The lowest mortalities

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I N E D

MSE
Mortalité Santé Épidémiologie

Objectives

- To calculate life expectancy resulting of the lowest mortality rates by age and cause of death observed in any countries with reliable data
- To compare trends in observed national values to the lowest values at the same time
- To discuss the predictive value of such indicator

Data

- WHO data base on death by causes
- Includes all available data since 1950
- Gives deaths by five-year age groups and by ICD items
- Age groups are : 0, 1-4, 5-9, 10-14, … 80-84, 85+
- Causes of death are given according to short or intermediate lists of ICD-6, ICD-7, ICD-8, and ICD-9, and by fully-detailed items of ICD-10

Selection of countries

- Every country of more than 5-million population in 1950 from North America, Europe (except former communist countries), and Oceania, plus Japan
- Including 15-16 countries: Canada and the USA; Austria, Belgium, France, Germany (FRG, then Germany), Greece, Italy, the Netherlands, Portugal, Spain, Sweden, and the UK; Australia; Japan
- Excluding: Denmark, Finland, Ireland, Norway, Switzerland, etc. (too small); Poland, Hungary, Czech Rep., Romania, etc. (central former communist countries of central Europe); countries of former Yugoslavia and the former USSR; and all developing countries

Selection of groups of causes of death

- 12 groups:
  - 1 Infectious diseases
  - 2 Cancer of stomach
  - 3 Cancer of the respiratory system
  - 4 Cancer of breast
  - 5 Cancer of uterus
  - 6 Other neoplasms
  - 7 Heart diseases
  - 8 Other diseases of the circulatory system
  - 9 Diseases of the respiratory system
  - 10 Other diseases
  - 11 Suicide
  - 12 Other external causes

  Most important statistical disruptions avoided but some minor ones persisting

Method

Using WHO five-year age group standard population for Europe: p_x^s

Compute five-year age group mortality rates all causes (m_x) and by cause ($m_{x,i}$), for each country

Compute SDR for all causes and by cause ($m_{x,i}$), to obtain SDR, for each country:

SDR all causes:

$$SDR = \frac{\sum_x m_x \cdot p_x^s}{\sum_x p_x^s}$$

SDR by cause:

$$SDR(i) = \frac{\sum_x m_{x,i} \cdot p_x^s}{\sum_x p_x^s}$$

Four possible minimizations of the standardized death rate

A) Without taking in account causes of death:

1. The minimum standardized death rate (the best country) :

$$\min SDR = \min\left[\frac{\sum_x m_x \cdot p_x^s}{\sum_x p_x^s}\right]$$

2. The standardized death rate using the minimum age specific death rates:

$$SDR[\min A] = \frac{\sum_x \min(m_x) \cdot p_x^s}{\sum_x p_x^s}$$

A) Taking in account causes of death:

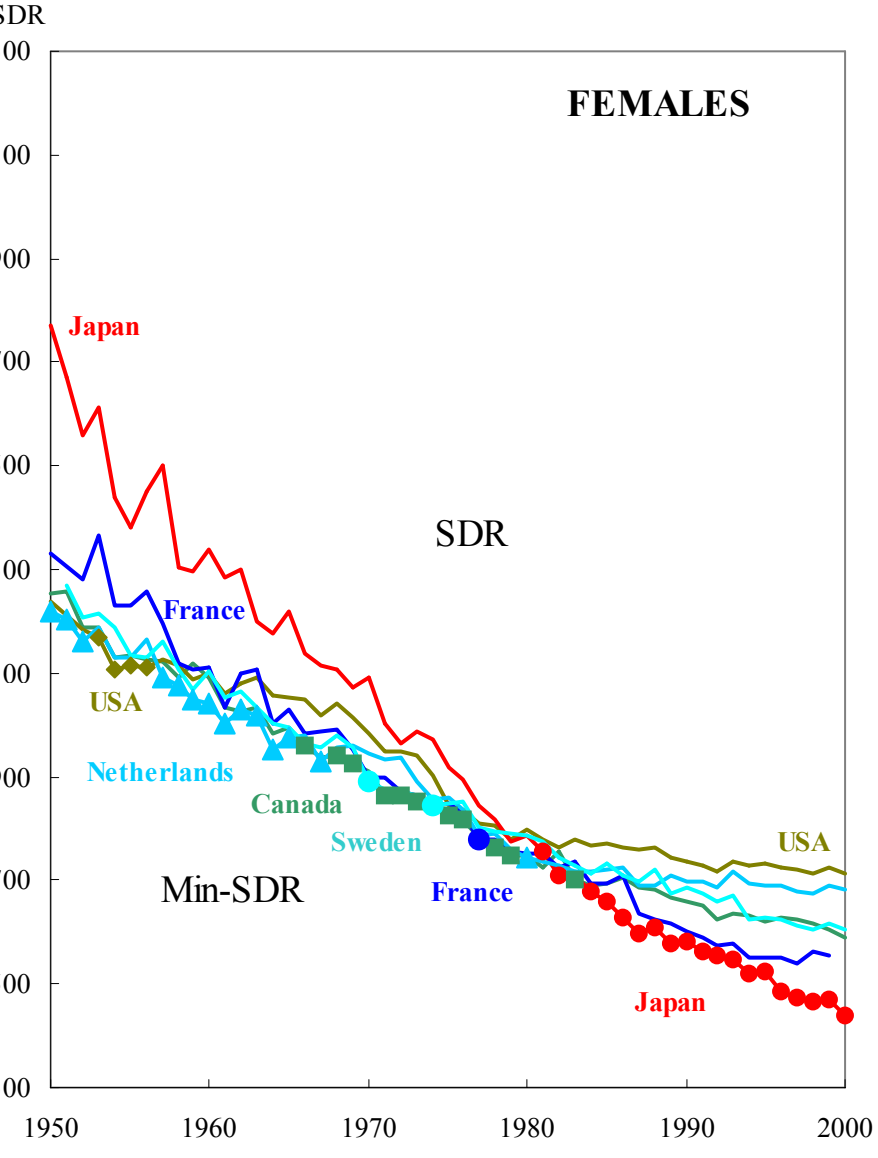
3. The sum of the best standardized rates by cause (the best country for each cause):

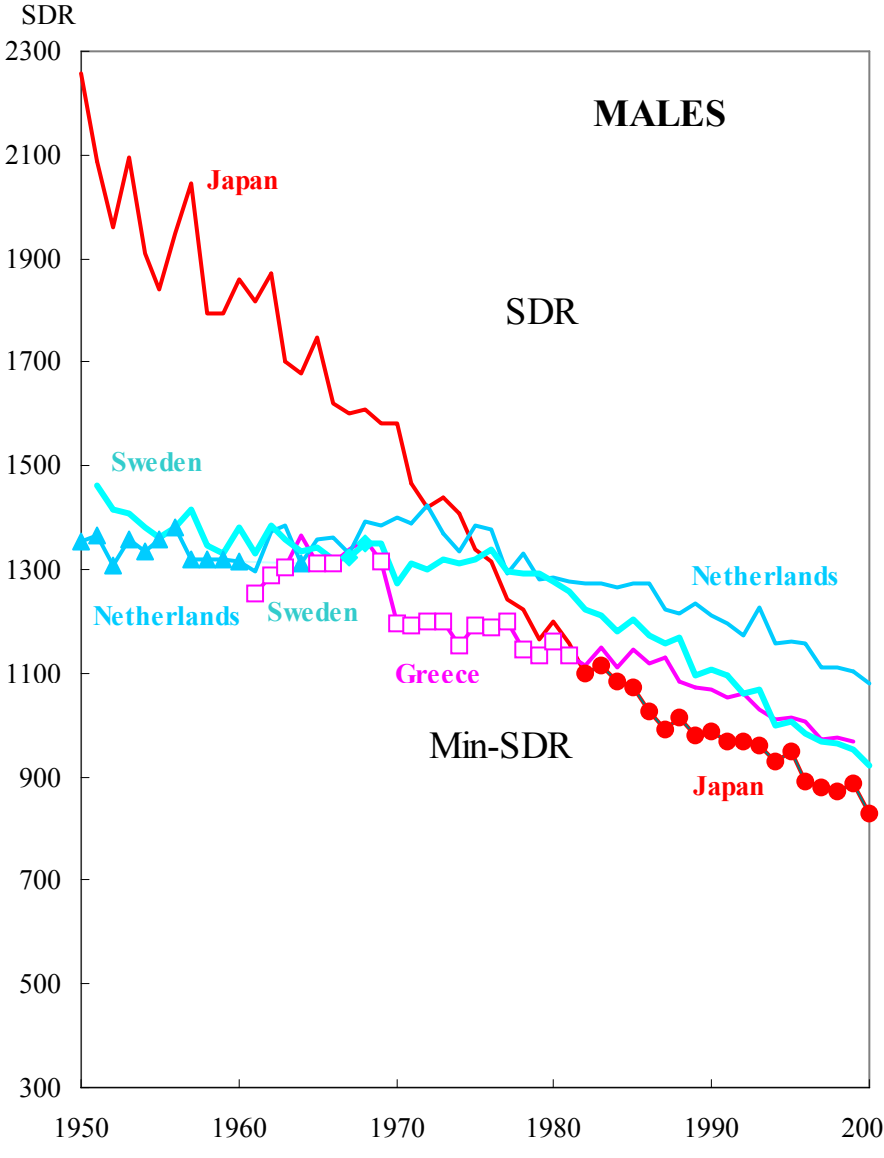
$$SDR[\min C] = \sum_i \min\left[\frac{\sum_x m_{x,i} \cdot p_x^s}{\sum_x p_x^s}\right]$$

4. The standardized death rate using the minimum age- and cause-specific mortality rates:

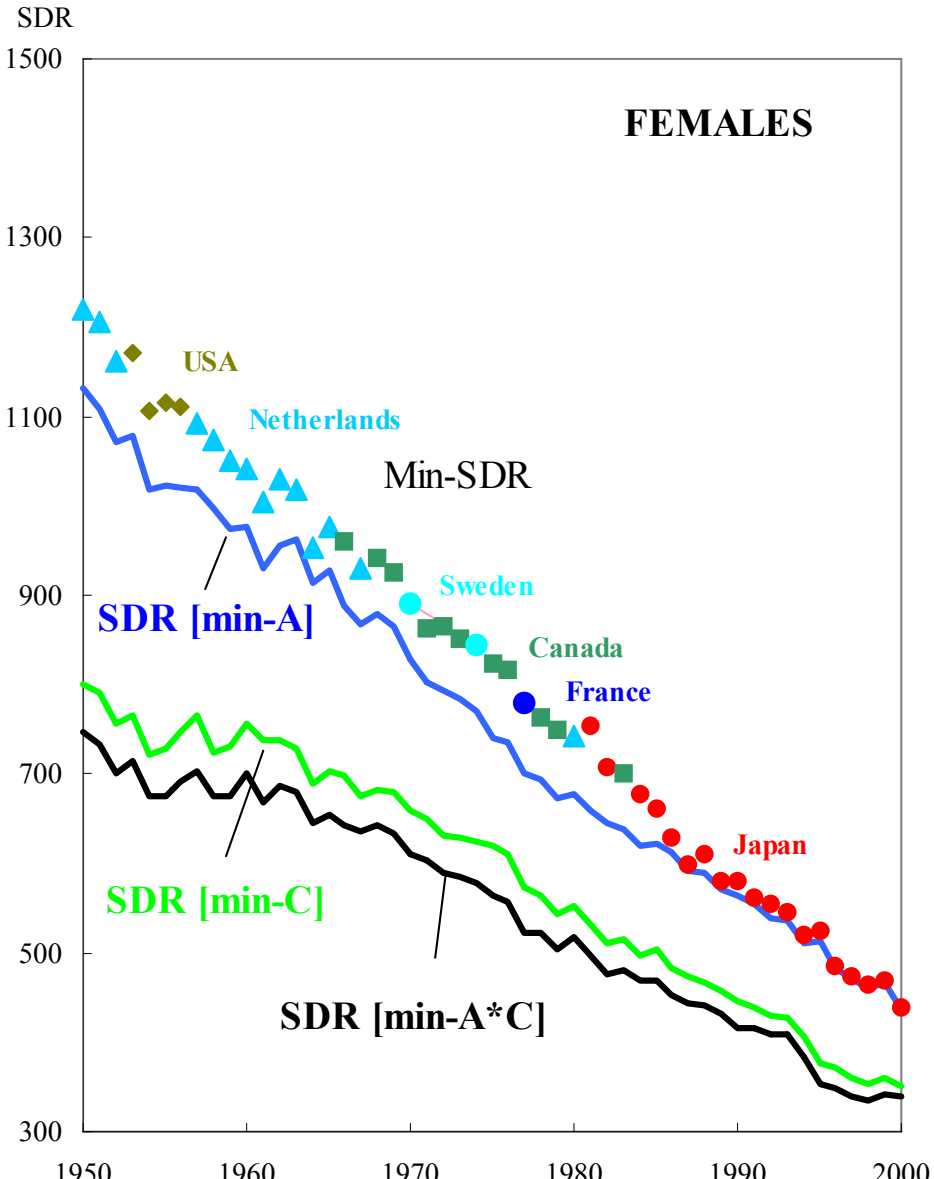
$$SDR[\min A*C] = \sum_i \frac{\sum_x \min(m_{x,i}) \cdot p_x^s}{\sum_x p_x^s}$$

Lowest age standardized mortality rates (Min-SDR) and trends in contributing countries 1950-2000





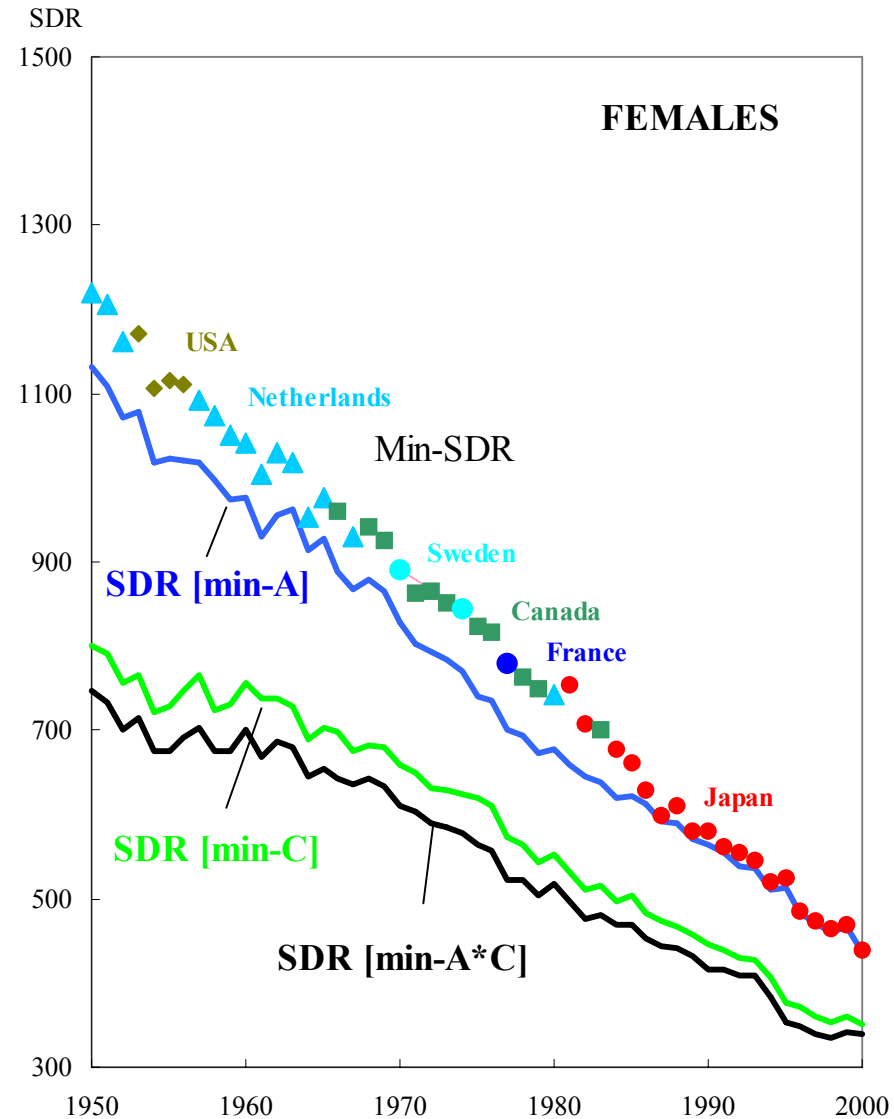
Lowest age-specific death rates and age-and-cause-specific death rates

