Demography and the Dynamics of Human Capital

CCP, February 2009

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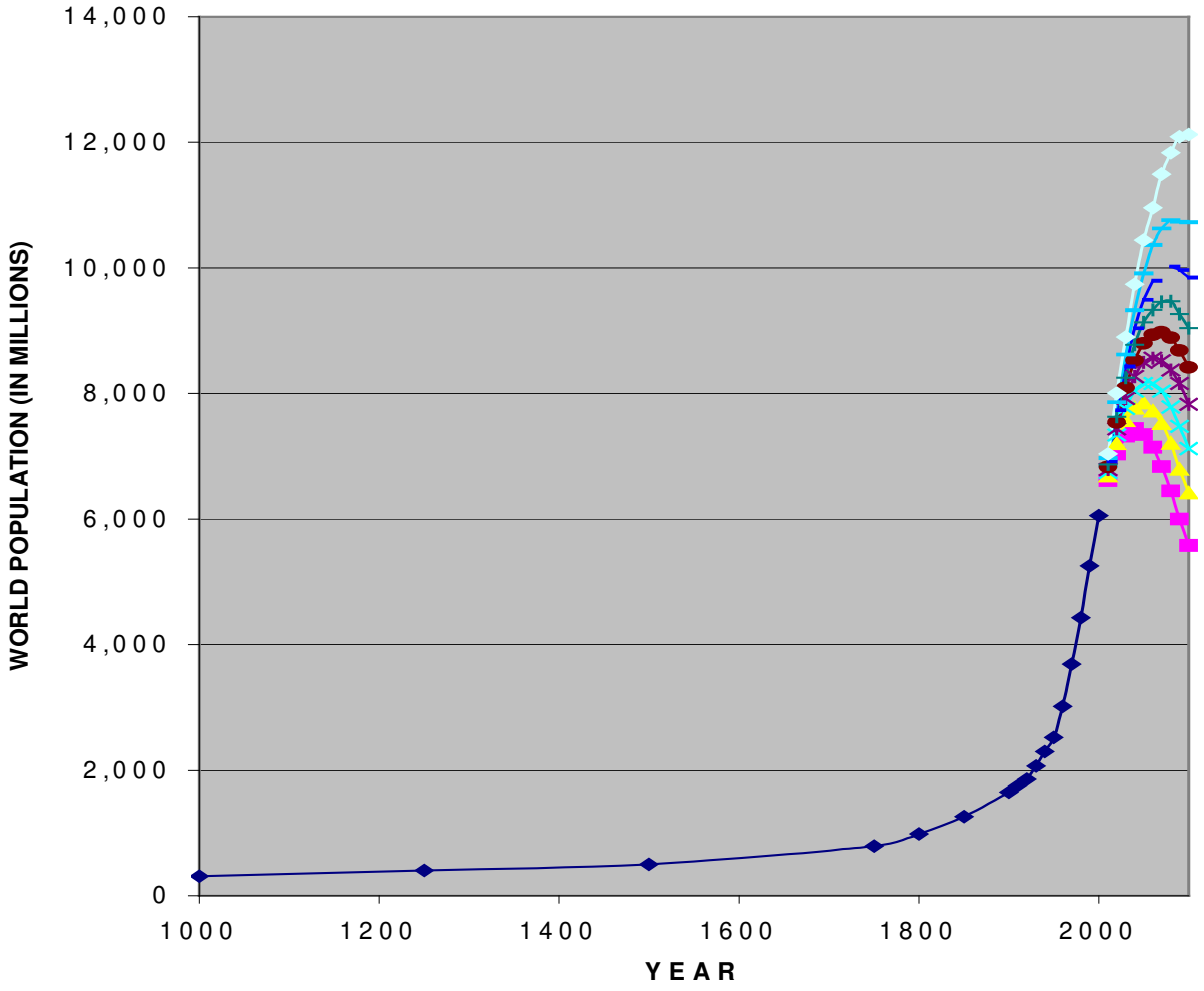
IIASA

Outline

- Probabilistic Population Projections and the Acceleration of Population Ageing
- The Demography of Education and Human Capital
- Work Plan of ERC Project “Forecasting societies’ adaptive capacities to climate change” and possible CCP involvement.

World Population from the year 1000 to 2100

(historical data from 1000 to 2000; deciles of IIASA's probabilistic forecasts to 2100)

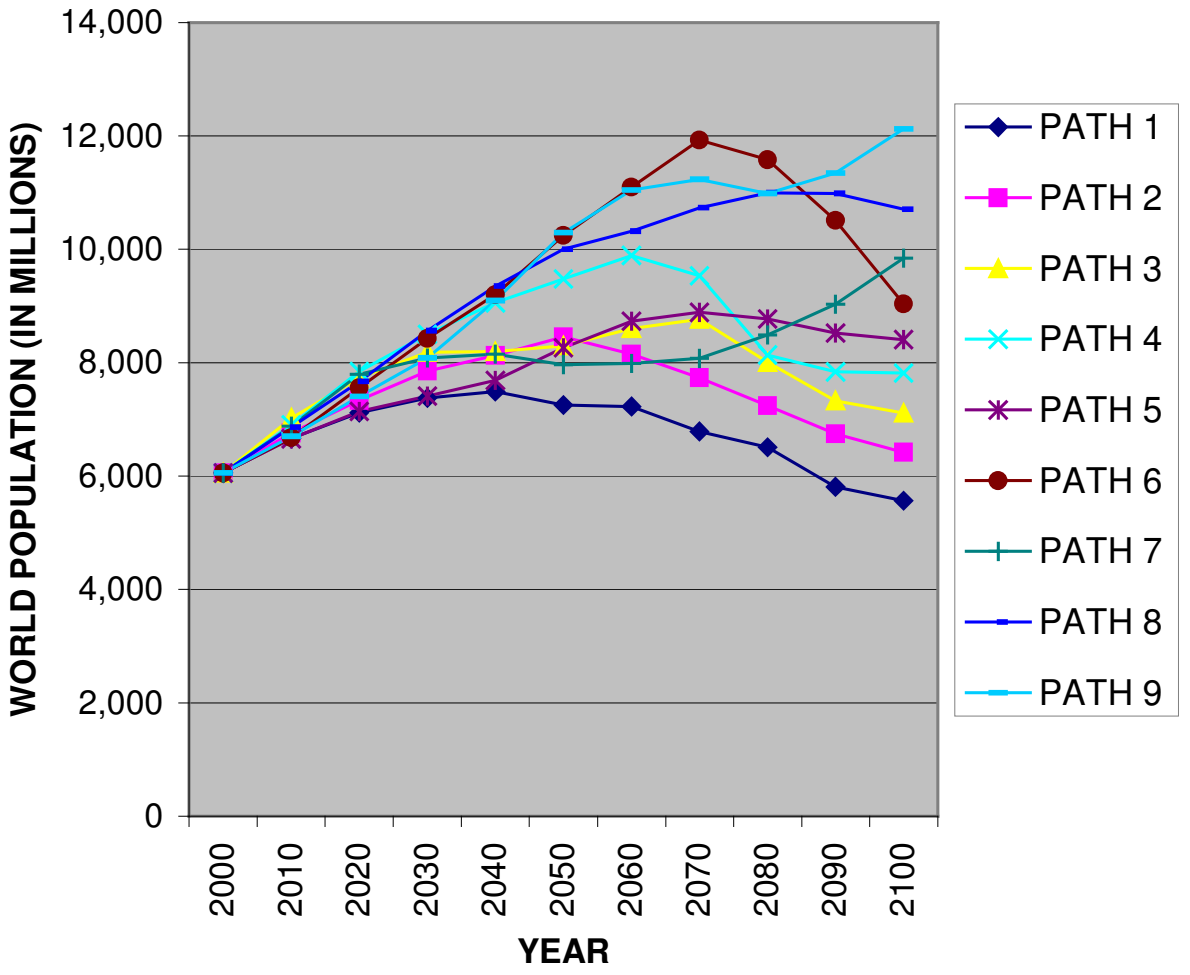


Deciles of uncertainty distribution to 2100

Source of historical data: UN 2001

Probabilistic population projections: IIASA 2007

Nine sample paths (out of 2,000 simulated paths) of world population size from 2000 to 2100



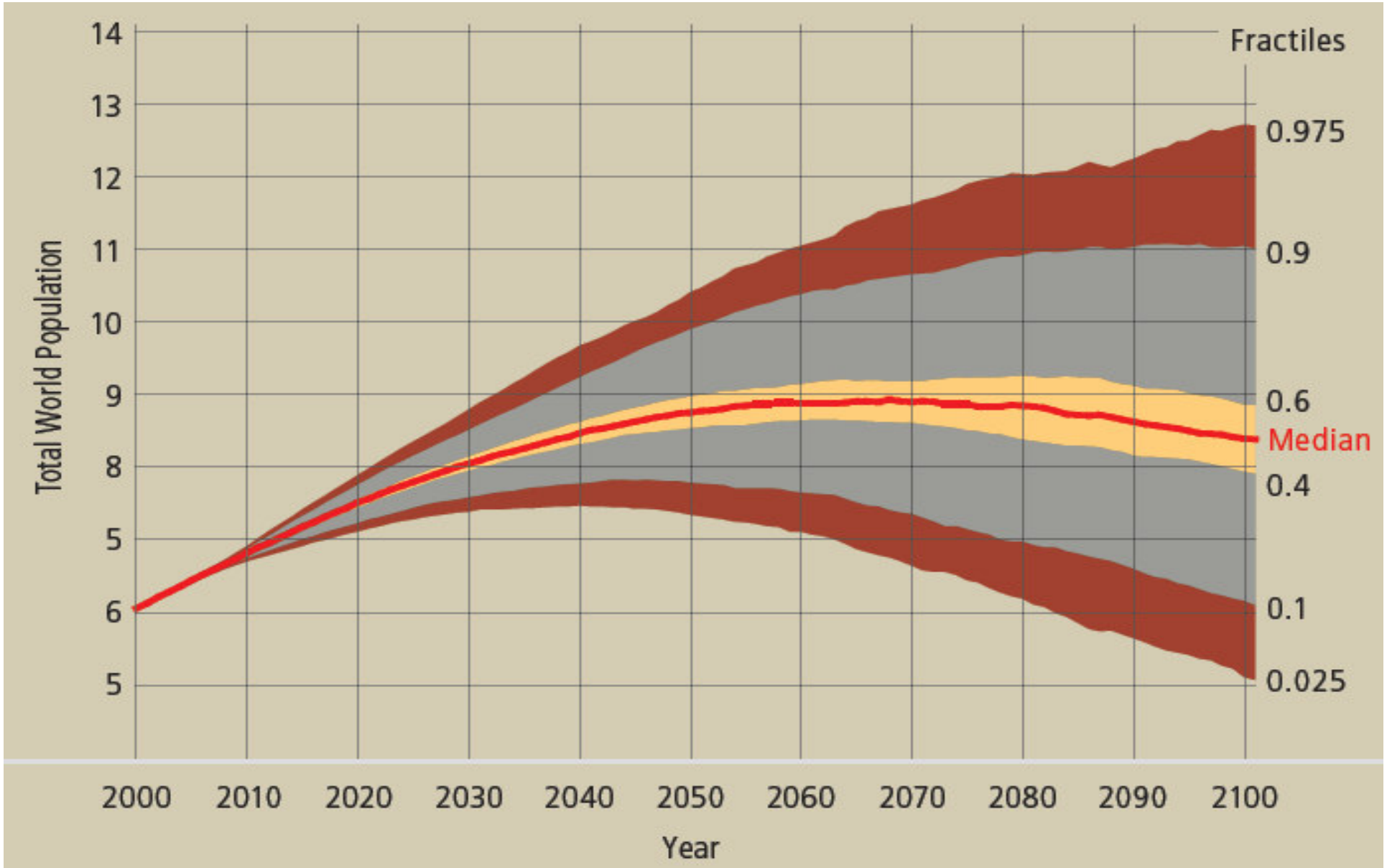


Figure 1. Uncertainty distribution of total world population to 2100, in billions.

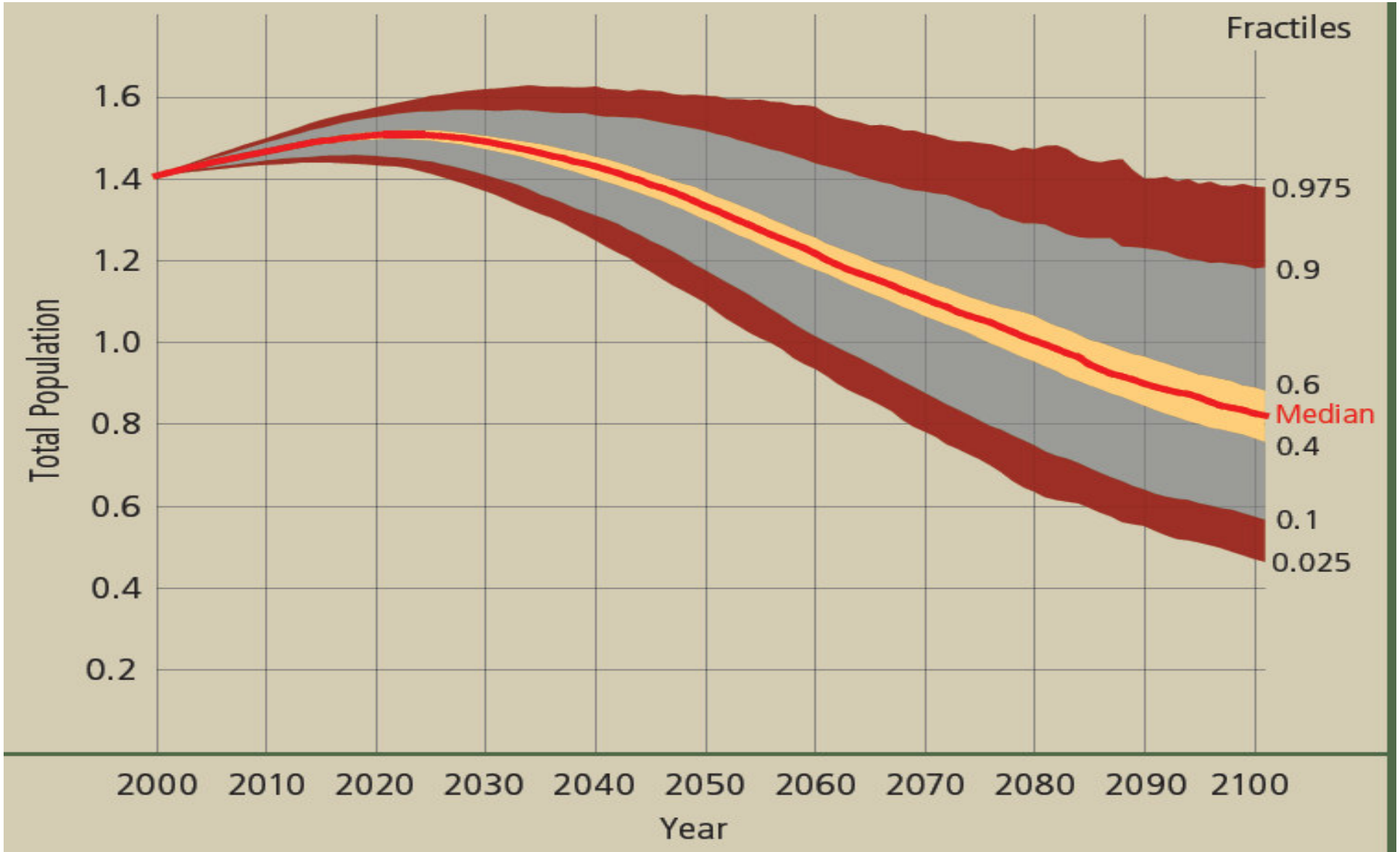
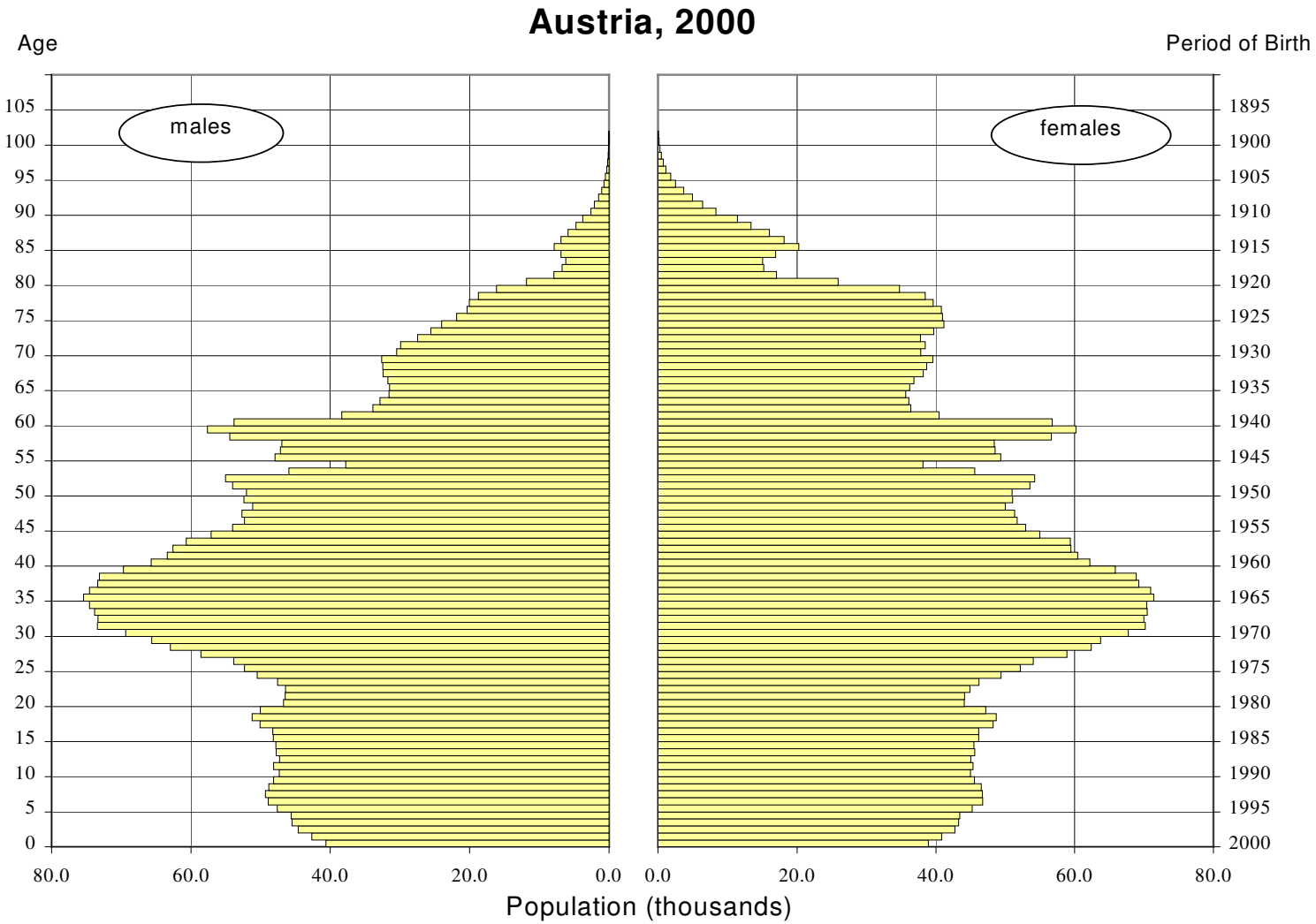
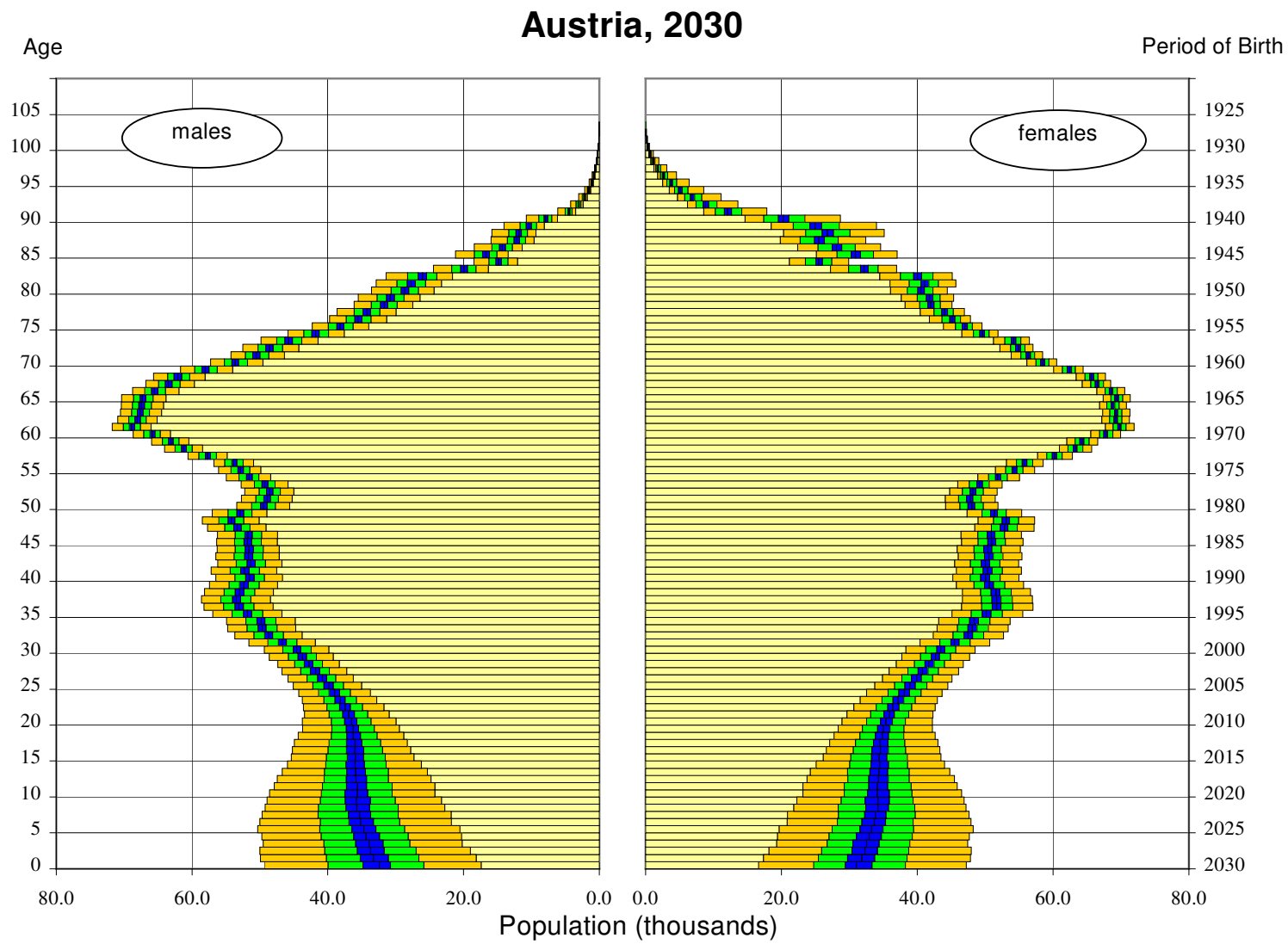


Figure 4. Population of China and Cambodia, Hong Kong, Laos, Mongolia, North Korea, Taiwan, Vietnam, in billions.

