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

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2. Model
3. Calibration
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Low Fertility, Demographic Aging, and Policy Interventions

- Low fertility and demographic aging drive the pro-natal policies in many countries:
  - 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.
  - to enhance the workers' productivity to deal with labor force shortage.
- Does it work as expected? To what extent? Does the answer depend on its target?

  Without understanding those points, that action would come at a further cost.

Questions

- What are the macroeconomic effects of education subsidies?
  - Fertility rate, aggregate quantities, prices, tax rates, college enrollment, etc.
- How different are the implications of different types of subsidies?
  - Unconditional transfers,
  - Income-tested (need-base),
  - Ability-tested (merit-base), etc.

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).
- Examines the macroeconomic effects of education subsidies.
  - Introduce several types of subsidy in expenditure-neutral ways.
  - Expand the payment per eligible student for each program.

Main Findings

Introducing the subsidies:

- All the programs increase the TFR and college enrollment to some extent.
- Ability-tested would bring the greatest output, income-tested would do the fewest.

  Fertility responses amplify these heterogeneous effects.

Expanding the payments per eligible student:

- Less room for expanding ability-tested one to affect fertility choices.
- Expanding the unconditional/income-tested ones $\Rightarrow$ greater impacts on fertility.

  Income/insurance effects on fertility choices work stronger for the latter programs.

Literature

1. Macroeconomic analysis of education subsidies (especially for college students):

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

2. Macroeconomic analysis using models with the quantity-quality trade-off:

   De la Croix and Doepke (2003, AER), Daruich and Kozlowski (2020, RED), Zhou (2022), Kim et al. (2023), etc.

Contributions to the Most Related Literature

Macroeconomic analysis of education subsidies for college students:

- Standard: Incomplete market GE-OLG with education and IVT.
- This paper: Standard + Fertility choices
  - fertility margin amplifies the heterogeneous policy effects.
  - allows us to quantity their impacts on fertility and demographic structure.

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Overview

Model with fertility choices otherwise standard in literature (1).

- Incomplete market GE-OLG framework.
- Lifecycle:
  - Education stage ▸ IG linkages ▸ Cost & Benefit
  - Working stage
    - Fertility ▸ Costs of children
    - IVT
  - Retirement stage

Preliminaries

- Demographics
- Intergenerational linkages
- Preferences
- Costs of children
- Labor income
- Financial markets
- Technology
- Government

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.

Intergenerational Linkages and Initial Endowment

Three factors transmitted across generation and affecting college enrollment decision:

1. Asset a_{CL} through inter-vivo transfers from their parents.
2. School tastes ("psychic costs" of studying in college).
   - Studying in college entails some disutility $\phi \sim g^{\phi}_{e_p}$.
   - The distribution depends on parents' education level e_p.
3. Human capital h (time-invariant).
   - Stochastic and follows $g^{h}_{h_p}$.
   - The distribution depends on parents' human capital level h_p.
   - Human capital determines education return.

Overview

Preferences

- Households draw utility from consumption c and leisure l according to $u(c, l)$.
- While having children aged 18 (before completing high school), they further draw utility from the "quantity and quality" of children according to $b(n)v(q)$:
  - q: investments on children's quality
    - Caveat: the investment does not affect children's human capital.
  - $v(q)$ is discounted by $b(n)$, where the discount rate depends on the number of children $n \in \{0, 1, ..., N\}$.

Costs of children

Monetary costs:

- Living expenses (captured by the equivalence scale)
- Investments on children's quality q until children graduate high school.
- Inter-vivo transfers ONLY IF children enroll in college.
  - Average transfers amount to about 40% of those made for children under 18.
  - Uncertainty about children's college enrollment.
    $\Rightarrow$ expenditure risks.

Time costs:

- Having a child requires a κ fraction of disposable time.

▸ Overview

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 $j \in \{J_F, ..., J_R - 1\}$: $r^- = (r + \iota) > r^s$.

Production Technology

A representative firm operates with the Cobb-Douglus production function with capital and labor inputs:

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

where

$$L = \left[(1-\omega_h)(L_l)^{\chi} + \omega_h(L_h)^{\chi}\right]^{1/\chi}.$$

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

Government: revenue

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

Financial aid for college students

Grants $g(h, h_p)$:

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

Loans:

- Students can have access to the subsidized loans.
- Government incurs the costs implied by the wedge btw r^- and r^s.

