Demographic Theory and Practice

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Yerevan – November 2016

Istat

Content

1. General demographic patterns

2. Looking for data in international databases

3. Crude rates and population growth rate

4. Issues in comparisons

5. More refined measures

6. Population stock and flows

7. Indices on demographic characteristics

8. International commitments: from the MDGs to the SDGs

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Patterns in population evolution
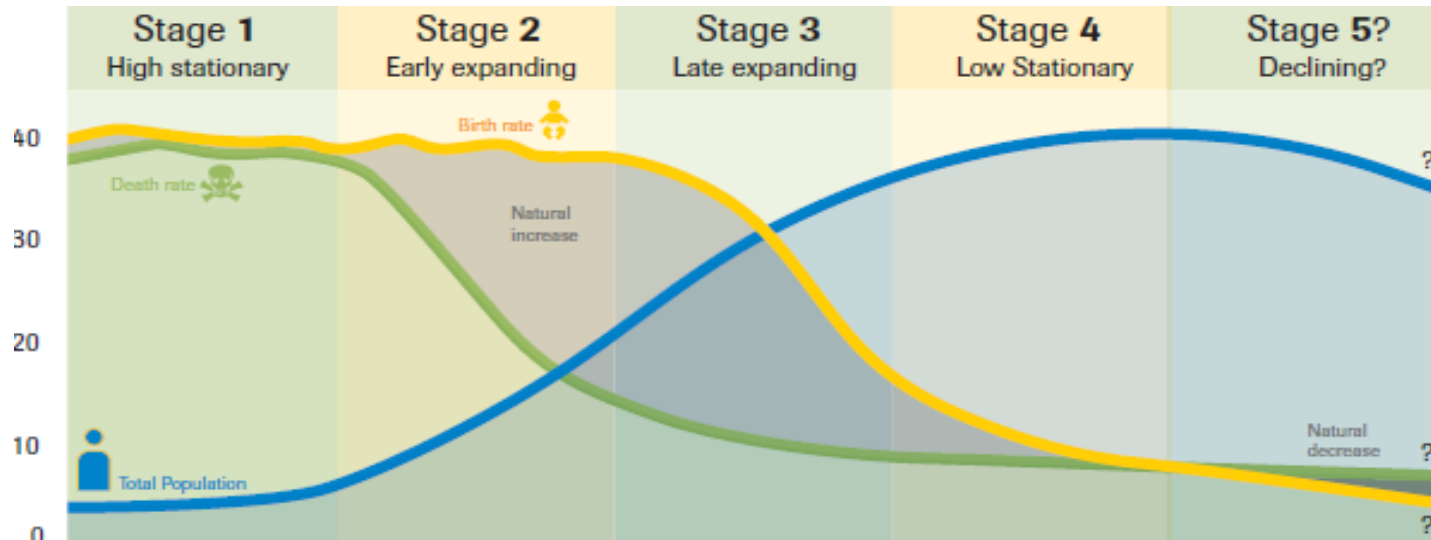
The first demographic transition
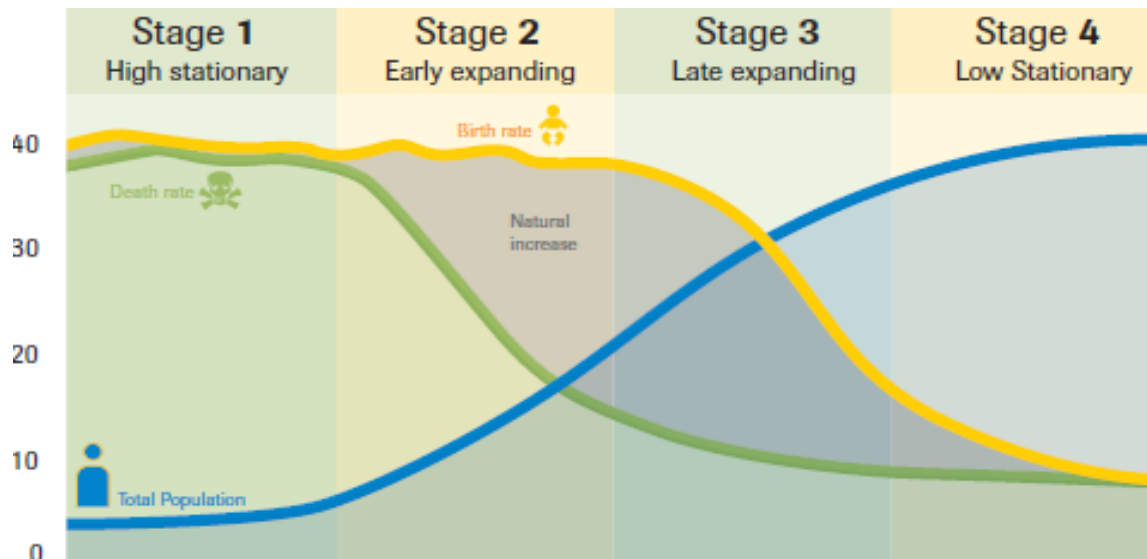
www.populationeducation.org

linking dropping fertility and mortality to social and economic development

Patterns in population evolution

The second demographic transition (Ron Lesthaeghe and Dirk van de Kaa, 1986)

Stage 1 High stationary	Stage 2 Early expanding	Stage 3 Late expanding	Stage 4 Low Stationary	Stage 5? Declining?

Birth rate

Death rate

Natural increase

Total Population

Natural decrease ?

40 30 20 10 0

? ? ?

