Asymmetric Fertility Elasticities

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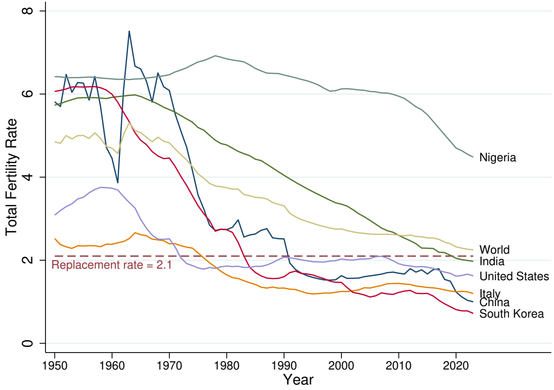
The emergence of below-replacement fertility



- Major implications for the pension system, international relations, firm dynamics, economic growth. . .
- Policy relevant: ¥3600/year from age 0 to 3 in China (¥90 billion budget)

Two fundamental challenges

Challenge 1: Change in economic fundamentals doesn’t offer a fully satisfactory explanation for fertility decline in many countries

Challenge 2: While reducing fertility seems to be easy, raising fertility has been proven to be prohibitively difficult

Research Questions

- Which theory can explain these facts?
- What are the policy implications?

This paper

1. Incorporating loss aversion into fertility choice models resolves both challenges
2. The model generates several new predictions that are empirically supported. These facts are otherwise hard to explain in traditional models
3. The calibrated model leads to new policy implications, in particular a precautionary motive to set higher fertility targets

Literature

- Empirical evaluations of fertility policies

  McElroy and Yang (2000), Liu and Raftery (2020), Schultz (2007), Milligan (2005), Laroque and Salanié (2014), Raute (2019), González and Trommlerová (2023)

- Structural models of fertility

  Barro and Becker (1989), de la Croix and Doepke (2004), Córdoba and Ripoll (2019), Kim, Tertilt, and Yum (2024)

- Long-run fertility and population trajectories

  Malthus (1872), Becker (1960), Easterlin (1968), Galor and Weil (2000), Feyrer et al. (2008), Lutz et al. (2007), Ibbitson (2019)

Model

Motivations

- Motivation 1: Shocks on beliefs and preferences can have significant effects on fertility (Kearney et al. 2015; Guetto, R et al. 2023; Bassi, V. and Rasul, I., 2017).
- Motivation 2: Rich empirical evidence on the existence of loss aversion:
  - → Experimental setting (Kahneman et al. 1991).
  - → Labor supply (Farber 2008, Crawford and Meng 2011, Thakral and Tô 2021).
  - → Voting (Alesina and Passarelli, 2019).
  - → Portfolio choice (Berkelaar et al. 2004).
- What would happen to fertility when people have loss aversion over their consumption, leisure, or career outcome?

Fertility Choice Model with Loss Aversion

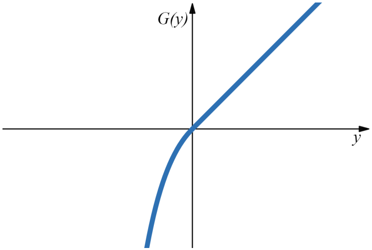
- Conditional on reference r, solve

$$\max_{c,n} \quad \frac{1}{2}[u(c)+\beta u(n)]+\frac{1}{2}[G(u(c)-u(r))+u(r)]$$

$$c+\chi n = I \qquad u(n)=\frac{n^{1-\gamma}-1}{1-\gamma} \quad \gamma>1$$

- c is interpreted as composite good
- Loss aversion when $\alpha > 0$

$$G(y)=\begin{cases} y & y \geq 0 \\ y-\alpha y^2 & y<0 \end{cases}$$



- Consistency: $r = c$ in static model with RA

Prediction 1 and 2

- **Prediction 1 (Asymmetric Fertility Elasticities):** Holding r unchanged, the optimal fertility response to an increase in χ is larger than the optimal response to a decrease in χ

$$\left.\frac{\partial \log n^*}{\partial \log \chi}\right|_{+,\alpha>0} < \left.\frac{\partial \log n^*}{\partial \log \chi}\right|_{-,\alpha>0} < 0 \tag{1}$$

- **Prediction 2 (Asymmetric Fertility Effect of Income Shocks):** Holding r unchanged, the optimal fertility response to a decrease in I is larger than the optimal response to a increase in I

$$\left.\frac{\partial \log n^*}{\partial \log I}\right|_{-,\alpha>0} < \left.\frac{\partial \log n^*}{\partial \log I}\right|_{+,\alpha>0} < 0 \tag{2}$$

Dynamic extension

- In period t, fertile households takes r_t as given and choose $\{c_t(r_t), n_t(r_t)\}$
- Endogenous formation of the reference point

$$r_t = \phi \cdot r_{t-1} + (1 - \phi) \cdot c_{t-1} + \epsilon_t \qquad \epsilon_t \sim \mathcal{N}(0, \sigma^2) \tag{3}$$

that formalizes the "relative status" in the Easterlin hypothesis

- ϕ is the persistence of past reference:
  - $\rightarrow$ $\phi = 1$: random walk of r_t
  - $\rightarrow$ $\phi = 0$: immediate updating $r_t = c_{t-1}$

Prediction 3

- **Prediction 3a (Asymmetric Fertility Effect of Policy Implementation and Reversal):** If χ initially decreases and then increases back to its original level, the initial fertility increase is smaller than the subsequent fertility decrease
- **Prediction 3b (Asymmetric Utility Effect of Policy Implementation and Reversal):** If χ initially decreases and then increases back to its original level, the initial utility increase is smaller than the subsequent fertility decrease

Prediction 4

- **Prediction 4 (The "slippery slope" perspective):** Starting from any consistent reference level $r_0 = c_0$, the expected fertility $\mathbb{E}_0(n_t)$ declines with time while the expected consumption $\mathbb{E}_0(c_t)$ and reference level $\mathbb{E}_0(r_t)$ rises with time.

