

MCR HRD Institute Hyderabad:  
83rd Foundation Course for Central Civil Service Officers

# **Population Dynamics & Public Policy**

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## **Presentation Plan**

1. A Few Demographic Concepts
2. World Population Trends
3. Models and Theories on Population Dynamics

# Selected Demographic Concepts

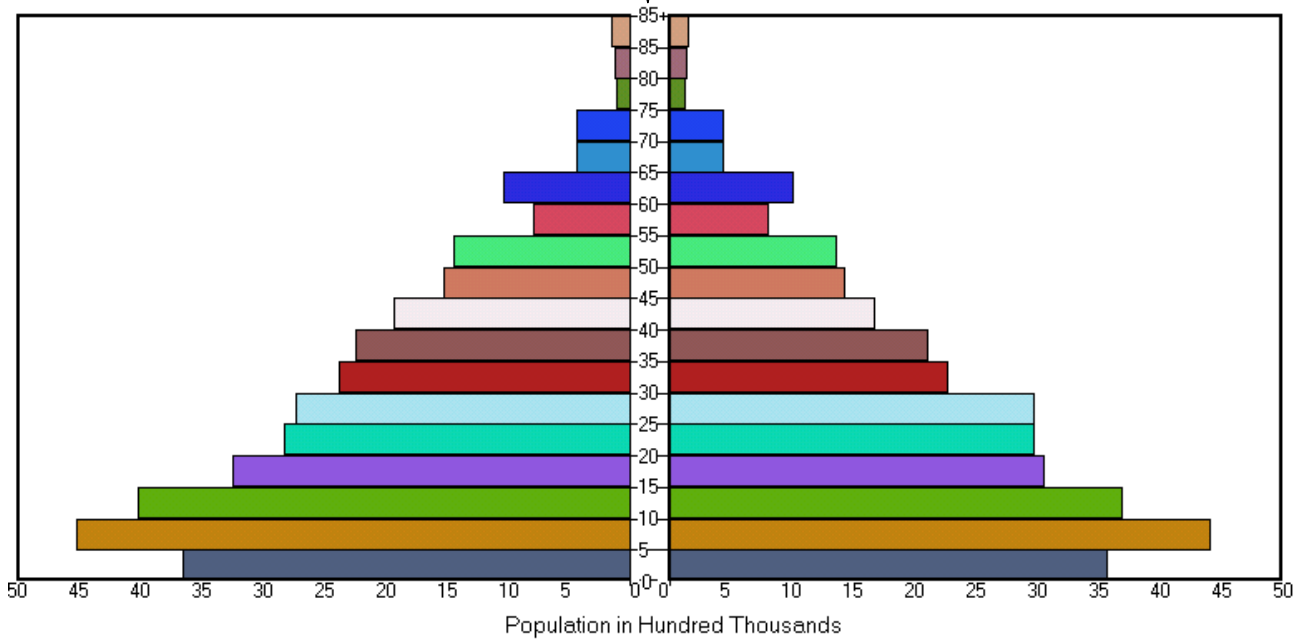
## Basic Demographic Equation

$$\text{Pop}_{t+1} = \text{Pop}_t + \overbrace{\text{Births-Deaths}}^{\text{Natural Increase}} + \underbrace{\text{In-Out}}_{\text{Net Migration}}$$

⇒ Population change = Natural increase + Net migration

# Population Pyramids

Age group



Age-Sex Pyramids / Age Structure Diagram

# Dependency Ratios

Child dependency ratio:  $\frac{P_{0-14}}{P_{15-64}} \times 100$

Old age (Aged) dependency ratio:  $\frac{P_{65+}}{P_{15-64}} \times 100$



Children + Elderly Working Ages  $\times 100$

$\frac{P_{0-14} + P_{65+}}{P_{15-64}} \times 100$

## Dependency Ratio of Selected Populations, 2005

	Child Dep Ratio %	Old Age Dep Ratio %	Total Dep Ratio %
France	28	26	54
India	53	7	60
Iran	39	7	46
Japan	21	30	51
USA	31	19	50

Source: UN Data <http://data.un.org/> accessed on 21/10/09

## Fertility Measures

Age Specific Fertility Rate (ASFR) =  $\frac{\text{Births in the year to women aged } x}{\text{Women aged } x \text{ at mid year}}$

Total Fertility Rate (TFR) = Total number of children an average woman will bear during her reproductive life, say 15-49 years.

Gross Reproduction Rate (GRR) = Average number of daughters a woman would have if she survived to at least age 50 (i.e. mortality was zero till age 50) and experienced the given female ASFRs.

Net Reproduction Rate (NRR) = Average number of daughters a woman would have allowing for prevailing mortality among women in reproductive age. NRR incorporates GRR (Reproductivity) and ASDR (Mortality).

