Rationed Fertility: Theory and Evidence

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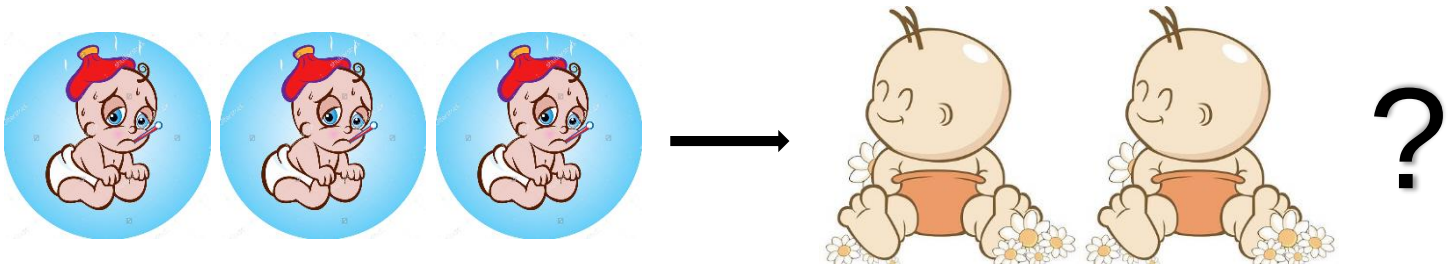
Research Question

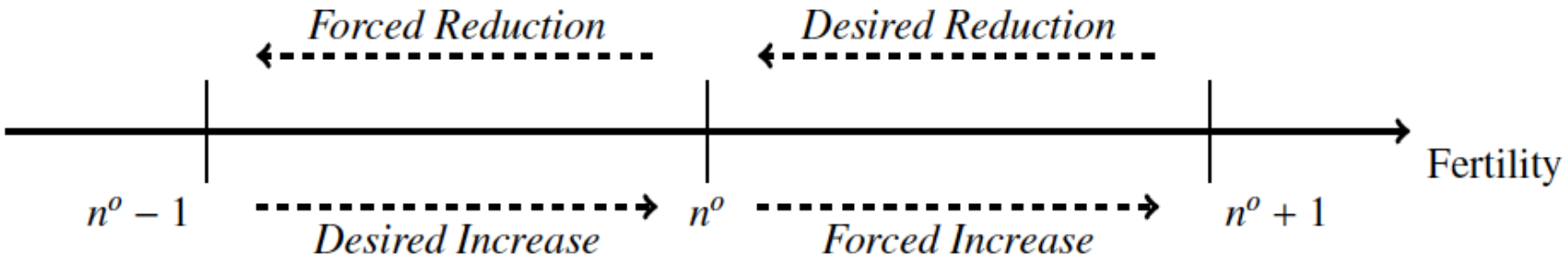
Do population control policies promote human capital investment?



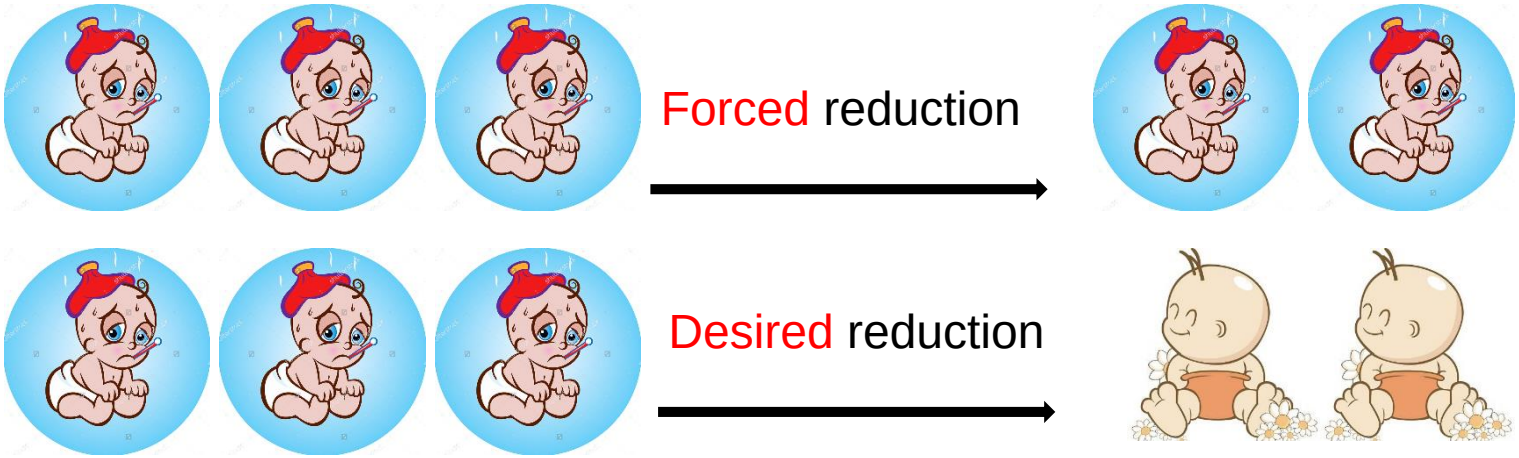
Why Study?