Supporting Evidence

Prediction 1: Empirical Evidence

Prediction 1 (Asymmetric Fertility Elasticities)

- Specification 1: TWFE regression with country panel data
  1. Independent variable:
     $\text{Policy\_Lower/Raise}_{it} = \frac{1}{N}\sum_{T=t-N}^{t-1} \mathbb{I}(\text{Policy}_{iT} = \text{Lower/Raise})$
  2. Dependent Variable: TFR

detail

- Specification 2: Cohort Exposure design with individual repeat cross-sectional data
  1. Independent variable:
     $\text{Policy\_Lower/Raise}_{cb} = \frac{1}{11}\sum_{t\in[b+\text{MAC}_{cb}-5,b+\text{MAC}_{cb}+5]} \mathbb{I}(\text{Policy}_{ct} = \text{Lower/Raise})$, where MAC is country-birth year specific mean childbirth age
  2. Dependent Variable: Children number

detail robust

Prediction 1: Result of Specification 1

Table 1: Population Policy and TFR

Dependent Variable	ΔTotal Fertility Rate/Lagged Fertility Rate			
Construction of Policy Variables	Last Year		Average in the Last Five Years	
	(1)	(2)	(3)	(4)
Lower fertility	-0.0118***	-0.0055***	-0.0133***	-0.0062***
	(0.0013)	(0.0016)	(0.0015)	(0.0021)
Raise fertility	0.0032	0.0006	0.0027	-0.0005
	(0.0034)	(0.0030)	(0.0041)	(0.0036)
Country Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Control Variables	No	Yes	No	Yes
Observations	10301	7373	9545	6821
R^2	0.132	0.170	0.129	0.171

- Anti-fertility policies' effect on TFR is larger than that of pro-fertility policies

Prediction 1: Result of Specification 2

Table 2: Population Policy and the Number of Children

Dependent Variable	Number of Children								
Interpolation of MAC	Country-Specific Year Polynomial			Nearest Neighbor			Socioeconomic Variables		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Target: Lower fertility	-0.551***	-0.512***	-0.382***	-0.638***	-0.583***	-0.428***	-0.674***	-0.633***	-0.464***
	(0.091)	(0.091)	(0.092)	(0.089)	(0.090)	(0.092)	(0.096)	(0.097)	(0.010)
Target: Raise fertility	0.287***	0.317***	0.202**	0.187**	0.207***	0.078	0.220***	0.220***	0.063
	(0.077)	(0.076)	(0.084)	(0.075)	(0.075)	(0.082)	(0.079)	(0.078)	(0.086)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income Level-Age FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Education Level-Age FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Macroeconomic Controls	No	No	Yes	No	No	Yes	No	No	Yes
Observations	107602	95852	85031	120709	106534	94432	109996	96933	88150
R^2	0.276	0.295	0.303	0.278	0.296	0.303	0.273	0.295	0.300

- Same result at the individual level
- Results mostly explained by changes in high-order births
- The degree of asymmetry increases in education/income

result

Prediction 2: Empirical Evidence

Prediction 2 (Asymmetric Fertility Effect of Income Shocks)

- Chatterjee and Vogl (2018): fixed effect regression with country-year-age group data from DHS
    1. Independent variable: Change in log GDP per adult
    2. Dependent variable: conception rate
- Conceptions fall sharply in deep recessions but do not rise in rapid expansions

Prediction 3a: Empirical Evidence

Prediction 3a (Asymmetric Fertility Effect of Policy Implementation and Reversal)

- González and Trommlerová (2023): Spain's introduction of lump-sum child benefit in 2007 and its elimination in 2010.
- Specification: regression controlling province fixed effect and calendar month fixed effect with province-month panel data
    1. Independent variable: time dummies of Transition into child benefit/Child benefit period/Transition out of child benefit/Post-child-benefit period.
    2. Dependent variable: number of births.
- The benefit's introduction increased birth rates by 0.33 while its cancellation resulted in a decrease of 0.70 births per 100,000 women, a magnitude almost twice as large

Prediction 3b: Empirical Evidence

Prediction 3b (Asymmetric Utility Effect of Policy Implementation and Reversal)

- Specification: Time RD design, taking use of Australia's unexpected baby bonus increase in 2004 and unexpected decrease in 2013
    1. Independent variable: being affected by the unexpected increase/decrease of baby bonus
    2. Dependent variable: Happiness level (0-5)
    3. Sample: respondents with at least one birth in the previous year
    4. Identification assumption: most parents can't shift birth time of babies in response to the policy. According to Gans and Leigh (2009), fewer than 0.5% of annual births shifted in response to the policy in 2024

detail

Prediction 3b: Effect of Baby Bonus Increase

Table 3: The 2004 Baby Bonus Increase's Effect on Happiness

Dependent Variable	Happiness (0-5)		
Model	Ordered Probit		
Sample Year	2004	2003	2002
	(1)	(2)	(3)
$\mathbb{1}(\text{last\_birth}_i > \text{July 1})$	0.037	0.273	0.223
	(0.240)	(0.265)	(0.210)
Control Variables	Yes	Yes	Yes
Observations	423	422	422
R^2	0.389	0.323	0.304

- Red coefficient: utility effect of baby bonus increase, not significant.
- Black coefficients: effect of placebo policies, not significant.

Prediction 3b: Effect of Baby Bonus Decrease

Table 4: The 2013 Baby Bonus Cut's Effect on Happiness

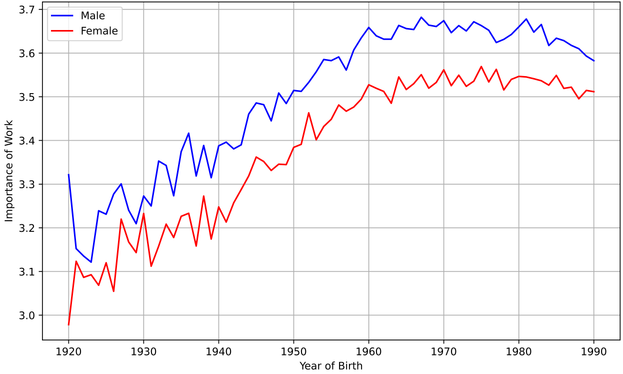
Dependent Variable	Happiness (0-5)		
Model	Ordered Probit		
Sample Year	2013	2012	2011
	(1)	(2)	(3)
$\mathbb{1}(\text{last\_birth}_i > \text{July 1}) \times \mathbb{1}(\text{Children\_number}_i > 1)$	-0.569**	0.029	-0.207
	(0.279)	(0.272)	(0.424)
Control Variables	Yes	Yes	Yes
Observations	656	681	469
R^2	0.192	0.189	0.303

- Red coefficient: utility effect of baby bonus decrease is negative and significant
- Black coefficients: utility effect of placebo policies, not significant.