## India - Fertility Rates

Year	Age at M	TFR	GRR
1997	19.1	3.3	1.6
1998	19.5	3.2	1.5
1999	19.6	3.2	1.5
2000	19.8	3.2	1.5
2001	19.9	3.1	1.5
2002	20.0	3.0	1.4
2003	20.1	3.0	1.4
2004	20.4	2.9	1.4
2005	20.2	2.9	1.4
2006	20.5	2.8	1.3

Source: SRS Annual Reports

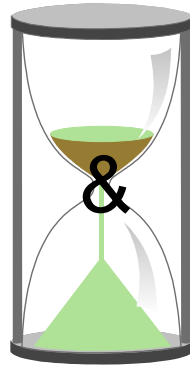
## What Would be the Maximum Natural Fertility?

- Hutterites are absolute pacifists, live in a community and do not practice contraception.
- Currently found in Canada (Alberta, Manitoba, Saskatchewan); USA (South Dakota, Montana).
- Eaton & Mayor (1953) estimated Hutterite TFR=10.9
- Subsequently, Robnins (1986) observed that some form of birth controls are actually at work among Hutterites.
- Adjusting for the same Robinso estimates max natural TFR= 15



Photo by Everett Baker downloaded on 21/10/09 from <http://landerspot.com/WordPress/?p=36#more-36>

Comments

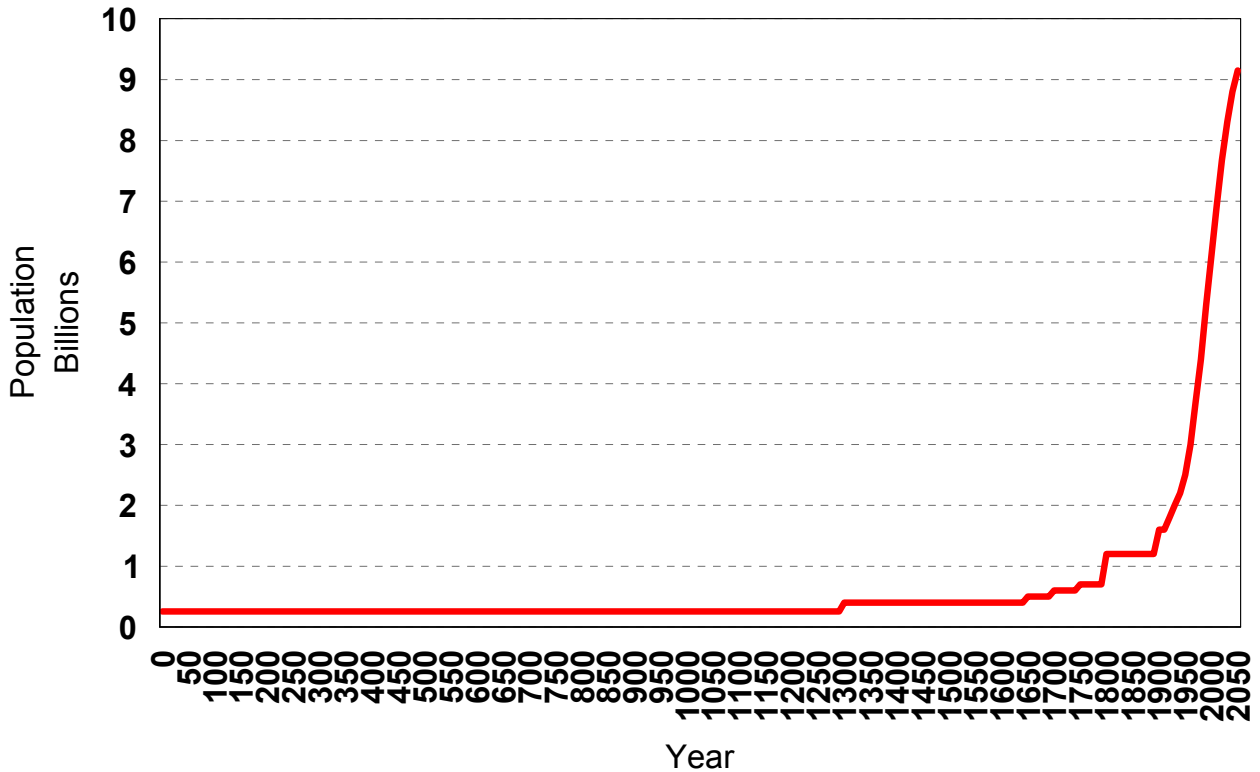


Questions?