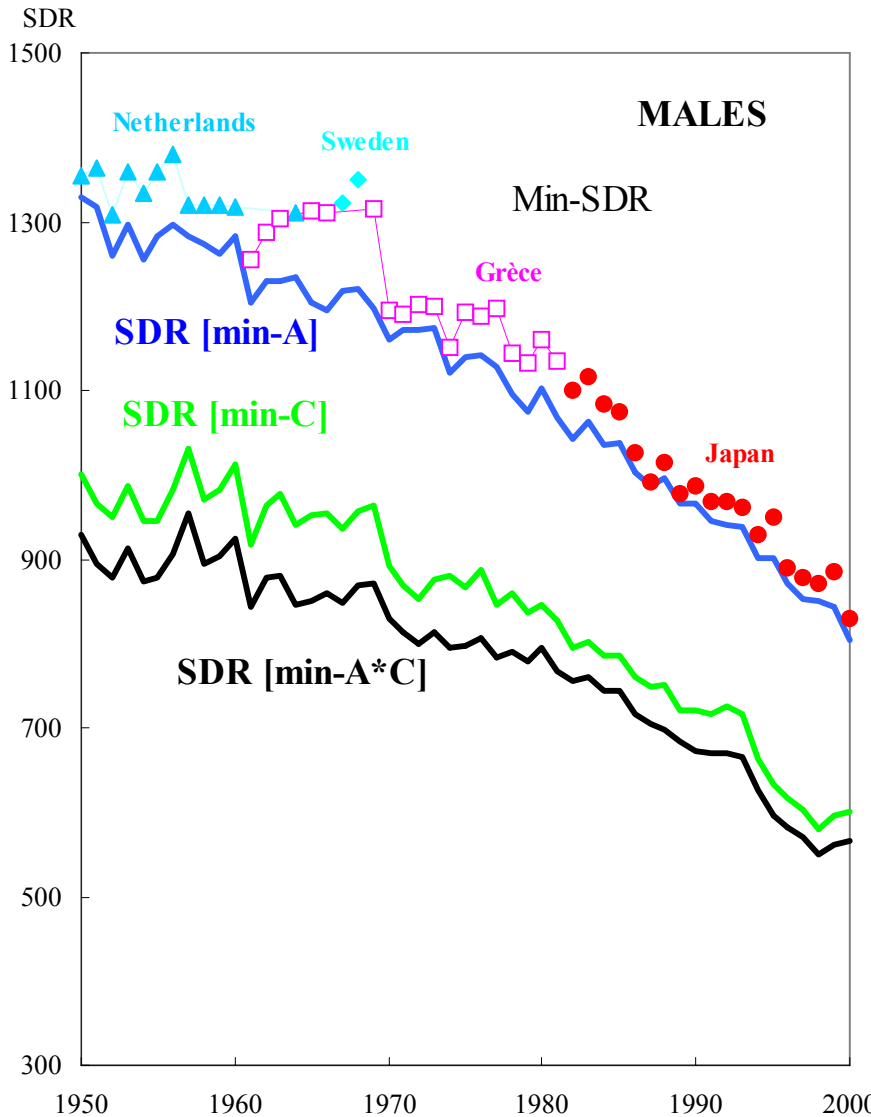


Small effect of age,

Much greater effect of cause

Lowest age-specific death rates and age-and-cause-specific death rates





Reducing the number of causes to 3 large groups

2 Cancer of stomach
3 Cancer of the respiratory system
4 Cancer of breast
5 Cancer of uterus
6 Other neoplasms

I. Neoplasms

7 Heart diseases
8 Other diseases of the circulatory system

II. Diseases of the circulatory system

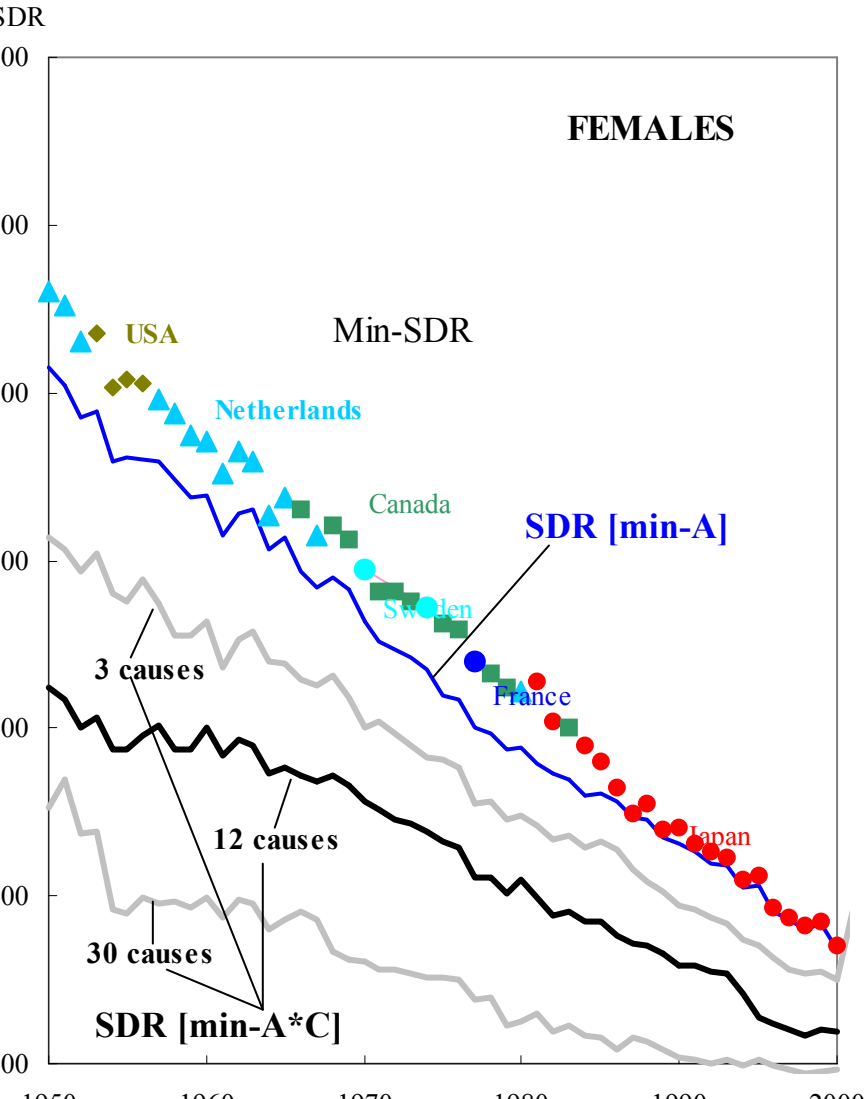
1 Infectious diseases
9 Diseases of the respiratory system
10 Other diseases
11 Suicide
12 Other external causes

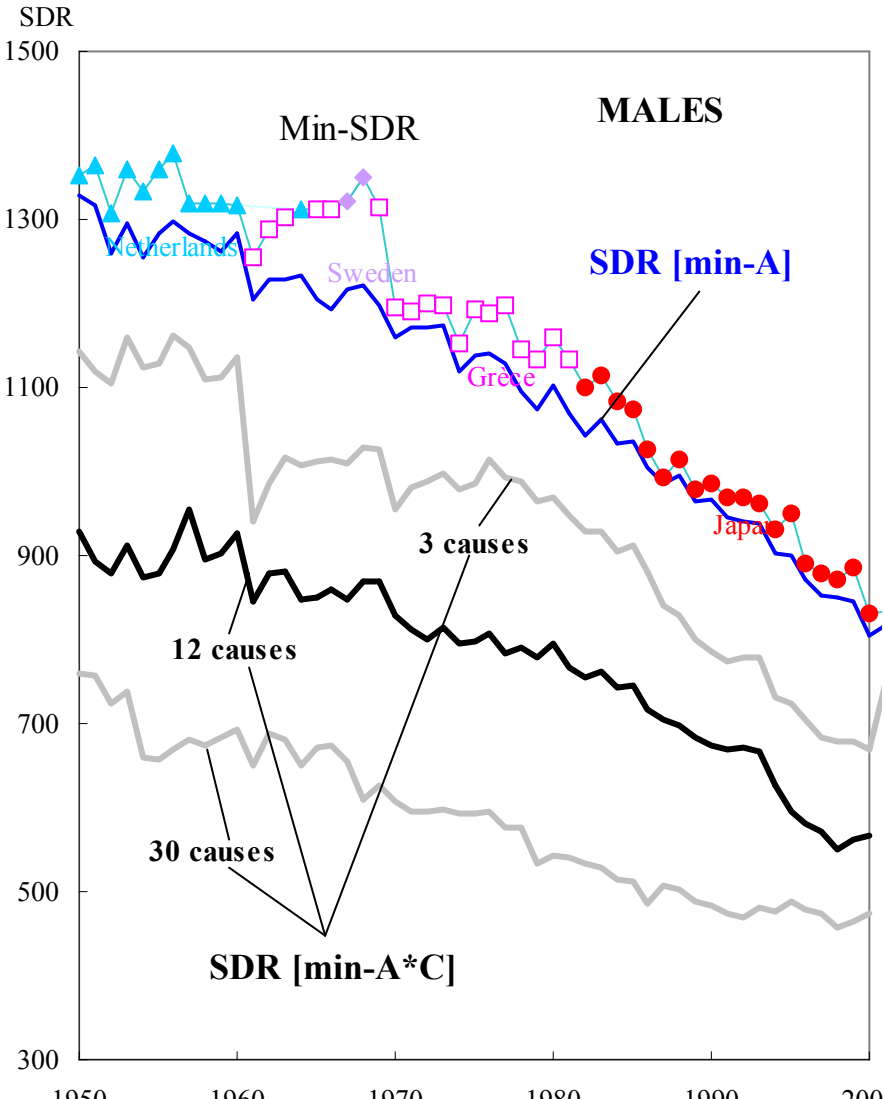
III. All other causes

Increasing the number of causes to 30 groups

- **Infectious diseases: split into 2 (Tuberculosis; Others)**
- **Cancer of stomach**
- **Cancer of the respiratory system**
- **Cancer of breast**
- **Cancer of uterus**
- **Other neoplasms: split into 7 (Intestine; Other digestive; Prostatis; Skin, bones etc.; Other genito-urinary; Blood etc.; Others)**
- **Heart diseases: split into 2 (IHD; Others)**
- **Other diseases of the circulatory system: split into 2 (Cerebrovascular; Others)**
- **Diseases of the respiratory system: split into 2 (Acute; Others)**
- **Other diseases: split into 6 (Nervous system; Digestive system; Genito-urinary system; Pregnancy, etc.; Perinatal, etc.; Others)**
- **Suicide**
- **Other external causes: split into 4 (Transport accidents; Falls; Homicide; Others)**

Lowest age-specific death rates and age-and-cause-specific death rates



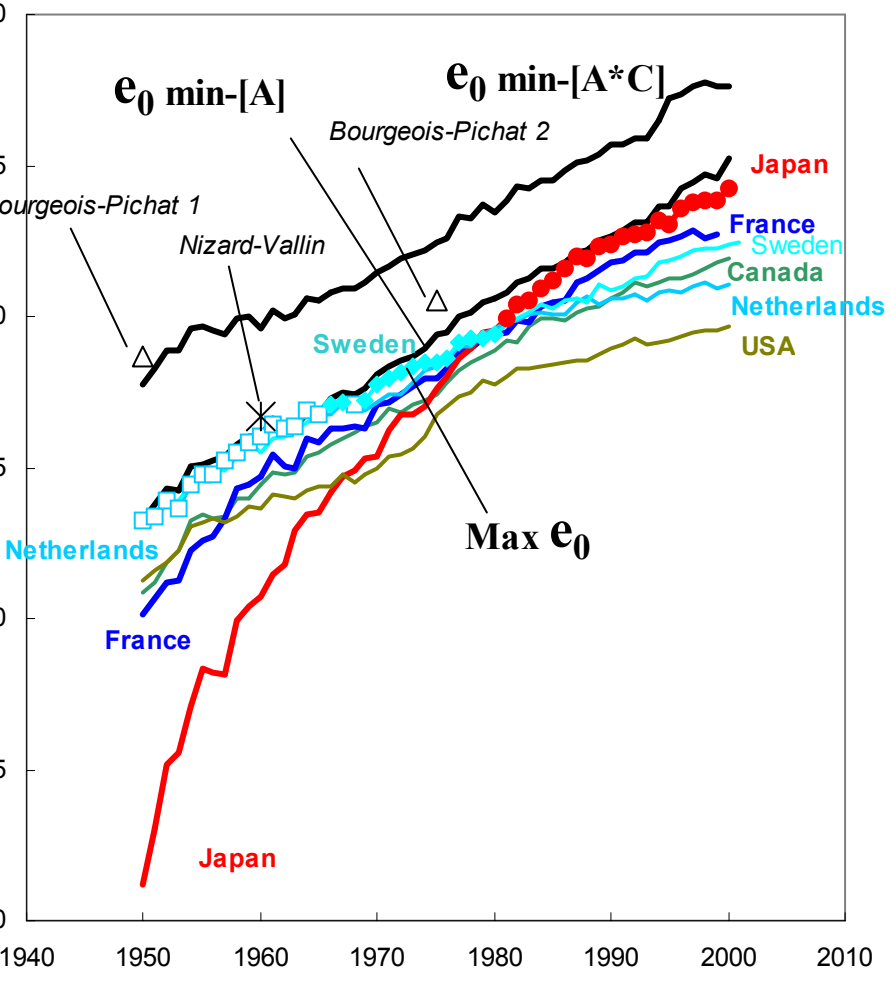


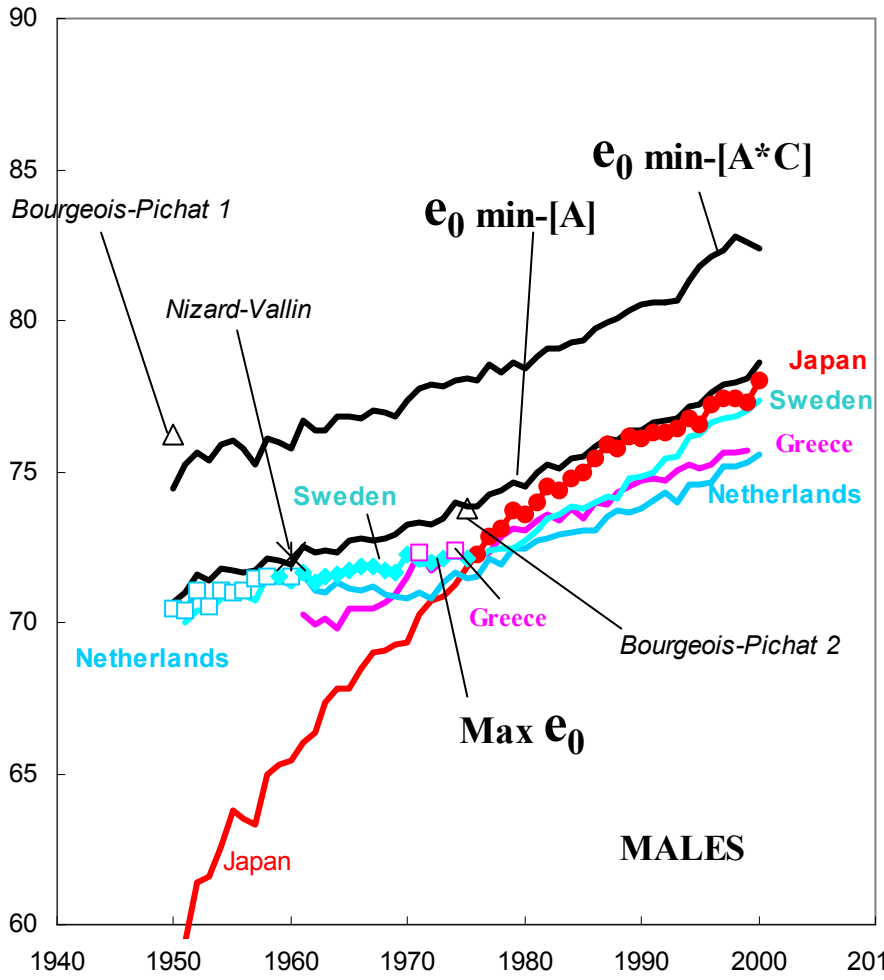
Computing life tables

- Using quinquennial m_x to estimate quinquennial q_x, from 0 to 85

- Estimating life expectancy at 85 on the basis of the mortality rate at 85+ through model life tables and stable populations of Coale and Demeny

