Rescaling the Life Cycle - Determinants of Life Cycle Changes in OECD Countries

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Abstract

This paper analyzes the effect of a rising life expectancy on reallocating time to different stages over the life cycle. By introducing the Ratio of Retirement to Lifespan (RRL) as an indicator for life cycle arrangements, it is possible to follow the development of the life cycle over time and to compare different country profiles. Also, characteristics of the social security system are included in order to identify a "behavioral effect" shaping the life cycle. Based on the analysis of a cross-sectional panel data set of OECD countries, this elaboration discovers an asymmetric change of the life cycle through a relative increase in the proportional life time spent in retirement between 1970 and 2005. First insights reveal that life cycle arrangements are rather determined by a behavioral effect than by a rising life expectancy.

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Contents

1 Introduction

The record life expectancy in industrialized countries has risen continuously over the past 160 years. Within the last century, the human record life expectancy increased from 60 to 85 years for females and from 58 to 78 for males (Oeppen and Vaupel, 2002). This longer life time is a positive achievement for modern societies. But increases in life expectancy of this dimension could impose substantial economic consequences for populations. The magnitude of these consequences depends primarily on the distribution of gained life years across the different stages of the life. A possible strategy could be to expand every life cycle stage proportionately to the increase in life expectancy. This change in the life cycle would be neutral, because individuals could behave identically as before - they would just spent proportionately more time in every stage.[1] But, although proportional rescaling of the life cycle offers a convenient, natural benchmark, institutional and health related constraints and conditions impede a neutral adaption (Lee and Goldstein, 2003). This concerns especially old ages.

For economic analysis the development of the retirement span is of special interest. An increase of time spent in retirement raises the need for retirement income. This affects in particular savings rates, social transfers and the welfare of the elderly (e. g., Bloom et al., 2003, 2007). These aspects have crucial implications for economic growth, consumption levels and intergenerational transfers (e. g., Auerbach et al., 1999; Mason et al., 2006; Deaton and Paxson, 1997). Moreover a longer time spent in retirement endangers the long-term financial sustainability of pension systems (e. g., OECD, 2000, 2007, 2009a). Therefore, it is necessary for people's decisions and for policy makers to be aware of the significance of life cycle changes.

This Paper explores the development of the life time spent in retirement and the interconnected change of the life cycle based on data of 26 OECD countries over the period 1970 to 2005.[2]

The paper is organized as follows: The main aspects shaping the human life cycle are specified in Section 2. The applied methods and the data are

[1] Another adaption alternative to increased longevity could be to raise retirement ages and to reduce working hours at each age simultaneously, thus redistributing leisure over the individual life cycle (Vaupel and Loichinger, 2006).

[2] See Table 1 in the appendix for details.

described in Section 3. Section 4 presents the results. A conclusion in Section 5 and a short outlook complete.

2 The Characterization of the Life Cycle

The concept of the life cycle is widely used in social sciences. However, its meanings and applications are diverse. Additionally, for denoting temporality in a general sense, the terms life cycle, life span or life course are often regarded as interchangeable (O'Rand and Krecker, 1990). By considering an individuals life as a chronological sequence of stages, the life cycle can be characterized by the occurrence of events and the length of the resulting life cycle stages. While there are various aspects of the life cycle interesting for analysis, this elaboration focus on a simplified life cycle that divides the human life span into working age and old age.[3] When analyzing the relocation of time between these two life stages, the development of longevity and the timing of retirement are important factors shaping the life cycle.

Improving longevity expands the life time, but especially in older ages gained life years may not be healthy ones. This implies that if longevity is accompanied by ill health and disability in old age, a proportional life cycle change would decrease the percentage of time spent in retirement in a healthy state. Thus, adding the gained (unhealthy) life years equally in all life cycle stages cannot be a reasonable strategy. However, strong evidence for the "compression of morbidity" weakens this apprehension (e. g., Fries, 1980, 2003; Crimmins et al., 1997; Costa, 2002).[4]

In addition to adjustments of the life cycle caused by health or disability, constraints and incentives of the pension system are of particular importance for the evolution of life cycles; e.g., decisions on retirement age are strongly dependent and influenced by institutional factors. There is a strong relationship between the effective retirement age and the age at which benefits from private or public pension plans can be withdrawn. Most of the

[3] Among others childhood, marriage, parenthood or widowhood are possible additional events within the life cycle that are of interest in life cycle research.