Government: expenditures

- public pension: p per household
- lump-sum transfers ψ to generate the progressivity for τ_w.
- cash benefits for households with children under 18: b per child
- the other expenditures: G

Government Budget Constraint

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

- C: total consumption,
- B: 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 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 attainment decisions:
  1. Inter-vivos transfers made by their parents conditional on enrolling in college (a_{CL}).
  2. Psychic costs of education ($\phi \sim g^{\phi}_{e_p}$), correlated with their parent's education.
  3. Their human capital ($h \sim g^{h}_{h_p}$), correlated with their parent's human capital.

Costs/Benefits of going to college

Costs:

- disutility ϕ (depends on e_p)
- opportunity costs (depends on h)
- tuition fees p_{CL}

Benefits:

- Chance to higher lifetime earnings (depends on h).

Budget constraints:

- Transfers from their parents a_{CL}
- Labor earnings by themselves (no heterogeneity in wage rate)
- Loan or grants provided by the government (depends on h and h_p)

Given a state vector (a_{CL}, h, h_p, ϕ), compare the values of going to college and entering the labor market as a high school graduate. Overview

Education choices

$$V_{g0}(a_{CL},\phi,h,h_p) = \max_{e\in\{0,1\}}\Big\{(1-e)\cdot\mathbb{E}_{z_0}[V^w(a=0,j=19,z_0;e=0,h)],\\ e\cdot V_{g1}(a_{CL};h,h_p)-\phi\Big\} \tag{2}$$

Value functions for college students

$$V_{g1}(a_{CL}; h, h_p) = \max_{c,l,a'} \{u(c,l) + \beta V_{g2}(a'; h, h_p)\},$$

$$V_{g2}(a; h, h_p) = \max_{c,l,a'} \{u(c,l) + \beta \mathbb{E}_{z_0}[V^w(a^s(a'), j = 23, z_0; e = 1, h)]\},$$

where

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

Budget constraints for college students

Eligible to loans:

$$
\begin{aligned}
&(1+\tau_c)c + p_{CL} + a' \qquad (3)\\
&-(1-\tau_w)w_l(1-\bar{t}-l) - \psi - g(h,h_p) = \begin{cases} (1+(1-\tau_a)r)a & \text{if } \ a \geq 0, \\ (1+r^s)a & \text{otherwise.} \end{cases} \qquad (4)\\
&a' \geq -\underline{A}_s.
\end{aligned}
$$

The rest:

$$
\begin{aligned}
(1+\tau_c)c + p_{CL} + a' &= (1+(1-\tau_a)r)a + (1-\tau_w)w_l(1-\bar{t}-l) + \psi, \\
a' &\geq 0.
\end{aligned}
$$

Working stage without children

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

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 choices and working stage with children I

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

where

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

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

Fertility choices and working stage with children II

where

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

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

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

where $\tilde{a}_{CL} = \frac{n \cdot a_{CL}}{1+(1-\tau_a)r}$.

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 $b(0) = 0$).

Preference: Targets

- λ_q: Income share of educational spending.
- λ_a: Average parental transfers to college students.
- $b(n)$: Distribution of the number of children.

Financial markets

Targets for

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

Borrowing limits are set outside the model:

- $\underline{A}_s$: 5.76 million yen.
- $\underline{A}$: 20 million yen.

School taste

- Psychic costs ϕ is given as $\tilde{\phi} \cdot \psi_{CL}$.
  - $\tilde{\phi}$ follows the uniform distribution on $[0, 1]$.
  - ψ_{CL} governs the college enrollment rate at the initial steady state.
- The CDF for ϕ is given as

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

- Target for ψ_{CL}: the college enrollment rate.
- Target for ω: intergenerational mobility of education $\frac{(2 - trace(P))}{2} = 0.31$.

Education Mobility

Parents/Children	<CL	CL
<CL	0.700 (0.798)	0.300(0.202)
CL	0.432 (0.423)	0.568 (0.577)

Table: Intergenerational transition matrix of education. *Note*: $(i,j)-$th entry of the matrix indicates the probability that children acquire skill j given that their parent's skill is i in the benchmark model, and values in parenthesis represent the data counterparts.