www.populationeducation.org

increased individualism and autonomy, particularly of women
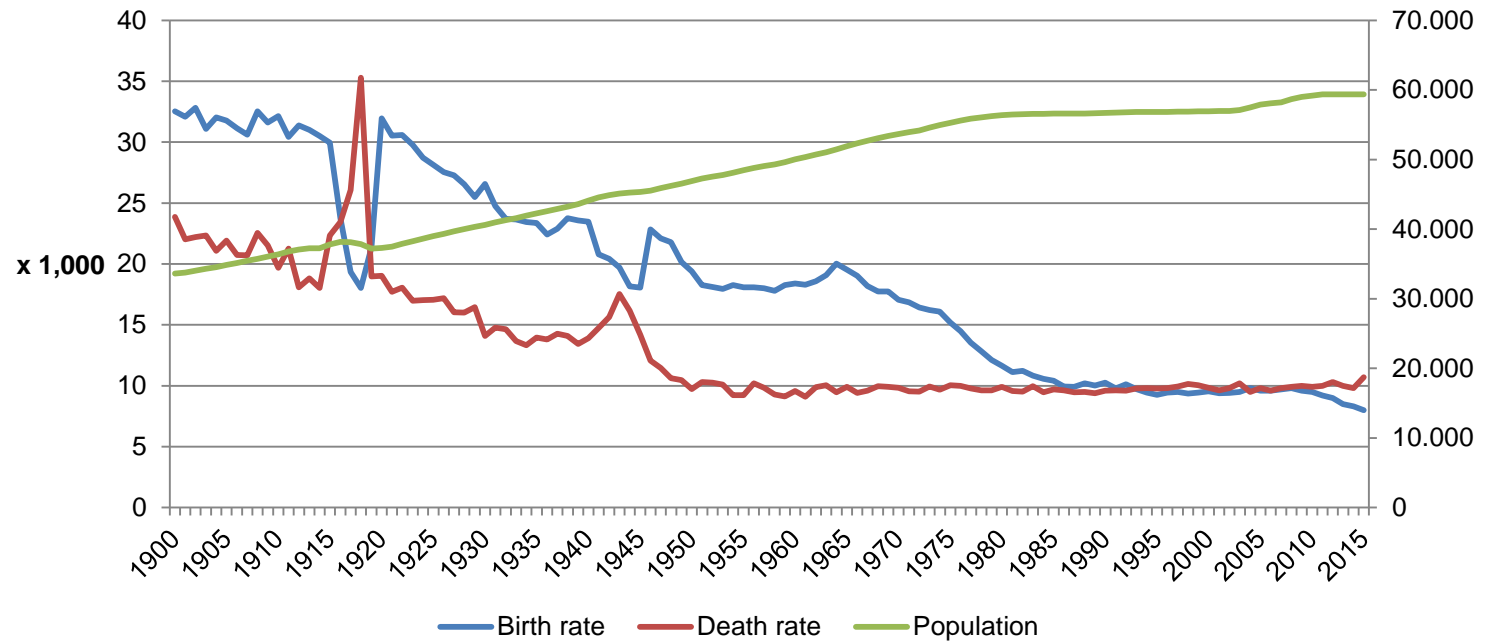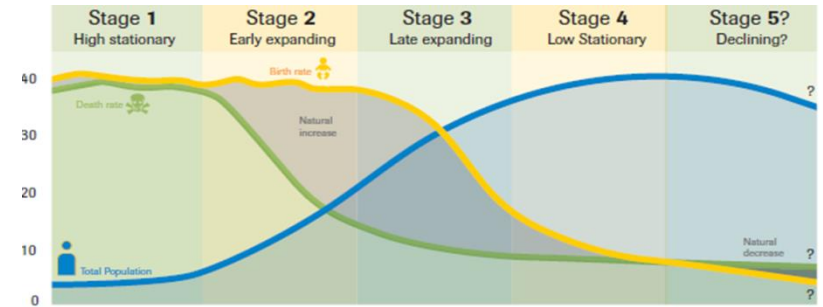+ women choosing to not marry or have children, single mothers
+ cohabitation outside marriage
+ participation by women in higher education and professional careers
→ sub-replacement fertility level.

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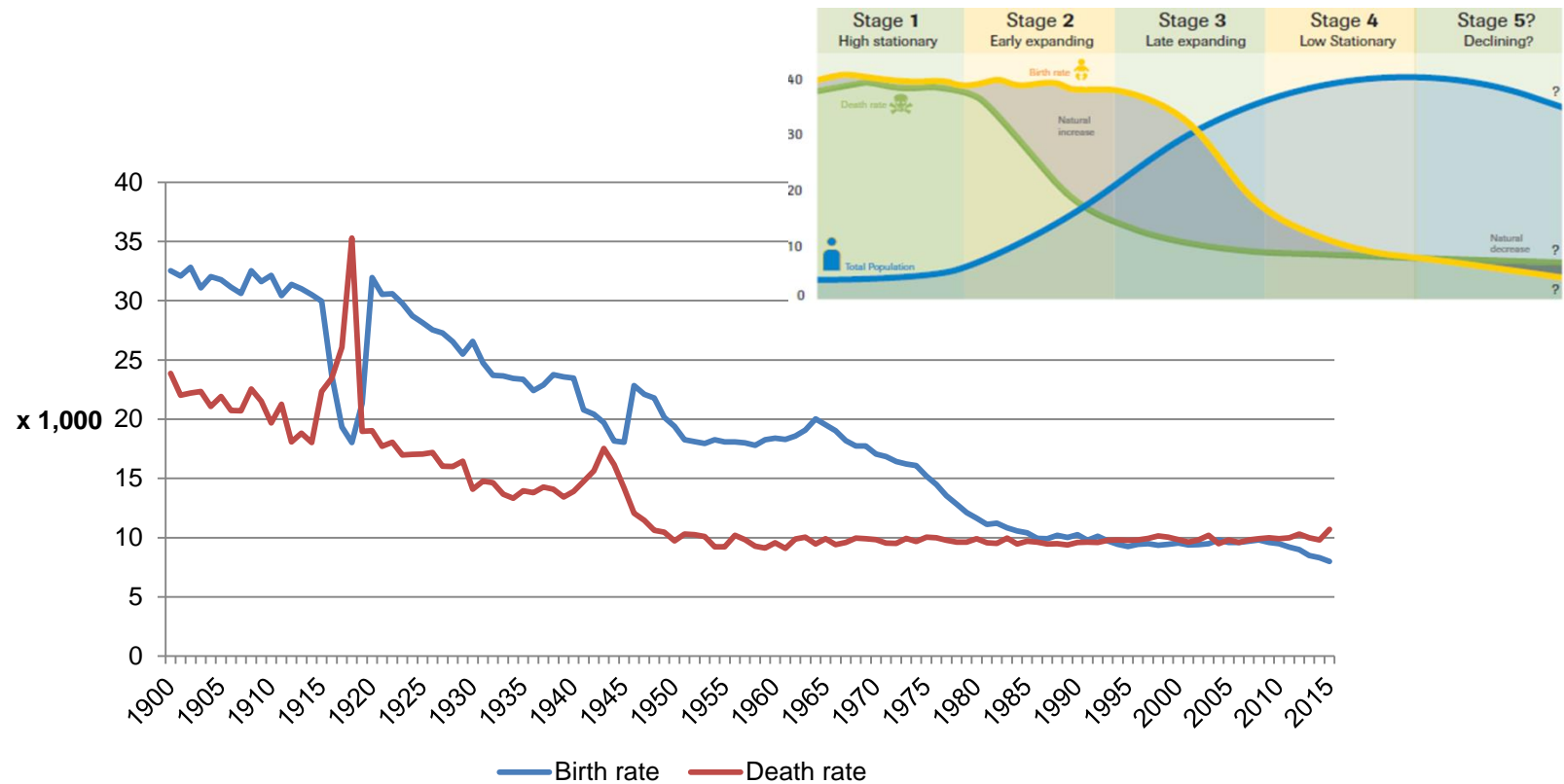
Trends in Italy

Source: Istat

Trends in Italy

Source: Istat

The demographic transition in practice

Where is Armenia along the transition path?

