Differential Fertility and Economic Opportunity: Evidence from China's One-Child Policy

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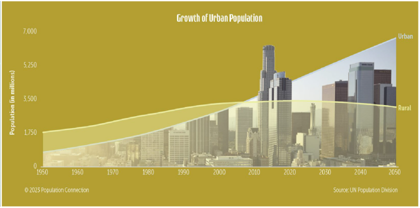
Urbanization and Demographic Transition

- Urbanization and demographic transition usually interact with each other (Sato and Yamamoto 2005, Sato 2007, Jedwab, Christiaensen, and Gindelsky 2017)
- Demographic factors, e.g., rural-urban migration (*"rural push"*, *"urban pull"*) or internal urban population growth (*"urban push"*)
- Identified to explain for rapid urbanization especially for developing countries



Urbanization and Demographic Transition

- Using socially engineered rural-urban disparity in fertility under China's One-Child Policy as a quasi-natural experiment,
- First set of empirical evidence on the impact of differential fertility btw urban/richer and rural/poorer families on intergenerational economic mobility
  - Economic opportunity based on parents' socioeconomic status
  - Policy implication to improve economic opportunity especially for children born in disadvantaged families (Piketty 2000; Corak 2013; Chetty et al. 2017)

Demographic Transition and Economic Opportunity

- **Malthusian era:** richer/more educated parents had higher fertility
- Fertility differential flipped along with the demographic transition
- **Modern regime:** parents with higher education/income have low fertility, b/c higher opportunity cost in rearing children (Lam 1986; De La Croix and Doepke 2003; Doepke 2004)
- More children born to poorer families; less human capital and lifetime income (child quality-quantity trade-off)
- **In theory**, reduced economic opportunity for children of the poor and decreased intergenerational mobility (Chu and Koo 1990)

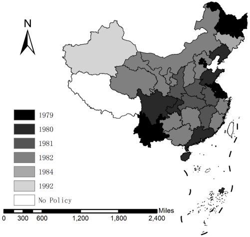
Empirical Challenges to Identify the Causal Impact

- **Challenge 1** - Endogeneity: unobserved parental preference for child quality/quantity correlates with fertility; simultaneously correlates with parent's and child's lifetime income

- **Challenge 2** - Difficult to obtain reliable estimates of intergenerational mobility; lifecycle bias, attenuation bias, and selection bias (Solon 1989, 1992; Mazumder 2005)

Address Challenge 1: Quasi-Natural Experiment of OCP

- A bundle of population control policies from 1979; reduce approx. 400 million population (half Europe)
- One of the most extreme forms of birth control: propaganda, regulations, incentives, monetary & employment penalties
- Vary in timing across provinces and cohorts:
  - Beijing and Tianjin took the lead in 1979; Hebei and Shanxi from 1982; Xinjiang as late as 1992 (Huang, 2021)



- Vary across ethnic groups → focus on Han population

China's One-Child Policy: Differential Fertility

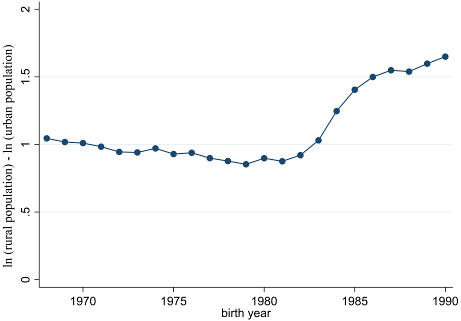
- Vary across richer/urban and poorer/rural areas in the enforcement of OCP:
  - **Fines**, proportional to monthly salary, onerous burden (Chu, 1987; Ebenstein, 2010) ⇒ Rural households defaulted as being unable to pay heavy fines; in contrast, richer/urban families' fertility choices were more restricted by fines
  - *Empirically*, fertility of the poor did not vary with fines, whereas the effect of fines on the fertility of the rich was significantly negative (Li & Zhang, 2004)
  - **Employment penalties**—e.g., demotion/dismissal in a state-owned enterprise or withdrawal of the children's right to go to school—more realistic for urban residents
- Strong resistance—even after written into 1982 Constitution—esp. for rural families with only one girl
  - practical and cultural reasons ⇒ traditional son preference strong, agricultural production labor intensive, old-age pension system largely absent