Prediction 4: Empirical Evidence

Prediction 4 (The "slippery slope" perspective)

Figure 1: Change of importance of work in life (Source: WVS Question A005)



- Importance of work increases over time for both male and female

Alternative Explanations

Table 5: Comparison with Alternative Explanations

	Propagation Mechanism	Technological Asymmetry	Liquidity Constraints	Reference Dependence
Asymmetric responses w.r.t				
Fertility policies	✗	✓	✓	✓
Implementation and reversal	✗	✗	✗	✓
Income shocks	✗	✗	✓	✓
The “slippery slope” perspective	✗	✗	✗	✓

Policy Implications

Government problem

- The policymaker faces social costs from population externalities

$$\mathcal{S}(n_t|\overline{n}) = \lambda \cdot (\log(n_t) - \log(\overline{n}))^2 \tag{4}$$

- Suppose the policymaker chooses n_0 (w/ consistent r_0) by permanently changing χ and solves

$$\min_{n_0} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \rho^t \mathcal{S}(n_t|\overline{n}) \tag{5}$$

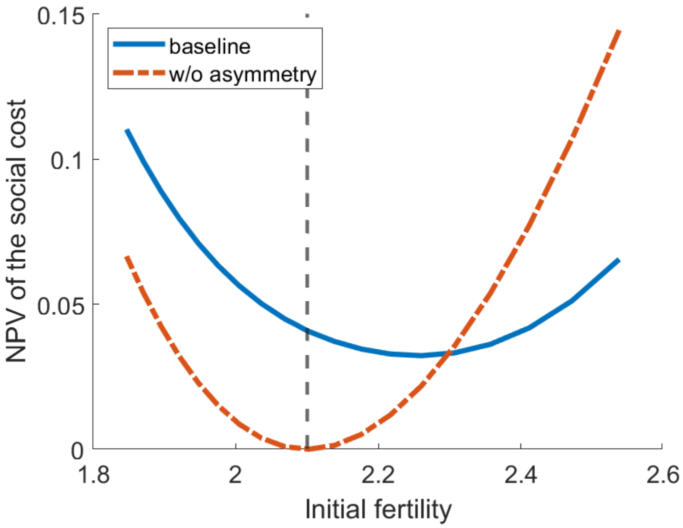
  where n_t are optimizing choices by households

- Question: What is the level of n_0 that minimizes the expected social cost?

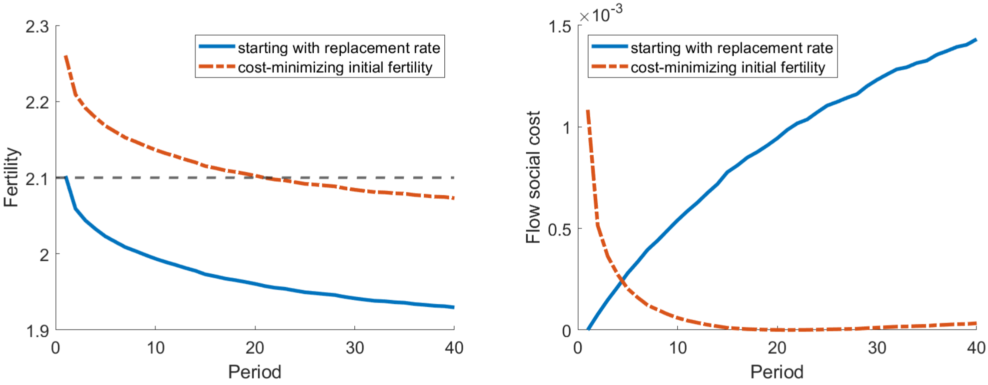
Calibration

- Set $\overline{n} = 2.1$ the replacement level
- $\lambda = 0.2 \implies n_{\text{U.S. 2022}} = 1.62$ generates $\mathcal{S} = 0.62\%$ of GDP
- Parameters in the decision problem
  - → Child costs $\chi = 0.075$ from Greenwood and Seshadri (2002)
  - → Child preference $\beta = 34$ to generate $n^* = 2.1$ in static steady state
  - → Curvature $\gamma = 5.9$ and loss aversion $\alpha = 98$ to generate pro-fertility elasticity and the degree of asymmetry in the data
- Updating parameters $\phi = 0.95$ and $\sigma = 0.01$ for annual frequency
- Simulate 10,000 paths for 40 years

Cost-minimizing initial fertility



Evolution of fertility and social cost



- When $\rho > 0$, there is an intertemporal tradeoff of social costs
- One can always find a path with $n_0 > \overline{n}$ that dominates $n_0 = \overline{n}$

Policy lessons

1. Precautionary motive of higher fertility rate target
2. To maintain n_0, policy effort needs to increase in time
3. The cost-minimizing initial fertility level depends on the degree of asymmetry, the reference updating process, and the social discount factor

Comparison with Alternative Explanations

Table 6: Comparison with Alternative Explanations

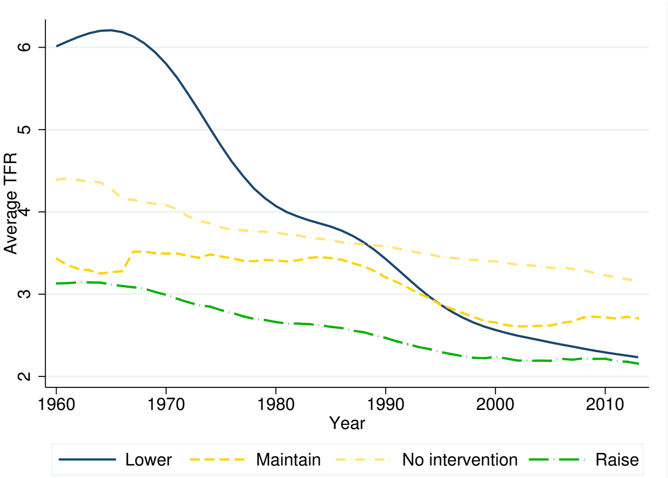
	Propagation Mechanism	Technological Asymmetry	Liquidity Constraints	Reference Dependence
Policy implications				
Precautionary high fertility	✗	✓	✗	✓
Rising pro-fertility effort	✗	✓	✗	✓