Data sources - national and international

Armenia National Statistical Office

[Demographic Database](#)

[Demographic Indicators](#)

UN
[Data](#)

United Nations

World Bank

THE WORLD BANK
IBRD · IDA

[Data](#)

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In recent years, birth rates and death rates are almost stable
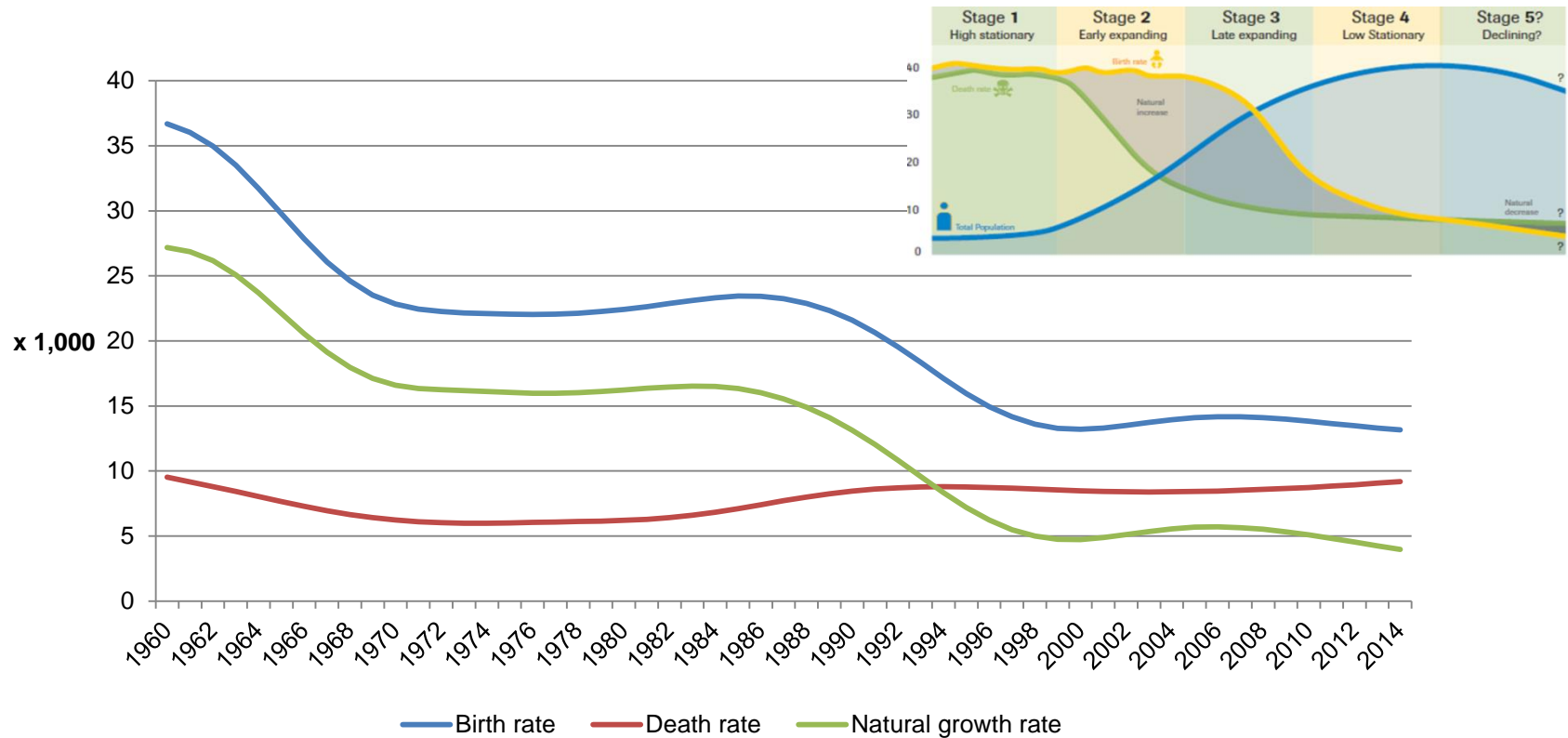
Source: World Development Indicators, The World Bank

What about total population?
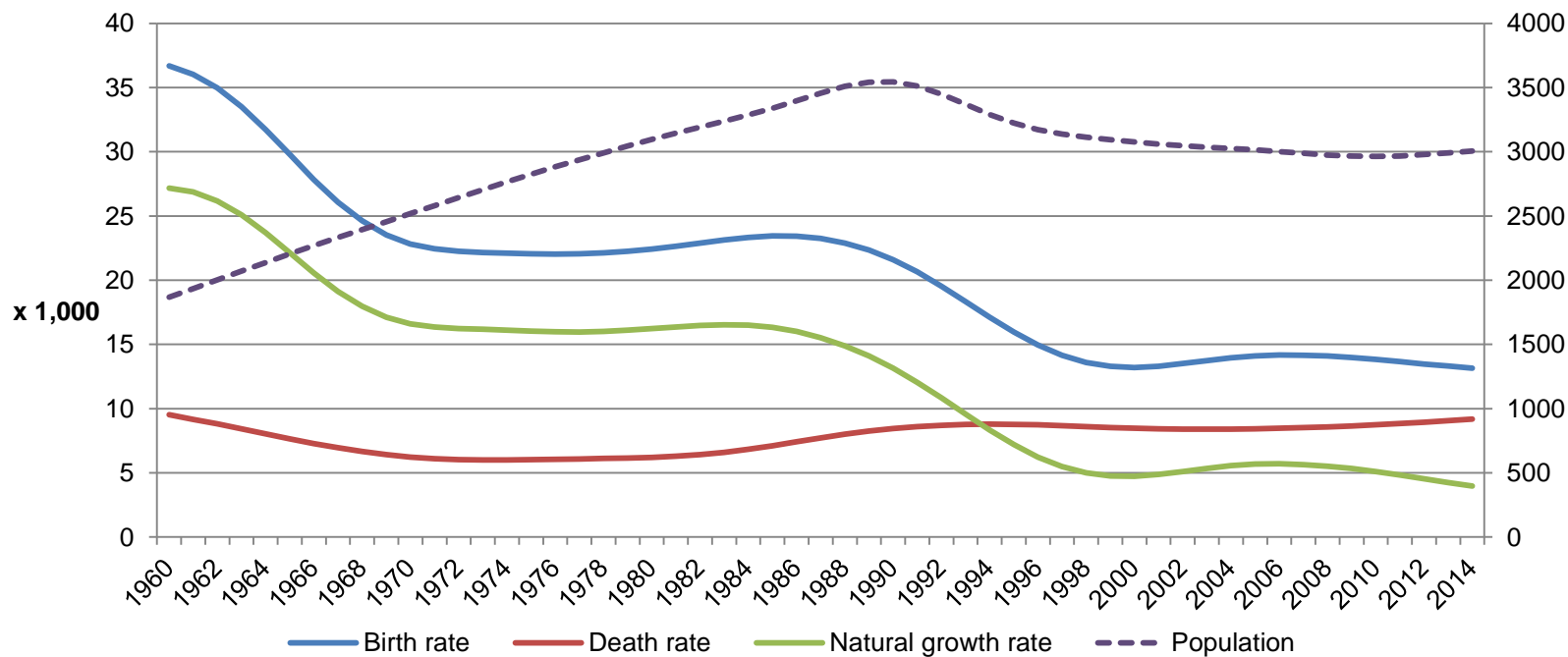
Source: World Development Indicators, The World Bank