[4] There still is an ongoing scientific debate on the disability trends of the elderly. Other studies showed inconsistent results and fluctuations with little to no improvement in health (e. g., Crimmins et al., 1989; Crimmins, 1996). For an overview see (e. g., Manton et al., 2006).

variation in labor force participation rates at older ages across countries are explained by the development of the "Social Security Wealth Accrual". The social security wealth accrual is calculated as the change in pension wealth resulting from a retirement postponement of one year (e. g., Blöndal and Scarpetta, 1997; Gruber and Wise, 1998).[5] The magnitude of the social security wealth accrual differs widely between countries and is mainly determined by the design of the social security system and the economic conditions. As a complement to institutional effects, Costa (1998) argues that rapid sectoral shifts in an economy and technological change can augment early retirement. Modified work requirements increase the depreciation of (productive) knowledge. Hence, older workers with obsolescent expertise are "pushed" out of the labor market. Moreover, wages rather depend on job tenure than on the marginal product of labor. This fact jointly considered with a declining labor productivity with age might be an argument for employers to release older workers.[6]

In summary, the design of the social security system, social policies as well as structural changes in an economy influence the life cycle adjustments additively to demographic changes.

3 Methods and Data

For the analysis of the life cycle development and the change in the time spent in retirement a relative view on the life cycle rather than the elaboration of absolute quantities is preferred. The life time horizon is used as the reference point. The relative view on the life cycle offers the opportunity to evaluate comparable measures over time and between countries as well as to consider changes in the effective retirement age and longevity simultaneously.

Let the Ratio of Retirement to Lifespan (RRL) at time t, denoted $\Phi(a_{R,t})$,

[5] A positive (negative) accrual adds to (reduces) the total compensation from working one additional year. Therefore, a negative accrual can be interpreted as an implicit tax tending to discourage work or encourage retirement and vice versa (e. g., Blöndal and Scarpetta, 1997; Gruber and Wise, 1998).

[6] In general labor productivity declines with advancing age are more likely to be true for manual workers than for skilled workers. For the latter group age could have a positive impact because experience is an important productivity factor.

be the relative measure of the proportion of entire life time of an individual spent in retirement conditional on survival. Evaluated at the age of retirement, the average RRL depends on the retirement age ($a_{R,t}$) and on the remaining life expectancy ($e(a_{R,t})$) at that age. Thus, the life time horizon ($T(a_{R,t})$) can be measured as the remaining life expectancy at the age of retirement plus the age at retirement. Formally:

$$\Phi(a_{R,t}) = \frac{e(a_{R,t})}{e(a_{R,t}) + a_{R,t}} = \frac{e(a_{R,t})}{T(a_{R,t})}$$
$$\text{with} \quad a_{R,t} \geq 0,\ e(a_{R,t}) > 0 \text{ and } \Phi(a_{R,t}) \in (0,1)\,.$$

For the calculation of the Ratio of Retirement to Lifespan OECD country data on the male average effective age of retirement is utilized (OECD, 2009b). Additionally, the analysis incorporates the widespread assumption of "normal retirement" at age 65. So, in addition to the effective RRL based on the actual age of retirement a stylized RRL for the fixed definition of retirement age is calculated as well. Related life expectancy measures are taken from the Human Mortality Database (HMD, 2009). The calculation of the overall development within the analyzed OECD countries is done by averaging the several country specific measures. To account for the variation between the countries the standard deviation is computed.

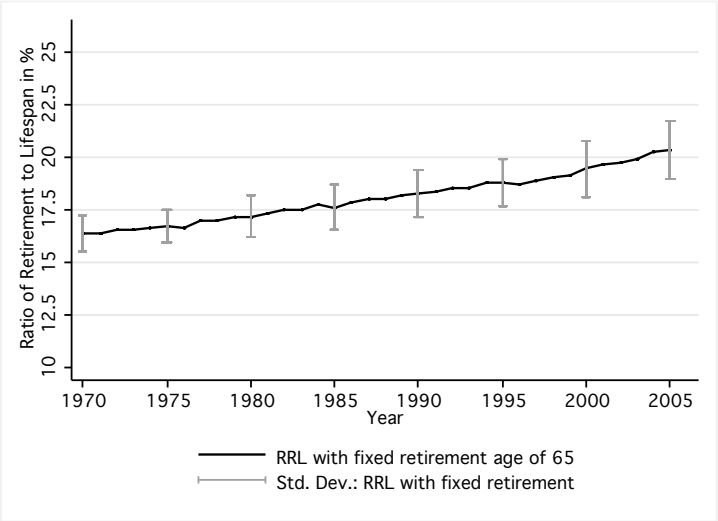
4 The Development of the Life Cycle in OECD Countries