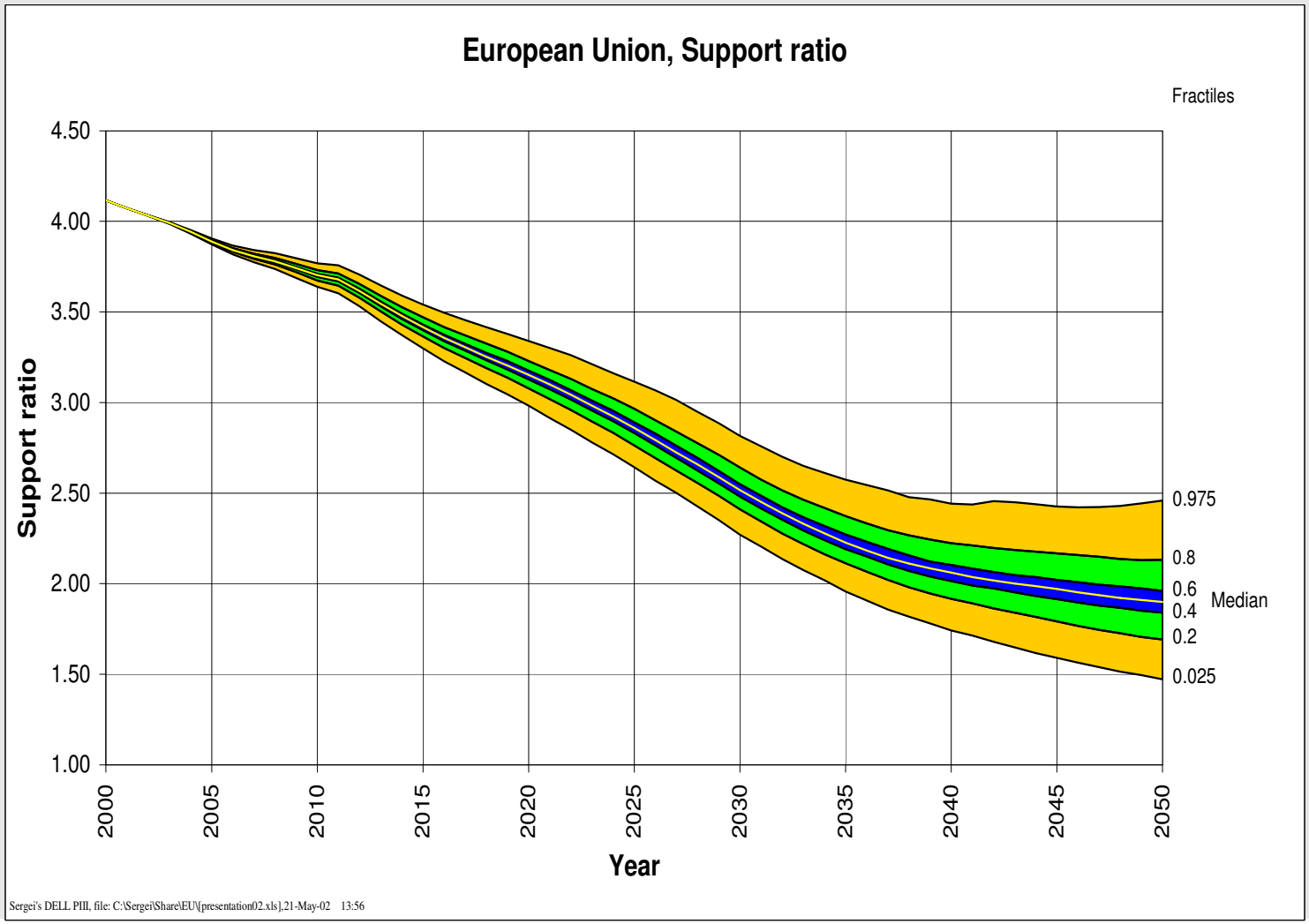
Age Pyramid Austria 2000



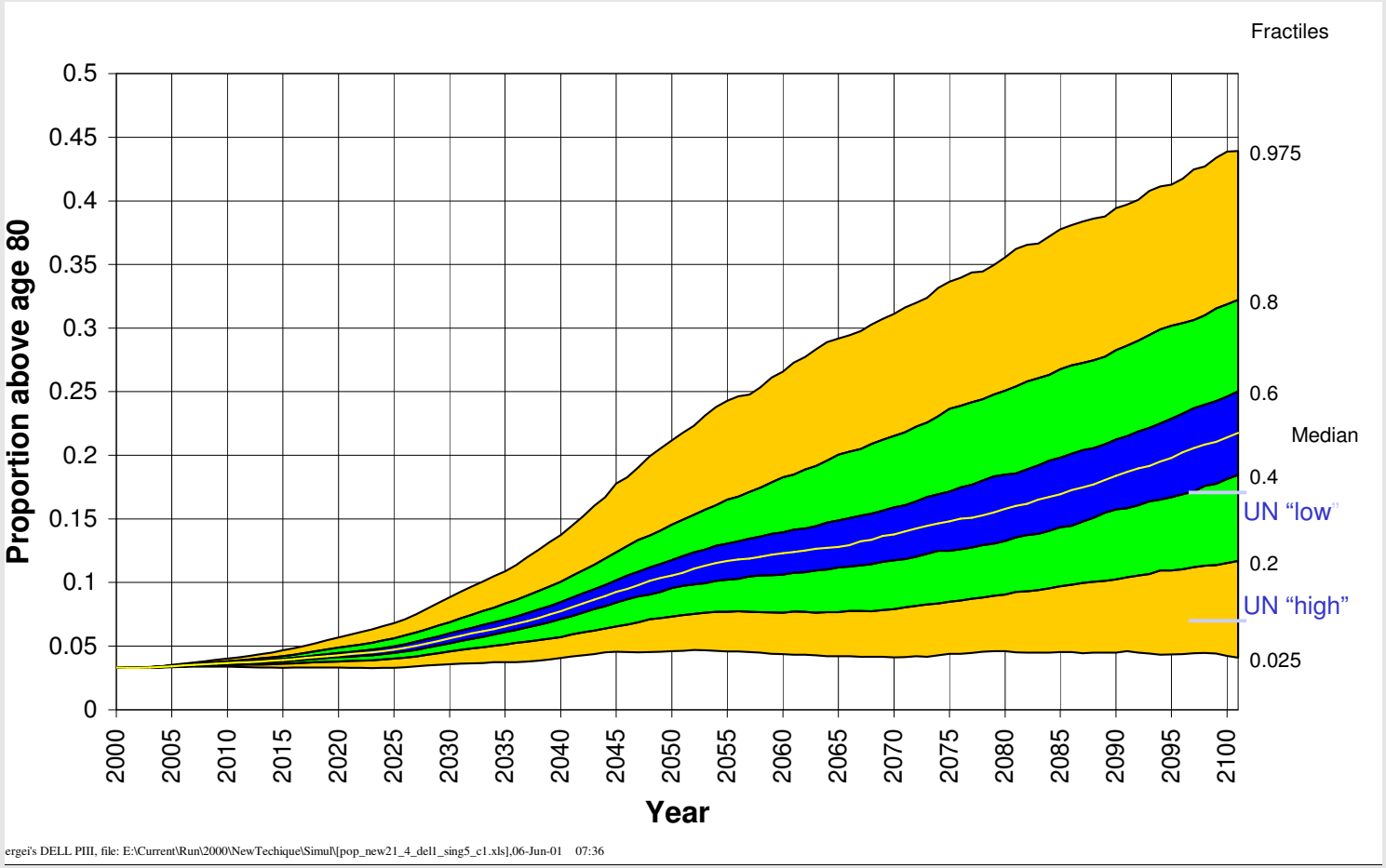
Probabilistic Age Pyramid, Austria 2030



European Union, Demographic Support Ratio
(20-64/65+)



Western Europe, Uncertainty Distribution of Proportion above Age 80 (2000-2100)



IIASA's new probabilistic world population projections

doi:10.1038/nature06516 nature

Published in *Nature* 7 February 2008

LETTERS

The coming acceleration of global population ageing

Wolfgang Lutz[1,2]*, Warren Sanderson[1,3]* & Sergei Scherbov[1,2]*

The future paths of population ageing result from specific combinations of declining fertility and increasing life expectancies in different parts of the world[1]. Here we measure the speed of population ageing by using conventional measures and new ones that take changes in longevity into account for the world as a whole and for 13 major regions. We report on future levels of indicators of ageing and the speed at which they change. We show how these depend on whether changes in life expectancy are taken into account. We also show that the speed of ageing is likely to increase over the coming decades and to decelerate in most regions by mid-century. All our measures indicate a continuous ageing of the world's population throughout the century. The median age of the world's population increases from 26.6 years in 2000 to 37.3 years in 2050 and then to 45.6 years in 2100, when it is not adjusted for longevity increase. When increases in life expectancy are taken into account[2,3], the adjusted median age rises from 26.6 in 2000 to 31.1 in 2050 and only to 32.9 in 2100, slightly less than what it was in the China region in 2005. There are large differences in the

population in age groups that have a remaining life expectancy of 15 years or less (see ref. 6 for the suggestion of a similar measure). If longevity increases, the minimum age of people included in Prop. RLE 15− increases. The adjusted version of the median age is called standardized or prospective median age (PMA)[2,3]. It is the age of a person in the year 2000 who has the same remaining life expectancy as a person at the median age in the year under consideration. The change in the prospective median age over some time period is roughly the change in the median age minus the change in life expectancy at the median age.

The adjusted version of the average age is the population average remaining years of life (PARYL). It is the weighted average of age-specific remaining life expectancies, where the weights are the proportions of the population at each age[7,8]. PARYL gives us the average remaining years of life of population members. Unlike the other measures, PARYL goes down as a population ages. We intuitively think of populations being younger when, on average, its members have more years left to live and PARYL is higher.

Indicators of Population Ageing

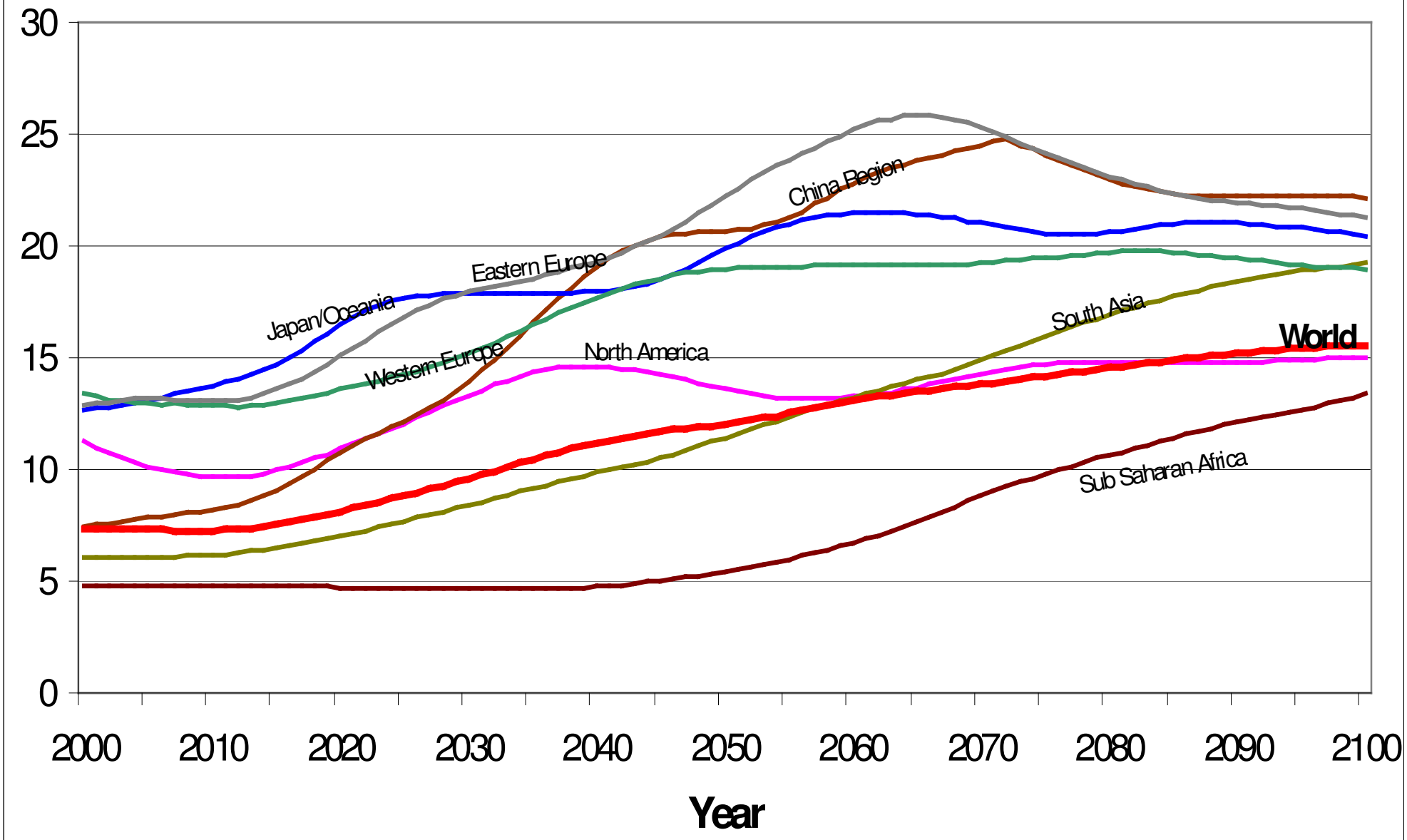
Conventional Indicators (Age defined as time since birth)

- Mean age: Arithmetic mean
- Median age: Age at which 50 percent of population are older/younger
- Proportion above certain age (60+, 65+, 80+)
- Old-age Dependency Ratio: (65+/20-64) or (60+/15-59) or (60+/20-59)
- Ageing Ratio: Proportion elderly to young e.g. (65+/0-19)
- Demographic Support Ratio: inverse of OADR, i.e. (20-64/65+)
- Economic Support Ratio: People actually working per people retired

New Indicators (considering remaining life expectancy)

- PMA: Prospective Median Age (Standardized for a certain year)
- Prop RLE 15 -: Proportion of the population at ages that have average remaining life expectancy of 15 years or less
- PARYL: Population average remaining years of life. Expected years to death of average person alive today.

Figure 3. Percentages with remaining life expectancy below 15 years



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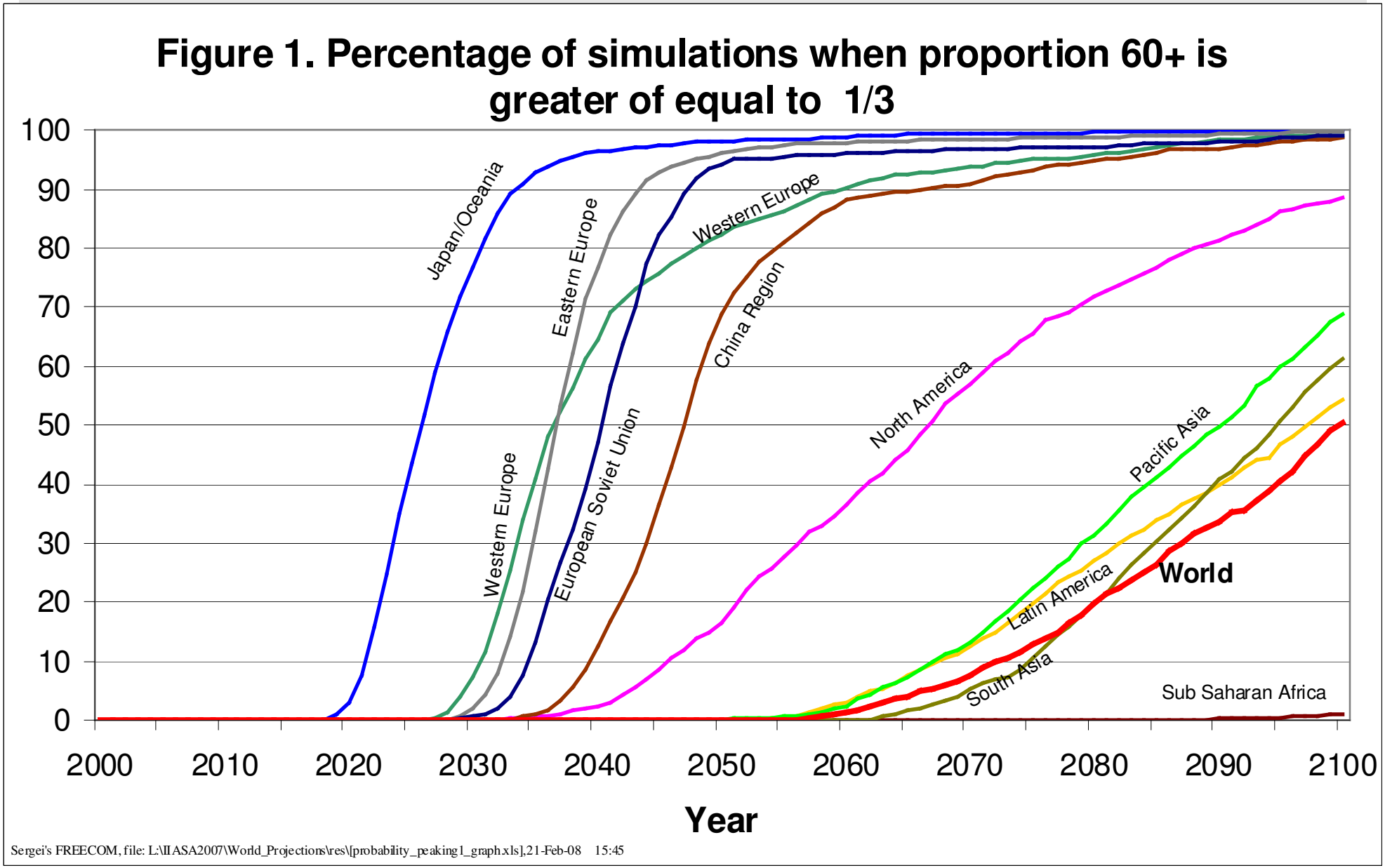
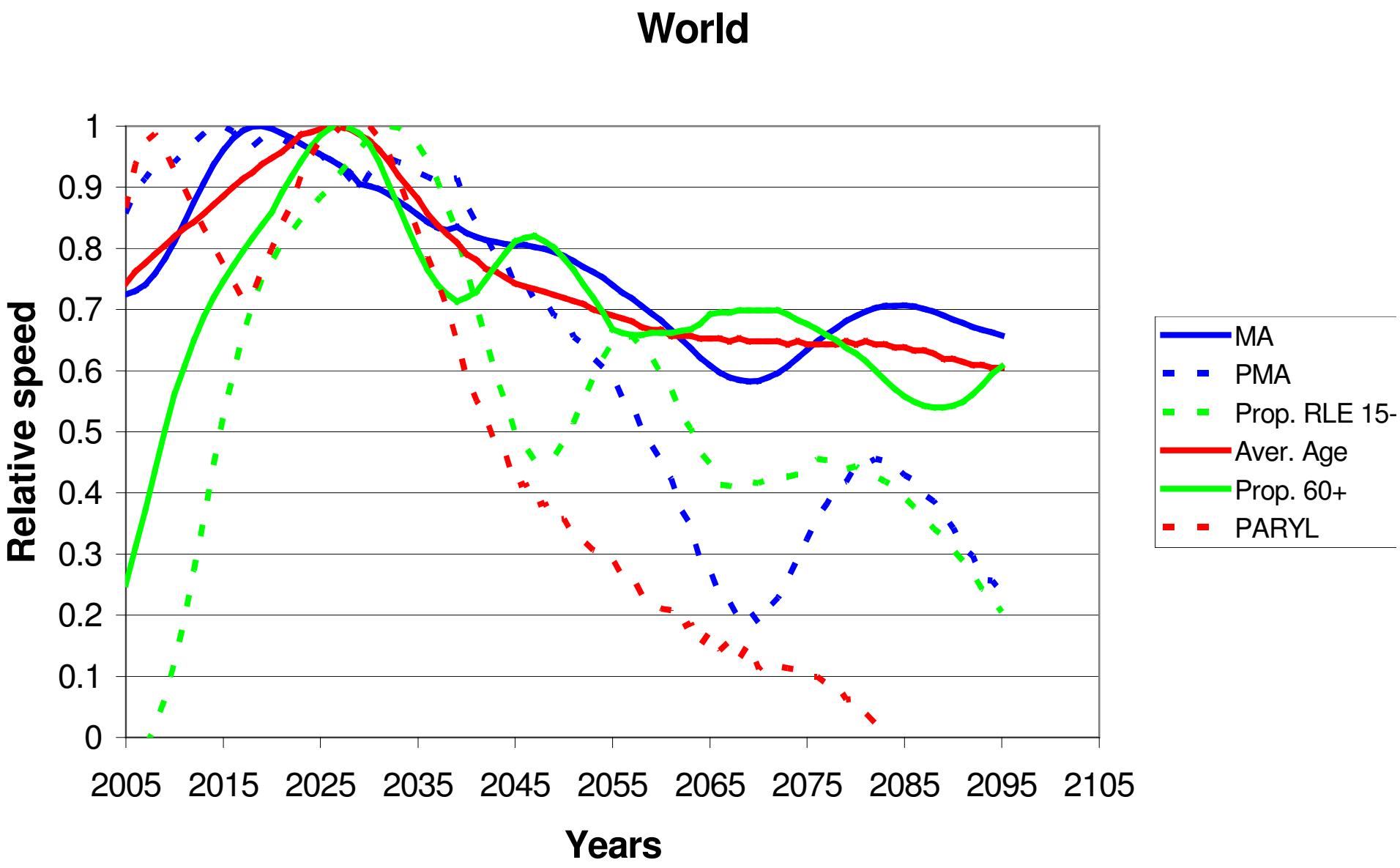
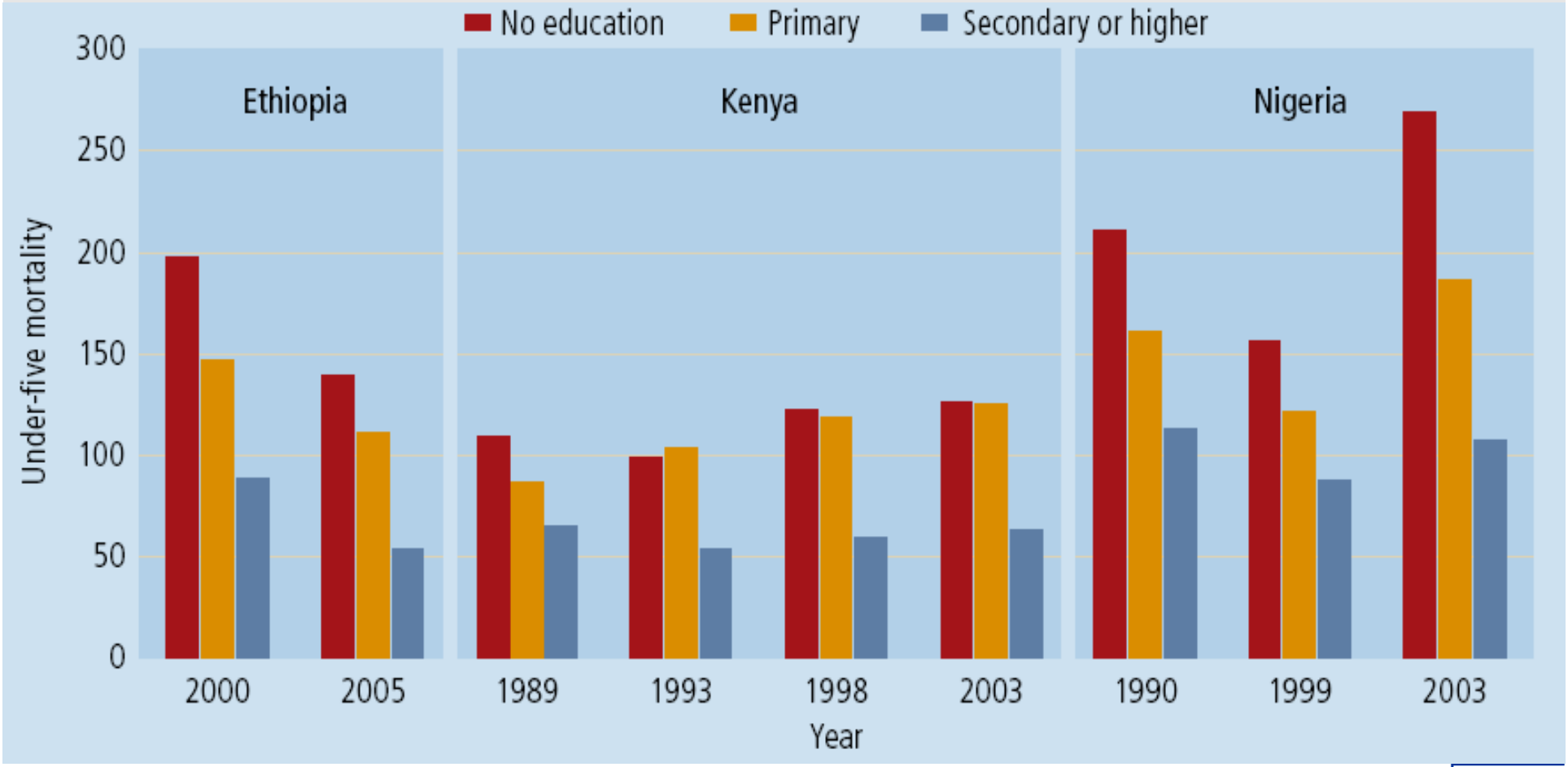
The coming acceleration of global population ageing (Lutz et al, *Nature, Feb 22,* 2008)



