Financial Costs of Children, Education Subsidies, and Parental Choices in Equilibrium

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1. Introduction
2. Model
3. Calibration
4. Numerical Analysis
5. Concluding Remarks
6. Appendix

Low Fertility, Demographic Aging, and Policy Interventions

- Low fertility and demographic aging drive the pro-natal policies in many countries.
    - Typical measures: cash benefits, childcare services, tax deduction, etc.
- In Japan, increasing grants for college students has garnered much attention.
    - Expected to increase fertility as education costs are a key obstacle (e.g., Gauthier, 2016).
    - To enhance the workers' productivity to deal with labor force shortage.

What are the macroeconomic consequences?

Does it work as expected? What are the consequences? – Unclear as:

- Education (Macro) literature abstracts fertility choices.
- Macro models with fertility choices abstract college enrollment and IVT choices.

$\Rightarrow$ Need for a macro model with fertility, college enrollment, and IVT choices.

This Paper

- Constructs an incomplete market GE-OLG model incorporating:
  - College enrollment choices,
  - Inter-vivo transfers (IVT),
  - Fertility choices.
- Calibrates the model to the Japanese economy using panel data.
  - The Japanese Panel Survey of Consumers (JPSC).
- Validates if the model implies reasonable fertility behavior.
  - The benefit elasticity of fertility (comparison with empirical works).
  - Fertility differential across education groups.
- Examines the macroeconomic effects of education subsidies for college students.
  - Existing program and its expansion.
  - Several types of the subsidies.

Literature and Contribution

(1) Education subsidies for college students in macro models:

Benabou (2002, Ecta), Krueger and Ludwig (2016, JME), Abbott et al. (2019, JPE), Matsuda and Mazur (2022, JME), etc.

- This paper: + Fertility choices
- Fertility margins amplify the effects on other macro variables.

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(2) Macro effects of pro-natal policies:

Erosa et al. (2010, RED), Hagiwara (2021), Zhou (2022), Kim et al. (2023), Nakakuni (2023), etc.

- This paper: + Education choice (its discreteness matters to fertility choices),
- and investigates effects of education subsidies for college students on fertility.

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(3) Macro models with fertility choices:

De la Croix and Doepke (2003, AER), De la Croix and Doepke (2004, JPubE), Daruich and Kozlowski (2020, RED), etc.

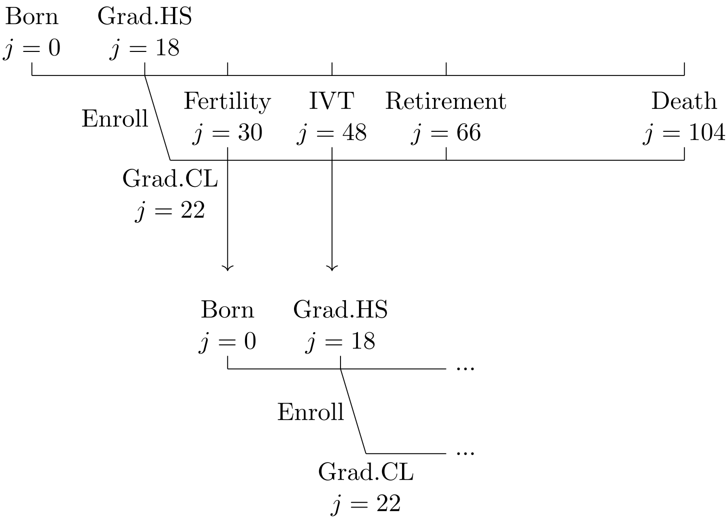
- This paper: + Full lifecycle + GE + uninsurable shocks + intergenerational linkages,
- all crucial to study the effects of education subsidies for college students.

Model

Model with fertility choices otherwise standard in Macro literature on education subsidies.
Krueger and Ludwig (2016, JME), Abbott et al. (2019, JPE), Matsuda and Mazur (2022, JME), etc.

- Incomplete market GE-OLG framework.
- Standard lifecycle $\underbrace{+\text{ Education} + \text{IVT}}_{\text{Literature standard}}$ + Fertility

Timeline


Born
$j = 0$
Grad.HS
$j = 18$
Enroll
Fertility
$j = 30$
IVT
$j = 48$
Retirement
$j = 66$
Death
$j = 104$
Grad.CL
$j = 22$
Born
$j = 0$
Grad.HS
$j = 18$
...
Enroll
...
Grad.CL
$j = 22$

Preliminaries

- Technology
- Demographics
- Preferences
- Labor income
- Financial markets
- Government

Production Technology

A representative firm operates with the Cobb-Douglus production function:

$$Y = ZK^{\alpha}L^{1-\alpha},$$

where

$$L = \left[\omega_{HS} \cdot (L_{HS})^{\chi} + \omega_{CL} \cdot (L_{CL})^{\chi}\right]^{1/\chi}.$$

- L_e: total efficiency labor with skill $e \in \{HS, CL\}$.

