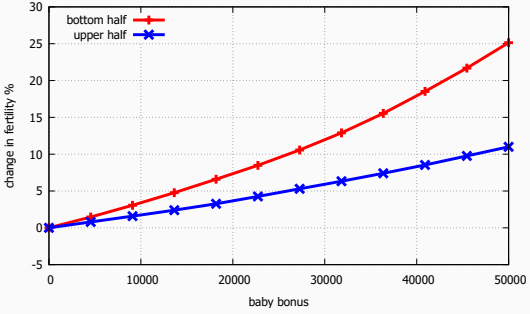


Figure 4: Heterogeneous fertility response



- **Quality/quantity trade-off**: Parents **reduce** private investments by 8%
- **Composition effects**: Parents with lower human capital respond more in fertility

Average Human Capital and Social Mobility

Figure 5: Average human capital

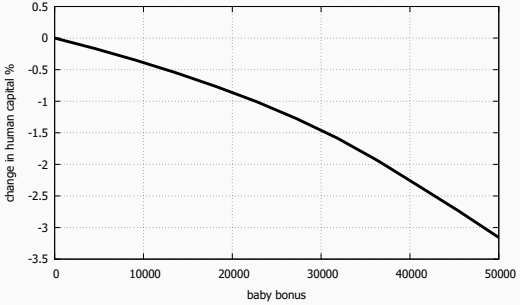
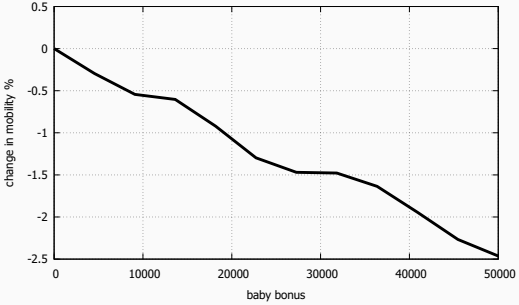


Figure 6: Intergenerational mobility



- Average human capital falls by **1.5%** with $\mathcal{B} = \$31,000$

Average Human Capital and Social Mobility

Figure 5: Average human capital

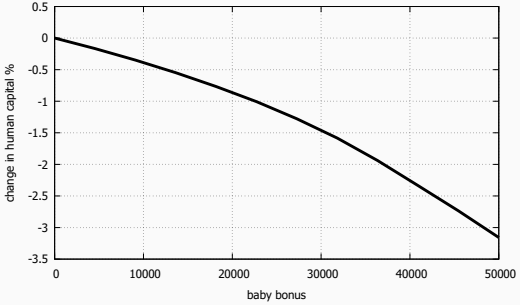
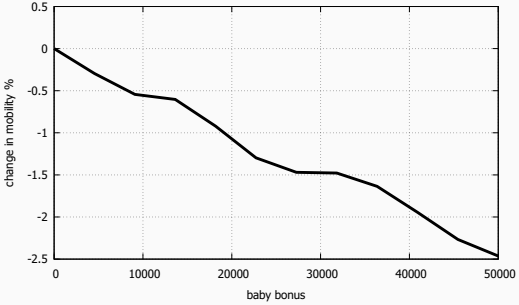


Figure 6: Intergenerational mobility



- Average human capital falls by **1.5%** with $\mathcal{B} = \$31,000$
- Intergenerational mobility **decreases by 1.6%** due to heterogeneous responses

Average Human Capital and Social Mobility

Figure 5: Average human capital

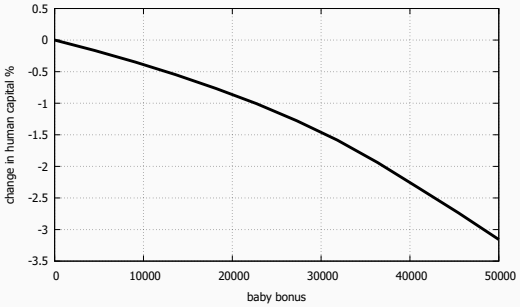
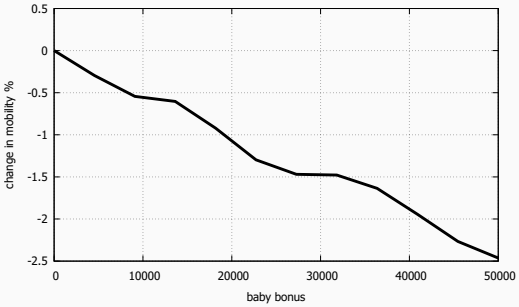