Relative Speed of Aging:
The fastest inter-decadal increase = 1.0



Mortality under age 5 by mothers' education (Source: DHS)



Total Fertility Rate by Education

(Source: DHS)

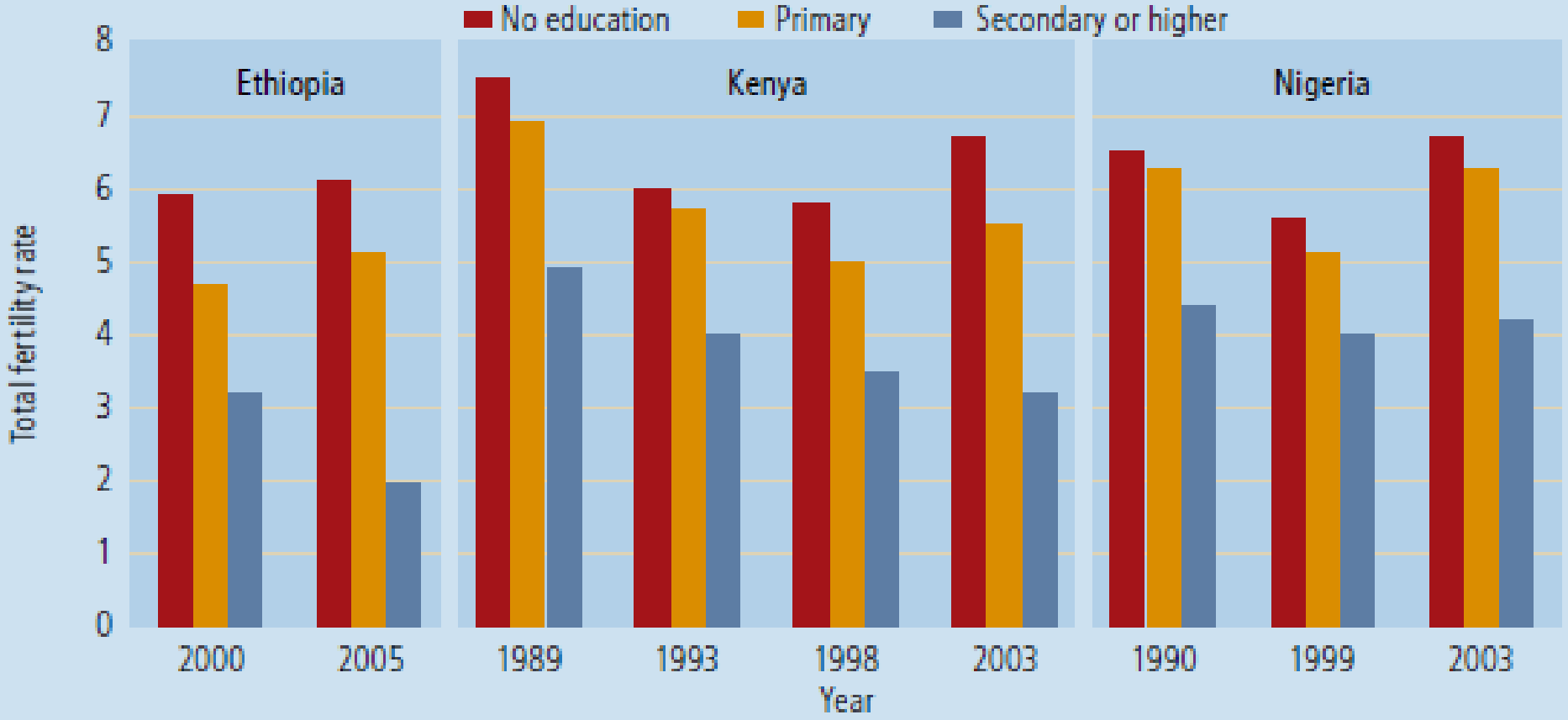
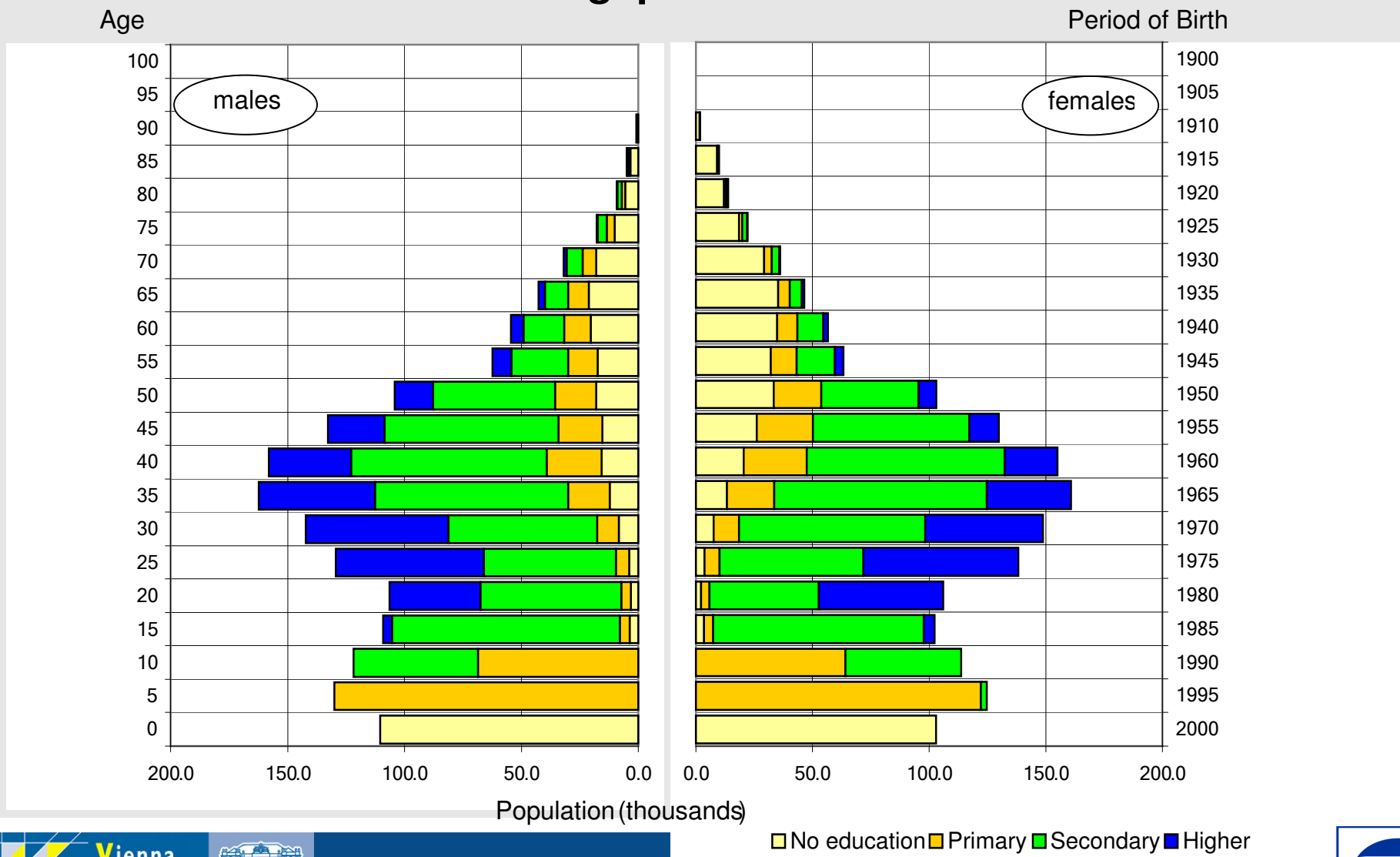


FIGURE 2 Total fertility rates by level of educational attainment. (*Source*: Several DHSs)

Singapore2000



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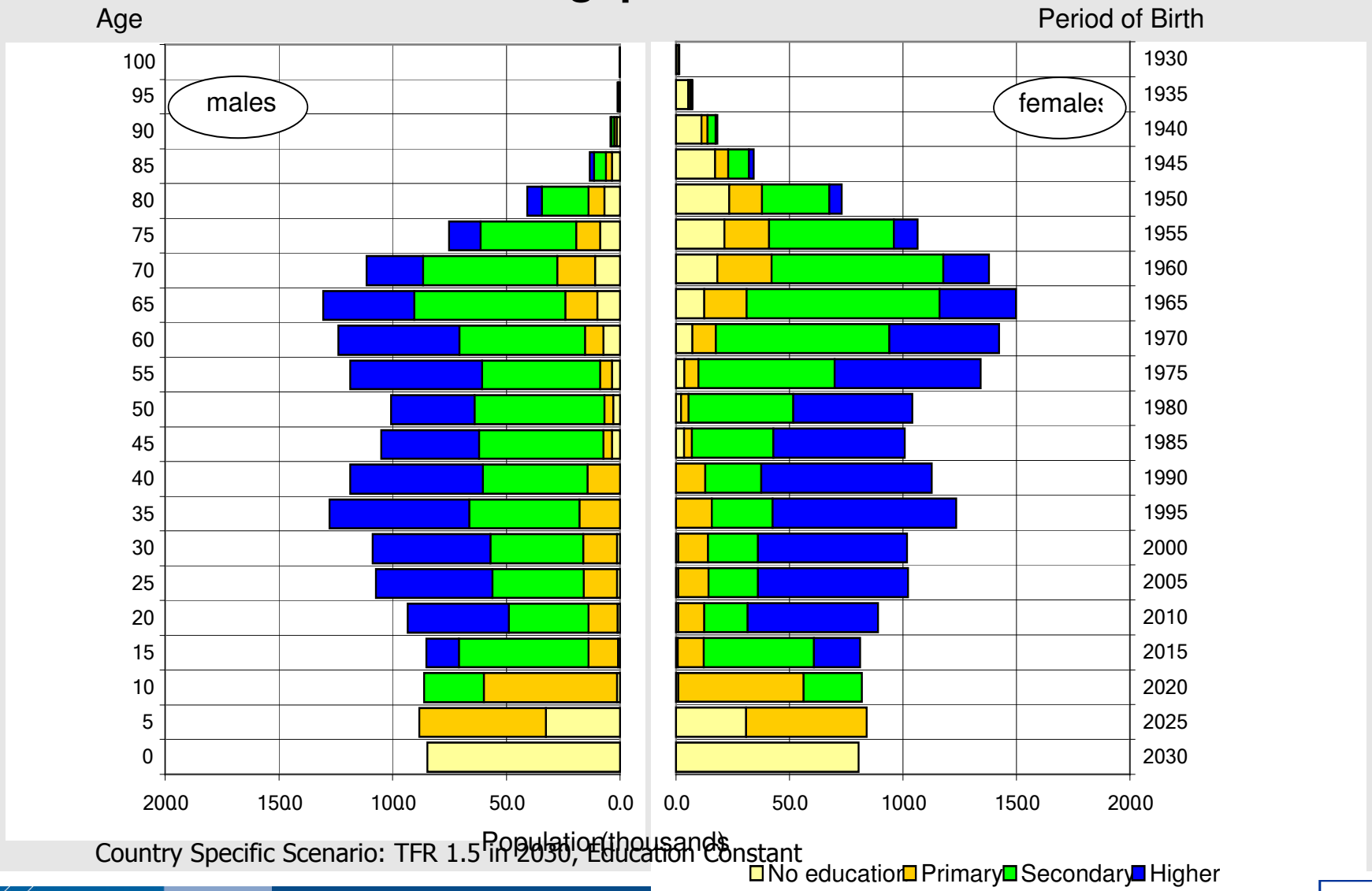
Singapore2030



Country Specific Scenario: TFR 1.5 in 2030, Education Constant

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Education Matters

- For individual income (Micro)
- For economic development (Macro)

"Whereas at the micro case ... it is established beyond any reasonable doubt that there are tangible and measurable returns to investment in education, such evidence is not as consistent and forthcoming in the macro literature " (Psacharopoulos and Patrinos 2002)

Findings are dependent on education indicators chosen (mean years of schooling, for which age groups, distribution by attainment level) and quality (consistency across countries and time)

- For health/mortality and fertility
- Indirect effects of education on institutions and good governance

Education has multiple benefits also at different time horizons:

- It leads to lower child mortality, lower fertility and better health in the **short term**
- It leads to higher economic growth in the **medium term**
- It leads to more democracy and human rights in the medium to long term
- It leads to better health status of the elderly in the long term

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POLICYFORUM

ECONOMICS

The Demography of Educational Attainment and Economic Growth

Wolfgang Lutz,[1*] Jesus Crespo Cuaresma,[2] Warren Sanderson[3]

Complementing primary education with secondary education in broad segments of the population is likely to give a strong boost to economic growth.

Measuring Formal Education

- **Education Flows** – Policy variable

(Gross and Net Enrolment by Age, Repetition Rates)

- **Education Stocks** - Change very slowly due to great momentum
  - Mean years of schooling
  - Distribution by highest educational attainment
  - Functional literacy (IALS, LAMP)

Our four education categories for 2000

based on ISCED, from censuses and surveys (mostly DHS)

- **No education** — Never been to school
- **Primary** — Some primary, complete primary, incomplete lower secondary
- **Secondary** — Completed lower secondary to incomplete first level of tertiary
- **Tertiary** — Completed first level of tertiary or higher.

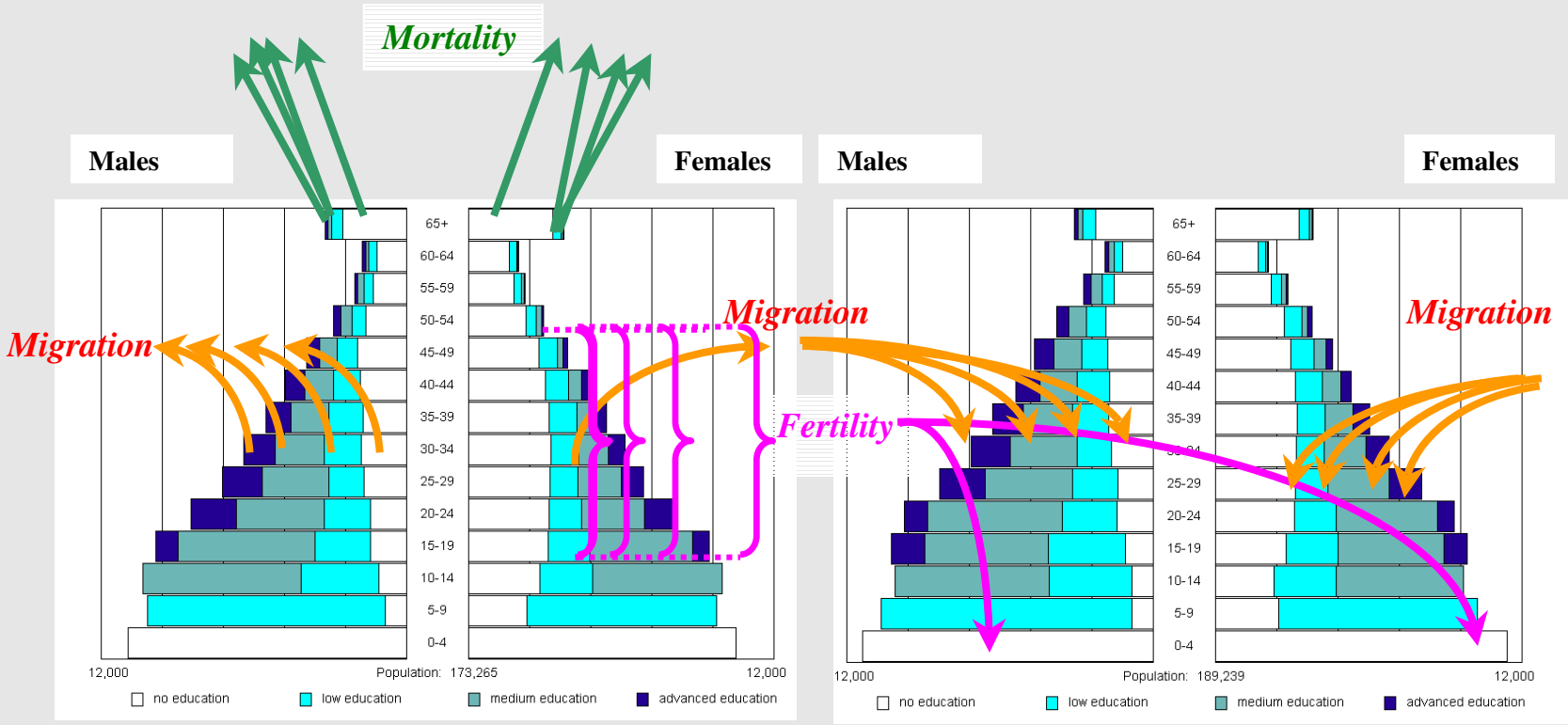
Sample Table

India

Population distribution ('000) by age, sex and level of education and mean years of schooling (MYS)

