Long term demographics, income distribution and expenditure: effects on growth

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Overview

- Economic slowdown - possible causes
  - long term demographics
  - income distribution
- Population projections
  - income effects on
    - fertility
    - infant mortality
    - life expectancy

Analysis using UN population data, 210 countries, 1980-2050

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GDP growth stagnation

Table 1. Average real GDP growth rates for selected economies (stagnation period in bold)

	1980-84	1985-89	1990-94	1995-99	2000-04	**2005-09**	**2010-14**	2015-20 (IMF)	(2005-14) - (1980-04)
Argentina	-2.0	-0.1	6.0	2.7	2.4	**5.8**	**2.7**	2.0	2.5
Australia	3.1	3.5	2.7	4.1	3.3	**2.8**	**2.7**	2.8	-0.6
China	10.7	8.0	12.3	8.6	9.8	**11.3**	**7.8**	6.1	-0.3
France	1.6	3.4	1.3	2.9	1.7	**0.8**	**0.8**	1.5	-1.3
Germany	1.2	3.5	2.0	1.9	0.5	**1.3**	**1.6**	1.4	-0.4
India	5.2	6.0	5.1	6.0	6.8	**8.3**	**6.7**	7.6	1.7
Indonesia	5.1	7.8	7.8	1.0	4.7	**6.1**	**5.5**	5.5	0.5
Italy	1.7	3.1	1.2	2.0	0.9	**-0.3**	**-0.7**	1.0	-2.3
Japan	4.3	5.0	1.4	0.9	1.2	**0.4**	**0.6**	0.4	-2.0
Korea, South	9.4	10.5	8.4	5.7	4.7	**4.1**	**3.0**	2.9	-4.2
Russia	-1.0	-1.0	-5.5	1.8	6.1	**3.7**	**1.2**	0.6	2.4
United Kingdom	2.4	3.5	1.7	3.2	2.8	**0.4**	**2.1**	2.1	-1.5
United States	3.4	3.4	2.6	4.3	2.5	**0.8**	**2.0**	2.3	-1.8

Source: IMF, World Economic Outlook database

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Ratio of age 15-65 to total population
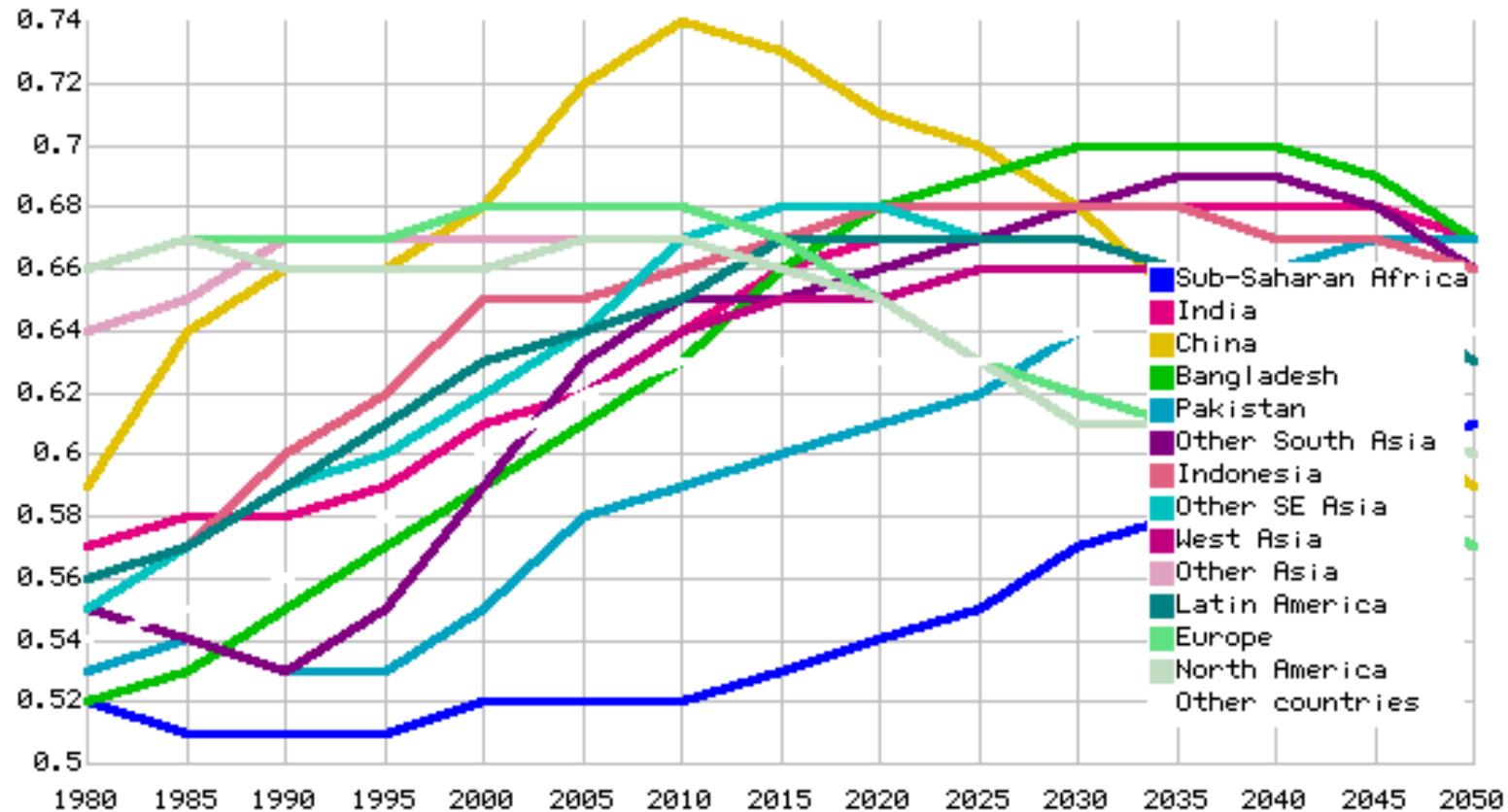
Source: UN World Population Projections