- Theory: Becker & Lewis (1973) predicts a negative correlation between child quantity and quality.
- Empirical studies exploit exogenous changes in child quantity to test Becker & Lewis's (1973), and show inconsistent results.
- A gap: there are little theoretical analyses on the effect of exogenous changes in child quantity on quality.

Theory of Exogenous Fertility Change



- Forced change -> negative income effect on child quality
- Desired change -> positive income effect on child quality



Empirical Strategy

- Empirical tests exploiting the combination of:
  - the natural experiment of twin births
  - China's unprecedented One-child Policy (OCP)
- OCP rations fertility below the desired level
- Without OCP: twinning induces forced fertility increases
- Under OCP: twinning induces a mix of forced and desired fertility increases

Evidence

- Han versus Minority Chinese
  - Han: restricted by the One-child Policy
  - Minority: unrestricted by the One-child Policy
  - The magnitude of the negative effect of exogenous fertility increase on child quality is larger for minority than for Han.
- Before versus After the One-child Policy (OCP)
  - Before: unrestricted; After: restricted
  - The magnitude of the negative effect of exogenous fertility increase on child quality is larger before the OCP than after the OCP for Han Chinese.

Our Contributions

- Understanding the heterogeneous fertility effect on child quality recently documented by Mogstad & Wiswall (2016) and Brinch, Mogstad, & Wiswall (2017).
- Population control policy: "voluntary" versus "mandatory" policy instruments (Schultz, 2007).
- Understanding the modest effect of China's One-child Policy on human capital investments (e.g., Rosenzweig & Zhang, 2009).

Theory: Setting

- Utility Maximization Problem

$$\max_{n,q,s} \quad U(n, q, s),$$

$$\text{subject to} \quad \pi_{nq} nq + \pi_n n + \pi_q q + \pi_s s \leq y,$$

  - child quantity n
  - child quality q
  - composite good s
- Price of q: $\pi_q + \pi_{nq} n$
- Price of n: $\pi_n + \pi_{nq} q$
- Optimal fertility: n^o

Theory: Rationed Fertility

- Fix child quantity (set $n = \bar{n}$), solve the model, then consider the effect of $\bar{n}$ on q.

$$\max_{n,q,s} \quad U(n, q, s),$$

$$\text{subject to} \quad \pi_{nq} nq + \pi_n n + \pi_q q + \pi_s s \leq y,$$

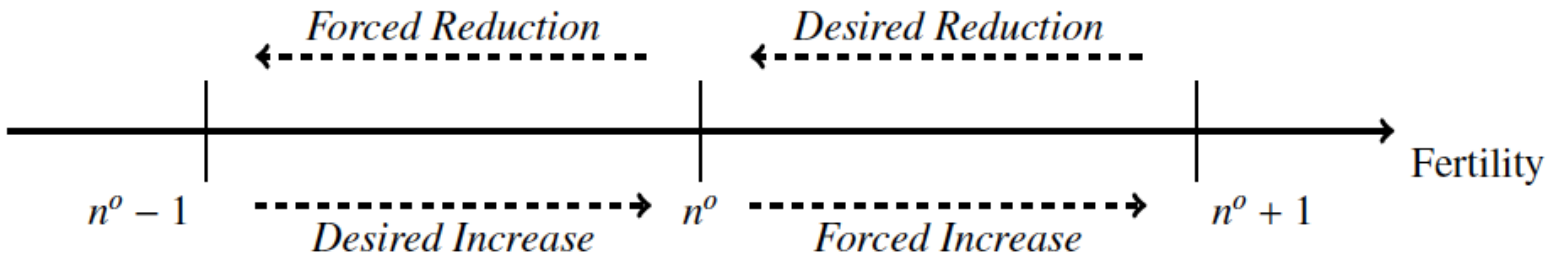
n^o: choice

$$\max_{q,s} \quad U(\bar{n}, q, s),$$

$$\text{subject to} \quad \pi_n \bar{n} + (\pi_{nq} \bar{n} + \pi_q) q + \pi_s s \leq y,$$

$\bar{n}$: rationed

Theory: Forced versus Desired



- The *supporting fixed price*: $\bar{\pi}_n$
  - $\bar{\pi}_n$ is part of the monetary-equivalent of the utility return of an additional child (shadow price of $\bar{n}$).

$$\bar{n} = n^c(\pi_{-n}, \bar{\pi}_n, u),$$

Definition 1 *When $\bar{n} < n^o$, $\bar{\pi}_n - \pi_n > 0$, an increase in $\bar{n}$ is a **desired** fertility increase.*

Definition 2 *When $\bar{n} > n^o$, $\bar{\pi}_n - \pi_n < 0$, an increase in $\bar{n}$ is a **forced** fertility increase.*

Theory: Off the Optimal Fertility

- Rosenzweig & Wolpin (1980): evaluate the model at the unrestricted optimal fertility level ($\bar{n} = n^o$).
- We evaluate the model both at and off the unrestricted optimal fertility level ($\bar{n} = n^o$ or $\bar{n} \neq n^o$).
- Techniques
  - Rationing theory of Neary & Roberts (1980)
  - Duality theorem

Theory: Decomposition

$$\frac{\partial \tilde{q}}{\partial \bar{n}} = \pi_{nq}\frac{\partial \tilde{q^{*c}}}{\partial \pi_q^*} + (1 - \alpha_\Delta \epsilon_{n^*,y})\frac{\partial \tilde{q^{*c}}}{\partial \bar{n}} + (\bar{\pi}_n - \pi_n)\frac{\partial q^*}{\partial y}$$

- *Price effect*
  - Child quantity enters the price of child quality (Becker & Lewis, 1973).
- *Substitution effect*
  - Child quantity directly enters the utility function (Rosenzweig & Wolpin, 1980).
- *Income effect*
  - The rationed child quantity can differ from parental choice (our contribution).