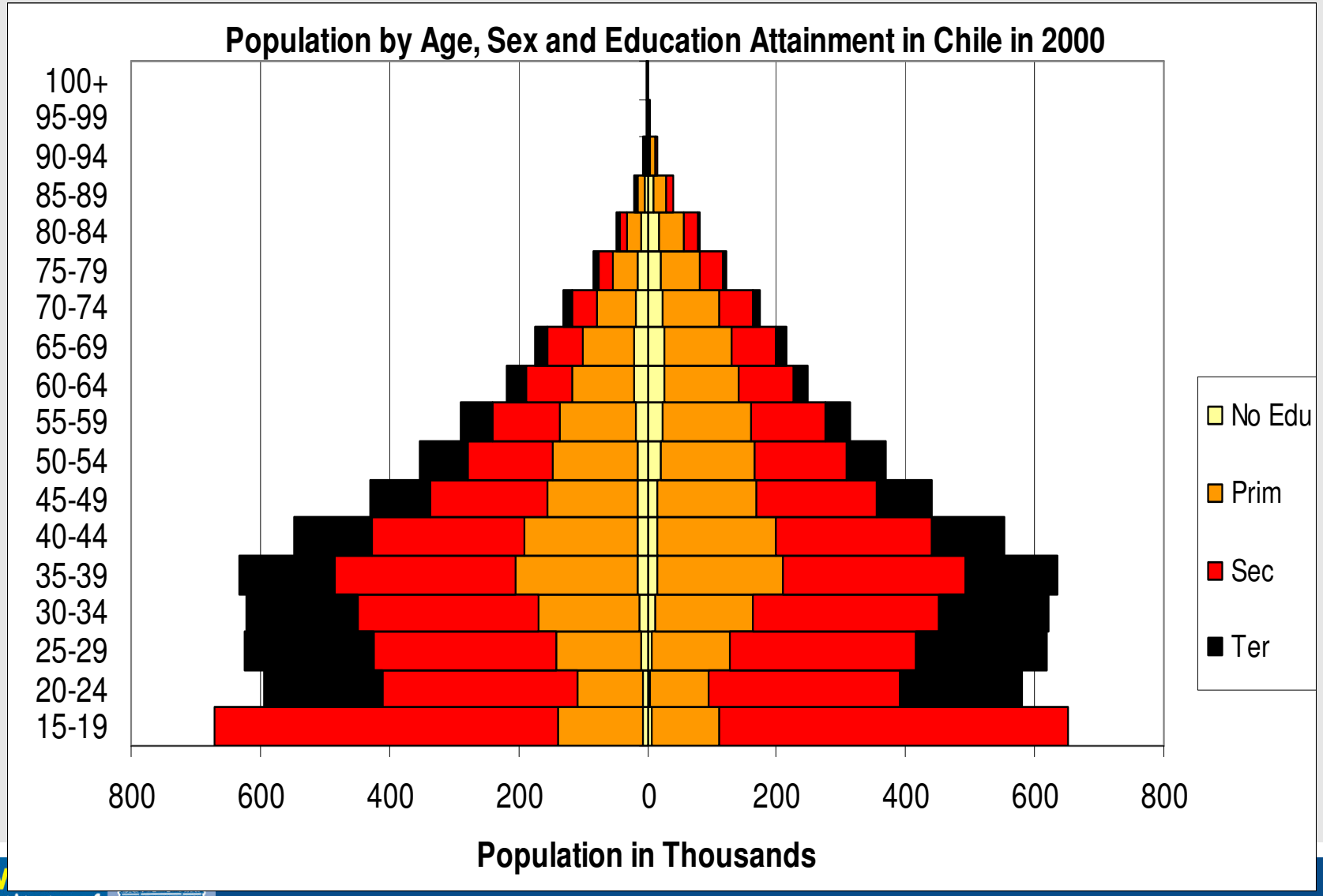
		Males				
		No Edu.	Primary	Secondary	Tertiary	MYS
2000	15-19	8867.9	14274.4	29681.6	0.0	**6.6**
	20-24	8917.9	10326.9	23088.3	3906.1	**7.2**
	25-29	10535.7	10117.4	18153.7	5191.1	**6.9**
	30-34	11251.9	9467.0	14566.2	4328.1	**6.4**
	35-39	11258.2	9195.7	11243.9	3274.6	**5.7**
	40-44	10281.5	8067.7	9242.1	2785.4	**5.6**
	45-49	8523.5	6780.7	7453.6	2298.9	**5.5**
	50-54	7591.1	5223.6	5313.0	1683.8	**5.1**
	55-59	6255.8	4633.0	3937.7	1157.7	**4.7**
	60-64	6389.9	3614.5	2346.7	619.9	**3.6**
	65+	12124.9	7331.6	3515.5	855.0	**3.2**
	15+	*101998.4*	*89032.5*	*128542.2*	*26100.7*	***5.9***
	25+	*84212.5*	*64431.2*	*75772.3*	*22194.6*	***5.5***