Conclusion

- Propose a fertility choice model under loss aversion to lifestyle
- The model generates unique predictions that are supported in the data
- The framework provides new policy implications, in particular "precautionary fertility"

Appendix

Fertility trends by policy regime in 1976



Fertility trends by policy regime in 1976

back

Prediction 1: Data of Specification 1

- Fertility level and policy regime data from the United Nations
  - $\rightarrow$ Policy regime dummy assigned by the UN Population Division since 1976 - lower, raise, maintain, no intervention trend map
- Family planning funding from de Silva and Tenreyro (2017)
- Aggregate variables from PWT, WDI, Barro and Lee (2013): GDP per capita, urbanization, infant mortality, female labor force participation, education
- Individual-level data on fertility, education, and income from the World Value Survey (WVS) Database

  $\Longrightarrow$ cohort exposure design for individual-level responses

back

Prediction 1: Specification 1

$$\Delta \text{TFR}_{it}/\text{TFR}_{it-1} = \alpha + \beta_1 \text{Policy\_Lower}_{it} + \beta_2 \text{Policy\_Raise}_{it} + \beta_3 \text{Control}_{it} + \sigma_i + \eta_t + \epsilon \tag{6}$$

- i: country; t: year.
- Policy_Lower_{it} and Policy_Raise_{it}: policy exposure in the last several years, calculated by:
  $\text{Policy\_Lower/Raise}_{it} = \frac{1}{N}\sum_{T=t-N}^{t-1} \mathbb{I}(\text{Policy}_{iT} = \text{Lower/Raise})$.
- $\Delta \text{TFR}_{it}/\text{TFR}_{it-1}$: change rate of TFR in country i between year t and year $t+1$.

back

Prediction 1: Specification 1

$$\Delta \text{TFR}_{it}/\text{TFR}_{it-1} = \alpha + \beta_1 \text{Policy\_Lower}_{it} + \beta_2 \text{Policy\_Raise}_{it} + \beta_3 \text{Control}_{it} + \sigma_i + \eta_t + \epsilon \tag{7}$$

- Control_{it}: the level and growth rate of GDP per capita, education, urbanization, infant mortality, and female labor force participation.
- σ_i: country FE; η_t: year FE
- ϵ: standard error cluster at country level.

back

Prediction 1: Data of Specification 2

- Policy regime dummy and other aggregate variables: see 2.
- Individual-level data on fertility, education, and income from the World Value Survey (WVS) Database
- Sample: individuals with age $> MAC + 5$.

back

Prediction 1: Specification 2

$$\text{Child}_{icbt} = \alpha + \beta_1 \text{Policy\_Lower}_{cb} + \beta_2 \text{Policy\_Raise}_{cb} + \eta \text{Age}_i + \gamma_{ct} + \delta_b + Control_{cb} + \epsilon \tag{8}$$

- i: individual; c: country, b:birth year, t: year of survey.
- Policy_Lower_{cb} and Policy_Raise_{cb}: cohort exposure to fertility policy, calculated by: $\text{Policy\_Lower/Raise}_{cb} = \frac{1}{11}\sum_{t \in [b+\text{MAC}_{cb}-5, b+\text{MAC}_{cb}+5]} \mathbb{I}(\text{Policy}_{ct} = \text{Lower/Raise})$.
- Child_{icbt}: children number of individual i.

back

Prediction 1: Specification 2

$$\text{Child}_{icbt} = \alpha + \beta_1 \text{Policy\_Lower}_{cb} + \beta_2 \text{Policy\_Raise}_{cb} \\ + \eta \text{Age}_i + \gamma_{ct} + \delta_b + Control_{cb} + \epsilon \tag{9}$$

- Age_i: age fixed effect; γ_{ct}: country-survey year fixed effect; δ_b: birth year fixed effect.
- $Control_{cb}$: macroeconomic control variables, including average GDP per capita and its growth rate during individual i's child birth MAC.
- ϵ: standard error cluster at cohort level.

back

Prediction 3b: Data

- Data: HILDA (Household, Income and Labour Dynamics) Survey from Australia
- Individual level repeat cross sectional data.
- Can identify whether the last birth occurred before or after July 1st, but there is no record of the exact date.
- Sample: individual with at least one birth within the last one year.
- Unexpected policy change in the size of Australia baby bonus:
    1. \$2,000 increase in baby bonus for all births on July 1, 2004
    2. \$2,000 reduction in baby bonus for 2nd & higher-order births on July 1, 2013

back

Prediction 3b: Specification

- Evaluate the effect of 2004 reform:

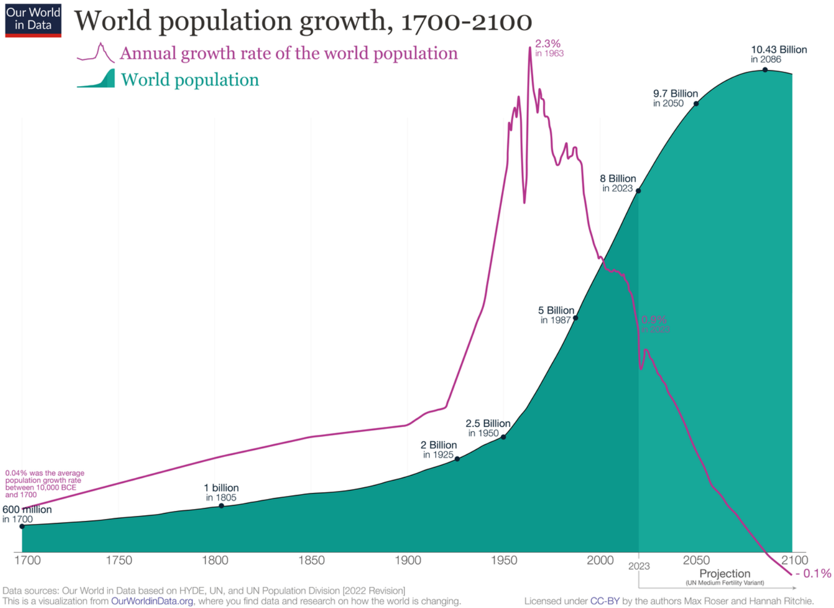
$$\text{happiness}_i = \alpha + \beta \mathbb{1}(\text{last\_birth}_i > \text{July 1}) + \gamma \text{control}_i + \epsilon \tag{10}$$