Life expectancy at birth according to the lowest mortalities





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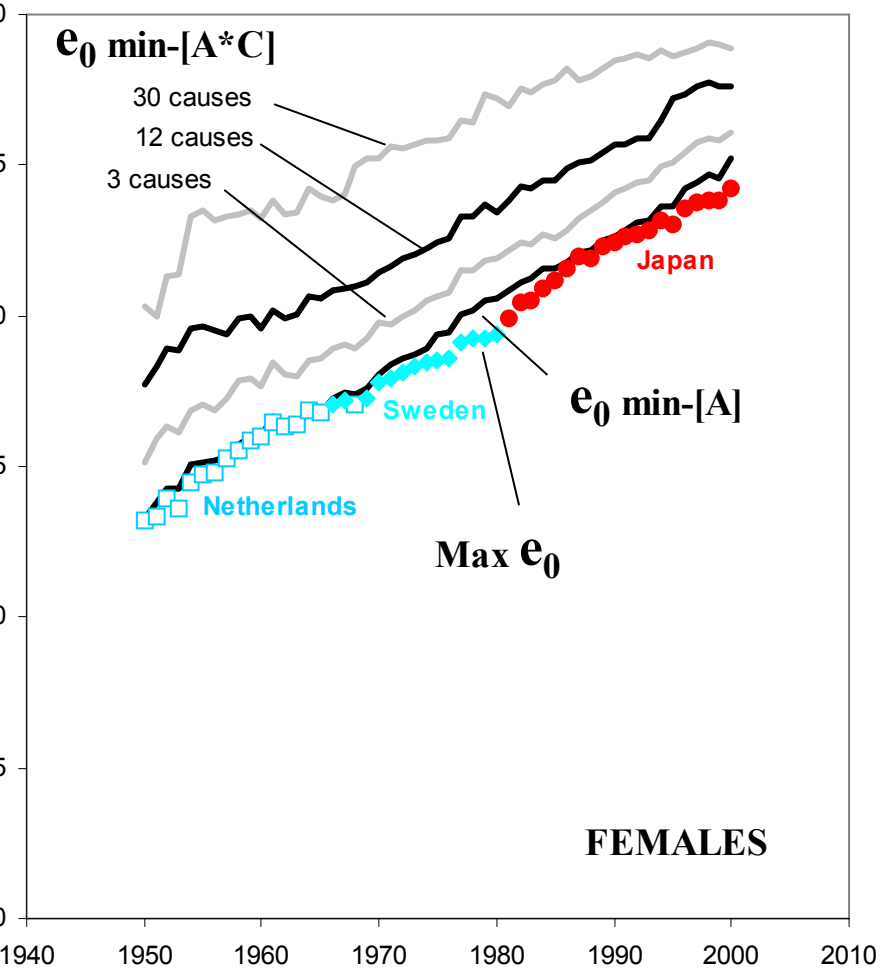
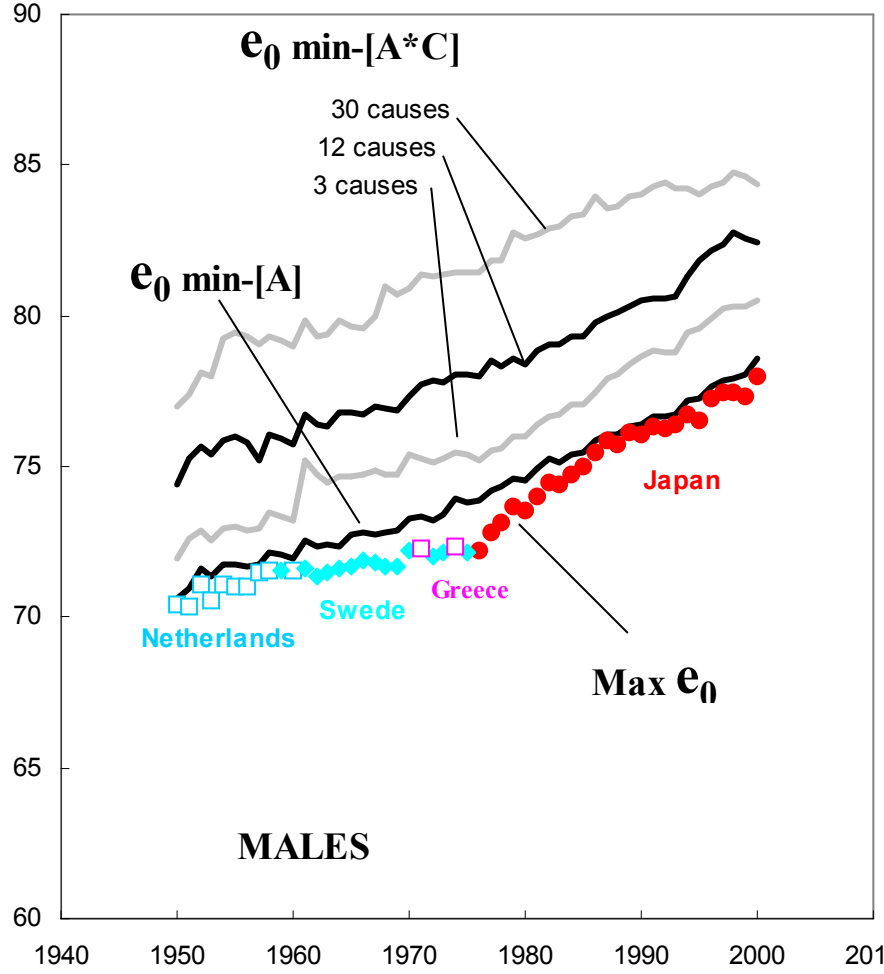




Possible gains in 2000

Indicator		Females		Males	
		e0	gain	e0	gain
Max e0 (Japan)		84.2		78.0	
e0 min A		85.2	1.0	78.6	0.6
	3 c	86.1	1.9	80.5	2.5
e0 min A*C	12 c	87.6	3.4	82.4	4.4
	30 c	88.9	4.7	84.4	6.4

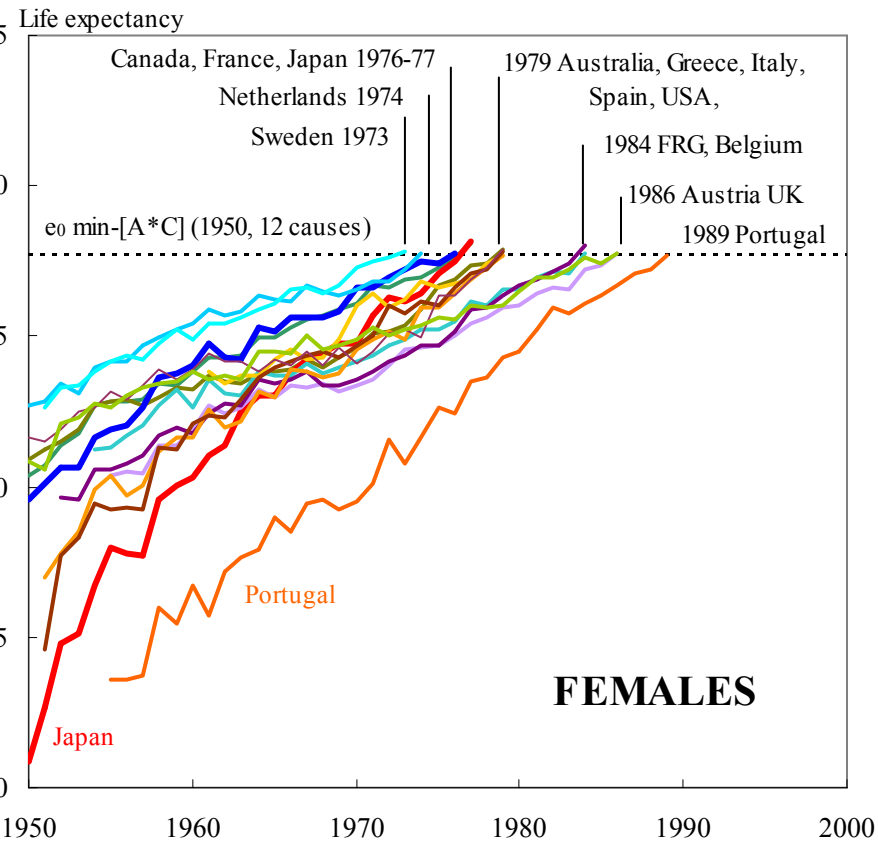
Is it realistic to consider life expectancy at birth according to the lowest mortalities by age and cause?

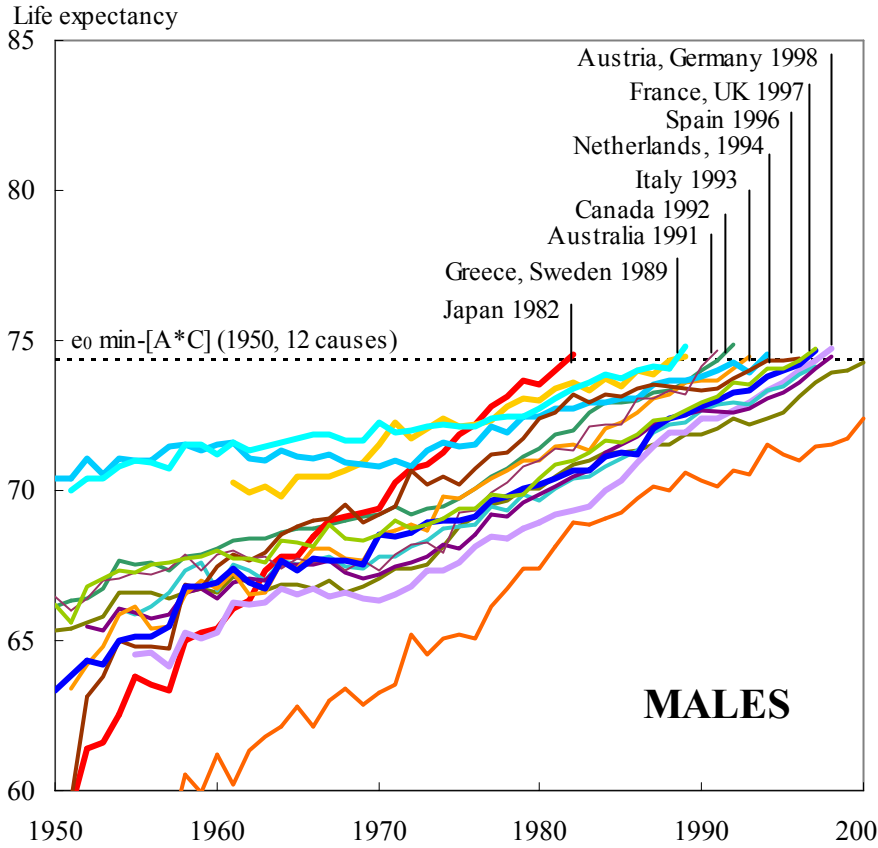
Probably not because:

1. Each country has a specificities which could not be replicated in others
2. In some countries, some cause-specific rates are biaised by misclassification
3. Mortality rate for one cause is not independant of mortality for the other causes

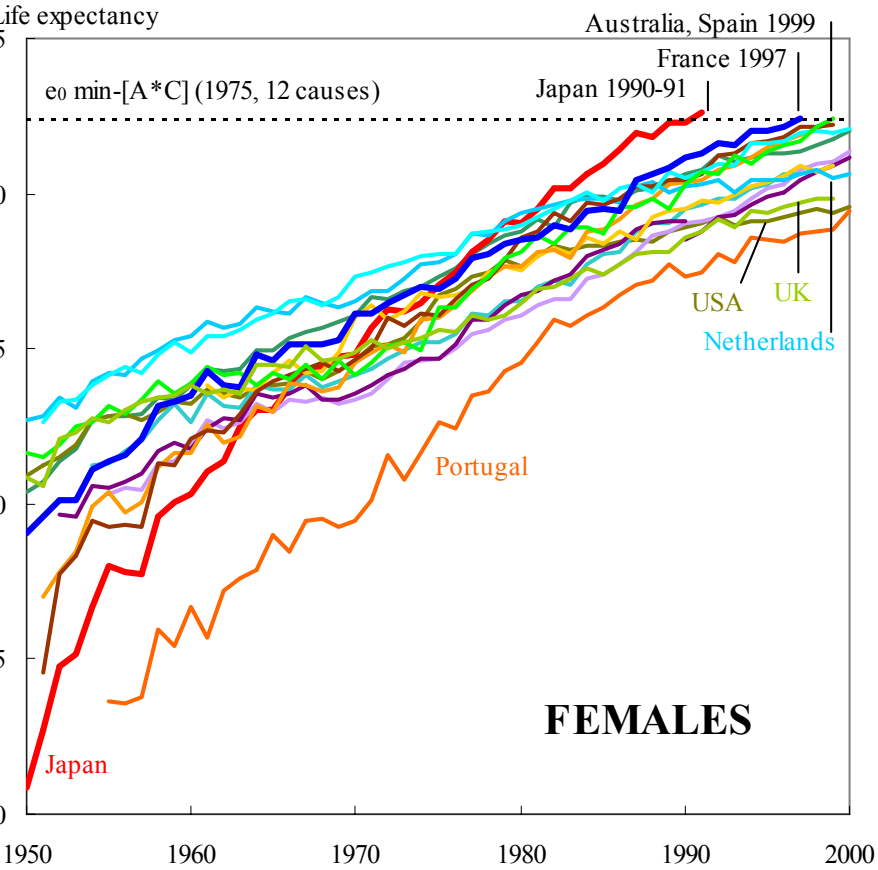
However…

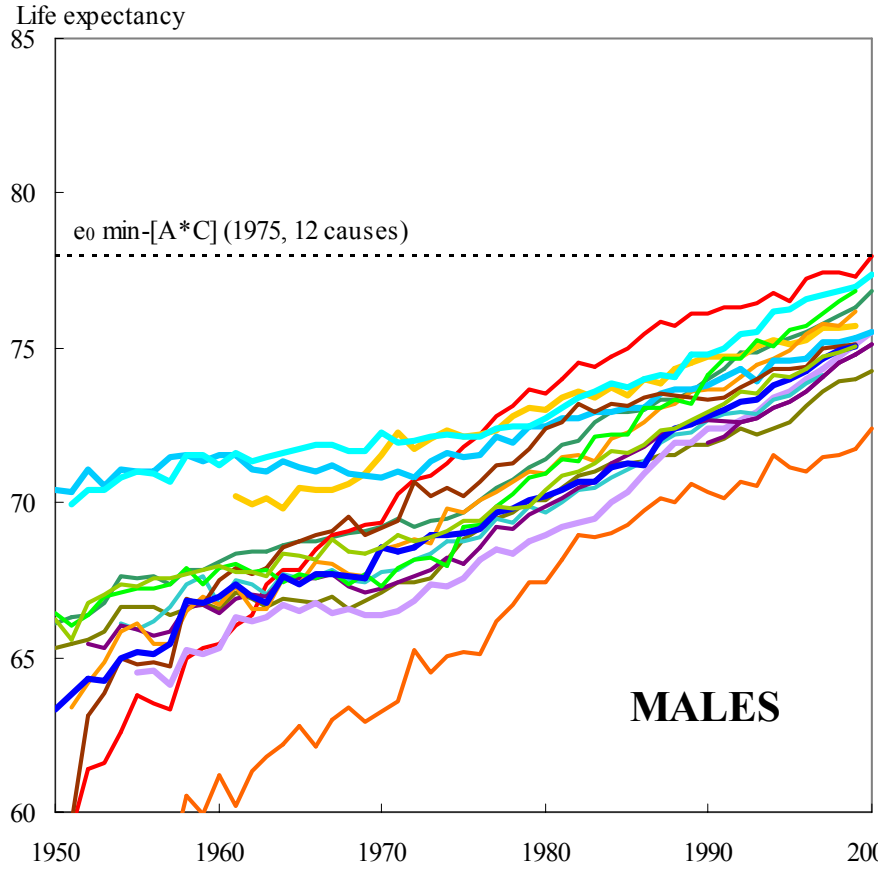
Actual life expectancy trends by country from 1950 to the year where they reach the 1950 level of lowest mortalities by cause



