

Lecture notes on population and fertility

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Population pressures



Outline

1. Basic data
2. Malthusian theories
3. Demographic transitions
4. Demographic gifts and burdens

11:09 am, Monday 10 April 2017

Population:

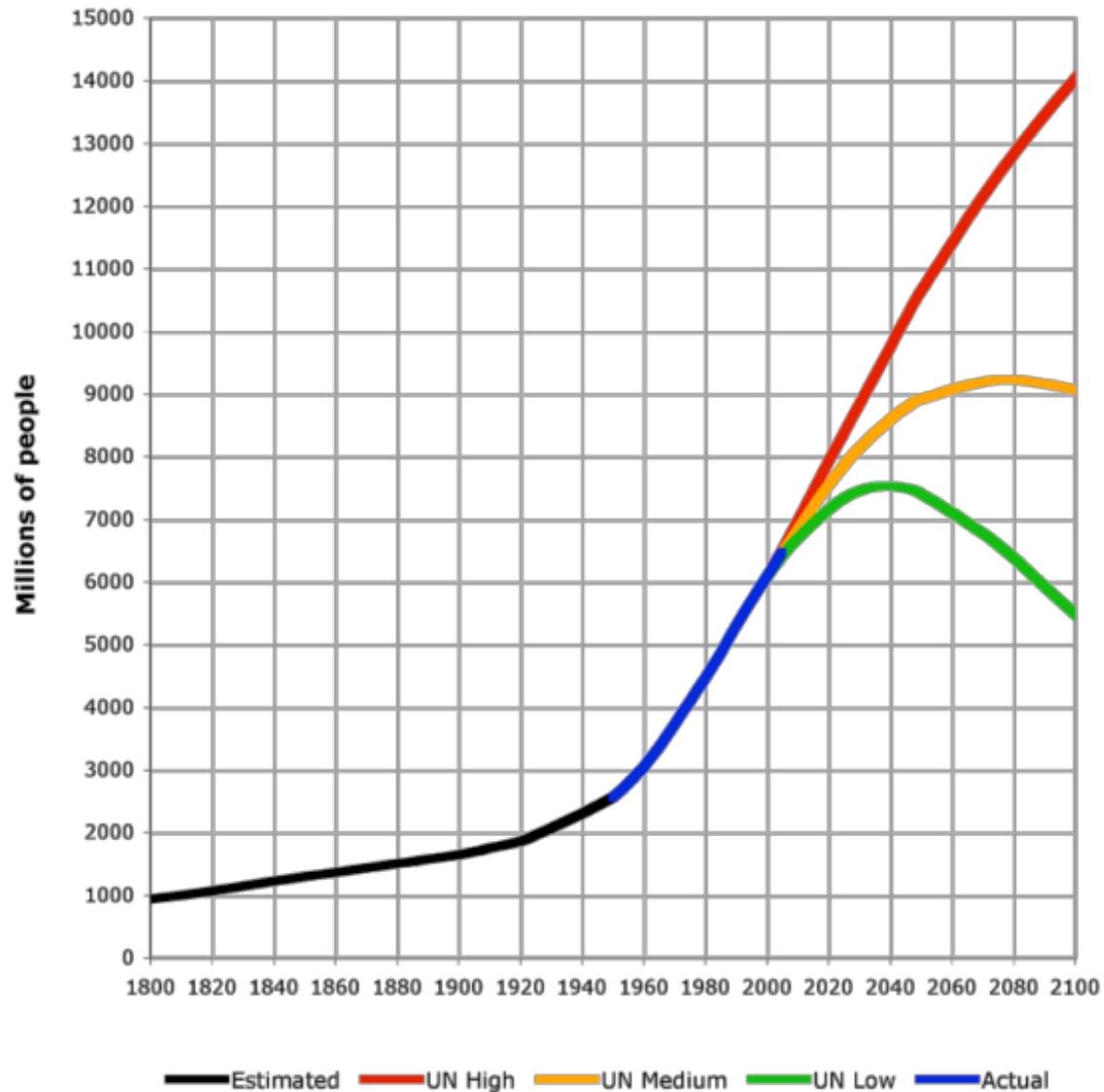
%↑

U.S.	325,935,142	0.73
China	1,387,182,921	0.43
India	1,339,000,964	1.2
World	7,497,095,733	
Growth from 2016:	94 859 245 (1.1%)	



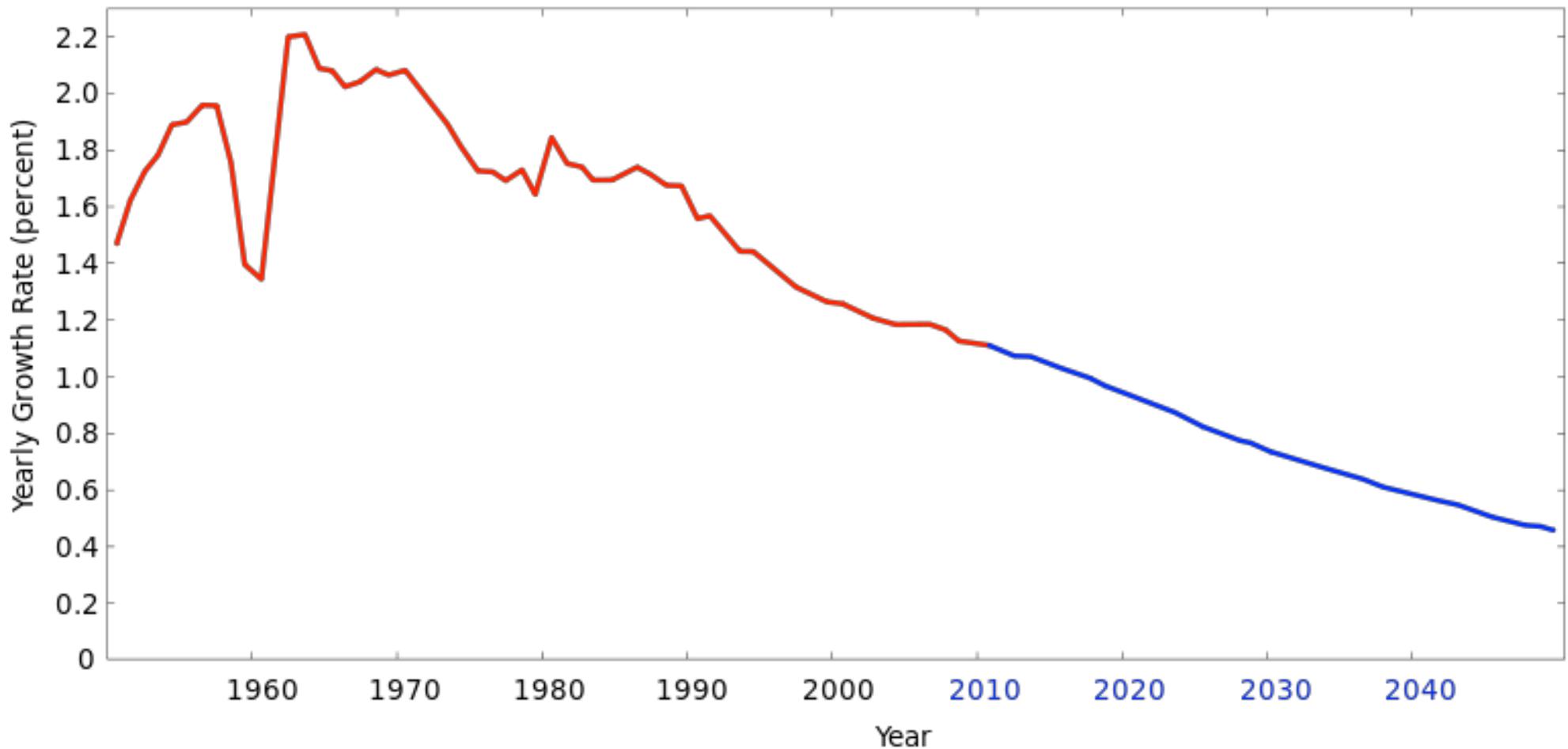
<http://www.worldometers.info/world-population/us-population/>

Data check: Population levels



World population from 1800 to 2100, based on UN 2004 projections and US Census Bureau historical estimates.

Data check: Population growth



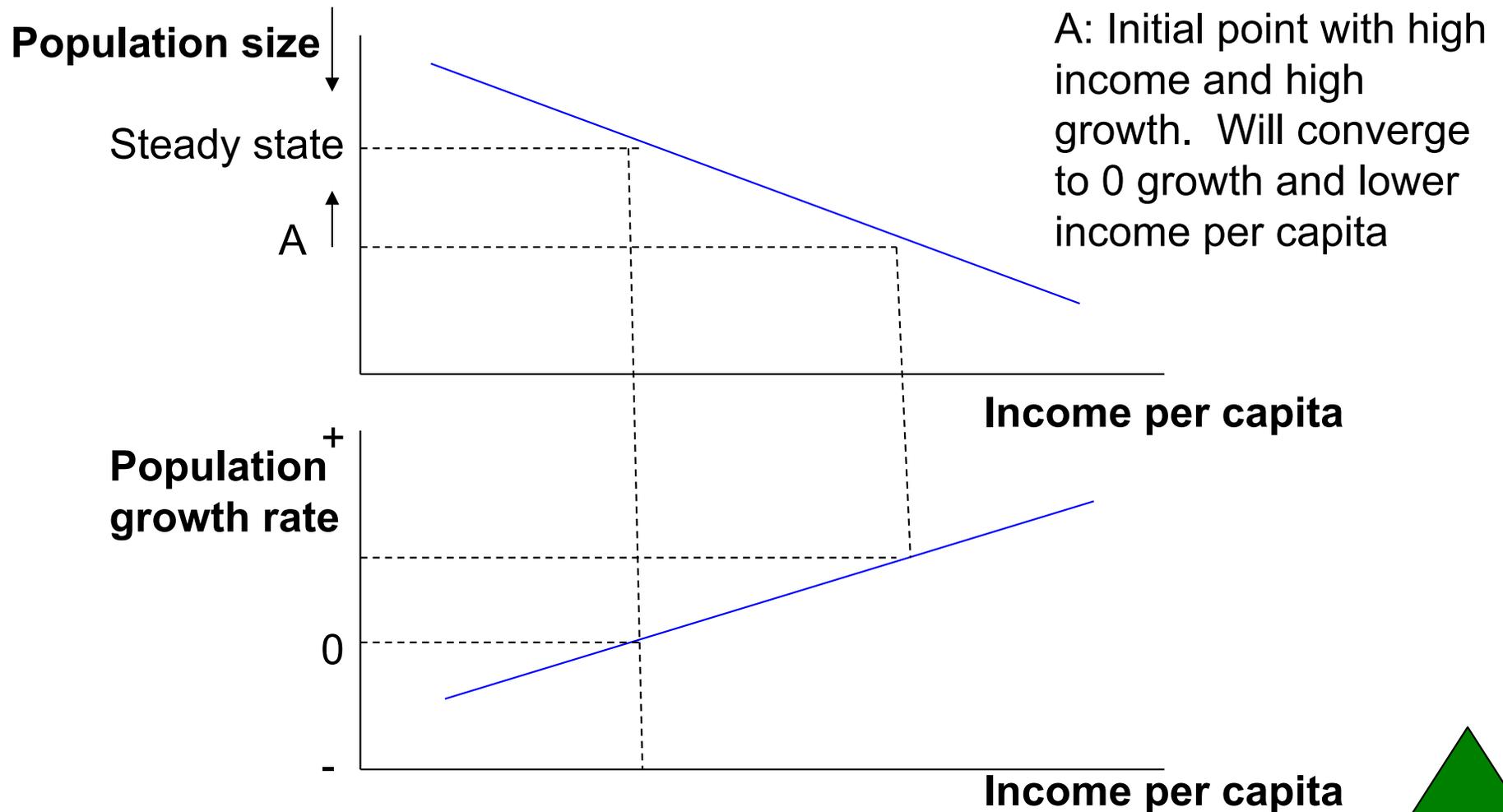
Perspectives

- Two separate and related questions:
 - Macro: population growth and economic growth
 - Micro: fertility and poverty
- Similar (and somewhat surprising) answers:
 - Deep fears not materializing.
 - Short-term heavy costs for medium-term gains

Malthusian theories

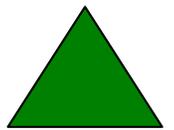
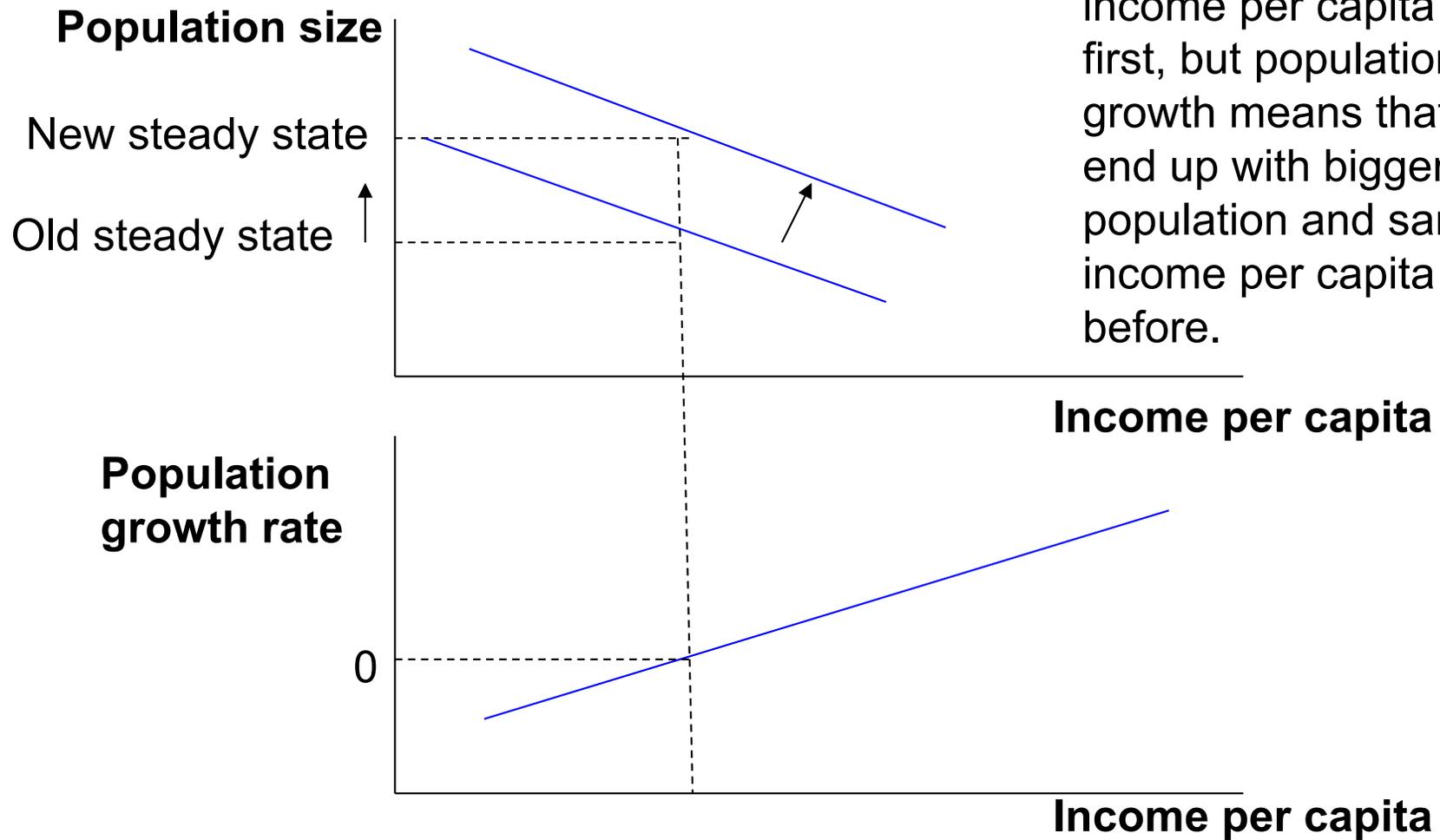
- Thomas Malthus (1766-1834): *Essay on the Principle of Population* (1798).
 - Population grows when there is enough land and resources.
 - “Steady state” growth rate = zero.
 - Mechanism to achieve this is lack of resources, not deliberate choice...
 - With more resources, population growth increases, reducing per capita income back to its original level.
 - You’re trapped.

