

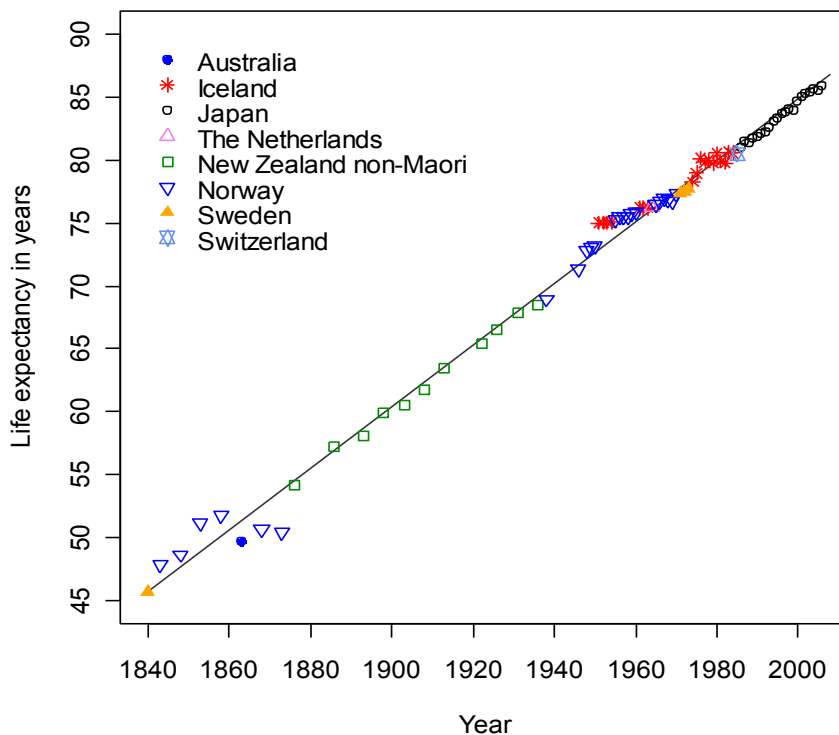
# Highest Life Expectancies: Which Leader after Japan?

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Extended abstract

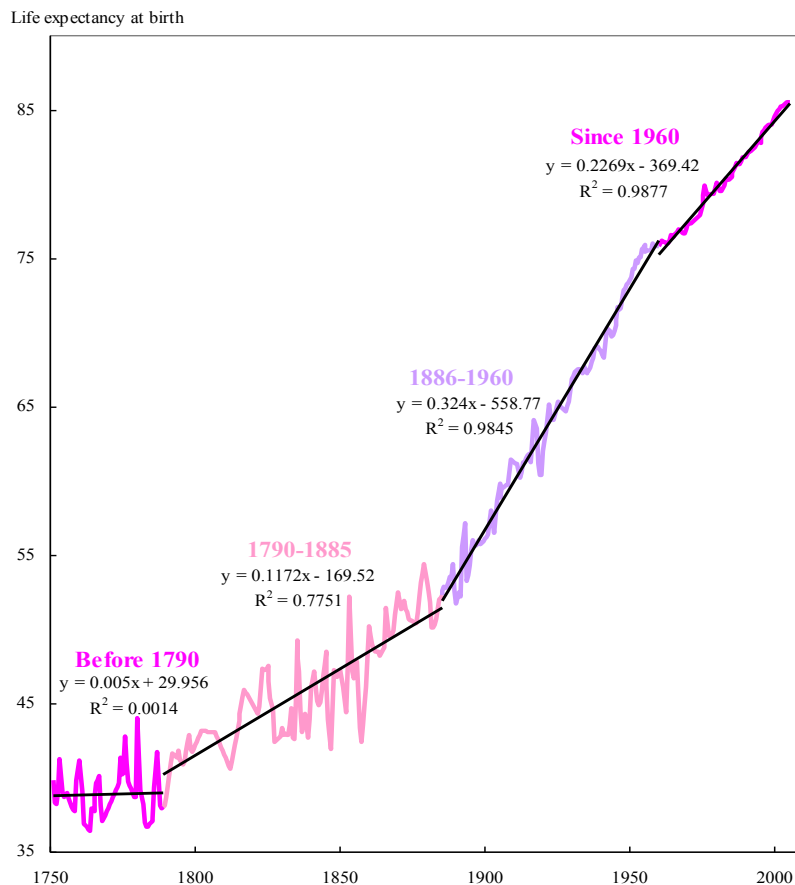
## Introduction

Oeppen and Vaupel (2002) showed that, since the mid 19<sup>th</sup> century, world maximum life expectancy followed straight-line trends (Figure 1).