Figure 1 illustrates the average percentage of life time spent in stylized retirement (age 65 and above) for males in the analyzed OECD countries.[7] Using the assumption of a fixed retirement at age 65 the graph shows the relative expansion of the retirement span in the period 1970 to 2005. Additionally, in order to account for the variation between the countries, Figure 1 comprises the range of one standard deviation of the average retirement span for every five years.[8]

[7] See Table 1 in the appendix for details.

[8] Let σ denote the standard deviation and μ the arithmetic mean of the sample. Then, the upper and lower bound of the range is calculated as: $\mu \pm \sigma$.

Figure 1: Life cycle changes with a fixed retirement at age 65



Source: Author's calculations.

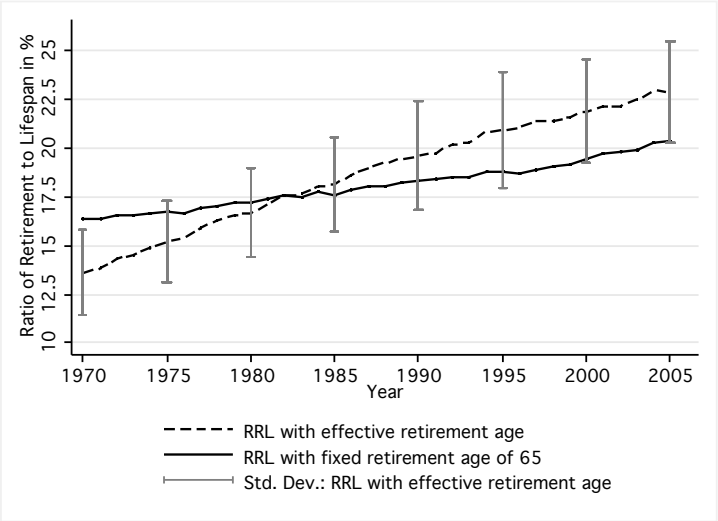
In 1970, on average 15.5 percent of the life time was spent in retirement. Until 2005 the proportion rose linearly to 20.4 percent. Thus, given the age of 65 defining retirement, within 35 years the last stage of the life cycle increased on average by 4.0 percent. Within the observed period the variation between the observed countries changed slightly. The range between the standard deviation bounds increased marginally from 1.7 percent in 1970 to 2.9 percent in 2005.[9]

Based on the assumption of a fixed retirement at age 65, gained life years are added at the end of life. Therefore, alterations in the proportion of life spent in retirement are driven by the development of longevity.

The application of age 65 as a fixed point in life for defining old age and retirement obscures the picture of the life cycle. Between 1970 and 2005 the effective retirement behavior changed considerably in addition to the gains in life expectancy. Figure 2 presents the life cycle development based on the effective average age at retirement in comparison to the expected life cycle arrangements drawn on the assumption of a fixed retirement. The variation in the effective life cycle development of the analyzed countries is captured by the range of the standard deviation in five year intervals.

[9]See Figure 5 in the appendix for further details.

Figure 2: The effective life cycle change and the "behavioral effect"



Source: Author's calculations.

Whereas at the beginning of 1970 the effective proportion of life time spent in retirement was on an average level of 13.6 percent, it expanded steadily to about 23.0 percent in 2005. Overall the effective proportion of life time spent in retirement increased by approximately 10.0 percent within this 35 years. Thereby, the variation increased over time. The range between the upper and lower standard deviation changed slightly from 4.1 percent in 1970 to 5.2 percent in 2005 reaching a peak of 6.1 percent in 1993.[10]

Compared to the life cycle development under the assumption of a fixed retirement age of 65, the effective life cycle arrangements diversified more distinctively within the last decades. The actual expansion of the relative life time spent in retirement was more than twice as high as under the assumption of a fixed retirement age. This implies a strong effect of the actual retirement behavior ("behavioral effect").