Demographics

- The size of new cohort grows at rate g_n.
  - g_n is determined enodgenously.
- Mortality risks after retirement.
  - $\zeta_{j,j+1}$: Survival probability at age $j+1$ conditional on surviving until age j.
- g_n and $\{\zeta_{j,j+1}\}_{j \geq J_R}$ pin down the age distribution μ_j.

Preferences

- Households draw utility from consumption c and leisure l according to $u(c, l)$.
- If they have children under 18 (before completing HS), they further draw utility from the "quantity and quality" of children according to $b(n) \cdot v(q)$:
  - n: the number of children.
  - $b(n)$: increasing in $n \in \{0, 1, ..., N\}$ and concave.
    i.e., marginal utility gains from having additional child diminishes as n increases.
  - q: investments on children's quality.
    - Caveat: the investment does not affect children's human capital.

Preference: IVT

Utility from the IVT for households with n children is given as follows:

$$\underbrace{b(n) \cdot \lambda_a}_{\text{Discounting}} \cdot \underbrace{V_{g0}(a_{CL}, \phi_k, h_k, I)}_{\text{Value function for children}} .$$

Labor income

- Gross labor income is determined by:
  1. equilibrium wage rates w_e varying with skill (education levels) e,
  2. productivity $\eta_{j,z,e,h}$,
  3. hours worked.

- The productivity $\eta_{j,z,e,h}$ depends on:
  1. age j,
  2. skill e,
  3. human capital h,
  4. a stochastic component $z \sim \pi(z' \mid z)$.

Financial Markets

- Incomplete market: households can trade only claims for risk-free bonds.
- Households face debt limits that vary over the life-cycle:
  - young households ($j < J_F$) and retired ones ($j > J_R$) cannot borrow,
  - (1) college students and (2) households aged $j \in \{J_F, ..., J_R - 1\}$ may borrow.
    - Interest rates for (eligible) students: $r^s = r + \iota_s$.
    - Interest rates for households aged $j \in \{J_F, ..., J_R - 1\}$: $r^- = (r + \iota) > r^s$.

Government: revenue

- Consumption tax: τ_c
- Capital income tax: τ_a
- Labor income tax: τ_w
- Accidental bequests: Q

Government: expenditures

- Public pension: p per household
- Cash benefits for households with children under 18: B per child
- Lump-sum transfers ψ to generate the progressivity for τ_w.
- Education subsidies/loans for college students.
- The other expenditures: G

Financial aid for college students

Grants $g(h, I)$:

- Eligibility and payments can depend on:
  1. student' human capital (a proxy of "ability"),
  2. household income (I).
- No grants in the benchmark.

Loans:

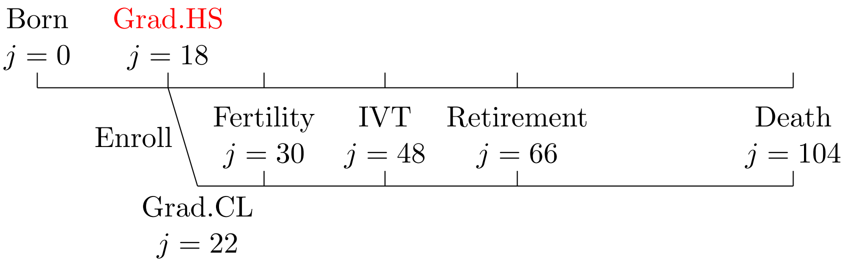
- Eligible students can access to the subsidized loans with interest rate $r^s \leq r^-$.
- Eligibility is determined by (h, I).
- Government incurs the costs implied by the wedge b/w r^- and r^s.

Government Budget Constraint

$$\tau_c \cdot C + \tau_w \cdot (L_l + L_h) + \tau_a \cdot K + Q = p \cdot \mu_{old} + (\iota - \iota_s) \cdot K_s + g(h, I) \cdot \mu_{es} + \psi + B \cdot \mu_{j \leq 18} + G, \quad (1)$$

- C: total consumption,
- Q: total accidental bequests,
- μ_{old}: population mass of retired households,
- $\mu_{j \leq 18}$: population mass of children under age 18,
- K_s: total amount of borrowing by college students,
- μ_{es}: mass of students eligible for the grants.