The Malthusian model



The Malthusian model

New technology raises income per capita at first, but population growth means that we end up with bigger population and same income per capita as before.



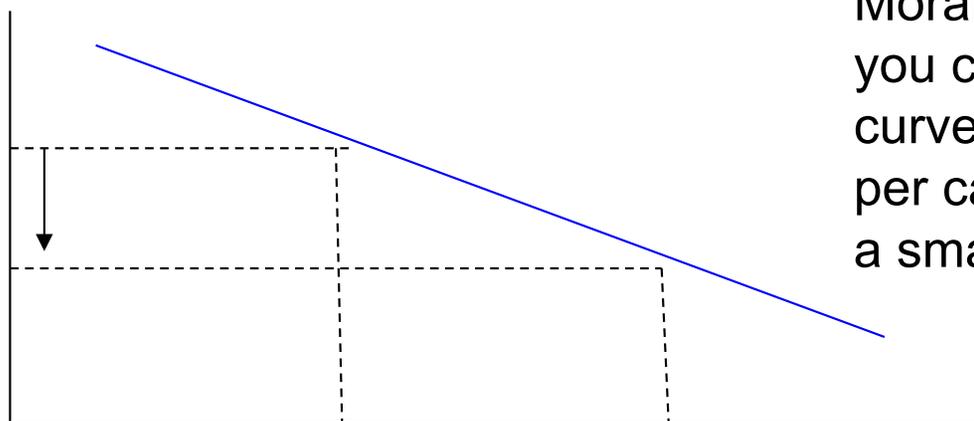
Malthusian model

- China: In AD 1000, China was the most technologically advanced country in the world.
 - But population density was high, so Chinese population lived as close to margin of subsistence as did population of technologically-backward Europe.
 - Introduction of potatoes to Ireland (from America) meant could feed 2-3 times as much as could with a field of grain. But, as a result, Irish population tripled.
 - So what will make people better off?
 - Malthus: “moral restraint”: reduce population growth.

The Malthusian model (Weil, p. 92)

Population size

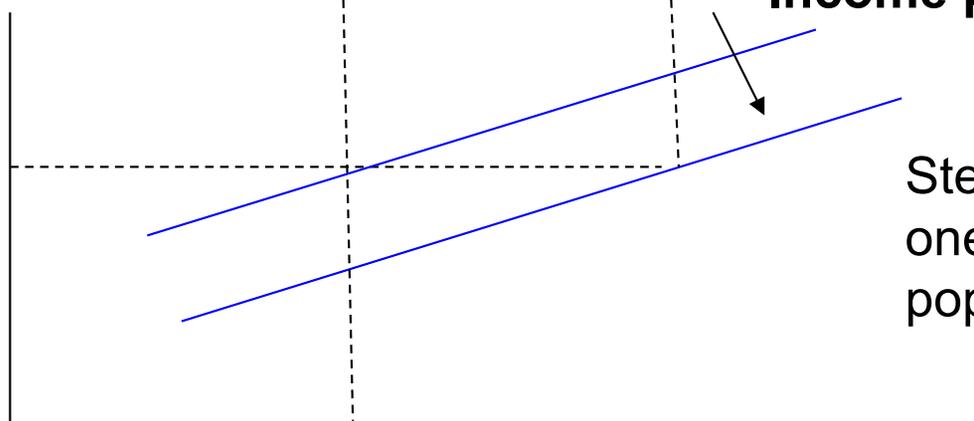
Old steady state
New steady state



Moral restraint means you can shift *along* the curve and have higher per capita income and a smaller population.

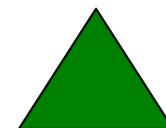
Population growth rate

0



Steady state remains one with zero population growth.

Income per capita



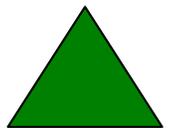
Evidence does not support the Malthusian Model

- **Malthusian prediction:** higher income per capita should lead to higher population growth.
- **Evidence:** Today, richer countries have *lowest* population growth (Europe, most dramatically)
- World population has grown dramatically while the world has grown richer.
 - Boserup: Induced innovation (plus)
 - Ability (and desire) to control fertility (“moral restraint”)?

Julian Simon: *The Ultimate Resource* (1986)

- Countered Ehrlich and argued that human ingenuity tends to overcome constraints.
- Argued that natural resource prices won't rise.
- Proposed a bet with Paul Ehrlich:
 - Chose 5 minerals (tungsten, nickel, copper, chrome, tin).
Calculated how much of each you could buy with \$200 in 1980.
 - Bet: Would the total buy $><$ \$1000 (after inflation) in 1990?
 - Winner would get the difference.
 - Result: Basket was worth just \$429.93 in 1990
 - Basic result held for 37 of 35 minerals considered.
 - Ehrlich refused another bet on 1990-2000.

■ (From Weil, 2005, p. 481)



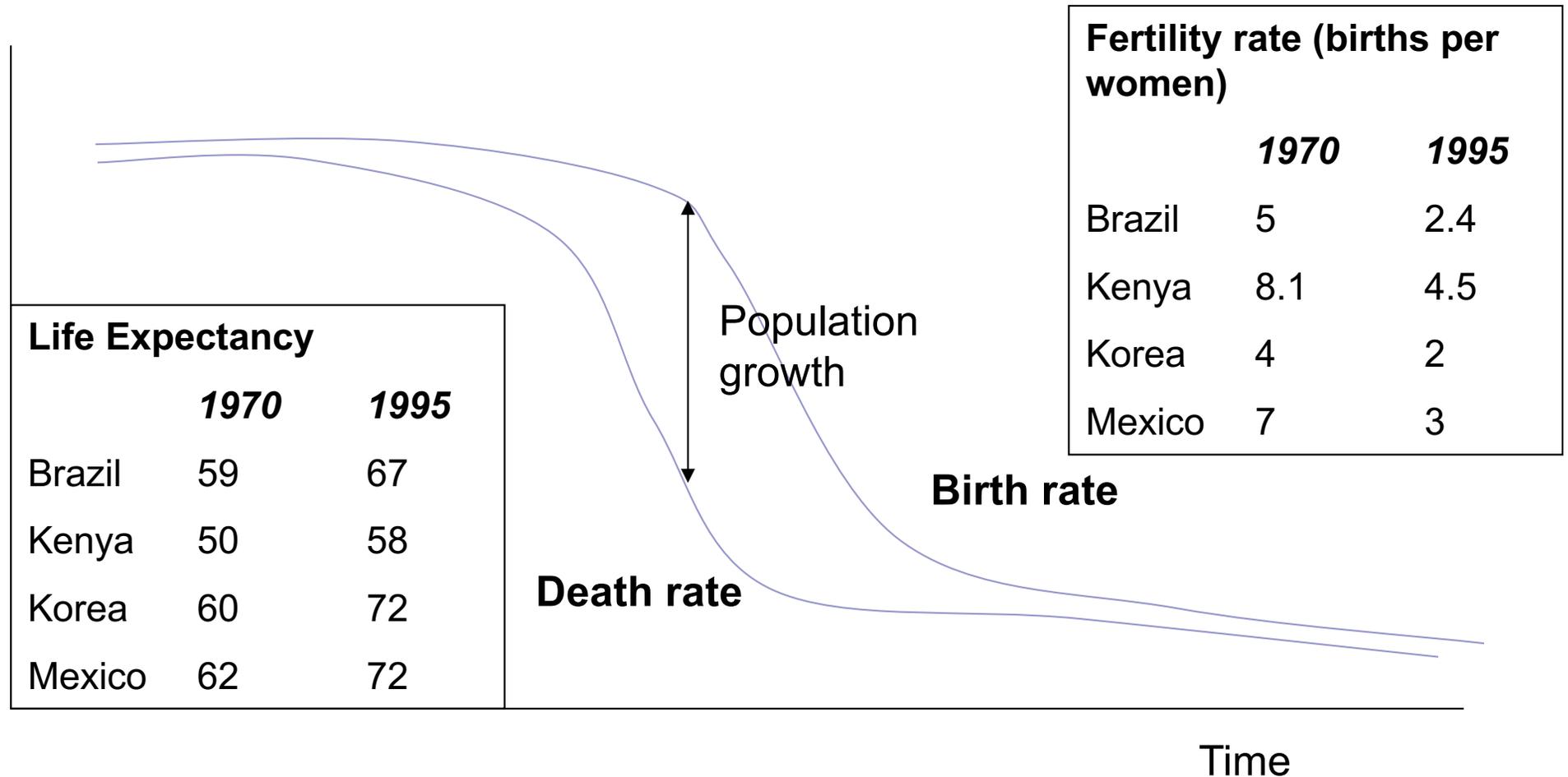
Demographic shock: mortality reduction from newly available medicines

- 1927: penicillin discovered (but not available till 1945)
- 1932: sulfa drugs
- 1943: bacitracin discovered
- 1943: streptomycin isolated (against tuberculosis)
- 1943: DDT available (in Sri Lanka the crude death rate fell from 21.5 to 12.6, 1945-50).
- 1945: chloroquine shown to be effective against malaria
- 1945: non-military use of penicillin
- 1948: tetracycline

Demographic shock

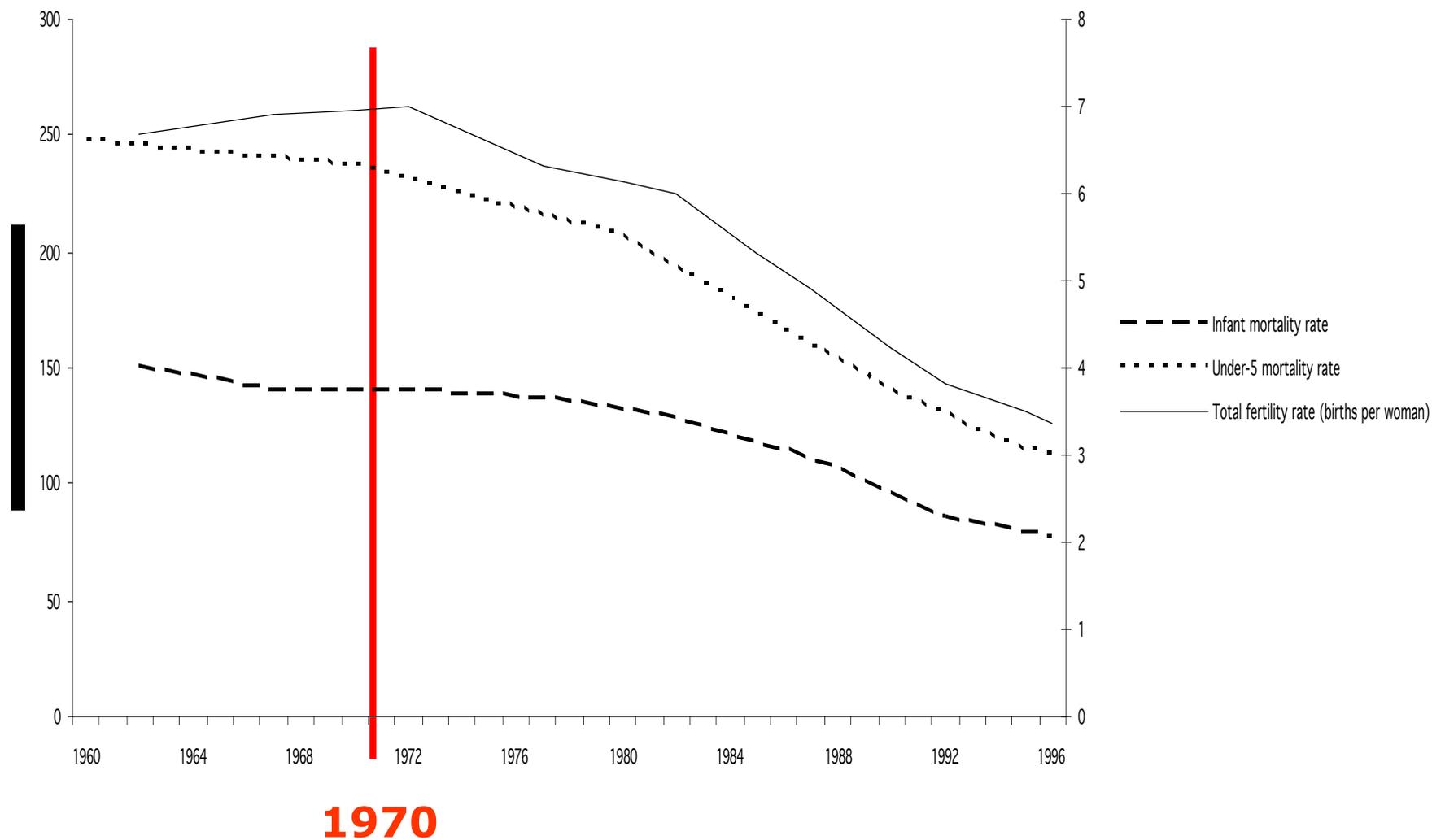
- Massive reductions in infant mortality rates meant that:
 - If households take into account infant mortality in their optimal family size, then until they adapt to lower mortality rates, they overshoot in terms of fertility.