Principles of Population Projection by age, sex, and education



Population by Age, Sex, and Education 2000

Population by Age, Sex, and Education 2005


Population by Age, Sex and Education Attainment in Chile in 2000
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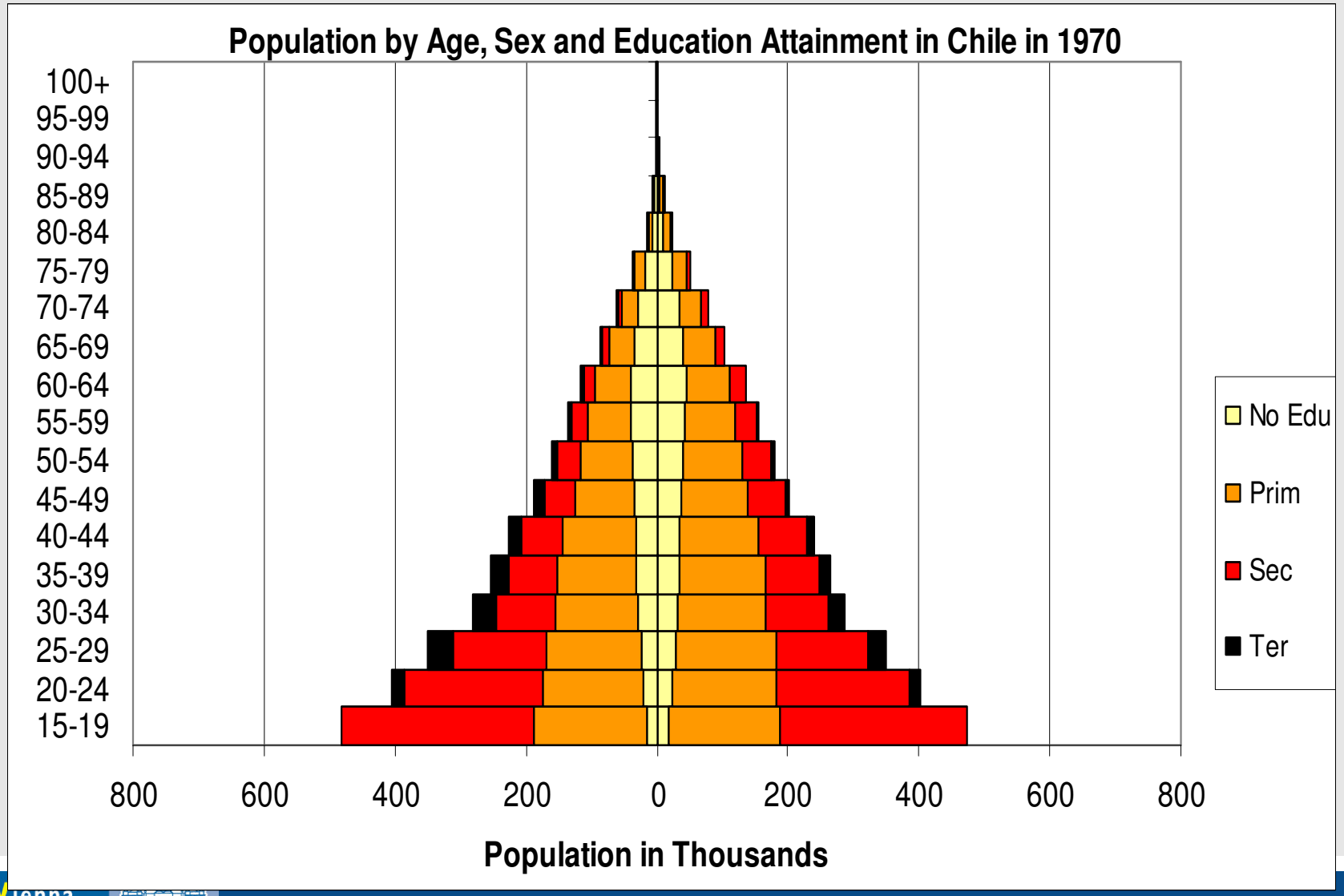
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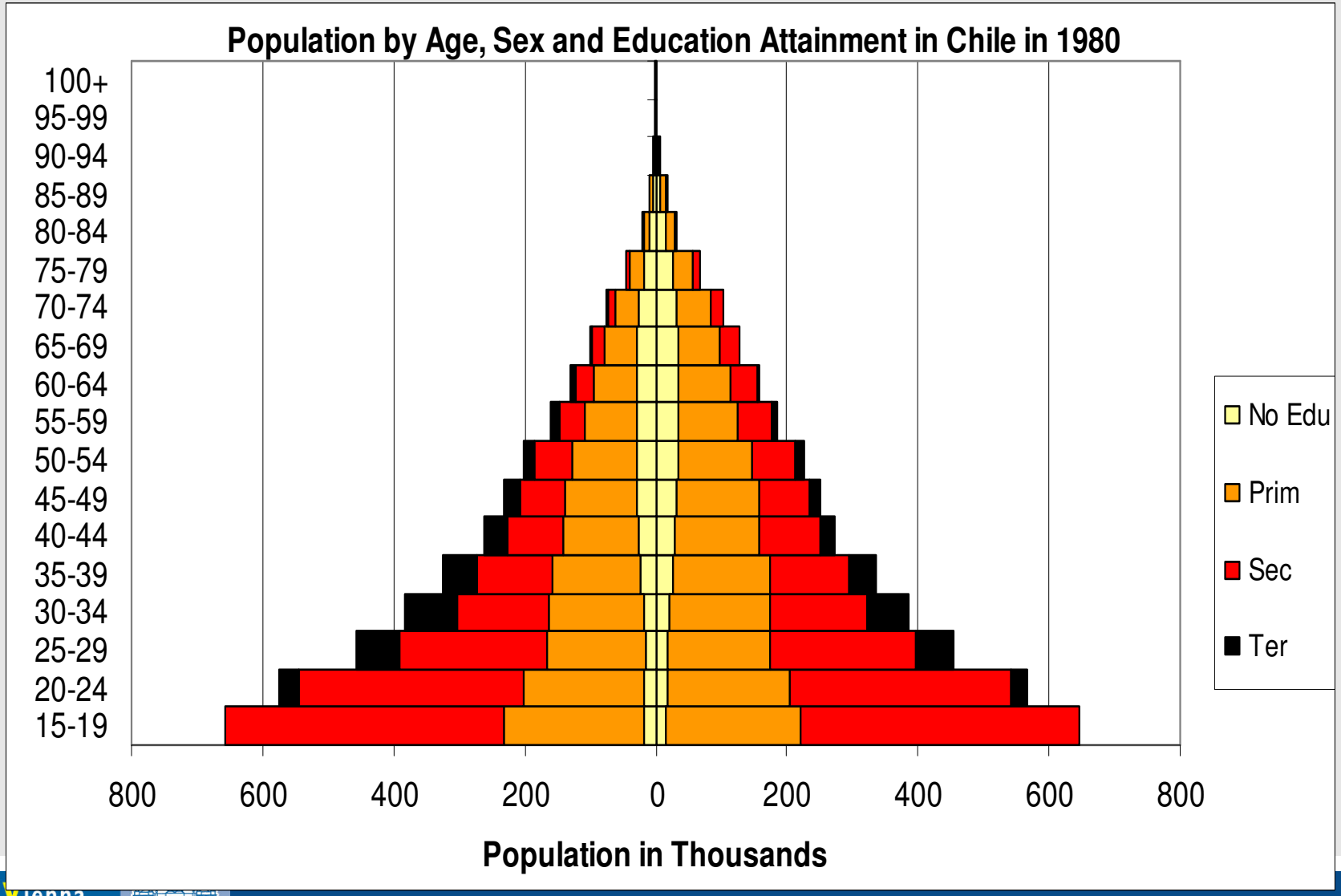
Population by Age, Sex and Education Attainment in Chile in 1980
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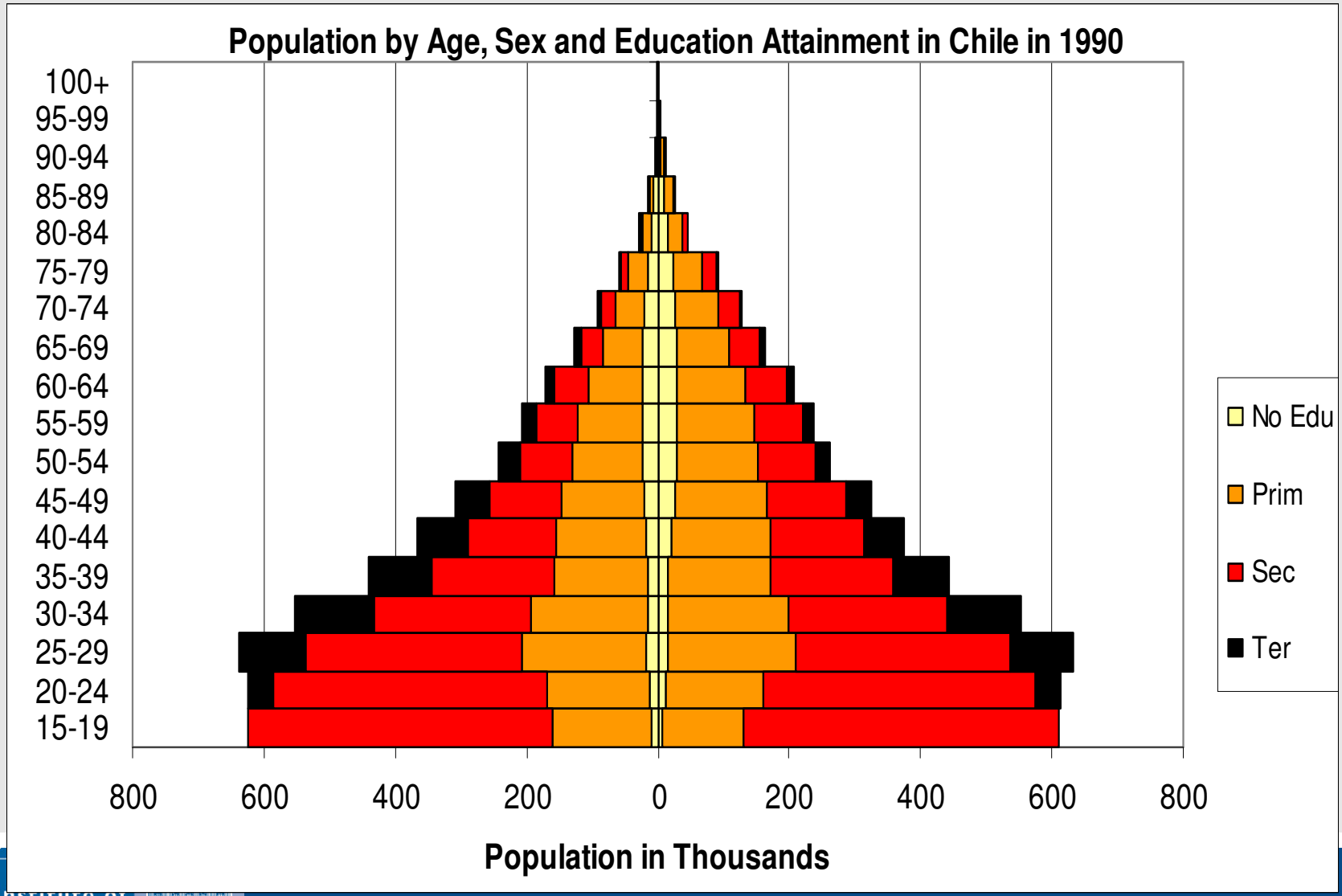
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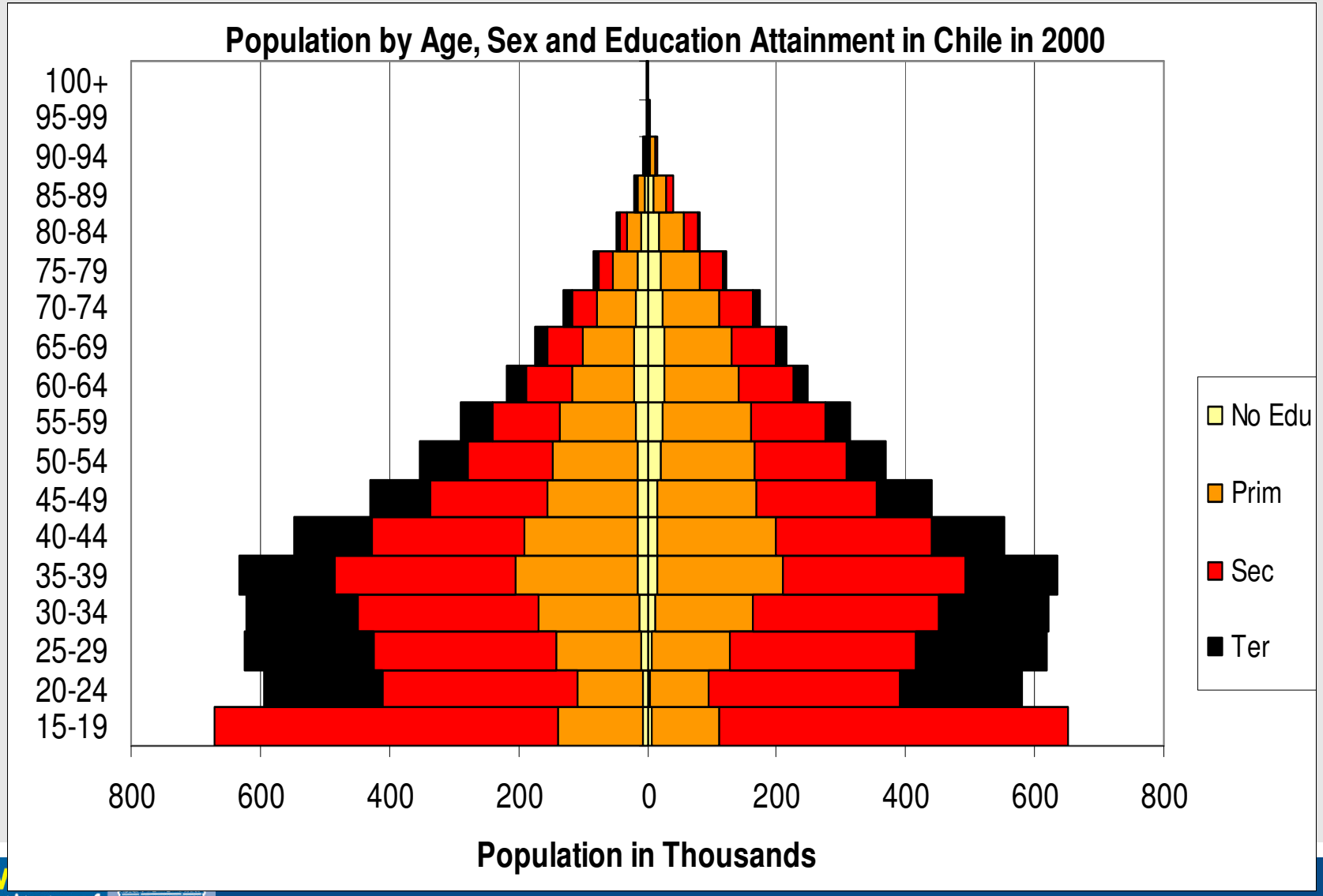
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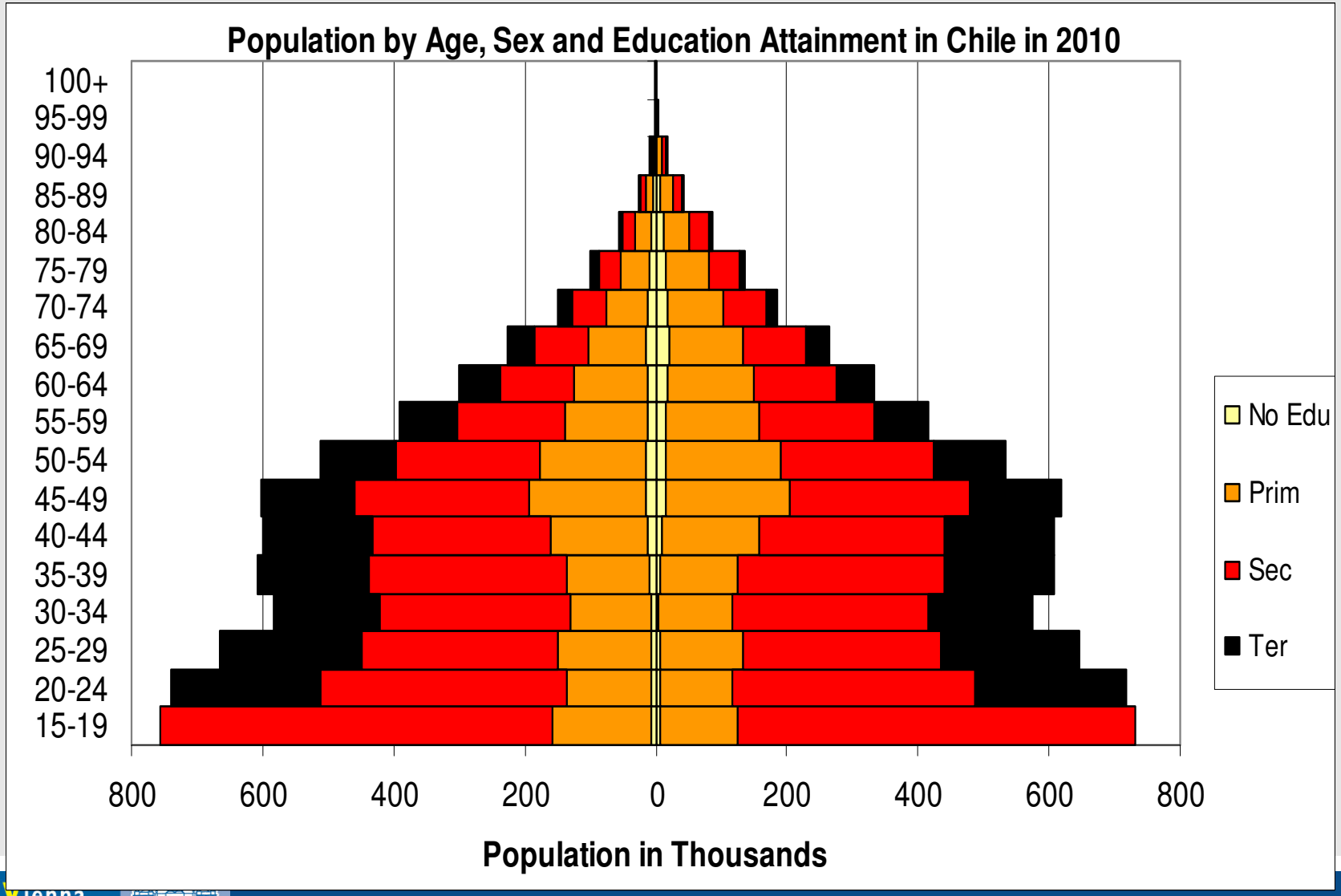
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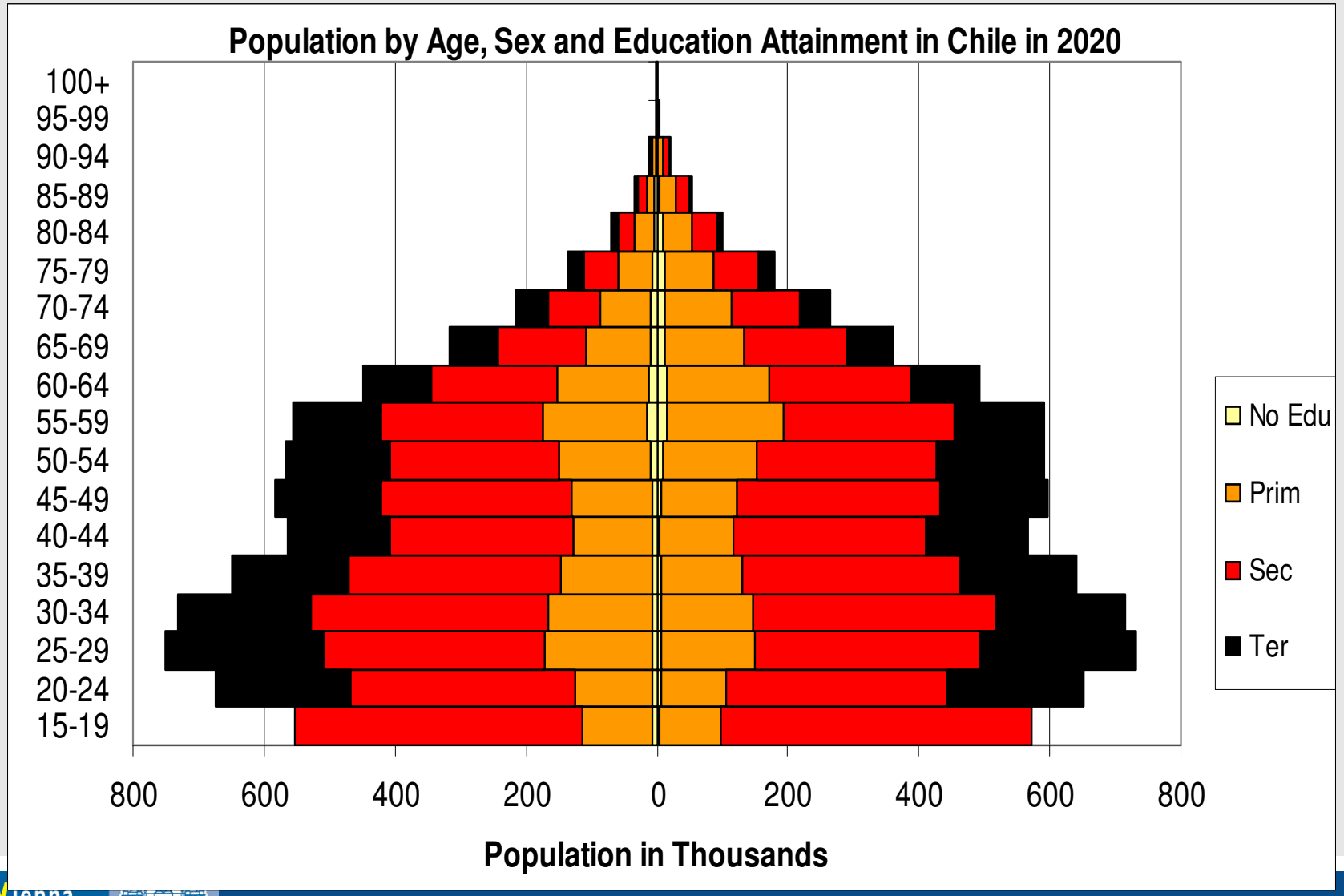
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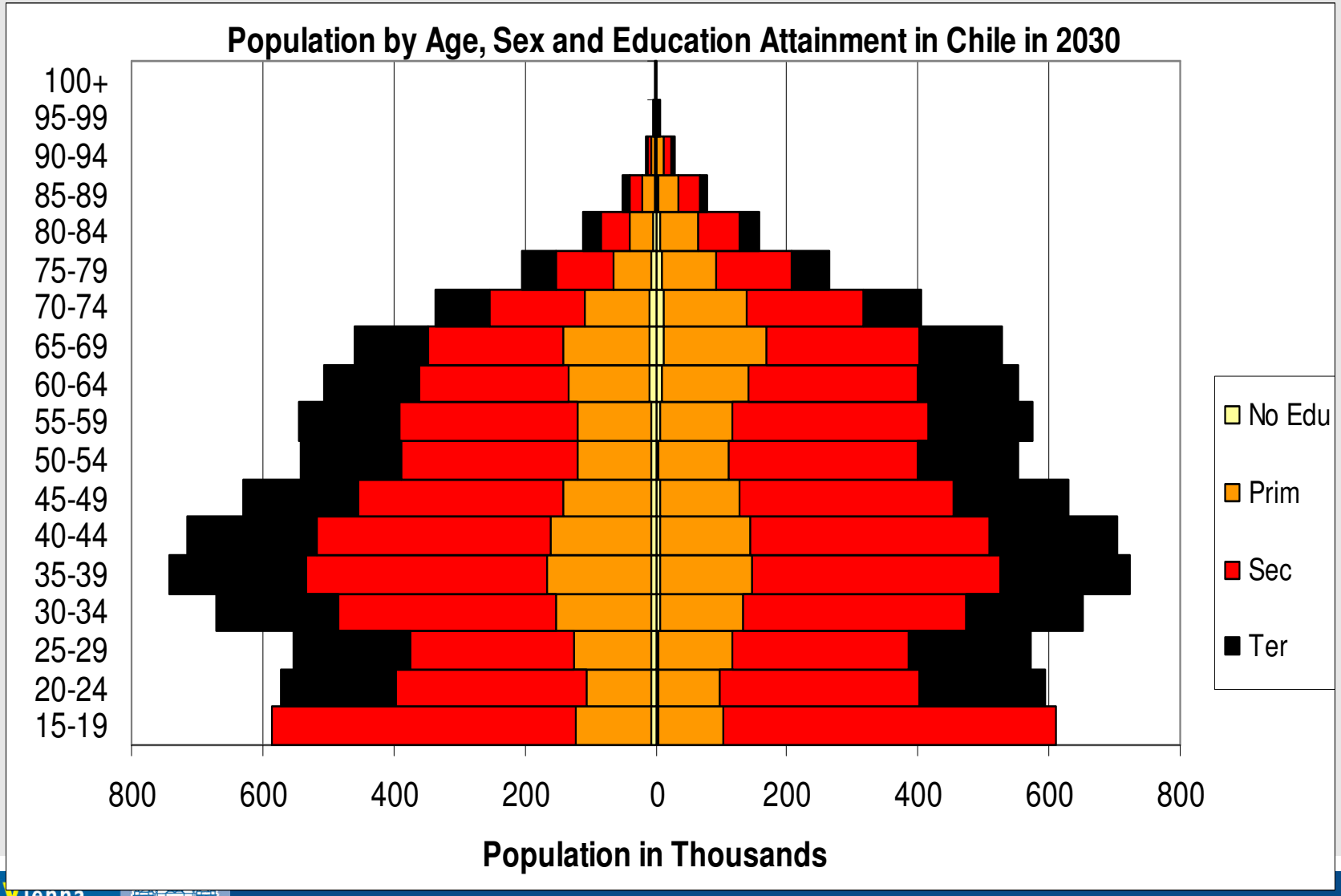
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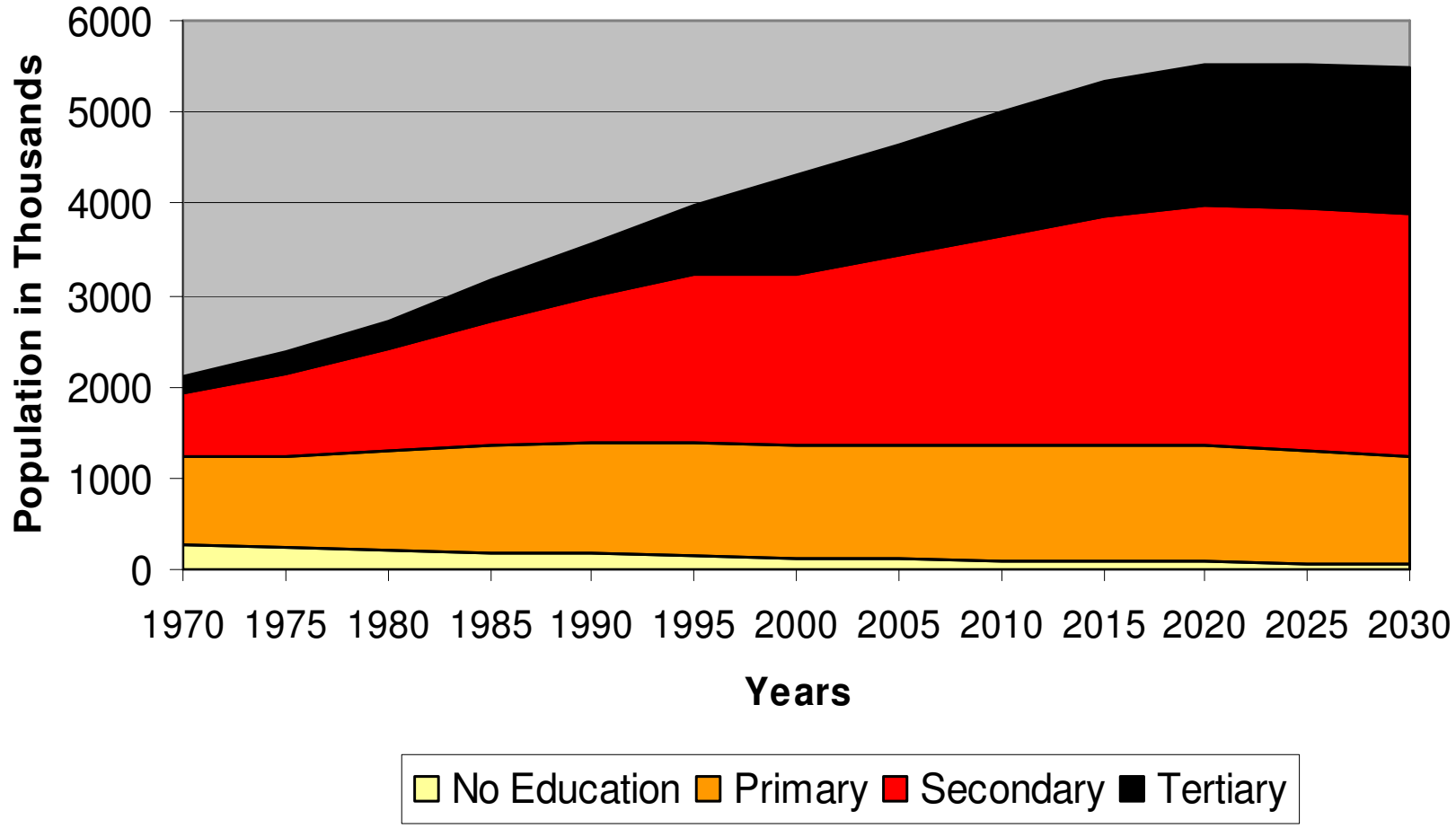
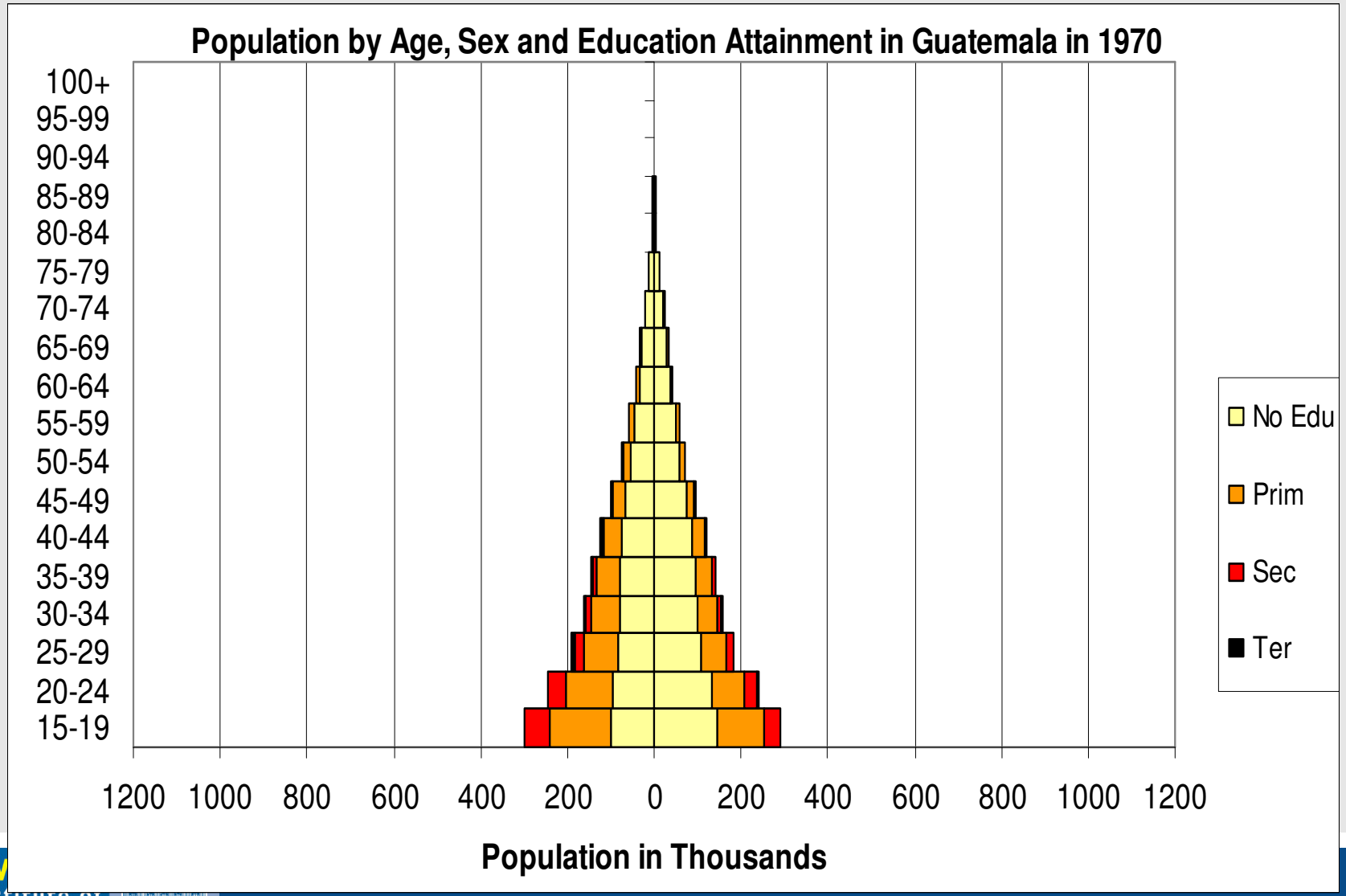
Education Attainment of Male Population Aged 20-65 in Chile during 1970-2030