Education choices



Education stage

- When an individual graduates high school, he/she chooses whether to go to college.
  - If they proceed to college education, it takes 4 years to complete.
  - If they do not, they enter the labor market as high school graduates.

- Three factors influence their college enrollment decisions:
  1. IVTs made by their parents (a_{CL}).
  2. Psychic costs of education ($\phi \sim g^{\phi}_{h,e_p}$).
  3. Their human capital ($h \sim g^{h}_{h_p}$).

Budget constraints: college students

Expenditures:

- Tuition fees p_{CL} (exogenous)
- Living expenses c (endogenous/choice)

Revenue:

- Transfers from their parents a_{CL} (parent's choice).
- Labor earnings by themselves (endogenous/choice).
  - Can supply at most $1 - \bar{t}$ fraction of time, $\bar{t}$ is the fraction to be spent on studying.
- Loans/Grants provided by the government (depending on h and I):

Education choices

$$V_{g0}(a_{CL}, \phi, h, I) = \max_{e \in \{0,1\}} \Big\{ (1-e) \cdot \mathbb{E}_{z_0}[V^w(a_{CL}, j = 18, z_0; e = 0, h)] + e \cdot [V_{g1}(a_{CL}; h, I) - \phi] \Big\}, \tag{2}$$

where $e = 1$ represents enrolling in college.

Value functions for college students

$$
\begin{aligned}
V_{g1}(a_{CL}; h, I) &= \max_{c,l,a'} \{u(c,l) + \beta V_{g2}(a'; h, I)\}, \\
V_{g2}(a; h, I) &= \max_{c,l,a'} \{u(c,l) + \beta \mathbb{E}_{z_0}[V^w(a^s(a'), j = 22, z_0; e = 1, h)]\}.
\end{aligned}
$$

Budget constraints for college students

$$a^s(a') = a' \times \frac{r^s}{1-(1+r^s)^{-10}} \times \frac{1-(1+r^-)^{-10}}{r^-}.$$

Eligible to loans:

$$(1+\tau_c)c + p_{CL} + a' \tag{3}$$

$$-(1-\tau_w)w_{HS}(1-\bar{t}-l) - \psi - g(h,I) = \begin{cases} (1+(1-\tau_a)r)a & \text{if } \ a \geq 0, \\ (1+r^s)a & \text{otherwise.} \end{cases} \tag{4}$$

$$a' \geq -\underline{A}_s.$$

The rest:

$$(1+\tau_c)c + p_{CL} + a' = (1+(1-\tau_a)r)a + (1-\tau_w)w_{HS}(1-\bar{t}-l) + \psi,$$
$$a' \geq 0.$$

Working stage without children

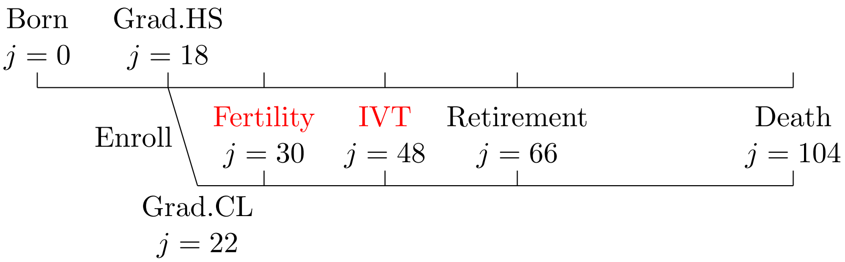
$$V^w(a,j,z;e,h) = \max_{c,l,a'}\{u(c,l) + \beta\mathbb{E}[V^w(a',j+1,z';e,h)]\}$$

s.t.

$$(1+\tau_c)c + a' = (1-\tau_w)w_e\eta_{j,z,e,h}(1-l) + \psi + (1+(1-\tau_a)r)a,$$

$$z' \sim \pi(z',z),\ a' \geq 0.$$

Fertility and IVT choices



Fertility choices and working stage with children I

The value function at age $j = J_f$:

$$V^f(a,z,e,h) = \max_{n\in\{0,1,..,N\}} \left\{ V^{wf}(a, j = J_F, z; e, h, n) \right\}$$

where

$$V^{fw}(a,j,z;e,h,n) = \max_{c,l,q,a'} \{u(c/\Lambda(n),l) + b(n)\cdot v(q)$$
$$+ \left\{ \begin{array}{ll} \beta \mathbb{E}_{z'|z}[V^{wf}(a', j+1, z'; e, h, n)] & \text{if } j \in \{J_f+1, ..., J_{IVT}-2\} \\ \beta \mathbb{E}_{z'|z,\phi_k|e,h_k|h}[V^{IVT}] & \text{if } j = J_{IVT}-1 \end{array} \right\},$$

$$(1+\tau_c)c + a' = \begin{cases} Y_{fw} - (1+\tau_c)nq & \text{if } j \in \{J_f+1, ..., J_{IVT}-1\}, \\ Y_{IVT} - na_{CL} & \text{if } j = J_{IVT}, \end{cases} \tag{5}$$