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Demographic indicators - 1

Crude rate is

The rate of any demographic event computed for an entire population

Births/ mid-year Population *1,000 → Birth rate

Deaths/ mid-year Population *1,000 → Death rate

Birth rate - Death rate = Natural growth rate

Usually C.R. refer to one calendar year
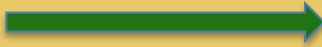
Same formula can be applied to other demographic events
(e.g.Marriages, Divorces,....)
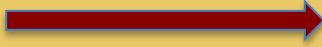
n.b. a widely used proxy of the mid-year population is the average of the
population at the beginning and end of the year

Demographic indicators - 1
Population Growth Rate

Two alternative hypothesis about population growth from time 0 to t:

1. Linear $P_t = P_0 \times r \times t$ → $r = (P_t - P_0)/P_0 \times t$

2. Exponential $P_t = P_t \times e^{rt}$ → $r = \ln(P_t/P_0)/t$
(compound interest)

N.B. For one year periods the two alternatives are usually almost coincident

Let's verify that with data for Armenia (2002-2011)

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Demographic indicators - 1
Population Growth Rate

Populatin growth rate										
NSSRA data										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	3208317	3191218	3173858	3156011	3136812	3117406	3097385	3076851	3055236	3034499
	t=10									
2002-2011	linear growth		exponential							
	-5,42		-5,57							
2010-2011	linear growth		exponential							
	-6,79		-6,81							

Crude rates
Pros and Cons

Simple and straightforward
Describing a fact

Don't take into account possible relevant factors, e.g. sex and age

→Uncertain interpretation

→Unclear comparisons

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Births
Comparing Armenia and Russia (2014)

Country	CBR (x 1,000)
ARMENIA	13.2
RUSSIA	13.3

Source: World Bank Database

Birth Rate is the same
Is reproductive behaviour the same?
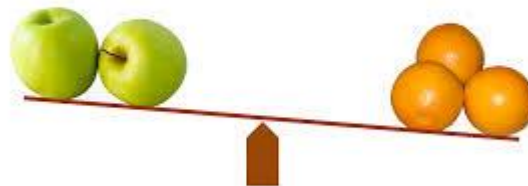
Births
Comparing Armenia and Russia (2014)

Country	CBR (x 1,000)	TFR
ARMENIA	13.2	1.5
RUSSIA	13.3	1.7

Source: World Bank Database

No

Possible explanations?

Deaths
Armenia vs Sweden (2014)

Country	CDR
ARMENIA	9.2
SWEDEN	9.2

Source: World Bank Database

Same CDR
Are survival conditions the same?

Deaths
Armenia vs Sweden (2014)

Country	CDR	% pop >=65
ARMENIA	9.2	10.6
SWEDEN	9.2	19.6

Source: World Bank Database

Same CDR, but different age composition

Deaths
Armenia vs Sweden (2014)

Country	CDR	% pop >=65	Life Expectancy
ARMENIA	9.2	10.6	74.7
SWEDEN	9.2	19.6	82.0

Source: World Bank Database

Life expectancy tells us a different story from CDR

The CDR is strongly affected by the age composition

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Crude rates and more refined indicators

FACT:

- Crude rates can lead to incorrect comparisons

WHY?

- The age structure is crucial when considering demographic phenomena

WHAT TO DO?

- Standardization makes rates comparable (but are theoretical values)

- Synthetic indicators (such as TFR and e0) are adequate to comparisons in space and time

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When data in national and international DB are different

How to deal with different figures?

ITALY (2014)	CDR	Life Expectancy M	Life Expectancy F	% pop>=65
ISTAT	9.8	80.3	85.0	21.4
World Bank	9.8	80.3	85.2	22.0

1. Look at metadata on data sources

Data sources for WB data:
- United Nations Population Division. World Population Prospects,
- Census reports and other statistical publications from national statistical offices,
- Eurostat: Demographic Statistics,
- United Nations Statistical Division. Population and Vital Statistics Report,
- U.S. Census Bureau: International Database,
- Secretariat of the Pacific Community: Statistics and Demography Programme.

Data sources are not the national ones

How to deal with differences?

ITALY (2014)	CDR	Life Expectancy M	Life Expectancy F	% pop>=65
ISTAT	9.8	80.3	85.0	21.4
World Bank	9.8	80.3	85.2	22.0

2. Look at metadata on methodology

WB Methodology:
- Age structure in World Bank's population estimates is based on the age structure in United Nations Population Division's World Population Prospects.
  For more information, see the original source.
- Total population is based on the de facto population including all residents regardless of legal status or citizenship.
- The values shown are midyear estimates.

How to deal with differences?

ITALY (2014)	CDR	Life Expectancy Males	Life Expectancy Females	% pop >=65 (1 .1)
ISTAT	9.8	80.3	85.0	21.4
World Bank	9.8	80.3	85.2	22.0

Not always metadata help explain the difference

It could be due to:

- a misalignment due to material error or a typo
- Provisional/updated data
- results of different estimation models

→Check the original data source; contact the data provider

In any case, quote the data source

Practice: data for Armenia

Armenia (2014)	CDR (x 1,000)	Life Expectancy	Population (x 1,000)	CBR (x 1,000)	TFR
NSSRA					
World Bank	9.2	74.7	3006.1	13.2	1.5

Are national and international data consistent?