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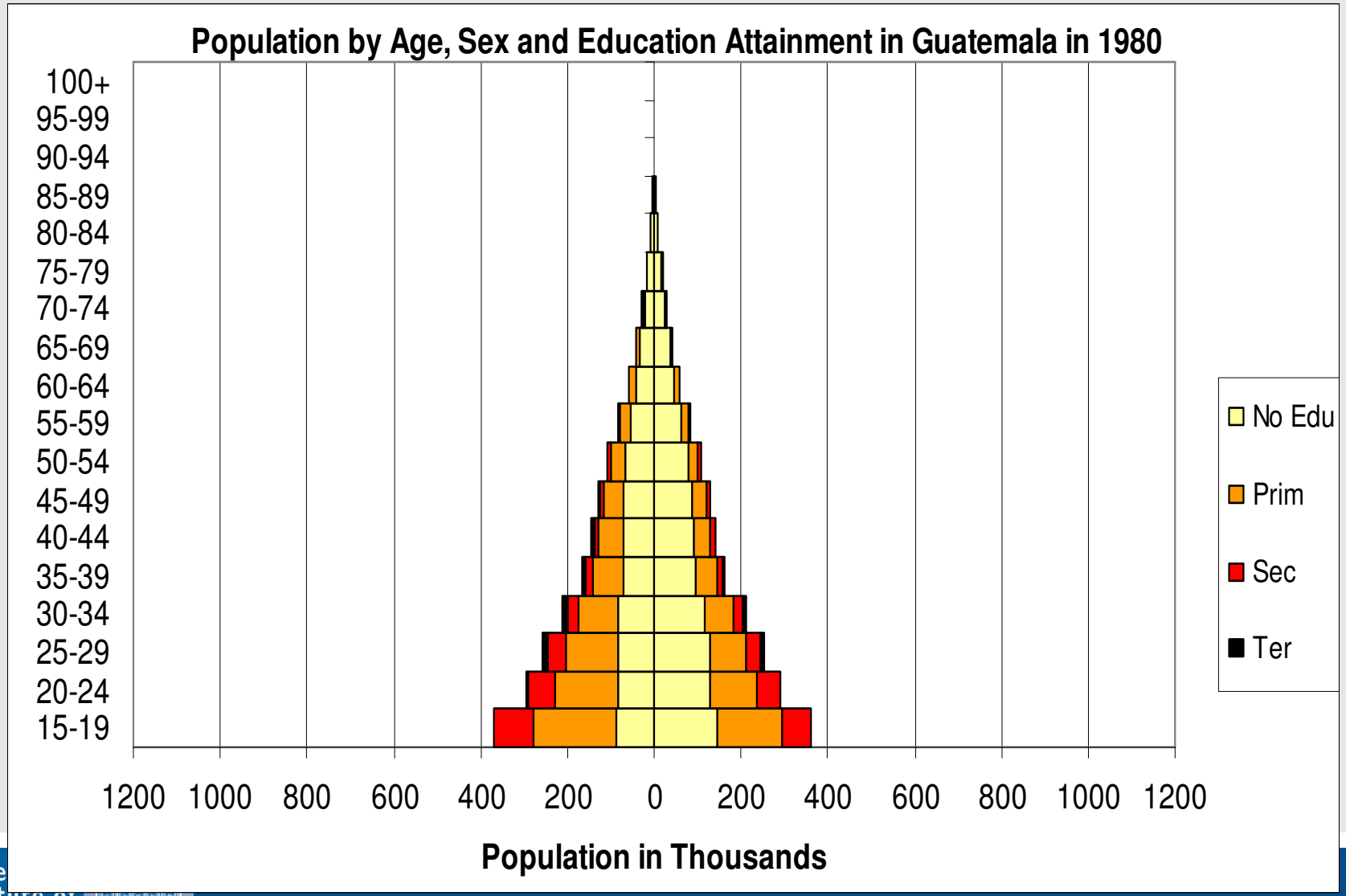
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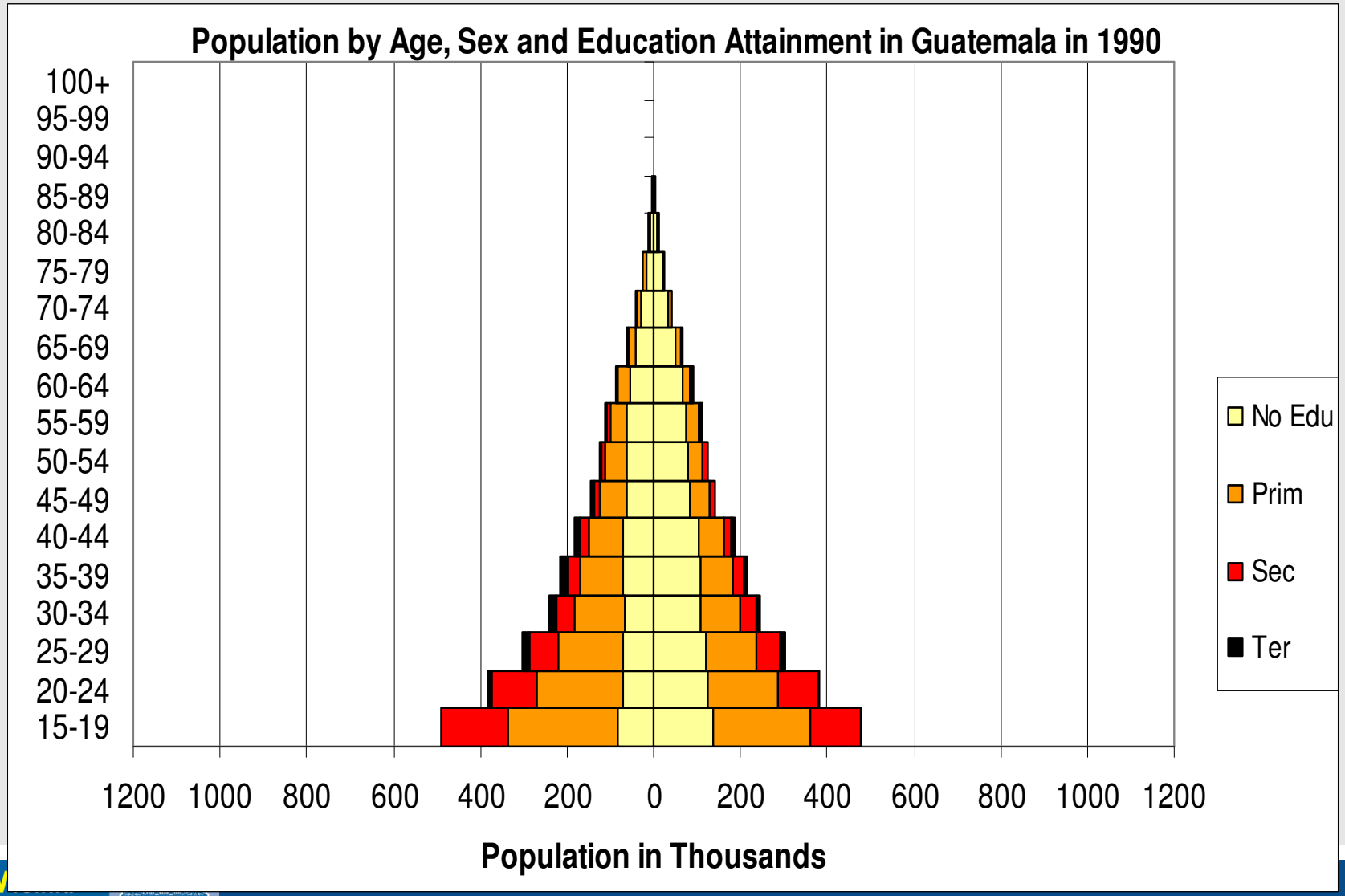
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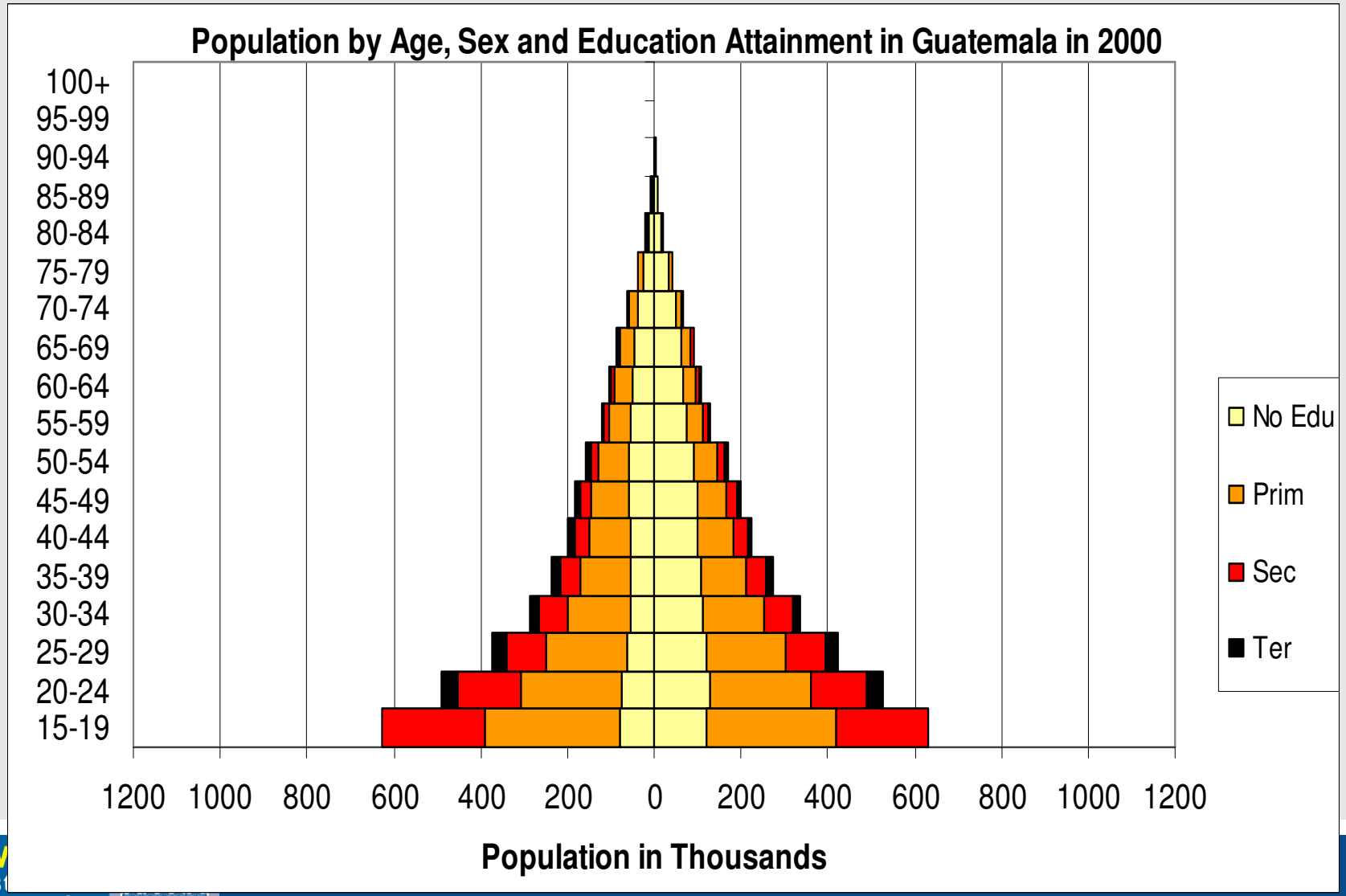
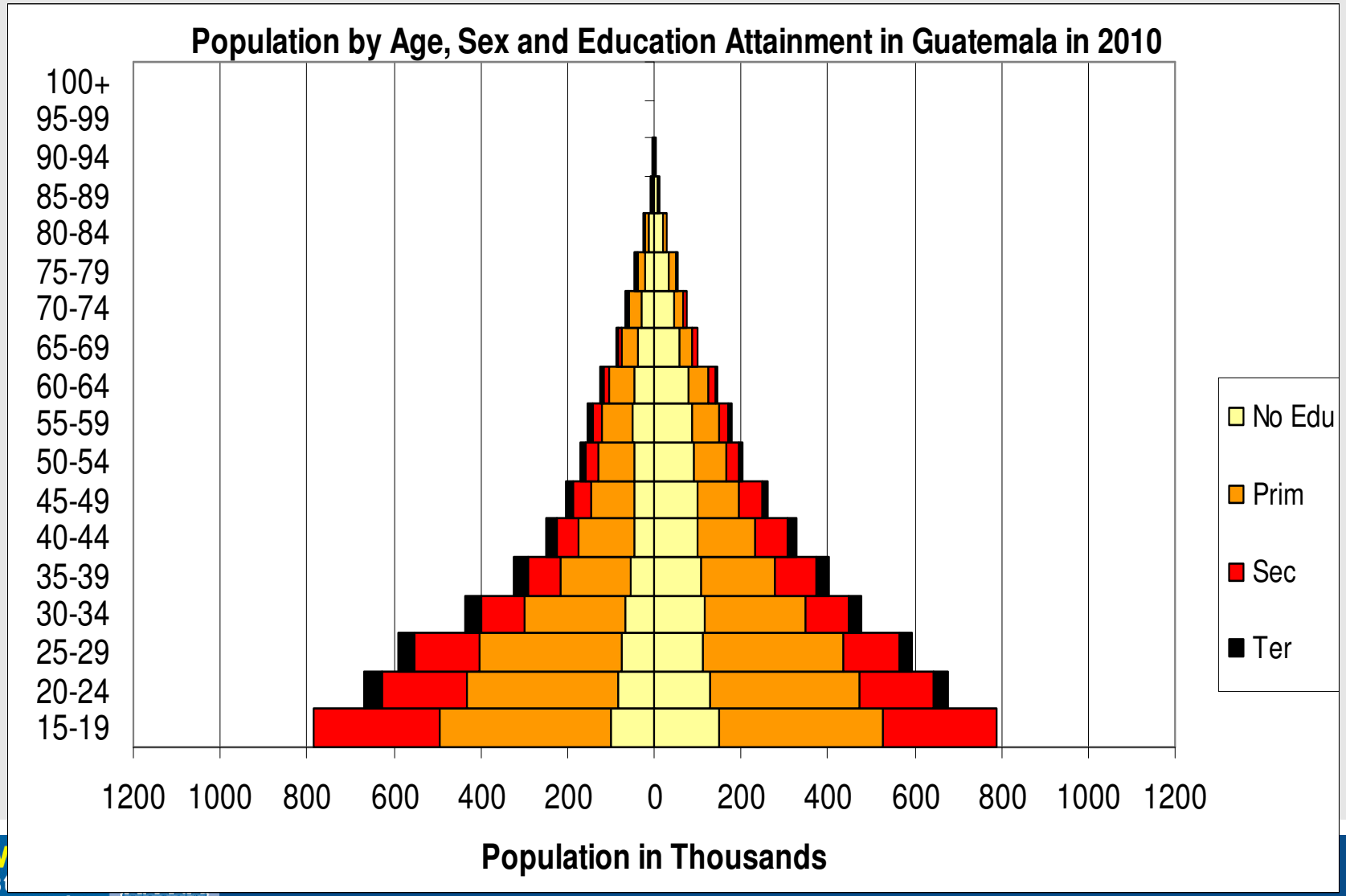
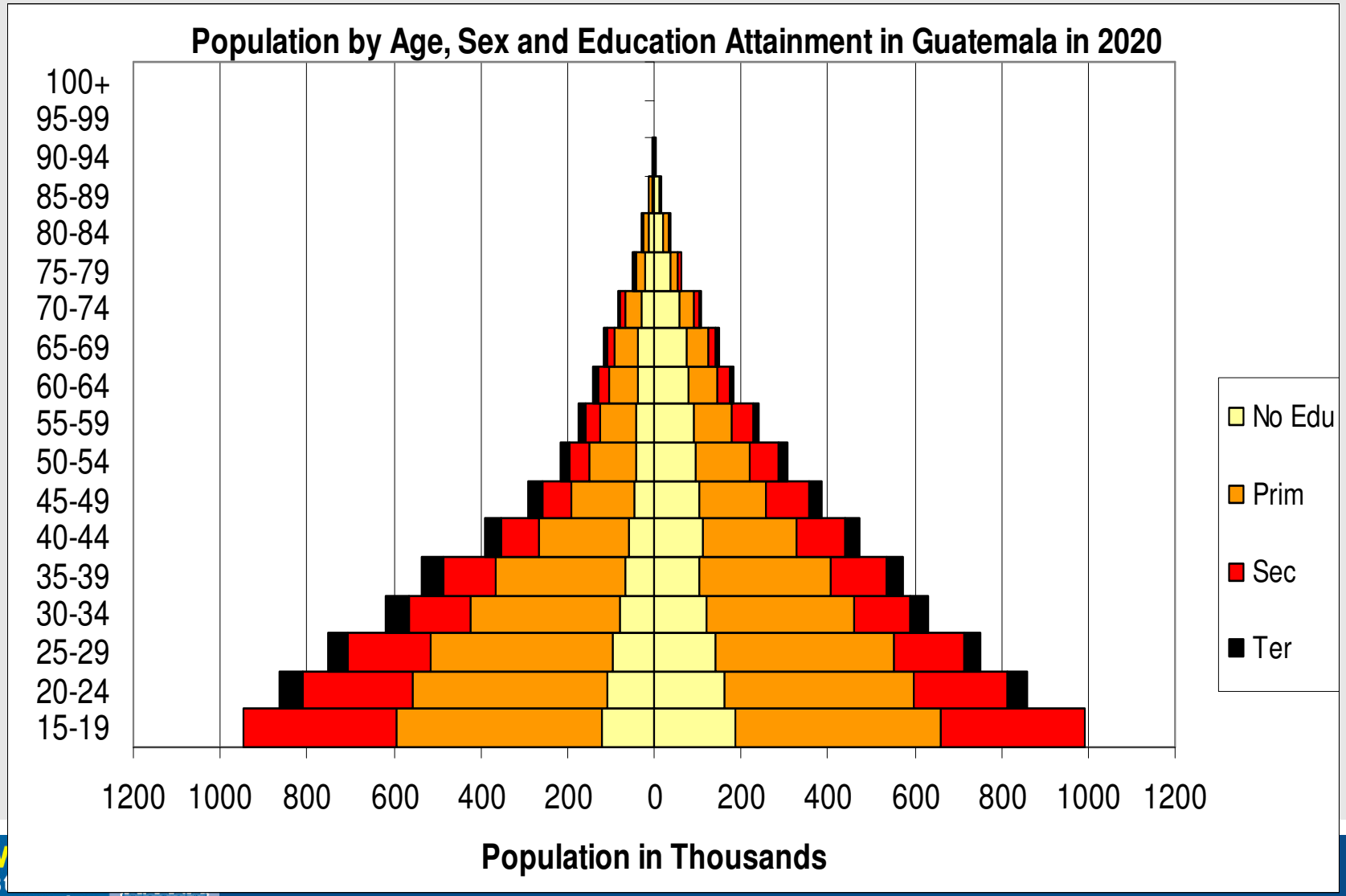
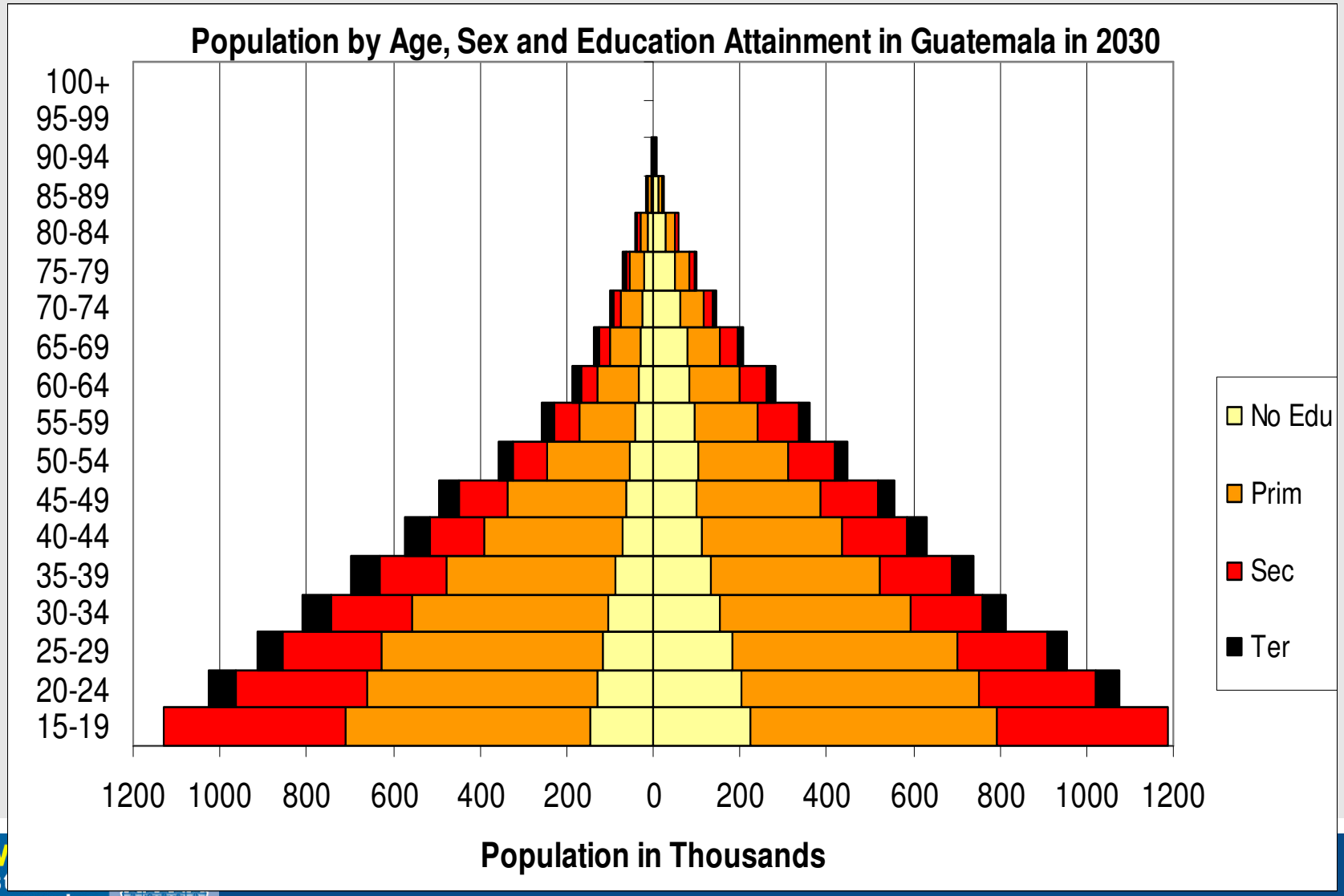

Population by Age, Sex and Education Attainment in Guatemala in 2000
100+
95-99
90-94
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
1200 1000 800 600 400 200 0 200 400 600 800 1000 1200
Population in Thousands
No Edu
Prim
Sec
Ter


Population by Age, Sex and Education Attainment in Guatemala in 2010
100+
95-99
90-94
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
1200 1000 800 600 400 200 0 200 400 600 800 1000 1200
Population in Thousands
No Edu
Prim
Sec
Ter

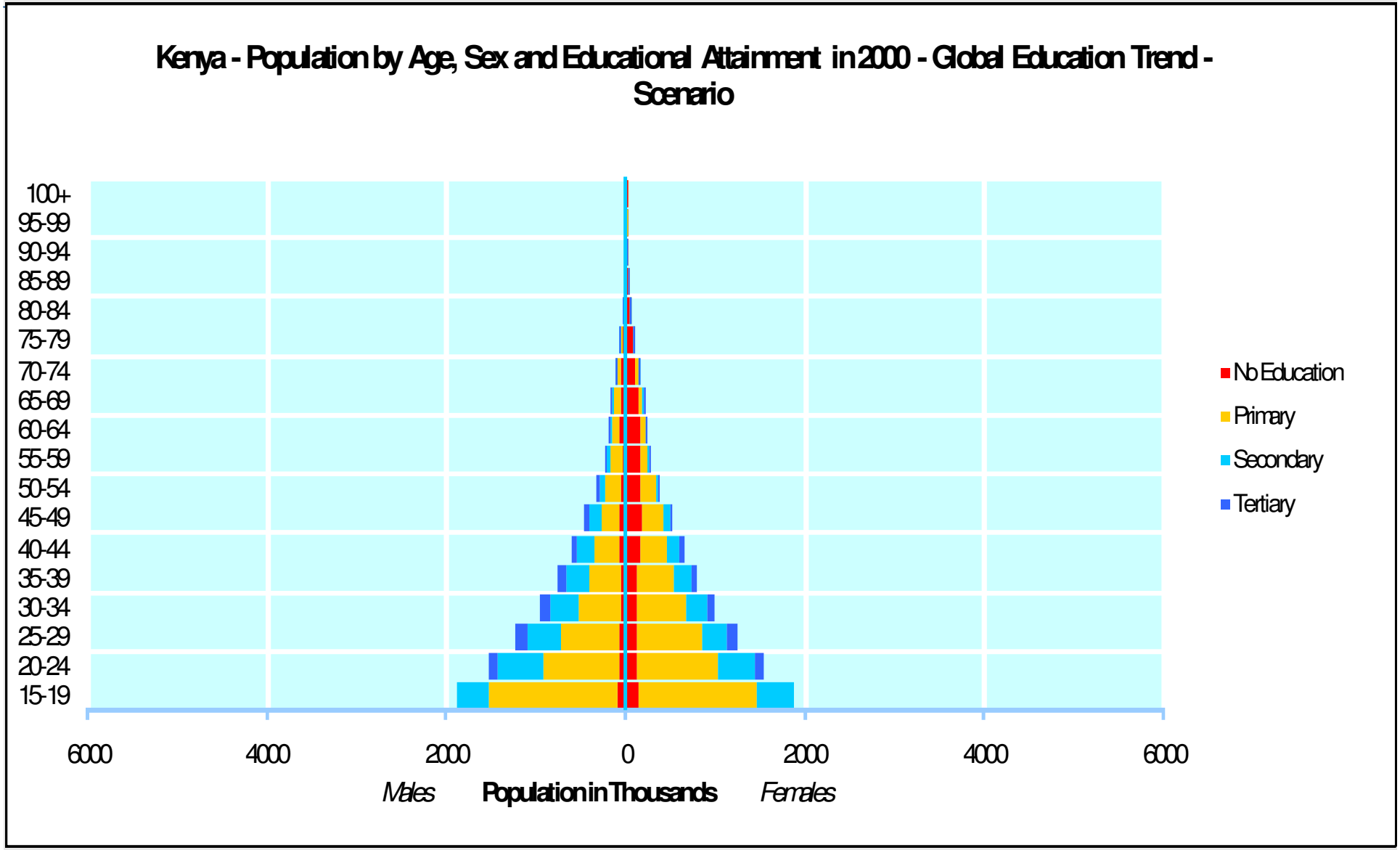

Population by Age, Sex and Education Attainment in Guatemala in 2020
100+
95-99
90-94
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
1200 1000 800 600 400 200 0 200 400 600 800 1000 1200
Population in Thousands
No Edu
Prim
Sec
Ter