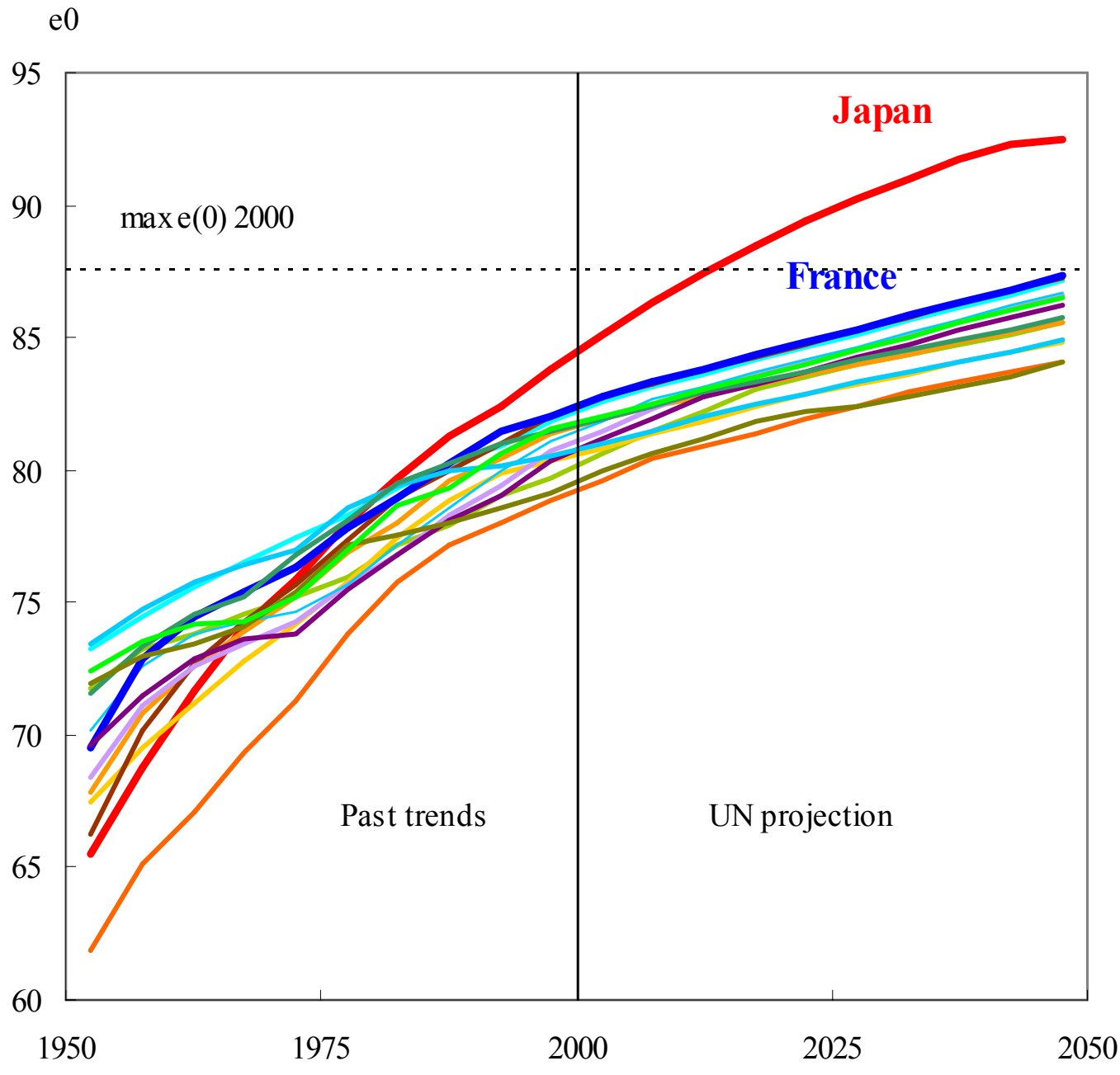


Actual life expectancy trends by country from 1950 to the year where they reach the 1975 level of lowest mortalities by cause





Actual life expectancy trends and UN projection by country as compared to the 2000 level of lowest mortalities by cause



Conclusion 1

On one side:

It's mainly a game, but an exciting one and we could play more at many different levels:

- geography: more countries,
  sub-national regions;
- social classes;
- causes-of-death grouping;
- lowest seasonnal mortality;
- etc.

Conclusion 2

On the other side:

Lowest mortality can also be used as a predictor:

- 25 years later, the lowest mortality can be reached by the most advanced countries;
- we could also use observed trends in lowest mortality to project this indicator in the future and to use the result as a possible long term target for national mortality projections.

Thanks for attention!

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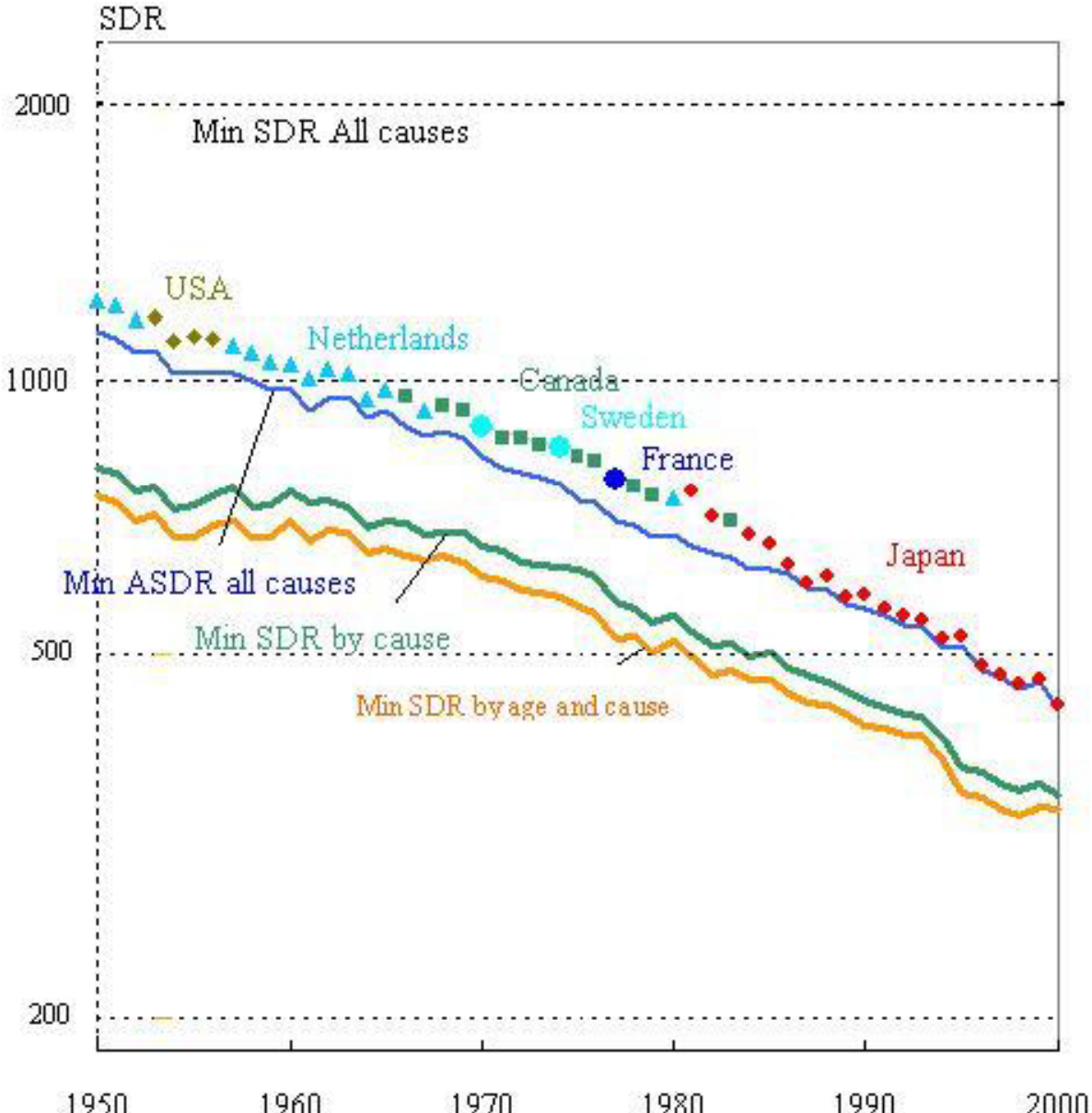
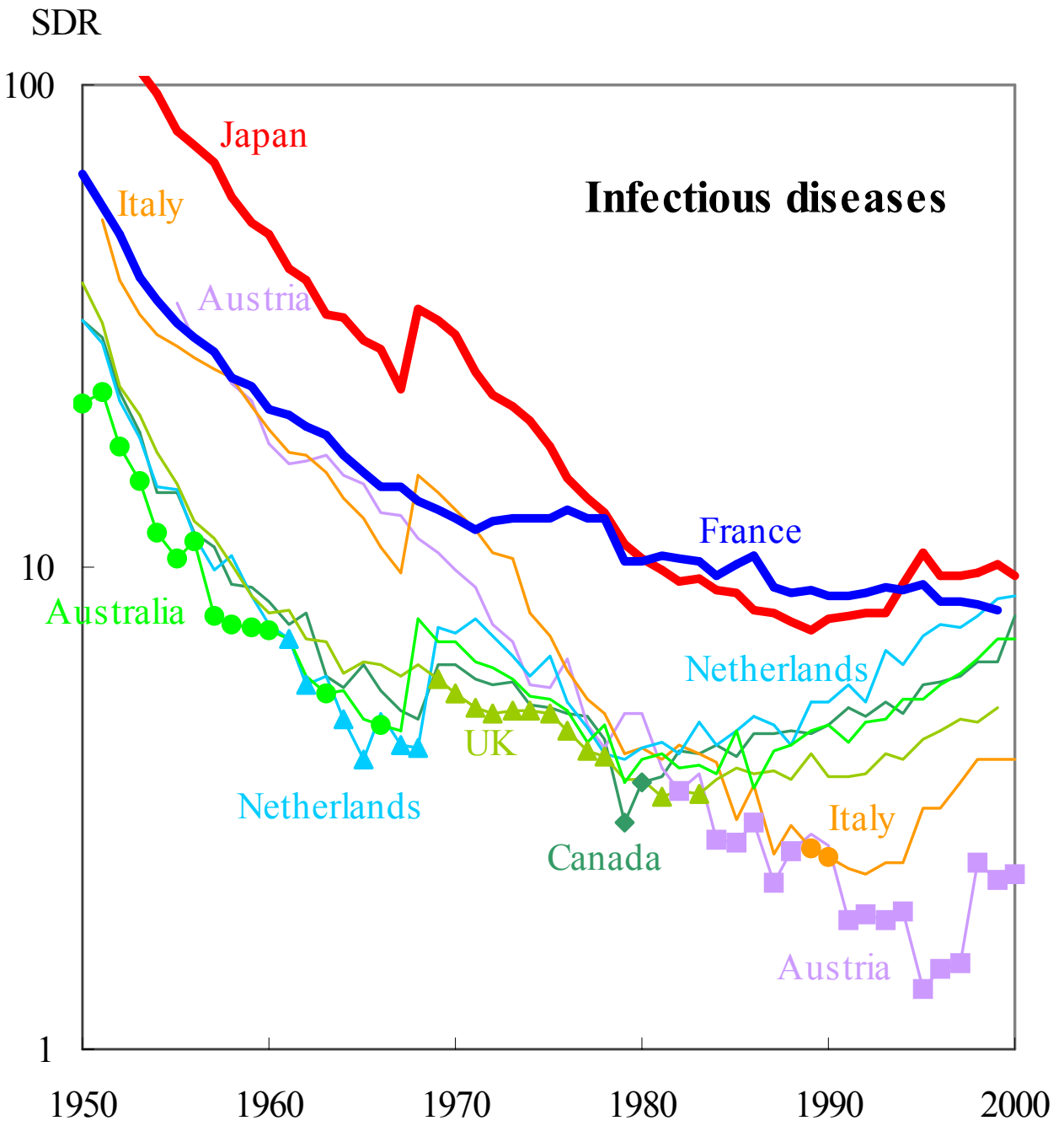
Lowest mortalities : log scale