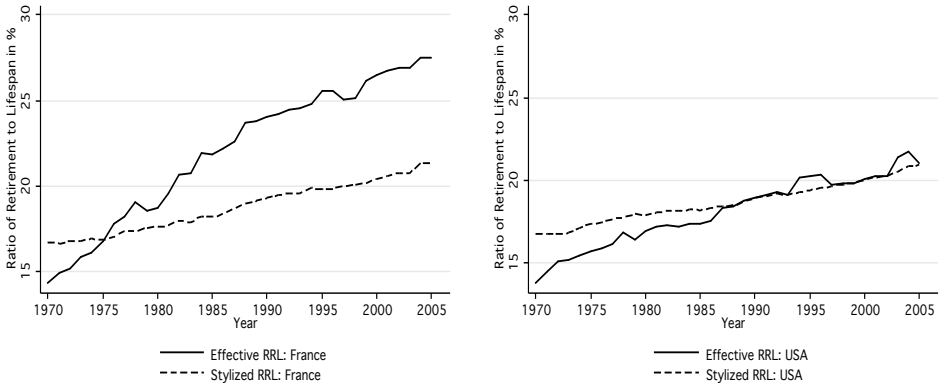
Fluctuations in life cycle arrangements differ between the analyzed OECD countries according to variations in longevity and the effective retirement ages. Amongst others, diversity in the development of life expectancy could be caused by differing public health systems, distinct education levels or the economic development (e. g., Riley, 2001). The labor force participa-

[10] See Figure 5 in the appendix for further details.

tion in older ages and the resulting effective retirement ages are influenced by economic conditions and social security system arrangements. Likewise longevity and health differences also affect the retirement decision of individuals (e. g., Bloom et al., 2007).

For example, the remaining life expectancy at age 65 for French and US males increased between 1970 and 2005 on an almost similar level from 13.0 to 17.6 years in France and from 13.0 to 17.2 years in the US. But, the retirement behavior in both countries varies considerably.[11] For France Blanchet and Pelé (1999) and for the US Diamond and Gruber (1999) found evidence, that the diverse retirement ages are influenced by different social security systems.

Figure 3: Comparison of France and the US



France **United States**

Source: Author's calculations.

Figure 3 illustrates the emerging disparities in the proportional life time spent in retirement between both countries. In 1970, under the assumption of a "normal retirement age" of 65, about 16.7 percent of life time of French and US males were spent in retirement. Until 2005 this proportion grew by roughly 4.0 percent to 21.3 percent in France and 20.9 percent in the United States.

However, the effective life cycle arrangement between both countries diverged substantially. In France the effective length of the retirement span

[11] For more details and other country specific information see Table 2 in the appendix.

nearly doubled from 14.3 percent in 1970 to 27.5 percent in 2005. In comparison, the effective retirement span in the US rose between 1970 and 2005 from 13.7 percent to 21.0 percent in 2005. The example shows, that social security systems inherent retirement incentives could have a strong effect on rescaling the life cycle.

5 Conclusion

Within the period 1970 to 2005 longevity in the analyzed OECD countries improved. As individuals can look forward to longer, healthier lives it is likely that life cycle behavior is affected. The additional life time offers opportunities to increase the length of the working life, to invest further time in education or to enjoy more time in leisure. The disproportional change in the life cycle with the assumption of a fixed retirement at age 65 illustrates the sole effect of increased longevity. It is of particular interest that a fixed retirement age does not imply a fixed life cycle arrangement. Therefore, life cycle effects should be examined in the presence of changing longevity and prevailing health conditions.