Data for Armenia

Armenia (2014)	CDR (x 1,000)	Life Expectancy	Population (x 1,000)	CBR (x 1,000)	TFR
NSSRA	9.2	75.0	3013.8	14.3	1.7
World Bank	9.2	74.7	3006.1	13.2	1.5

Are national and international data consistent?

Comments?

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Demographic indicators - 2
From crude rates to more specific indicators

Population events, particularly vital events such as births or deaths, do not affect people in all age groups in the same way.

→Specifying the denominator increases precision

E.g.
- General fertility rate (GFR) is the total number of live births per 1,000 women of reproductive age (15 to 49 years) in a population per year
- The denominator refers only to the relevant part of the total population

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Demographic indicators - 3
Synthetic indicators

Total fertility rate

Life expectancy

Monitoring births

If policy makers need data about natality, which information are important?

1) Number of newborn → to plan services / evaluate population dynamics

2) CBR → to have a broad idea of short term trends

3) Propensity to have children → to plan/monitor policies

Proxy → Total fertility rate (TFR)

= *Average number of children per woman*
= *Number of children a woman <u>would have</u>*
- *assuming her childbearing conforms to the age-specific fertility rates registered during the reference year during all her childbearing years,*
- *and she survives throughout all her childbearing years.*

Hypothetical measure

Total Fertility Rate

$$TFR_t = \Sigma_x (B_{x,t}/W_{x,t}) = \Sigma_x f_{x,t}$$

$B_{x,t}$ is the number of children born to mother in age x at time t

$W_{x,t}$ is the average number of women aged x at time t

$f_{x,t}$ is the age-specific fertility rate

x   is the age, and varies from 15 to 49

t   is the calendar year

TFR takes into account:
- the fact that births occur only to a part of the population (women in childbearing ages, usually between 15 and 49 years)
- age - specific rates

It doesn't take into account:
- Any change in childbearing behaviour that may occur in the future (e.g. anticipation/postponement)
- Migration trends
- Mortality

Total Fertility Rate

TFR is a synthetic rate not based on the fertility of any real group of women

→ *It measures fertility of an imaginary woman*

TFR is just a proxy of actual completed family size

→ *measured by the Total Cohort Fertility Rate (sum of the age-specific fertility rates that actually applied to each cohort as they aged through time)*

TFR is not an accurate predictor of how many children young women now will eventually have,
→ *as their fertility rates in years to come may change from those of older women now (changes in level).*

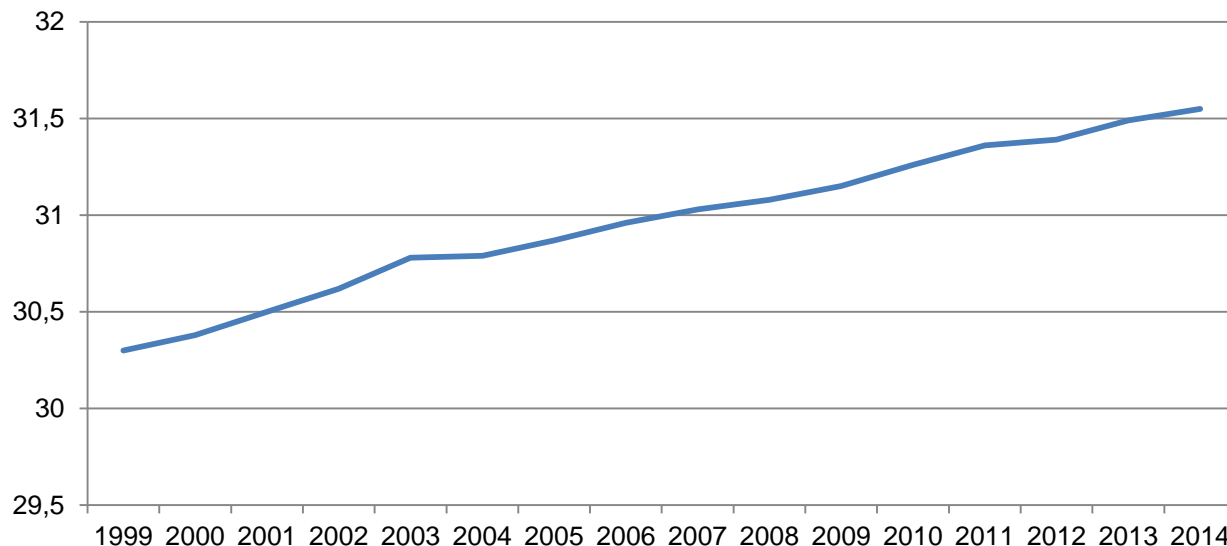TFR is affected by a tempo effect :

→ *if age of childbearing increases (and life cycle fertility unchanged) then TFR will be in a first phase lower (because the births are deferred), and then will increase (due to the deferred births occurring in the later period).*

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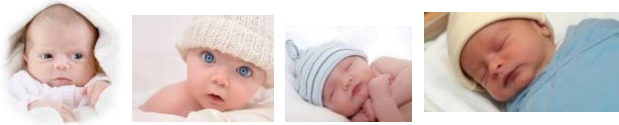
Mean age at childbearing

$$MAC_t = \Sigma_x (x+0.5) * f_{x,t} / TFR$$

Mean age at chidbearing – Italy (1999-2014)

Fertility trends in Armenia

Monitoring deaths

- Number of deaths → planning services / evaluating population dynamics
- CDR   → general trends
- Survival conditions/health conditions of population
    → to plan/monitor policies

Proxy ⟶ Life expectancy (at birth, at specific ages)

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Life expectancy

Life expectancy is a measure of the time a person is expected to live, depending on his/her age and sex.