Life cycle incomes

Chart 1. Income and expenditures, by age of reference person, 2013
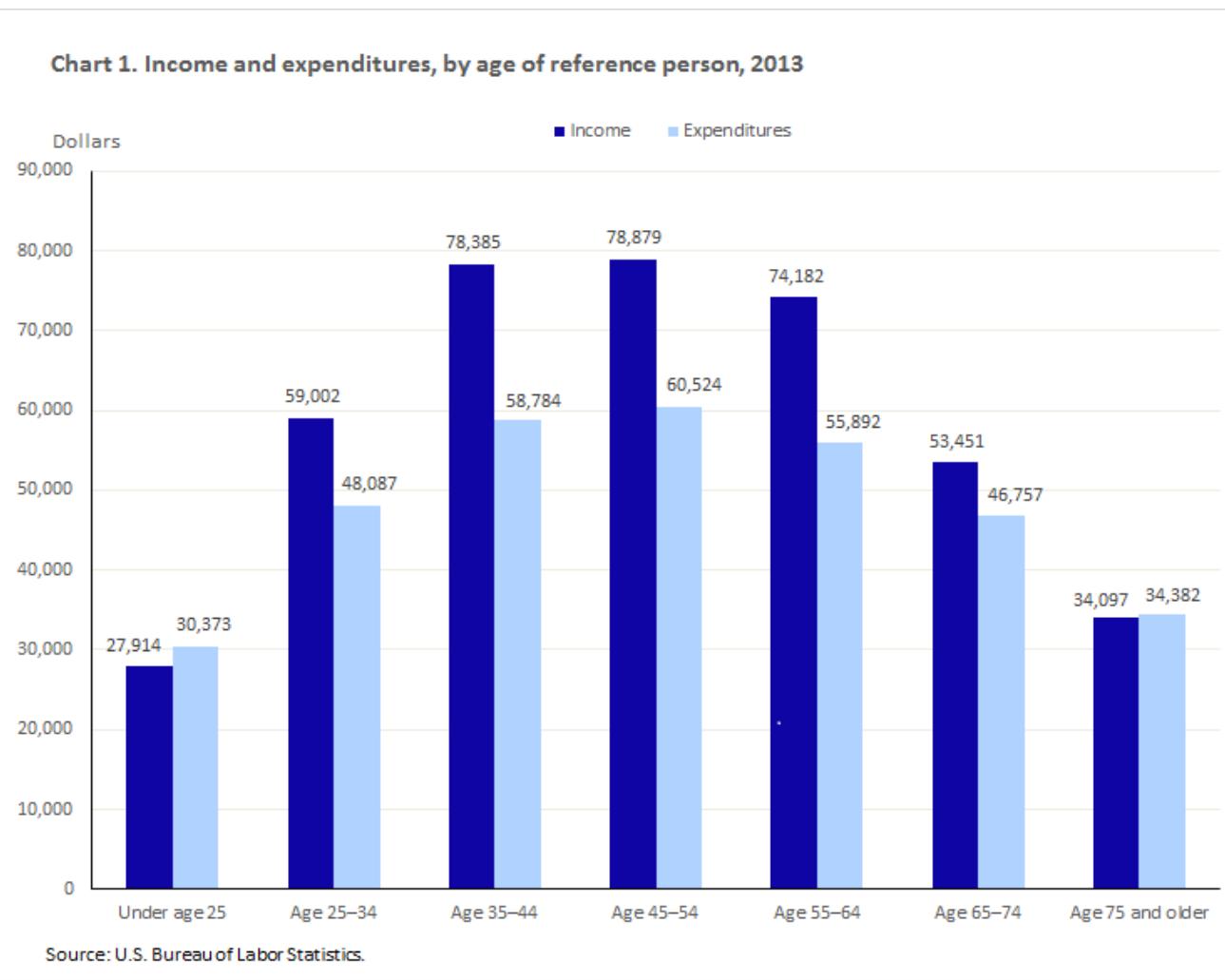
Time variation in age income profile
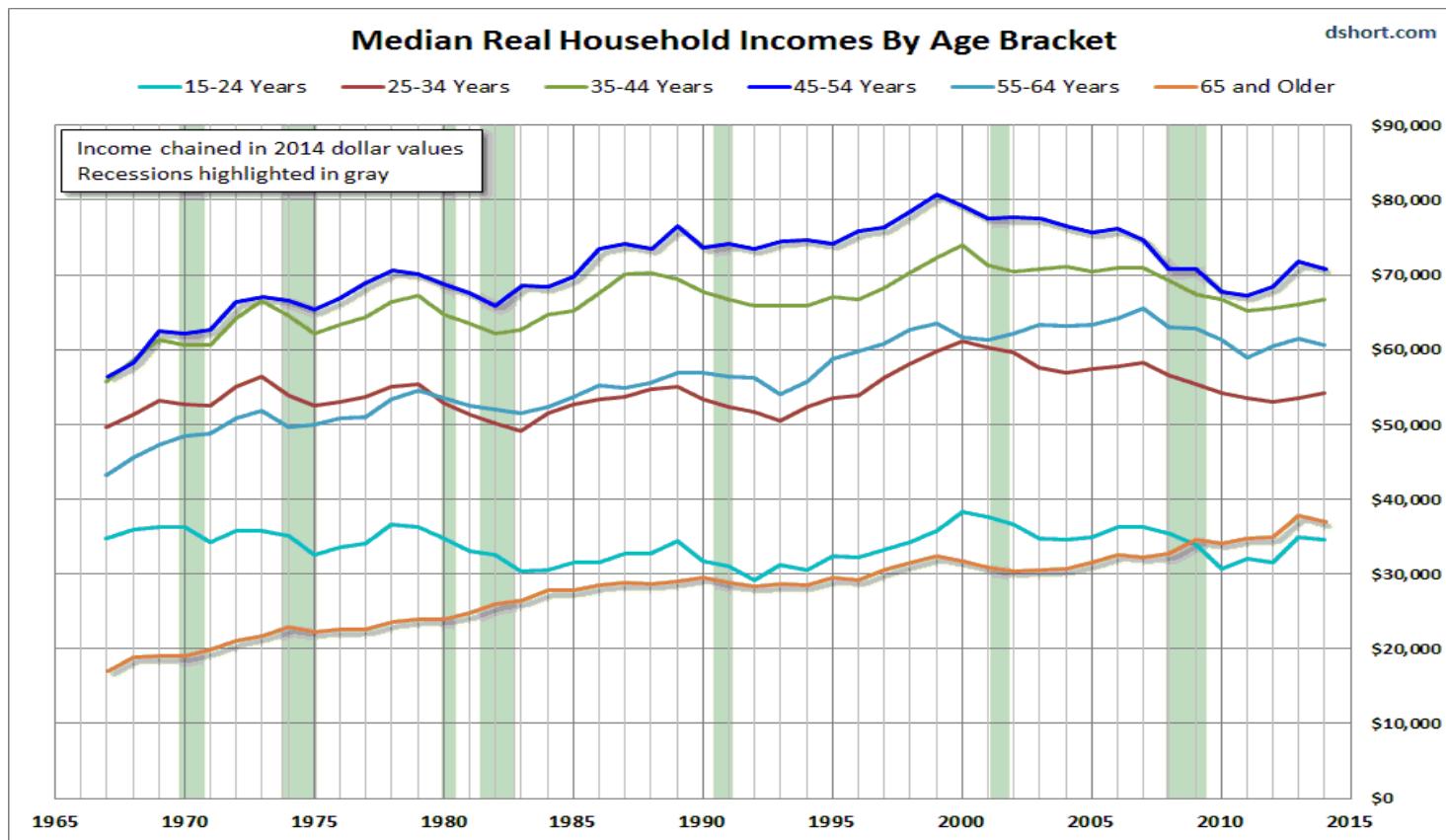
Source: Doug Short, Advisor Perspectives

Life cycle weighted income

Age-weighted disposable income, summed over age groups is

$$\mathbf{Y_a} = \Sigma \; \mathbf{n_a} \; \mathbf{y_a}$$

Where $\mathbf{n_a}$ is the age group population and the disposable income by age group, $\mathbf{y_a}$, is derived from the life cycle data. The ratio

$$\mathbf{Y_a} / \mathbf{Y},$$

gives an indication of the relative demographic dividend provided by the population age structure.