**Figure 1. Maximum female life expectancy since 1840 according to Oeppen and Vaupel (2002)**

A few years later, studying a longer period and excluding dubious data, we found that the slope of the adjustment changed according to the type of improvement that caused life expectancy progress (Vallin and Meslé, 2008). Before the end of the 18<sup>th</sup> century, world record life expectancy was stagnating. From then until the 1880s, it progressed with the first victories against famine and infection steadily but slowly. Then progress accelerated strongly when Pasteur Revolution opened the door to radical tools as immunization and antibiotics. Conversely, progress slowed down in the 1960s when new improvement in life expectancy had to rely on receding cardio-vascular diseases, more difficult to fight and less productive in terms of life expectancy gains (Figure 2). The statistical significance of all these changes in the slope of adjustment lines was confirmed in a more recent paper carefully (Camarda et al., 2012).



**Figure 2. Maximum female life expectancy at birth since 1750 but excluding Norway (until 1866) and New Zealand**

*Source: Vallin and Meslé 2008*

At the beginning (1750-1780), maximum life expectancies were observed in Sweden, Finland, and England and Wales, alternatively). Denmark took the lead for the period 1780-1830, then Norway for 1830-1920, then Australia and/or Canada for 1920-1950, Norway again and/or Iceland until 1983, and finally Japan took the lead in 1984 and remained the absolute leader until now.

How long can this Japanese advantage last?

### **Has Japan any challenger?**

A possible way to select potential candidates to overpass Japan performance could be to look at historical second best performers. In our previous study, such a strategy helped us to detect false leaders in the past. Indeed, the way to make sure that, at one moment, country leader does not take advantage from any observation or measurement error is to compare the trends in top leaders to those of second best performers. Considering that a lot of countries are in competition, it would be very dubious that it could have a much lower life expectancy than the top leader. Indeed, when drawing the two trends on the same graph, it appears that important gaps occurred only three times in a two centuries and half (Vallin and Meslé, 2008). It was to the benefit of Norway in the first decades of the 18<sup>th</sup> century, then to that of New Zealand from its introduction in the

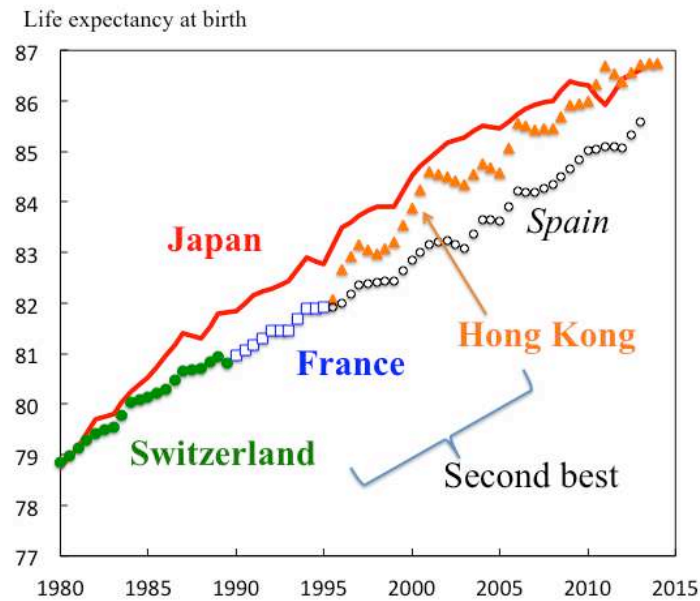
database to WW-2 (late 1870s), and finally to that of Japan, recently. After checking carefully used data, it appeared that death registration in Norway was not complete at the considered period while the New Zealand population covered (only not Maori population) relied on a very small number of females, most of them emigrated from very far Europe, highly selected according to their health, and finally not appropriate for the purpose. Japan, on the contrary, did not show any major question of data quality, but a very understandable reason to have become the leader, as we shall mention later.