# World Population Trends

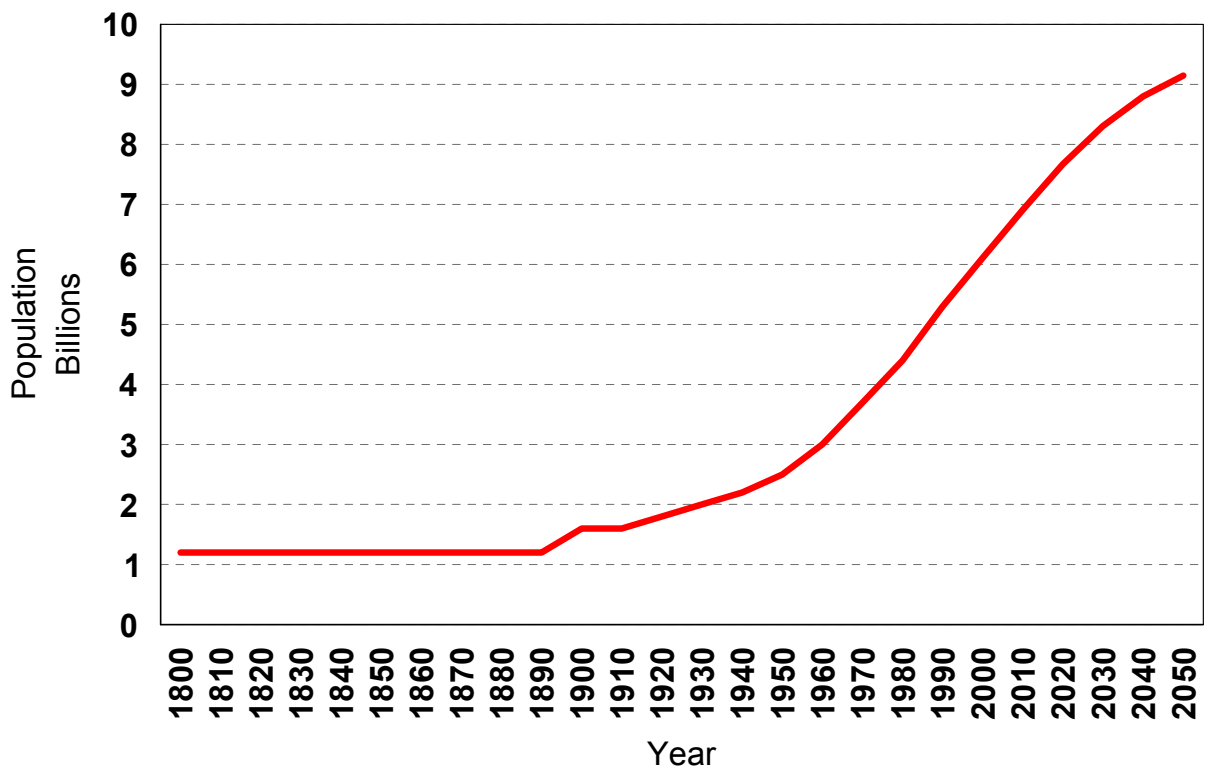
An Overview

# World Population 1 AD to 2050



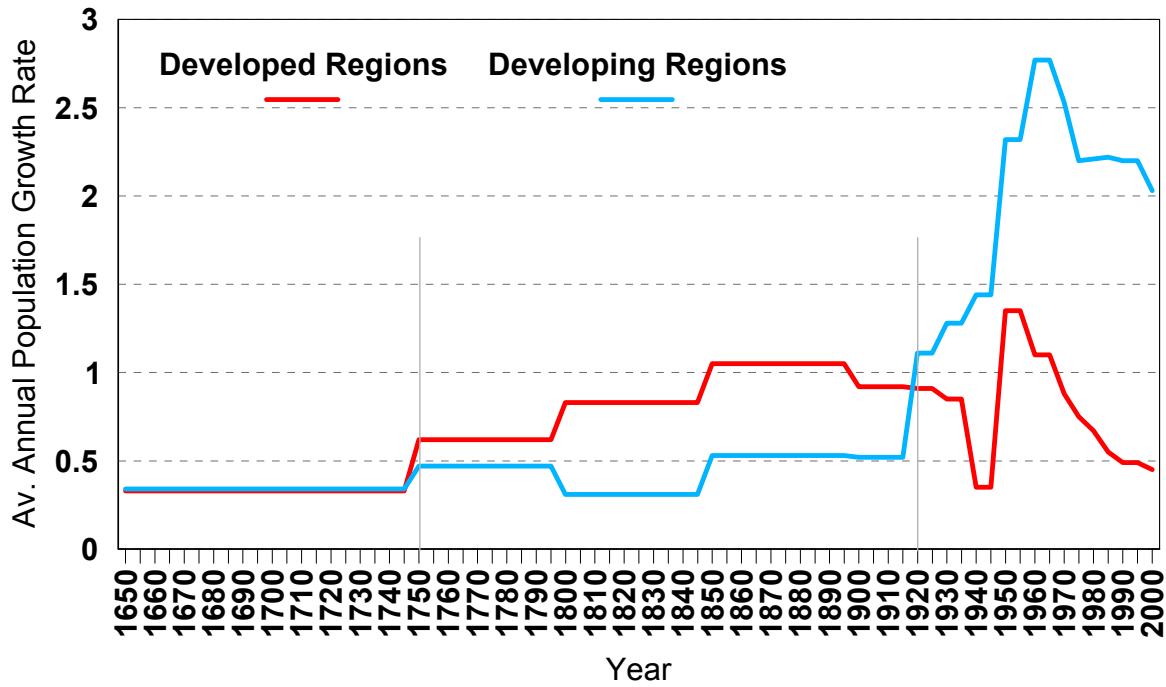
Source: Post 1920 from UN; pre 1920 from Ralph Thomlinson, 1965 and Brock & Web 1973. The figures to generate the chart were gathered from Table-3.3 at p65 in Bhende and Kanitkar, 2001 (1 AD to 1990) and from UN World Pop Prospects (2000 to 2050)