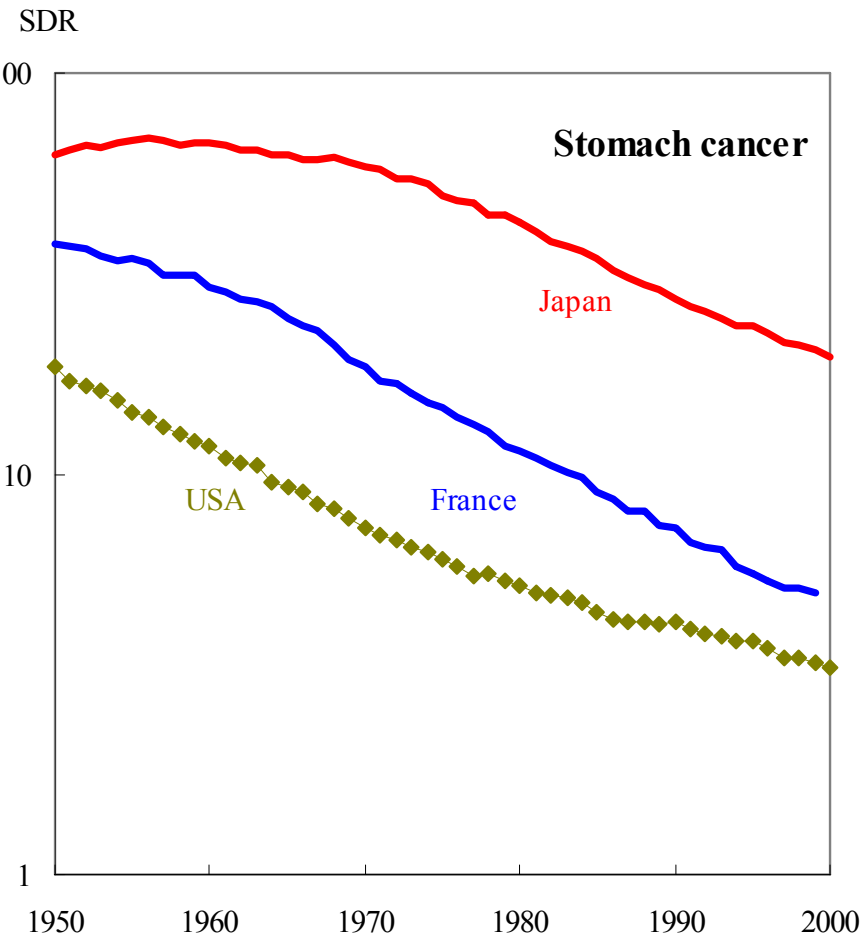


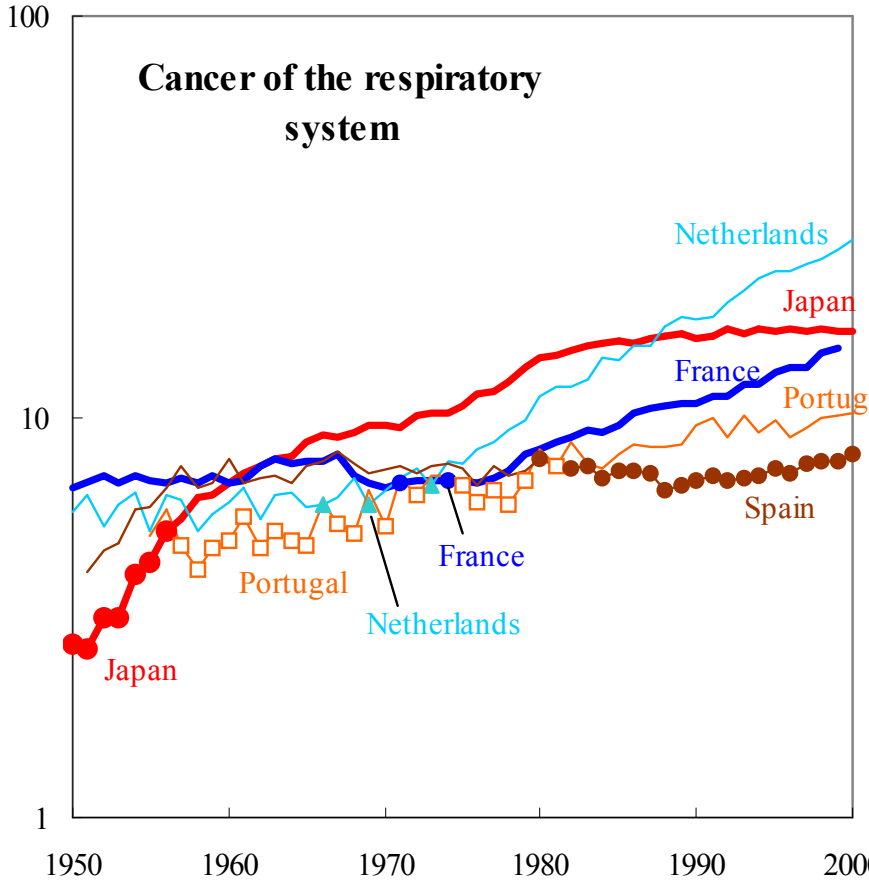
Log scale shows that the reduction of the lowest mortality rates accelerates, especially when measured by cause of death

Lowest SDR by cause: infectious diseases



Lowest SDR by cause: neoplasms





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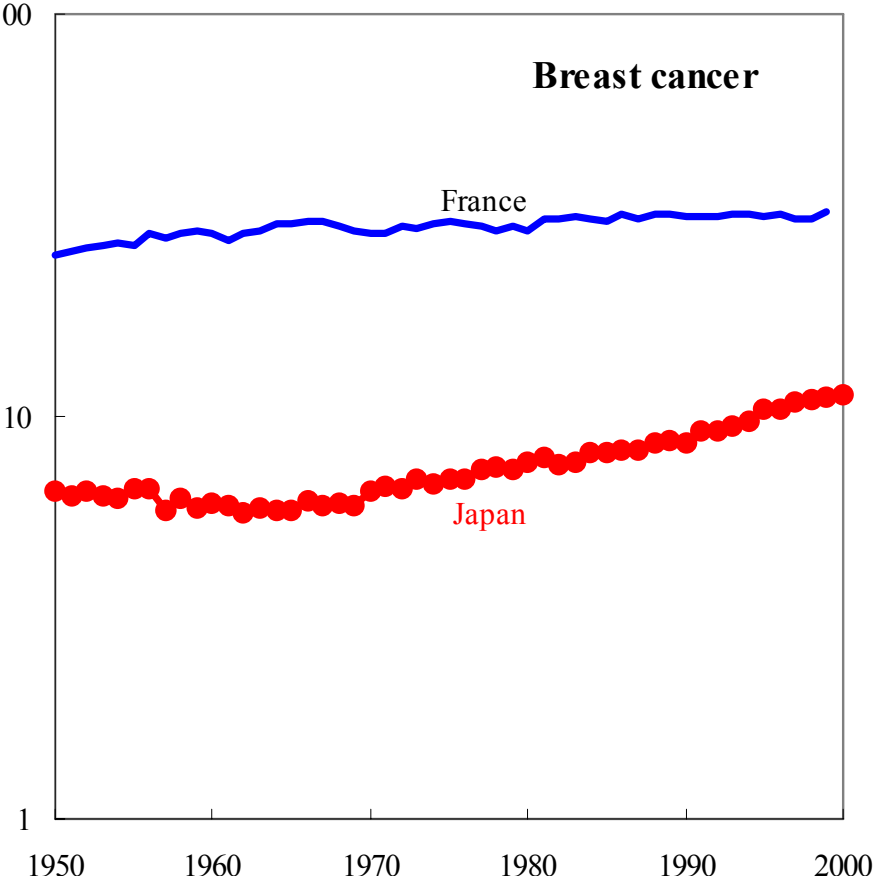
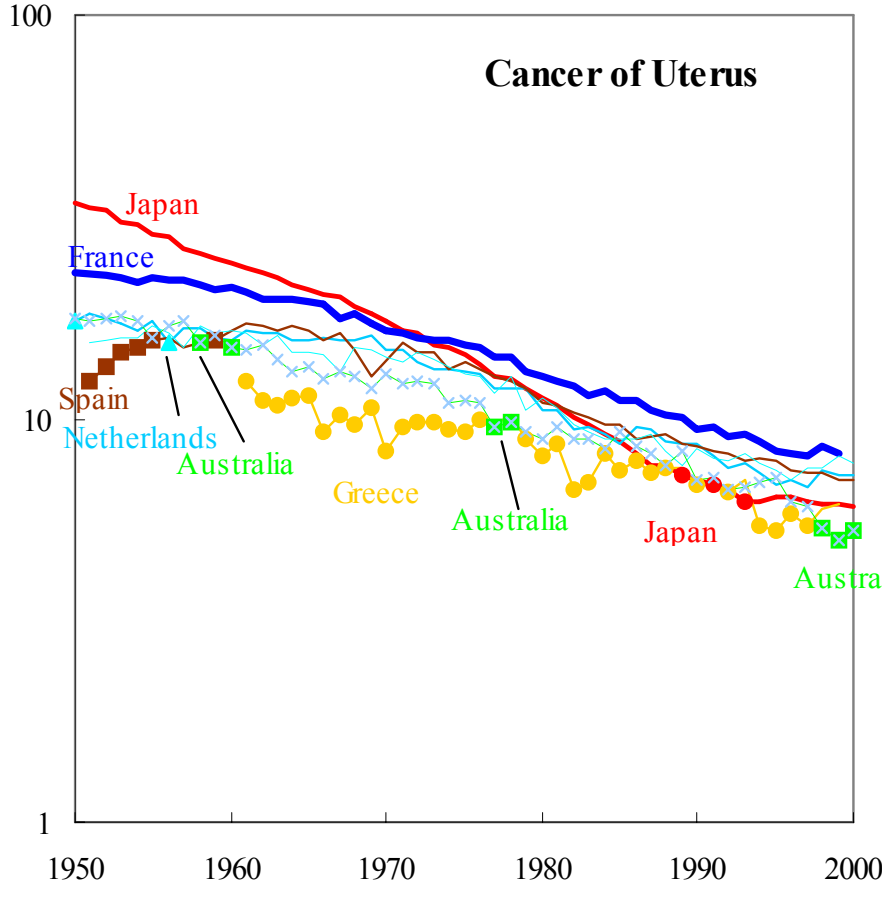
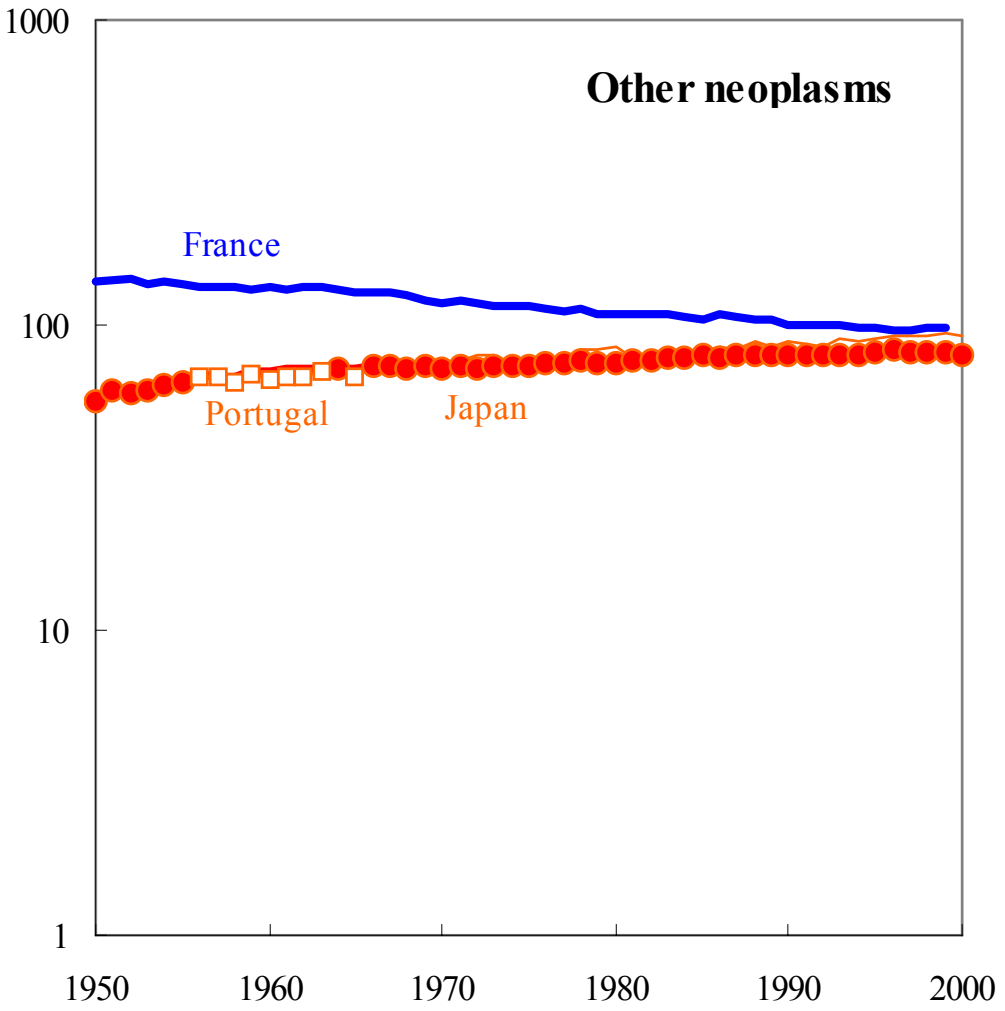
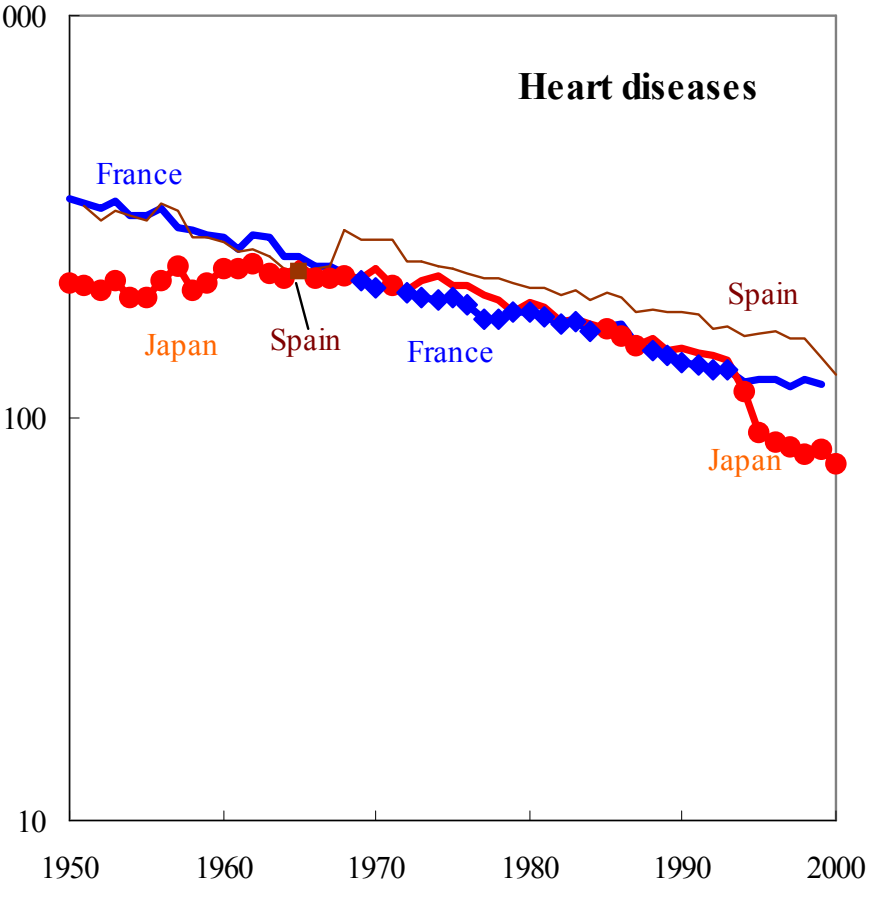