Intergenerational transmission of human capital

- The initial draw of human capital:

$$\log(h) = \rho_h \left[\log(h_p) - \log(\bar{h}_p)\right] + \varepsilon_h,$$
$$\varepsilon_h \sim N(0, \sigma_h).$$

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

Income process

- Consider the income process $\eta_{j,z,e,h}$ is given as follows:

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

- $\gamma_{j,e}$: estimate the second-order polynomial of hourly wages on age.
- Assume that $\rho_z = 0.95$ and $\sigma_z = 0.02$.

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 (0.12).
- Target for β_{CL}: Variance of log(wage) for college grad. workers (0.14).

Production

- $\chi = 0.39$ following Abbott et al. (2019).
- $\omega_h = 0.45$: 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
$\underline{A}_s$	20 million yen	Borrowing limit for students
$\underline{A}$	2.88 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	¥$160,000$/month	Pension benefits
b	¥$10,000$/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	0.33
$\bar{t}$	0.8	Income share of labor earnings	0.20	0.17
ι_s	0.055	Share of students using loans	0.44	0.32
ι	0.07	Household share with negative net worth	0.54	0.58
ω_h	0.45	CL−CL≤ wage ratio	1.36	1.40
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	0.25
ω	1.51	Intergenerational mobility of education	0.31	0.37
σ_h	0.71	Variance of log(income) at age 28	0.27	0.24
ψ_{CL}	18.7	College enrollment rate	0.377	0.409
α_{CL}	0.1	Log wage ratio (CL−CL≤) 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	0.54	Share of one child	0.16	0.18
b_2	0.64	Share of two children	0.55	0.60
b_3	0.67	Share of three children	0.22	0.21
b_4	0.68	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

Validation

- College enrollment rates by household income.
- Tuition elasticity of college enrollment.
- xxx elasticity of fertility.
- Anything else?

Road Map

1. Introducing several policies where each is expenditure-neutral in the short run.
   - Unconditional transfers for college students.
   - Income-tested transfers.
   - Ability-tested transfers.
2. Inspecting the mechanism:
   - Behavioral and Composition effects (Short-run vs. Long-run)
   - Roles of fertility responses
3. Effects of expanding each program.

Introducing Subsidies: What I Do

Following Abbott et al. (2019), consider expenditure-neutral policies as follows:

- Unconditional transfers of 0.12 million yen/year ($\sim$ 13% of tuition fees).
- Arbitrary set thresholds for income- and ability-tested transfers.
  - Income test: bottom 40% in household income (proxy: h_p)
  - Ability test: top 40% in students' ability (proxy: h)
- Based on the thresholds, set the payment per eligible student so that the short-run expenditure is the same as the unconditional one.

▸ Formula

Results

- Positive impacts on college enrollment rate and fertility rate.
  - Subsidies serve as insurance against expenditure risks or compensate the costs.
  - Composition effects play a key role for higher enrollment rate. ▸ Decomposition

$\Rightarrow$ Aggregate labor in efficiency units $\uparrow$.

- Negative impacts on aggregate savings
  - Reduce saving incentives, IVT crowded out, changes in age distribution.

- The greatest (fewest) output increase in ability-tested (income-tested) program.
  - Key: education return of students newly enrolling in college.

Results

	(1) Uncond.	(2) Income	(3) Ability
CL share (40.91)	41.14	40.97	42.60
TFR (2.094)	2.145	2.148	2.127
IVT ($\Delta\%$)	-2.46	-7.77	-0.21
Var (log income at $J_F - 1$)	$+0.01$	-0.02	0.00
Output ($\Delta\%$)	0.7	-0.5	3.3
Capital ($\Delta\%$)	-2.4	-3.5	3.5
Labor ($\Delta\%$)	1.5	0.7	2.1
Tax (35.0)	34.7	35.0	34.1

Table: Main results. *Note*: The values in parenthesis in the first column indicate the benchmark results. Rows where the first column has ($\Delta\%$) indicate the %-changes compared to the benchmark.

Mechanism: 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: takeaway

- The effects on output are attenuated toward the origin.
- Fertility behavior amplifies the heterogeneous implications for aggregate output.
  - Income-tested (Ability-tested) changes fertility of some low (high) human capital parents.
    $\Rightarrow$ lower (higher) human capital share $\uparrow$, whose education return is lower (higher).

