

EE461

Lecture 4: Population growth and economic growth

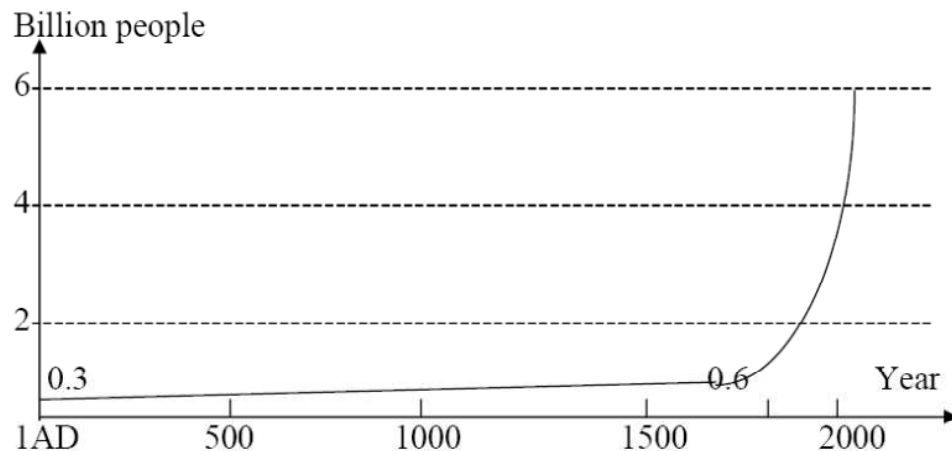
February 4th, 2012

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FACTS ON POPULATION GROWTH: FROM THE STONE AGE TO MODERN WORLD

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Pictures of the world 1



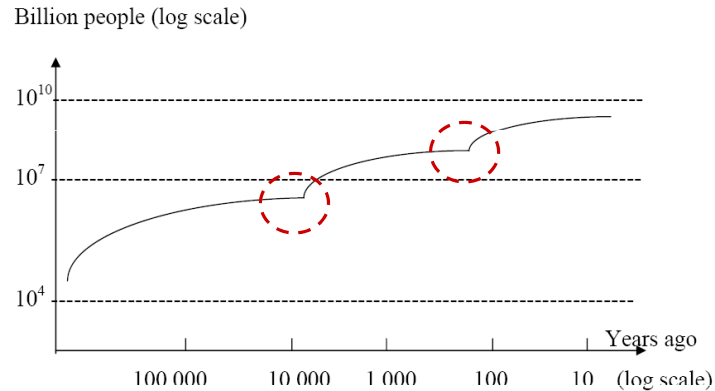
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Some Facts

- It took mankind more than 10,000 years to reach the first billion of population, 123 years to reach the second, 33 years for the third, 14 years for the fourth, 13 years for the fifth.
- Current world population: 7 billion (UN)

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Pictures of the world 2



What are the causes of sudden rise in pop. growth?

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Population growth and Economic growth over time

Period	Population growth	Economic growth
1. The Pre agricultural Era (99% of human time)	Practically Nil (10,000 BC)	Practically Nil. World Pop < 100m
2. The Settled Agricultural Era (10,000 BC to 1,800 AD)	<0.1 % per Year. World Pop:1.7 billion in 1800	Practically nil per Capita. From 0.2% to 1.4% in 1700-1820
3. The Industrial Revolution Era(around 1820-1970)	Increased from 0.5 % annually to 2.1 % in the 1960s	From 1.0 to 3.0% in the industrializing countries
4. The Post-Industrial Era	Slowed down to 1.3% (1970 -2000). World Pop: 6 billion in 2000	Slow down to 1.7%.

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Why stagnant population before 1800 AD?

- Before 8000 BC:
 - all humans were gathers and hunter =>
- 8000 BC to 1800 AC:

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Population explosion?