Demographic transitions



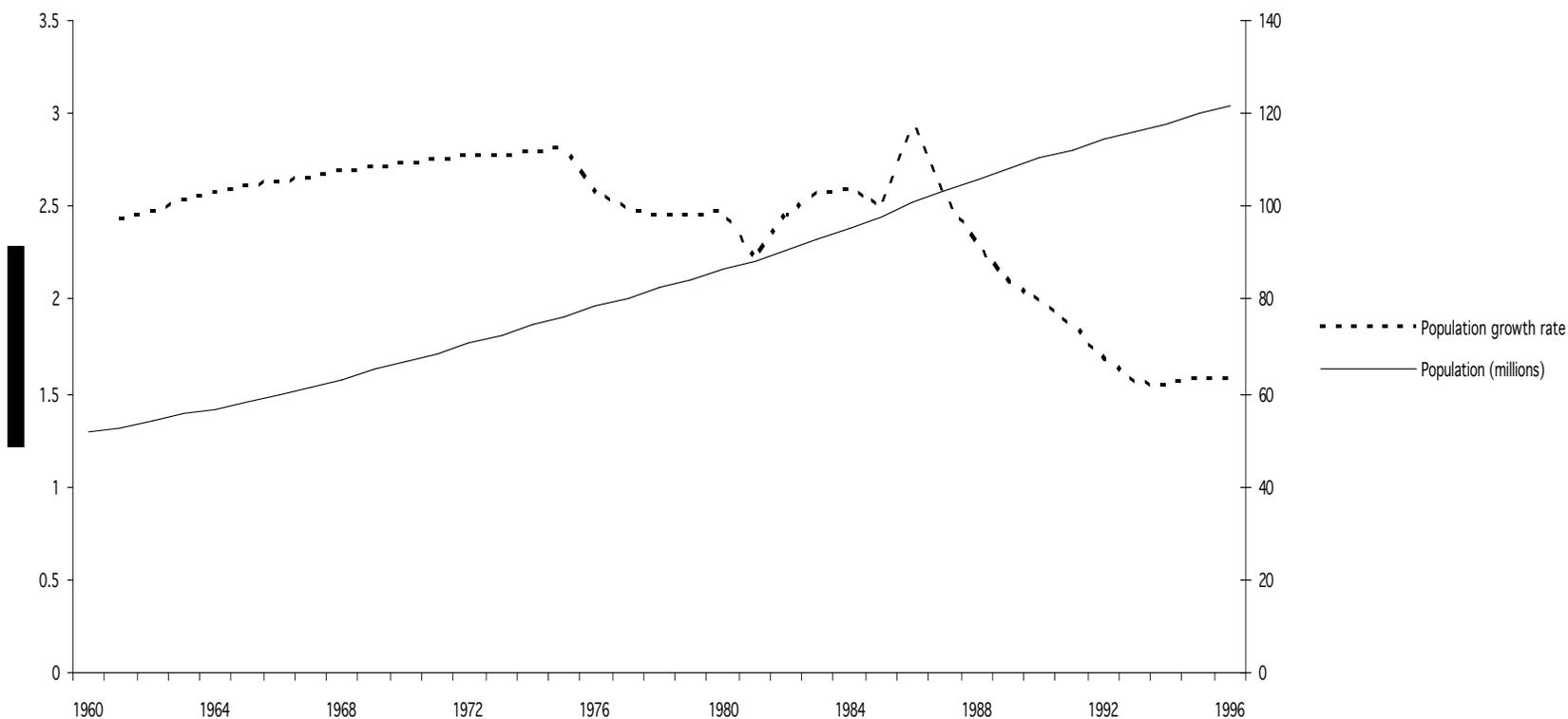
Source: World Bank, *World Development Indicators CD-ROM*.

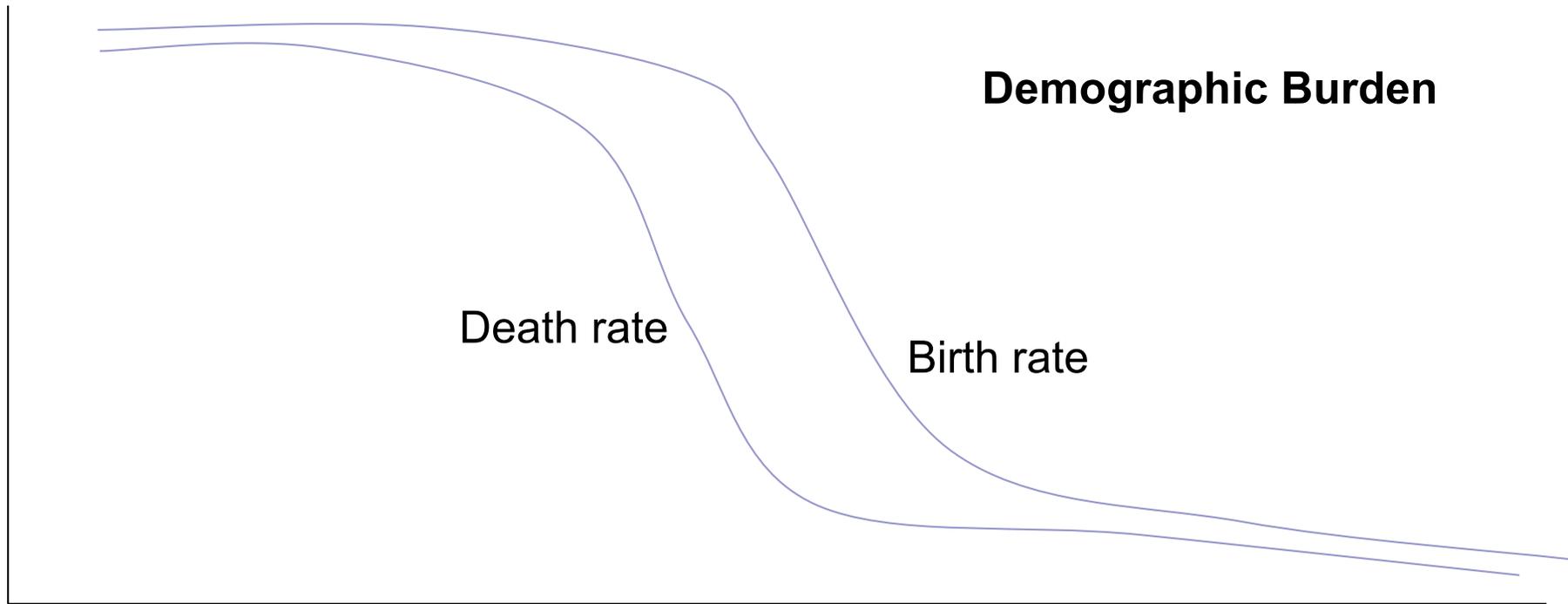
Demographic transition in Bangladesh, 1960-1995



Although reducing fertility rates won't necessarily reduce population growth in the short term