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Age profile dividend ratios
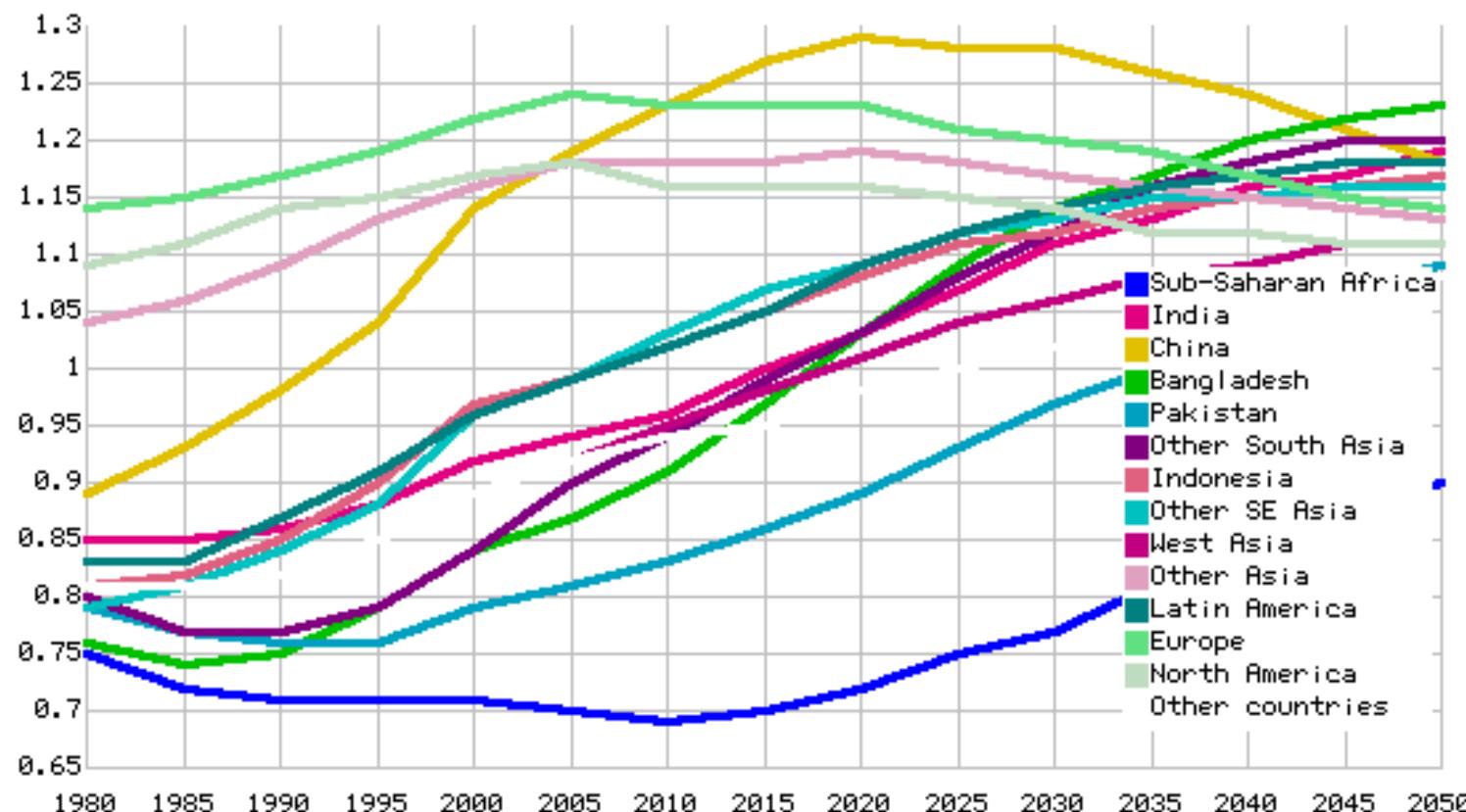
Source: calculations base on life cycle data and UN population data

Income distribution

Gini coefficients, selected countries (per cent)

	1980	1985	1990	1995	2000	2005	2010	2015
Australia	31	31	31	31	32	31	34	28
Belgium	27	27	27	29	29	27	26	26
Bolivia	42	42	42	42	62	56	49	49
Brazil	56	53	59	60	58	60	54	54
Canada	30	29	29	29	32	32	32	32
China	32	22	35	29	39	43	52	47
Denmark	22	22	23	22	23	23	25	28
France	30	30	29	28	29	29	29	31
Germany	25	25	26	27	26	28	29	29
Hong Kong	37	45	42	45	52	44	49	49
India	31	31	30	32	32	48	37	37
Indonesia	36	34	40	40	31	39	38	39
Italy	31	31	30	35	34	35	34	32
Japan	30	30	30	32	34	32	33	33
Mexico	45	45	45	52	51	47	48	48
Netherlands	26	27	29	30	29	28	29	26
Nigeria	43	39	39	52	51	43	45	45
Norway	22	22	22	24	26	28	25	23
Russia	25	25	26	43	43	44	35	35
Turkey	43	43	43	49	49	43	41	40
United Kingdom	27	31	35	34	35	33	34	33
United States	32	34	35	36	36	38	38	38

Source: World Income Inequality Database, UNU-WIDER, OECD

Income Distribution Database (IDD)

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The Gini coefficient

$$G = A/(A+B)$$
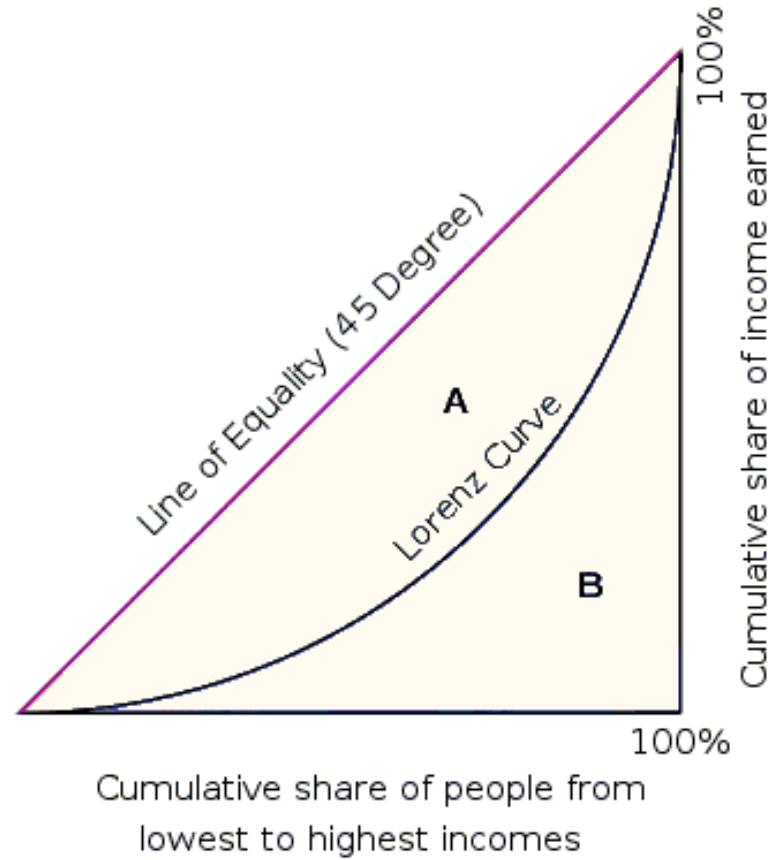
Is there a formula that best approximates the Lorenz curve given the Gini, and mean and median incomes?

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Lorenz curve approximation

Consider the equation:

$$y = a\, x^n + (1-a)\, x$$

* quadratic function, passes through the origin (x=0, y=0), and through (1,1)
* replicates equality line when n=1, higher inequality when n is higher
* parameter **a** balances linear and quadratic forms
* can solve for n in terms of G (integrating and using G = 1 –2B)

$$n = 2/(1-G/a) - 1$$

Hence the Lorenz curve approximation can be written

$$y = a\, x^{2/(1-G/a)\, -1} + (1-a)\, x$$

The value of **a** can be optimised using the mean/median ratio

It was found to provide a good approximation at least using deciles.