Figure 6: Intergenerational mobility



- Average human capital falls by **1.5%** with $\mathcal{B} = \$31,000$
- Intergenerational mobility **decreases by 1.6%** due to heterogeneous responses
- Results are **stronger** when baby bonus is targeted at low-income households

Output and Tax: Demographic Structure Effects

Figure 7: Per capita output

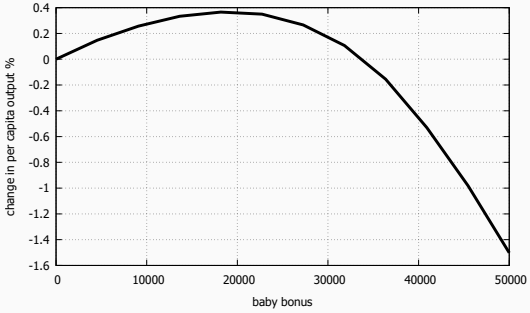
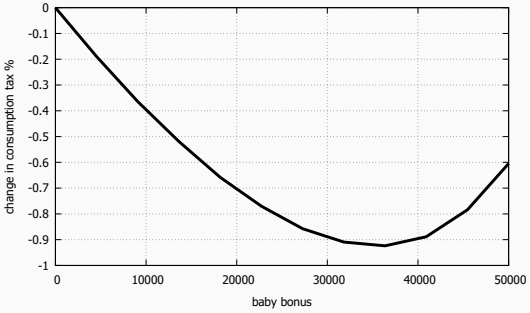


Figure 8: Change in consumption tax



- Per capita output rises initially as mass of retired households fall
- **Demographic structure effects**: government reduces consumption tax by 0.8%

Output and Tax: Demographic Structure Effects

Figure 7: Per capita output

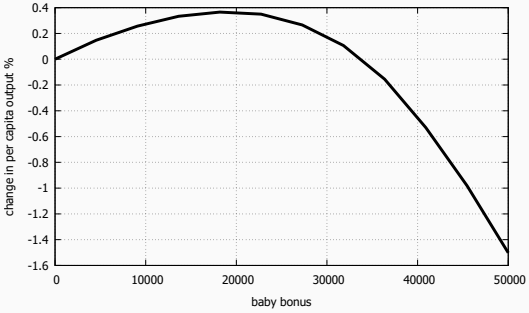
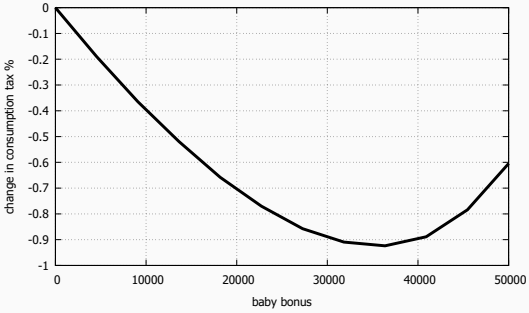


Figure 8: Change in consumption tax



- Per capita output rises initially as mass of retired households fall
- **Demographic structure effects**: government reduces consumption tax by 0.8%
- Effects reversed as baby bonus gets larger because (1) average human capital worsens, and (2) public education expenditure rises

Welfare Effects

Figure 9: Welfare-Fertility expansion path

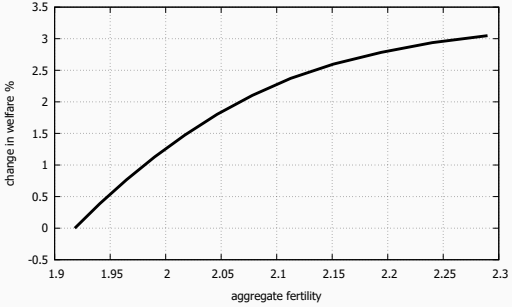
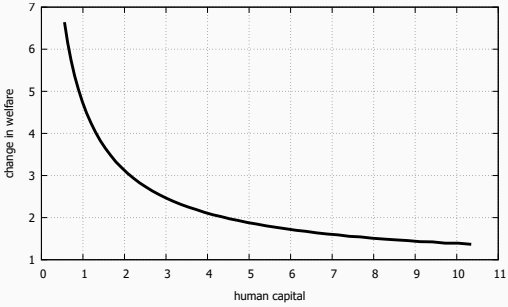