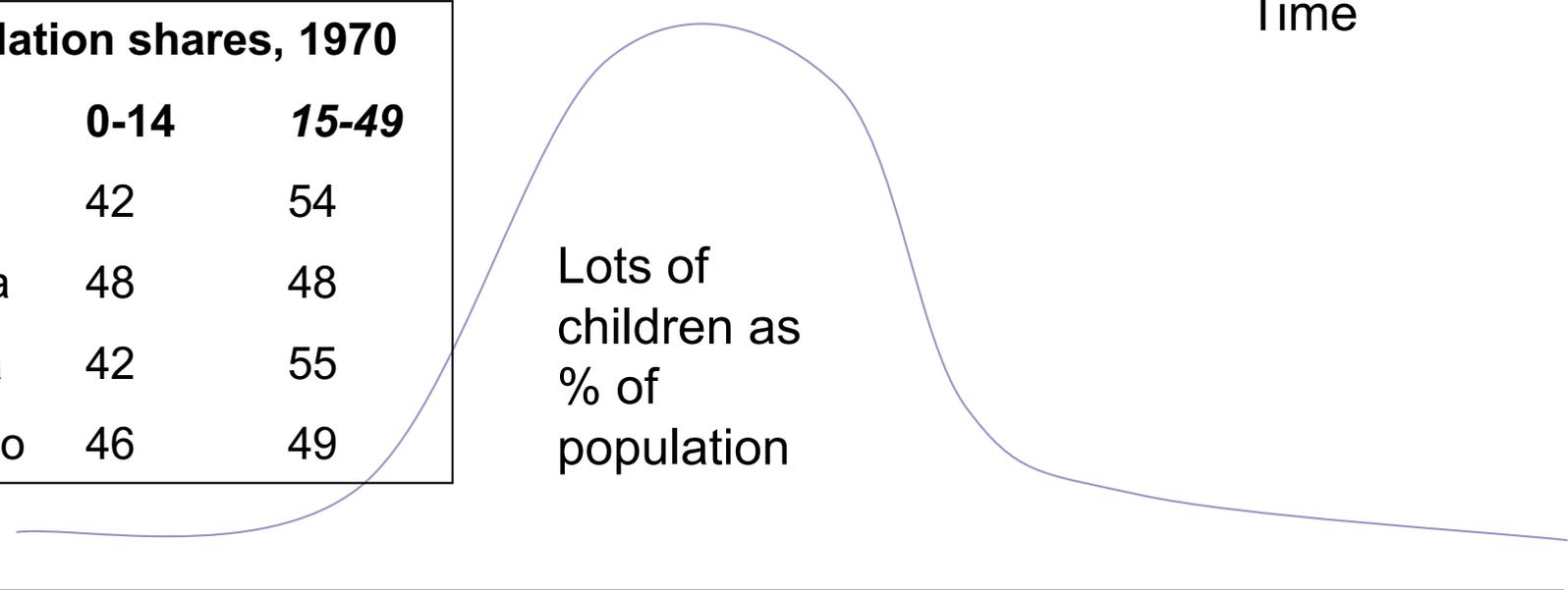
Evidence from Bangladesh



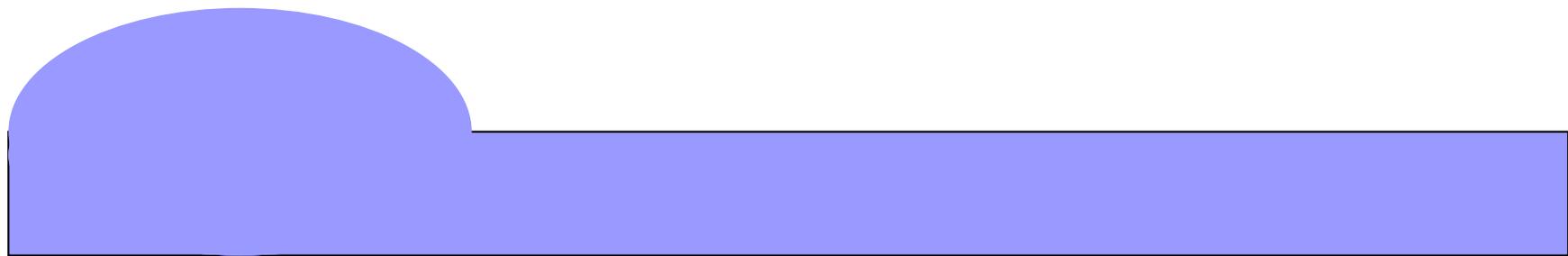


Population shares, 1970

	0-14	15-49
Brazil	42	54
Kenya	48	48
Korea	42	55
Mexico	46	49



Demographic Transition



Young
children

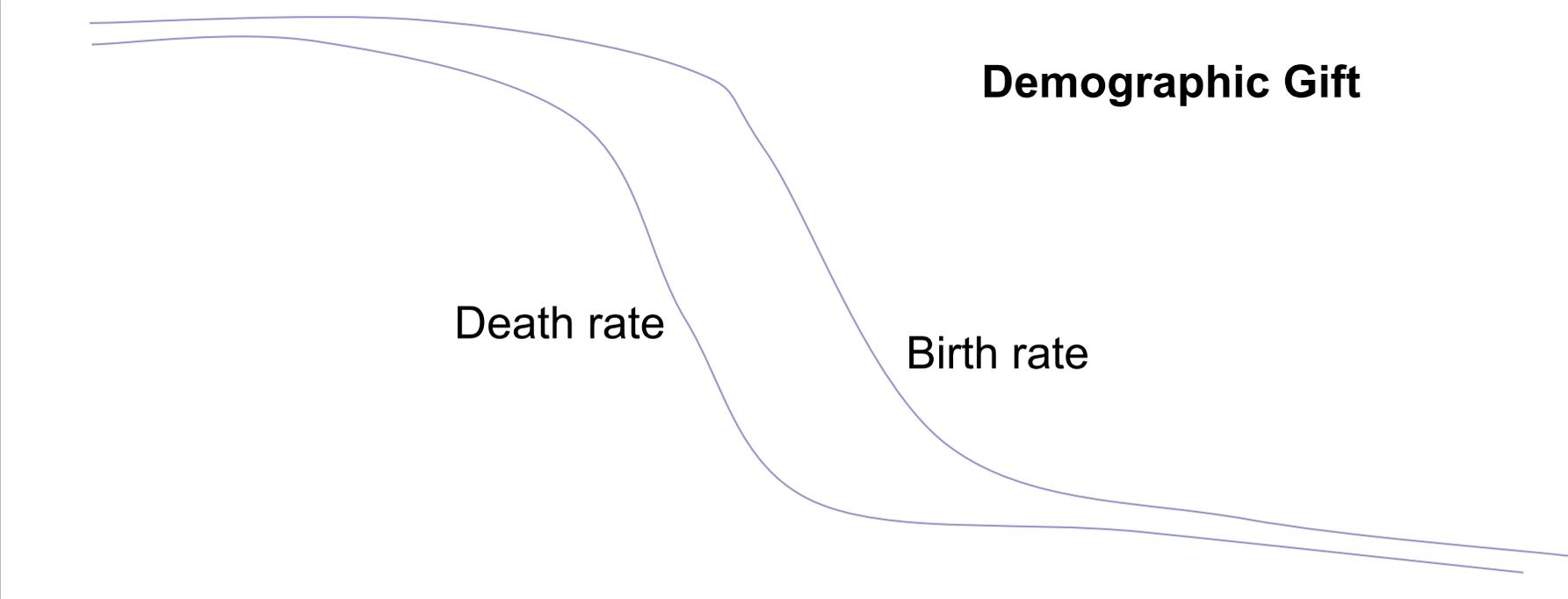
Older
children

Young
adults

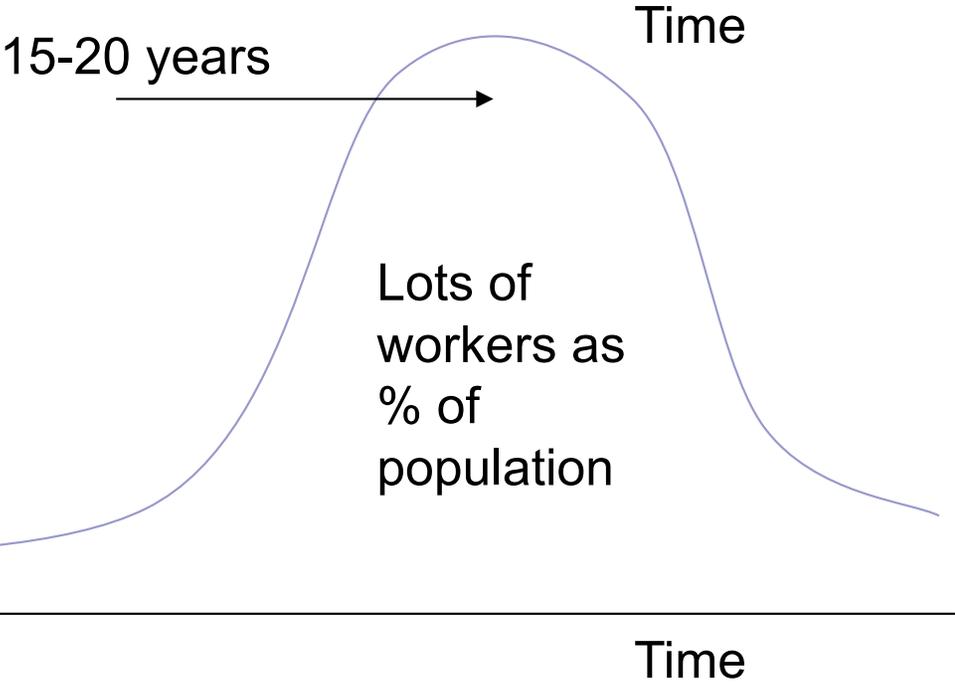
Older
adults

Old
age

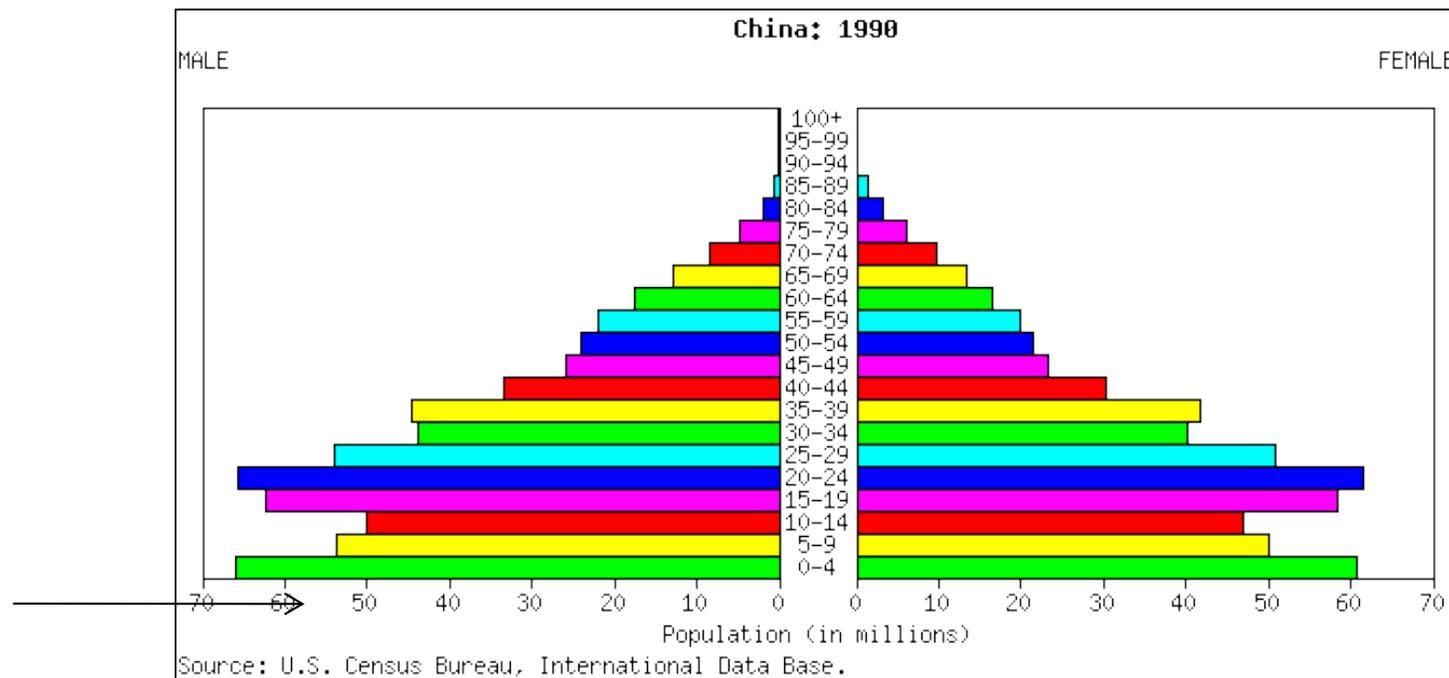
Demographic Gift



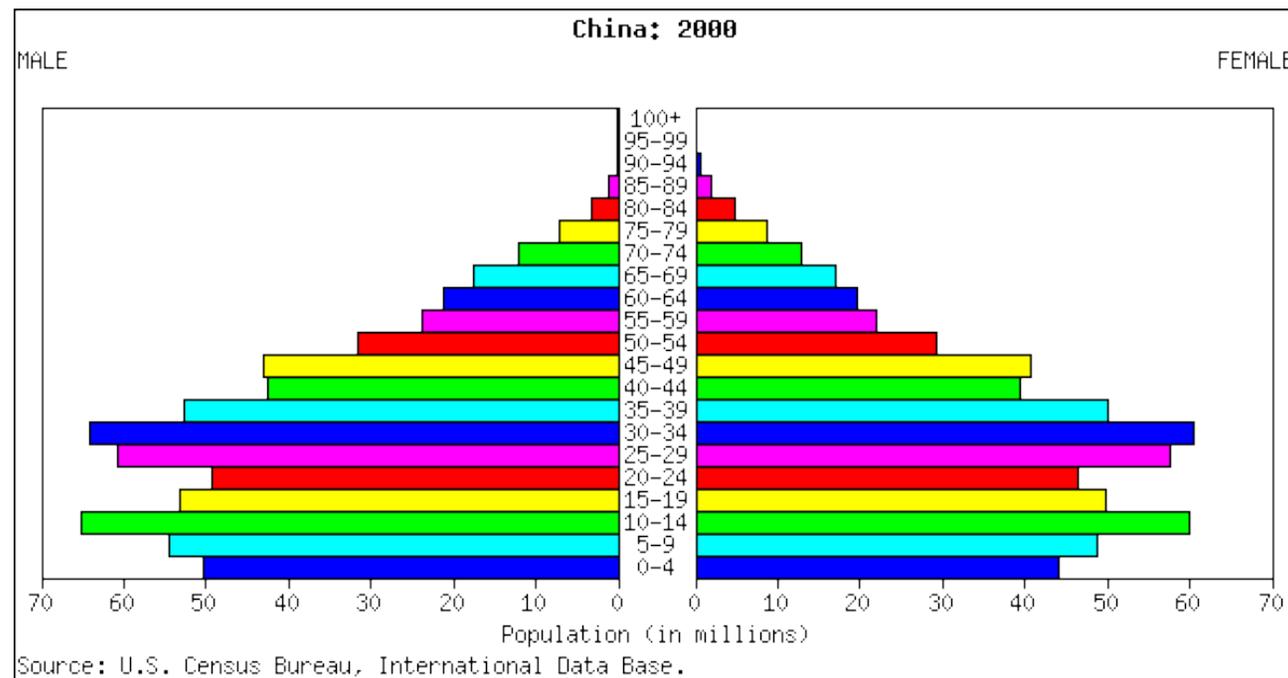
Population shares, 1990		
	0-14	15-49
Brazil	32	64
Kenya	46	51
Korea	23	71
Mexico	36	60