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The effects of income distribution

- use PPP per capita income for each country
- obtain income distributions for each country and year
- obtain expenditure estimates for income groups using life cycle data
- assume a log-linear relationship between expenditure and income (i.e assume a declining marginal propensity to consume, cf declining marginal utility of income)

$$e_i = \alpha + \beta \log(y_i)$$

- estimate α and β at one point in time across countries
- use this to compute an index of expenditure over time reflecting changes in the income distribution

Distribution effects on spending

Effect of income distribution on aggregate expenditure, per cent change

	1985	1990	1995	2000	2005	2010	2015
Australia	0.0	0.0	0.0	-0.2	-0.2	-0.8	0.8
Belgium	0.0	0.0	-0.4	-0.4	0.1	0.4	0.4
Bolivia	0.0	0.0	0.0	-10.8	-7.1	-3.3	-3.3
Brazil	1.8	-1.9	-2.6	-1.3	-2.6	1.2	1.2
Canada	0.3	0.5	0.4	-0.4	-0.4	-0.6	-0.6
China	2.7	-1.0	0.9	-2.5	-4.1	-8.3	-5.9
Denmark	0.0	-0.1	0.1	-0.1	-0.2	-0.6	-1.4
France	0.0	0.3	0.6	0.4	0.3	0.2	-0.3
Germany	0.0	-0.1	-0.4	-0.3	-0.9	-1.1	-1.0
Hong Kong	-3.2	-1.9	-3.2	-6.5	-2.8	-5.1	-5.1
India	0.0	0.3	-0.3	-0.3	-6.6	-2.0	-2.0
Indonesia	0.7	-1.5	-1.5	1.7	-1.1	-0.7	-1.1
Italy	0.0	0.4	-1.3	-1.1	-1.4	-0.9	-0.3
Japan	0.0	0.0	-0.6	-1.0	-0.5	-0.8	-0.8
Mexico	0.0	0.0	-3.4	-2.7	-1.1	-1.2	-1.3
Netherlands	-0.2	-0.8	-0.9	-0.8	-0.5	-0.8	0.1
Nigeria	1.7	1.7	-4.4	-3.9	0.0	-0.9	-0.9
Norway	0.0	0.0	-0.5	-0.9	-1.3	-0.6	-0.2
Russia	0.0	-0.2	-5.9	-5.9	-6.3	-2.9	-2.9
Turkey	0.0	0.0	-2.7	-2.7	0.2	1.1	1.5
United Kingdom	-1.1	-2.6	-2.0	-2.5	-1.8	-2.3	-1.8
United States	-0.7	-1.0	-1.5	-1.3	-2.2	-2.1	-2.2

Source: Computations based on Gini coefficients. Change since 1980.

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Inequality at the top

Income Gains at the Top Dwarf Those of Low- and Middle-Income Households

Percent change in real after-tax income since 1979

- Top 1 percent
- Next 19 percent
- Middle 60 percent
- Bottom 20 percent

192%
68%
46%
41%
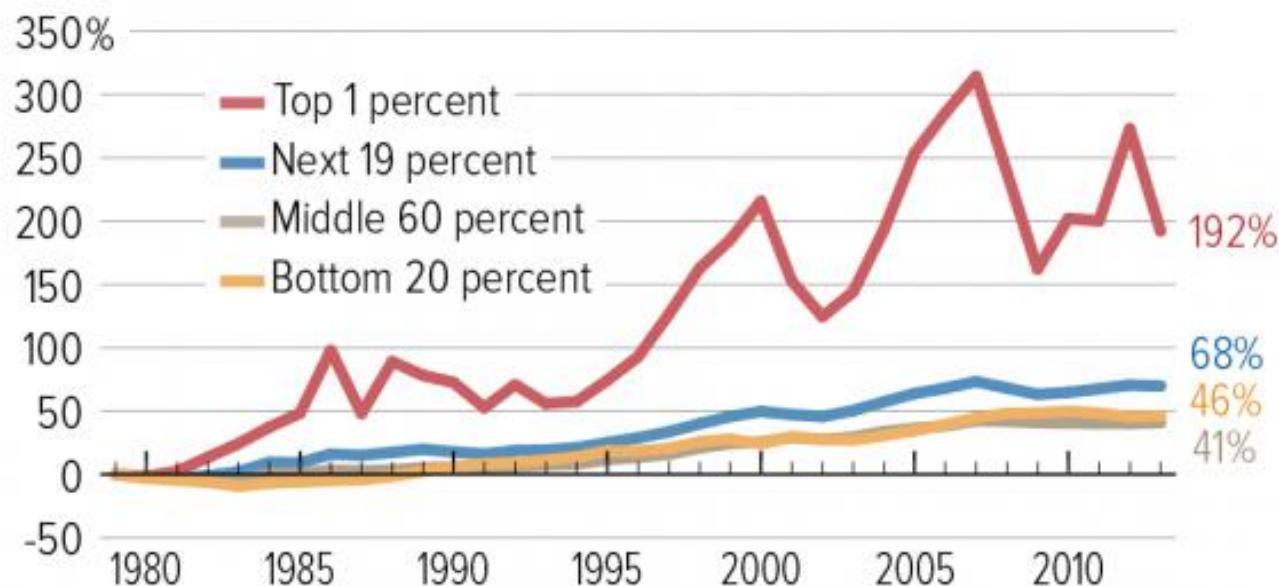
Source: Congressional Budget Office

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Inequality and age brackets

Median Real Household Incomes By Age Bracket

dshort.com

— 15-24 Years — 25-34 Years — 35-44 Years — 45-54 Years — 55-64 Years — 65 and Older

Income chained in 2014 dollar values
Recessions highlighted in gray

Gini coefficient
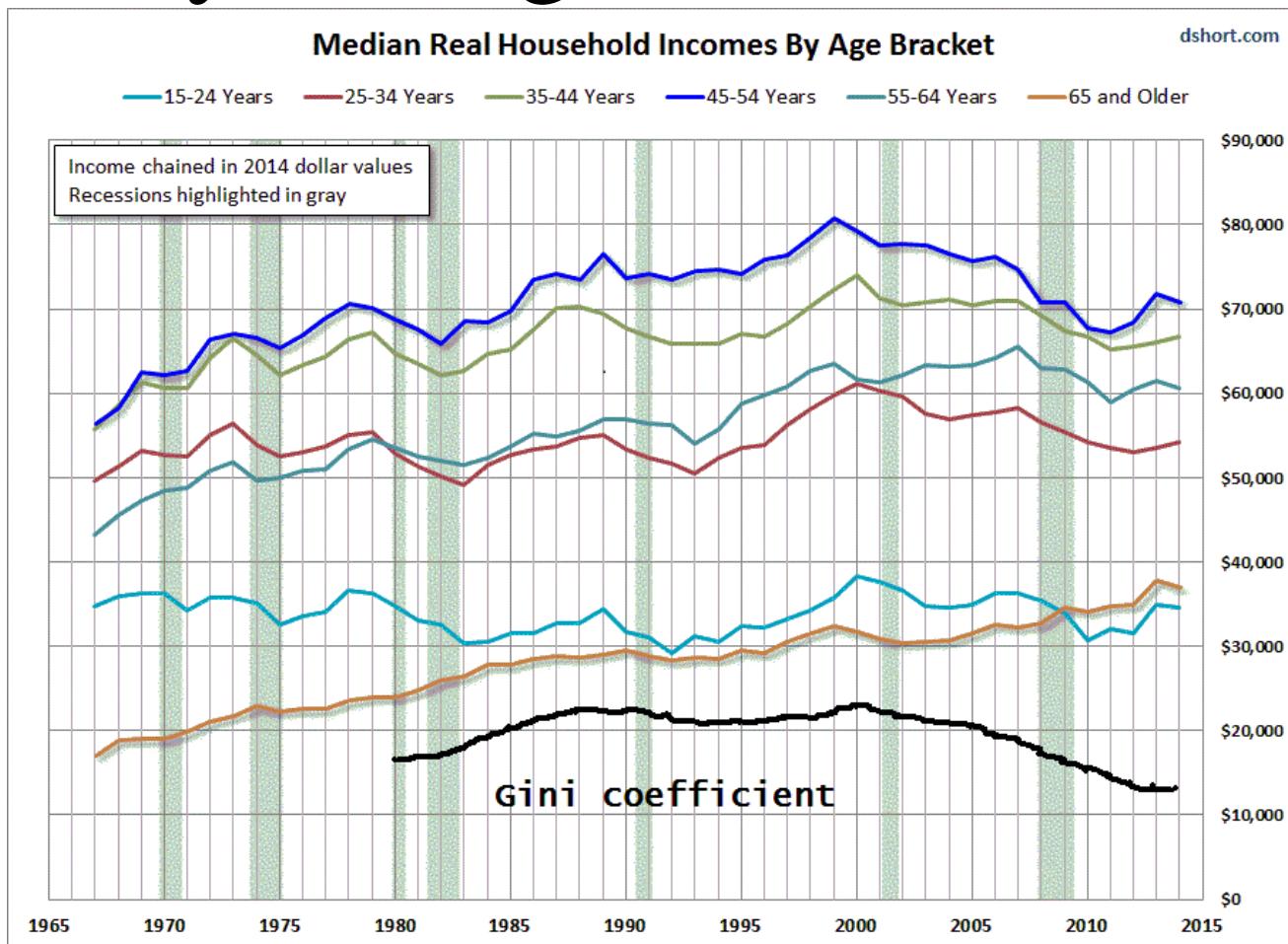
Computation assuming equal distribution within age brackets