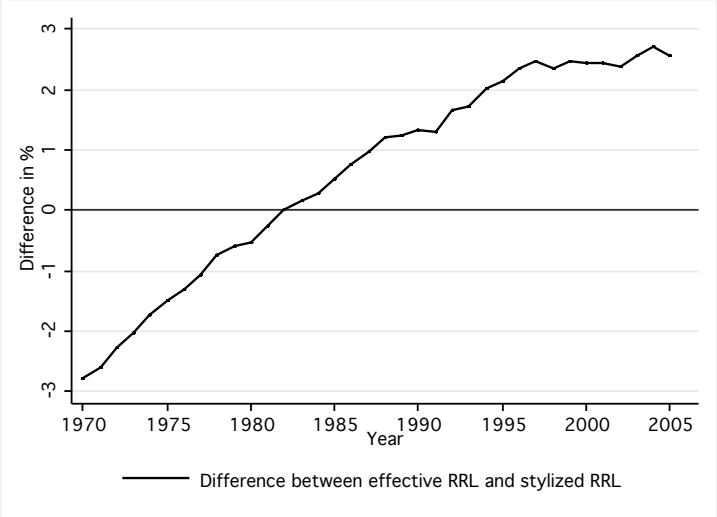
Further, the application of the "normal retirement age" of 65 excludes the impact of social security systems and economic conditions on the retirement age and the associated life cycle rearrangements (e. g., Sheshinski, 1978; Crawford and Lilien, 1981). Within the analyzed sample the improvements in longevity are on average accompanied by a decreasing trend in the effective retirement age. Supplementary to the increasing life expectancy this tendency amplifies the disproportional life cycle change.

Especially when analyzing the need for retirement income or the impact of old age dependency rates on economic development, the concept of a fixed retirement at age 65 is misleading.[12] Thus, by assuming a fixed retirement age the evaluation of longevity effects will presumably be biased.

Figure 4 depicts the observed differences between the effective life cycle arrangements and the life cycle change based on a fixed retirement at age

[12] Varying retirement ages also influence the ratio between the economically active population and the individuals who have left the labor market. With decreasing retirement age the proportion of dependent individuals in old age increases.

Figure 4: Difference between the effective life cycle development from the life cycle fixed retirement age



Source: Author's calculations.

65. In 1970 effective proportional life time spent in retirement was about 3.0 percent lower than the life time distribution with a fixed retirement age. Figure 4 shows that possible effects of life cycle rearrangements have probably been overstated until the beginning of the 1980s. Afterwards, the proportional life time spent in retirement augmented, so in 2005 the actual share of life spent in retirement was approximately 3.0 percent higher than the results based on a fixed retirement age would suggest.[13]

The analysis of the life cycle arrangements identifies an overall increase in the relative length of the retirement span. This implies a necessary change in the life cycle behavior. Individuals have to be aware that retirement, consumption and savings decisions have to be assessed in the context of improving longevity. The strong impact of retirement ages on life cycle arrangements emphasizes the important role of social security systems. As governmental social transfer arrangements have partially overtaken individual financial security functions, policy makers have to be conscious of life cycle dynamics arising from increasing life expectancy and varying retirement ages.

[13]Since the mid 1990s the growth of the effective time spent in retirement decelerates in relation to the stylized life cycle development.

For further analysis it would be desirable to combine the life cycle measures with macroeconomic indicators and to investigate how life cycle changes influenced the average individual cycle behavior. Additionally, it could be of special interest to investigate how specific aspects of social security systems affect the life cycle arrangement.

6 Appendix

Table 1: Analyzed countries

1	Australia	14	Japan
2	Austria	15	Luxembourg
3	Belgium	16	Netherlands
4	Canada	17	New Zealand
5	Czech Republic	18	Norway
6	Denmark	19	Poland
7	Finland	20	Portugal
8	France	21	Slovak Republic
8	Germany	22	Spain
10	Hungary	23	Sweden
11	Iceland	24	Switzerland
12	Ireland	25	United Kingdom
13	Italy	26	United States

Source: Author's illustration.

Table 2: Country data on RRS determinants

Year	Country	Effective retirement age	Life expectancy at age 65	RRL with fixed stylized retirement	RRL with effective retirement
1970	Australia	67.36	11.98	15.56	13.91
1980	Australia	64.13	13.74	17.45	18.32
1990	Australia	62.53	15.19	18.94	20.96
2000	Australia	62.02	17.17	20.90	23.98
2005	Australia	63.74	18.47	22.13	23.21
1970	Austria	66.70	11.69	15.24	13.66
1980	Austria	64.80	12.87	16.53	16.57