- Evaluate the effect of 2013 reform:

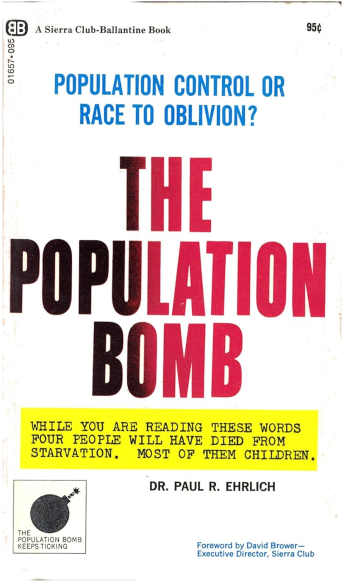
$$\begin{aligned} \text{happiness}_i =& \alpha + \beta \mathbb{1}(\text{last\_birth}_i > \text{July 1}) \times \mathbb{1}(\text{Children\_number}_i > 1) \\ &+ \gamma \text{control}_i + \epsilon \end{aligned} \tag{11}$$

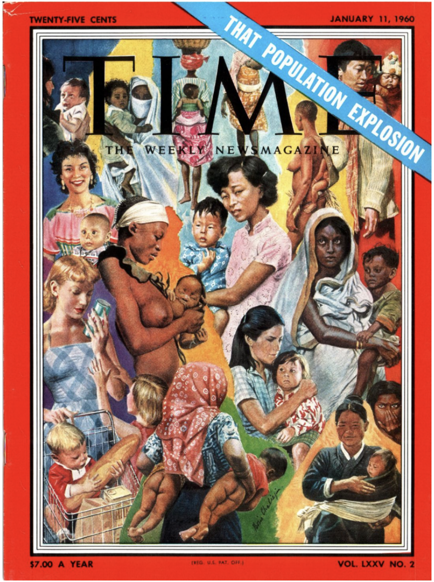
- Sample: respondents with at least one birth in the previous year
- $control_i$: control variables, including family size fixed effect, children number fixed effect, age fixed effect, logarithm of income, state×socioeconomic status fixed effect; all interacted with gender.

The specter of Malthus in the 1960s



The population bomb





The global family planning movement

- Led by global organizations such as the United Nations, the World Bank, USAID, and Bill & Melinda Gates Foundation
- $4.2 billion spent across low- & lower-middle-income countries in 2021
- Many country-specific policies (e.g., the one-child-policy in China)
- Gradually attaches more benefits to low fertility: economic development, health, gender equity, environment. . .
- Evidence that fertility policies played an important role in the rapid fertility decline (de Silva and Tenreyro 2020)

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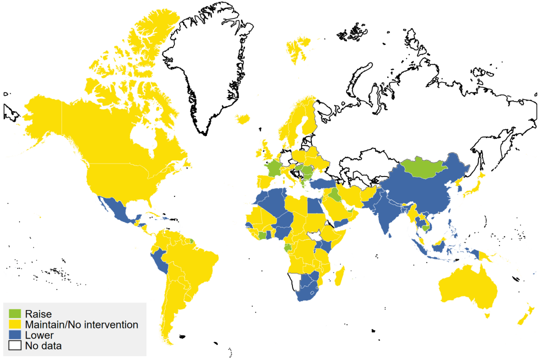
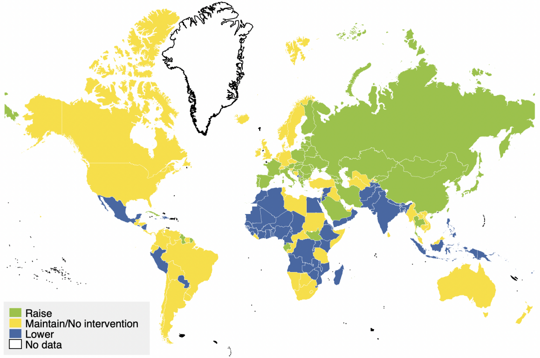
Fertility policy in 1986 and 2021



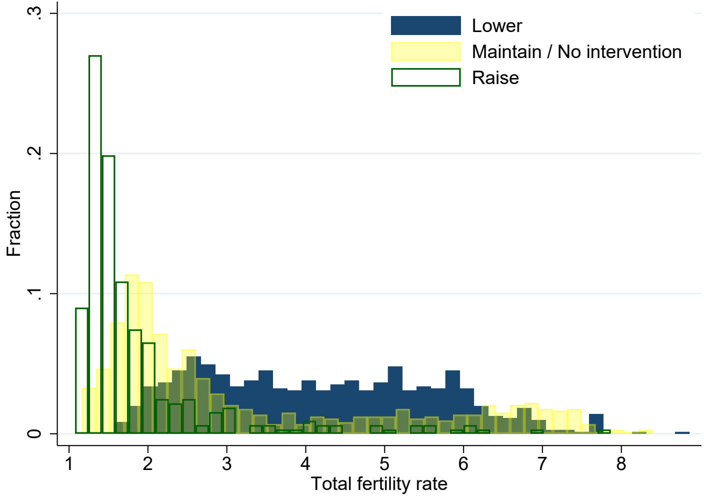
Source: United Nations Population Division