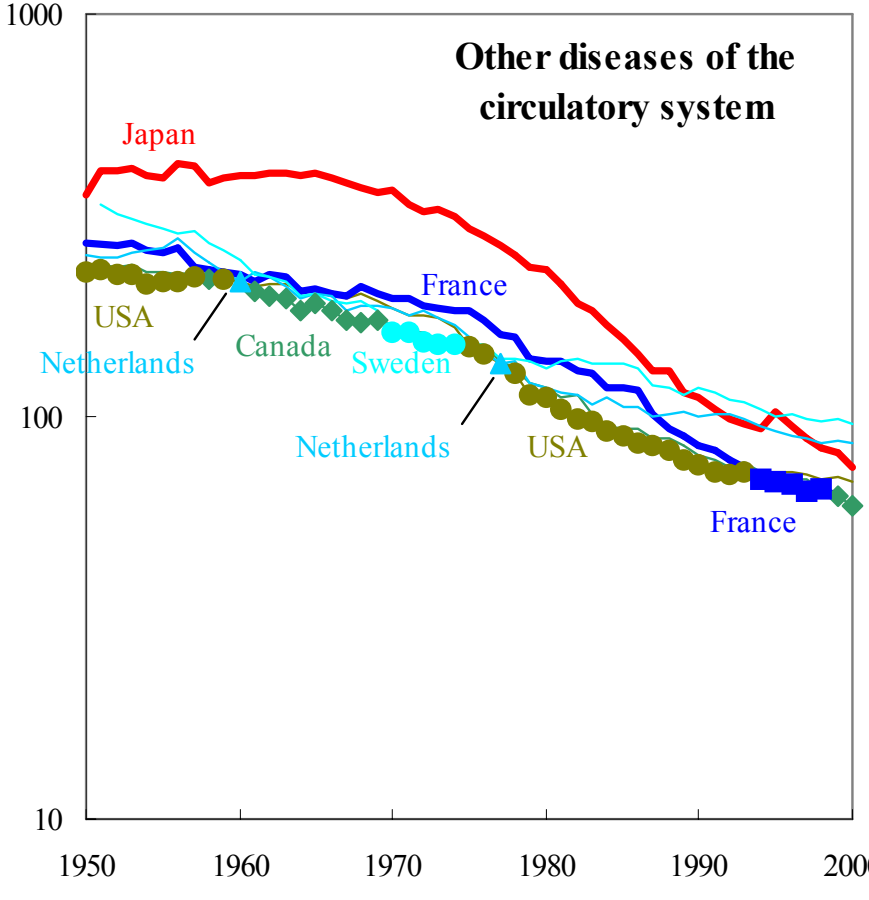


Lowest SDR by cause: neoplasms

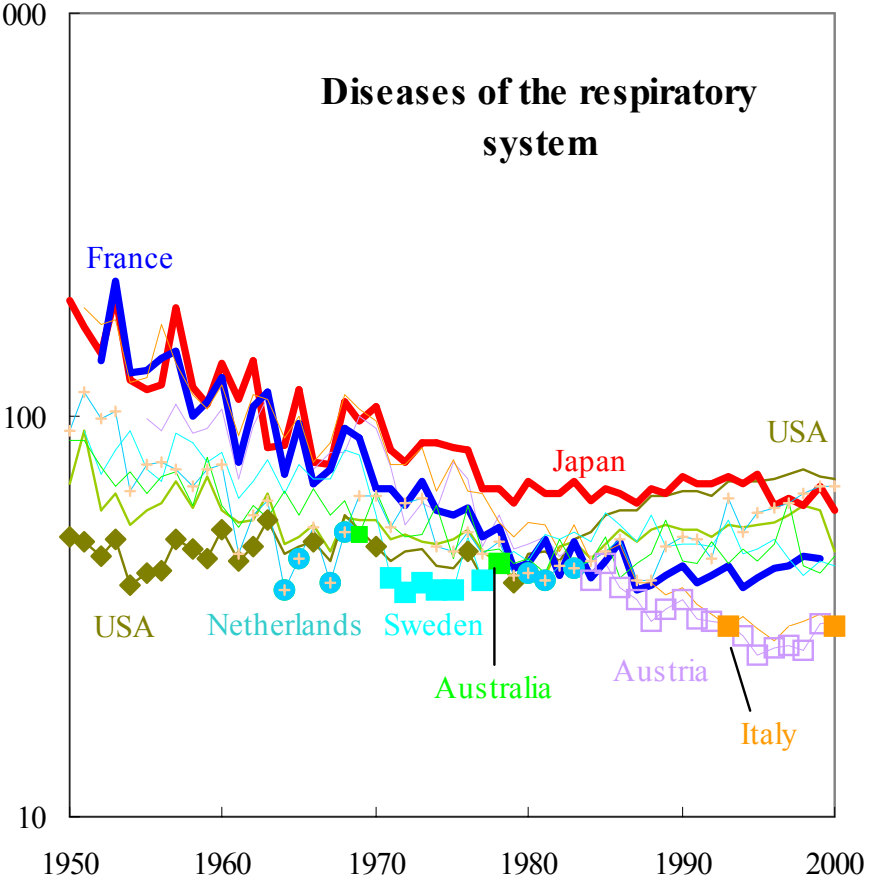


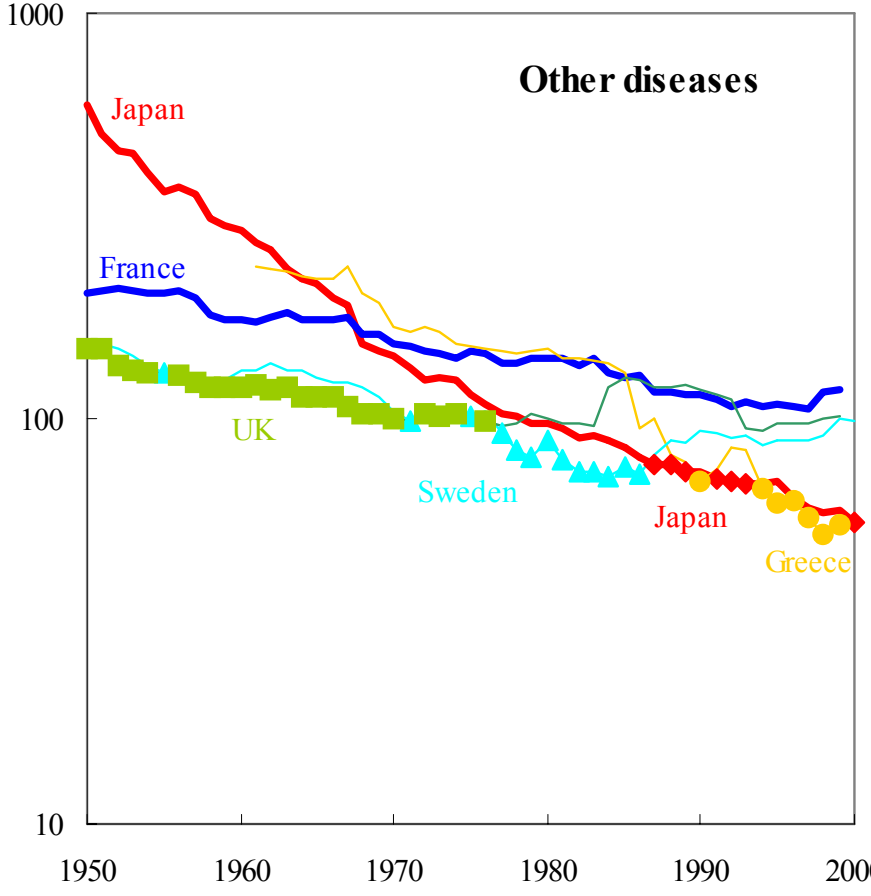
Lowest SDR by cause: diseases of the circulatory system



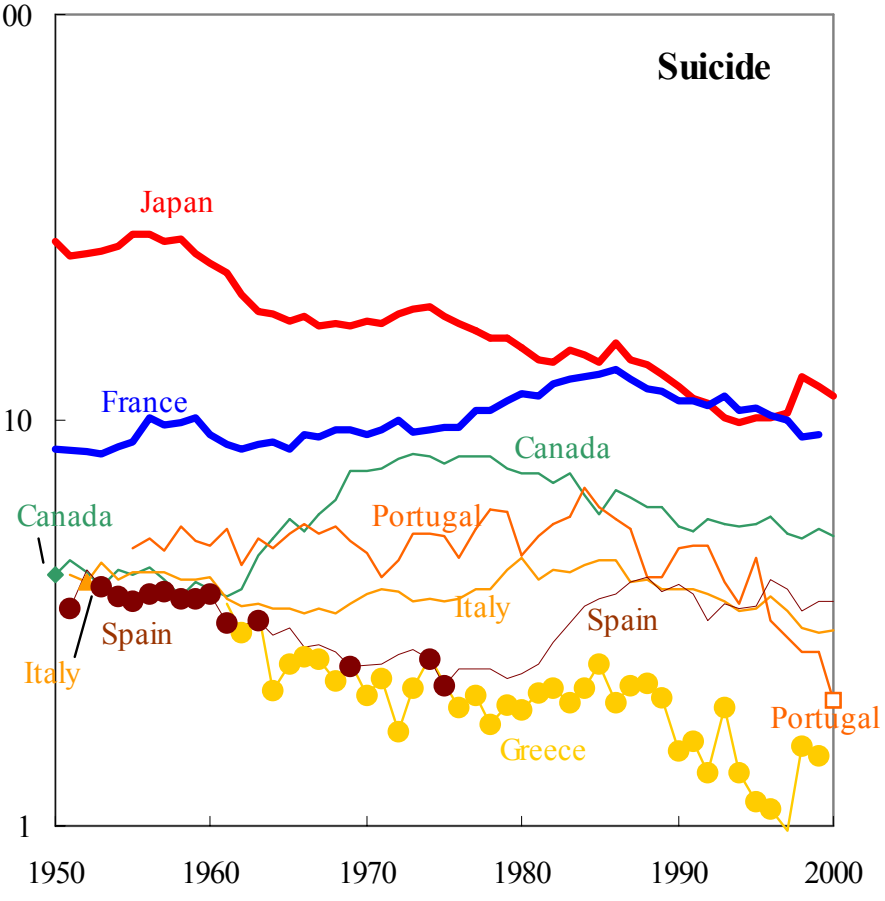


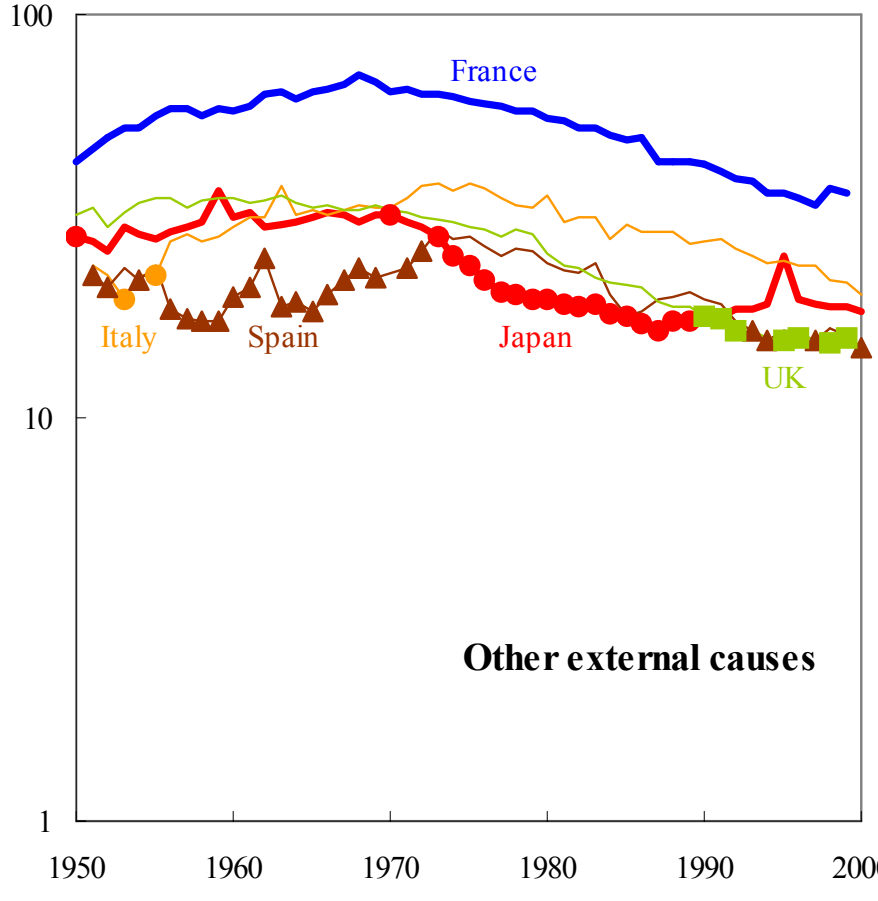
Lowest SDR by cause: diseases of the respiratory system and other diseases