Figure 10: Change in welfare



- Long-run welfare increases by 2.2% at replacement fertility because (1) higher fertility, (2) lower taxes, and (3) “social safety net" via baby bonus
- **Progressive**: large welfare improvement for parents with low human capital

Transition Path of $\mathcal{B} = \$31,000$ - Replacement Fertility

Figure 11: Change in consumption tax

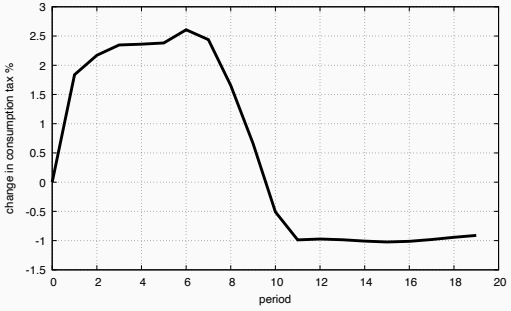
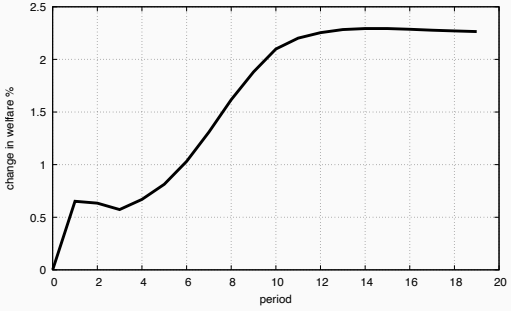


Figure 12: Change in welfare



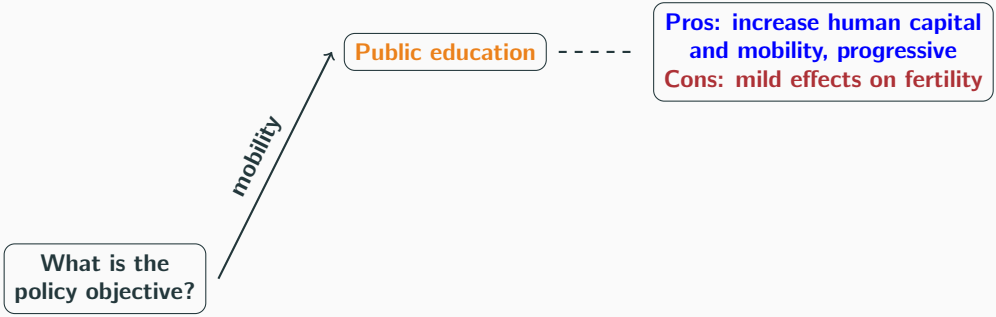
- Government needs to **raise taxes initially** to finance larger child-related expenditures including education
- Welfare effects for new-borns along the transition path are positive
- Welfare effects for most existing households are negative

Summary of Policy Comparisons

What is the policy objective?