- The idea started as late as the mid 1990s
 - “World population growth is the largest threat to mankind” - Robert McNamara 1994
- Muslim, the Vatican, and several environmentalist groups **resented all interventions aimed at holding birth rates down.**
- What was the cause for such conflict (other than religions and beliefs)?

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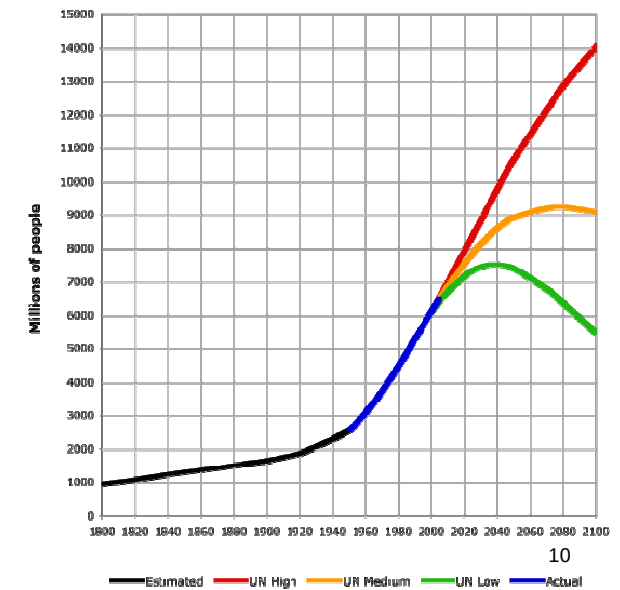
Faulty Statistics by UN

- The world population projection made by the UN at the time **did not** incorporate many relevant variables
- The data on world population growth during the preceding decade (1980s), turned out to be a serious **over-estimates**
 - Enormous **downward revision** for the 1980s; less for 1990s, for the world as a whole and also for all groups of countries
 - For some individual countries, population is actually **declining** (European and Central Asian)

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World Population Estimates

By UN estimate (high case), world population will be doubled by 2100



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Population vs. Economic Growth

		Economic Growth	
		Exogenous	Endogenous
Population Growth	Exogenous	Neo-Classical growth model in SS	Malthusian and Neo-Malthusian
	Endogenous	Transition Theory	Revisionist Theory

- Several theories see different causalities between population growth and economic growth

THEORIES

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EXOGENOUS POPULATION GROWTH ON ECONOMIC GROWTH

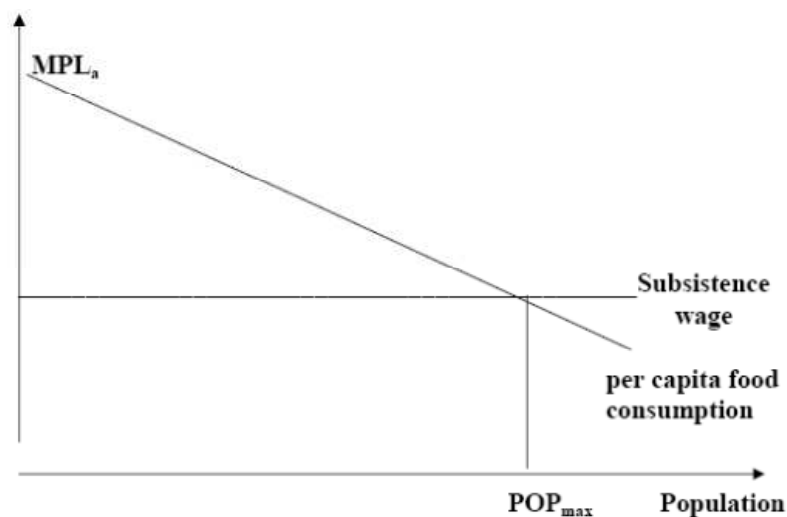
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Malthus' "Doomsday" Model: Basic Assumptions

1. Population grows exponentially (and exogenously)
2. The arable land area and production technologies are also given
 - As population grows,
3. No technological progress in agriculture (later revised by Malthus himself)