Population by Age, Sex and Education Attainment in Guatemala in 2030
100+
95-99
90-94
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
1200 1000 800 600 400 200 0 200 400 600 800 1000 1200
Population in Thousands
No Edu
Prim
Sec
Ter

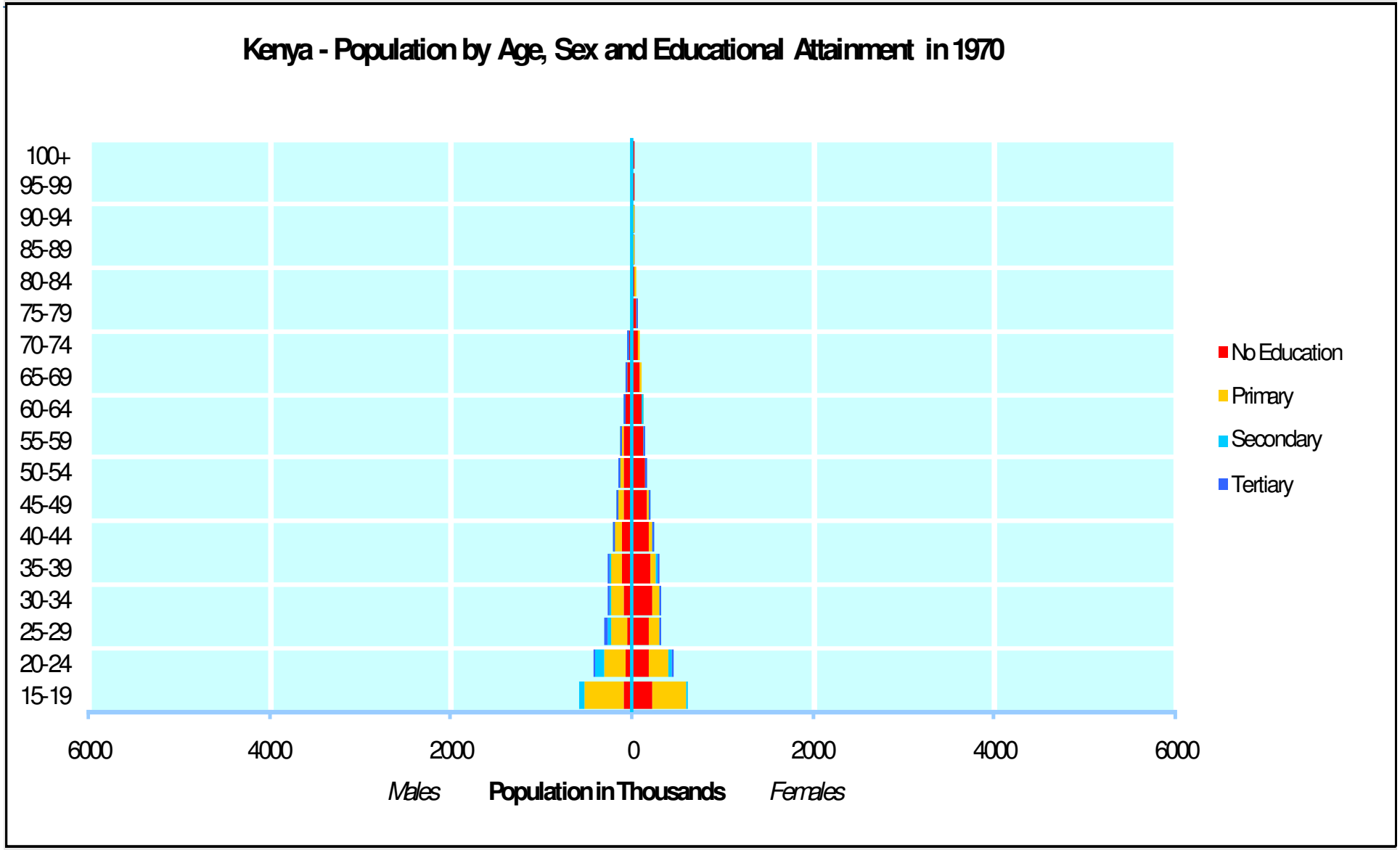
Alternative Education Scenarios to 2050

- **FT – Fast Track**: Universal Primary Education, 90% Junior Secondary, 60% some Tertiary
- **GET – Global Education Trend**: Improvements in education transition rates that follow global experience of past 30 years (driven by Asian experience)
- **CER – Constant Enrolment Rates**: Keep proportion in school constant over time.
- **CEN – Constant Absolute Enrolment Numbers:** No new places in school – while number of children grows.

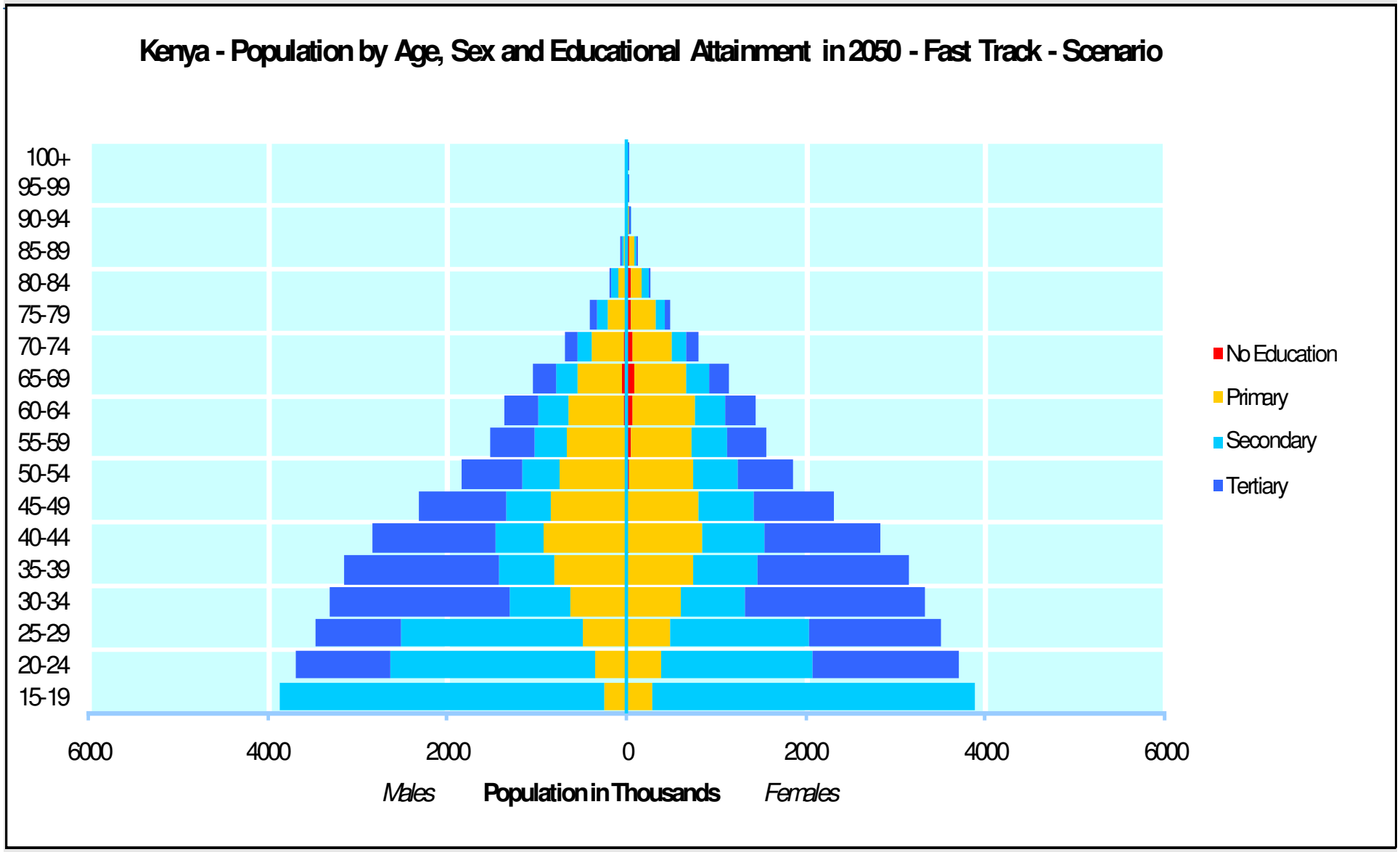
Kenya 2000


Kenya - Population by Age, Sex and Educational Attainment in 2000 - Global Education Trend - Scenario
100+
95-99
90-94
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
6000
4000
2000
0
2000
4000
6000
Males
Population in Thousands
Females
No Education
Primary
Secondary
Tertiary

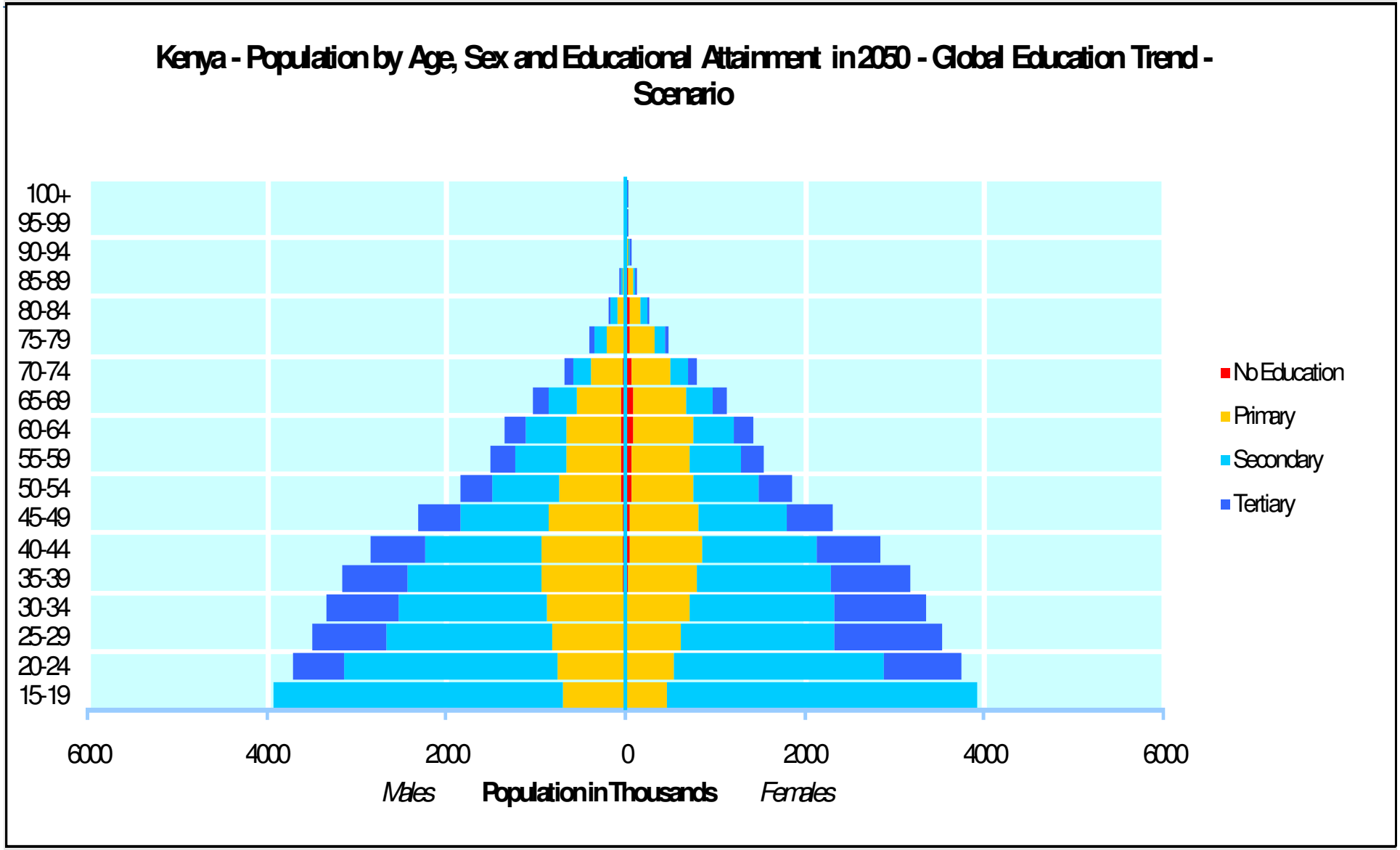
Kenya 1970


Kenya - Population by Age, Sex and Educational Attainment in 1970
100+
95-99
90-94
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
6000
4000
2000
0
2000
4000
6000
Males
Population in Thousands
Females
No Education
Primary
Secondary
Tertiary