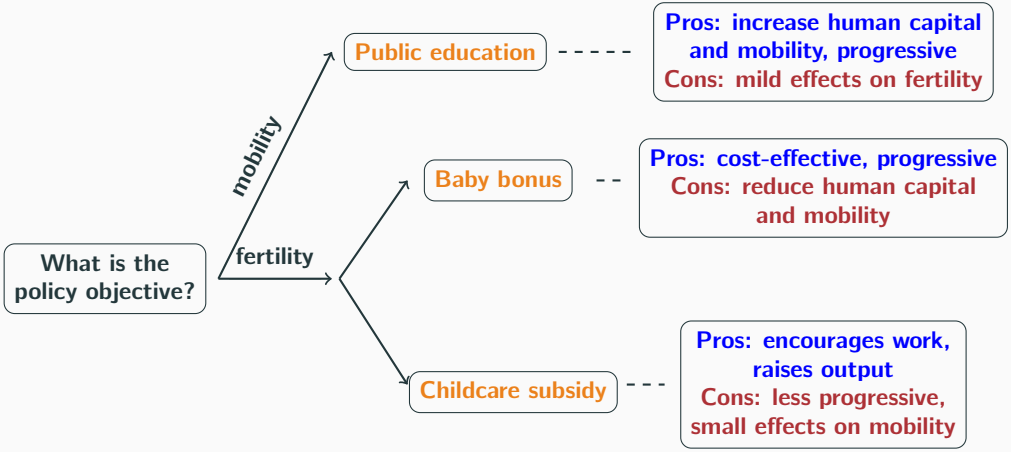
► public education ► childcare subsidy

Summary of Policy Comparisons



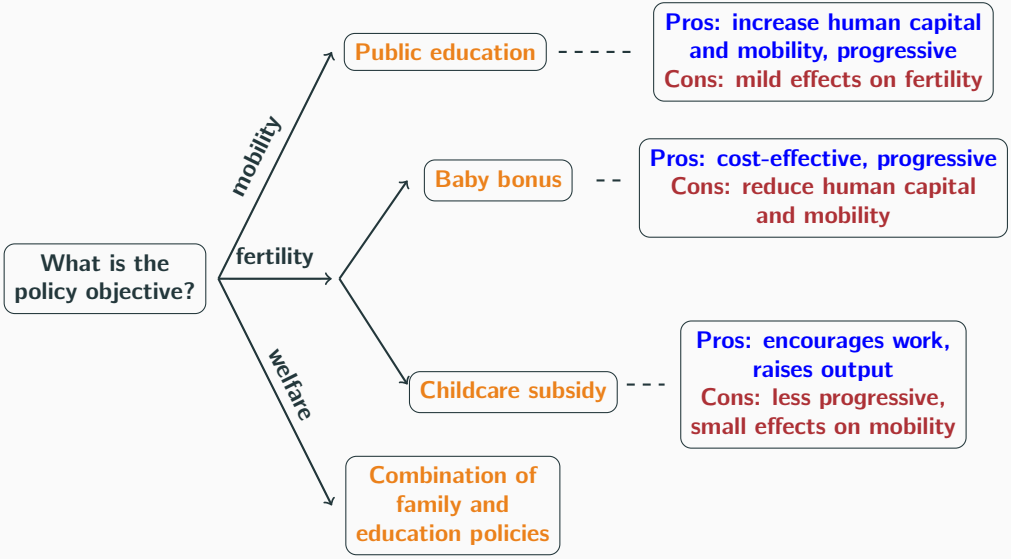
► public education ► childcare subsidy

Summary of Policy Comparisons



► public education ► childcare subsidy

Summary of Policy Comparisons



► public education ► childcare subsidy

Conclusion

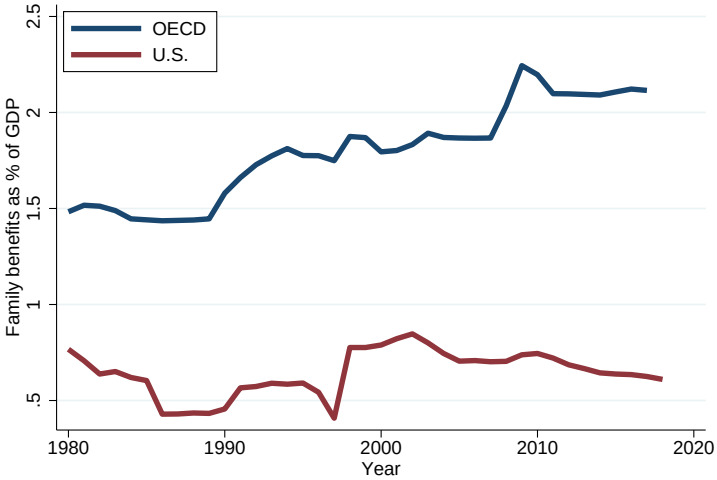
Study macroeconomic consequences of large-scale family policies