# World Population 1800 to 2050



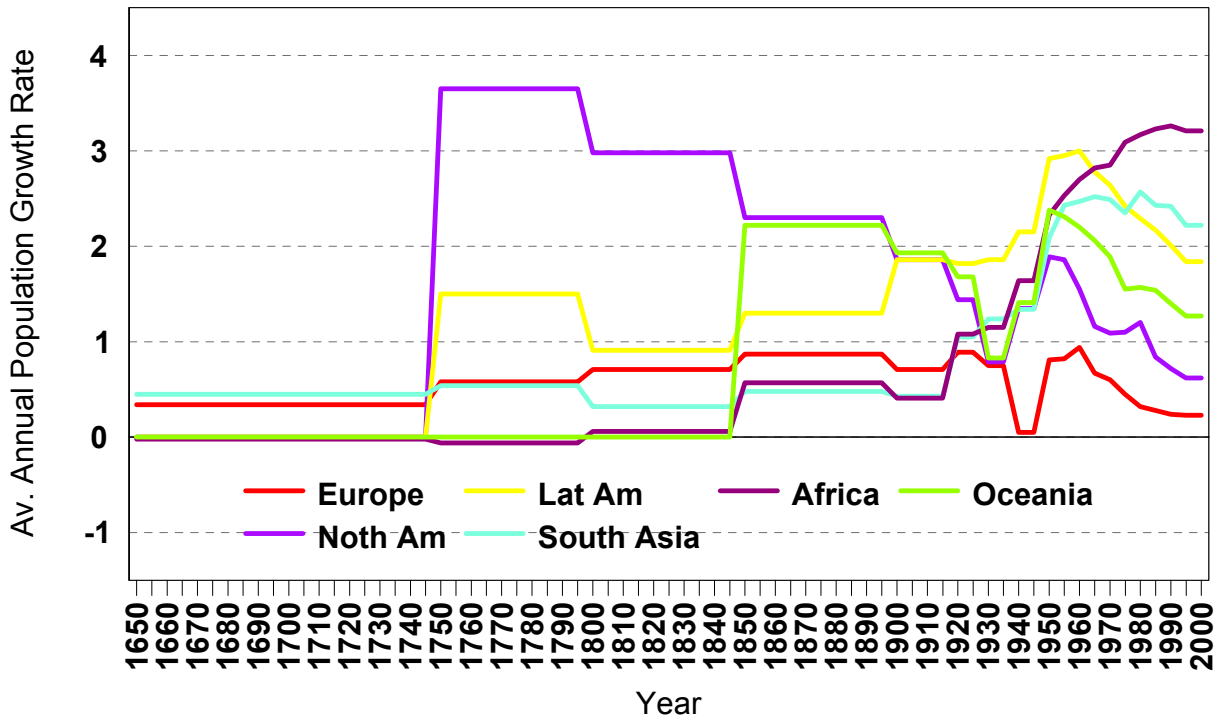
Source: Post 1920 from UN; pre 1920 from Ralph Thomlinson, 1965 and Brock & Web 1973. The figures to generate the chart were gathered from Table-3.3 at p65 in Bhende and Kanitkar, 2001 (1 AD to 1990) and from UN World Pop Prospects (2000 to 2050)

## Time Trend of Pop Growth Rate in Developed and Developing Regions



Source: Post 1950 from UN; pre 1950 from Donald J. Bogue, 1969. The figures to generate the chart were gathered from Table-3.7 at p71 in Bhende and Kaniitkar, 2001.