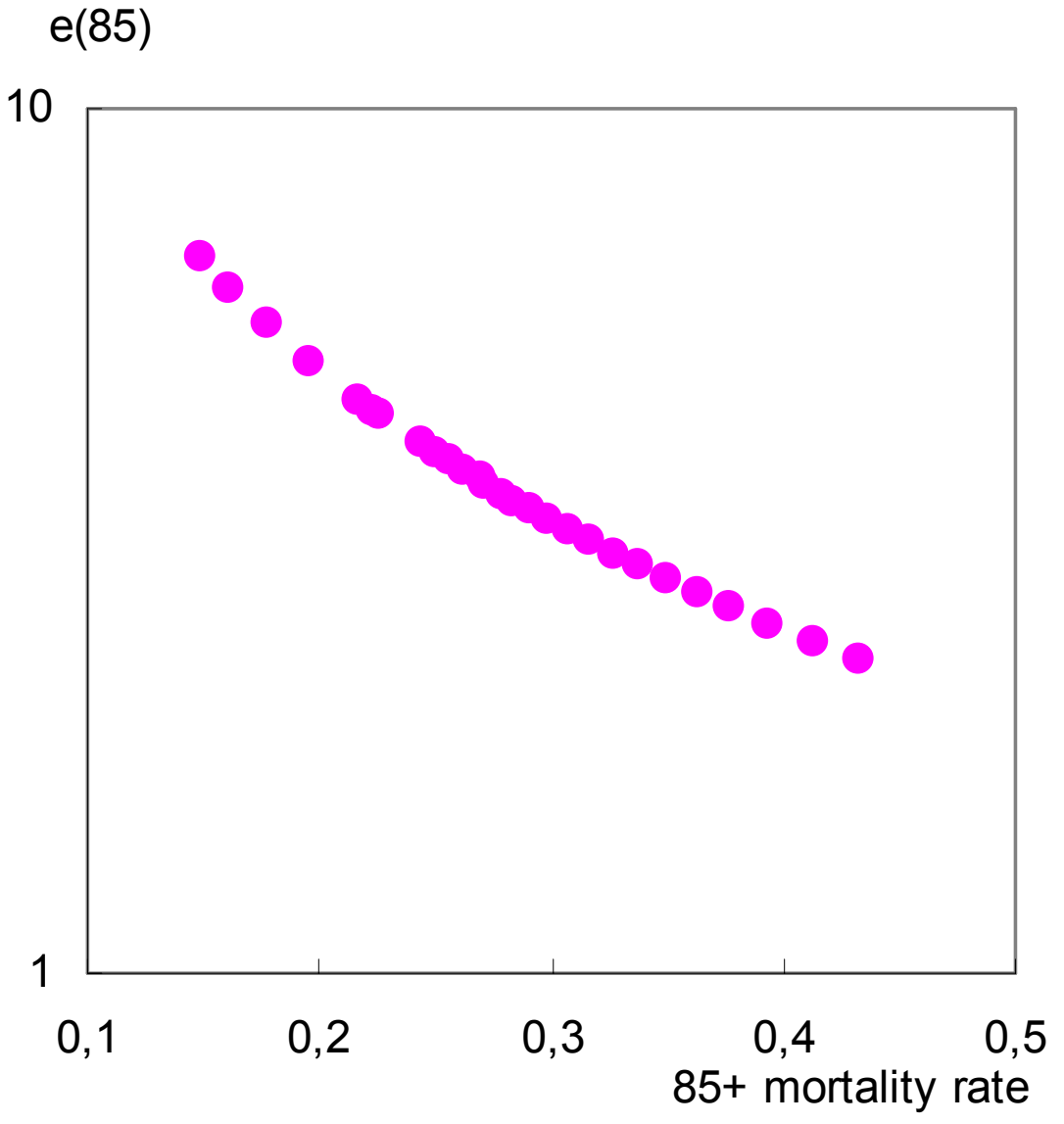


Lowest SDR by cause: external causes





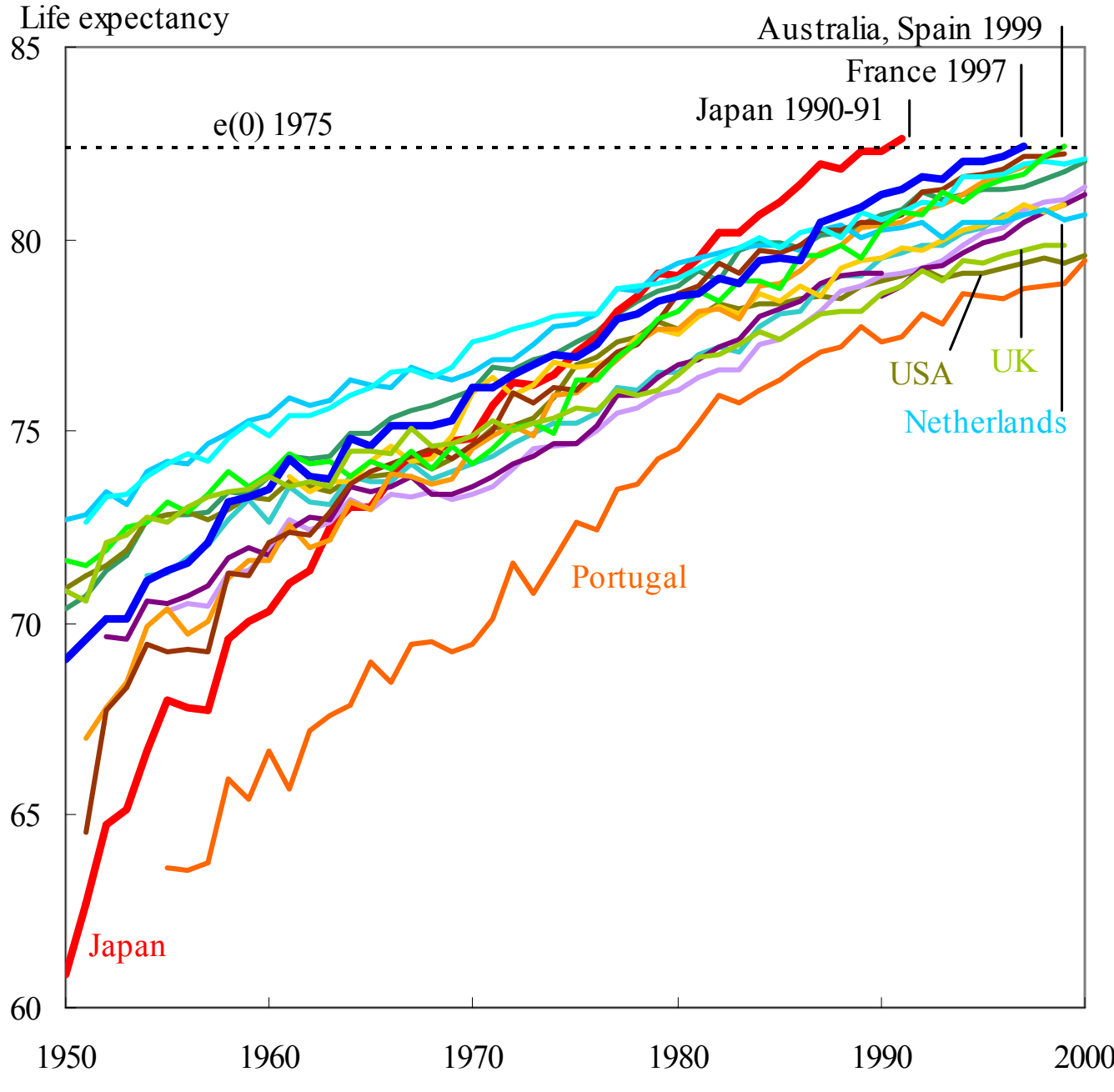
Relation between life expectancy at 85 and death rate at 85+ in model West of Coale and Demeny



Life expectancy at birth according to lowest mortalities as compared to Japan and France

Life table	1950	1975	2000
Highest national LE	73,2 (Netherlands)	78,5 (Sweden)	84,3 (Japan)
Min ASDR all causes	73,3	79,4	85,2
Min ASDR by cause	**77,7**	**82,4**	**87,6**
France	*69,2*	*76,9*	*82,9*
Japan	*61,2*	*77,6*	*84,9*

Actual life expectancy trends by country from 1950 to the year where they reach the 1975 level of lowest mortalities by cause



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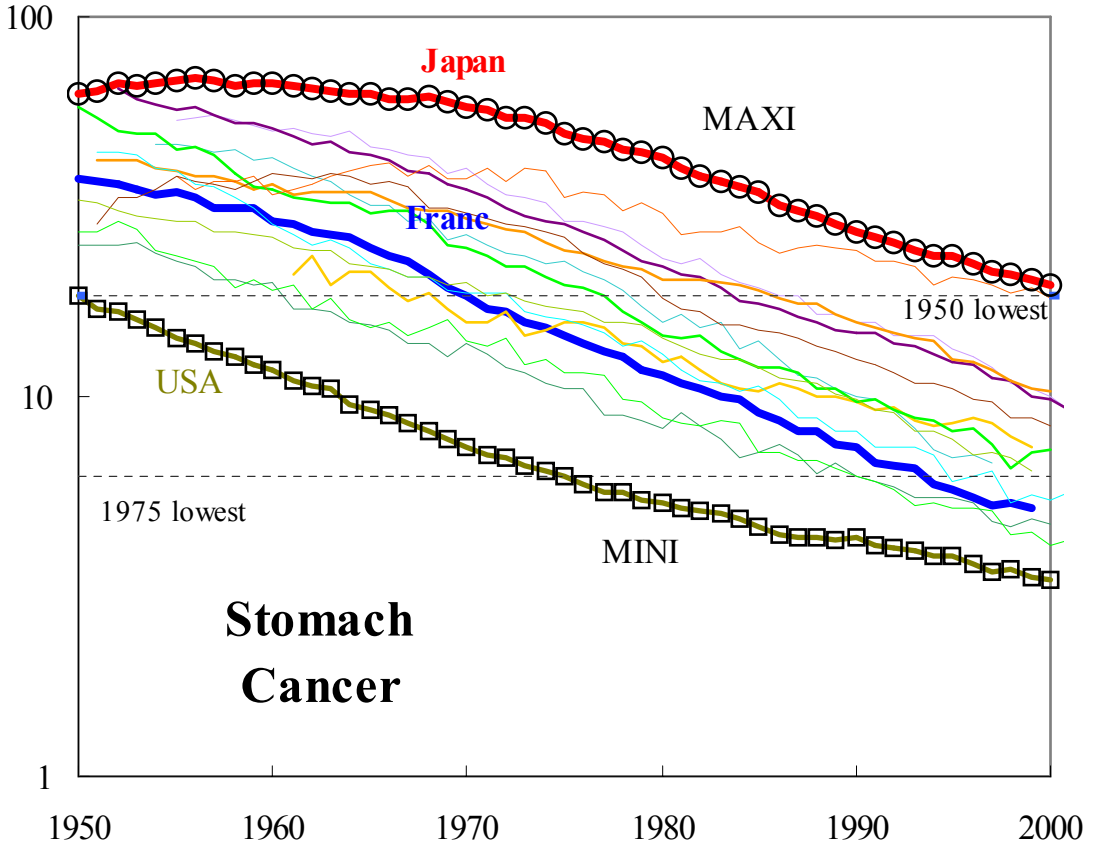
- 25 years later, the lowest mortality can be reached by the most advanced countries;
- we could also use observed trends in lowest mortality to project that indicator in the future and to use the result as a possible long term target for national mortality projections.

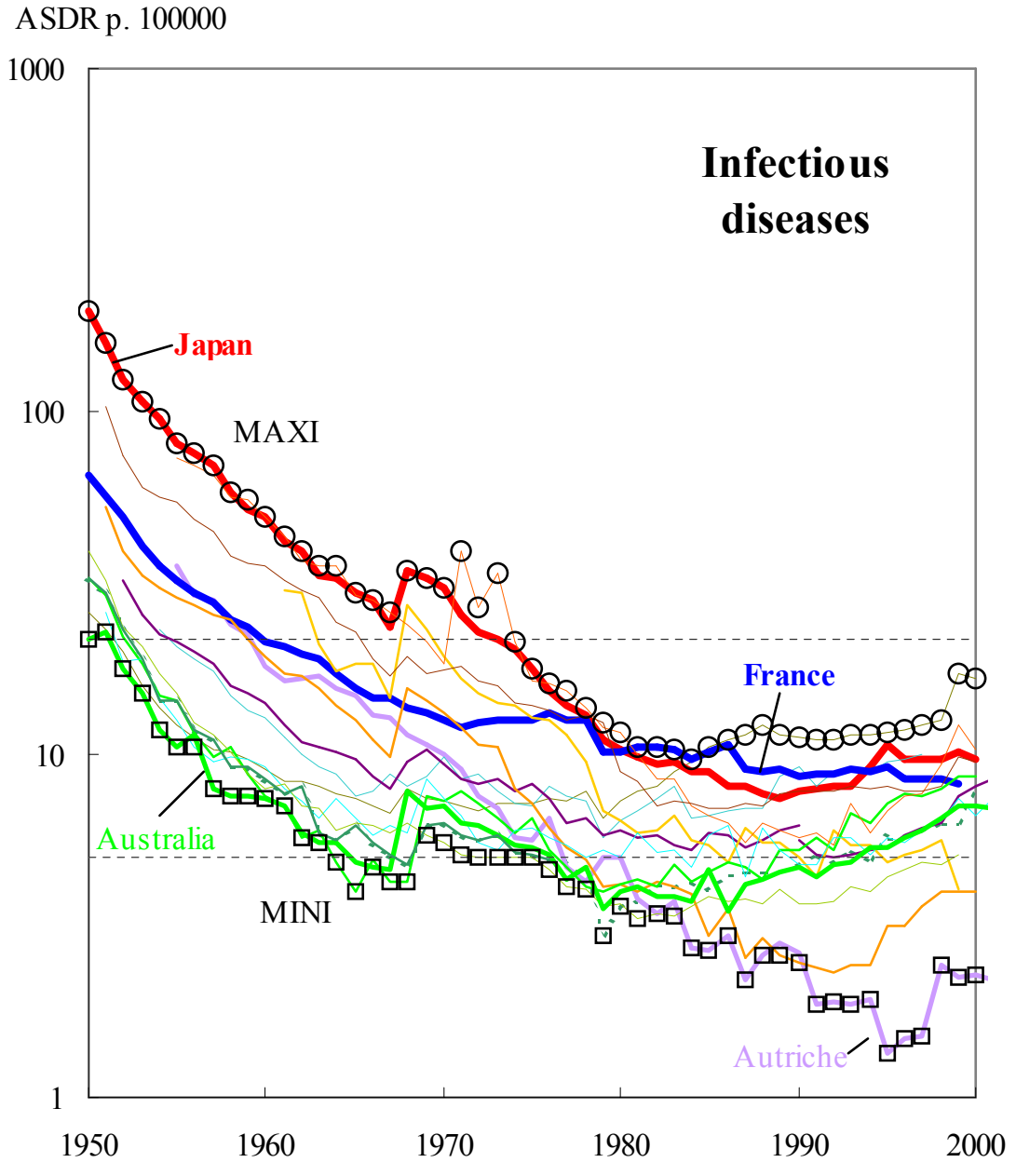
More precisely, is it realistic to consider that mortality by cause of any country can reach the lowest SMR by cause?

A great diversity of answers !

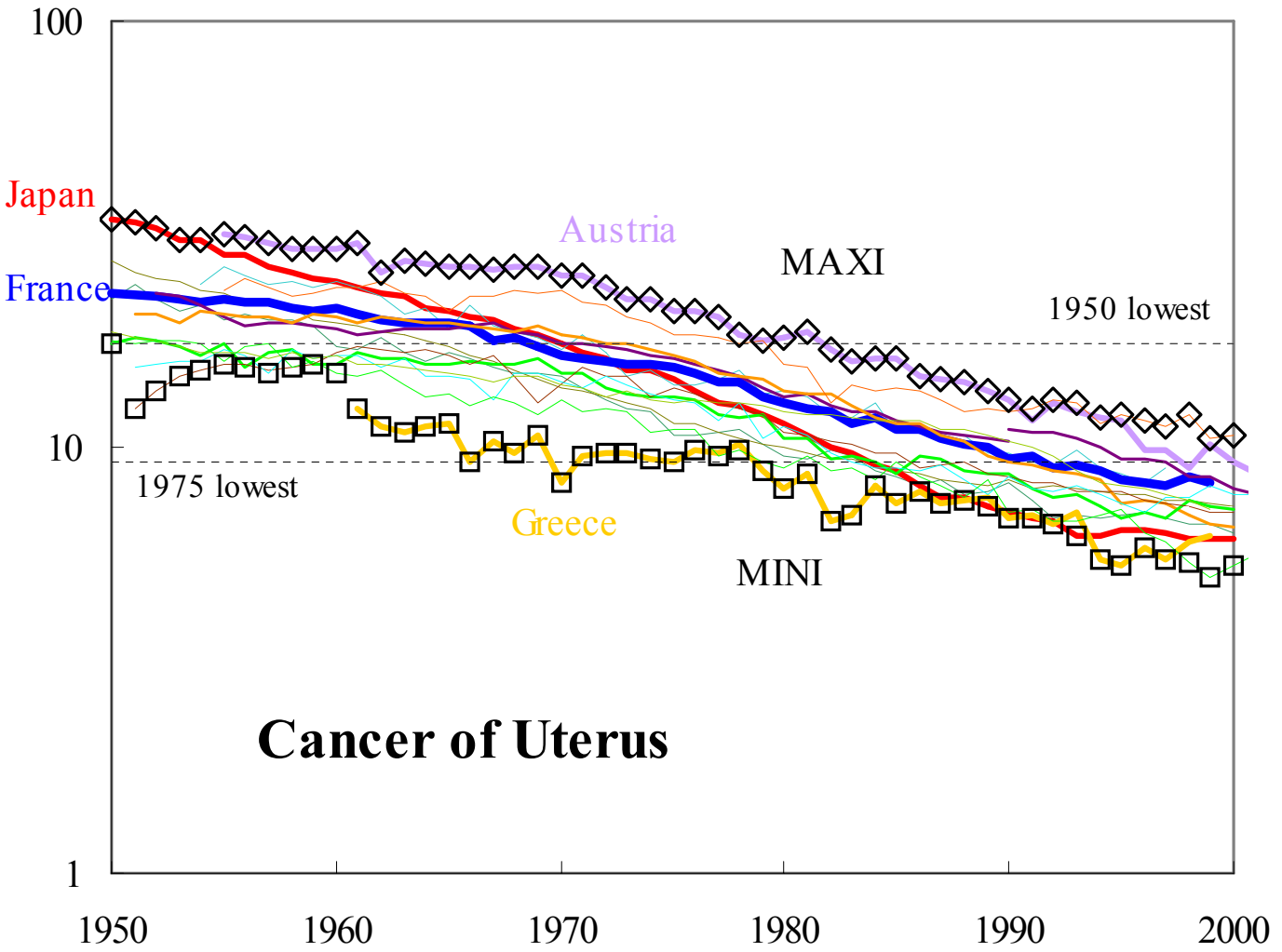
In some cases every country already reached the 1950 lowest level and some of them even reached the 1975 lowest: *Stomach cancer*