- Model **endogenous child quantity and quality** in a GE-OLG model
- Discipline **fertility elasticity** using data moments and validate using policy

Results:

1. Compared with previous studies where fertility is fixed, introducing endogenous fertility reverses policy implications on child outcome and social mobility
2. A \$31k baby bonus raises fertility to 2.1 and improves long welfare by **2.2%** with reduced taxes. Government needs to raise taxes initially in transition
3. Public education is effective in improving child outcome, social mobility and welfare despite having mild effects on fertility

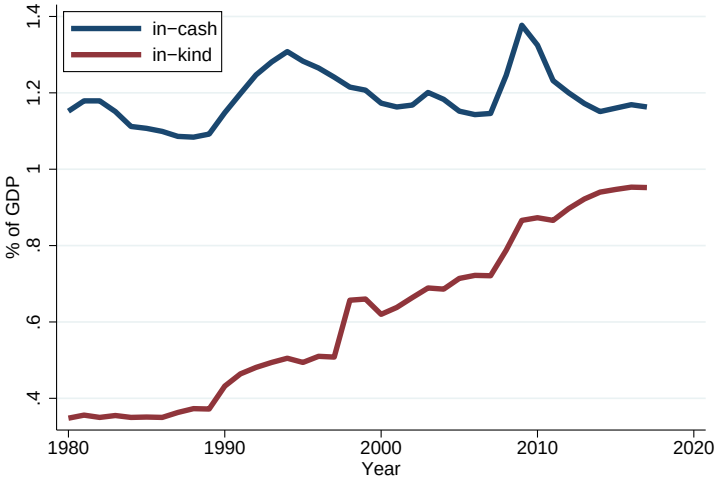
Time Trend of Public Expenditures on Child Benefits



Source: OECD database

► back to intro

Expenditure Breakdown



Source: OECD database

► back to intro

Working Without Children and Retirement

- For households working without children:

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

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

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

- For retired households:

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

$$(1+\tau_c)c + a' = (1+r-r\tau_a)a + \pi \cdot wh$$

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

where π is pension replacement rate

► back to transfer

Stationary Equilibrium

- **Distributions:**
  - Demographic structure $\{\omega_j\}_{j=0}^{8}$ and distribution of agents over states $\{\mu_j\}_{j=0}^{8}$ are invariant over time periods
  - Distribution of initial states is determined by older generations and shock processes
- **Households Optimize**: Households choose consumption, savings, fertility, childcare arrangements, child investments and inter-vivos transfers such that utility is maximized
- **Firms maximize profits**
- **Prices clear markets**
- **Government balances budget in period to period**

► back to firm and gov.

Child's Skill Production Function

- **Children's skill production function**:

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

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

- $\rho = 0.28$ - rank-rank mobility (Chetty, Hendren, Kline and Saez 2014)
- $\mathcal{E} = 0.15$ - \$12k per pupil per year (NCES)
- $\kappa = 0.17$ - **RCT evidence** from García, Heckman, Leaf and Prados (2020)

► mobiltiy fit ► RCT ► back

Child's Skill Production Function Cont'd

Use **RCT evidence** to discipline the productivity of inputs κ:

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

- **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 $\kappa = 0.17$**

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

- Elasticity of substitution: $\upsilon = 0.5$ - 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:

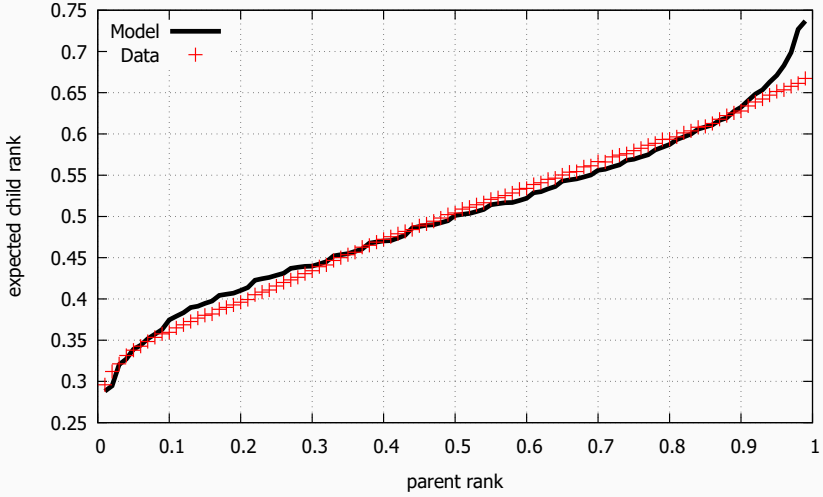
$$h_{j+1} = \exp(z)\left(h_j + \zeta(h_j t)\right)^{\eta}$$