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Year	Country	Effective retirement age	Life expectancy at age 65	RRL with fixed stylized retirement	RRL with effective retirement
1990	Austria	62.70	14.35	18.08	20.03
2000	Austria	60.36	15.97	19.72	24.63
2005	Austria	59.06	16.99	20.72	26.76
1970	Belgium	63.85	12.18	15.78	16.67
1980	Belgium	61.50	12.86	16.52	20.13
1990	Belgium	58.48	14.32	18.05	24.95
2000	Belgium	58.48	15.53	19.28	26.36
2005	Belgium	59.29	16.54	20.28	26.26
1970	Canada	65.88	13.76	17.47	16.67
1980	Canada	64.94	14.49	18.23	18.24
1990	Canada	63.32	15.53	19.28	21.10
2000	Canada	62.66	16.76	20.50	22.57
2005	Canada	63.30	17.81	21.51	23.40
1970	Czech Rep.	na	na	na	na
1980	Czech Rep.	na	na	na	na
1990	Czech Rep.	na	na	na	na
2000	Czech Rep.	61.67	13.64	17.34	20.17
2005	Czech Rep.	61.48	14.44	18.18	21.80
1970	Denmark	68.28	13.77	17.48	14.88
1980	Denmark	65.47	13.63	17.33	17.23
1990	Denmark	65.43	13.99	17.71	17.62
2000	Denmark	63.42	15.16	18.91	20.76
2005	Denmark	64.08	16.11	19.86	20.83
1970	Finland	65.87	11.50	15.03	14.29
1980	Finland	65.92	12.60	16.24	15.41
1990	Finland	61.59	13.74	17.45	20.30
2000	Finland	60.17	15.47	19.22	24.19
2005	Finland	60.54	16.74	20.48	24.52
1970	France	67.60	13.04	16.71	14.32
1980	France	63.50	13.92	17.64	18.70
1990	France	60.02	15.54	19.29	24.05
2000	France	58.79	16.68	20.42	26.49

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Year	Country	Effective retirement age	Life expectancy at age 65	RRL with fixed stylized retirement	RRL with effective retirement
2005	France	58.61	17.62	21.33	27.47
1970	Germany	na	na	na	na
1980	Germany	na	na	na	na
1990	Germany	na	na	na	na
2000	Germany	60.97	15.75	19.50	23.49
2005	Germany	61.55	16.75	20.49	23.61
1970	Hungary	69.72	11.95	15.53	11.70
1980	Hungary	65.43	11.58	15.12	15.04
1990	Hungary	63.23	12.05	15.64	17.16
2000	Hungary	58.50	12.96	16.62	21.88
2005	Hungary	57.87	13.30	16.99	23.16
1970	Iceland	na	na	na	na
1980	Iceland	70.02	15.58	19.33	14.77
1990	Iceland	71.27	16.20	19.95	14.78
2000	Iceland	69.85	17.76	21.46	16.80
2005	Iceland	68.48	18.25	21.92	18.78
1970	Ireland	73.14	12.26	15.87	10.00
1980	Ireland	68.18	12.60	16.24	13.70
1990	Ireland	63.99	13.35	17.04	17.94
2000	Ireland	65.26	14.62	18.36	18.30
2005	Ireland	65.17	16.62	20.36	20.32
1970	Italy	65.90	13.27	16.95	16.09
1980	Italy	62.16	13.51	17.21	19.97
1990	Italy	62.29	15.04	18.79	21.57
2000	Italy	60.19	16.55	20.29	25.34
2005	Italy	60.40	17.47	21.18	26.22
1970	Japan	72.32	12.52	16.15	10.56
1980	Japan	70.70	14.57	18.31	13.02
1990	Japan	70.44	16.23	19.98	15.24
2000	Japan	70.13	17.51	21.22	16.59
2005	Japan	69.34	18.13	21.81	17.89
1970	Luxembourg	65.26	11.92	15.50	15.44