Fertility choices and working stage with children II

where

$$\begin{aligned} Y_{wf} &= (1-\tau_w) w_e \eta_{j,z,e,h}(1-l-\kappa) \\ &\qquad\qquad + n \cdot B + \psi + \begin{cases} (1+(1-\tau_a)r)a & \text{if} \quad a \geq 0, \\ (1+r^-)a & \text{otherwise.} \end{cases} \\ a' &\geq -\underline{A}, \end{aligned}$$

and

$$\begin{aligned} Y_{IVT} &= (1-\tau_w) w_e \eta_{j,z,e,h}(1-l) + \psi + (1+(1-\tau_a)r)a, \\ a' &\geq 0. \end{aligned}$$

Inter-vivo transfers

$$V^{IVT}(a, z; \phi_k, h_k, e, h, n) = \max_{c,l,a',a_{CL}} \Big\{ V^w(a - \tilde{a}_{CL}, J_{IVT}, z; e, h) + b(n) \cdot \lambda_a \cdot V_{g0}(a_{CL}, \phi_k, h_k, I) \Big\},$$

where $\tilde{a}_{CL} = \frac{n \cdot a_{CL}}{1+(1-\tau_a)r}$ and $I = I(J_{IVT}, z, e, h)$.

- Children's policy function for education and parents' one for IVT determined simultaneously.

Retirement stage

$$V^r(a, j; e) = \max_{c,a'} u(c, 1) + \beta\xi_{j,j+1}V^r(a', j+1; e)$$

$$\text{s.t.}$$

$$(1+\tau_c)c + a' = p + (1 + (1-\tau_a)r)a + \psi,$$

$$a' \geq 0 \ (a' = 0 \text{ when } j = J).$$

Data

The Japanese Panel Survey of Consumers (JPSC)

- Panel survey of women and their household members.
- Starts in 1993 with 1,500 women aged 24-34.

Sample selection:

- Birth cohort: 1959-69
- Married (1993-2020)

Preferences

Instantaneous utility for students and adults:

$$u(c,l) = \frac{(c^{\mu} l^{1-\mu})^{1-\gamma}}{1-\gamma}$$

Instantaneous utility from quantity and quality of children:

$$v(q) = \lambda_q \frac{q^{1-\gamma_q}}{1-\gamma_q}$$

The discount function takes a non-parametric form (i.e., $b(n) = b_n$ and $b(0) = 0$).

Financial markets

Targets for

- ι: share of negative net worth,
- ι_s: share of students borrowing

Borrowing limits are set outside the model:

- $\underline{A}_s$: 2.88 million yen.
- $\underline{A}$: 20 million yen.

School taste

- Psychic costs ϕ are given as $\phi = \psi_{CL} \cdot \exp(-h) \cdot \tilde{\phi}$.
  - ψ_{CL} governs the college enrollment rate at the initial steady state.
  - $\tilde{\phi}$ is distributed on $[0, 1]$.
- As in Daruich and Kozlowski (2020), the CDF for $\tilde{\phi}$ is given as

$$G_{e^p}^{\tilde{\phi}} = \begin{cases} \tilde{\phi}^{\omega} & \text{if } e^p = 0 \\ 1 - (1 - \tilde{\phi})^{\omega} & \text{if } e^p = 1 \end{cases}$$

- Target for ψ_{CL}: the college enrollment rate (37.7%).
- Target for ω: intergenerational transition matrix of education.

Education Mobility

Parents/Children	HS	CL
HS	0.725 (0.798)	0.275 (0.202)
CL	0.412 (0.423)	0.588 (0.577)

Table: Intergenerational transition matrix of education.

Intergenerational transmission of human capital

- The initial draw of human capital:

$$\log(h) = \rho_h \log(h_p) + \varepsilon_h,$$
$$\varepsilon_h \sim N(0, \sigma_h).$$

- $\rho_h = 0.19$ following Daruich and Kozlowski (2020).
- Target for σ_h: Variance of log(income) at age 28-29.