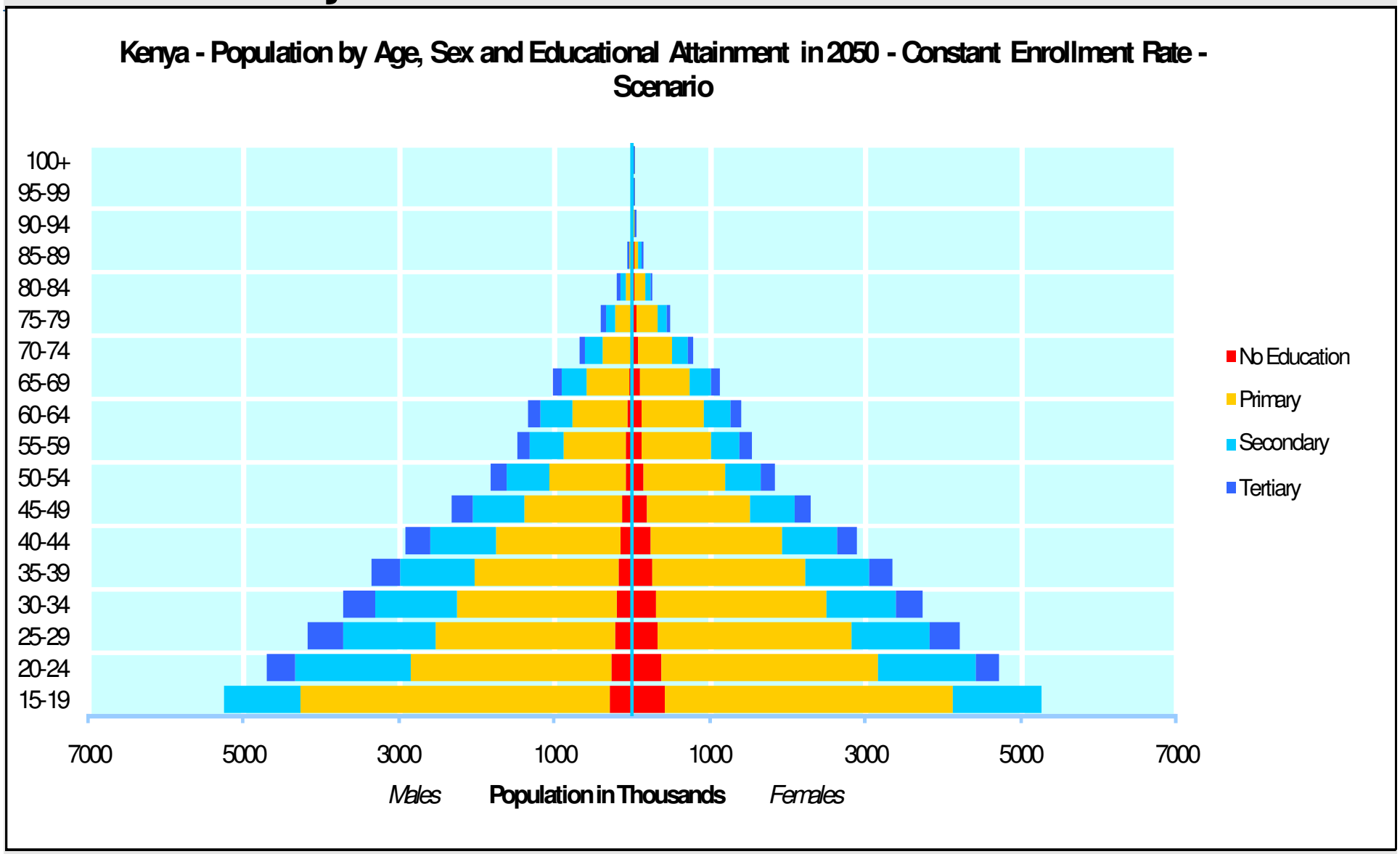
Kenya 2050 – Fast Track Scenario



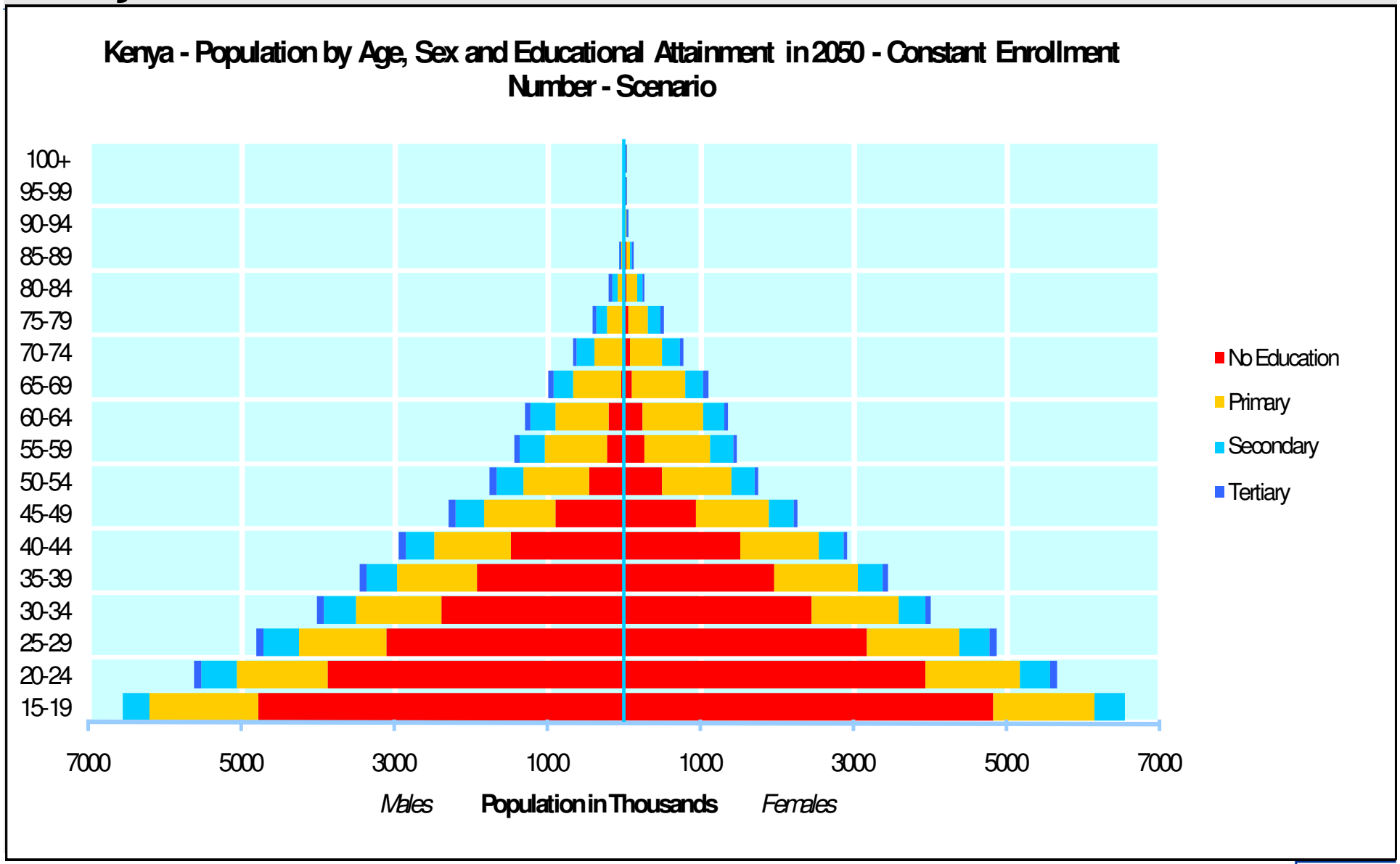
Kenya 2050 – Global Education Trend

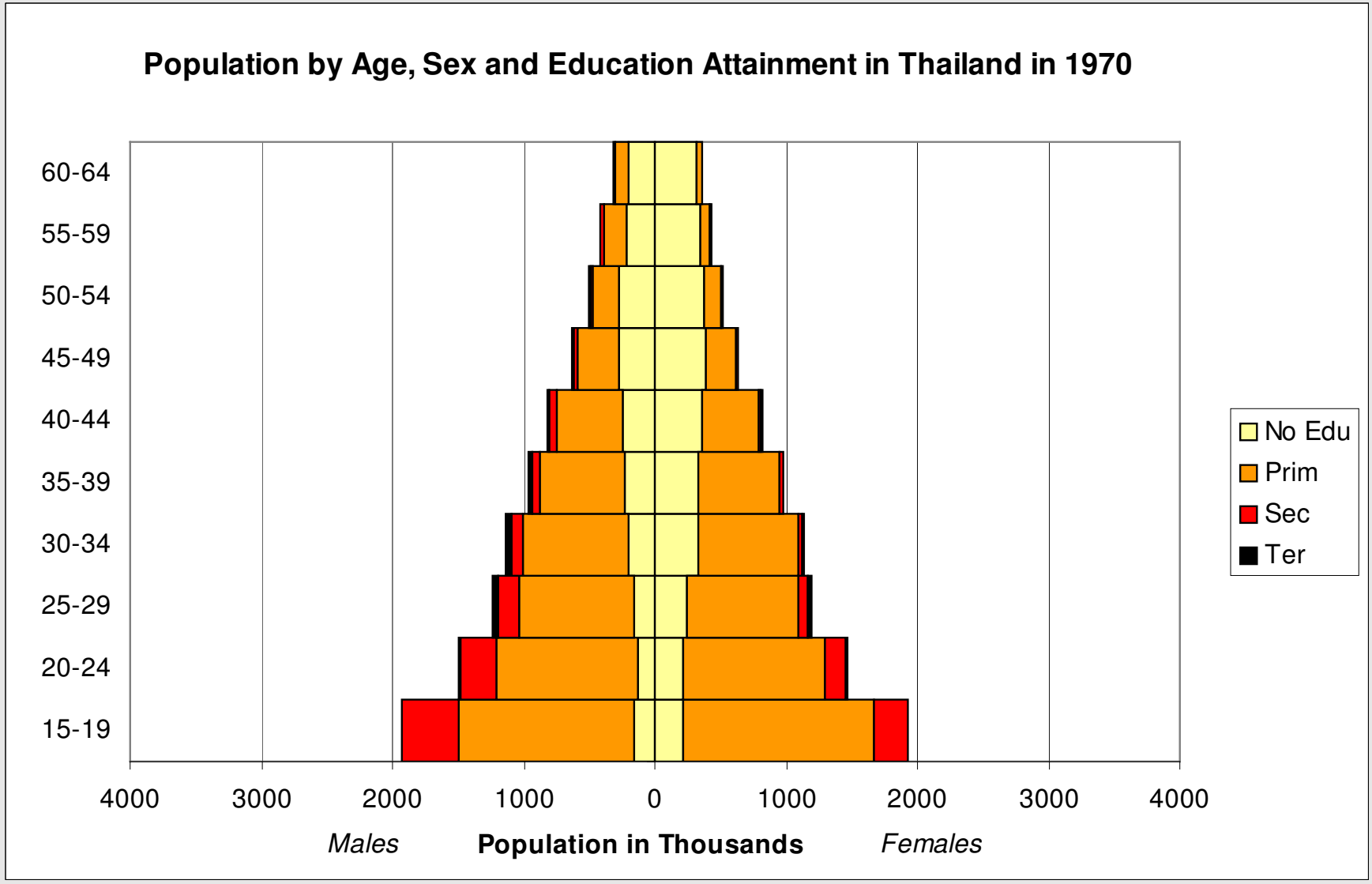


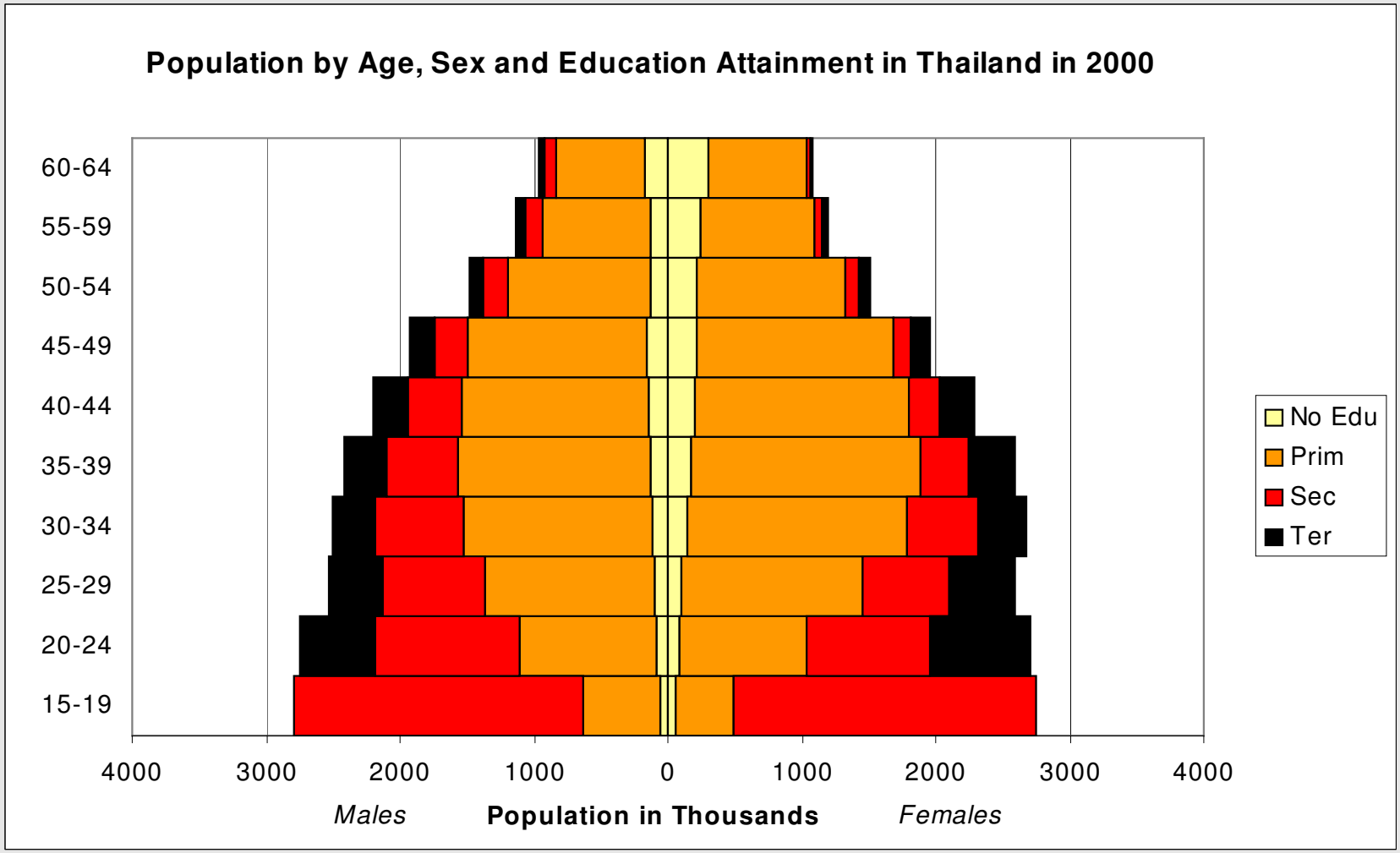
Kenya 2050 – Constant Enrollment Rates

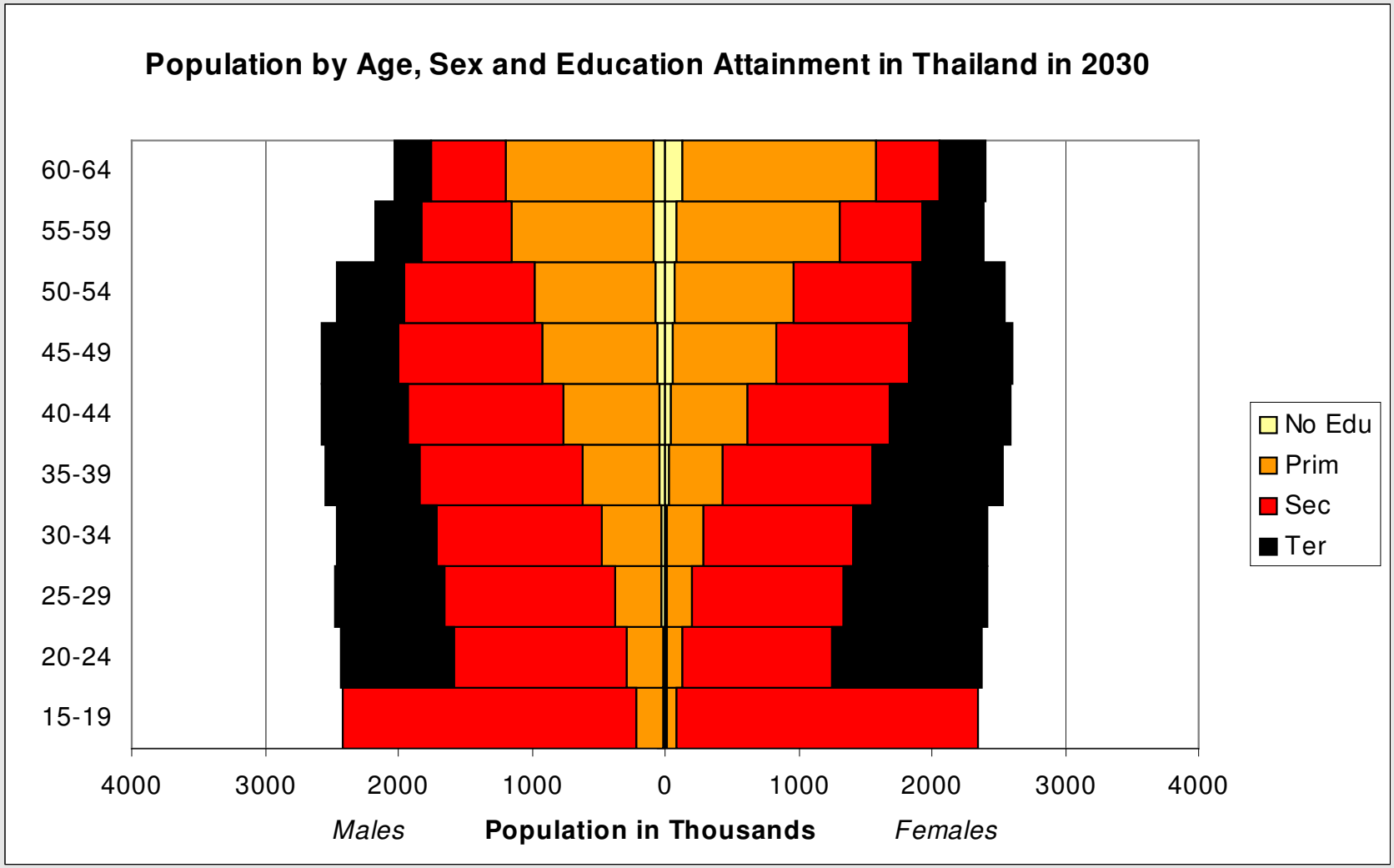


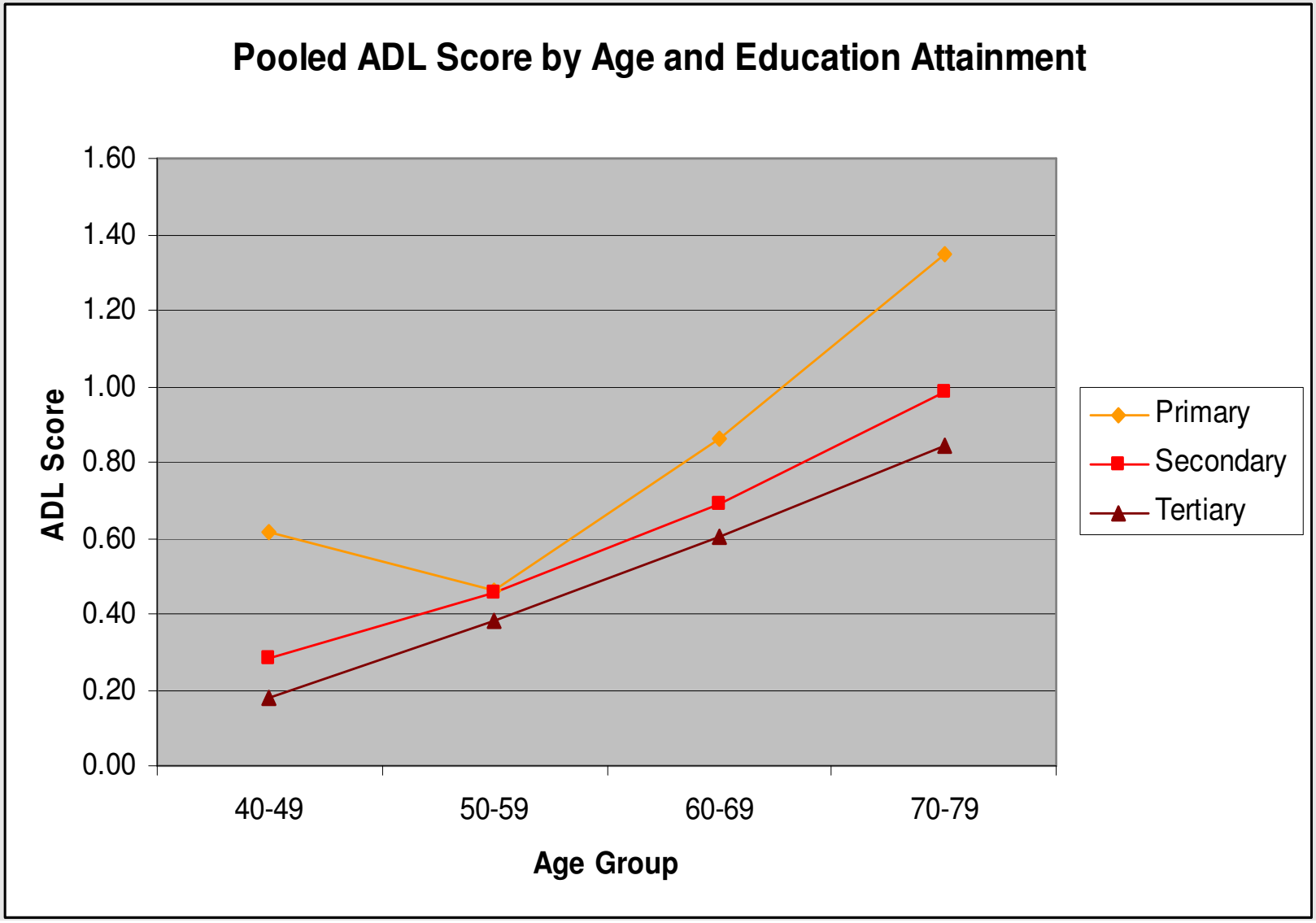
Kenya 2050 – Constant Absolute Enrollment Numbers

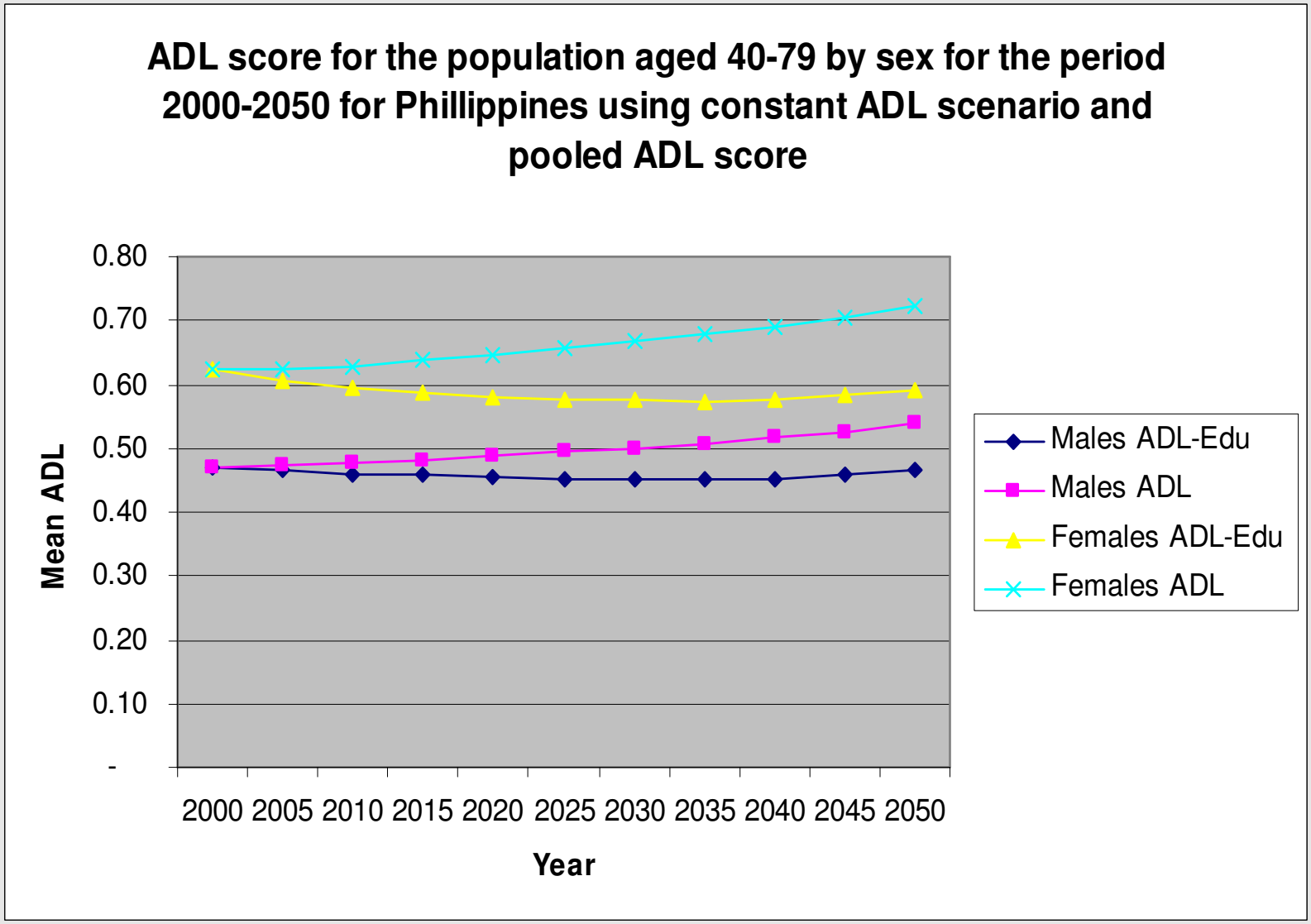



Population by Age, Sex and Education Attainment in Thailand in 1970
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
4000
3000
2000
1000
0
1000
2000
3000
4000
Males
Population in Thousands
Females
No Edu
Prim
Sec
Ter


Population by Age, Sex and Education Attainment in Thailand in 2000
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
4000
3000
2000
1000
0
1000
2000
3000
4000
Males
Population in Thousands
Females
No Edu
Prim
Sec
Ter

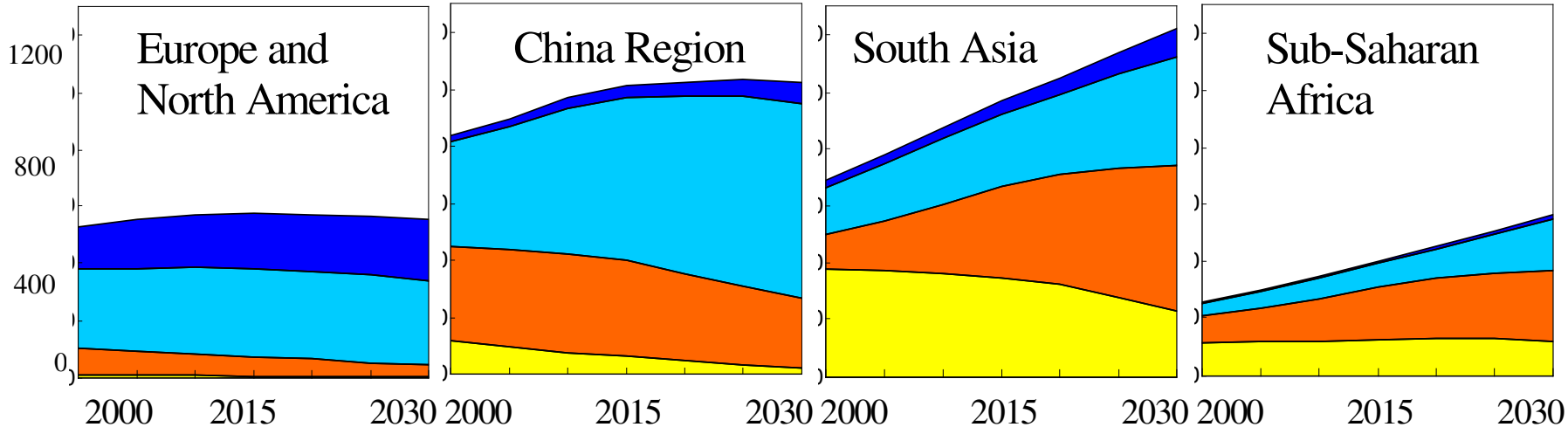

Population by Age, Sex and Education Attainment in Thailand in 2030
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
4000
3000
2000
1000
0
1000
2000
3000
4000
Males
Population in Thousands
Females
No Edu
Prim
Sec
Ter


Pooled ADL Score by Age and Education Attainment
ADL Score
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
40-49
50-59
60-69
70-79
Age Group
Primary
Secondary
Tertiary


ADL score for the population aged 40-79 by sex for the period 2000-2050 for Phillippines using constant ADL scenario and pooled ADL score
Mean ADL
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
-
2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050
Year
Males ADL-Edu
Males ADL
Females ADL-Edu
Females ADL

The changing human capital distribution in the world

Education level of population aged 15-64 in four mega-regions



New ERC Project

"Forecasting societies' adaptive capacity to climate change"

Focus on differential vulnerability – Education as possible climate change adaptation policy

- Three empirical case studies: Sahelian Drought, Asian Tsunami and Hurricane Mitch
- Global level time series analyses
- A new "demographic theory of social change with predictive power": Age – Period – Cohort changes.
- New "science based" population and education projections for all countries in the world. Assumptions based on broadly based evaluation of alternative arguments – large numbers of expert per region.