Theory: Implications

- Implication 1
  - Compared with a desired fertility increase, a forced fertility increase is more likely to reduce child quality.
- Implication 2
  - Compared with a desired fertility reduction, a forced fertility reduction is less likely to increase child quality.

Decomposition: A Simulation

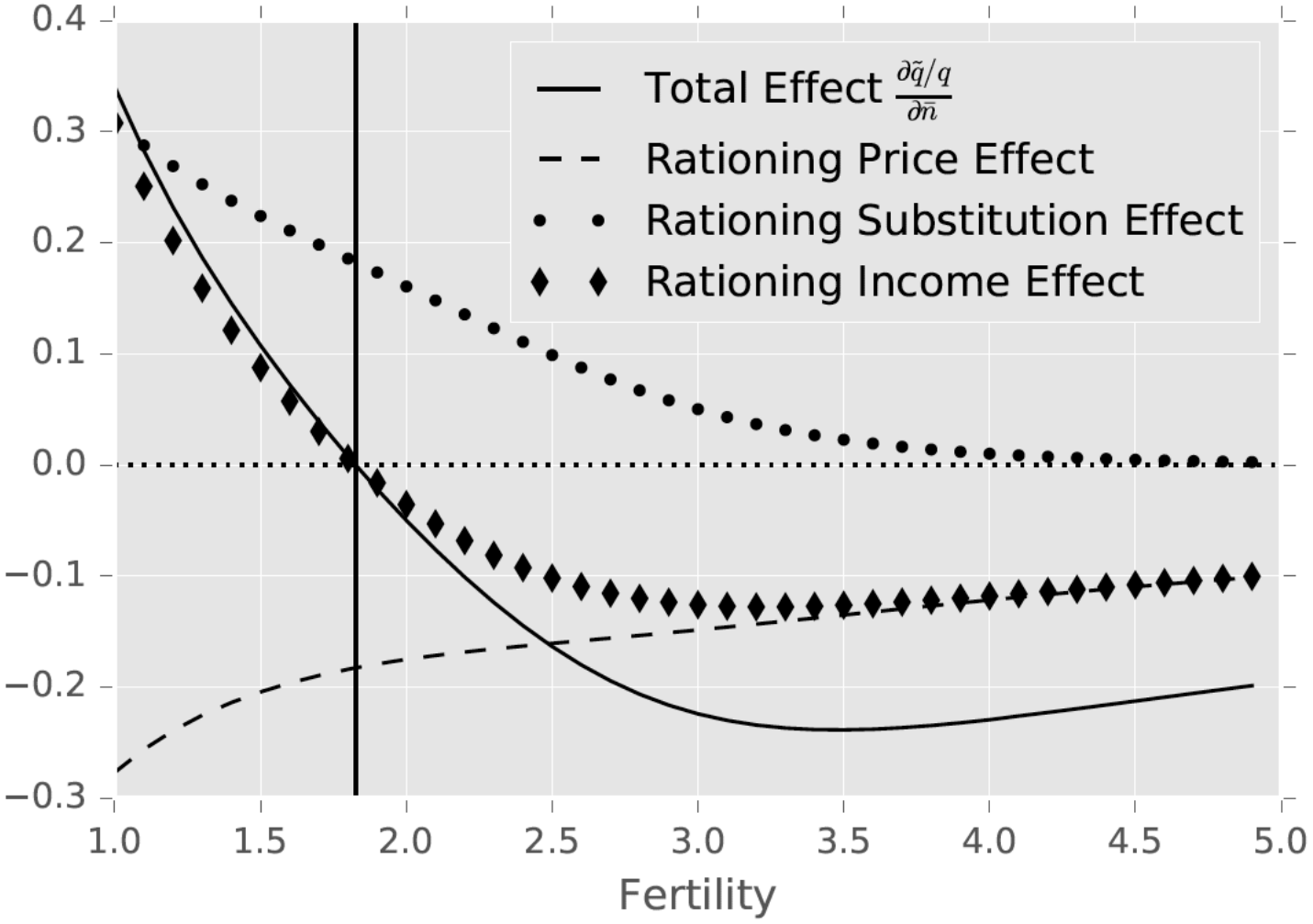
- Parametric version, nested CD-CES:

$$U(\bar{n}, q, s) = U_1^{\theta} s^{1-\theta},$$

$$\text{and} \quad U_1 = (\alpha \bar{n}^{\rho} + (1-\alpha) q^{\rho})^{\frac{1}{\rho}},$$

- As in Mogstad & Wiswall (2016)