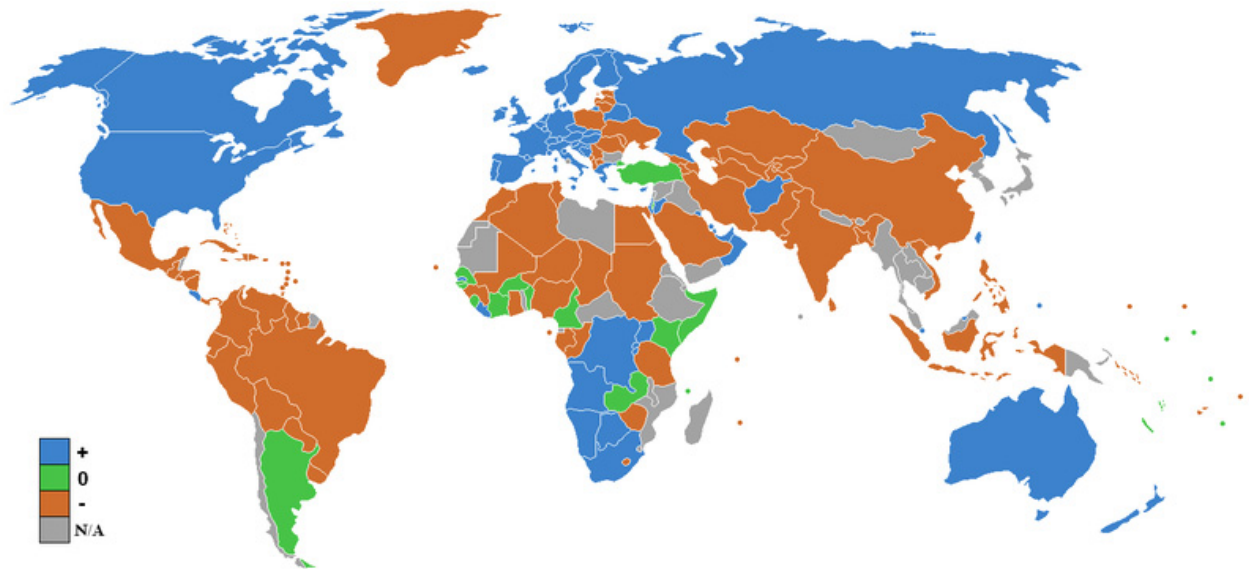
## Time Trend of Pop Growth Rate in World Regions



Source: Post 1950 from UN; pre 1950 from Donald J. Bogue, 1969. The figures to generate the chart were gathered from Table-3.7 at p71 in Bhende and Kaniitkar, 2001; Combined Asia estimates for 1650 to 1950 adopted for South Asia.



## World - Netmigration, 2006



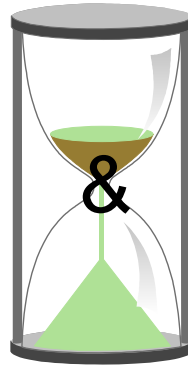
Source: Wikipedia ([http://en.wikipedia.org/wiki/File:Net\\_migration\\_rate\\_world.PNG#file](http://en.wikipedia.org/wiki/File:Net_migration_rate_world.PNG#file)); Data from CIA's The World Fact Book (<https://www.cia.gov/library/publications/the-world-factbook/fields/2112.html>) accessed in April, 2006.

## Migration & Population Dynamics

- Worldwide Births / Day (1992) : 250,000
- Worldwide Deaths / Day(1989): 25,000
- Net migrants (S->N) / Day : 5,000
- Annually less than 1 of 2000 inhabitants in developing country migrates to North (developed countries).
- Thus:
  - ▶ Migration is of lower order magnitude compared to natural increase for pop dynamics
  - ▶ However, reduction in barriers to migration, as well as socioeconomic and political issues arising from migration will gain importance in 21st century.

Source: Oberg Sture. Spatial and economic factors in future south-north migration. in: Lutz Wolfgang. The future population of the world. What can we assume today? Revised and Updated Edition ed. London: Earthscan Publications; 1996; pp. 336-358.

Comments



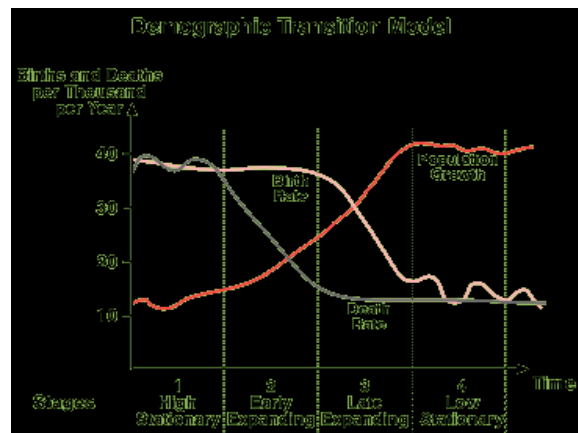
Questions?

# Models and Theories on Population Dynamics

# Demographic Transition Model (DTM)

Firs proposed by Warren Thompson, 1929; developed by CP Blacker,, Frank Notestein, Ansely J. Coale & Edgar M. Hoover.