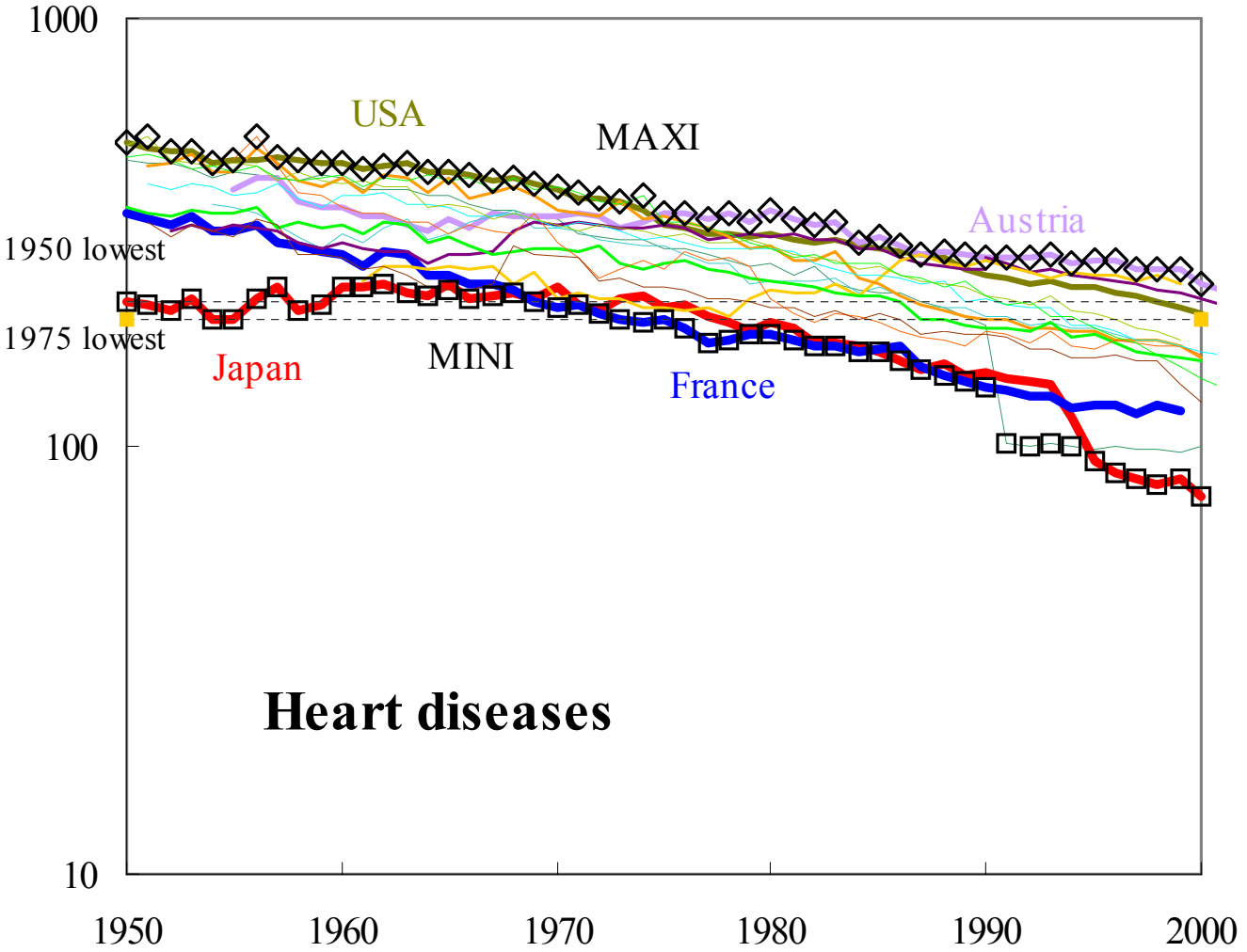
It is the same for *infectious diseases* but trends in the most recent years are unfavorable



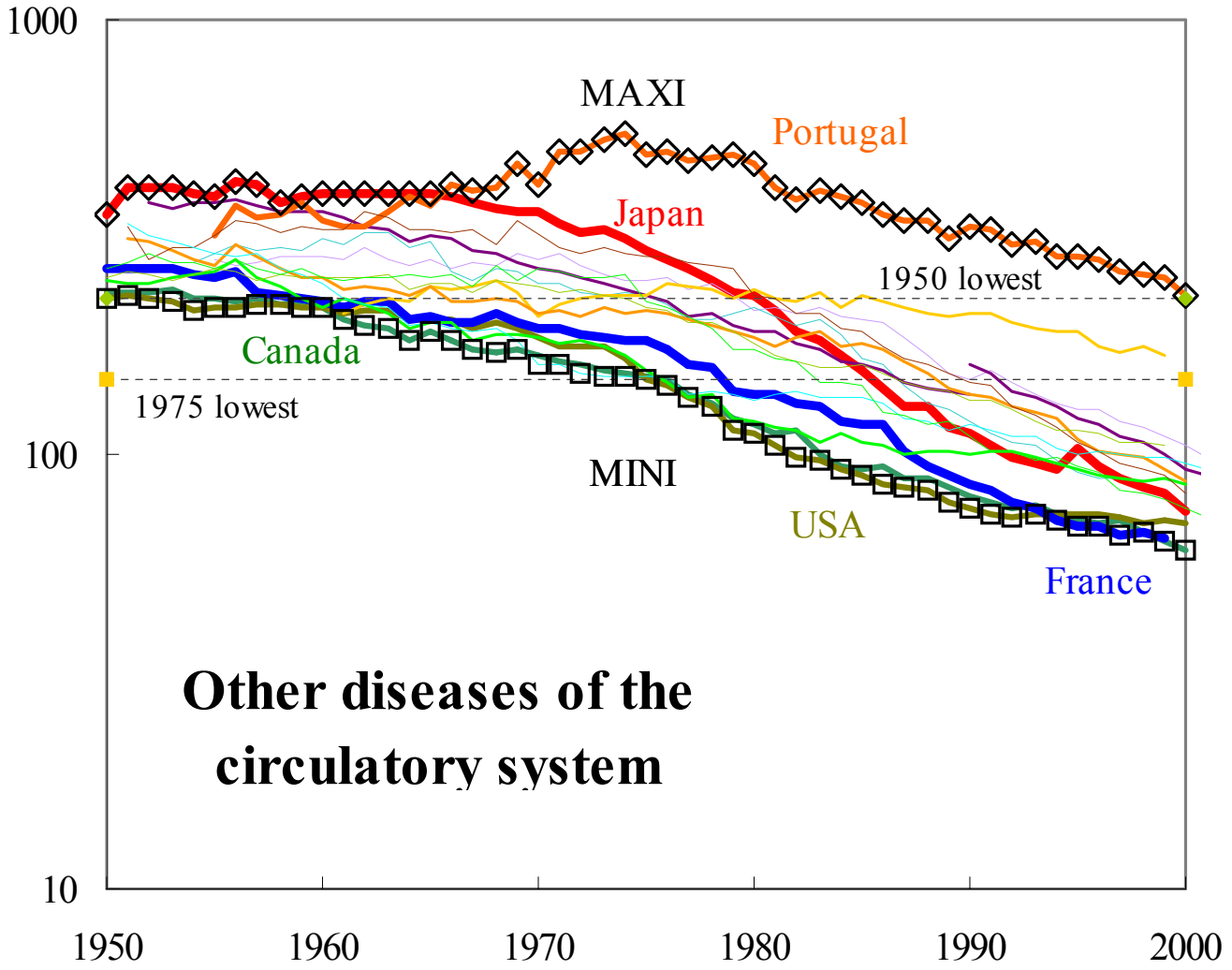
It is much better for *cancer of uterus*



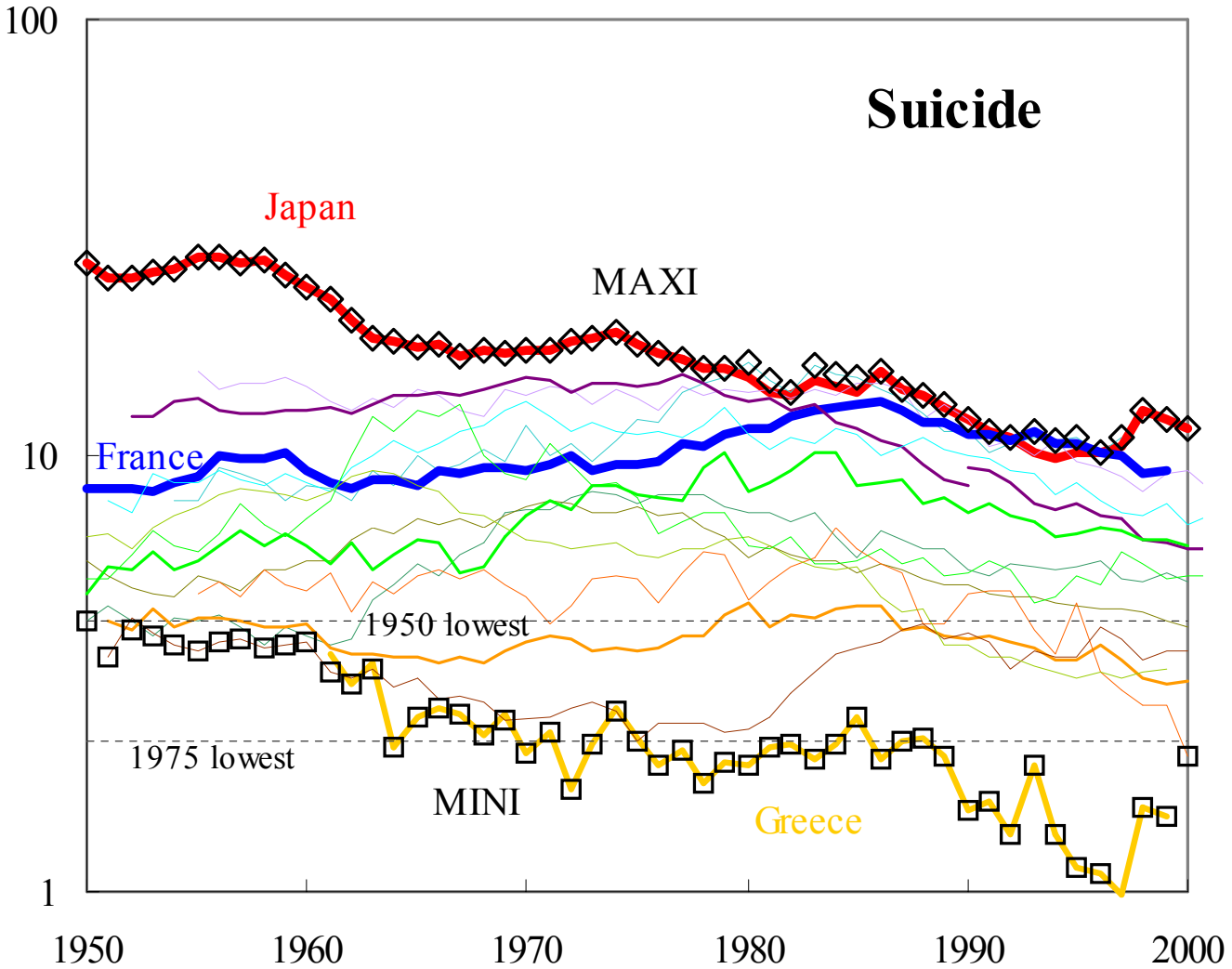
… for *heart diseases*



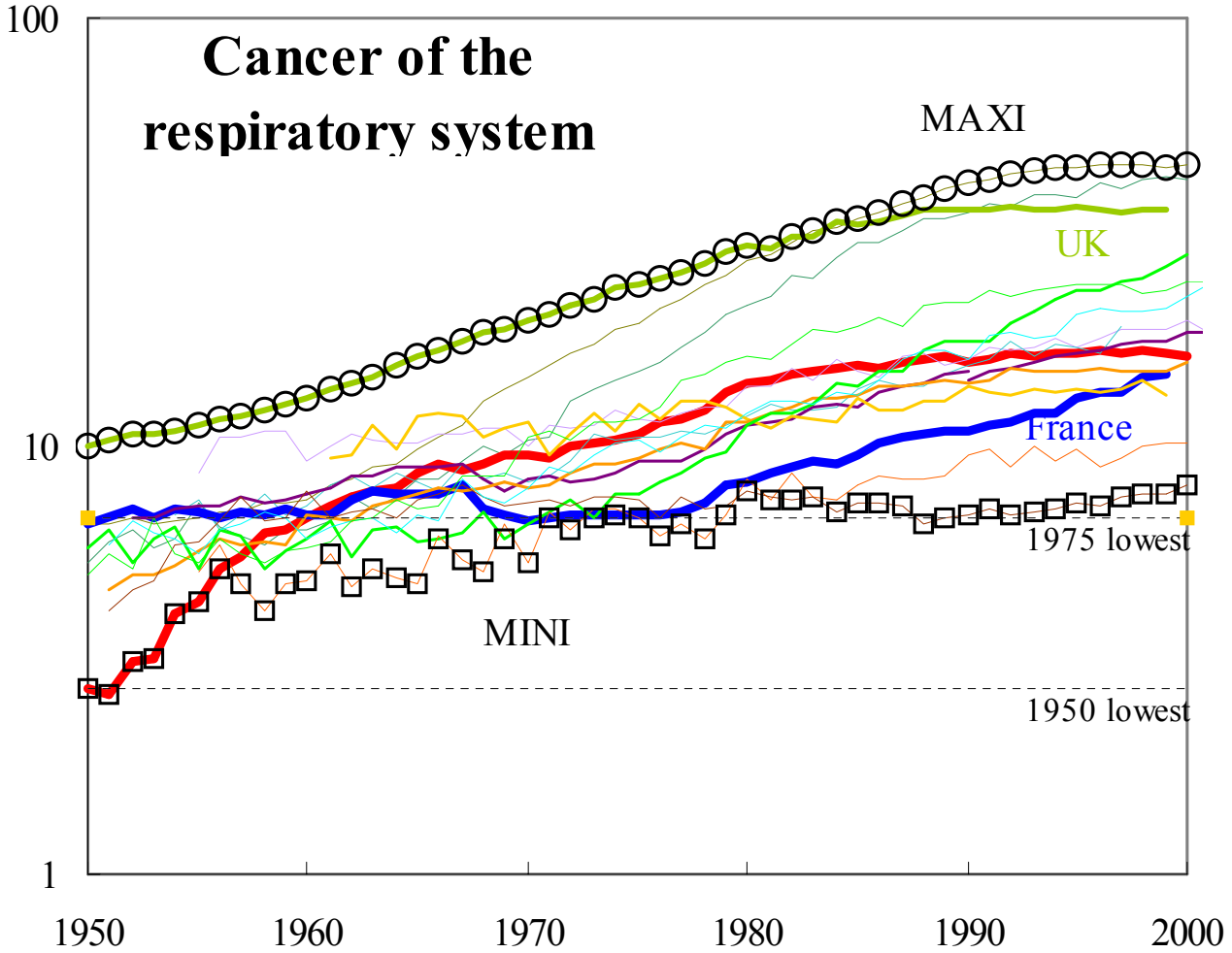
… and for *other diseases of the circulatory system*



… it is much more problematic for *suicide*



… and the question has no sense for
cancers of the respiratory system



… nor for *breast cancer*