Income Process

- Labor productivity $\eta_{j,z,e,h}$:

$$\begin{aligned} \log \eta_{j,z,e,h} &= \log f^e(h) + \gamma_{j,e} + z \\ z' &= \rho_z z + \zeta, \quad \zeta \sim N(0, \sigma_z). \end{aligned}$$

- $\gamma_{j,e}$: estimate the second-order polynomial of hourly wages on age.

Education returns

- Consider the following human-capital production function of the non-linear form:

$$f^e(h) = h + e \cdot (\alpha_{CL} h^{\beta_{CL}})$$

- Target for α_{CL}: Log(wage) ratio (CL$-$ $\leq$CL) at age 28-29 (0.34).
- Target for β_{CL}: Variance of log(wage) for college grad. workers (0.14).

Production

- $\chi = 0.39$ following Matsuda and Mazur (2022).
- $\omega_h = 0.52$: to replicate the wage ratio between CL and the rest.
- $Z = 1.99$: s.t. low skill wage $= 1$.
- $\alpha = 0.33$.
- $\delta = 0.07$ (annual).

Externally determined

Parameter	Value	Description
$\underline{A}_s$	2.88 million yen	Borrowing limit for students
$\underline{A}$	20 million yen	Borrowing limit
p_{CL}	1.05 million yen/year	Tuition fees
κ	0.044	Time costs
$\xi_{j,j+1}$	–	survival prob.
τ_c	0.10	Consumption tax
τ_a	0.35	Capital income tax
τ_w	0.35	Labor income tax
p	$¥160,000/\text{month}$	Pension benefits
b	$¥10,000/\text{month}$	Cash transfers
α	0.33	Capital share
δ	0.07	Depreciation rate
χ	0.39	Elasticity of substitution
ρ_z	0.95	Persistence
σ_z	0.02	Transitory
γ	0.5	Curvature
β	0.98	Discount factor
ρ_h	0.19	Transmission of h

Internally determined

Parameter	Value	Moment	Data	Model
μ	0.23	Work hours	0.33	0.30
$\bar{t}$	0.8	Income share of labor earnings	0.20	0.17
ι_s	0.055	Share of students using loans	0.44	0.34
ι	0.054	Household share with negative net worth	0.54	0.45
ω_h	0.52	CL−HS wage ratio	1.36	1.48
ψ	0.01	Var(log disposable income)/Var(log gross income)	0.60	0.68
λ_q	0.62	Average transfer / Average income at age 28	0.07	0.07
λ_a	1.03	Average transfer / Average income at age 28	0.27	0.27
ω	1.71	Intergenerational mobility of education	–	–
σ_h	0.65	Variance of log(income) at age 28	0.27	0.24
ψ_{CL}	20.8	College enrollment rate	0.377	0.376
α_{CL}	0.1	Log wage ratio (CL−HS) at age 28	0.34	0.38
β_{CL}	0.1	Var log wage for CL at age 28	0.14	0.24
b_1	0.49	Share of one child	0.16	0.15
b_2	0.53	Share of two children	0.55	0.61
b_3	0.55	Share of three children	0.22	0.24
b_4	0.56	Share of four or more children	0.02	0.00
Z	1.99	Low skill wage	1.0	1.0

Wage age-profile

	College graduates	The rest
Age	0.048	0.041
$\text{Age}^2 \times 10,000$	-5.364	-4.551

Table: Wage age-profile

Non-targeted Moments

- Fertility differential across education.
- The benefit elasticity of fertility.

Fertility differential across education

More (less) educated parents have fewer (more) children, robust to cohorts/data.

	Data
HS	2.12
CL	1.92

Table: Fertility differential across education in the benchmark.

Fertility differential across education

More (less) educated parents have fewer (more) children, robust to cohorts/data.

	Data	Model
HS	2.12	2.28
CL	1.92	1.79

Table: Fertility differential across education in the benchmark.

Validation: Fertility elasticity

- The most relevant moment: the subsidy elasticity of fertility (non-targeted).
  - Few empirical evidence.
- Second best: validation based on the benefit elasticity of fertility.
  - 1% of cash benefits for children increases fertility rates by $0.1 - 0.2\%$.
    e.g.) Milligan (2005), Cohen et al. (2013), etc.
- The benchmark model implies the elasticity of $0.13 \in [0.1, 0.2]$.

▸ Procedure

Road Map

1. Examining the effects of introducing grants.
2. Inspecting the mechanism:
   - Behavioral and distributional effects
   - Roles of endogenous fertility
3. Expanding the income threshold for eligibility.