= mean number of years of life remaining at a given age,
- assuming age-specific mortality rates remain at levels of the current year

$$e_x = (L_{x+1} + L_{x+2} + \ldots L_\omega) / l_x$$

L_x the number of person-years lived between exact ages x and x+1

l_x the number of persons surviving to exact age x

With reference to a life table

Life expectancy at birth

- Life expectancy at birth (e0) is the mean length of life of a newborn assumed to be exposed since birth until death to the mortality rates observed at a given year

- Life expectancy at birth is highly influenced by infant and child mortality rates

- Because of its sensitivity to early childhood mortality, which is itself affected by many quality-of-living factors, it is often used as an indicator of general well-being

Life expectancy

✓ As TFR, it is a <u>hypothetical measure</u>

✓ It is not a forecast, just a <u>projection of present conditions</u> into the future

✓ It is an indicator of mortality conditions and, by proxy, of health conditions

- Doesn't suffer from the effects of age and sex distribution

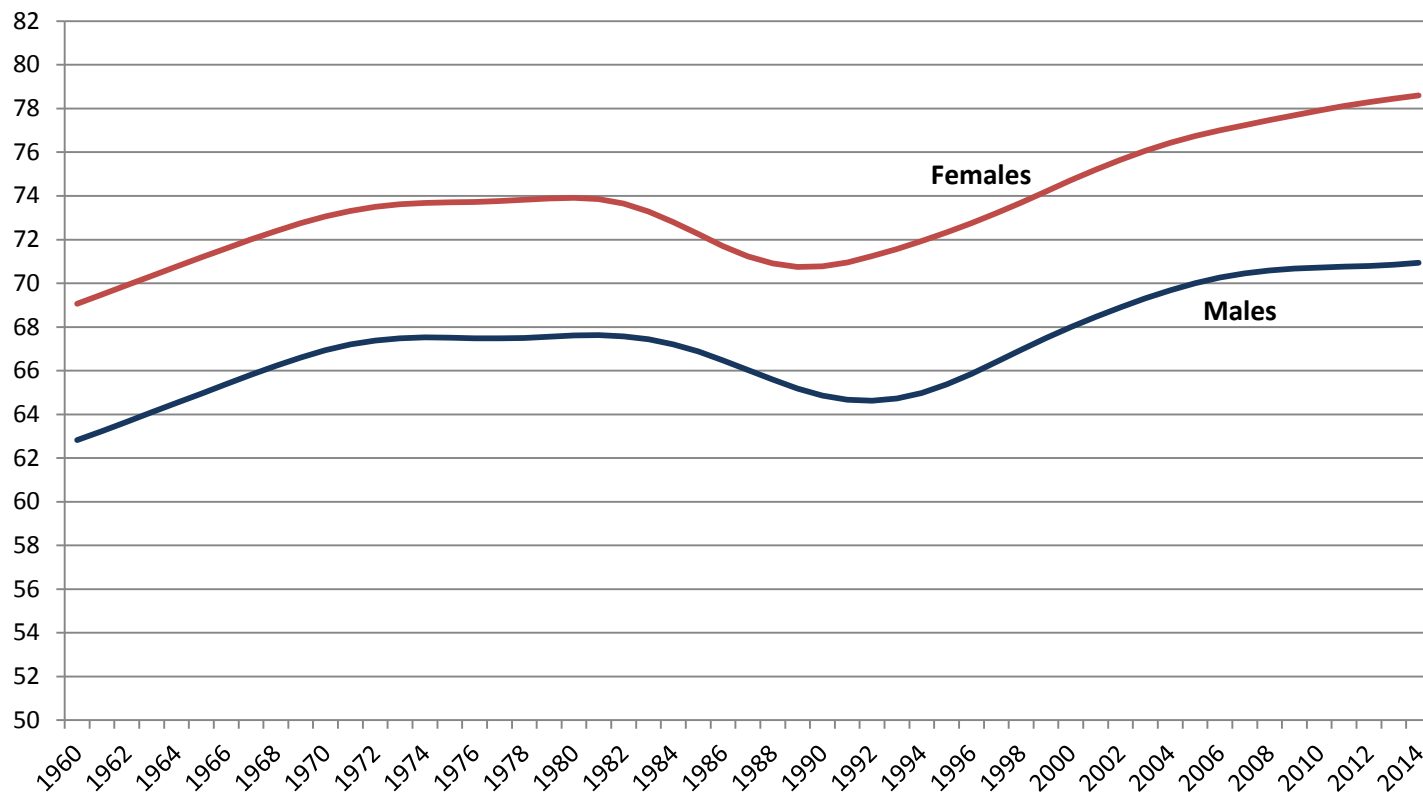- Considers specific mortality probabilities in a given year

It doesn't take into account:
- Changes in survival conditions that may occur in the future
- Differential migration effects

For more details about the calculation of a life table:
http://www.who.int/healthinfo/statistics/LT_method.pdf?ua=1&ua=1

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Life expectancy in Armenia: long period trends

Data source: World Development Indicators

Comments on data and trends?

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How to count population?

$$\text{Population}_{t+1} = \text{Stock}_t + \text{Flows}_t$$

$$\text{Pop}_{t+1} = \text{Pop}_t + \text{Births}_t - \text{Deaths}_t + \text{Immigrants}_t - \text{Emigrants}_t$$

Data sources for population stock

$$Pop_{t+1} = Pop_t + Births_t - Deaths_t + Immigrants_t - Emigrants_t$$

- Census
- Population registers

Possible issues in population count:
- Underestimation of emigrants
- Miscounting of immigrants
- Underestimation of other "difficult to count" groups (e.g. homeless, Roma,…)
- Double counting
- Misreporting of the place of residence

In census operations, it can also occur:
- Age rounding
- Memory failure for retroactive questions (e.g. when did you move to your present place of residence?)
- ….

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Data sources for population flows

$$Pop_{t+1} = Pop_t + Births_t - Deaths_t + Immigrants_t - Emigrants_t$$

- Civil register / Population register
- Special surveys
- Other administrative data

Possible issues:
- Partial coverage
- Different concepts/classification (especially when using administrative data) (e.g. resident/de facto population)
- ….

Which are the main issues in Armenia?

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Mismatches

10 years after the census, usually the yearly population estimates do not match the new census population

What to do?
- To re-adjust the 10 years series using the 2 census points
- Census data are sometimes corrected following the post-enumeration survey
- To plan long term projects to align the data sources (setting up a central population register, a continuous census)

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Population characteristics for structural indicators