Source: United Nations Population Division

back distribution

Fertility policy distribution



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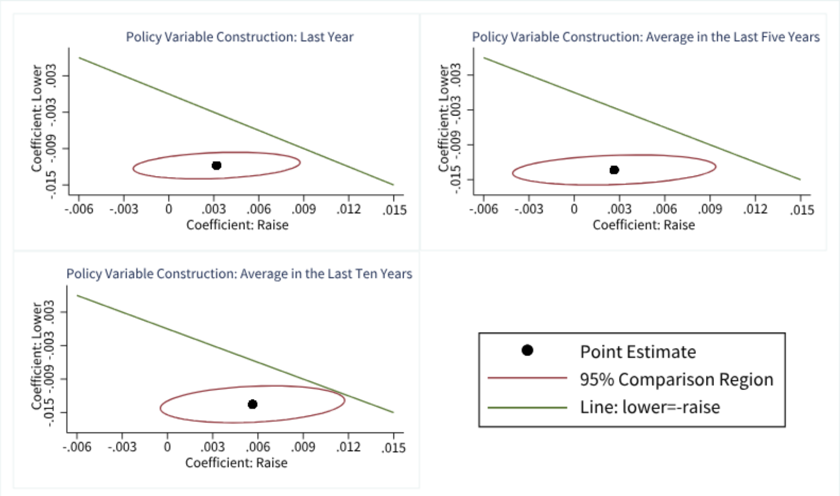
The sum of coefficients is significantly negative



- Wald test-based comparison regions for simultaneous inference for two parameters (Eckert and Vach 2020)

back

Decomposition of Policy Effect

Table 7: Fertility Policies' Effect Conditional on Children Number

Dependent Variable	Number of Children				
Sample	Whole Sample	NChild>0	NChild>1	NChild>2	NChild>3
	(1)	(2)	(3)	(4)	(5)
Lower fertility	-0.583***	-0.632***	-0.746***	-0.474***	-0.213***
	(0.090)	(0.075)	(0.067)	(0.066)	(0.052)
Raise fertility	0.207***	0.391***	0.507***	0.488***	0.109
	(0.075)	(0.067)	(0.068)	(0.082)	(0.091)
Baseline Controls	Yes	Yes	Yes	Yes	Yes
Income Level-Age FE	No	No	No	No	No
Education Level-Age FE	No	No	No	No	No
Macroeconomic Controls	No	No	No	No	No
Observations	106534	91949	75727	42669	22624
R^2	0.296	0.308	0.324	0.241	0.140

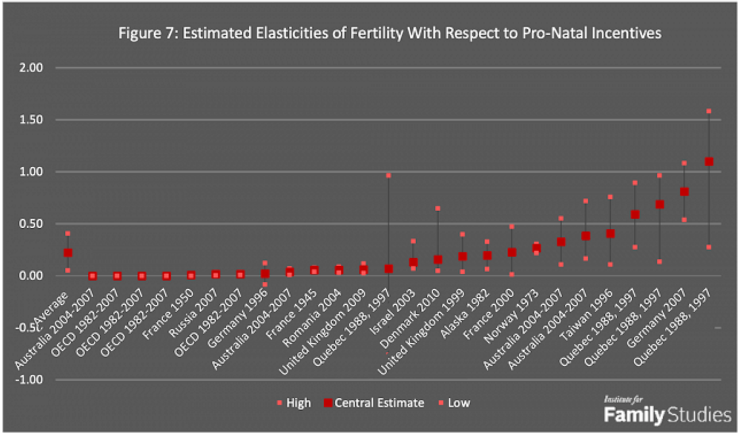
Heterogeneity by Income

Table 8: Heterogeneity by Income

Dependent Variable	Number of Children		
Interpolation of MAC	Country-Specific Year Polynomial	Nearest Neighbor	Socioeconomic Variables
	(1)	(2)	(3)
Lower fertility#Income	-0.146***	-0.159***	-0.159***
	(0.028)	(0.031)	(0.031)
Lower fertility	0.133	0.112	0.092
	(0.300)	(0.300)	(0.340)
Raise fertility#Income	-0.129***	-0.122***	-0.126***
	(0.042)	(0.040)	(0.042)
Raise fertility	0.948***	0.825***	0.886***
	(0.249)	(0.255)	(0.276)
Baseline Controls	Yes	Yes	Yes
Observations	100383	111448	101319
R^2	0.273	0.274	0.268

back

Responses to pro-fertility policies



- "An increase in the present value of child benefits equal to 10% of a household's income can be expected to produce between 0.5% and 4.1% higher birth rates." (Stone 2020)

back

Robustness

- Empirical finding is robust to
  1. Policy effects at different horizons
  2. Controlling for past fertility to mitigate reverse causality
  3. Split sample by initial fertility and GDP per capita
  4. Evaluate the cumulative contributions of policies to fertility changes for specific countries and compare with existing studies

back

Technological Reversibility

1. Propaganda: “It’s better to make a family disappear than to make a second new birth appear” (China) & “have one for mum, one for dad and one for the country” (Australia) & “Do it for Denmark”
2. Family policies: childlessness tax (Soviet) & maternity capital (Russia)
3. Access to tech.: planned parenthood (global) & Decree 770 (Romania)
4. Reproductive coercion: forced sterilization (Bangladesh) & monthly gynecological exam w/ plant-level birth target (Romania)

Fertility policies have different combinations of cost-effectiveness and repugnancy. But each of them is technologically feasible in either direction

back

Control for past fertility

Table 9: Population Policy and TFR: Control Average TFR in the Last Five Years

Dependent Variable	ΔTotal Fertility Rate/Lagged Fertility Rate			
Construction of Policy Variables	Last Year		Average in the Last Five Years	
	(1)	(2)	(3)	(4)
Lower fertility	-0.0121***	-0.0065***	-0.0134***	-0.0070***
	(0.0014)	(0.0015)	(0.0016)	(0.0017)
Raise fertility	0.0031	0.0013	0.0033	0.0009
	(0.0037)	(0.0033)	(0.0043)	(0.0038)
Country Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Control Variables	No	Yes	No	Yes
Average TFR in the Last Five Years	Yes	Yes	Yes	Yes
Observations	9881	8446	9881	8446
R^2	0.134	0.182	0.133	0.182