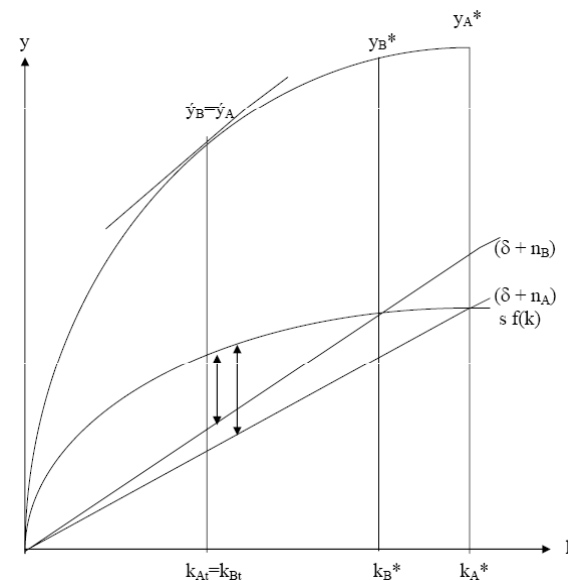
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Malthus' "Doomsday" Model



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Solow Model Revisited



Assumptions:

- $y_B = y_A = f(k)$
- $k_{Bt} = k_{At}$
- $s_B = s_A$
- $n_B > n_A$

Results:

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EXOGENOUS ECONOMIC GROWTH ON POPULATION GROWTH

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Demographic Transition Theory

5 stages of transition

1st stage (Pre-industrial society):

- high & balance death and birth rates

2nd stage (Developing countries):

- death rates drop rapidly due to improvements in food supply and sanitation

3rd stage (Urbanization):

- birth rates fall due to...

- Population begins to remain stable

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Demographic Transition Theory

4th (Developed countries)

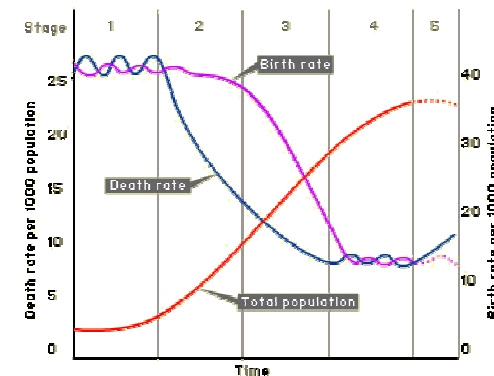
- Birth and death rates are both low, therefore the total population is high and stable.

5th (Aging Society)

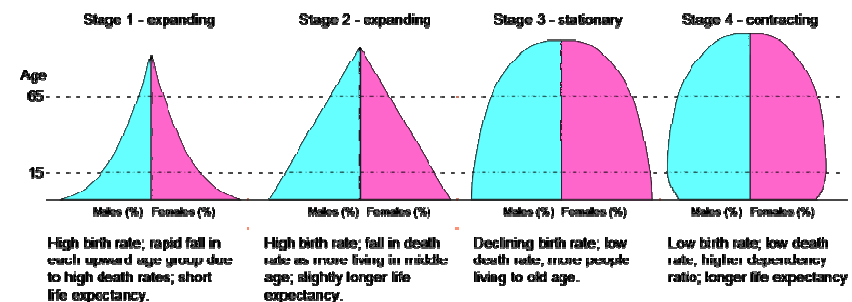
- sub-replacement fertility (total fertility rate or TFR not high enough to replace an area's population)
- higher death rates than birth rates



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How about S5?



