Faster Increases in Human Life Expectancy Will Lead to Slower Population Aging

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ABSTRACT:

Counterintuitively, faster increases in human life expectancy will lead to slower population aging. The conventional view that faster increases in human life expectancy will lead to faster population aging is based on the assumption that people become old at a fixed chronological age. A preferable alternative is to base measures of aging on people's time left to death, because this is more closely related to the characteristics that are associated with old age. Using this alternative interpretation, we show that faster increases in life expectancy will lead to slower population aging. Among other things, this finding affects the assessment of the speed at which countries will age. Our results suggest that many of the challenges of population aging will be harder not when life expectancy growth is faster, but when it is slower.

MAIN TEXT:

The challenges posed by human population aging are widely discussed(1, 2). The scientific foundation of this discussion and of the related policy dialog is a set of conventional measures such as those presented in the United Nations' *World Population Ageing 2013* (2). Those measures are computed for all countries of the world at 5-year intervals from 1950 to 2100. In that volume, the UN categorizes people as being old when they reach age 60. One measure of population aging presented there is the proportion of the population 60+ years old. However, the life expectancy of 60 year old Bangladeshi women in 1950-55 was 14.4 years and that of 60 year old Swedish women in 2095-2100 was forecast to be 34.4 years(3). The UN measures treat both women as becoming old at the same chronological age, even though one group of women has a remaining life expectancy 20 years longer than the other. This is implausible and misleading.

Many studies of population aging focus on specific countries and make forecasts over many decades. Over these long spans of time of characteristics of older people can change considerably. 60 year olds, for example, could have become healthier (4), have longer life expectancies (2, 3, 5, 6), have better cognition (7) and have become less dependent upon others for their daily care (4). Conventional measures of aging are incomplete and biased because they ignore the general improvement in the functioning of older people, at each chronological age.

Ryder (8) challenged the conventional view in which people are classified as old based on a fixed chronological age. In the study of aging, he argued that it would be preferable to consider people as old not based on their chronological ages, but instead on their expected remaining lifetimes. He argued that those expected lifespans were a better reflection of older people's health, dependence on others, and their general level of functioning than their chronological ages. Ryder's insight has been independently rediscovered (9, 10), applied (11–13) and elaborated (10, 14–18). That literature demonstrates that, in the study of population aging over a long time period and across countries with quite different mortality conditions, it is preferable to use a definition of age based on remaining life expectancy than one based on chronological age.

Age can be measured backwards as the number of years since birth or forwards based on the expected number of years till death. The first age measure is simply a person's chronological age. We call ages based on remaining life expectancy *prospective age*s. For example, 74 year old French women in 2012 had a remaining life expectancy of 15.24 years. 74 year old French women in 1970 had a remaining life expectancy of 10.37, almost 5 years less. The chronological ages of these two groups of women are the same, but they had different remaining life expectancies. 67 year old French women in 1970 had the same remaining life expectancy as the 74 year old French women in 2012, 15.24 years (19). Those two groups of women are the same in terms of remaining life expectancy, even though their chronological ages are different. Using 1970 as a base year, 74 year old French women in 2014 have a prospective age of 67, because the 74 year old French women in 2014 had the same remaining life expectancy as 67 year old French women in 1970. Adjusting ages for differences in remaining life expectancies is analogous to what economists do when they adjust monetary quantities for changes in the price level.

In this paper, we show a previously unobserved implication of using prospective ages. Increases in measures of population aging are slower when the pace of life expectancy improvements is faster. This is the opposite of the conventional view that faster increases in life expectancy will cause the speed of aging to increase.

RESULTS

In order to take the changing characteristics of older people into account, we have computed *prospective ages*. These are ages based on the expected number of years people have left to live. In the conventional approach, people are assumed to become old when they reach their 60th or 65th birthdays. In contrast, we define the old age threshold as the age at which remaining life expectancy first falls below 15 years. This is roughly the remaining life expectancy of people in low mortality countries in the 1960s (19).