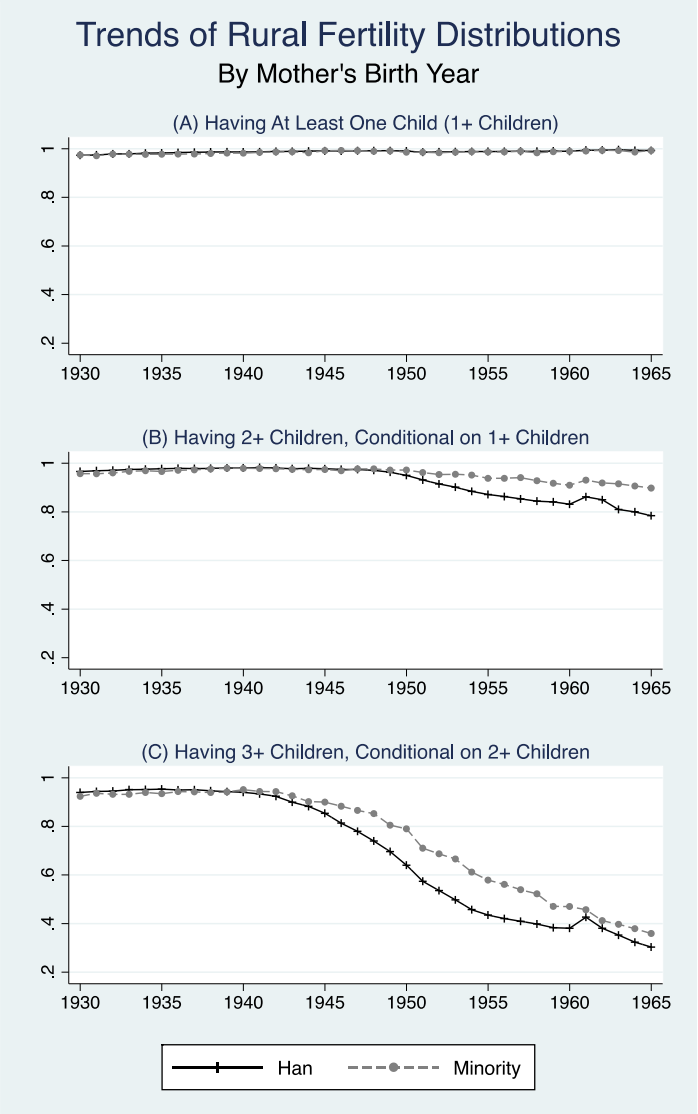
Decomposition: A Simulation



Empirical Strategy

- One-child Policy (OCP) in rural China
  - OCP rations fertility at the two-to-three margin
- Without the OCP
  - For parents who desire two children
  - Twinning at the second birth shifts fertility to three, beyond the desired two
- Under the OCP
  - Parents who want three children can only have two
  - Twinning at the second birth breaks the OCP, shifting fertility to three, towards the desired level

Trends of Fertility Distributions



- Data Source: China population censuses in 1982, 1990, 2000, and 2005.
- The OCP rations fertility at the two-to-three margin.

Two variations of rationing

- Han versus Minority Chinese under the OCP
- Before versus After OCP for Han Chinese

Empirical Specifications

$$Y_{ij} = \alpha_0 + \alpha_1 N_j + \mathbf{X_i}\alpha_2 + \mathbf{C_{ij}}\alpha_3 + \epsilon_{ij},$$

- Y_{ij}: quality indicator of child i in family j.
- N_j: child quantity
  - instrumented by twinning at the second birth
- $\mathrm{X_i}$: family level control variables, age at second birth, parents' age, years of schooling, etc.
- $\mathrm{C_{ij}}$: child level control variables, child gender, age, age squared, and age cubed

Empirical Specifications: Tests

- Han versus Minority

$$Y_{ij} = \beta_0 + \beta_1 N_j + \beta_2 N_j \cdot Han_j + \beta_3 Han_j + \mathbf{X_i}\beta_4 + \mathbf{C_{ij}}\beta_5 + \epsilon_{ij},$$

  - Our theory implies: $\beta_2 > 0$

- Before versus After

$$Y_{ij} = \gamma_0 + \gamma_1 N_j + \gamma_2 N_j \cdot OCP_j + \gamma_3 OCP_j + \mathbf{X_i}\gamma_4 + \mathbf{C_{ij}}\gamma_5 + \epsilon_{ij},$$

  - Our theory implies: $\gamma_2 > 0$ for Han Chinese
    - Placebo test: $\gamma_2 = 0$ or $\gamma_2 < 0$ for minority Chinese

Data

- China population censuses 1982 and 1990
  - 1% sample
- Advantages
  - nationally representative administrative data
  - publically available
- Main Limitation
  - census data only contains intermediate education outcome of children co-residing with parents

Summary Statistics

Table 1: Summary statistics, 1982 and 1990 China population censuses

	Agri. Hukou		Agri. Employment			
	After-OCP (1990 Census)		After-OCP (1990 Census)		Before-OCP (1982 Census)	
Panel A. Family-level information						
	Mean (1)	SD (2)	Mean (3)	SD (4)	Mean (5)	SD (6)
Number of children	2.50	0.72	2.52	0.73	2.99	0.91
Both parents are Han	0.92	0.27	0.91	0.28	0.94	0.24
Twinning at the second birth	0.65%	0.08	0.61%	0.08	0.36%	0.06
Father's age	34.17	3.73	34.18	3.78	34.01	3.91
Mother's age	31.57	2.83	31.53	2.85	31.10	2.59
Mother's age at second birth	25.47	3.07	25.38	3.04	23.92	2.47
Father's years of schooling	7.56	2.96	7.42	2.96	5.95	3.00
Mother's years of schooling	5.21	3.62	5.06	3.60	2.94	3.29
Observations	282734		245233		198798	
Panel B. Child-level information						
	Mean (1)	SD (2)	Mean (3)	SD (4)	Mean (5)	SD (6)
Age	8.48	2.01	8.49	2.01	8.78	2.13
Male	0.50	0.50	0.51	0.50	0.51	0.50
Primary school attendance (dummy)	0.81	0.39	0.81	0.39	0.65	0.48
School enrollment (dummy)	0.81	0.39	-	-	-	-
Observations	457164		398762		386306	