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Two transitional effects on economic growth

- 1) In stage 2 and 3, when the working force is growing relative to the population, the number of hands relative to mouths increases (or the dependency ratio declines). This means that
 - on a **per-capita** basis, economic growth will increase (if everything else is equal)
- 2) When the labor force is on the rise in the population, MPK (and return to capital) increases. If savings and investment are mainly out of capital income,

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From economic growth to death and birth rate

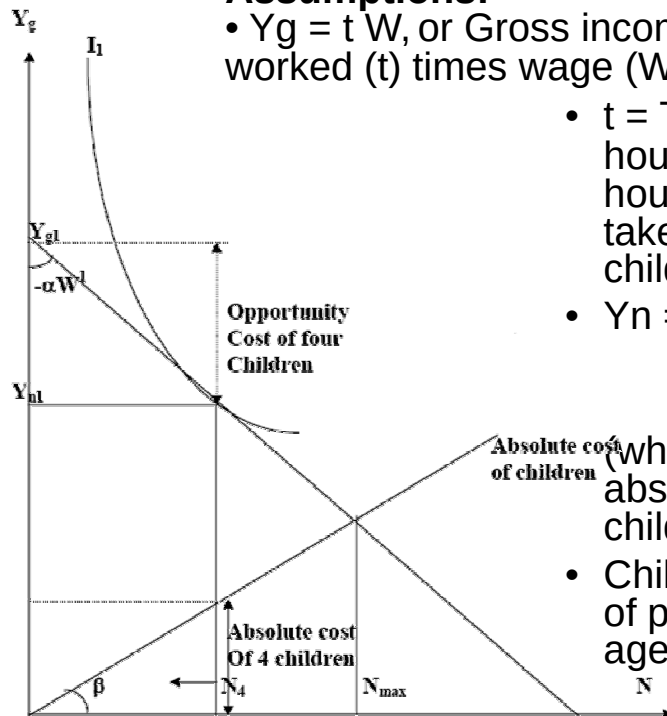
- **Death rate:** Higher incomes => higher effective demand for education, health services and good nutrition
- **Birth rate:**
 - 1) Higher household income leads **directly** to lower demand for children:
 - Higher opportunity cost for children
 - Increased survival of own children with higher economic standards (food, health care) means that fewer children are needed to replace those who die
 - Demand for Child Labor in the household falls
 - 2) Higher income in society at large leads **indirectly** to lower demand for children:
 - Possibilities for alternative pension schemes
 - Better information about contraception, which makes more children than wanted less likely
 - Change of Social Preferences: *Quality* rather than *quantity*

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Assumptions:

- $Y_g = tW$, or Gross income is no. of hours worked (t) times wage (W)
 - $t = T - \alpha N$
hours worked are total hours minus the time it takes to tend to N children, α for each.
 - $Y_n = (T - \alpha N)W - \beta N$

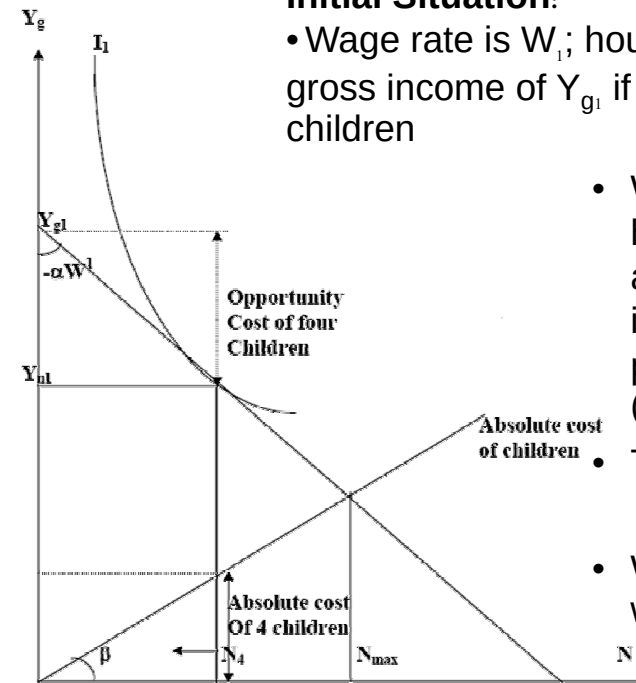
$$= TW - (\alpha W + \beta)N,$$
 (where β is the absolute cost of each child- food, cloths, etc)
 - Children will take care of parents in their old age