We use three scenarios for population projections. The baseline scenario (Scenario 3) is the one used elsewhere to make population forecasts from 2013 to 2050 for all European countries(20). Scenario 1 is identical to Scenario 3 except that life expectancies at birth are kept constant at their 2013 levels. In

Scenario 2, gains in life expectancy at birth from 2013 onwards are half as large as in Scenario 3. Thus, the speed of life expectancy increase rises with the scenario number. The derived life expectancies at age 65 for all European countries for 2013, 2030, and 2050 are presented in Table SI1. The average pace of increase of life expectancy at 65 in all European countries is around 0.7 years per decade in the second scenario and around 1.4 years per decade in the third.

Table 1 shows the proportions of the German population, for the years 2013, 2030, and 2050, who are old using as the old age threshold: (1) age 65, and (2) the age when remaining life expectancy first falls below 15 years. Table 1 shows that faster gains in life expectancy increase the measured speed of aging using the conventional measure, but decrease it when changes in longevity are taken into account. In 2050, in Scenario 1, with no life expectancy increase, the proportion of the German population 65+ years old would be 0.278. With the expected increase in life expectancy, but unaltered fertility and mortality rates, the proportion grows to 0.329. In Scenario 3, more elderly people survive and the proportion 65+ increases. When prospective age is used, the threshold age at which people are categorized as old changes over time. The prospective proportion old is 0.237 in Scenario 1. In Scenarios 2 and 3 it is lower, 0.218 and 0.199 respectively. The proportion of the population old falls with increases the speed of life expectancy gains. All European countries exhibit the same pattern (Table SI2).

The computation of the conventional and the prospective proportion old require the specification of a criterion which separates old people from those who are not old. Another common measure of population aging is the speed of change in a population’s median age. The computation of the median age differs from that of the proportion old in that no criterion is needed to separate who is old from who is not.

In Table 2, we show the conventional median age and prospective median age for Germany under the three scenarios for 2013, 2030, and 2050. The prospective median age is the age in the base year (in this case 2013) where remaining life expectancy is the same as at the median age in the indicated year. Thus, in addition to changes in the conventional median age, the prospective median age takes into account how life expectancy at the conventional median age is changing. As life expectancy increases it is possible that, simultaneously, the conventional median age grows older and remaining life expectancy at that median age grows longer (10).

The conventional median age and the prospective median age are identical in Scenario 1, where there is no increase in life expectancy. In 2013, the median age of the German population was 46.5 years. If age-specific survival rates remained constant at their 2013 levels, the median age is forecast to rise to 49.3 in 2050 because of the age structure of the German population in 2013 and assumptions about fertility and migration rates. If, in addition, age-specific survival rates were to increase as in Scenario 3, the median age would rise another 3.3 years to 52.6 in 2050. This example illustrates that when the conventional median age is used as an indicator of aging, faster increases in life expectancy appear to cause faster increases in aging.

When the prospective median age is used as an indicator of aging, Table 2 demonstrates the opposite result. If there would be no increase in life expectancy between 2013 and 2050, the prospective median age would rise 2.8 years from 46.5 to 49.3. If life expectancy increases, as in Scenario 3, the prospective median age actually decreases. The prospective median age in Scenario 3 in 2050 is 3.7 years lower than it would be under the assumption of no life expectancy increase. Here again faster increases in life expectancy lead to slower increases in measured population aging. This pattern, again, is the same for all European countries (Table SI3).

DISCUSSION

We present data here on the two of most commonly used measures of population aging, the proportion of the population old and the median age of the population for 39 European countries for 2013, 2030, and 2050 in Tables SI2, and SI3. These countries, which include Germany, Iceland, Moldova, and Russia, exhibit a wide variety of demographic conditions and in all these cases the prospective measures indicate that faster increases in life expectancy lead to slower population aging.

The main difference between the prospective and conventional measures of the proportion of the population who are old is not that they use different old age thresholds. It is that, in the case of the prospective measure, the old age threshold changes slowly over time as life expectancy changes.

The prospective median age is an indicator of the median remaining lifespan of the population. When we compare populations in Scenario 1, with no increase in longevity, with those in Scenario 3, we see that the chronological median age of the populations in Scenario 3 are higher than those in Scenario 1, but that the median remaining life expectancies are also higher. Increases in life expectancy gains make populations relatively younger in the sense of having a longer median remaining lifespan.