Differential Fertility

- Widespread opposition and difficulties with enforcement led to a conditional two-child policy in rural China
    - Central Document No. 7 (1984) conditional two-child policy in rural: most rural families were officially allowed to have a second child if the first were a girl
    - Strict one-child policy in urban area
    - Punishment for third or higher-order child was also less severe in rural areas than urban ones (Ebenstein 2010, 2011, 2014; Zhang 2017)

Differences in Cohort Size btw Rural and Urban China

- Enlarging differential fertility btw urban and rural areas: population gap triples from 5.8m (1979 cohort) to 15.1m (1990 cohort) (1% sample of 2000 census)



- Quasi-experimental variations in fertility differential induced by the OCP mimic the flipped fertility differential during the demographic transition

Address Challenge 2: Econometric Strategies

- Three measures on intergenerational income mobility: rank-rank slope, expected income percentile rank of children born to fathers at the 25 and the 75 percentile ranks
- Empirical strategies to overcome lifecycle bias, attenuation bias, and selection bias (Fan et al., 2021)
- Combine data from nationally representative longitudinal household surveys: 2010–2018 China Family Panel Studies (CFPS) and 2011–2015 China Health and Retirement Longitudinal Study (CHARLS)

Our Findings

- Instrumental variable (IV) estimation to quantify the causal effects of differential fertility induced by the OCP on intergenerational income mobility
- Differential fertility amplifies intergenerational inequality: rural-urban fertility ratio increases by 1, intergenerational income persistence increases by 0.133 (53.2%)
- Mainly driven by increase in mean percentile rank of children born to urban/wealthier families
- Possible mechanism: human-capital investment
- Back-of-envelope calculation: The OCP accounts for about 25% of the decline in intergenerational income mobility

Potential Contribution

- Literature on **differential fertility and intergenerational inequality**:
  - Among the first to empirically test the impact; consistent with earlier theoretical predictions (Lam, 1986; Chu and Koo, 1990; Doepke, 2004)
- Literature on **economic opportunity and intergenerational mobility**:
  - Most from developed countries; evidence from developing country
  - Determinants of intergenerational mobility: neighborhood quality, school finance (Chetty et al., 2018; Biasi, 2019); first strand of empirics from demographic perspective

Policy Implication

- **Population policies**—aimed at either slowing population growth in developing countries or fighting falling birth rates in developed countries—could have differential impacts across families
- These differential impacts of population policies could have unexpected intergenerational consequences

Rest of the Paper

- Measures of intergenerational mobility and econometric challenges
  - Three measures
  - Econometric challenges
- Data, variables, sample construction, and intergenerational estimates
  - Data sources and variables
  - Sample construction
  - Summary statistics
- Causal effect of differential fertility on intergenerational mobility
  - Econometric specification
  - instrumental variable, identification assumption and justification
  - IV estimates
  - Robustness and heterogeneity analyses
- Human-capital mechanism
- % of OCP account for declining intergenerational mobility

Measures of Intergenerational Mobility

- **Rank-rank slope, α_1**:
  - Compute each child's/father's lifetime income and compare with peers, to calculate the respective percentile rank at the national level (0-100) by child's birth cohort
  - Regress child's percentile rank on father's percentile rank:

$$rank_i = \alpha_0 + \alpha_1 rank_f + \epsilon_i \tag{1}$$

$rank_i$ is the income percentile rank of child i in each birth cohort, and $rank_f$ is his/her father f's income percentile rank; control demographics such as child's sex, age, age^2, father's age, age^2

  - Larger (smaller) rank-rank slope estimate α_1 indicates higher (lower) income persistence across generations
  - Drawback: relative mobility can be driven by either better outcomes for children of the poor or worse outcomes for those of the rich

Measures of Intergenerational Mobility

- Mean income percentile rank of children born to fathers at the 25 percentile rank, $income^{25}$

$$income^{25} = \alpha_0 + \alpha_1 \times 25 \quad (2)$$

where α_0 and α_1 are estimates from equation (1)

- A larger estimate, $income^{25}$, indicates higher mean percentile rank of children from families in the bottom income percentiles

- Mean income percentile rank of children born to fathers at the 75 percentile rank, $income^{75}$

$$income^{75} = \alpha_0 + \alpha_1 \times 75 \quad (3)$$

- A larger estimate, $income^{75}$, indicates higher mean percentile rank of children from families in the top income percentiles