- Age
- Sex
- Geographical distribution
- Marital status
- Household composition
- Ethnicity
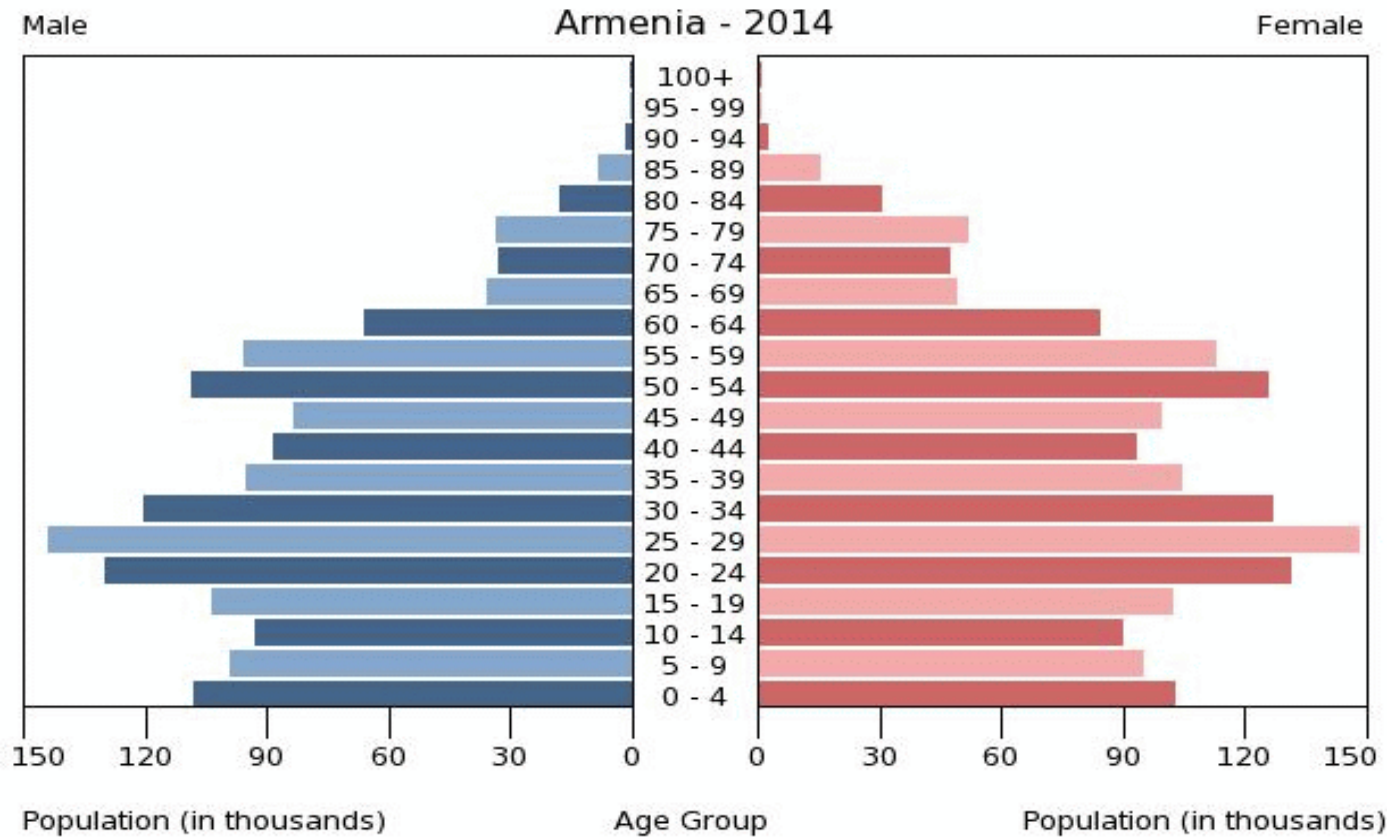- Educational level
- .....

Which indicators are currently produced and published at NSSRA?

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Population pyramid

Source: Indexmundi (CIA factbook)

A dynamic pyramid

Comparing population pyramids

Armenia - 2014 — Male / Female — Population (in thousands) / Age Group

Italy - 2014 — Male / Female — Age Group / Population (in millions)
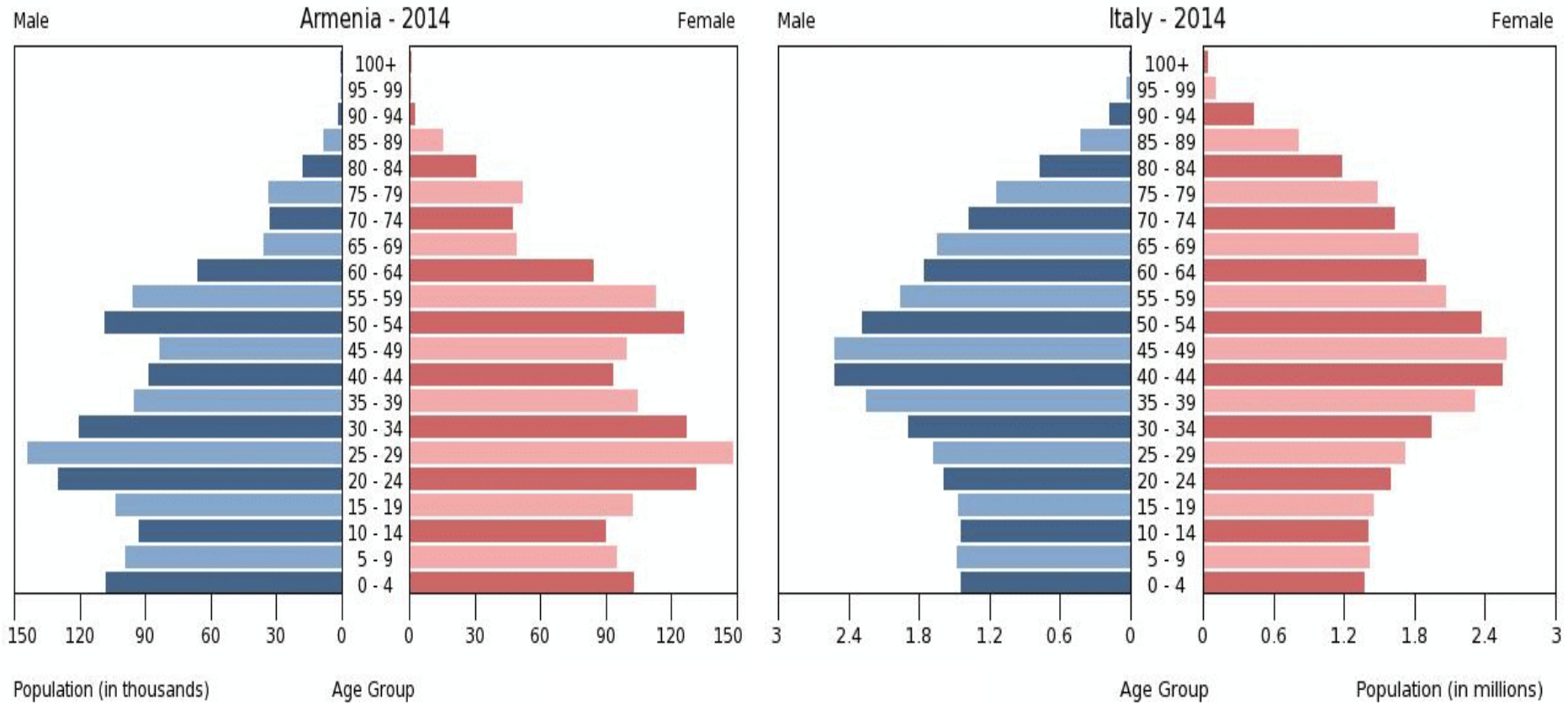
Source: Indexmundi (CIA factbook)

Comments?