The connections between life expectancy and aging presented here are important for understanding the future speed of aging. There are numerous data sources that provide information on the extent and speed of aging in various countries(21, 22). Virtually all of these cite the UN measures that assume old age begins at 60 or 65, but those measures are incomplete. There are two aspects of aging that need to be incorporated into studies of population aging, changes in the age structures of populations and changes in the characteristics of people.

One way in which population aging can occur is that fertility falls and everything else about the population, including life expectancy, remains the same. This is a situation in which the age structure of the population changes, but the age-specific characteristics of people remain the same. In this case, the conventional and prospective proportions of the population who are old and the conventional and prospective median ages of the population would rise, not because there are more elderly people, but because there are fewer young people. Faster decreases in fertility, everything else being equal, would result in faster increases in the measures of aging, but conventional and prospective median ages would remain identical. When population aging happens only because of reductions in fertility, but not because of changes in life expectancy, the conventional measures, based solely on chronological age work well.

Population aging in most European countries in the last half century has not been the result solely of decreases in fertility. Life expectancy has also risen at each older age. The prospective approach takes this into account.

METHODS

The population projections made in this paper use the cohort component method(23) The required inputs are initial distributions of populations by age and sex in the base year and assumptions about future age-specific rates of fertility, mortality, and migration. In Scenario 3, we use the initial population distributions and the future age-specific rates that were used in making the projections in the European Demographic Data Sheet 2014(20). The initial population age structures used there come from Eurostat(24). The forecasts of age-specific rates come from a study that utilized both historical data and expert opinion(25). Scenario 1 uses the same initial population distributions, age-specific fertility and migration assumptions as Scenario 3, but keeps age-specific survival rates constant. Scenario 2 was created on the assumption that changes in life expectancy at birth from 2013 onward were half of those in Scenario 3. This was done separately for men and women. Age-specific mortality rates in Scenario 2 and 3 were obtained from scenarios specified with respect to life expectancy at birth, using a Brass relationship model(26).

Prospective median ages are the ages in 2013 where remaining life expectancy is the same as at the median age in the indicated year. More formally, Let $ma(t)$ be the median age of a population in year t, *e(a,t)* be remaining life expectancy at age *a* in year *t* and let the remaining life expectancy at the median age be $e(ma(t), t)$. The prospective median age is the age in the base year (2013, in this case) with the same remaining life expectancy as observed at the median age in year t ($e^{-1}(e(ma(t), t), 2013)$).

The threshold ages for being categorized as old are defined as those ages where remaining life expectancy is 15 years or less. Let $a_{old}(t)$ be the old age threshold in year *t.* The old age threshold, then is defined as $a_{old}(t) = e^{-1}(15, t)$.

The mechanics of the computation of prospective median age and the proportion old are quite different. The life table for each country in 2013 is used as a standard in the calculation of prospective median ages. It does not matter which year is chosen for the standard or even if one of the standards was used for all the countries. Faster increases in life expectancy would still lead to slower changes in measures of population aging.

The computation of the proportion old does not rely on a standard. Instead, it uses the assumption that old age begins when remaining life expectancy first falls below 15 years. The exact assumption about the threshold remaining life expectancy does not matter. If we had instead used any plausible number, the faster increases in life expectancy would again lead to slower changes in measures of population aging. It is possible to imagine different criteria for the onset of old age. We have investigated some of these and not found any that would change the conclusions presented here.

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	Proportion of Population 65+ Years Old (Conventional Proportion Old)			Proportion of Population in Age Groups with Remaining Life Expectancy of 15 Years or Less (Prospective Proportion Old)		
Year	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
2013	0.207	0.207	0.207	0.132	0.132	0.132
2030	0.267	0.273	0.279	0.176	0.166	0.155
2050	0.278	0.303	0.329	0.237	0.218	0.199

Table 1: Conventional and Prospective Proportions Old, Germany 2013, 2030, and 2050: Three Scenarios of Life Expectancy Increase

	Conventional Median Age			Prospective Median Age		
Year	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
2013	46.5	46.5	46.5	46.5	46.5	46.5
2030	49.1	49.5	49.9	49.1	47.9	46.6
2050	49.3	50.9	52.6	49.3	47.4	45.6

Table 2: Conventional and Median Prospective Ages, Germany, 2013, 2030, and 2050 for 3 Scenarios of the Speed of Life Expectancy Increase

Note: 2013 is used as the standard year.