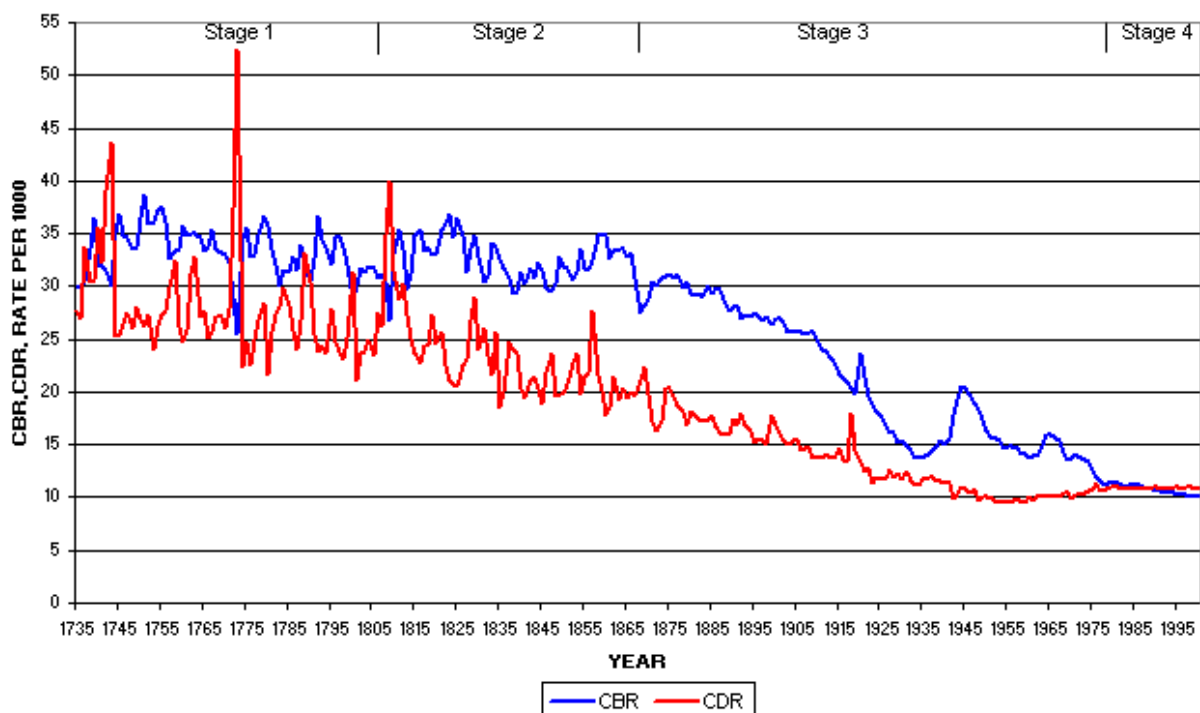
- Generalised explanation of decline in mortality & fertility
- Visualised Four Stages
- Stage-1 (premodern, pretransition, high stationary): High fertility & high fluctuating mortality.
- Stage-2 (Transitional, Industrialising, Early expanding): Declining death rate, but high birth rates.
- Stage-3 (Transitional, Industrialising, Late expanding): Low death rate & declining birth rates.



Source: Picture downloaded from site of Barcelona Field Study Ctr; <http://geographyfieldwork.com/DemographicTransition.htm>

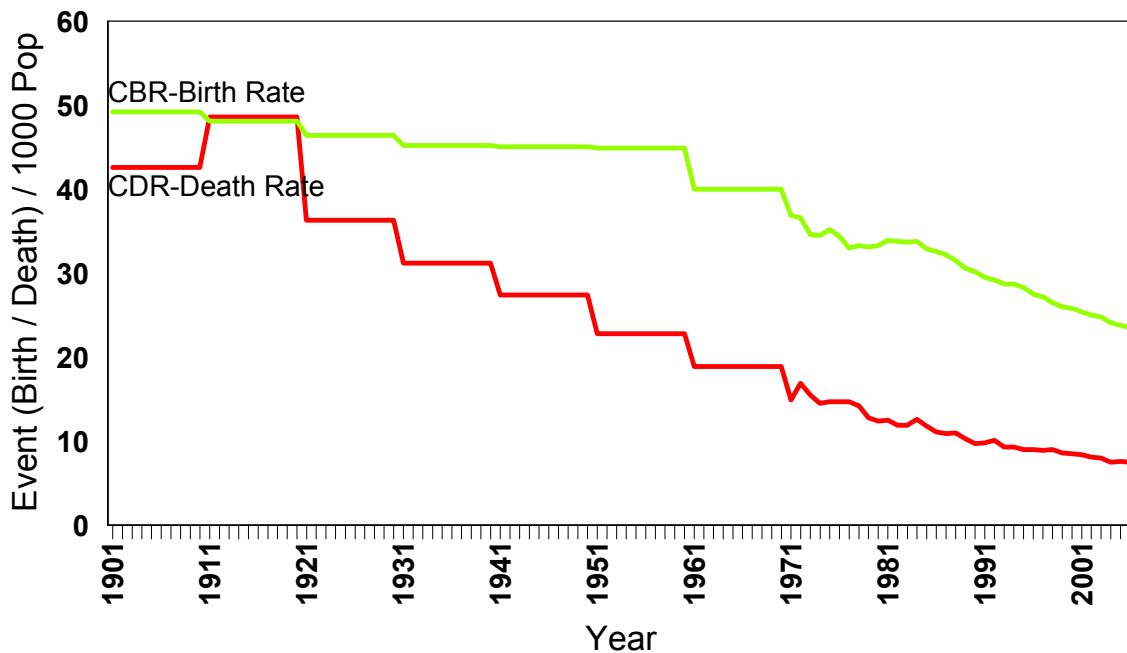
- Stage-4 (Industrial): Both birth & death rates are low.
- Stage-5 (Post transition): Low mortality & very low fertility. Declining populations.