Han versus Minority

Table 2: The effect of rationed fertility on child quality, Han versus Minority

Dependent variable	Primary school attendance				School enrollment			
Sample	Han (1)	Minority (2)	Pooled I (3)	Pooled II (4)	Han (5)	Minority (6)	Pooled I (7)	Pooled II (8)
Number of children (N)	0.002	-0.089**	-0.093*	-0.089**	0.003	-0.083**	-0.086*	-0.083**
	(0.010)	(0.039)	(0.051)	(0.039)	(0.010)	(0.039)	(0.051)	(0.039)
N * Han			0.096*	0.091**			0.089*	0.086**
			(0.053)	(0.040)			(0.053)	(0.040)
Han			-0.229	-0.399			-0.208	-0.378
			(0.149)	(0.284)			(0.149)	(0.290)
Observations	417496	39240	456736	456736	417496	39240	456736	456736

Before versus After One-child Policy

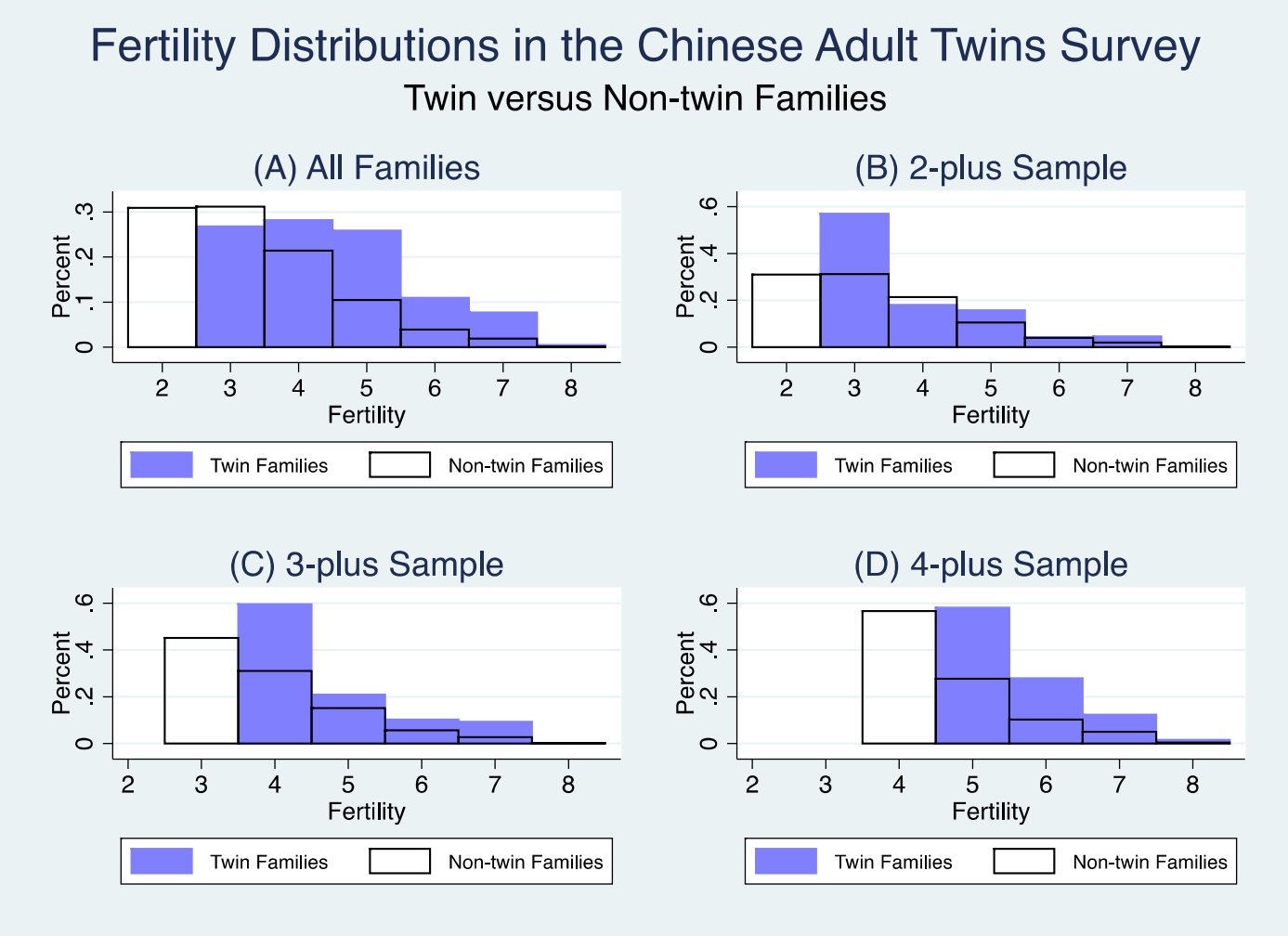
Table 3: The effect of rationed fertility on child quality, before versus after One-child Policy