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

- $\eta = 0.61$, $\zeta = 0.72$ - lifecycle earnings (PSID) (Huggett, Ventura and Yaron 2011)
- $\mu_z = -0.23, \sigma_z = 0.42$ - 2% skill depreciation and lifecycle Gini coefficient of earnings (Huggett, Ventura and Yaron 2011)

► back

Intergenerational Mobility: Model vs Data



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

► back

Other Parameters

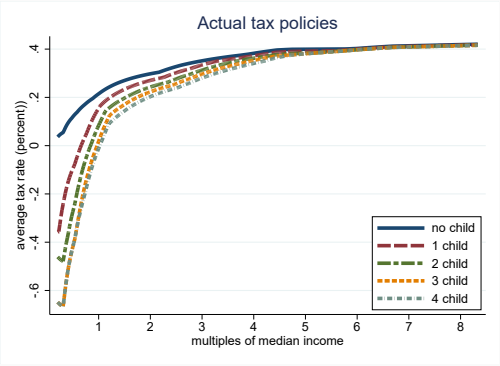
- **Firms' production function**: capital share $\alpha = 0.33$ and 4% capital depreciation
- **Government taxes**
  - **Income taxes**:

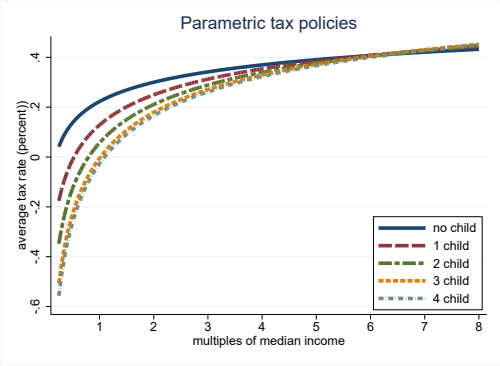
$$\mathcal{T}(y, a, n) = y \cdot (1 - \tau_y^n y^{-\lambda_y^n}) + \tau_a r a$$

    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**: $\pi = 40\%$

► back

Income Taxes: Model vs Data





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

► back

Australian Baby Bonus

- **A$3,000 baby bonus**[4] 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

[4] 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.

Australian Baby Bonus

- **A$3,000 baby bonus**[4] 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 quality/quantity trade-off

► back to validation

[4] 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**[5] to every child born on or after July 1st 2007
- González (2013) finds:
  - Total fertility rate increased by 6%
  - Mothers reduced labor supply
  - Fewer children were enrolled in formal childcare

[5] 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.

Spanish Baby Bonus

- **€$2,500 baby bonus**[5] to every child born on or after July 1st 2007
- González (2013) finds:
  - Total fertility rate increased by 6%
  - 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 → 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

[5] 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.

Georgia's Cherokee Land Lottery in 1832

- Georgia allocated more than 18,000 parcels of land via large-scale lottery in 1832. More than 98% of eligible man participated
- Shock in wealth rather than change in price of child
- Winners were about $748 wealthier than losers by 1850[6]
- Bleakley and Ferrie (2016) finds:
  - Parents increase fertility slightly
  - Decedents of winners have no better adult outcomes than the sons of nonwinners

[6] Equivalent to 1,010 days of earnings for an unskilled laborer in the South

Georgia's Cherokee Land Lottery in 1832

- Georgia allocated more than 18,000 parcels of land via large-scale lottery in 1832. More than 98% of eligible man participated
- Shock in wealth rather than change in price of child
- Winners were about \$748 wealthier than losers by 1850[6]
- Bleakley and Ferrie (2016) finds:
  - Parents increase fertility slightly
  - Decedents of winners have no better adult outcomes than the sons of nonwinners
- As skill price increases, Cherokee results provides:
  1. Upper bound for fertility responses
  2. Lower bound for child quality responses
- Model predictions consistent with these predictions:

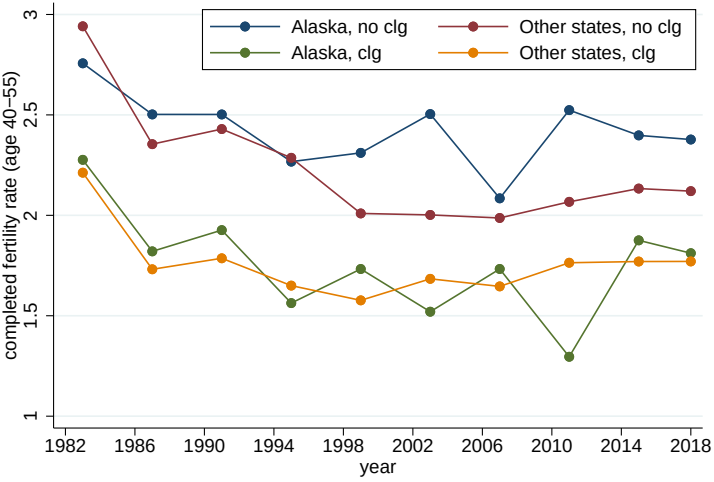
$$n^*(h, a) \leq n^*(h, a) \quad e^*(h, a') \gg e^*(h, a)$$

for fixed h and $a' > a$

► back to validation

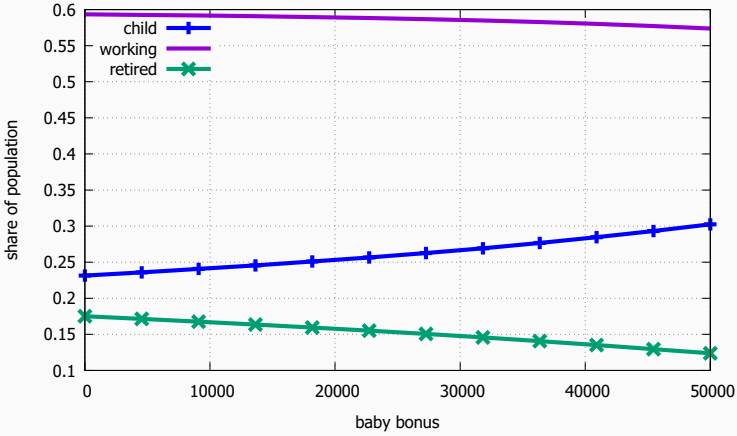
[6] Equivalent to 1,010 days of earnings for an unskilled laborer in the South

Evidence from Completed Fertility Rates



► back to validation

Change in Demographic Structure



► back to results

Highlights for Subsidized Childcare $\mathcal{S}$

Figure 13: Fertility

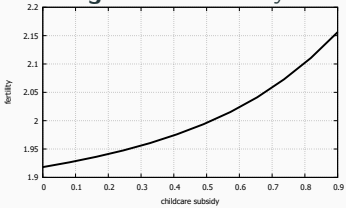


Figure 14: $\Delta\overline{h}$

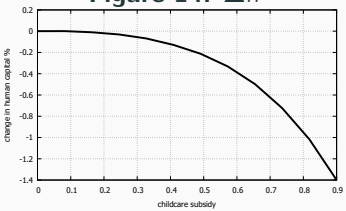


Figure 15: Per capita output

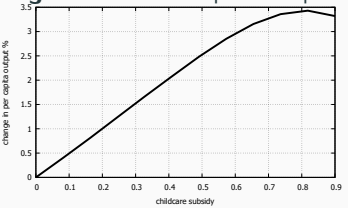


Figure 16: $\Delta\tau_c$

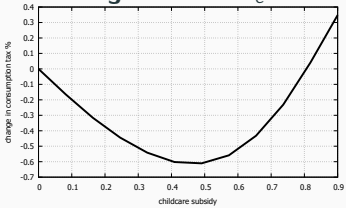


Figure 17: Mobility

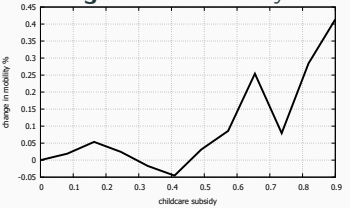
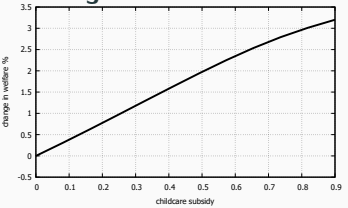