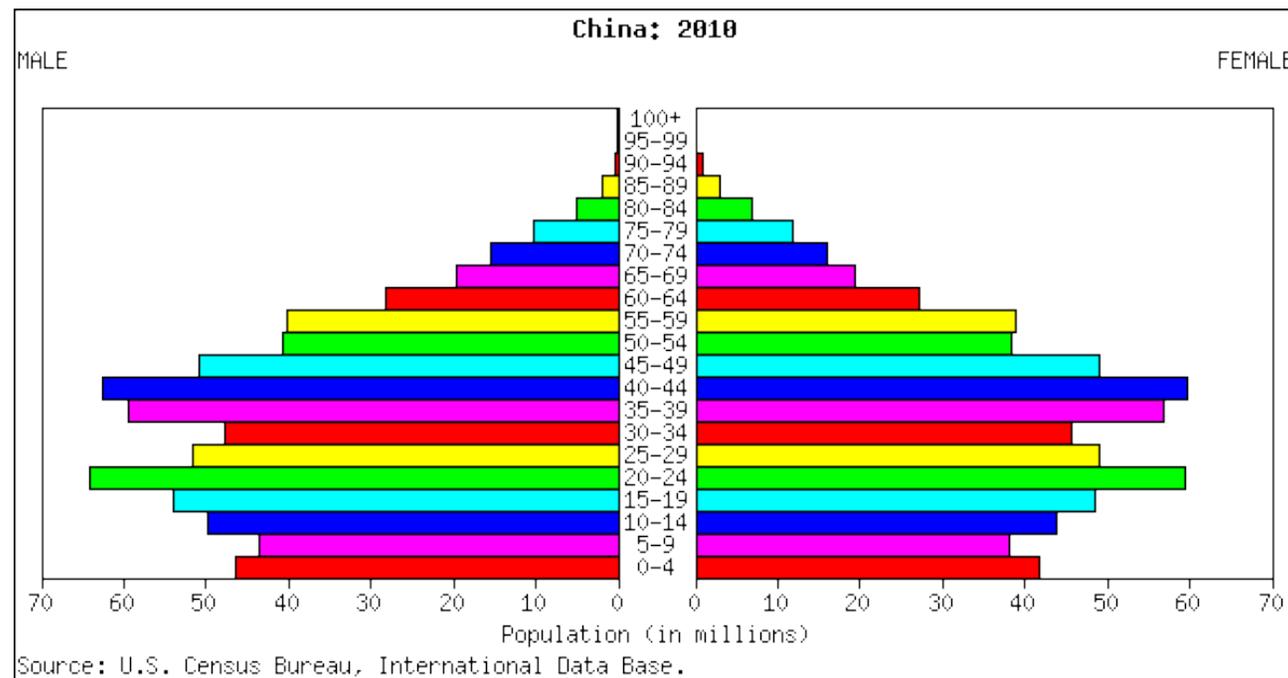
Demographic transition: China 1990



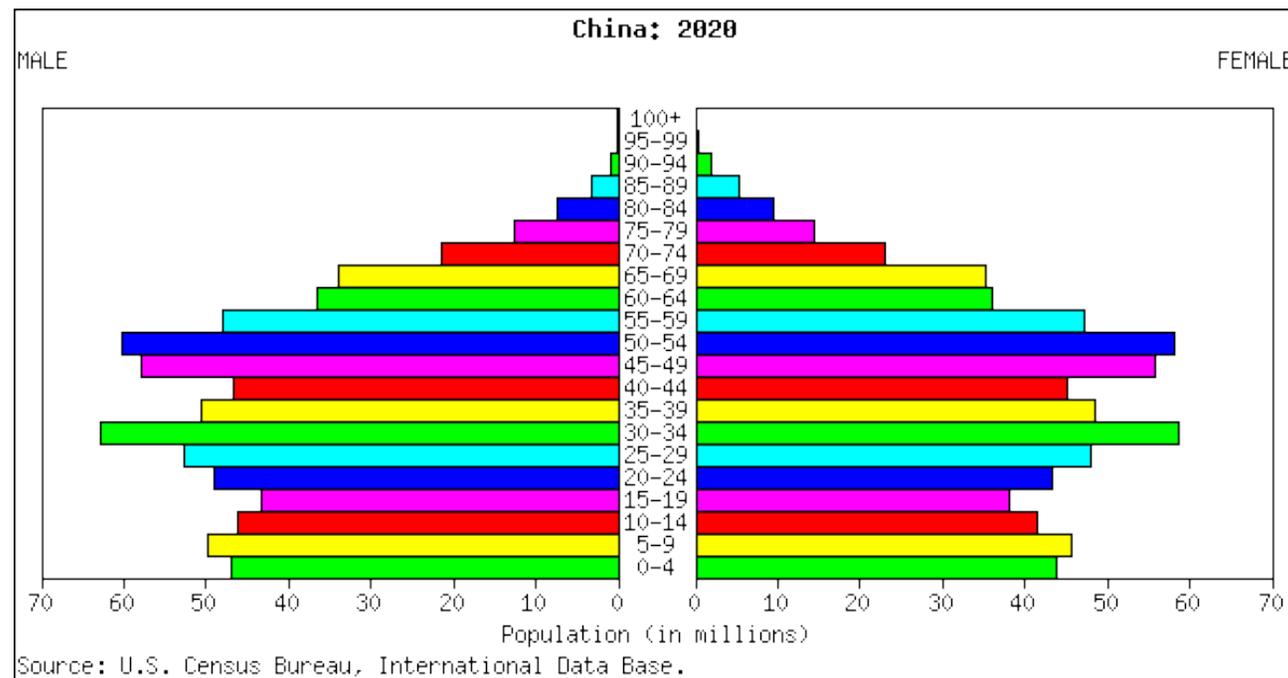
Demographic transition: China 2000



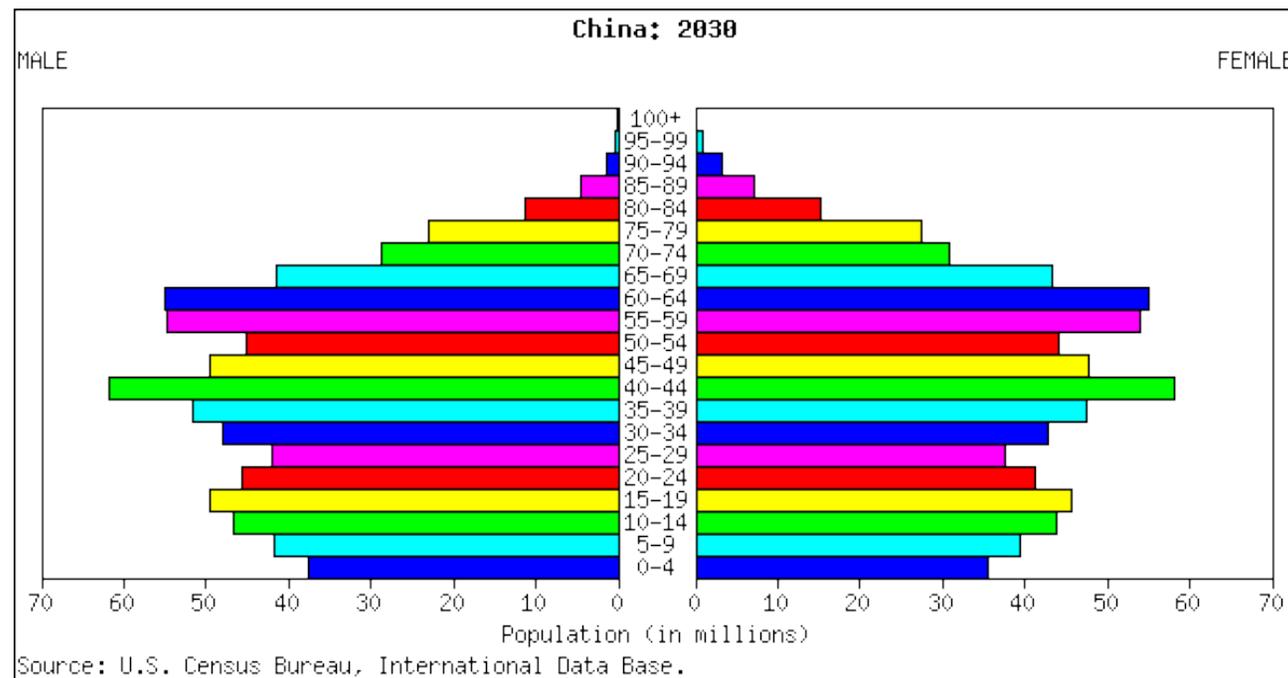
Demographic transition: China 2010



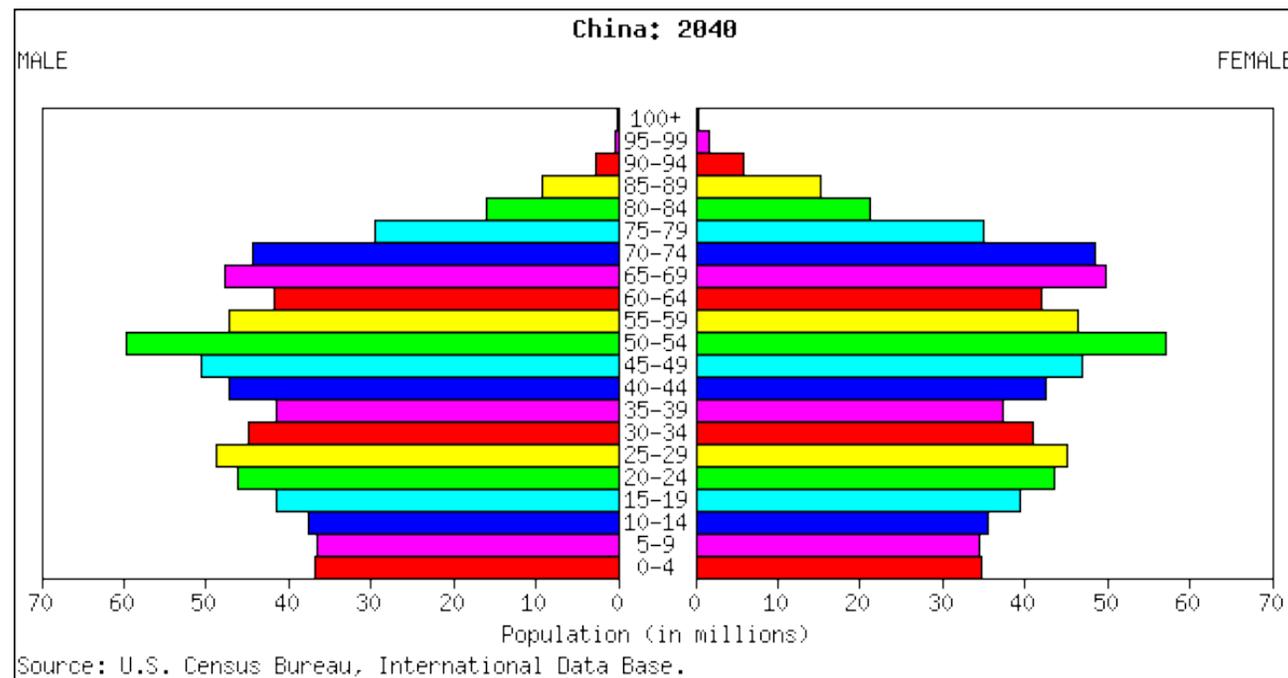
Demographic transition: China 2020



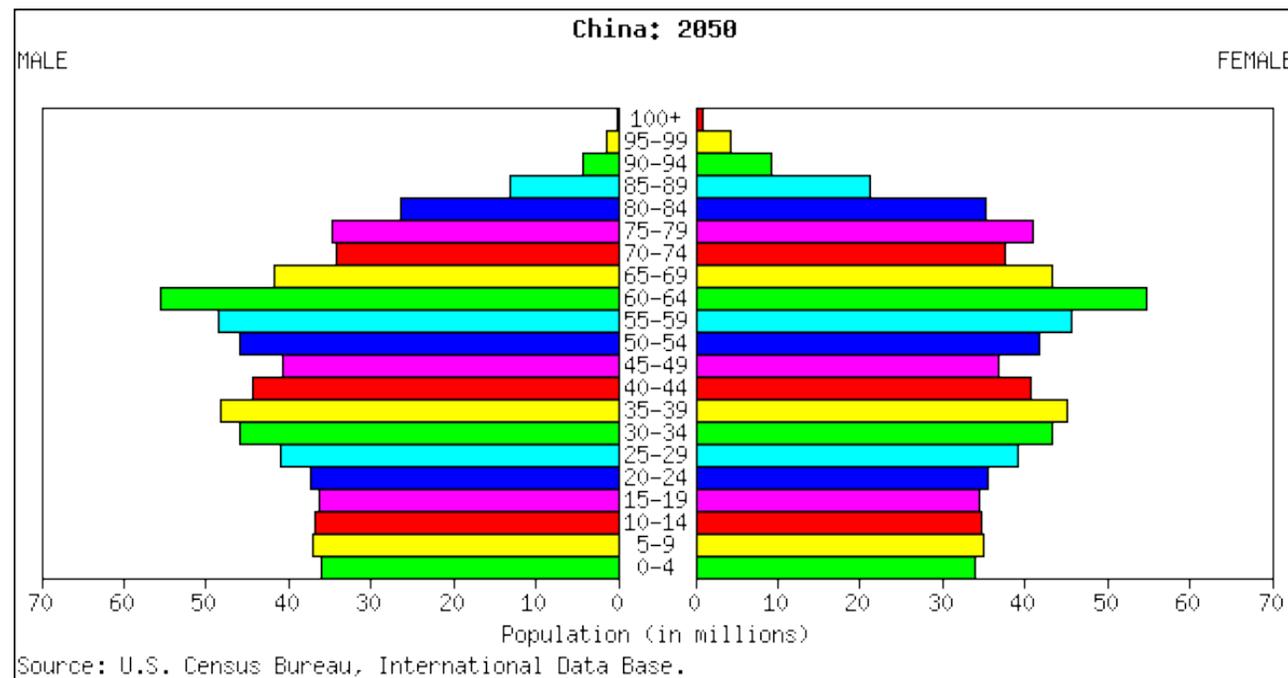
Demographic transition: China 2030



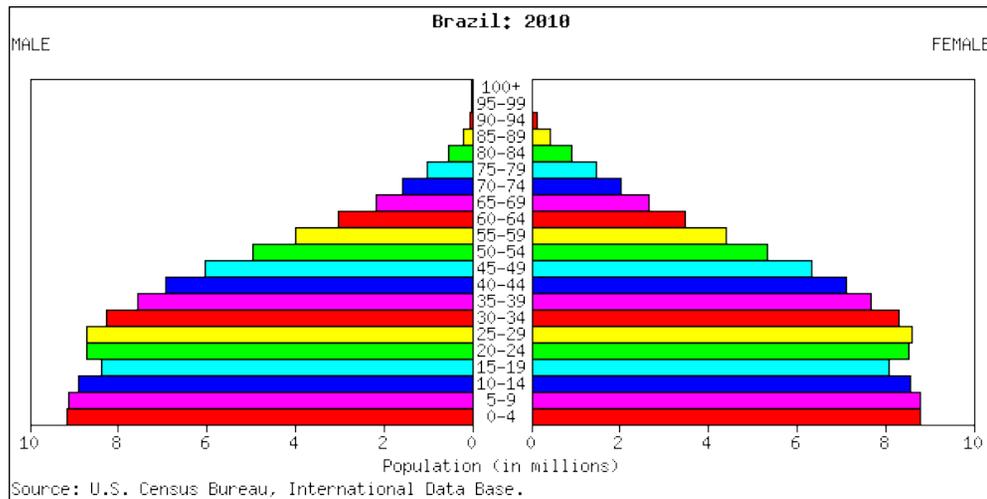
Demographic transition: China 2040



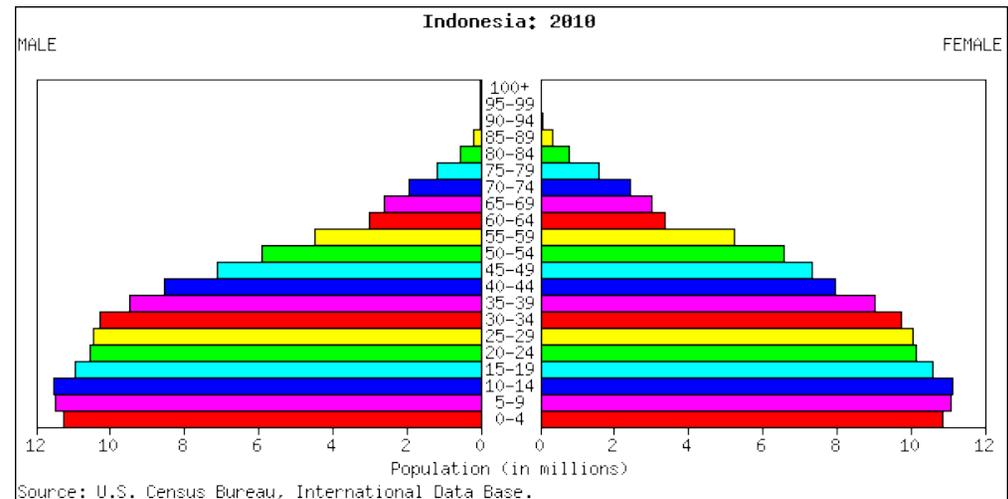
Demographic transition: China 2050



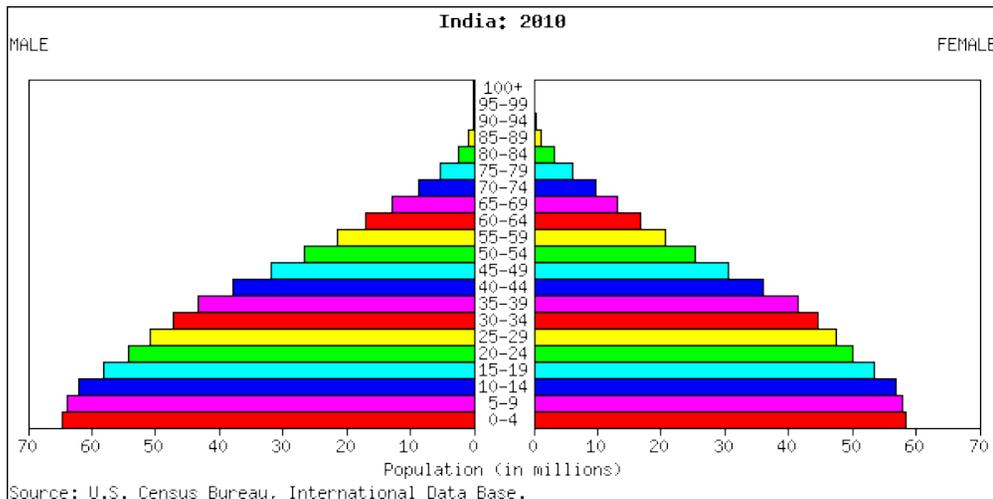
Demographic transition: 2010



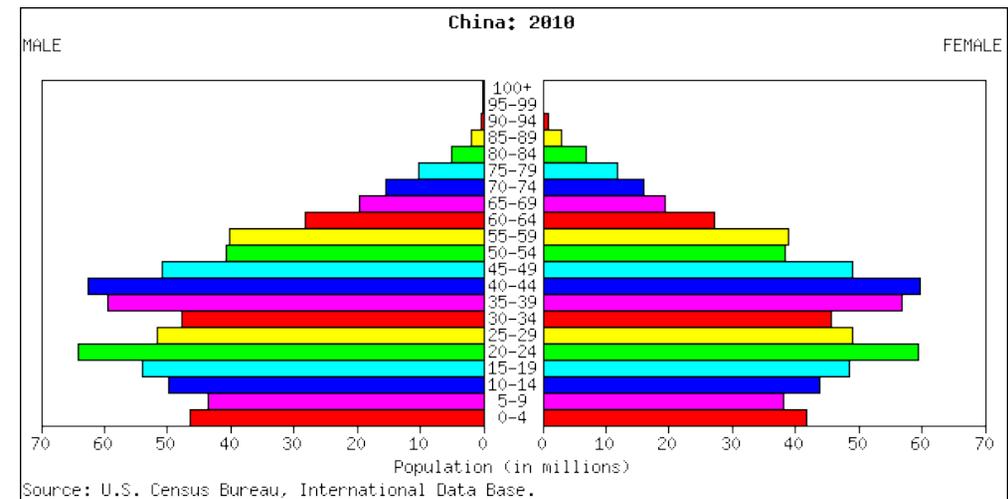
Brazil



Indonesia



India



China

Population growth and economic growth

- Bloom, Canning, and Sevilla (2001).
- Economists rediscover demographics and the importance of age structure to economic growth.