Supplementary Information

Table SI1: Remaining Life Expectancies at Age 65 (females)

	Scenario 1	Scenario 2	Scenario 3
Albania			
2013	19.43	19.43	19.43
2030	19.43	20.45	21.56
2050	19.43	21.74	24.44
Austria			
2013	21.37	21.37	21.37
2030	21.37	22.75	24.24
2050	21.37	24.47	28.01
Belarus			
2013	17.45	17.45	17.45
2030	17.45	18.23	19.07
2050	17.45	19.45	21.79
Belgium			
2013	21.31	21.31	21.31
2030	21.31	22.66	24.13
2050	21.31	24.12	27.35
Bulgaria			
2013	17.18	17.18	17.18
2030	17.18	17.95	18.78
2050	17.18	19.19	21.55
Croatia			
2013	18.68	18.68	18.68
2030	18.68	19.83	21.07
2050	18.68	21.25	24.21
Cyprus			
2013	20.41	20.41	20.41
2030	20.41	21.41	22.48
2050	20.41	22.97	25.86
Czech Rep.			
2013	19.32	19.32	19.32
2030	19.32	20.67	22.12
2050	19.32	22.32	25.77
Denmark			
2013	20.17	20.17	20.17
2030	20.17	21.20	22.30
2050	20.17	22.63	25.38
Estonia			
2013	20.00	20.00	20.00

	Scenario 1	Scenario 2	Scenario 3
2030	20.00	20.41	20.84
2050	20.00	21.67	23.53
Finland			
2013	21.61	21.61	21.61
2030	21.61	22.85	24.18
2050	21.61	24.33	27.43
France			
2013	23.70	23.70	23.70
2030	23.70	24.82	26.01
2050	23.70	26.30	29.22
Georgia			
2013	17.63	17.63	17.63
2030	17.63	18.41	19.24
2050	17.63	19.70	22.08
Germany			
2013	21.14	21.14	21.14
2030	21.14	22.33	23.60
2050	21.14	23.81	26.84
Greece			
2013	20.84	20.84	20.84
2030	20.84	22.20	23.66
2050	20.84	23.73	27.06
Hungary			
2013	18.09	18.09	18.09
2030	18.09	19.03	20.05
2050	18.09	20.27	22.81
Iceland			
2013	21.40	21.40	21.40
2030	21.40	22.73	24.13
2050	21.40	24.33	27.56
Ireland			
2013	20.99	20.99	20.99
2030	20.99	22.05	23.18
2050	20.99	23.49	26.30
Italy			
2013	22.61	22.61	22.61
2030	22.61	23.77	24.99
2050	22.61	25.33	28.35
Latvia			
2013	18.43	18.43	18.43
2030	18.43	19.33	20.30
2050	18.43	20.58	23.08

	Scenario 1	Scenario 2	Scenario 3
Lithuania			
2013	19.07	19.07	19.07
2030	19.07	19.89	20.77
2050	19.07	21.14	23.54
Luxembourg			
2013	21.24	21.24	21.24
2030	21.24	22.30	23.41
2050	21.24	23.79	26.64
Macedonia			
2013	15.93	15.93	15.93
2030	15.93	17.05	18.29
2050	15.93	18.52	21.68
Malta			
2013	20.64	20.64	20.64
2030	20.64	21.64	22.70
2050	20.64	23.08	25.87
Moldova			
2013	15.57	15.57	15.57
2030	15.57	16.18	16.83
2050	15.57	17.30	19.32
Montenegro			
2013	17.25	17.25	17.25
2030	17.25	18.64	20.19
2050	17.25	20.05	23.42
Netherland			
2013	21.05	21.05	21.05
2030	21.05	22.13	23.27
2050	21.05	23.58	26.43
Norway			
2013	21.24	21.24	21.24
2030	21.24	22.44	23.71
2050	21.24	23.96	27.00
Poland			
2013	19.73	19.73	19.73
2030	19.73	20.66	21.64
2050	19.73	21.99	24.55
Portugal			
2013	21.23	21.23	21.23
2030	21.23	22.29	23.42
2050	21.23	23.75	26.62
Romania			
2013	17.71	17.71	17.71