Dependent variable	Primary schooling attendance							
Sample	Han				Minority			
	Before-OCP	After-OCP	Pooled I	Pooled II	Before-OCP	After-OCP	Pooled I	Pooled II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number of children (N)	-0.055***	-0.007	-0.061***	-0.055***	-0.023	-0.076*	-0.037	-0.023
	(0.019)	(0.011)	(0.021)	(0.019)	(0.070)	(0.042)	(0.080)	(0.070)
N * OCP			0.070***	0.048**			-0.039	-0.053
			(0.026)	(0.022)			(0.107)	(0.082)
OCP			-0.064	-1.689***			0.263	-3.560***
			(0.080)	(0.153)			(0.368)	(0.487)
Observations	362830	361895	724725	724725	23020	36455	59475	59475

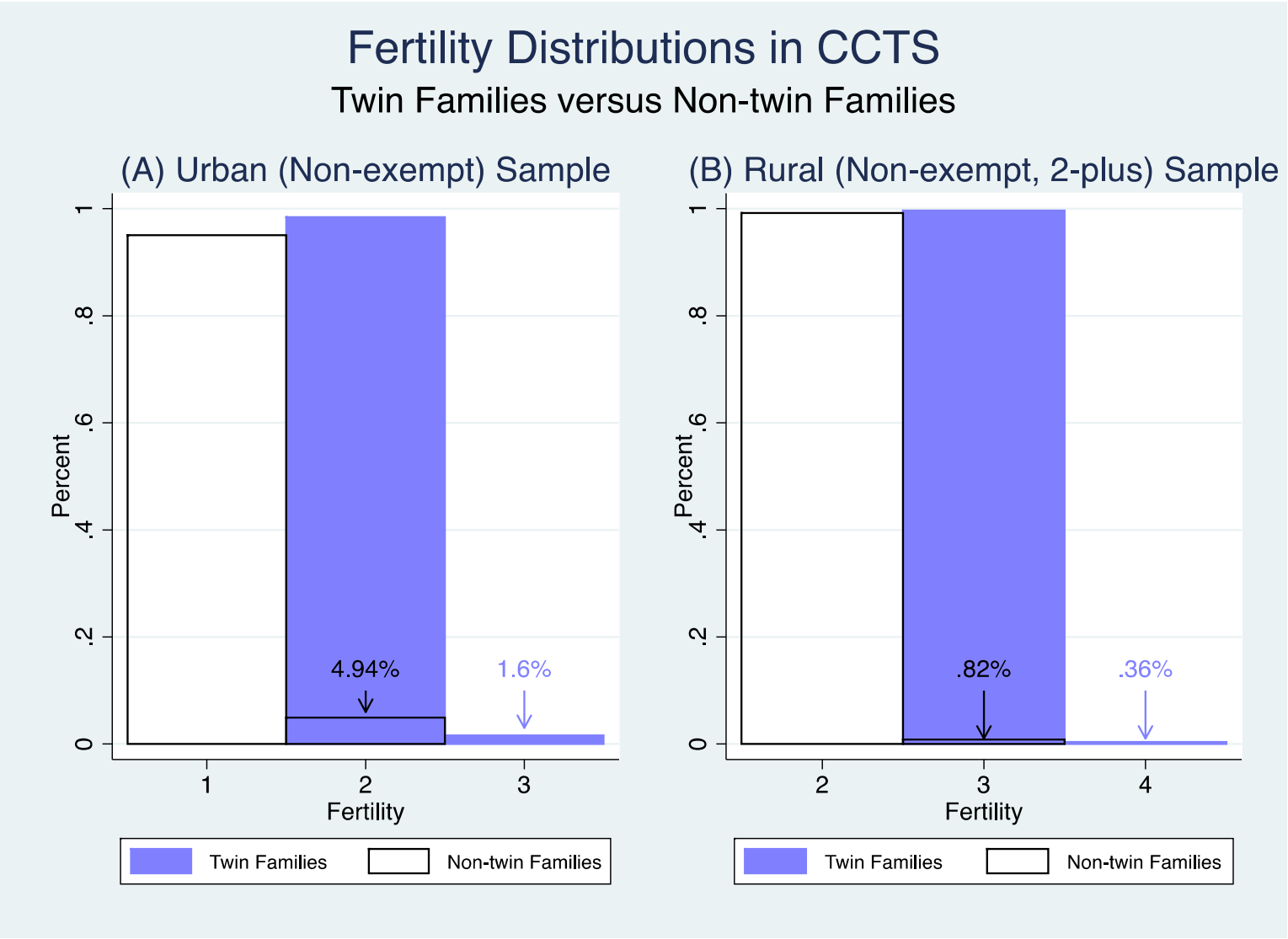
Robustness: Data

- Two unique surveys of Chinese twins
  - both conducted by the National Bureau of Statistics
  - collected in 2002 through face-to-face interviews
  - better indicators of child quality
- Chinese Adult Twins Survey
  - adult twins aged 18-65 in five Chinese cities
- Chinese Child Twins Survey
  - child twins aged 6-18 in the Kunming City of China