Econometric Challenges: Lifecycle Bias

- Developed countries ⇒ administrative data; Developing countries ⇒ survey data
- Lifecycle bias arises when using current earnings of children—especially in early life stages—to estimate intergenerational income mobility
- Earnings at early stage of life cycle systematically differ from lifetime earnings (Grawe, 2006; Haider & Solon, 2006; Nybom & Stuhler, 2016b)
- Overcoming strategies:
  - Children at midlife stage and fathers at mid-to-late life stage
  - Rank-based estimate: most age-stable among all measures (Nybom & Stuhler, 2017)
  - Use predicted lifetime income including age polynomials for children and fathers

Econometric Challenges: Attenuation Bias

- Income from a specific year may not be a proper measurement of lifetime income
- Transitory shock and measurement errors (Solon, 1989, 1992; Mazumder, 2005)
- Overcoming strategies:
  - Take average across two to eight years using the longitudinal data
  - Rank-rank estimation is subject least to attenuation bias (Nybom & Stuhler, 2017)
  - Predict both fathers and children lifetime income

Econometric Challenges: Selection Bias

- **Co-residence bias** as individuals choose to stay at home (e.g., when children get married, they usually leave their parents' household and form a new household)
- **Temporary migrants** who are usually not recorded in household surveys ⇒ severe during the economic reform
- Overcoming strategies:
  - Heckman selection model to address selection bias (Heckman, 1979)
  - Generate predicted lifetime income at the individual level for children and fathers

Data Sources and Variables

- Combine data from two nationally representative biannual longitudinal household surveys: the 2010–2018 CFPS and the 2011–2015 CHARLS
  - Both CFPS and CHARLS samples are nationally representative
  - The panel structure facilitates calculating lifetime income
  - Demographic and socioeconomic characteristics for household members and non-coresiding spouses, parents, children, siblings
  - Predicted lifetime income for co-residing and non-coresiding children and parents using education and demographic information (Fan et al., 2021)
- Income summation: wage, farming/self-employment, property, transfer, and other
- Averaged across two to eight years; adjusted to 2010 price
- Other variables: age, hukou, coast region, schooling, gender

Summary Statistics at Individual Level

- Nationally representative sample of 22,169 Han father–child pairs; children born 1970-1985 and from 21 provinces/ autonomous regions

Variable	Observations	Mean	SD
Panel A. Children			
Age	22,169	31.299	4.264
Hukou status (rural = 1)	22,169	0.722	0.448
Coast (coastal region = 1)	22,169	0.341	0.474
Schooling years	22,169	8.769	4.234
Gender (male = 1)	22,169	0.492	0.5
Computed lifetime income (in log form)	22,169	9.808	0.37
Panel B. Fathers			
Age	22,169	57.733	4.387
Hukou status (rural = 1)	22,169	0.738	0.44
Coast (coastal region = 1)	22,169	0.341	0.474
Schooling years	22,169	5.907	4.353
Computed lifetime income (in log form)	22,169	9.408	0.295
Number of children	22,169	2.855	1.179

Sample Construction at Province-Cohort Level

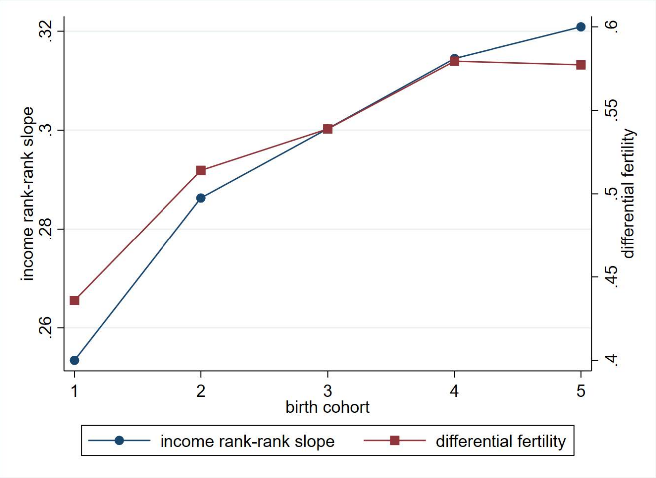
- Divide the full sample into 105 groups by the child's birth cohort and province
  - Five cohorts by child's birth year 1970–1973, 1974–1976, 1977–1979, 1980–1982, and 1983–1985
- **Intergenerational income mobility** measured by the three estimates of intergenerational mobility by cohort and province
- **Differential fertility** measured by difference in average number of children btw rural and urban households by cohort and province
- **Control variables:** sex ratio, share of rural mothers (p.p), policy exposure to land reform, GRP per capita, share of primary industry, beds per 10,000 ppl, imports & exports per capita (growing-up environment at age 3-12)