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Split samples

Panel A: Subsample with High TFR in 1960				
Dependent Variable	ΔTotal Fertility Rate/Lagged Fertility Rate			
Construction of Policy Variables	Last Year		Average in the Last Five Years	
	(1)	(2)	(3)	(4)
Lower fertility	-0.0076***	-0.0056***	-0.0080***	-0.0057***
	(0.0014)	(0.0014)	(0.0018)	(0.0018)
Raise fertility	0.0003	0.0005	0.0009	0.0007
	(0.0034)	(0.0055)	(0.0062)	(0.0056)
Observations	5936	5247	5936	5247
R^2	0.339	0.390	0.337	0.388
Panel B: Subsample with Low TFR in 1960				
Dependent Variable	ΔTotal Fertility Rate/Lagged Fertility Rate			
Construction of Policy Variables	Last Year		Average in the Last Five Years	
	(1)	(2)	(3)	(4)
Lower fertility	-0.0150**	-0.0117**	-0.0151***	-0.0117**
	(0.0028)	(0.0049)	(0.0023)	(0.0047)
Raise fertility	0.0016	0.0030	0.0024	0.0038
	(0.0038)	(0.0037)	(0.0044)	(0.0043)
Country Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Control Variables	No	Yes	No	Yes
Observations	4789	3899	4789	3899
R^2	0.128	0.147	0.128	0.147

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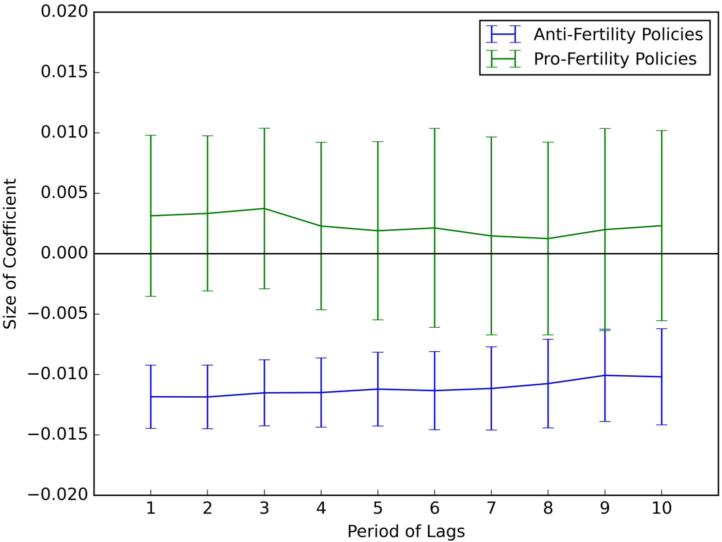
Different horizons



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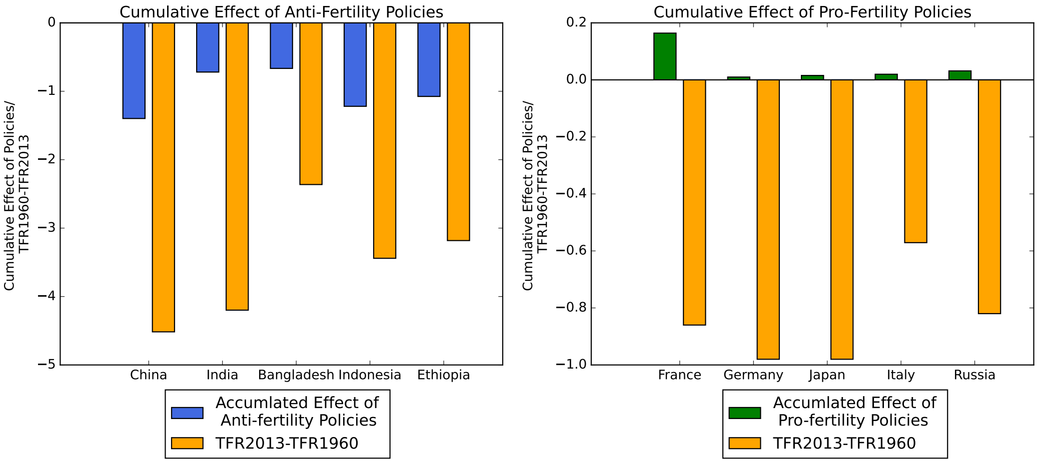
Cumulative effects



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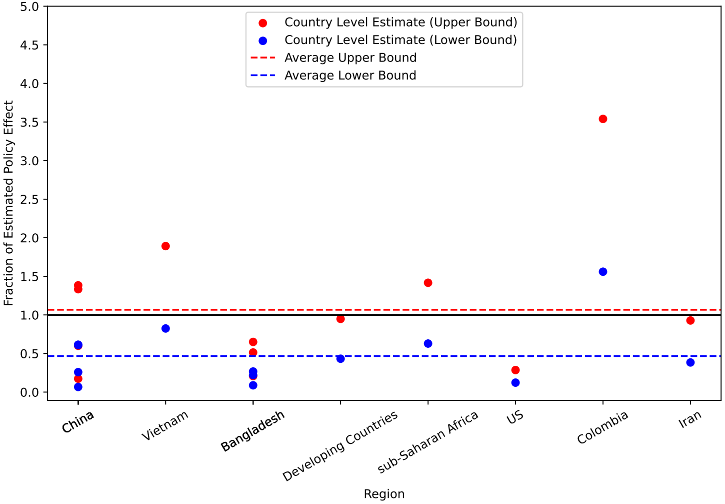
Comparison with other existing studies



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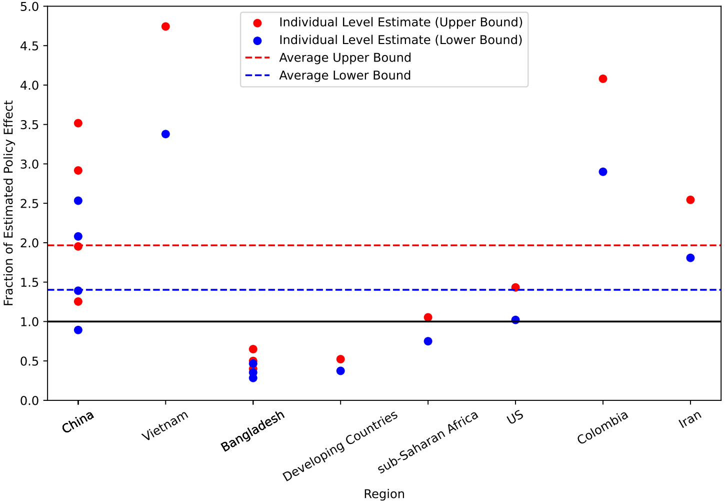
Comparison with other existing studies