continued on next page

Year	Country	Effective retirement age	Life expectancy at age 65	RRL with fixed stylized retirement	RRL with effective retirement
1980	Luxembourg	60.79	12.42	16.04	19.85
1990	Luxembourg	60.29	14.18	17.91	22.70
2000	Luxembourg	59.69	15.38	19.13	24.22
2005	Luxembourg	59.16	16.70	20.44	26.34
1970	Netherlands	66.55	13.57	17.27	15.67
1980	Netherlands	62.98	13.93	17.65	19.49
1990	Netherlands	59.75	14.38	18.12	23.22
2000	Netherlands	60.59	15.32	19.07	23.28
2005	Netherlands	60.27	16.39	20.14	25.24
1970	New Zealand	67.87	12.45	16.07	13.71
1980	New Zealand	64.95	12.94	16.60	16.61
1990	New Zealand	62.91	14.63	18.37	20.30
2000	New Zealand	64.20	16.59	20.33	21.30
2005	New Zealand	na	na	na	na
1970	Norway	68.21	13.79	17.50	14.89
1980	Norway	67.33	14.24	17.97	16.18
1990	Norway	63.31	14.55	18.29	20.09
2000	Norway	63.95	16.08	19.83	20.85
2005	Norway	63.30	17.15	20.88	22.83
1970	Poland	73.59	12.30	15.91	9.47
1980	Poland	68.01	12.11	15.70	13.27
1990	Poland	66.24	12.41	16.03	15.20
2000	Poland	61.58	13.50	17.20	19.91
2005	Poland	61.36	14.28	18.01	21.48
1970	Portugal	73.15	12.38	16.00	9.84
1980	Portugal	68.75	13.28	16.96	13.58
1990	Portugal	65.43	14.14	17.87	17.77
2000	Portugal	65.06	15.43	19.18	19.17
2005	Portugal	66.22	16.06	19.81	18.81
1970	Slovak Rep.	na	na	na	na
1980	Slovak Rep.	na	na	na	na
1990	Slovak Rep.	na	na	na	na

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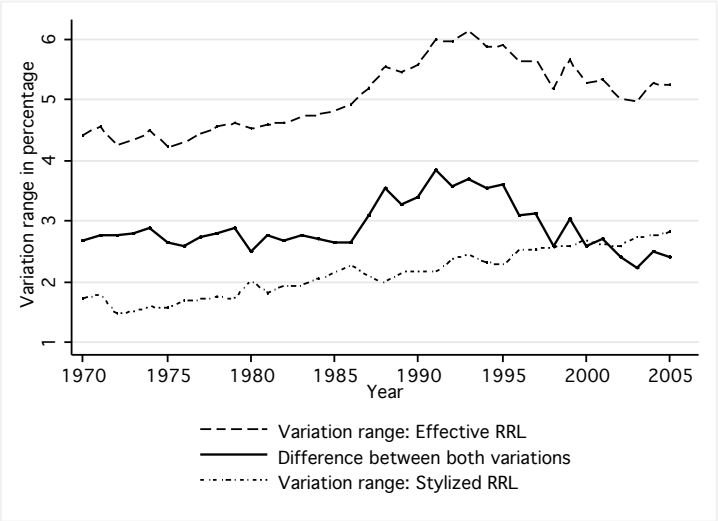
Year	Country	Effective retirement age	Life expectancy at age 65	RRL with fixed stylized retirement	RRL with effective retirement
2000	Slovak Rep.	59.36	12.78	16.43	21.69
2005	Slovak Rep.	59.24	13.29	16.98	22.40
1970	Spain	69.35	13.52	17.22	13.74
1980	Spain	64.80	14.60	18.34	18.39
1990	Spain	62.94	15.45	19.20	21.16
2000	Spain	61.73	16.62	20.36	23.39
2005	Spain	61.16	17.15	20.88	24.86
1970	Sweden	67.88	14.30	18.03	15.39
1980	Sweden	65.31	14.32	18.05	17.98
1990	Sweden	64.24	15.31	19.06	19.96
2000	Sweden	63.68	16.69	20.43	21.50
2005	Sweden	65.40	17.36	21.08	20.98
1970	Switzerland	71.99	13.30	16.99	11.44
1980	Switzerland	69.47	14.29	18.02	14.49
1990	Switzerland	67.77	15.26	19.01	16.32
2000	Switzerland	65.50	16.98	20.71	19.86
2005	Switzerland	65.28	18.05	21.73	21.66
1970	UK	67.71	12.10	15.69	13.36
1980	UK	65.97	12.83	16.48	15.64
1990	UK	62.83	14.00	17.72	19.63
2000	UK	62.39	15.72	19.47	22.36
2005	UK	63.24	16.91	20.64	22.57
1970	USA	68.51	13.04	16.71	13.75
1980	USA	66.40	14.12	17.85	16.92
1990	USA	64.68	15.14	18.89	18.97
2000	USA	64.69	16.25	20.00	20.08
2005	USA	64.56	17.18	20.91	21.02

Source: Author's calculations.

Figure 5: Development of the variation range



Source: Author's calculations.

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