Results: Exogenous fertility

	(1) Uncond.	(2) Income	(3) Ability
CL share (40.91)	41.13 (41.14)	40.91 (40.97)	42.68 (42.60)
Output (Δ%)	0.4 (0.7)	−0.2 (−0.5)	1.5 (3.3)
Capital (Δ%)	0.9 (−2.4)	0.1 (−3.5)	3.0 (3.5)
Labor (Δ%)	0.1 (1.5)	−0.2 (0.7)	0.6 (2.1)
Tax (35.0)	35.0 (34.7)	35.0 (35.0)	35.0 (34.1)

Table: Results under exogenous fertility. *Note*: Values in parenthesis in each cell represent the result under endogenous fertility reported in Table 3. 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.

Results: expanding the programs

- Expanding the unconditional or income-tested transfers lead to:
  - limited effects on college enrollment,
  - higher TFR due to income/insurance effects of the education subsidies.
- Marginal effects of expanding the ability-tested one decrease faster:
  - High-ability students are more likely to have high-ability parents.
    $\Rightarrow$ income/insurance effects are weaker for those households.
- Despite the smaller impacts, the ability-tested ones still lead to a greater output and lower tax rate than the income-tested ones.

Expanding the programs

	$X = 1$	$X = 2$	$X = 3$
(1) Unconditional			
CL share (40.91)	41.14	42.61	42.63
TFR (2.094)	2.145	2.165	2.188
Output (Δ%)	0.7	4.3	3.9
Tax rate (35.0)	34.7	34.1	34.1
(2) Income-tested			
CL share (40.91)	40.97	41.11	41.12
TFR (2.094)	2.148	2.149	2.161
Output (Δ%)	−0.5	2.1	1.9
Tax rate (35.0)	35.0	34.3	34.4
(3) Ability-tested			
CL share (40.91)	42.60	42.60	42.60
TFR (2.094)	2.127	2.132	2.133
Output (Δ%)	3.3	3.2	3.1
Tax rate (35.0)	34.1	34.2	34.3

Recap/Policy Implications

- Based on a pro-natalist view point, expanding subsidies to cover broader income classes especially lower ones would be more effective.
  - income/insurance effects work stronger.
- Ability-tested program would bring the greatest gains in output up to some point, but less room for expansion.
  - weaker income/insurance effects & margins disappear faster.
- Still, the ability-test would bring the greater output/fiscal gains than income-test.

To Do Next

- Data work and empirical analysis:
    - Whose fertility behavior are more likely to be constrained due to the financial reasons?
- Welfare analysis (c.f., Golosov et al., 2007).
- Solving the transition dynamics.
- Policy experiments actually discussed and considered in Japan.
    - More payments for households with more children.

Why is a “plan” lower than “ideal”?

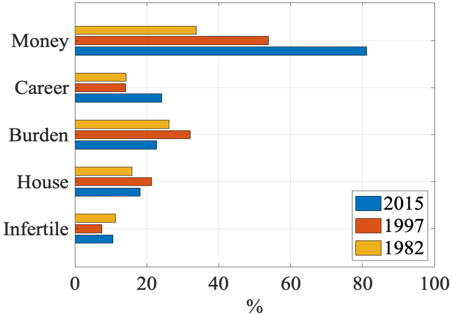
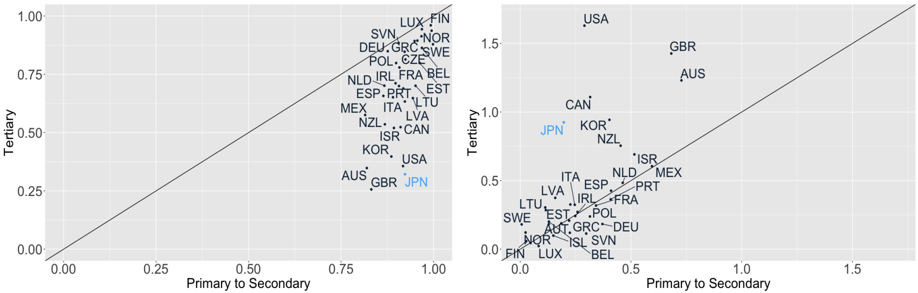


Figure: Reasons why the planned number of children is lower than the ideal one. The sample consists of wives aged 30-34, whose planned number of children is lower than the ideal number. They can choose more than one reason.