Fertility Distribution of Adult Twins



Fertility Distribution of Child Twins



Summary Statistics of Adult Twins

Table A1: Summary statistics, the Chinese Adult Twins Survey (CATS)

	Panel A. Family-level information			
	Non-twin Family (Obs.=1260)		Twin Family (Obs.=649)	
	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)
Number of children	3.32	1.24	4.46	1.23
Father's age	73.57	8.90	71.65	9.25
Mother's age	70.05	8.37	67.95	8.69
Father's years of schooling	8.54	3.21	8.75	3.39
Mother's years of schooling	7.49	2.57	7.63	2.71
	Panel B. Child-level information			
	Non-twin Family (Obs.=4177)		Twin Family (Obs.=2894)	
	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)
Age	43.03	7.54	41.21	8.07
Years of schooling	11.55	2.72	11.38	2.64
Male	0.49	0.50	0.51	0.50

Summary Statistics of Child Twins

Table A2: Summary statistics, the Chinese Child Twins Survey (CCTS)

	Urban (non-exempt) sample				Rural (exempt) sample			
	Panel A. Family-level information							
	Non-twin (Obs.=567)		Twin (Obs.=500)		Non-twin (Obs.=364)		Twin (Obs.=278)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)	(7)	(8)	(9)	(10)
Number of children	1.05	0.22	2.02	0.13	2.01	0.09	3.00	0.06
Father's age	38.43	4.68	38.90	5.05	37.20	4.72	40.20	4.74
Mother's age	36.12	4.13	36.52	4.54	35.28	4.41	37.99	4.35
Mother's age at birth†	24.70	2.99	25.46	3.53	26.79	3.81	27.10	3.76
Father's schooling years	11.03	3.31	10.79	3.36	8.42	2.65	8.02	2.43
Mother's schooling years	10.66	3.03	10.27	3.26	7.36	2.50	6.83	2.39
	Panel B. Child-level information							
	Non-twin (Obs.=532)		Twin (Obs.=1000)		Non-twin (Obs.=514)		Twin (Obs.=748)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)	(7)	(8)	(9)	(10)
Age	11.44	2.71	11.48	2.88	11.74	2.84	11.93	2.93
Male	0.52	0.50	0.50	0.50	0.50	0.50	0.55	0.50
Birthweight (kg)	3.15	0.47	2.42	0.49	3.11	0.48	2.66	0.49
Expected schooling years	15.78	2.35	15.11	2.47	13.17	2.19	12.27	2.48
Child investment (¥/year)	2139.11	2409.27	1960.42	2302.67	882.30	990.20	772.61	730.35
Home tutorial (minutes/day)	20.66	21.12	23.70	22.51	10.99	14.81	9.08	15.09

Robustness: Before versus After

Table 4: The effect of rationed fertility on child quality, evidence from two Chinese twins surveys

Panel A. Chinese Adult Twins Survey (before One-child Policy)			
Dependent variable	Completed schooling years		
Sample	2-plus	3-plus	4-plus
	(1)	(2)	(3)
Number of children	-0.838***	-0.619***	-1.059***
	(0.220)	(0.203)	(0.280)
Observations	5149	4248	2824
Panel B. Urban sample of Chinese Child Twins Survey (after One-child Policy)			
Dependent variable	Expected schooling years	Child investment	Home tutorial time
	(1)	(2)	(3)
Twinning	-0.268	-0.067	0.263**
	(0.166)	(0.069)	(0.113)
Observations	1506	1532	1510
R-squared	0.28	0.12	0.14
Panel C. Rural sample of Chinese Child Twins Survey (after One-child Policy)			
Dependent variable	Expected schooling years	Child investment	Home tutorial
	(1)	(2)	(3)
Twinning on 1st-born	-0.202	-0.295	-0.217
	(0.286)	(0.145)	(0.178)
Twinning on 2nd-born	-0.082	0.153	0.027
	(0.251)	(0.098)	(0.163)
Observations	1181	1262	1136
R-squared	0.14	0.11	0.16

Parental Responses

- Why the estimated fertility effect on child quality, such as our estimates using CCTS, can be so small?
  - Galor (2012): in response to externally imposed non-optimal fertility level, parents may adjust in margins other than child quality.
  - Angrist, Lavy, & Schlosser (2010): parents may reduce consumption or increase labor supply to maintain child quality.
- Lack of empirical tests
  - Data sets with information on parental consumption rarely contain a large sample of twins.

Data: Chinese Child Twins Survey

Table A6: Summary statistics of the Chinese Child Twins Survey, parental consumption and labor supply