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UN World Population Projections

	PPP PCI	2000	%	2010	%	2020	%	2030	%	2040	%	2050	%
Bangladesh	3841	131	2.2	152	1.5	170	1.2	186	0.9	197	0.6	202	0.3
Cameroon	3248	16	2.8	21	2.6	26	2.5	33	2.3	40	2.1	48	1.8
Canada	46199	31	1.0	34	1.1	38	1.0	40	0.7	42	0.5	44	0.4
China	15095	1270	1.0	1341	0.5	1403	0.5	1416	0.1	1395	-0.1	1348	-0.3
Egypt	12113	68	1.9	82	1.8	101	2.1	117	1.5	134	1.4	151	1.2
Ethiopia	1869	66	3.3	88	2.8	112	2.5	138	2.1	164	1.7	188	1.4
France	41868	59	0.4	63	0.6	66	0.4	68	0.3	70	0.3	71	0.2
Germany	47536	82	0.4	80	-0.2	80	0.0	79	-0.1	77	-0.3	75	-0.4
India	6599	1053	1.9	1231	1.6	1389	1.2	1528	1.0	1634	0.7	1705	0.4
Indonesia	11633	212	1.5	242	1.3	272	1.2	295	0.8	312	0.6	322	0.3
Japan	38731	126	0.3	127	0.1	125	-0.2	120	-0.4	114	-0.5	107	-0.6
Kenya	3338	31	2.9	40	2.6	52	2.6	65	2.3	80	2.0	96	1.8
Mexico	17906	103	1.8	119	1.4	135	1.3	148	0.9	158	0.6	164	0.4
Niger	1110	11	3.6	16	3.8	24	4.1	36	4.0	52	3.7	72	3.4
Nigeria	6143	123	2.5	159	2.6	207	2.6	263	2.4	327	2.2	399	2.0
Pakistan	5174	138	2.5	170	2.1	208	2.1	245	1.6	279	1.3	310	1.0
Philippines	7613	78	2.3	93	1.8	108	1.5	124	1.3	137	1.0	148	0.8
Russia	25186	146	-0.1	143	-0.2	143	0.0	139	-0.3	133	-0.4	129	-0.3
Sudan	4416	35	3.0	46	2.9	59	2.6	74	2.3	90	1.9	106	1.7
Tanzania	3073	34	2.9	46	3.0	62	3.2	83	2.9	108	2.7	137	2.4
Uganda	2067	24	3.2	33	3.4	46	3.3	62	3.1	81	2.7	102	2.3
United Kingdom	42041	59	0.3	63	0.6	67	0.6	70	0.5	73	0.4	75	0.3
United States	57220	283	1.1	310	0.9	334	0.7	356	0.6	374	0.5	389	0.4
Vietnam	6400	80	1.6	88	1.0	98	1.1	105	0.7	110	0.4	113	0.3

Source: IMF WEO and United Nations Medium Variant Population Projections.

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Population - major regions
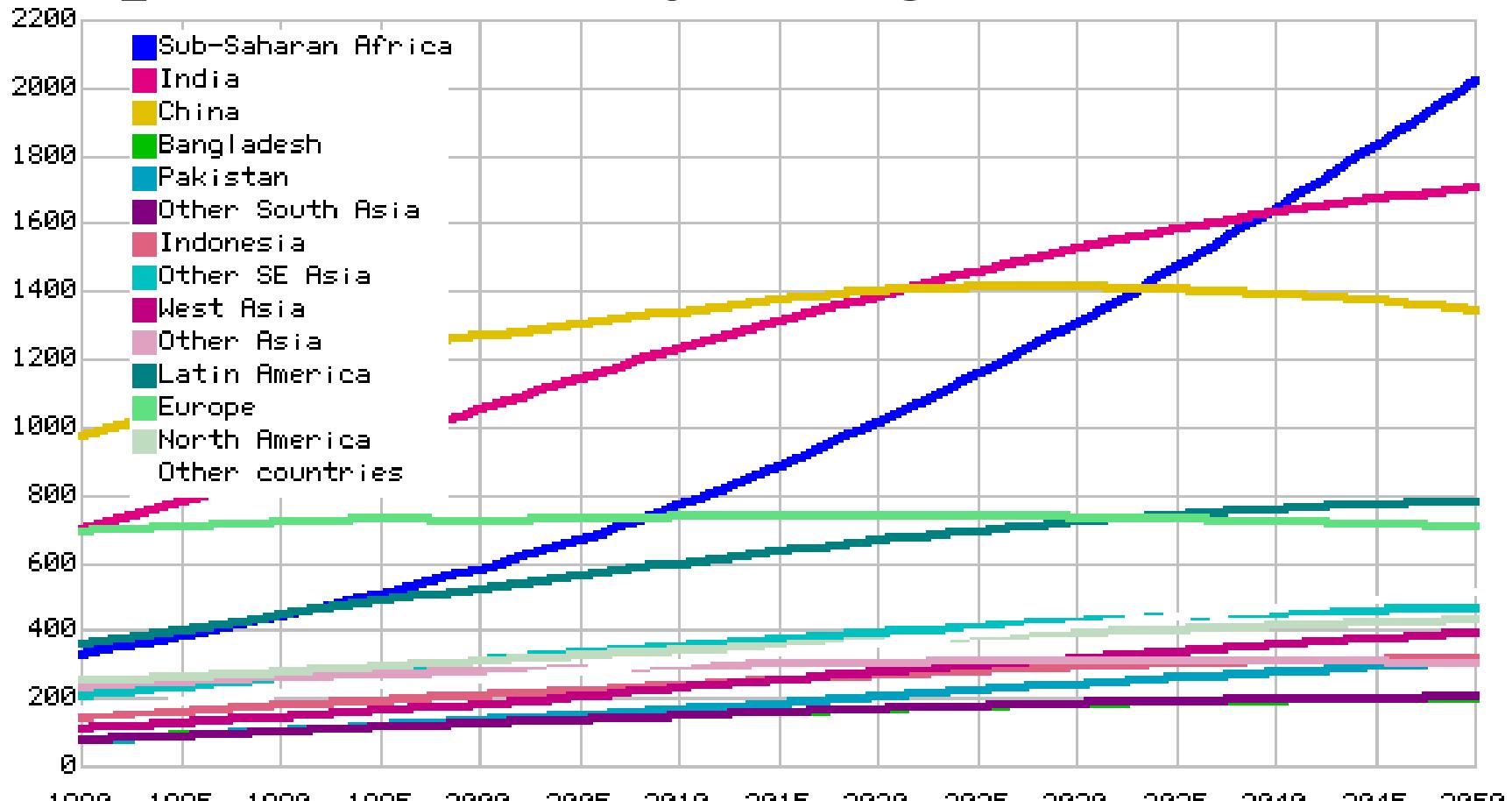