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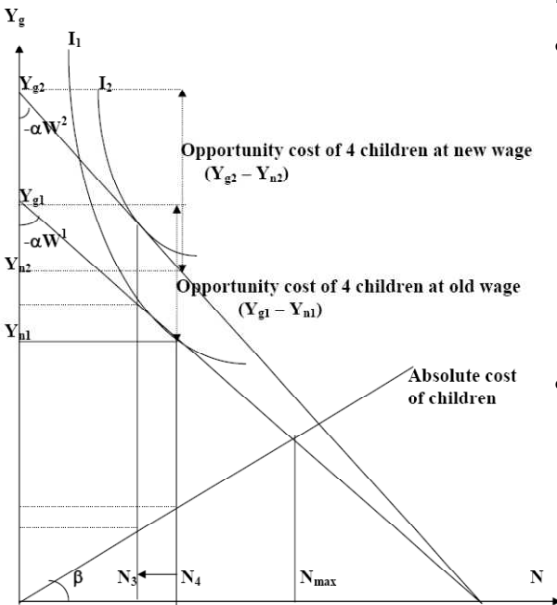
Initial Situation:

- Wage rate is W_1 ; household could earn a gross income of Y_{g1} if it chooses to have no children



- With the preference of having an income at old age, reflected in the indifference curve I_1 , it plans to have 4 children (N_4)
- The net income is hence
- What happens if the wage rate is instead W_2 ?

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New situation:

- At the wage rate W_2 , the opportunity cost of 4 children increases from $(Y_{g1} - Y_{n1})$ to $(Y_{g2} - Y_{n2})$
 - Children become more 'expensive'
- If inter-temporal income preferences are given by I_2 , the household will opt for only 3 children.

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How many kids, Honey?

- Number of children also depends on the probability of each child to actually provide support
- Define:
 - ρ = Probability that a **given** child will actually support his/her old parents
 - $(1-\rho)$ = Probability that one given child will **not** support his/her old parents
 - (it may die, become disabled, unemployed, run away or just be "rotten")
- $(1-\rho)(1-\rho)$ = Probability that **none** of 2 children will support
- $(1-\rho)^n$ = Probability that **none** of n children will support
- $1 - (1-\rho)^n$ = Probability that at least one of n children will support**

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Let me think...

Probability that at least one children will take care of their parents.

ρ	$1-\rho$	Number of children						
		1	2	3	4	5	6	7
0.25	0.75	0.25	0.44	0.58	0.68	0.76	0.82	0.87
0.50	0.50	0.50	0.75	0.88	0.94	0.97	0.98	0.99
0.70	0.30	0.70	0.91	0.97	0.99	1.00	1.00	1.00

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Gender Bias

- Can be immensely costly
- Suppose a couple wishes to receive support from just one son
- Suppose $\rho = 0.5$ and they want to be at least 90% certain of such support
- This couple will end up, on average, having

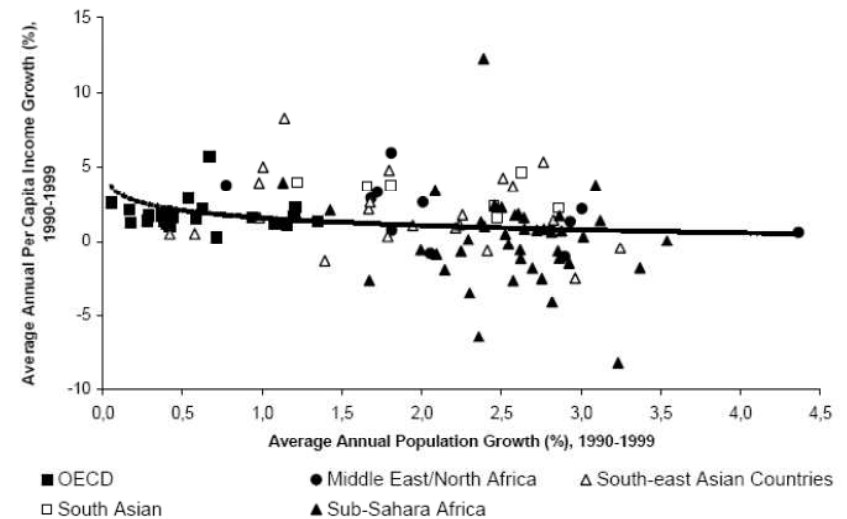
(The same applies to the wish towards a daughter as well)