Contribution of population growth to economic growth, 1965-90

	GDP growth per capita	Population, growth average	Economically active pop growth	Dependent pop growth	Estimated, contribution
E. Asia	6.1	1.6	2.4	0.3	1.4
S. Asia	1.7	2.3	2.5	2.0	0.4
Africa	1.0	2.6	2.6	2.9	-0.1
S. America	0.9	2.1	2.5	1.7	0.7
N. America	1.6	1.7	2.1	1.1	0.7
Europe	1.8	0.5	0.7	0.2	0.3

(Bloom and Williamson, 1997, NBER, Table 6)

Projected Growth rates, 1990-2025

(Bloom and Williamson, 1997, NBER, Table 7)

	Economically active pop	Dependent pop	Est. contribution
E. Asia	0.2	0.9	-0.4
S. Asia	2.1	0.9	0.8
Africa	2.8	1.9	0.7
S. America	1.9	0.9	0.6
N. America	1.3	1.2	0.1
Europe	-0.004	0.5	-0.3

Concluding thoughts on demographics

- The key seems to be timing: if the demographic dividend of highly productive workers arrives in a period of high growth and productivity, then can be advantageous.
- If instead, the demographic dividend is “squandered” in a low-growth period, you could be stuck with just the demographic burden.

Fertility

Demand

Supply



Four sets of questions

1. Is economics at all relevant in fertility choices?
2. What determines the quantity of children?
 - A. Development (=income) and fertility
 - B. Contraception and fertility
 - C. Financial incentives and fertility
 - Cross-country
 - Welfare studies
 - One-child policy
 - Direct financial incentives
 - D. Social norms
3. Is there a quantity-quality tradeoff?
4. What determines the timing of births or selection into fertility?

Question 1: Relevance of economics

- Becker (1960): knowledge of fertility means that fertility becomes a choice.
- Means of then controlling fertility vary with technology: abstinence, abortion, contraception.
- With choice comes the economic framework: income and prices can play some role, though not the only role.

Question 2 framework: What determines the number of children?

Prichett on desired fertility and policy:

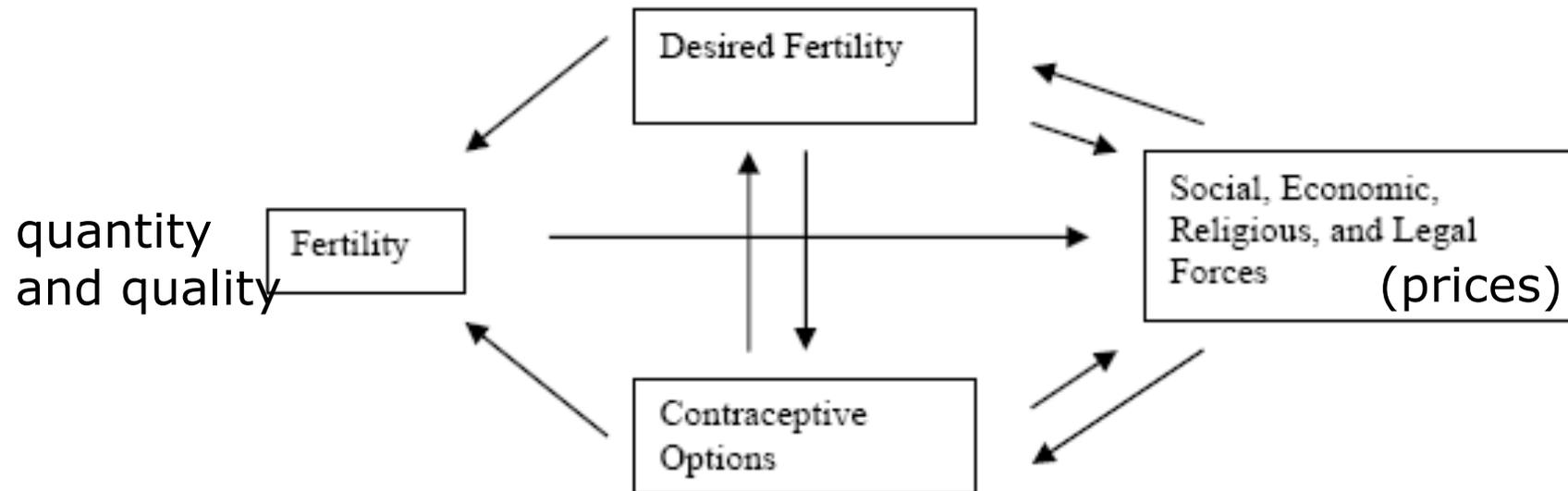
■ Two views:

- Contraceptives are the best contraceptive (view of Family Planning advocates)
- Development is the best contraceptive -- Pritchett's (and many economists') view

■ Or supply of birth control methods versus demand for children

The directions of causality

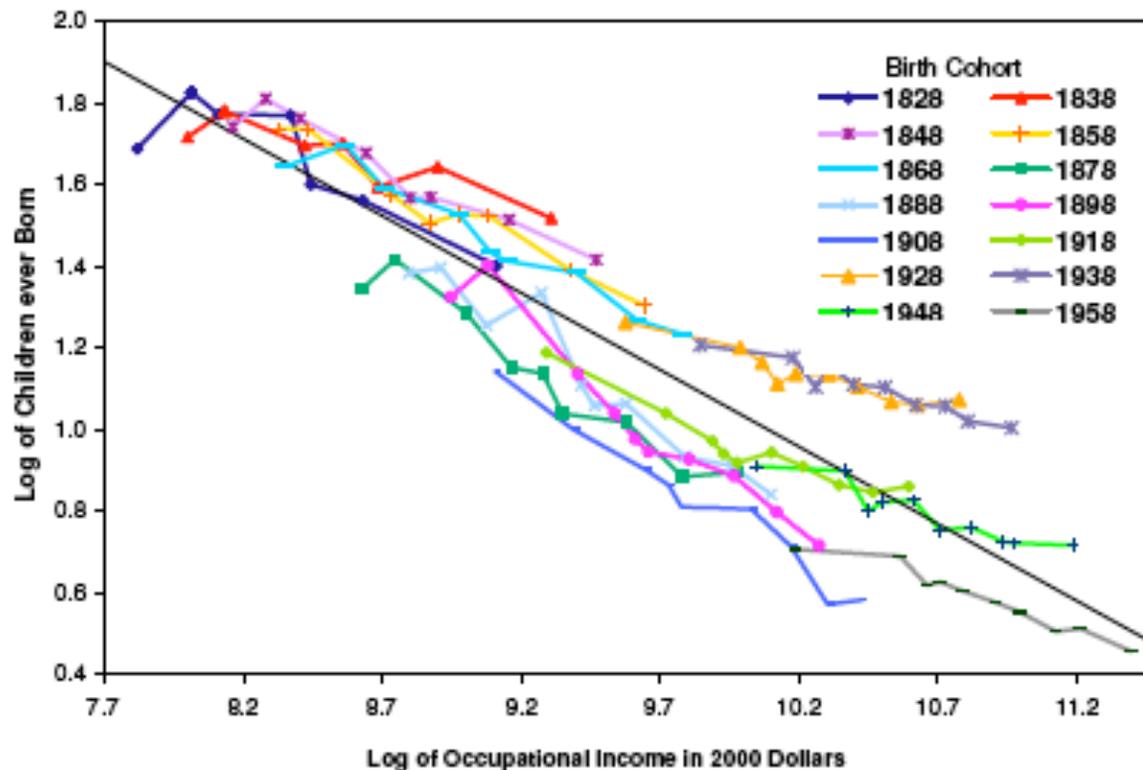
I imagine the directions of causality to work something like this:



Question 2a: Income and fertility

- From the US (Jones and Tertilt):

Figure 5: Log (CEB) by Log(Occupational Income)



Questions 2b: Contraception and fertility:

Pop-Eleches, The Supply of Birth Control Methods, Education and Fertility

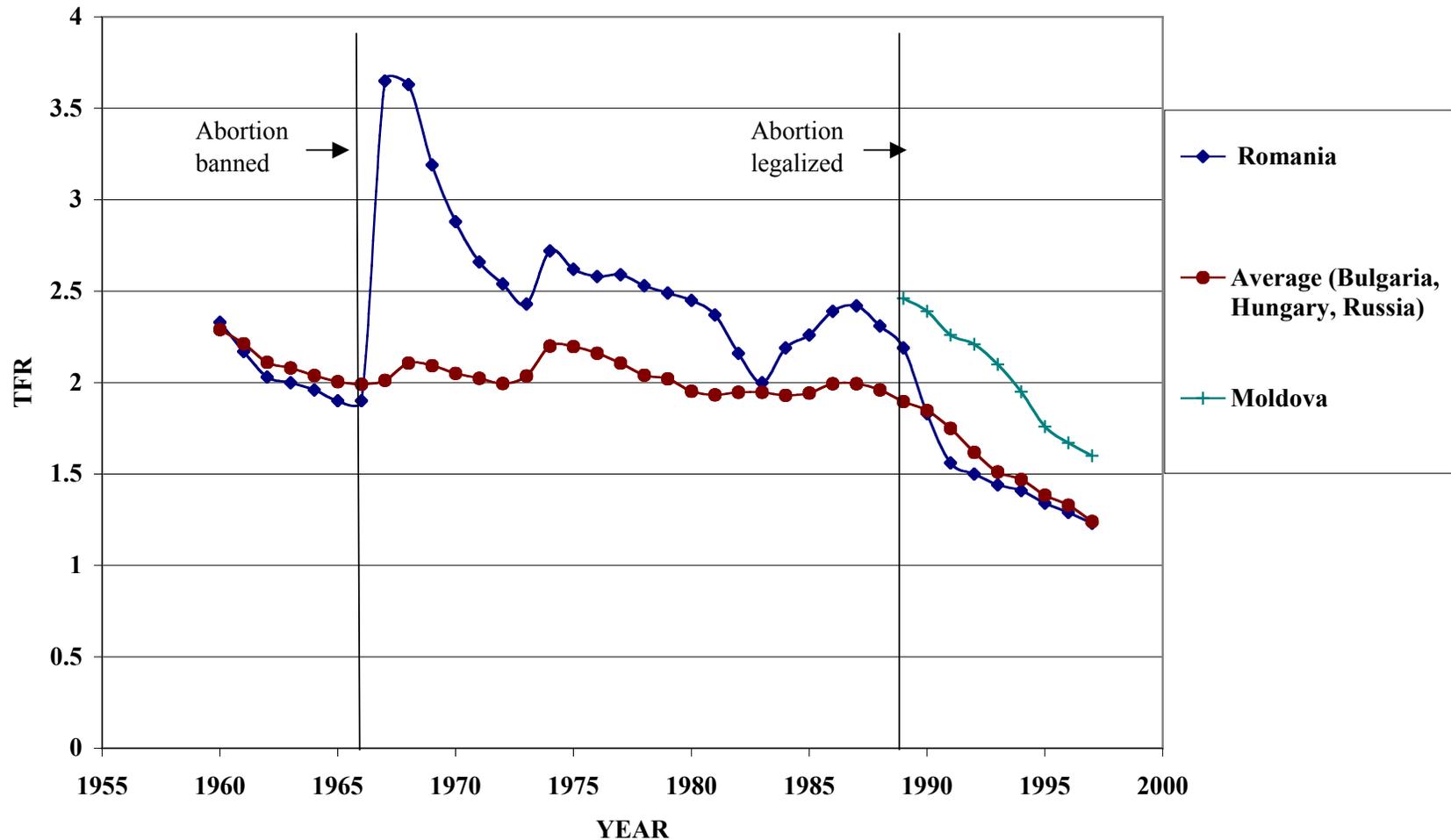
- How important is the supply of methods of birth control in decreasing fertility rates?
- This question is important to find out if family planning programs work.
- Still a lot of disagreement in the literature.
- Difficulties with estimation:
 - hard to find an exogenous change in price of birth control methods that has an instantaneous effect

Question 2b (alternate): Why do educated women have lower fertility?