	Scenario 1	Scenario 2	Scenario 3
2030	17.71	18.80	20.00
2050	17.71	20.11	22.96
Russian Federation			
2013	16.97	16.97	16.97
2030	16.97	17.59	18.26
2050	16.97	18.54	20.39
Serbia			
2013	16.49	16.49	16.49
2030	16.49	17.39	18.36
2050	16.49	18.67	21.24
Slovakia			
2013	18.44	18.44	18.44
2030	18.44	19.49	20.62
2050	18.44	20.85	23.65
Slovenia			
2013	20.86	20.86	20.86
2030	20.86	21.83	22.85
2050	20.86	23.28	25.98
Spain			
2013	22.64	22.64	22.64
2030	22.64	23.62	24.66
2050	22.64	25.15	27.97
Sweden			
2013	21.22	21.22	21.22
2030	21.22	22.33	23.50
2050	21.22	23.83	26.72
Switzerland			
2013	22.42	22.42	22.42
2030	22.42	23.82	25.31
2050	22.42	25.37	28.71
UK			
2013	21.22	21.22	21.22
2030	21.22	22.34	23.52
2050	21.22	23.76	26.62
Ukraine			
2013	16.65	16.65	16.65
2030	16.65	16.95	17.26
2050	16.65	17.96	19.44

Note: Scenarios are based on the assumptions concerning life expectancies at birth discussed in the text.

TableSI2: Proportions Old

	Proportion 65+			Proportion With Remaining Life Expectancy 15 Years or Less		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Albania						
2013	0.118	0.118	0.118	0.099	0.099	0.099
2030	0.189	0.193	0.198	0.154	0.145	0.135
2050	0.222	0.242	0.263	0.190	0.179	0.170
Austria						
2013	0.181	0.181	0.181	0.119	0.119	0.119
2030	0.236	0.243	0.250	0.152	0.141	0.131
2050	0.263	0.290	0.317	0.189	0.183	0.174
Belarus						
2013	0.138	0.138	0.138	0.148	0.148	0.148
2030	0.197	0.201	0.205	0.198	0.185	0.174
2050	0.224	0.244	0.267	0.231	0.209	0.190
Belgium						
2013	0.176	0.176	0.176	0.121	0.121	0.121
2030	0.216	0.222	0.228	0.146	0.137	0.128
2050	0.220	0.241	0.263	0.158	0.152	0.145
Bulgaria						
2013	0.192	0.192	0.192	0.182	0.182	0.182
2030	0.227	0.231	0.235	0.218	0.209	0.201
2050	0.260	0.281	0.304	0.250	0.235	0.220
Croatia						
2013	0.181	0.181	0.181	0.158	0.158	0.158
2030	0.228	0.234	0.241	0.197	0.187	0.176
2050	0.245	0.269	0.295	0.212	0.198	0.185
Cyprus						
2013	0.132	0.132	0.132	0.087	0.087	0.087
2030	0.169	0.172	0.175	0.115	0.109	0.104
2050	0.197	0.211	0.226	0.133	0.123	0.113
Czech Rep.						
2013	0.168	0.168	0.168	0.126	0.126	0.126
2030	0.210	0.217	0.223	0.173	0.164	0.155
2050	0.239	0.264	0.290	0.197	0.180	0.159
Denmark						
2013	0.178	0.178	0.178	0.117	0.117	0.117
2030	0.212	0.215	0.219	0.154	0.147	0.140
2050	0.199	0.215	0.233	0.153	0.148	0.140
Estonia						
2013	0.180	0.180	0.180	0.147	0.147	0.147