Summary Statistics at Province-Cohort Level

Variable	Mean	SD
Panel A. Intergenerational Income Mobility		
Income rank-rank slope	0.295	0.123
Mean income percentile rank of children born to fathers at the 25 income percentile rank	43.34	8.313
Mean income percentile rank of children born to fathers at the 75 income percentile rank	57.065	5.633
Panel B. Intergenerational Education Mobility		
Education rank-rank slope	0.337	0.106
Mean education percentile rank of children born to fathers at the 25 education percentile rank	42.187	6.416
Mean education percentile rank of children born to fathers at the 75 education percentile rank	58.958	6.653
Panel C. Main Independent Variable		
Differential fertility (difference in average number of children between rural and urban areas)	0.529	0.357
Panel D. Control Variables		
Logarithm of GRP per capita	6.362	0.455
Share of primary industry	32.347	8.22
Number of beds per 10,000 persons	22.203	7.972
Imports and exports per capita	60.697	91.645
Sex ratio	0.515	0.005
Policy exposure of mothers to land reform	0.782	0.21
Share of rural mothers (percentage points)	75.466	12.24
Panel E. Instrumental Variable		
Policy exposure of mothers to OCP	0.68	0.159

Note: Data are derived from the CFPS (2010–2018), CHARLS (2011–2015), China Compendium of Statistics (1949–2008), and China Compilation of Demographic Data (1949–1985). Number of observations: 105.

Differential Fertility and Intergenerational Mobility



Differential Fertility and Intergenerational Mobility

- **Fixed-effects (FE) Estimation:**

$$Y_{pc} = \beta_0 + \beta_1 DiFertility_{pc} + X_{pc}\beta_X + \mu_r + \lambda_c + \epsilon_{pc}, \tag{4}$$

- Y_{pc}: measure of intergenerational income mobility for birth cohort c in province p
- $DiFertility_{pc}$: difference of average rural-urban fertility for birth cohort c in province p
- X_{pc}: sex ratio, share of rural mothers (p.p), policy exposure to land reform, GRP per capita, share of primary industry, beds per 10,000 ppl, imports & exports per capita (growing-up environment at age 3-12)
- Bootstrapped standard errors: sample size is small; independent variables and major dependent variables are calculated/estimated based on the full sample

Instrumental Variables

- Endogeneity concern in FE estimation
- Use the rollout of the OCP across provinces and birth cohorts to construct IVs
- The OCP was strictly implemented in urban China, though less effectively implemented in rural China and with exemptions
- Differential fertility depends on the mothers' policy exposure during their childbearing years and share of rural mothers
- Use policy exposure of mothers and its interaction with share of rural mothers as IVs

Instrumental Variables

- **Policy exposure of mothers of child i in province p of cohort c ($exposure_{ipc}$):**
- Calculation based on (i) the start year of implementing OCP in province p, $PolicyYear_p$, (ii) the mother's birth year, τ, and (iii) the mother's probability of giving birth at age a, $ProbBirth_e(a)$ (Chen and Fang, 2018; Guo et al., 2016)

$$ProbBirth_e(a) \times I[\tau + a \geq PolicyYear_p] \tag{5}$$

  - where $ProbBirth_e(a)$ is the standardized probability of a mother in 1930-1939 cohorts with education e giving birth at age a, using 1% Sample of the 1982 Chinese Population Census
  - where the indicator variable, $I[\tau + a \geq PolicyYear_p]$, is equal to 1 if child i's mother born in year τ and province p was subject to OCP at age a, and 0 otherwise

- Calculate the total policy exposure of child i's mother, $exposure_{ipc}$, by summing the policy exposures between 17 and 46 years old:

$$exposure_{ipc} = \sum_{a=17}^{46} ProbBirth_e(a) \times I[\tau + a \geq PolicyYear_p] \tag{6}$$