Figure 18: Welfare



- Need **80%** refund to reach 2.1 fertility, **50%** less cost-effective than baby bonus
- Impacts of subsidized childcare are qualitatively similar to baby bonus except that **it encourages work** (Guner, Kaygusuz and Ventura 2020) and **mobility effect is small**
- **Less progressive** because subsidy amount depends on childcare expenditures

► back

Highlights for Public Education Expansion $\mathcal{E}$

Figure 19: Fertility

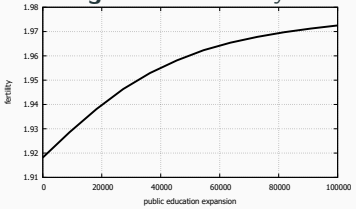


Figure 20: $\Delta\overline{h}$

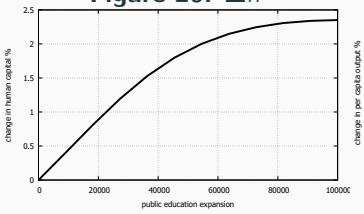


Figure 21: Per capita output

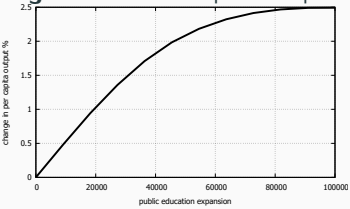


Figure 22: $\Delta\tau_c$

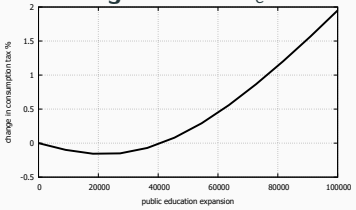


Figure 23: Mobility

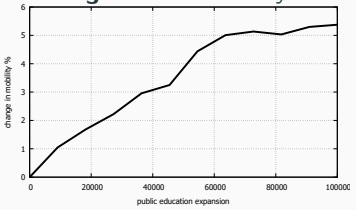
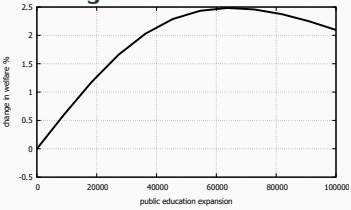


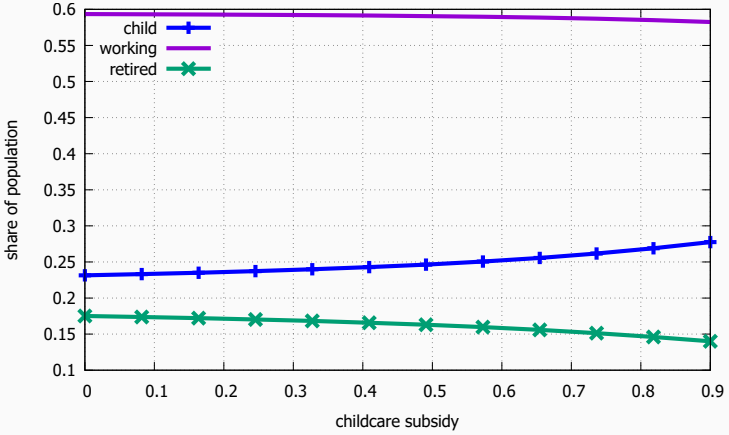
Figure 24: Welfare



- **Mildest fertility effects** (0.03 boost vs 0.2 boost using \$30k baby bonus)
- **Most effective in improving mobility** (5% increase using \$60k)
- **Progressive** policy with large welfare improvement for low-income households

► back

Change in Demographic Structure



Change in Demographic Structure