2030	0.222	0.224	0.225	0.181	0.176	0.170
2050	0.244	0.258	0.273	0.202	0.189	0.177
Finland						
2013	0.188	0.188	0.188	0.117	0.117	0.117
2030	0.238	0.244	0.250	0.167	0.159	0.151
2050	0.217	0.237	0.258	0.152	0.146	0.141
France						
2013	0.175	0.175	0.175	0.103	0.103	0.103
2030	0.228	0.233	0.237	0.137	0.129	0.122
2050	0.233	0.251	0.271	0.153	0.147	0.139
Georgia						
2013	0.138	0.138	0.138	0.132	0.132	0.132
2030	0.195	0.199	0.204	0.176	0.166	0.155
2050	0.257	0.279	0.302	0.237	0.218	0.199
Germany						
2013	0.207	0.207	0.207	0.148	0.148	0.148
2030	0.267	0.273	0.279	0.177	0.166	0.156
2050	0.278	0.303	0.329	0.205	0.201	0.197
Greece						
2013	0.201	0.201	0.201	0.144	0.144	0.144
2030	0.234	0.240	0.247	0.164	0.155	0.146
2050	0.280	0.304	0.330	0.205	0.192	0.178
Hungary						
2013	0.172	0.172	0.172	0.153	0.153	0.153
2030	0.208	0.213	0.219	0.191	0.183	0.176
2050	0.239	0.261	0.283	0.219	0.206	0.192
Iceland						
2013	0.129	0.129	0.129	0.076	0.076	0.076
2030	0.181	0.185	0.189	0.111	0.105	0.098
2050	0.191	0.206	0.223	0.124	0.119	0.113
Ireland						
2013	0.122	0.122	0.122	0.079	0.079	0.079
2030	0.169	0.172	0.176	0.113	0.107	0.101
2050	0.211	0.226	0.242	0.147	0.136	0.125
Italy						
2013	0.212	0.212	0.212	0.137	0.137	0.137
2030	0.261	0.266	0.271	0.166	0.158	0.150
2050	0.302	0.325	0.347	0.218	0.206	0.192
Latvia						
2013	0.188	0.188	0.188	0.173	0.173	0.173
2030	0.226	0.231	0.237	0.203	0.192	0.181
2050	0.252	0.275	0.300	0.232	0.215	0.201
Lithuania						

2013	0.182	0.182	0.182	0.160	0.160	0.160
2030	0.228	0.232	0.236	0.193	0.182	0.170
2050	0.244	0.265	0.288	0.217	0.205	0.195
Luxembourg						
2013	0.140	0.140	0.140	0.094	0.094	0.094
2030	0.172	0.175	0.179	0.110	0.103	0.097
2050	0.186	0.202	0.218	0.130	0.124	0.118
Macedonia						
2013	0.120	0.120	0.120	0.122	0.122	0.122
2030	0.170	0.176	0.182	0.172	0.162	0.152
2050	0.210	0.235	0.261	0.212	0.194	0.178
Malta						
2013	0.172	0.172	0.172	0.109	0.109	0.109
2030	0.238	0.242	0.246	0.177	0.168	0.160
2050	0.252	0.270	0.289	0.182	0.168	0.157
Moldova						
2013	0.099	0.099	0.099	0.115	0.115	0.115
2030	0.180	0.183	0.186	0.196	0.187	0.178
2050	0.256	0.275	0.296	0.290	0.257	0.227
Montenegro						
2013	0.132	0.132	0.132	0.119	0.119	0.119
2030	0.182	0.188	0.195	0.164	0.153	0.143
2050	0.200	0.223	0.249	0.180	0.167	0.154
Netherland						
2013	0.168	0.168	0.168	0.107	0.107	0.107
2030	0.234	0.239	0.244	0.160	0.152	0.143
2050	0.238	0.258	0.279	0.178	0.173	0.167
Norway						
2013	0.157	0.157	0.157	0.097	0.097	0.097
2030	0.190	0.194	0.199	0.128	0.121	0.115
2050	0.198	0.214	0.232	0.140	0.133	0.125
Poland						
2013	0.142	0.142	0.142	0.112	0.112	0.112
2030	0.215	0.220	0.224	0.174	0.165	0.156
2050	0.259	0.279	0.300	0.203	0.184	0.168
Portugal						
2013	0.194	0.194	0.194	0.136	0.136	0.136
2030	0.238	0.243	0.248	0.167	0.159	0.150
2050	0.261	0.281	0.303	0.195	0.184	0.172
Romania						
2013	0.164	0.164	0.164	0.149	0.149	0.149
2030	0.210	0.216	0.222	0.193	0.185	0.176
2050	0.271	0.297	0.324	0.251	0.236	0.218