- The negative association is very “robust”.
- Example:
 - Romania (early 1990’ s): TFR: 2.26 - primary, 1.66 - secondary, 1.07 - tertiary education
 - Tanzania (1990’ s): TFR 6.4 – no education, 3.2 - secondary +
- The negative relationship is consistent with many stories:
 - → Supply of contraceptives? Could be, e.g., urban vs rural.
 - Demand: Price of time effect in the household model (Becker 1960)
 - Demand: education improves efficiency/knowledge/access in the use of contraceptives (Becker; Rosenzweig & Schultz, 1989)
 - Demand: “Taste” effect of education for fewer, better educated kids
 - Demand: Age at marriage is delayed for women who go to school
- Difficult to distinguish among theories empirically

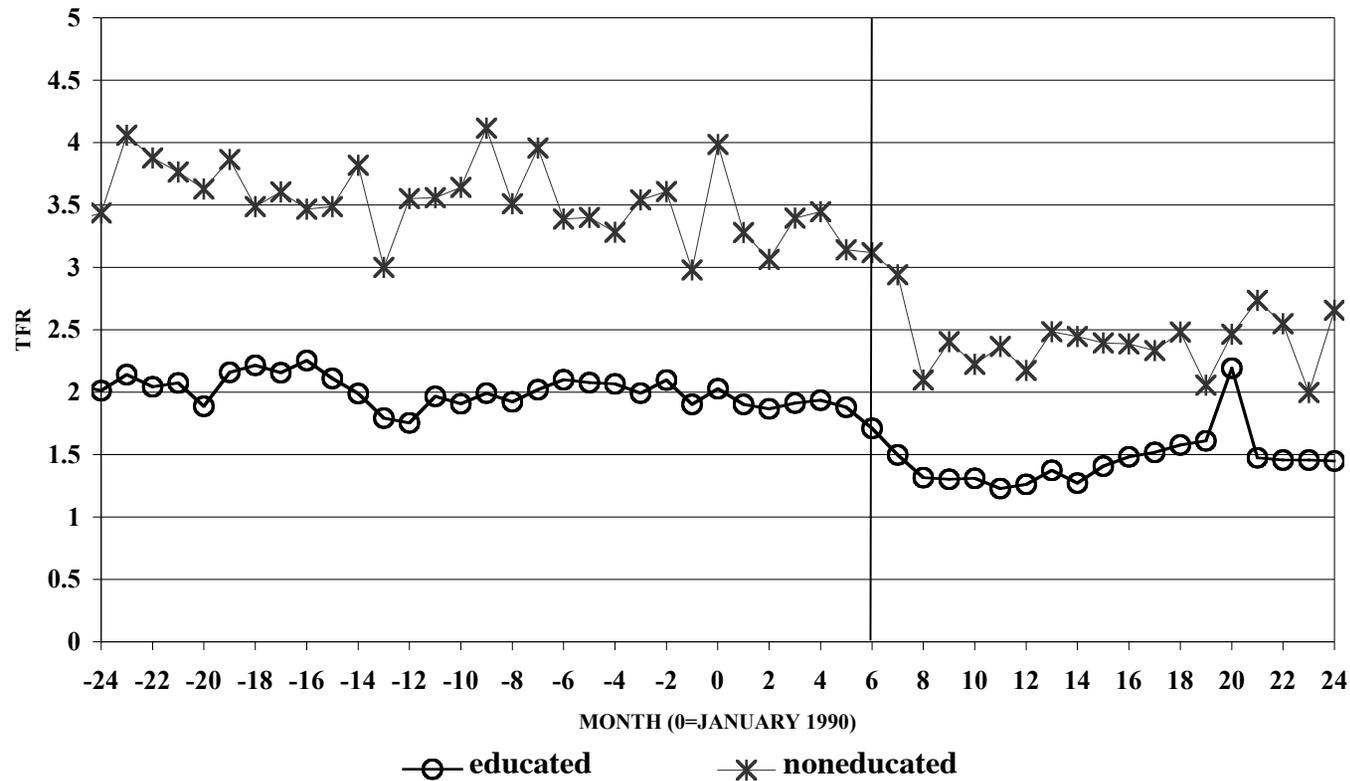
Abortion and Romania

FIGURE 1: TOTAL FERTILITY RATES



Notes: The total fertility rate is the average total number of births that would be born per woman in her lifetime, assuming no mortality in the childbearing ages, calculated from the age distribution and age-specific fertility rates of a specified group in a given reference period. Source: UN (2002).

Romania: education and technology



Notes: This graph plots the Total Fertility Rate (TFR) by month of birth and educational level of mothers using the own-children method of fertility estimation for the period January 1988 to December 1991. The abortion ban was lifted at the end of December 1989 and the fertility drop can be observed roughly 6 months later. Source: 1992 Romanian Census.

Summary of Results

- Large increases in fertility: overall 25% higher lifetime fertility (about .5 children) as a result of restricting access to methods of fertility control
 - Supply matters.
- Fertility differential by education narrows substantially (by about 50%) when birth control methods become widely available.
 - Demand (i.e., effective demand) also matters.

Question 2c:

Prices and the quantity of children

- Does the price of a child actually affect the demand for children?
- Many developing and developed countries have tried to use this as a lever to affect fertility.
- Much research / concern that welfare reduces the price of kids, hence leads to more kids.

Evidence 1

Price effect

- Cross-country and US welfare-reform studies:
 - E.g., Demeny 1986, Blanchet and Ekert-Jaffe 1994, Gauthier and Hatzius 1997) and US welfare incentive studies (e.g., Whittington 1992, Blau and Robins 1989, Acs1996, Levine 2001, Kearny 2004).
 - Find no, weak, or inconsistent effects.

Evidence 2: China's one-child policy

- Widely publicized effort to reduce fertility by legal prohibitions on second and higher births.
- But this turns out to be a system of disincentives -- costly, but not infinitely to have two or more children.
 - Originally, the policy excluded additional children from free public education and parents were subject to fines. Following a forced sterilization and abortion campaign in 1983 that created domestic unrest, Chinese policymakers began considering revisions to the policy. By allowing some mothers to have a second child, the government hoped to discourage violations and increase public support for the policy (Gu et al. 2007).

Ebenstein

- The one child limit was enforced on urban residents, but mothers of a daughter in several rural provinces were allowed to have a single additional birth (a “1.5-child” policy) and families in remote areas or minorities a second or third child.
- One-child policy comparing by severity of the policy

Table 4
Male Fraction of Births by Fertility Policy in China

Parity	Sex Combination	Prior to One Child Policy (China 1982 Census)				Post One Child Policy (China 2000 Census)			
		One	1.5	Two	Minority	One	1.5	Two	Minority
1st	None	0.51	0.51	0.51	0.51	0.52	0.52	0.51	0.51
2nd	One girl	0.53	0.53	0.52	0.51	0.65	0.62	0.62	0.58
3rd	Two girls	0.54	0.55	0.52	0.52	0.71	0.70	0.69	0.65
4th	Three girls	0.55	0.57	0.52	0.50	0.73	0.73	0.68	0.67

Ebenstein

■ Impact of the fine:

Table 6
Regression (OLS) Estimates of Fertility Outcomes (LHS) on Fertility Fines (RHS)
Following Daughters: China 1964–2000

	Did you have another child? (1 = yes)		Among those with another child, was the next birth male? (1 = yes)	
	Those with one daughter	Those with two daughters	Those with one daughter	Those with two daughters
Log of Fertility Fine	-0.102*** (0.024)	-0.102*** (0.034)	0.008* (0.004)	0.023** (0.009)
Mother's Education	-0.014*** (0.002)	-0.004** (0.002)	0.001 (0.001)	0.002 (0.002)
Farmer	0.288*** (0.019)	0.185*** (0.021)	0.000 (0.006)	-0.009 (0.013)
Sample Average	0.788	0.647	0.540	0.601
Observations	234,570	85,074	184,955	55,045

Evidence 3: Price incentives in Israel

Table 1: Monthly Marginal Child Subsidy

Year	1999	2000	2001	2002	2003		2004		2005	
					Children born in 2003	Children born before 2003	Children born in 2003 or later	Children born before 2003	Children born in 2003 or later	Children born before 2003
Birth order among children < age 18										
1	190	191	188	159	150	150	127	127	123	123
2	190	191	188	159	150	150	127	127	123	123
3	381	381	378	316	150	259	127	176	123	160
4	770	772	765	640	150	550	127	436	123	369
5	647	648	943	790	150	663	127	500	123	412
6+	713	715	943	790	150	663	127	500	123	412

Halpert Reform

2003 Reform

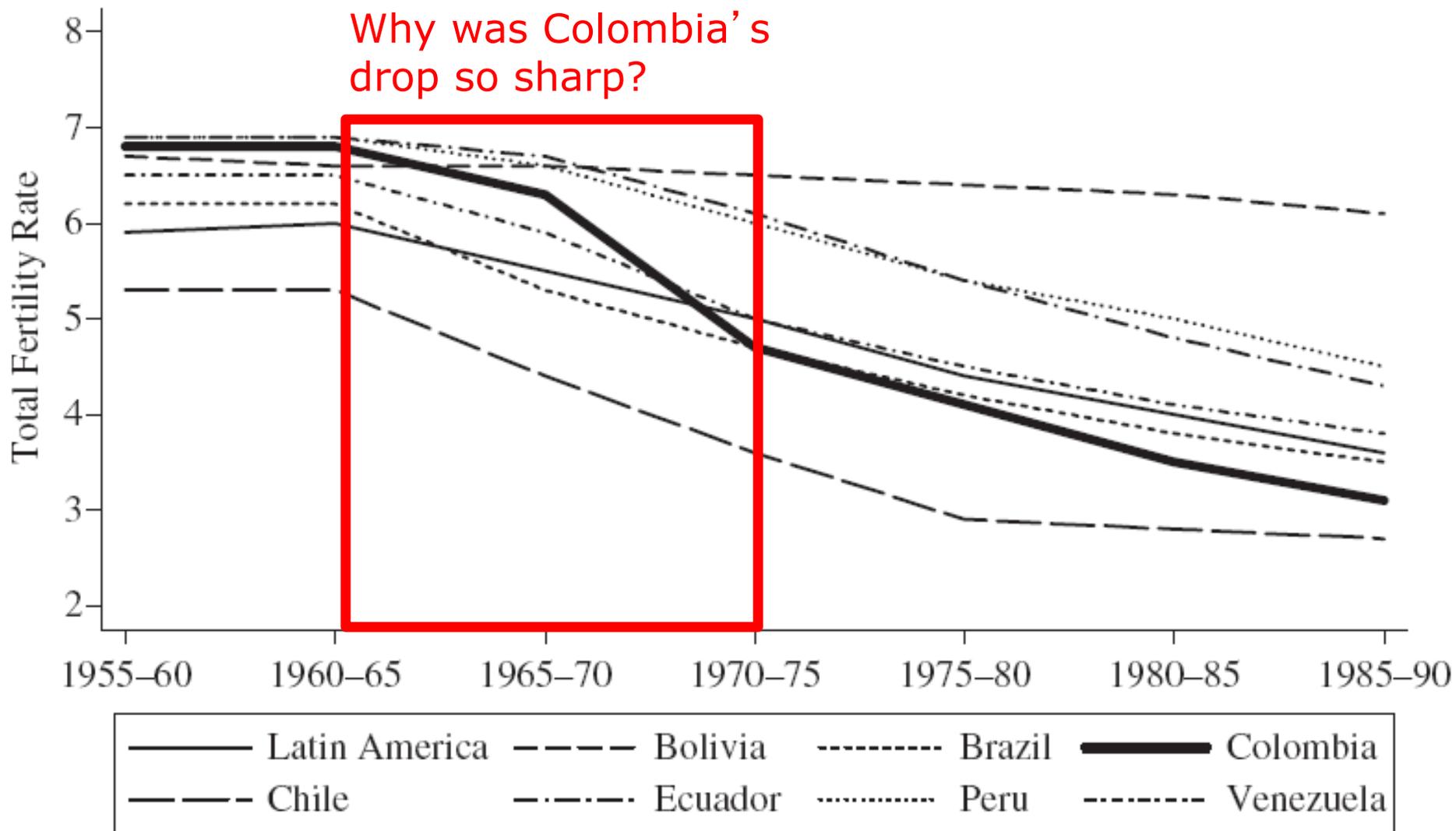
4 NIS ~ 1 US Dollar



Table 16: Elasticities

Specification	Full sample	Below poverty line	Poverty line to 90th percentile	Above 90th percentile	Secular Jewish	Orthodox Jewish	Ultra-Orthodox Jewish	Arabs
Price elasticity	0.540 (0.077)	0.333 (0.005)	0.546 (0.010)	0.884 (0.026)	0.645 (0.014)	0.490 (0.024)	0.100 (0.031)	0.745 (0.023)
<i>Comparisons to the literature</i>								
Laroque and Salanié (2005)	0.2							
Benefit elasticity	0.192 (0.028)	0.151 (0.018)	0.196 (0.043)	0.229 (0.098)	0.325 (0.092)	0.178 (0.045)	0.029 (0.018)	0.243 (0.032)
<i>Comparisons to the literature</i>								
Gauthier and Hatzius	0.16							
Zhang et al.	0.05-0.11							
Whittington et al.	0.127-0.248							
Milligan (2005)	0.107							
Income elasticity	-0.005973 (0.0993)	-0.07449 (0.00883)	0.0176 (0.03843)	0.0862 (0.02951)	0.0213 (0.011)	-0.00233 (0.01)	-0.0509 (0.0066)	-0.0675 (0.00864)
<i>Comparisons to the literature</i>								
Hotz and Miller (1988)	0.02							
Black et al. (2008)	0.5							

Evidence 4: Fertility changes in Latin America



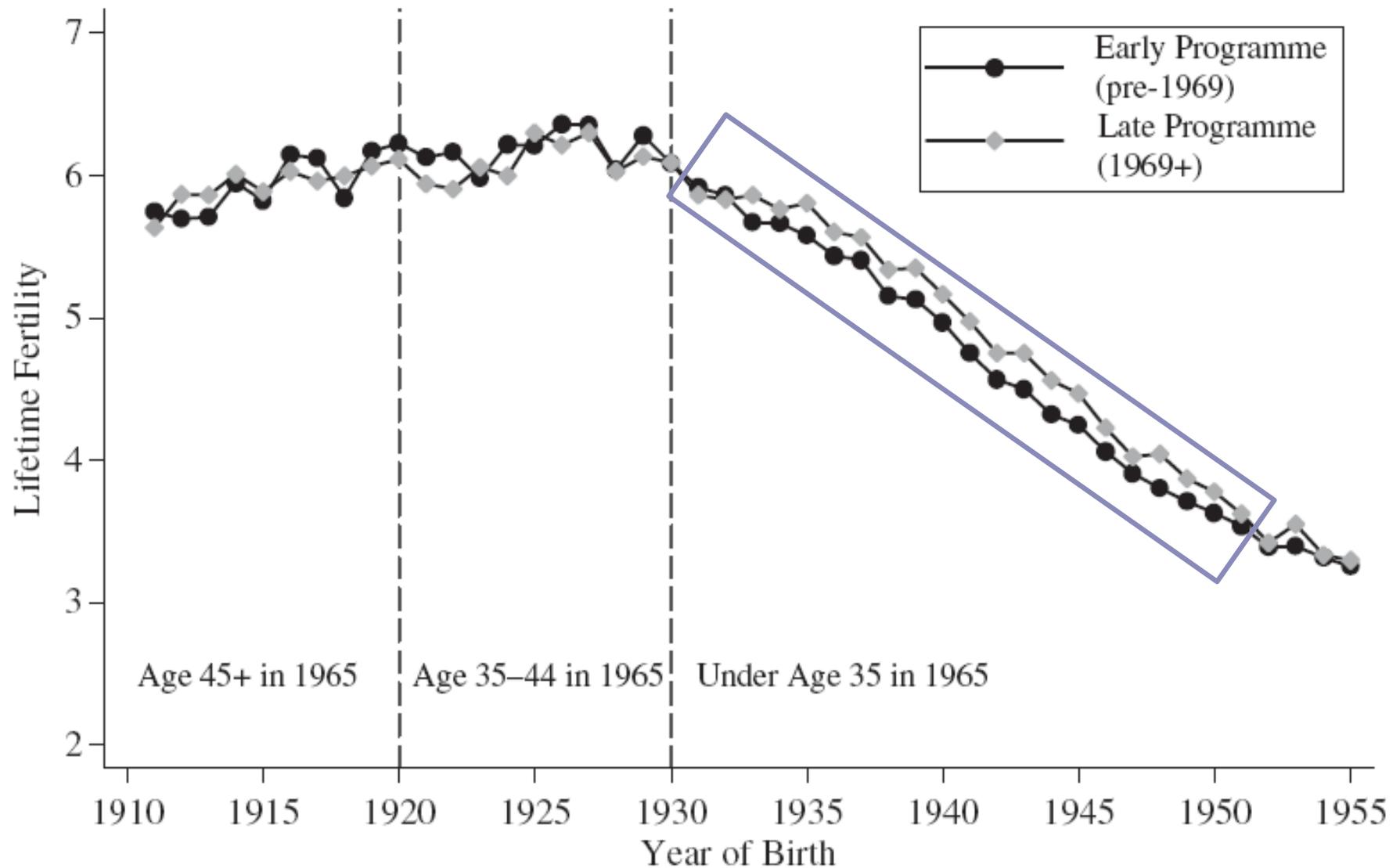
ProFamilia



Analysis of expansion of ProFamilia family planning services in Colombia, 1960' s and 1970' s