Introducing Subsidies: What I Do

Introduce subsidies for college students in low-income households.

- **Threshold** $\simeq$ the bottom 15% of income dist. over HHs with college students.
- (**Tuition fee exemption + Grants**) $\simeq$ 2/3 of the students' average expenses.
- Budget balance by adjusting the labor income tax rate.

Results: Education and Fertility

Education:

- College enrollment rate: 4 p.p. $\uparrow$
- Educational mobility (HS$\rightarrow$CL): 2.5 p.p. $\uparrow$
- Skill premium (w_{CL}/w_{HS}): 0.02 points $\downarrow$

Fertility:

- TFR: 3% $\uparrow$
- Largely driven by fertility increases among college graduates.

Introducing Subsidies: Aggregate Quantity

- Efficiency labor (per-capita): 1.3% $\uparrow$
  - Higher CL share $\Rightarrow$ Larger share of skilled workers.
  - Higher TFR $\Rightarrow$ Larger working-age population share.
- Capital (per-capita): 1.8% $\downarrow$
  - Reduce saving incentives/Crowd out IVTs.
  - Higher TFR $\Rightarrow$ Larger share of younger generations, who hold fewer assets.
- Output (per-capita): 0.7% $\uparrow$
  - Positive effects (on labor force/productivity) $>$ Negative ones (on physical capital).

Inspecting the mechanism

Changes in the TFR and college enrollment can be driven by changes in several factors:

1. Grant function $g(h, I)$
2. Prices (in particular, w_{CL}/w_{HS})
3. Tax rate τ_l
4. Distribution:
    - Skill distribution (i.e., college graduates share)

Decomposition

Decompose the long-run effects into the following four effects:

1. **Direct effects** driven by changes only in $g(h, I)$
2. **GE (Price) effects** driven by changes only in prices.
3. **Taxation effects** driven by changes only in the tax rate τ_l.
4. **Distributional effects** driven by changes only in the distributions.

Decomposition: Education

	Bench.	Direct	Prices	Tax	Dist.	All
CL share	37.6	40.2	37.6	37.6	39.5	41.5

Table: Decomposing the effects on education.

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- Direct $\Rightarrow$ The subsidy relaxes the financial constraint (short/long run).

Decomposition: Education

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Table: Decomposing the effects on education.

- Direct $\Rightarrow$ The subsidy relaxes the financial constraint (short/long run).
- Dist. $\Rightarrow$ The effects are amplified in the long run via IG linkages.
  CL share among parents $\uparrow$ $\Rightarrow$ share of children favoring college $\uparrow$ $\Rightarrow$ CL share $\uparrow$

Decomposition: Education

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- Direct $\Rightarrow$ The subsidy relaxes the financial constraint (short/long run).
- Dist. $\Rightarrow$ The effects are amplified in the long run via IG linkages.
  CL share among parents $\uparrow \Rightarrow$ share of children favoring college $\uparrow \Rightarrow$ CL share $\uparrow$
- Fertility margins also play roles:
  College graduates have more children, who are likely to be college graduates.

Exogenous Fertility

Decomposition: Fertility

	Bench.	Direct	Prices	Tax	Dist.	All
TFR	2.096	2.128	2.113	2.096	2.088	2.160
HS	2.282	2.304	2.283	2.283	2.280	2.290
CL	1.786	1.867	1.830	1.787	1.794	1.978

Table: Decomposing the effects on fertility.

Decomposition: Fertility

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Table: Decomposing the effects on fertility.

- Note: HHs do not know whether they will be eligible when making fertility choices.
  - Source of uncertainty: productivity shocks and children's characteristics (ϕ_k and h_k).
- Direct: Reduce the expected costs of children or provide insurance expenditure risks.
  - Some HHs who are (ex-post) not eligible increase fertility.

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- Direct: Reduce the expected costs of children or provide insurance expenditure risks.
  - Some HHs who are (ex-post) not eligible increase fertility.
- Prices: CL share $\uparrow \Rightarrow w_{CL} \downarrow \Rightarrow$ Opportunity costs $\downarrow \Rightarrow$ Fertility $\uparrow$

Mechanism: Recap

The income-tested grants increase the fertility of college graduates by:

- reducing the expected costs of children or providing insurance (Direct effects)
- reducing the opportunity costs of skilled parents (GE effects)

The subsidy promote enrolling in college and the effects are strengthened by:

- increasing the share of skilled parents (Distributional effects)
- Fertility margins also play roles.
  College graduates have more children, who are likely to be college graduates.