  - where c is child i's birth cohort

Instrumental Variables

- **Policy exposure of mothers at province-cohort level**
  - For each group, calculate the variable of mothers' policy exposure, $Exposure_{pc}$, by averaging the value $exposure_{ipc}$ across all children within the group
- **Share of rural mothers at province-cohort level**
  - We measure share of rural mothers based on the *hukou* status of the mothers
- Address heterogeneity of mothers in birth years, education, and provinces; robust to alternative measure of exposure intensity (Guo, Yi, and Zhang, 2020)

First-stage Estimation

- **First stage:**

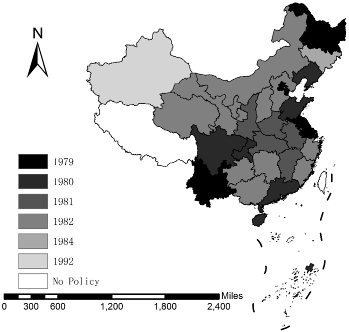
$$\begin{aligned} DiFertility_{pc} = \gamma_0 + \gamma_1 Exposure_{pc} + \gamma_3 Exposure_{pc} \times RuralMother_{pc} \\ + X_{pc}\gamma_X + \mu_r + \lambda_c + \epsilon_{pc}, \end{aligned} \quad (7)$$

  - $Exposure_{pc}$ is the policy exposure of mothers for birth cohort c in province p
  - $RuralMother_{pc}$ is the share of rural mothers

- The identification of equation (7) exploits cross-province and cross-cohort variations in the policy exposure of mothers

Identification Assumptions and Justifications

- Our IV estimation strategy relies on the assumption that the staggered rollout of OCP across provinces and years is exogenous
- Institutionally, the rollout timing of implementation OCP across regions depended on top-down decision process and enforcement (Huang, 2021)



- Literature has also extensively used this policy variation as exogenous shock (Ebenstein, 2011; Zhang, 2017)

Identification Assumptions and Justifications

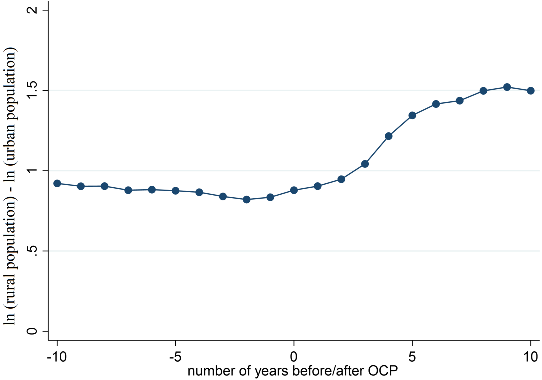
- **Independence:** other historical events or policies during China's transition period may affect intergenerational income mobility differentially for urban and rural areas, and thus confound the impact of OCP

- Potentially confounding policies:
  - "Later, Longer, and Fewer" campaign ⇒ different timelines and affect different cohorts (Guo, Yi, and Zhang, 2020; Chen and Fang, 2021)
  - Land reform ⇒ controlled

- **Exclusion restriction:** fertility may affect intergenerational mobility through channels other than the OCP, e.g., sex ratio ⇒ controlled

Identification Assumptions and Justifications

- **Empirical test:** temporal effect of OCP on fertility in rural vs. urban China (2000 census 1% sample)
- Regress log rural/urban population on birth year and province FE → average regression residuals relative to OCP adoption years across provinces → calculate differences btw rural and urban areas in cohort sizes



IV Estimates

	Differential fertility	Rank-rank slope	Mean percentile rank of children born to fathers at the 25 percentile rank	Mean percentile rank of children born to fathers at the 75 percentile rank
	(1)	(2)	(3)	(4)
Panel A. FE Estimation Results				
Differential fertility		0.078**	-0.146	2.475*
		(0.031)	(1.635)	(1.326)
R-squared		0.525	0.607	0.377
Panel B. IV Estimation Results				
Differential fertility		0.133**	3.536	9.666***
		(0.054)	(2.318)	(2.716)
Policy exposure of mothers	0.555			
	(1.562)			
Policy exposure of mothers × share of rural mothers	-0.046**			
	(0.018)			
Control variables	YES	YES	YES	YES
Cohort FE	YES	YES	YES	YES
Regional FE	YES	YES	YES	YES
Observations	105	105	105	105

First-stage F statistic 20.783; p-value of Sargan test on over-identifying restriction 0.183