## DEMOGRAPHIC CHANGE, SWEDEN, 1735-2000



Source: [http://en.wikipedia.org/wiki/File:Demographic\\_change\\_in\\_Sweden\\_1735-2000.gif](http://en.wikipedia.org/wiki/File:Demographic_change_in_Sweden_1735-2000.gif)

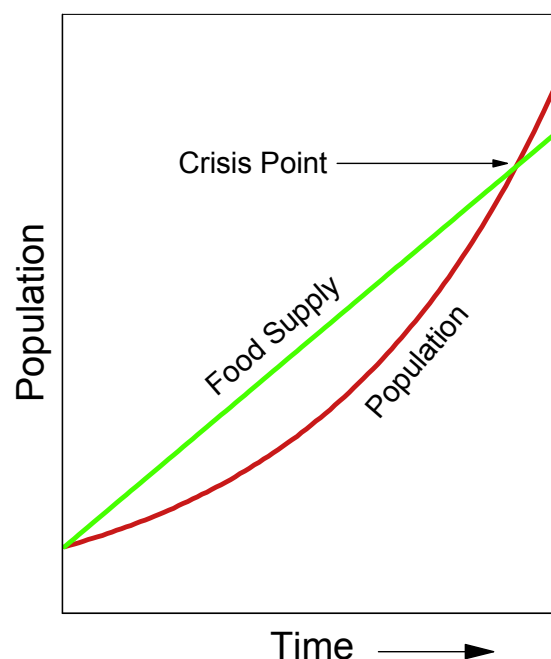
## India - Birth & Death Rates



Source: Bhende and Kanitkar, Principles of Pop. Studies Tables 7.10, 7.11 (CDR), Table 9.11 (CBR) and SRS Annual Reports.

## Malthusian Theory

- Thomas R. Malthus, 1766-1834; Anglican clergy, & British scholar in political economy & demography
- 1797: Anglican country curate
- 1805: Prof History & Pol Econ
- 1798-1826: An essay on the principles of population (6 eds)
- Population increases geometrically (1,2,4,8,16, 32..)
- Food production increases arithmetically (1,2,3,4,...).
- Preventive checks: Birth control by moral restraint - postpone marriage & celibacy.



# The Club of Rome

A society formed in 1968 of academicians, scientists, civil servants & others, now based in Paris.

- 1972: The Limits to Growth
- 1993: Beyond the Limits, 20 Yr update
- 2004: Limits to Growth: The 30 yr update
- Modelled world population, industrialization, pollution, food production and resource depletion.
- Assumed exponential population growth and linear technological innovation.
- Predicts economic and societal collapse in 21st century.
- Keith Suter, 1999: Most of the scenarios pointed to a major economic crisis happening in the early 1990s. This is not what happened.
- In 2008 Graham Turner examined 30 yrs of reality and found that changes in industrial production, food production and pollution are consistent with predictions in 1972.

Donella H. Meadows, Dennis L. Meadows, Jørgen Randers have authored all three books, William W. Behrens III was also a coauthors for the first book in 1972, Keith Suter is a member of the Club of Rome, since 1991. The quote here based on his interview to Australian Broadcasting Corporation, accessed on 21/10/09 at <http://www.abc.net.au/science/slab/rome/default.htm>. Graham Turners findings as reported by Jeff Hecht, "Prophecy of economic collapse 'coming true'", NewScientist, 17 November 2008 and cited in Wikipedia [http://en.wikipedia.org/wiki/The\\_Limits\\_to\\_Growth](http://en.wikipedia.org/wiki/The_Limits_to_Growth) accessed on 21/10/09

## Studies on Earths Carrying Capacity

Date	LB-Billion	UB-Billions	References
1891	6.0	6.0	Ravenstein, 1891
1925	7.7	9.5	Penck, 1925
1945	0.9	2.8	Pearson & Harper, 1945
1960	30.0	30.0	Baade, 1960
1967	47.0	157.0	Clark, 1967
1967	41.0	41.0	Revelle, 1967
1973	35.0	40.0	Mückenhausen, 1973
1975	2.7	6.7	Buringh et al, 1977, 75
1978	1000.0	1000.0	Marchetti, 1978
1981	2.0	2.0	Westing, 1981; Mann, 1981
1982	No limit	No limit	Simon, 1981, Kahn 1982
1982	3.6	33.2	FAO/UNFPA/IIASA (Higgins etal, 1982) for 2000
1983	7.5	7.5	Gilland, 1983
1984	6.1	6.1	Resources for the Future, 1984
1992	2.8	5.5	World Hunger Program (Cohen, 1992)
1993	5.5	5.5	Ehrlich et al 1993

Source: Gerhard K. Heilig, in Wolfgang Lutz Ed "The Future Population of the World, 1996, Earthcan, London; Tbl-10.1 page 197.