- One of the world' s largest and oldest family planning/health programs

Women lifetime fertility



Family planning and fertility

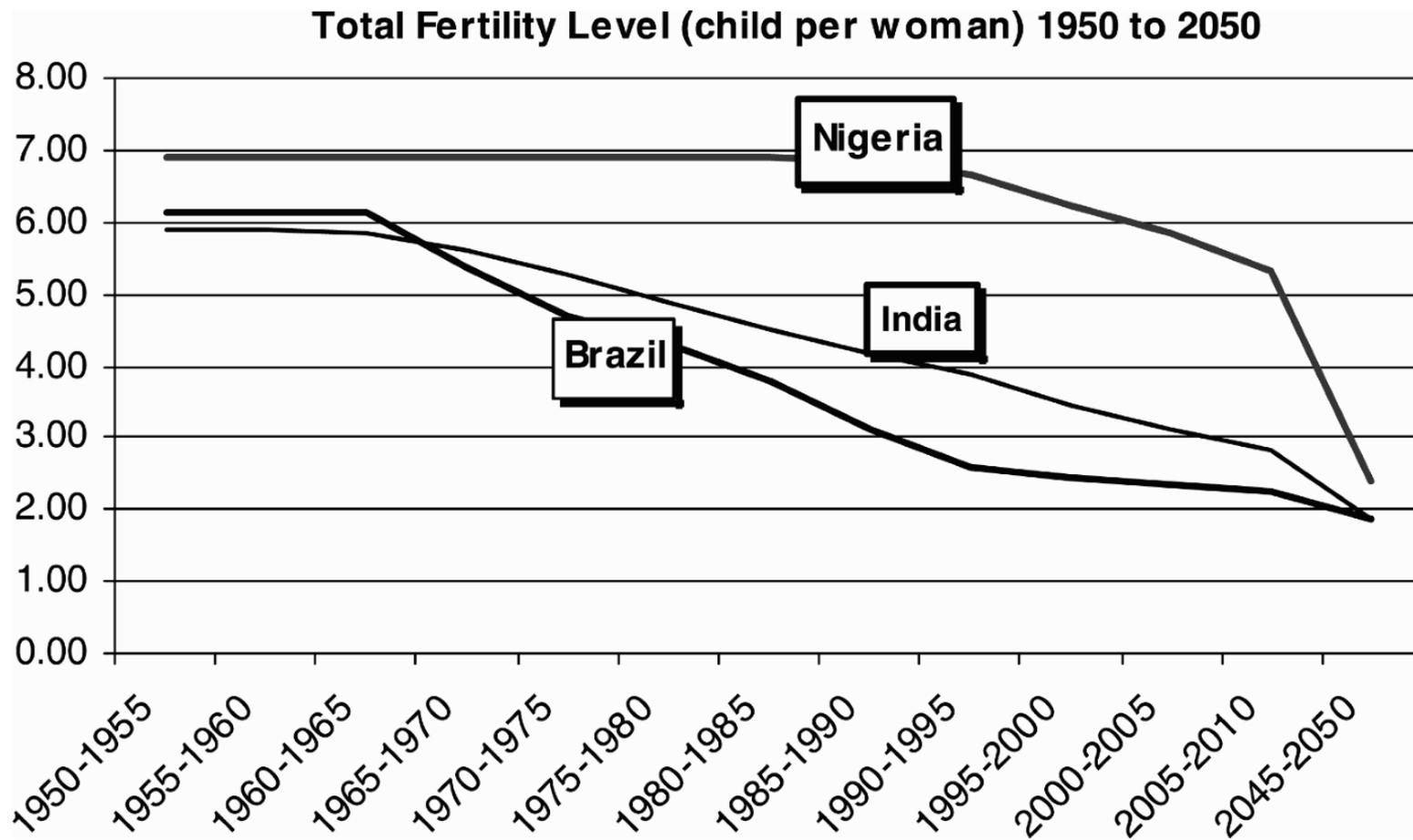
- Availability of modern contraceptives:
 - postponed first birth
 - about 5% fewer children in women's lifetime
- Other factors have a stronger role in decreased fertility
 - Family planning explained 6–7% of fertility decline in Colombia's major population centers between 1964 and 1993

Family planning and women's socio-economic status



- **Women** gaining access to family planning as teenagers
 - obtained 0.05 more years of **schooling**
 - were 7% more likely to work in the **formal sector**
 - were 2% less likely to cohabit with male partners
- Family planning among the most effective (and cost-effective) interventions to foster **human capital accumulation**
- Age pattern of results also suggests that **delayed first births** rather than reduced lifetime fertility are more closely linked to these socio-economic gains

Question 2d: Do social norms matter? Why did Brazil's fertility rate fall so soon?



Re-thinking the integration of women in population development initiatives

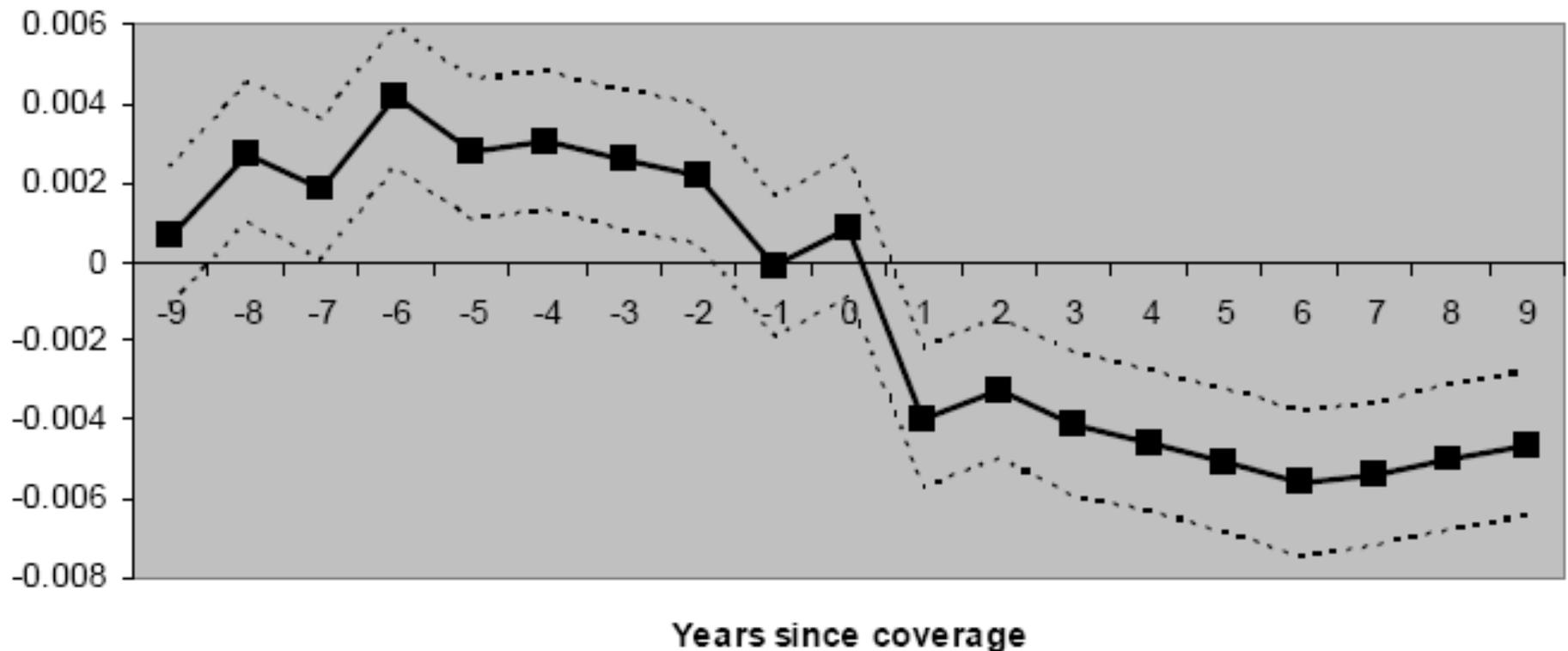
Carolette Norwood , *Development in Practice*, 1364-9213, Volume 19, Issue 7, 2009, Pages 906 – 911

What caused this drop in fertility?

- No population control policy in Brazil
- Supply-side factors:
 - ➔ □ Availability of contraception
- Lower desired fertility
- What is the impact of television on fertility choices?
- What is the impact of the content of TV programming on fertility?
 - Brazilian-produced telenovelas

Other unobserved determinants of fertility?

1. Timing of fertility decline corresponds to Rede Globo expansion



Question 3: Quantity-Quality tradeoff?

“The More the Merrier? The Effect of Family Composition on Children’s Education”

- Quantity-quality tradeoff: the idea from Becker that you care not only about how many kids you have but also their “quality”.
- Questions:
 - child quantity/quality tradeoff within a family
 - the importance of birth order on child outcome
- Idea: to understand the causal effect of n children look at effect of twins at $(n-1)$ st birth order
- Answer using incredible Norwegian data:
 - Small or no quantity/quality trade-off
 - Huge effect of birth order effects

Question 4: The timing of births

- In a permanent income hypothesis world there should be no impact of year-to-year changes in income on fertility.
- We have known for a long time that there is a cyclical pattern in births (recessions=less births)...

Dehejia and Lleras- Mune

- Looks at the idea that not only the level of fertility but also the selection into fertility varies with income.
- In particular who gives birth and babies' health varies with the business cycle.

Evidence

- Strong evidence of timing, but differs by race.
- Pattern of white fertility: low-skill, low-education mothers substitute into fertility in recession relative to higher-ed.
- Pattern of Black fertility: low-education blacks postpone fertility.
- But better health for both groups.

What does it mean for developing countries?

- Balhotra repeats the same exercise for India.
- Finds that infant mortality moves procyclically with income especially in rural areas.

Main findings

Table 1

The baseline model: the impact of state aggregate income shocks on infant mortality risk.

	Unconditional		Controlling for cross-sectional heterogeneity					
	(1)	(2)	(3)	(4)	(5)			
	No controls	State dummies	Mother characteristics	Mother fixed effects	Child characteristics			
Rural income	-0.042 [0.021]	-0.084* [0.011]	-0.075* [0.009]	-0.154* [0.014]	-0.069* [0.012]			
Urban income	-0.045* [0.013]	-0.054* [0.010]	-0.046* [0.009]	-0.132* [0.018]	-0.062* [0.022]			
	Controlling for aggregate shocks and state-specific trends				Controlling for state-specific shocks			Baseline
	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Time dummies	Time dum × birth quarter	Linear state trends	Cubic state trends	Rainfall shocks, + and -	Rainshocks × birth quarter	Population terms	Baseline model
Rural income	-0.055* [0.020]	-0.056* [0.020]	-0.035* [0.011]	-0.034* [0.012]	-0.027* [0.012]	-0.027* [0.012]	-0.027 [0.012]	-0.031* [0.013]
Urban income	-0.043 [0.031]	-0.043 [0.031]	-0.037 [0.038]	-0.031 [0.047]	-0.039 [0.047]	-0.039 [0.047]	-0.040 [0.047]	-0.041 [0.036]

Notes: The dependent variable is an indicator for infant mortality and *income* is the log of real per capita net state domestic product. The number of children (mothers) is 117,088 (36,068) in the rural sample and 35,783 (13,414) in the urban sample. Once mother fixed effects are introduced the effective samples, which exclude 1-child families, are 112,760 (31,740) and 34,068 (11,699). Robust standard errors clustered at the state level are in parentheses. Elasticities are at the mean infant mortality rate, 0.09481 (rural) and 0.0599 (urban). Mother characteristics refer to her education, her partner's education, her ethnicity, religion and height. Child characteristics include gender, birth-order, birth-month and age of the mother at the birth of the child. Rainshocks are allowed to have different effects according to whether they are positive or negative. Population terms are the log level, its difference and the ratio of the rural to the urban population. Changes are cumulative in moving from col. 1 to 12. In col. 13, I revert to linear state trends, drop interactions of time dummies and rainshocks with quarter of birth, and drop population shocks and the inverse urbanisation rate.

* Significance at the 5% level.

Conclusions

- Clearly very different mechanisms can operate in developed and developing countries.
- In the US, selection effect keeps low-quality mothers out when income is low (an indirect effect of income).
- In India, instead, the direct effects of income seem more important.

Pulling it all together

- The practitioner view emphasizes that the availability of birth control is what matters vs Economists: demand for kids matter.
- Both are right.
 - Birth control supply matters: Romania
 - Demand matters: Brazil example
 - Prices / income matter: China, Israel, US
- Where economists are wrong:
 - No evidence of quantity-quality tradeoff.
 - Strong evidence that timing of births matter.