Robustness Checks

	(1)	(2)	(3)
	Rank-rank slope	Mean percentile rank of children born to fathers at the 25 percentile rank	Mean percentile rank of children born to fathers at the 75 percentile rank
Panel A. Alternative Measure of Differential Fertility: Rural/Urban fertility ratio			
Differential fertility	0.261**	6.958	19.014***
	(0.104)	(4.645)	(5.287)
Panel B. Alternative Socioeconomic Measures of a Child's Early Environment: Ages 3–9			
Differential fertility	0.122**	4.160	9.854***
	(0.051)	(2.437)	(2.821)
Panel C. Alternative Measure of IV: Unstandardized Probability of Giving Birth			
Differential fertility	0.122**	2.330	8.043***
	(0.055)	(2.404)	(2.421)
Panel D. Alternative Definition of the First Cohort: Children Born between 1968 and 1973			
Differential fertility	0.119**	2.885	8.310***
	(0.049)	(2.227)	(2.428)
Control variables	YES	YES	YES
Cohort FE	YES	YES	YES
Regional FE	YES	YES	YES
Observations	105	105	105

Heterogeneity Analyses

	(1)	(2)	(3)
	Rank-rank slope	Mean percentile rank of children born to fathers at the 25 percentile rank	Mean percentile rank of children born to fathers at the 75 percentile rank
		Panel A. Sons	
Differential fertility	0.160	6.193	11.265**
	(0.100)	(6.151)	(5.665)
		Panel B. Daughters	
Differential fertility	0.200**	8.786	20.462***
	(0.091)	(7.281)	(6.996)
Control variables	YES	YES	YES
Cohort FE	YES	YES	YES
Regional FE	YES	YES	YES
Observations	100	100	100

Human Capital Mechanism

	Rank-rank slope	Mean percentile rank of children born to fathers at the 25 education percentile rank	Mean percentile rank of children born to fathers at the 75 education percentile rank
	(1)	(2)	(3)
Panel A. FE Estimation Results			
Differential fertility	0.073**	-1.416	1.761
	(0.028)	(1.237)	(1.335)
R-squared	0.329	0.525	0.461
Panel B. IV Estimation Results			
Differential fertility	0.103*	2.666	7.828***
	(0.054)	(2.359)	(3.038)
Control variables	YES	YES	YES
Cohort FE	YES	YES	YES
Regional FE	YES	YES	YES
Observations	105	105	105

How much does OCP account for decline in intergenerational income mobility?

$$\frac{\partial\, intergenerational\ mobility}{\partial\, OCP} = \frac{\partial\, intergenerational\ mobility}{\partial\, differential\ fertility} \times \frac{\partial\, differential\ fertility}{\partial\, OCP}$$

0.261 from our estimate

0.064 from literature

How much does OCP account for decline in intergenerational income mobility?

- OCP accounts for **around 25%** of the decrease in intergenerational mobility
  - Income rank-rank slope declines by 0.261 when differential fertility increases by 1
  - Increase in rank-rank slope by the OCP is 0.261×0.064
  - Rank-rank slope increases by 0.07 from the first to the last cohort ($0.25 \rightarrow 0.32$)
  - In total, it accounts for around 25% of the decrease in intergenerational mobility

New Era in China

- China relaxed its OCP and implemented two-child policy (Jan 2016) and three-child policy (May 2021)
- Experiment by Peking University: *How much money would you be motivated to have a 2nd/3rd child?*

"给多少钱你愿意生二胎三胎？"北大学者做了一项调查实验

表 1 不同实验因素的意愿支付价格（单位：万元）

	二孩生育潜力	三孩生育潜力
家庭照料（参照组：自己照料）		
父母公婆照料	12.5	6.29
市场化育儿服务（参照组：价格高公立私立）		
价格低公立托育服务	13.86	8.87
价格低私立托育服务	13.86	6.61

- Possible differential fertility btw families willing & unwilling to have higher-order child(ren)

Conclusion

OCP contributes significantly to China's declining intergenerational mobility

- The policy causes differential fertility between richer/urban and poorer/rural families
- Because of child quantity-quality trade-off, inequality in human capital investment in children born to the two types of families increases $\Rightarrow$ income inequality in one generation persists into the next
- China relaxed its OCP and implemented two-child policy (Jan 2016) and three-child policy (May 2021)
- Population control policy may have significant ramifications for Chinese society, not only intragenerationally but also intergenerationally

Thank You!

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