Population Ageing

Increasing share and growing number of older persons in the population

✓ One of the most prominent demographic phenomenon worldwide (2015 UN Report)
http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf

✓ The number of people aged 80 years or over, the "oldest-old" persons, is growing even faster

✓ Implications for many sectors of society:
  • demand for goods and services, such as housing, transportation, health and care
  • social protection systems
  • family structures
  • labour market
  • inter-generational ties.

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Drivers of Population Ageing in Armenia

Demographic drivers	Mark (1-10)
•fertility trends	
•trends in life expectancy and probabilities of survival to old age	
•international migration	

Indicators of Population Ageing

- Mean age $\qquad \Sigma_x (x+0.5)*P_x / \Sigma_x P_x$

weighted average of the population ages

- Median age

the age that divides a population into two groups of the same size, such that half the total population is younger than this age, and the other half older.

- Ageing index $\qquad P_{65+} / P_{0-14} * 100$

number of persons aged 65 years or over per one hundred persons aged 0 to 14 years

- Old-age dependency ratio $\qquad P_{65+} / P_{15-64} * 100$

number of persons aged 65 years or over per one hundred persons aged 15 to 64 years

- Child dependency ratio $\qquad P_{0-14} / P_{15-64} * 100$

number of persons 0 to 14 years per one hundred persons aged 15 to 64 years

- Total dependency ratio $\qquad P_{0-14} + P_{65+} / P_{15-64} * 100$

number of persons under age 15 years plus persons aged 65 years or over per one hundred persons aged 15 to 64 years (sum of the child dependency ratio and the old-age dependency ratio)

- Potential support ratio $\qquad P_{15-64} / P_{65+} * 100$

number of persons aged 15 to 64 years per every person aged 65 years or over.

Indicators of population ageing for Armenia

Data sources?
Results?
Comments?

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Global frameworks including demographic indicators - MDGs

Millennium development goals (2000-2015)

6 Population-related indicators

- Under-five mortality rate
- Infant mortality rate

- Maternal mortality ratio
- Adolescent birth rate

- Incidence and death rates associated with malaria

- Proportion of urban population living in slums

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Global frameworks including demographic indicators - SDGs

Sustainable development goals (2015-2030)

15 Population-related indicators

1. Maternal mortality ratio
2. Under five mortality rate
3. Neonatal mortality rate
4. Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease
5. Suicide mortality rate
6. Death rate due to road traffic injuries
7. Adolescent birth rate
8. *Mortality rate attributed to household and ambient air pollution*
9. *Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene*
10. *Mortality rate attributed to unintentional poisoning*

Global frameworks including demographic indicators - SDGs

11. Proportion of women aged 20-24 years who were married or in a union before age 15 and before age 18

12. Proportion of urban population living in slums, informal settlements, or inadequate housing

13. *Ratio of land consumption rate to population growth rate*

14. Number of victims of intentional homicide per 100,000 population

15. Proportion of children under 5 years of age whose births have been registered with a civil authority

Metadata and data gaps for SDGs indicators - Health

http://unstats.un.org/sdgs/metadata/files/Metadata-03-04-01.pdf/

- **Maternal mortality ratio (MDG)**

The annual number of female deaths from any <u>cause related to or aggravated by pregnancy</u> or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, expressed per 100 000 live births, for a specified time period.

- **Under five mortality rate (MDG)**

The probability of a child born in a specific year or period dying before reaching the age of 5 years, if subject to age-specific mortality rates of that period, expressed per 1000 live births.

The under-five mortality rate as defined here is, strictly speaking, not a rate (i.e. the number of deaths divided by the number of population at risk during a certain period of time) but a <u>probability of death</u> derived from a life table and expressed as a rate per 1000 live births.

- **Neonatal mortality rate (MDG)**

Probability that a child born in a specific year or period will die during the first 28 completed days of life if subject to age-specific mortality rates of that period, expressed per 1000 live births.

- **Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease (NEW)**

Unconditional probability of dying between the exact ages of 30 and 70 years from cardiovascular diseases, cancer, diabetes or chronic respiratory diseases, defined as the per cent of 30-year-old-people who would die before their 70th birthday from any of cardiovascular disease, cancer, diabetes, or chronic respiratory disease, assuming that s/he would experience current mortality rates at every age and s/he would not die from any other cause of death (e.g. injuries or HIV/AIDS).

Metadata for SDGs indicators - Health

- **Suicide mortality rate (NEW)**

Number of suicide deaths in a year, divided by the population and multiplied by 100 000.

- **Death rate due to road traffic injuries (NEW)**

Number of road traffic fatal injury deaths per 100 000 population (age-standardized).

- **Adolescent birth rate (MDG)**

Annual number of births to women aged 15-19 years per 1000 women in that age group. It is also referred to as the age-specific fertility rate for women aged 15-19 years.

- ***Mortality rate attributed to household and ambient air pollution (NEW)***

No metadata received on current indicator formulation

- ***Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (NEW)***

No metadata received on current indicator formulation

- ***Mortality rate attributed to unintentional poisoning (NEW)***

No metadata received on current indicator formulation

Metadata for SDGs indicators - Health

- **Proportion of women aged 20-24 years who were married or in a union before age 15 and before age 18 (NEW)**

It is calculated by dividing the number of women aged 20-24 who were first married or in union by age 18 by the total number of women aged 20-24 in the population.

- **Proportion of urban population living in slums, informal settlements, or inadequate housing (NEW)**

Proportion of people living in households lacking at least one of the following five housing conditions: access to improved water; access to improved sanitation facilities; sufficient-living area (not overcrowded); durable housing; and security of tenure.

- ***Ratio of land consumption rate to population growth rate (NEW)***

No metadata received on current indicator formulation

- **Number of victims of intentional homicide per 100,000 population (causes of death / justice records) (NEW)**

Defined as the total count of victims of intentional homicide divided by the total resident population, expressed per 100,000 population.

- **Proportion of children under 5 years of age whose births have been registered with a civil authority (NEW)**

It is calculated by dividing the number of children under the age of five whose births are reported as being registered with the relevant national civil authorities by the total number of children under the age of five in the population.

Conclusions

A lot to do….

…and thank you for your attention

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