Source: The National Fertility Survey (2015).

Education expenditures and subsidization rates

(a) Subsidization rate (b) Private expenditure

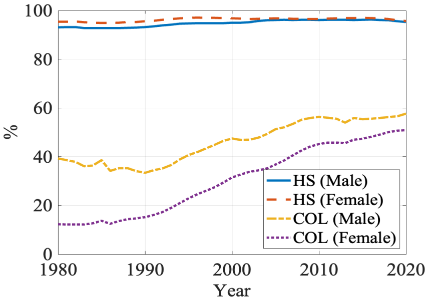


Figure

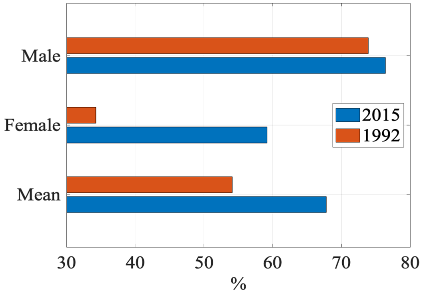
Source: OECD data (2018).

College attainment rates and parental preferences

(a) College enrollment rate



(b) Desired education attainment



Figure

Source: Basic School Survey and the NFS. Go Back

Fertility-income

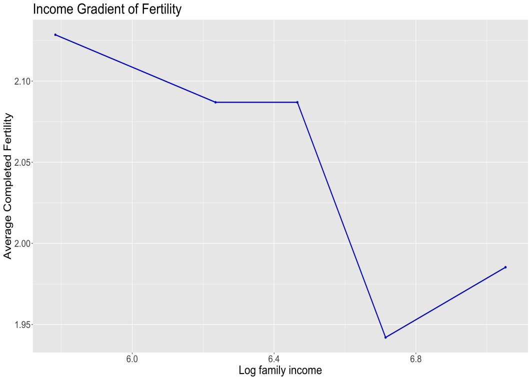


Figure: Completed fertility by income quintile. (JPSC)

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Education spending-income

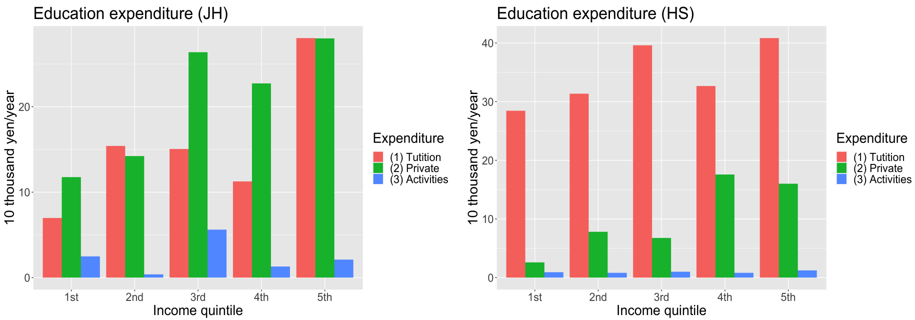

Figure: Education spending by income quintile. (JPSC)

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Payment Rules

Unconditional:

$$g(h, h_p) = ¥120,000 \quad \forall (h, h_p)$$

Ability-tested:

$$g(h, h_p) = \begin{cases} g^1 & \text{if } \; h > \underline{h} \\ 0 & \text{otherwise} \end{cases}$$

Income-tested:

$$g(h, h_p) = \begin{cases} g^2 & \text{if } \; h_p < \bar{h}_p \\ 0 & \text{otherwise} \end{cases}$$

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Decomposition

	Grant	Prices	Tax	Composition	All
<u>CL share</u>					
(1) Uncond.	41.15	40.94	40.94	40.97	41.14
(2) Income	40.94	40.94	40.94	41.00	40.97
(3) Ability	42.37	40.94	40.94	41.15	42.60
<u>TFR</u>					
(1) Uncond.	2.147	2.094	2.094	2.091	2.145
(2) Income	2.131	2.094	2.094	2.108	2.148
(3) Ability	2.200	2.094	2.093	2.041	2.127

Table: Decomposition results. *Note*: Rows “Grant”, “Prices”, “Tax”, and “Distribution” report the results when only grant, prices, labor income tax rate, and distribution change, respectively.