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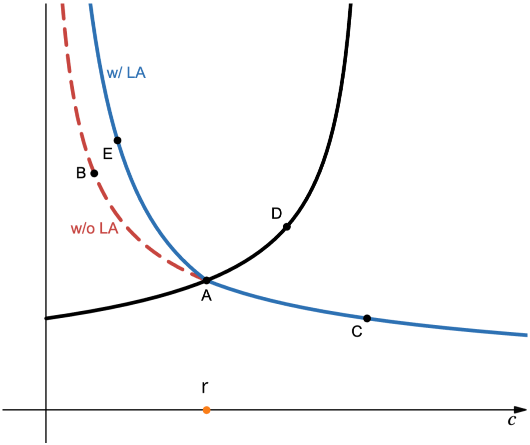
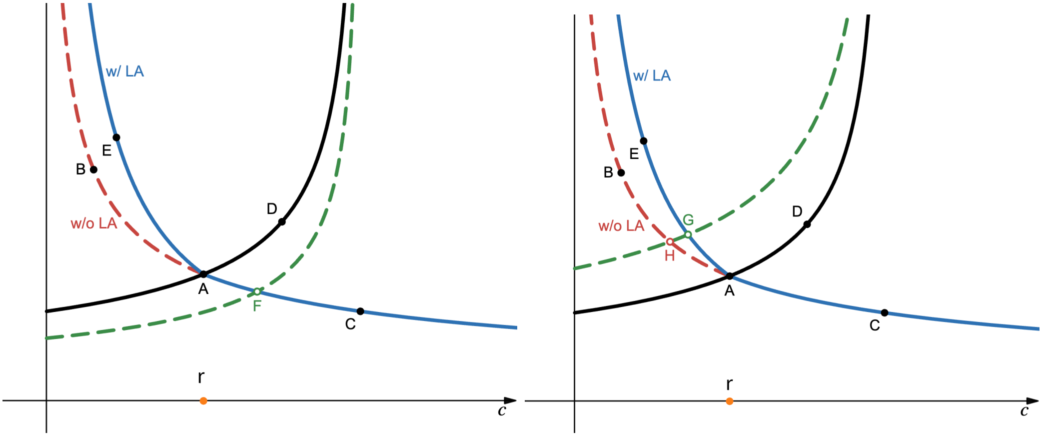
First-order condition

- The first-order condition of optimal consumption satisfies

$$u'(c) \cdot (1 + G'(u(c) - u(r)) = \frac{\beta}{\chi} \cdot u'\left(\frac{I - c}{\chi}\right)$$



Asymmetry in χ



- Comparative static when χ falls (left) or rises (right)

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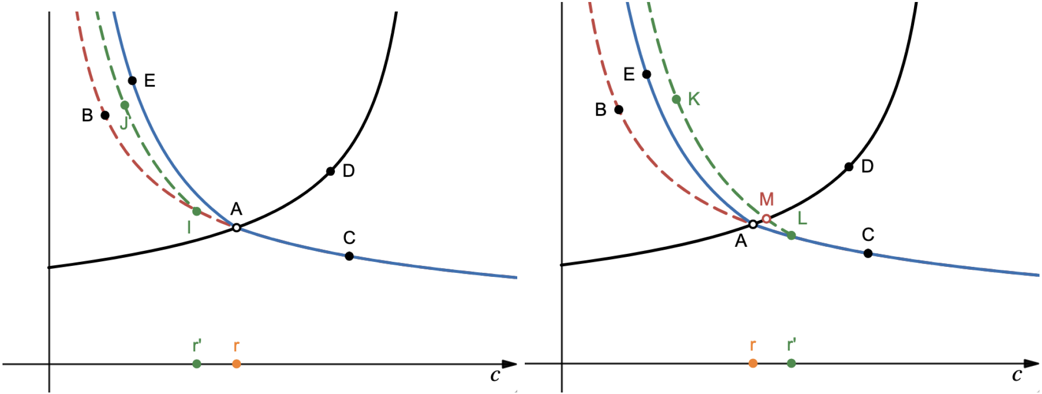
Asymmetry in r



- Comparative static when r falls (left) or rises (right)

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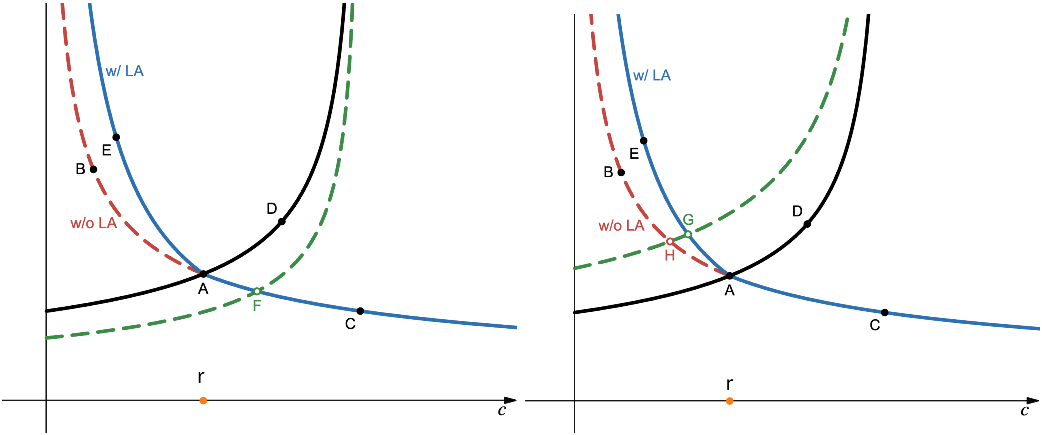
Asymmetry in I



- Comparative static when I rises (left) or falls (right)

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