Source: UN World Population Projections

Fertility - major regions
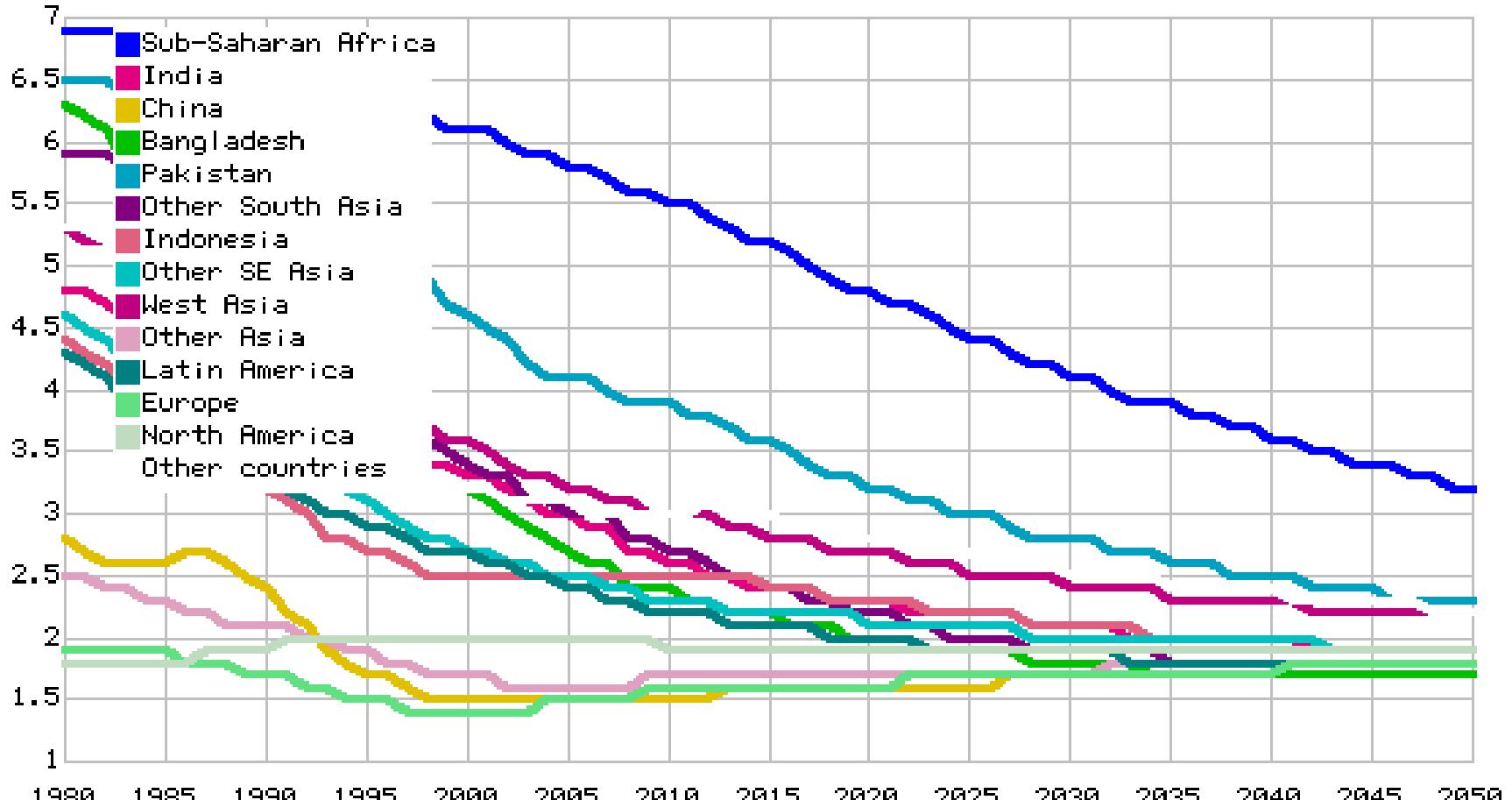
Source: UN World Population Projections