	Urban (Non-exempt) Sample				Rural (Exempt) Sample			
	Non-twin (N=567)		Twin (N=500)		Non-twin (N=364)		Twin (N=278)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)	(7)	(8)	(9)	(10)
Family income (¥/year)	15475.31	12718.49	15252.51	13649.34	10704.67	8845.79	11032.37	9888.22
Paternal Expenditure								
Cigarette expenses (¥/month)	103.58	101.88	98.56	128.38	58.82	65.51	47.49	54.93
Alcohol expenses (¥/month)	17.09	39.31	15.89	45.65	11.69	15.23	13.15	23.42
Clothing expenses (¥/six months)	246.21	391.24	211.73	361.59	124.20	177.34	87.77	168.39
Dinner out without children (dummy)	0.37	0.48	0.27	0.45	0.19	0.39	0.11	0.31
Maternal Expenditure								
Cosmetics expenses (¥/six months)	146.49	281.76	100.67	164.89	18.12	39.14	10.10	32.93
Clothing expenses (¥/six months)	339.57	461.80	264.67	377.01	118.55	146.37	82.32	109.33
Dinner out without children (dummy)	0.33	0.47	0.24	0.43	0.07	0.26	0.05	0.21
Paternal Labor Supply								
Labor force participation (dummy)	0.80	0.40	0.79	0.41	0.83	0.37	0.82	0.38
Days worked last month	24.11	5.03	24.58	4.79	25.88	4.32	26.38	4.64
Hours worked last week	46.68	14.74	48.42	15.67	48.73	13.65	49.57	14.35
Labor income (¥/month)	873.48	658.39	930.58	920.29	538.34	678.73	472.28	435.73
Earnings per hour (¥/hour)	6.82	6.49	6.78	5.49	3.48	4.12	3.38	3.62
Private business (dummy)	0.18	0.38	0.21	0.41	0.21	0.41	0.33	0.47
Out home one month (dummy)	0.09	0.29	0.12	0.33	0.10	0.30	0.12	0.32
Maternal Labor Supply								
Labor force participation (dummy)	0.63	0.48	0.65	0.48	0.78	0.42	0.78	0.41
Days worked last month	23.50	5.11	24.30	4.64	25.76	4.96	26.53	4.57
Hours worked last week	43.85	13.66	45.99	14.25	47.38	15.01	48.06	15.06
Labor income (¥/month)	589.45	522.88	621.41	706.38	285.13	296.91	267.47	245.65
Earnings per hour (¥/hour)	5.74	4.21	5.91	5.49	2.17	3.41	2.16	2.42
Private business (dummy)	0.16	0.37	0.23	0.42	0.20	0.40	0.35	0.48
Out home one month (dummy)	0.05	0.21	0.04	0.21	0.02	0.14	0.04	0.20

Parental Consumption

Table 5: The effect of rationed fertility on parental consumption (Chinese Child Twins Survey)

Dependent	Father's consumption				Mother's consumption		
variable	Cigarette	Alcohol	Clothing	Dinner out	Cosmetics	Clothing	Dinner out
			Panel A. Urban sample				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Twinning	-0.102	-0.159	-0.264*	-0.071**	-0.218*	-0.344**	-0.064**
	(0.140)	(0.105)	(0.155)	(0.028)	(0.127)	(0.148)	(0.027)
Observations	1067	1067	1067	1062	1067	1067	1060
R-squared	0.03	0.02	0.07	0.08	0.16	0.11	0.08
			Panel B. Rural sample				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Twinning	-0.091	0.027	-0.611***	-0.047	-0.470***	-0.614***	-0.020
	(0.141)	(0.119)	(0.167)	(0.029)	(0.129)	(0.165)	(0.019)
Observations	642	642	642	642	642	642	641
R-squared	0.02	0.03	0.10	0.03	0.10	0.12	0.02

Parental Labor Supply

Table 6: The effect of rationed fertility on parental labor supply (Chinese Child Twins Survey)

Dependent Variable	Labor force participation	Days worked last month	Hours worked last week	Labor income	Earnings per hour	Private business	Out home one month
			Panel A. Urban father's labor supply				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Twinning	-0.003	0.017	0.038*	0.077**	0.039	0.027	0.029
	(0.024)	(0.013)	(0.022)	(0.038)	(0.043)	(0.026)	(0.019)
Observations	1067	837	840	1030	834	845	1067
R-squared	0.09	0.06	0.03	0.20	0.23	0.12	0.03
			Panel B. Urban mother's labor supply				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Twinning	0.051*	0.018	0.048**	0.076	0.044	0.059**	-0.002
	(0.028)	(0.014)	(0.024)	(0.055)	(0.051)	(0.029)	(0.013)
Observations	1066	674	676	903	665	681	1067
R-squared	0.13	0.08	0.03	0.14	0.29	0.15	0.01
			Panel C. Rural father's labor supply				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Twinning	0.011	0.005	0.017	-0.021	0.047	0.114***	0.041
	(0.034)	(0.018)	(0.028)	(0.068)	(0.081)	(0.041)	(0.026)
Observations	642	530	528	629	529	532	642
R-squared	0.02	0.02	0.02	0.11	0.14	0.05	0.02
			Panel D. Rural mother's labor supply				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Twinning	0.002	0.016	-0.007	0.015	0.069	0.142***	0.031**
	(0.036)	(0.020)	(0.033)	(0.069)	(0.085)	(0.041)	(0.016)
Observations	640	498	496	587	484	500	642
R-squared	0.02	0.01	0.02	0.11	0.13	0.07	0.02

Conclusion

- Theory: Rationed Fertility
  - forced versus desired fertility changes
- Evidence: Twin Births + One-child Policy
  - Twinning-induced fertility increases are more likely to reduce child quality for families whose fertility was not rationed by the One-child Policy.
- Parental Responses
  - Parents work harder and consume less.
- Population Control Policies: “voluntary” policy instruments are preferred to “mandatory” ones.

The End

Thank you!