Russian Federation						
2013	0.129	0.129	0.129	0.138	0.138	0.138
2030	0.184	0.187	0.190	0.187	0.178	0.169
2050	0.199	0.213	0.230	0.206	0.189	0.172
Serbia						
2013	0.176	0.176	0.176	0.173	0.173	0.173
2030	0.217	0.223	0.229	0.212	0.204	0.195
2050	0.218	0.240	0.263	0.213	0.199	0.185
Slovakia						
2013	0.131	0.131	0.131	0.113	0.113	0.113
2030	0.195	0.200	0.206	0.172	0.162	0.153
2050	0.240	0.262	0.286	0.212	0.194	0.176
Slovenia						
2013	0.171	0.171	0.171	0.123	0.123	0.123
2030	0.239	0.243	0.246	0.174	0.165	0.157
2050	0.271	0.290	0.310	0.203	0.190	0.178
Spain						
2013	0.177	0.177	0.177	0.114	0.114	0.114
2030	0.230	0.234	0.238	0.142	0.135	0.127
2050	0.300	0.320	0.340	0.207	0.192	0.175
Sweden						
2013	0.191	0.191	0.191	0.119	0.119	0.119
2030	0.209	0.214	0.218	0.145	0.139	0.133
2050	0.200	0.217	0.234	0.142	0.135	0.128
Switzerland						
2013	0.174	0.174	0.174	0.102	0.102	0.102
2030	0.233	0.239	0.245	0.140	0.131	0.122
2050	0.260	0.282	0.305	0.175	0.168	0.159
UK						
2013	0.172	0.172	0.172	0.109	0.109	0.109
2030	0.206	0.211	0.215	0.136	0.129	0.122
2050	0.215	0.232	0.249	0.150	0.143	0.137
Ukraine						
2013	0.152	0.152	0.152	0.162	0.162	0.162
2030	0.190	0.192	0.193	0.196	0.192	0.187
2050	0.214	0.226	0.238	0.225	0.209	0.192

Note: Scenarios are based on the assumptions concerning life expectancies at birth discussed in the text.

Table SI3: Median Age and Prospective Median Age, 3 scenarios (females)

	Median Age			Prospective Median Age		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Albania						
2013	35.63	35.63	35.63	35.63	35.63	35.63
2030	42.09	42.33	42.57	42.09	40.99	39.84
2050	50.68	51.59	52.55	50.68	48.75	46.59
Austria						
2013	43.80	43.80	43.80	43.80	43.80	43.80
2030	47.07	47.45	47.83	47.07	45.62	44.12
2050	48.51	50.26	52.07	48.51	46.29	44.00
Belarus						
2013	42.32	42.32	42.32	42.32	42.32	42.32
2030	46.53	46.72	46.91	46.53	45.45	44.36
2050	48.44	50.05	51.77	48.44	47.01	45.57
Belgium						
2013	42.22	42.22	42.22	42.22	42.22	42.22
2030	43.40	43.78	44.17	43.40	41.88	40.35
2050	43.21	44.53	45.97	43.21	40.72	38.25
Bulgaria						
2013	44.96	44.96	44.96	44.96	44.96	44.96
2030	48.91	49.18	49.45	48.91	47.98	47.03
2050	49.69	51.26	53.16	49.69	48.28	47.09
Croatia						
2013	44.52	44.52	44.52	44.52	44.52	44.52
2030	47.18	47.57	47.96	47.18	45.95	44.71
2050	48.40	50.05	51.70	48.40	46.58	44.68
Cyprus						
2013	37.10	37.10	37.10	37.10	37.10	37.10
2030	41.85	42.00	42.14	41.85	40.71	39.54
2050	44.20	45.22	46.27	44.20	42.03	39.77
Czech Rep.						
2013	41.93	41.93	41.93	41.93	41.93	41.93
2030	46.88	47.29	47.70	46.88	45.42	43.92
2050	45.57	47.36	49.28	45.57	43.32	41.12
Denmark						
2013	41.90	41.90	41.90	41.90	41.90	41.90
2030	42.09	42.39	42.68	42.09	40.94	39.77
2050	41.48	42.55	43.66	41.48	39.21	36.91
Estonia						
2013	44.29	44.29	44.29	44.29	44.29	44.29
2030	47.26	47.33	47.40	47.26	46.73	46.19