### **Three possible types of challengers**

This concept of second best performer could be used to our new aim, to identify potential candidates to overpass Japanese performance. Further, we thought of looking also to those countries that were top leader before Japan (like Nordic countries or the Netherlands), or countries showing impressive mark of accelerated progress in recent decades (like Hong-Kong, South Korea, Singapore, etc.). As for the top-leader series, we will study statistical adjustments of national series to look at possible changes in their slope that could let imagine any accelerated trends faster than the Japanese one in the near future.

### ***Recent second best countries***

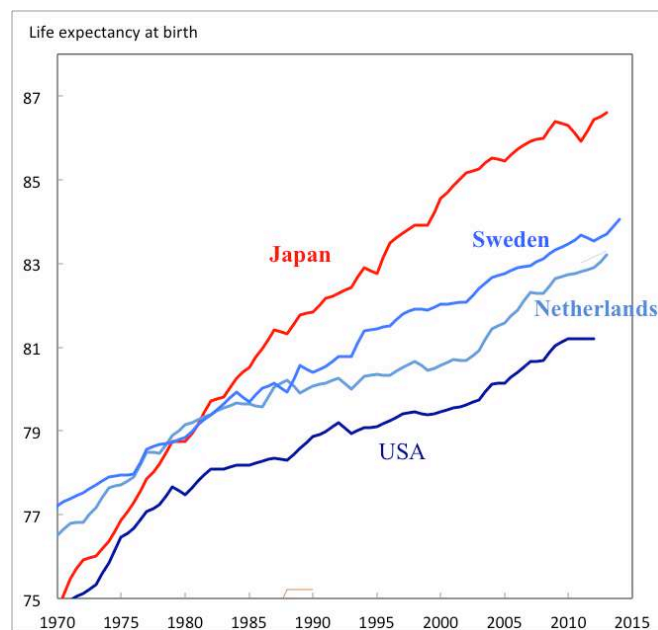
Since Japan has become the leader, in the early 1980s, several countries took the second position. Immediately after Japan takes the lead, in 1982, Switzerland becomes the second best performer (Figure 3) but not for long. Indeed in 1989, France overpasses Switzerland and takes the second place. However less than 7 years later, in 1996, France losses the place, opening a question mark. Is Hong Kong to be considered? In that case, it should be considered as the second best until it becomes itself the leader when catching up Japan in 2010. And, consequently our initial question would no longer be a open question since this event would give us a definitive answer: yes Japan had a challenger and Hong Kong is already the new leader, even if the 2011 gap between Japan and Hong Kong is somewhat artificially due to peak of mortality caused by the Fukushima catastrophe (Figure 3). But Hong Kong is not quite appropriate to a fair competition. It is not an independent country, while the philosophy of this work is based on international comparisons. Furthermore, Hong Kong is rather peculiar as almost totally made of a single urban area, which biases the comparison with much more heterogeneous combinations of urban/rural populations. Even if Hong Kong is removed, another one overpassed France anyway: Spain becomes the second best in 1996 and keeps the place until now. Have the three remaining countries concerned by the second place since Japan took the lead (Switzerland, France, Spain) any chance to really challenge Japan in the near future? Certainly yes, since Japanese trends clearly slowed down during the past ten years. We shall see that more precisely later, after examining the two other categories.



**Figure 3. Second best performers since Japan took the lead of maximum female life expectancy**

**Former leaders**

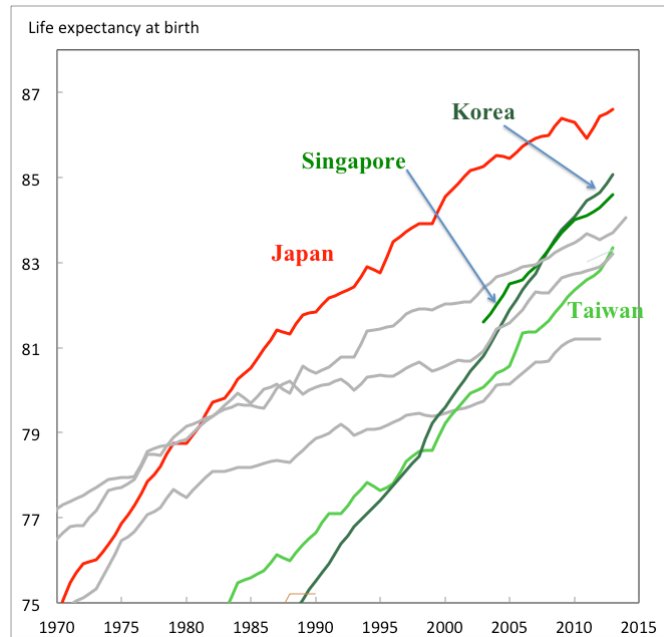
Contrary to the three countries mentioned above, no former leader seems to have any chance to catch up Japan soon. Recent trends in the Netherlands seem to be a bit faster than in Japan but at very different levels of achievement. In Sweden levels are less far from the Japanese ones but trends are less favorable than in the Netherlands. The USA combine both disadvantages (Figure 4)