Infant mortality - major regions
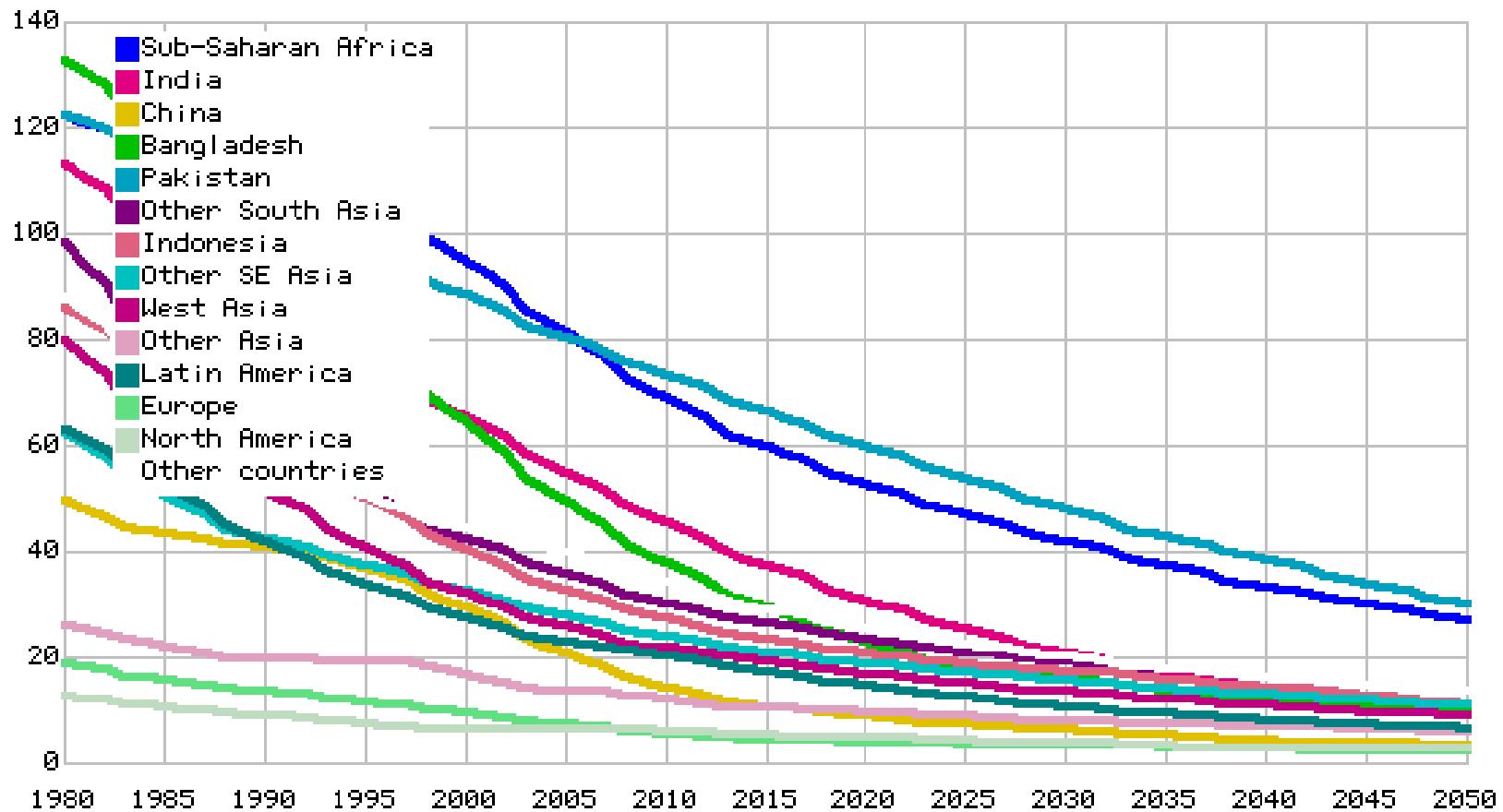

Source: UN World Population Projections

Life expectancy - major regions
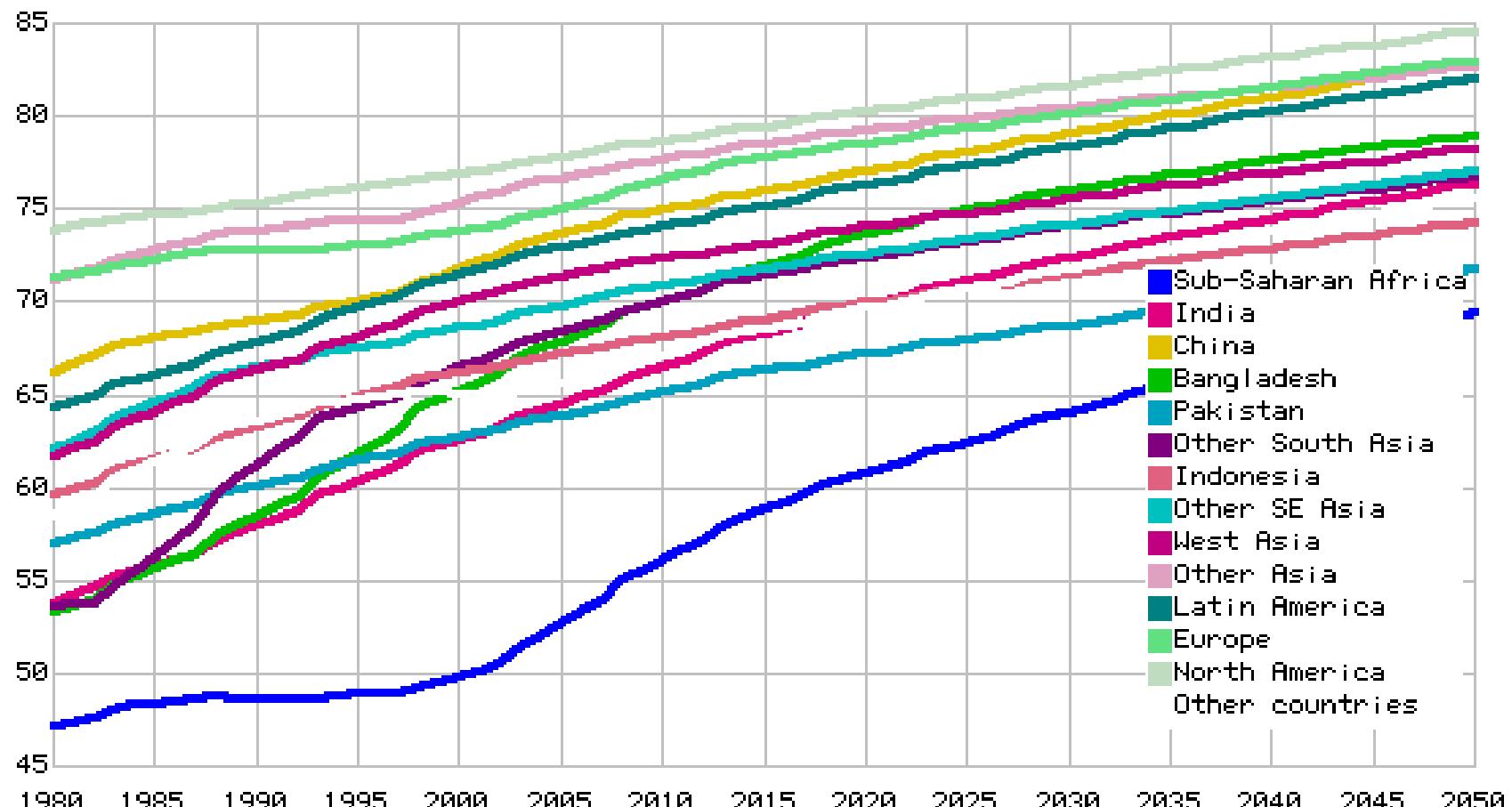
Source: UN World Population Projections

PPP income - major regions

Source: IMF World Economic Outlook

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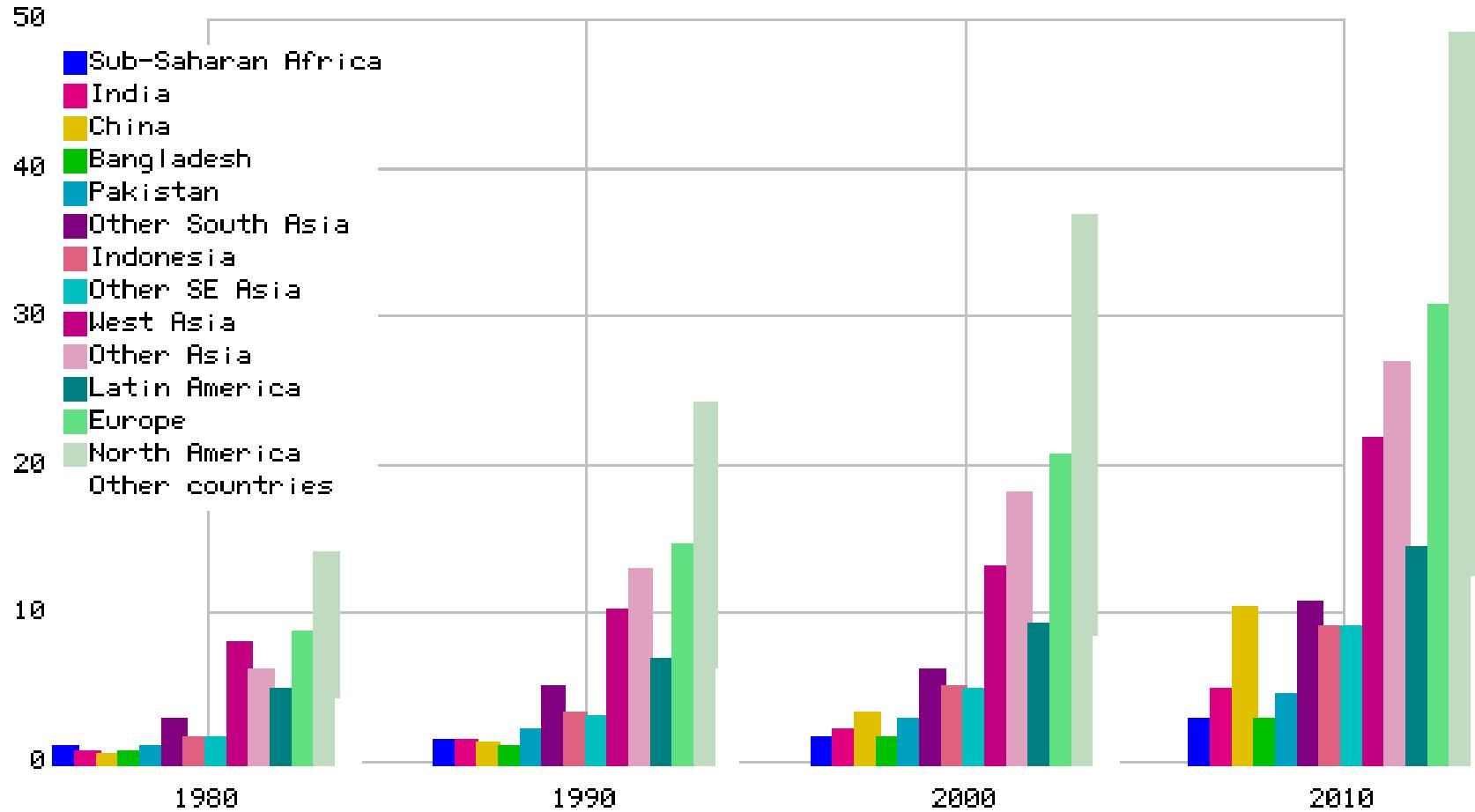
Fertility model