Expansion: What I Do

Raise the income threshold for grants eligibility to cover students in middle income HHs.

- **Threshold** $\simeq$ the bottom $x\%$ of income dist. over HHs with college students.

Expansion: Results

		Threshold			
	Bench.	15%	40%	50%	60%
CL share	37.6	41.5	42.3	43.2	43.8
TFR	2.096	2.160	2.158	2.151	2.157
Output (Δ%)	–	+0.70	+0.15	+1.07	+1.53
Tax	35.00	35.04	35.17	35.23	35.30

Table: Main results of higher income thresholds.

- CL share increases with the expansion.
- TFR would stagnate.

Expansion: Fertility

	Bench.	Threshold 15%	Threshold 40%	Threshold 50%	Threshold 60%
TFR	2.096	2.160	2.158	2.151	2.157
HS	2.282	2.290	2.277	2.267	2.263
CL	1.786	1.978	1.996	1.998	2.021

Table: Fertility by different educational background.

- College graduates' fertility rates continue to increase.
- High school graduates' fertility rates rather decrease.

Fertility Decomposition: Case of Threshold = 60%

	Bench.	Direct	Prices	Tax	Dist.	All
HS	2.282	2.265	2.250	2.283	2.279	2.263
CL	1.786	1.948	1.863	1.829	1.797	2.021

Table: Decomposing the effects on fertility when income threshold = 60%.

Fertility Decomposition: Case of Threshold = 60%

	Bench.	Direct	Prices	Tax	Dist.	All
HS	2.282	2.265	2.250	2.283	2.279	2.263
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Table: Decomposing the effects on fertility when income threshold = 60%.

- Higher education mobility ⇒ Higher expected costs of children ⇒ Fertility ↓

Fertility Decomposition: Case of Threshold = 60%

	Bench.	Direct	Prices	Tax	Dist.	All
HS	2.282	2.265	2.250	2.283	2.279	2.263
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Table: Decomposing the effects on fertility when income threshold = 60%.

- Higher education mobility $\Rightarrow$ Higher expected costs of children $\Rightarrow$ Fertility $\downarrow$
- CL share $\uparrow \Rightarrow w_{HS} \uparrow \Rightarrow$ Opportunity costs $\uparrow \Rightarrow$ Fertility $\downarrow$

Main Findings

- The existing (need-base) grants $\Rightarrow$ CL share 4 p.p. $\uparrow$, TFR 3% $\uparrow$, output 0.7% $\uparrow$.
  - Fertility of skilled parents $\uparrow$ via insurance and GE effects.
  - Fertility margins amplify the effects on CL share and output in the long run.
- Marginal effects of its expansion on the TFR are limited:
  - Expected costs of children $\uparrow$ due to higher enrollment rates & education mobility.
    $\Rightarrow$ downward pressure on the low skill parents' fertility.

1. Introduction
2. Model
3. Calibration
4. Numerical Analysis
5. Concluding Remarks
6. Appendix

Why is a “plan” lower than “ideal”?

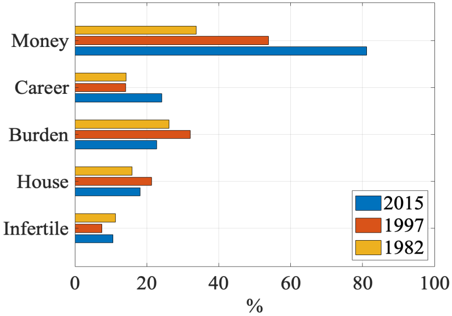
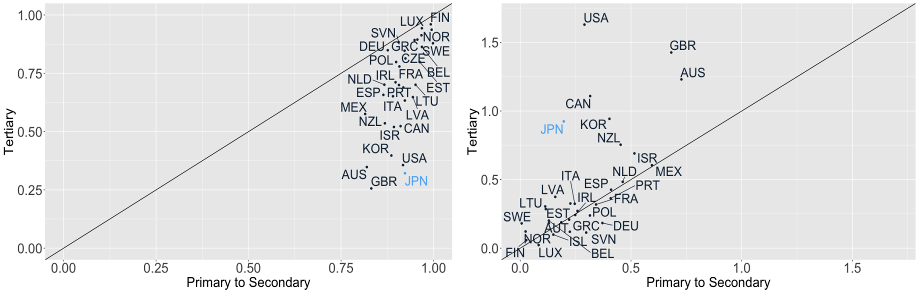


Figure: Reasons why the planned number of children is lower than the ideal one. The sample consists of wives aged 30-34, whose planned number of children is lower than the ideal number. They can choose more than one reason.