**Figure 4. Comparison of recent female life expectancy trends in Japan and those in three of the main former leader countries (Sweden, Netherlands and USA)**

### ***Possible new comers***

For sure, better possibilities seem to be present in developing countries that are still well under Japanese performance but where life expectancy grows exceptionally faster. In particular attention must be drawn on recent trends in Singapore, South Korea and Taiwan (Figure 5). Not only these three developing countries have already caught up or even overpassed the three former leaders mentioned above, but the pace of their progress during the last decade is much faster than that of Japan. The case of South Korea is the most impressive.



**Figure 5. Comparison of recent female life expectancy trends in Japan and those in three new comers from the developing world (Singapore, South Korea and Taiwan)**

### **What could be the results prolonging recent past trends?**

Simply applying a linear extrapolation of the trends in life expectancy observed for the past ten years, the 2013 Japanese level could be reached in the following year, in each of the above-mentioned countries:

- USA: 2042
- Sweden: 2033
- Netherlands: 2029
- Taiwan: 2024
- Singapore 2020
- France: 2020
- Spain: 2019
- South Korea 2017

Of course, it does not mean that these countries would have overpassed Japan yet, since Japan will continue to progress in the same time. To overpass Japan USA would have to wait more than 200 years, while the other countries would not be successful before the following years:

Sweden: 2110  
Netherlands: 2055  
France: 2043  
Taiwan: 2034  
Spain: 2031  
Singapore 2026  
South Korea 2018

What is remarkable here is that differences between these two possible events (reaching the 2013 Japanese level or catching up Japan) are much closer to each other in the three developing countries than in the others ones.

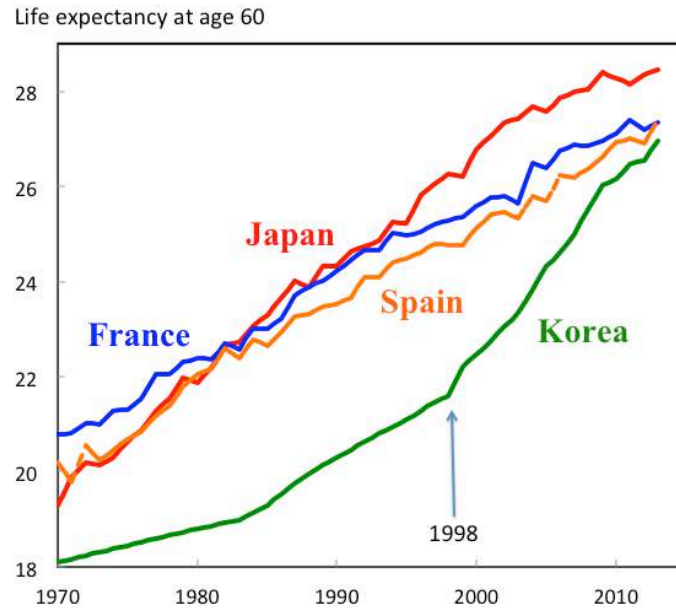
The case of South Korea is particularly fascinating since that country could not only reach the 2013 Japanese level in 2017 but even catch up Japan the year after. It deserves a more precise examination, mainly including a focus on mortality at old ages and a look at causes of death.