- fit parabolas through age fertility profiles, by country, year

Birth rate
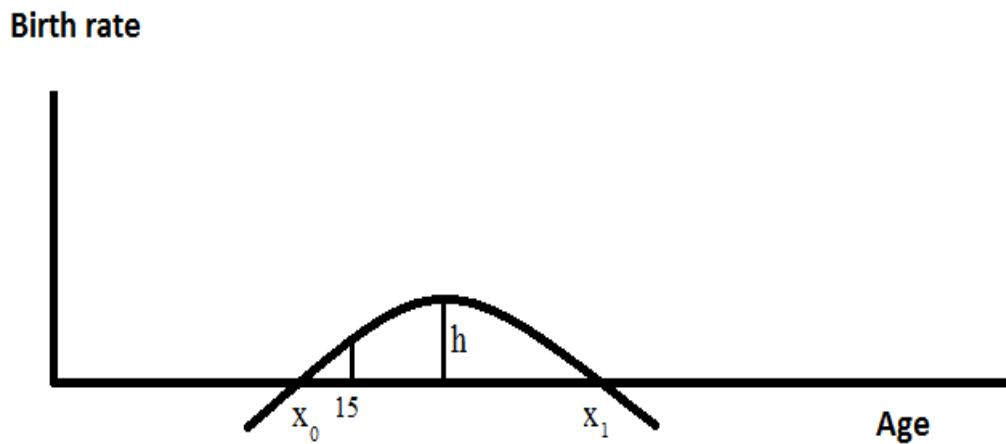
- relate x_0, x_1 and h to per capita income

$$x_{0,i} = \alpha_{0,i}/y_i + \beta_0 \log(y_i)$$
$$x_{1,i} = \alpha_{1,i}/y_i + \beta_1 \log(y_i)$$
$$x_{h,i} = \alpha_{h,i}/y_i + \beta_h \log(y_i)$$

Life expectancy model

- compute age specific death rates by county and year
- compute cumulative probability of survival by age

$$S_a = \Pi_1{}^a \ (1-p_a)$$

where p_a is the probability of death at age a

p_1 is infant mortality

- compute life expectancy

$$E = \Sigma \ p_a \ a$$

- derive births from fertility model
- derive deaths from life expectancy model

Results - fertility by income
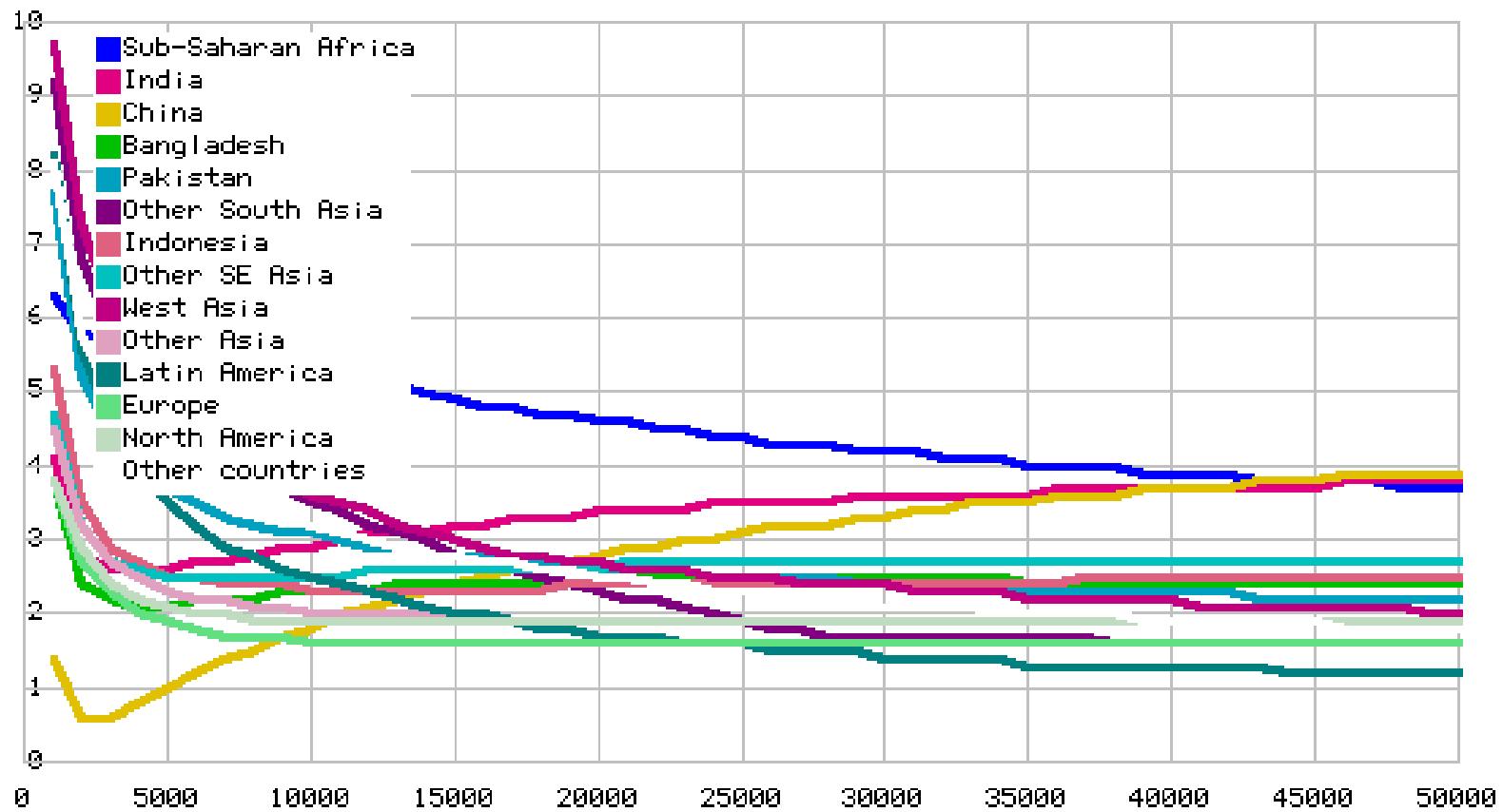
Source: relationship from estimated equations

Conclusion

- the age structure of populations in advanced countries may be a contributing cause of stagnation

- increased inequality may also be a contributing factor

- high population growth rates in some low income regions contribute to an on-going poverty trap

- population projections will need specific assumptions in some regions

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