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EMPIRICAL EVIDENCE

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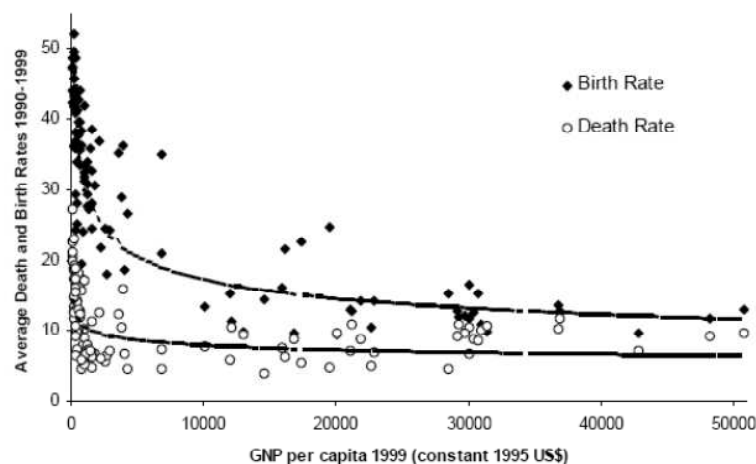
GNP per capita growth and Population growth



Source: World Development Indicators 2001, World Bank

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Birth & Death Rates and Income



Source: World Development Indicators 2001, World Bank

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Causality?

- Theories and models cannot pinpoint the causality between these two.
- Some researches find some trend while others do not
 - Barro(1997): Population growth not significant, but negative correlation between fertility and GDP per capita (support for transition theory)
 - Levine and Renelt (1992): Population growth not significant and not robust determinant of growth
 - Brander and Dowrick(1994): Population growth not significant, increase in the share of the work-force in the population significant and positive on economic growth, decline in the birth rate associated with higher economic growth

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Social Norms and Fertility Decline

Country	Fertility Rates	
	2000-05	2005-10
Afghanistan	7.5	7.1
Rwanda	6.0	5.9
Madagascar	5.3	4.8
Côte d'Ivoire	5.1	4.5
Brunei	2.5	2.1
Iran	2.1	2.0
USA	2.0	2.1
Thailand	1.83	1.85
UK	1.7	1.82

Total Fertility Rate = average number of children that would be born to a woman over her lifetime

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Summary on Empirical Findings

- Population growth rate has **no** significant and robust impact on economic growth, contrary to Malthus' theory of natural resource (food) constraints.
 - Solow below steady state? Discretionary changes?
- Lower BR induces a **transitional** increase in the share of population at working age, which **enhances economic growth**.
- Economic growth is not the only determinant of birth rates. Education and high child mortality (the replacement effect) also matter.

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CONCLUSION

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What we have seen so far...

- Population growth started to climb in 1800s
- Malthus' "Doomsday" model: population continues to grow until food are not sufficiently produced
- Solow Model: Different population growth rates have no effect on productivity and economic wellbeing (y), but negative for discrete changes
- Transition Theory: Different Birth and Death rates in different stages of development
- Number of children depends on the probability of each child to actually provide support to parents
- Hard to pinpoint causality by looking at empirical evidence

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