### **South Korea, as the most probable challenger**

#### ***Accelerated progress at old ages***

As shown in Figure 6, not only female life expectancy at age 60 is now progressing much faster in South Korea than in Japan but this is resulting from two successive accelerations, first in 1984 and the second and decisive one in 1998. Rather strikingly the latter coincides with the 1998 Asiatic financial crisis but this is not necessary surprising since economical crises are not necessary resulting in health crisis and it may be the reverse, sometimes. On another side, such acceleration strongly contradicts pessimistic hypotheses on the quality of the Korean civil registration system. It is quite possible that under-registration of old age deaths prevailed in the past but such under-registration regressed. Even if it may have not yet disappeared completely, improvement in registration coverage and/or age accuracy would result in an underestimation of the pace of the progress.

Anyway, the most important here is that gains in life expectancy at age 60 has been much greater in South Korea than in Japan for almost 20 years. By contrast, progress in France and Spain was much slower than in Korea which is very close to these two countries already. Indeed it must be also noticed that for the last five years or so, pace of progress slightly slowed down in Korea but the phenomenon is much less than in Japan.



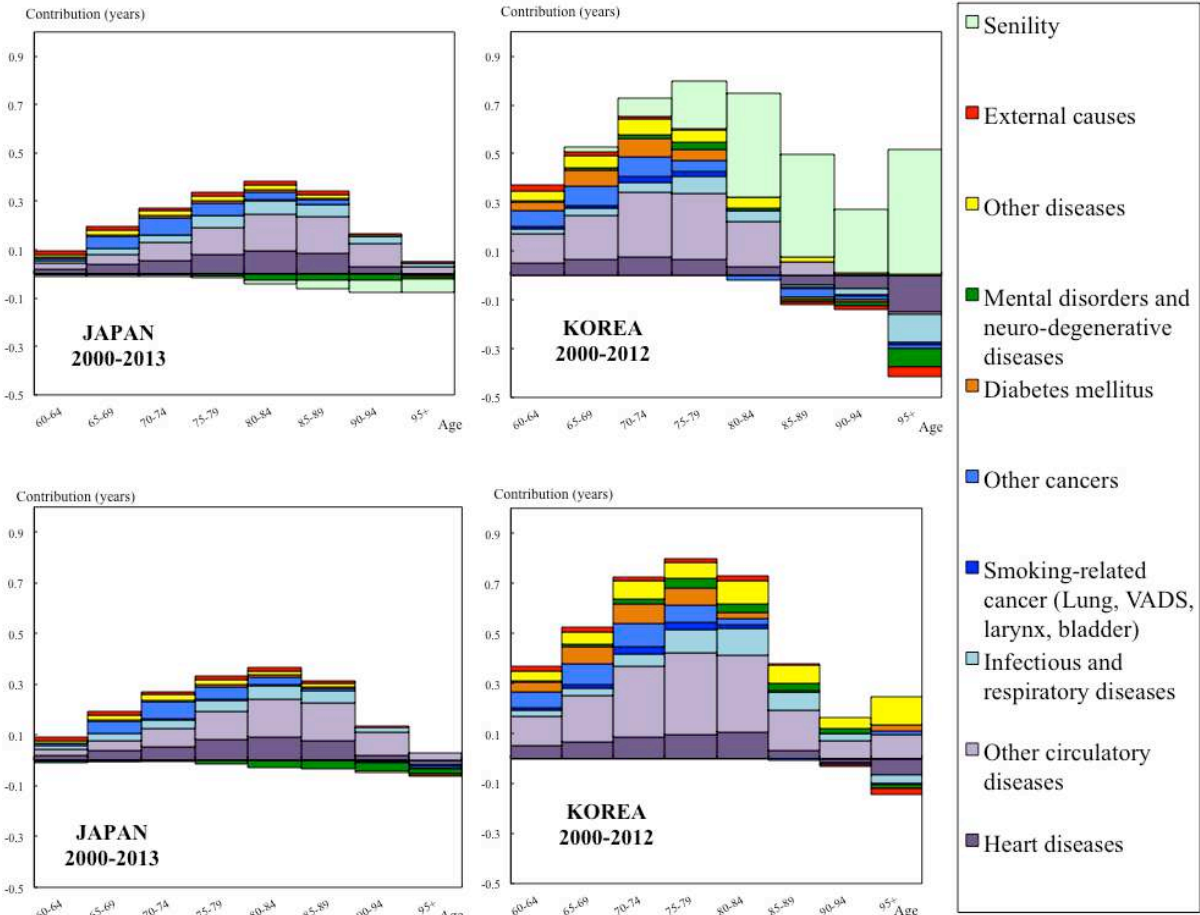
**Figure 6. Comparison of trends female life expectancy at age 60 in Japan and South Korea since 1970**