# Agricultural Intensification Theory

- Ester Boserup, 1910-1999, Danish Agricultural Economist.
- 1965: The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure;
- 1981: Population and Technological Change: A Study of Long-term Trends
- Propositions:
  - ▶ Population determines agriculture, not the other way.
  - ▶ People invent their way out of crisis.
  - ▶ The 'Malthusian Trap' may in fact drive technological innovation.
  - ▶ Necessity is the mother of invention.
- Critic:
  - ▶ If 'crisis' were driving tech. innovation, most advanced agri-tech should be found in areas with high population pressure.

Source: [http://en.wikipedia.org/wiki/Ester\\_Boserup](http://en.wikipedia.org/wiki/Ester_Boserup), accessed on 21/10/09

# People as the Ultimate Resource

- Julian L. Simon, 1932 - 1998; Was Prof. Bus Adm Univ. of Maryland, Sr. Fellow, Cato Institute.
- 1981: The Ultimate Resource.
- 1984: The Resourcefull Earth (Coed by Herman Kahn)
- 1996: The Ultimate Resource 2.
- As a resource becomes scarce, its price rises.
- High price is an incentive to discover more, ration it, and develop substitutes.
- Although supplies are limited physically, scope for recycling, more efficient technology, and discovery of new alternatives, in effect means physical resources are unlimited.
- Ultimate resource is human capacity to adapt and invent.
- Population is the solution to resource scarcities and environmental problems.

Source: Based on [http://en.wikipedia.org/wiki/The\\_Ultimate\\_Resource](http://en.wikipedia.org/wiki/The_Ultimate_Resource); and [http://en.wikipedia.org/wiki/Julian\\_Lincoln\\_Simon](http://en.wikipedia.org/wiki/Julian_Lincoln_Simon), accessed on 21/10/09

## The Simon - Ehrlich Wager!

- Julian L. Simon author of *The Ultimate Resource* (1981, 1996).
- Paul Ehrlich author of *The Population Bomb*, which argued that mankind was facing a demographic catastrophe with the rate of population growth quickly outstripping growth in the supply of food and resources.
- Both had a bet in 1980.
- Ehrlich chose 5 metals: copper, chromium, nickel, tin, & tungsten.
- Simon bet that their prices would go down.
- Ehrlich bet they would go up.
- The basket of goods costing \$1000 in 1980 went down by 57%
- As a result, in October 1990, Paul Ehrlich mailed Julian Simon a check for \$576.07 to settle the wager in Simon's favor.

Source: Based on [http://en.wikipedia.org/wiki/The\\_Ultimate\\_Resource](http://en.wikipedia.org/wiki/The_Ultimate_Resource); and [http://en.wikipedia.org/wiki/Julian\\_Lincoln\\_Simon](http://en.wikipedia.org/wiki/Julian_Lincoln_Simon), accessed on 21/10/09

## But the Jury is Still Out!

Subsequently, Simon Lost a Similar Bet on Timbre Prices, with David South.

Source: Based on [http://en.wikipedia.org/wiki/Julian\\_Lincoln\\_Simon](http://en.wikipedia.org/wiki/Julian_Lincoln_Simon), accessed on 21/10/09

# Demographic Dividend

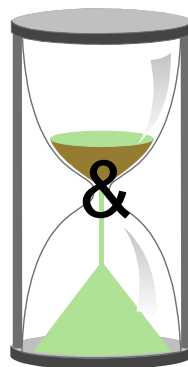
## Demographic Window Of Opportunity

- 1998: David E. Bloom & Jeffrey G. Williamson
- 2000: David E. Bloom, David Canning and Pia Malaney
- 2003: David E. Bloom, David Canning and Jaypee Sevilla
- Late in demographic transition, as fertility rate falls, dependency rates decline.
- The magnitude of demographic dividend depends on ability of the economy to absorb and productively employ extra workers.
- A good part of the rise in economic growth in Asian economies is due to rising share of working age population.

Source: Based on [http://en.wikipedia.org/wiki/The\\_Ultimate\\_Resource](http://en.wikipedia.org/wiki/The_Ultimate_Resource); and [http://en.wikipedia.org/wiki/Julian\\_Lincoln\\_Simon](http://en.wikipedia.org/wiki/Julian_Lincoln_Simon), accessed on 21/10/09

## And the Jury is Really Out!

Comments



Questions?