Source: The National Fertility Survey (2015). Go Back

Education expenditures and subsidization rates

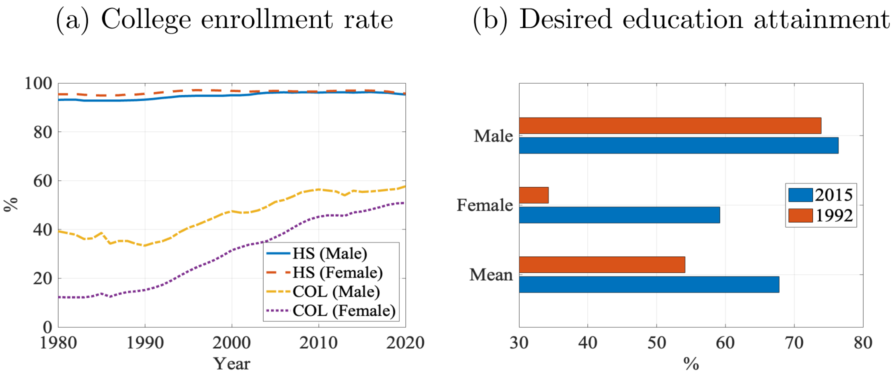
(a) Subsidization rate (b) Private expenditure



Figure

Source: OECD data (2018). Go Back

College attainment rates and parental preferences



Figure

Source: Basic School Survey and the NFS. ▸ Go Back

Fertility-income

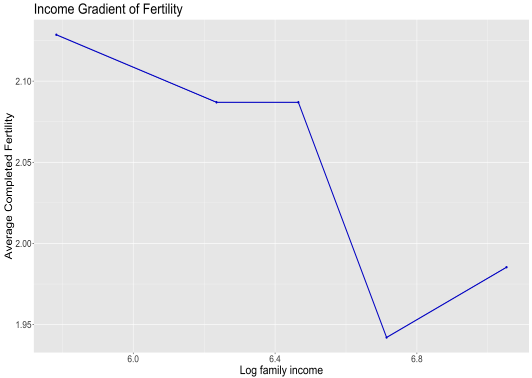


Figure: Completed fertility by income quintile. (JPSC)

Go Back

Education spending-income

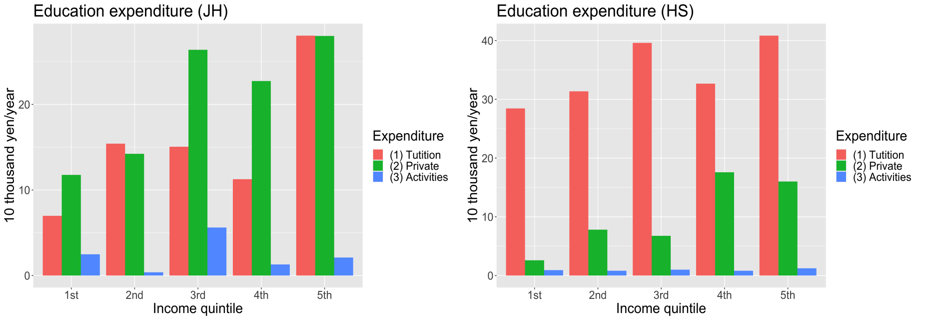


Figure: Education spending by income quintile. (JPSC)

Go Back

Validation: Fertility elasticity

- Set the per-child payment $B = B_0 \cdot X$ where $X \in \{1.1, 1.2, ..., 3.0\}$.
- Solve the household decisions with particular X and compute the TFR.
- Compute the implied elasticity for each X, denoted by ξ_X.
- After having $\{\xi_X\}_X$, compute the average elasticity $\bar{\xi}_X$.

Go Back

Roles of endogenous fertility

- Solve the equilibrium with each program under exogenous fertility.
- Policy functions for fertility are fixed as in the benchmark.

Exogenous fertility

Moments/Threshold	15%	40%	50%	60%
CL share	41.0 (41.5)	41.5 (42.3)	42.3 (43.2)	42.8 (43.8)
Output (Δ%)	0.65 (0.70)	0.55 (0.15)	0.85 (1.07)	1.23 (1.53)
Tax	35.14 (35.04)	35.36 (35.17)	35.37 (35.23)	35.40 (35.30)

Table: Main results of higher income thresholds. *Note*: The values in parenthesis in the first column indicate the benchmark results. Rows where the first column has (Δ%) indicate the %-changes compared to the benchmark. Values in parentheses in each cell represent the result under endogenous fertility

Go Back