***Encouraging profiles of cause-of-death changes***

Figure 7 displays the contribution of mortality changes by age groups for ten major groups of causes to the increase in life expectancy at age 60 since the year 2000. It must be noted that data being not available for 2013 in Korea, the period covered for that country is shorter than for Japan, which means that the Korean advantage over Japan is slightly underestimated. Nevertheless, gains are all much larger in South Korea than in Japan. Furthermore, the structure of the gains is quite different between the two countries. To make the results more comparable, Figure 7 includes two illustrations according to the way senility is treated. In the two upper graphs, senility is considered as a specific cause of death. It shows that the use of this category was much more important in Korea than in Japan but also that mortality rates by this cause declined drastically in Korean since 2000, producing huge gains in life expectancy, while in Japan it tended to increase slightly and produced small losses. For these reasons, it appeared preferable to consider senility as an ill-defined cause and to redistribute deaths for that cause among all specific causes, proportionally. Results are displayed in the two lower graphs of Figure 7.

Not only Korean gains are much higher than those of Japan but this is true at all ages, even the oldest ones and for all causes of death. However this Korean advantage varies a lot according to the cause of death. While gains due to the decrease of heart disease mortality are rather similar in both countries, South Korea benefitted from much more important decline in mortality by other cerebrovascular diseases. For the rest, Japanese gains are still significant only for infectious diseases and cancers while in Korea, not only these gains are even more important but also important gains are due to the decline of other causes, especially diabetes, mental diseases and “all other causes”. Finally, not only the greater killers (cardiovascular diseases and cancer) are declining much faster in

South Korea than in Japan, but also all the others causes of death are regressing significantly while they do not regress much in Japan.



**Figure 7. Contributions to the gains in life expectancy at age 60 of changes in mortality rates by five-year age groups for large groups of cause in South as compared to Japan: the two upper graphs includes senility as a cause of death while the lower graphs were drawn after a proportional redistribution of senility among all other causes (as for ill-defined causes)**

**The importance of changes in epidemiological profiles**

Should we have studied national trends in the 1950s or 1960s, would have been there any possibility to predict that Japan could take the lead a few decades later? It is quite improbable, since this radical change in leadership resulted from the cardiovascular revolution, hardly predictable before the mid 1970s. The reason why Japan emerged as the best performer was that this country was very ready to take immediate benefits from medical innovation in that major field of causes of death open in the early 1970s, because of its own epidemiological, economical, social and behavioral context. Furthermore, it seems that the reason why Japan continued to stand as a leader is that it also pioneered the entrance in a new step of the health transition based on the fight against causes of death at very old age (Meslé and Vallin, 2006). Quite identically, since 2000, South Korea made spectacular gains against both cardiovascular mortality and various other old-age diseases, while in Japan all these benefits slowed down. This make very understandable that South Korea could catch up Japan in term of life expectancy within a couple of years.



## **Toward a new change in the pace of progress?**

Having a new country to take the lead is not enough to maintain the pace of increase in the world maximum life expectancy. If it is very probable that South Korea will catch up Japan very soon, it does not mean that it will be able to continue to progress at its own pace. On the contrary, we already saw that it slowed down during the past five years. It would not be a great surprise if the arrival of that new leader coincides with a new change in the segmented line of the maximum life expectancy trends.

## **References**

- CAMARDA Carlo Giovanni, VALLIN Jacques, MESLÉ France, 2012. – Identifying the ruptures shaping the segmented line of the secular trends in maximum life expectancies, Diaporama, *EAPS, European Population Conference*, Stockholm, 13-16 juin 2012, 11 diapos.
- MESLÉ France, VALLIN Jacques, 2006. – Diverging trends in female old-age mortality: the United States and the Netherlands versus France and Japan, *Population and Development Review*, 32(1), p. 123-145.
- OEPPEN Jim and VAUPEL James W., 2002. – Broken limits to life expectancy, *Science*, vol. 296, n° 10 May 2002, p. 1029-1031.
- VALLIN Jacques, MESLÉ France, 2009. – The Segmented Trend Line of Highest Life Expectancies, *Population and Development Review*, 35(1), p. 159-187.