2050	47.32	48.33	49.41	47.32	46.00	44.63
Finland						
2013	44.04	44.04	44.04	44.04	44.04	44.04
2030	44.29	44.68	45.06	44.29	43.01	41.69
2050	42.51	43.81	45.23	42.51	40.22	37.96
France						
2013	41.83	41.83	41.83	41.83	41.83	41.83
2030	43.85	44.13	44.42	43.85	42.59	41.33
2050	43.63	44.78	46.01	43.63	41.33	39.05
Georgia						
2013	39.69	39.69	39.69	39.69	39.69	39.69
2030	45.99	46.17	46.35	45.99	45.03	44.04
2050	51.78	53.43	54.99	51.78	50.61	49.21
Germany						
2013	46.46	46.46	46.46	46.46	46.46	46.46
2030	49.07	49.46	49.85	49.07	47.85	46.61
2050	49.28	50.91	52.63	49.28	47.42	45.55
Greece						
2013	43.80	43.80	43.80	43.80	43.80	43.80
2030	48.58	48.96	49.33	48.58	47.19	45.75
2050	48.34	50.07	51.93	48.34	46.41	44.49
Hungary						
2013	43.47	43.47	43.47	43.47	43.47	43.47
2030	47.76	48.12	48.46	47.76	46.60	45.41
2050	48.46	49.93	51.50	48.46	46.56	44.69
Iceland						
2013	36.19	36.19	36.19	36.19	36.19	36.19
2030	38.53	38.77	39.00	38.53	37.09	35.58
2050	39.87	40.81	41.81	39.87	37.20	34.43
Ireland						
2013	35.90	35.90	35.90	35.90	35.90	35.90
2030	40.57	40.83	41.07	40.57	39.37	38.14
2050	40.75	41.59	42.46	40.75	38.27	35.74
Italy						
2013	45.71	45.71	45.71	45.71	45.71	45.71
2030	51.08	51.38	51.69	51.08	49.94	48.77
2050	50.54	52.16	53.86	50.54	48.84	47.12
Latvia						
2013	45.68	45.68	45.68	45.68	45.68	45.68
2030	48.54	48.89	49.24	48.54	47.48	46.40
2050	50.88	52.87	54.85	50.88	49.75	48.47
Lithuania						
2013	45.15	45.15	45.15	45.15	45.15	45.15

2030	48.11	48.41	48.72	48.11	47.09	46.06
2050	50.64	52.18	53.73	50.64	49.07	47.40
Luxembourg						
2013	39.68	39.68	39.68	39.68	39.68	39.68
2030	40.30	40.49	40.67	40.30	39.04	37.79
2050	40.47	41.31	42.17	40.47	37.97	35.40
Macedonia						
2013	37.67	37.67	37.67	37.67	37.67	37.67
2030	42.89	43.20	43.52	42.89	41.51	40.07
2050	46.25	47.91	49.58	46.25	44.15	41.91
Malta						
2013	41.96	41.96	41.96	41.96	41.96	41.96
2030	45.79	46.05	46.30	45.79	44.74	43.63
2050	48.17	49.46	50.79	48.17	46.34	44.41
Moldova						
2013	36.78	36.78	36.78	36.78	36.78	36.78
2030	45.71	45.83	45.95	45.71	44.80	43.84
2050	55.62	56.66	57.65	55.62	53.99	52.17
Montenegro						
2013	38.50	38.50	38.50	38.50	38.50	38.50
2030	42.06	42.49	42.92	42.06	40.40	38.66
2050	43.95	45.56	47.18	43.95	41.48	38.91
Netherland						
2013	42.39	42.39	42.39	42.39	42.39	42.39
2030	44.90	45.22	45.55	44.90	43.72	42.53
2050	44.98	46.28	47.62	44.98	42.87	40.72
Norway						
2013	39.68	39.68	39.68	39.68	39.68	39.68
2030	40.52	40.78	41.04	40.52	39.19	37.83
2050	40.69	41.72	42.79	40.69	38.19	35.63
Poland						
2013	40.53	40.53	40.53	40.53	40.53	40.53
2030	46.63	46.83	47.03	46.63	45.47	44.29
2050	49.84	51.34	52.86	49.84	48.15	46.42
Portugal						
2013	44.14	44.14	44.14	44.14	44.14	44.14
2030	48.91	49.18	49.46	48.91	47.78	46.62
2050	47.63	48.93	50.25	47.63	45.68	43.62
Romania						
2013	42.70	42.70	42.70	42.70	42.70	42.70
2030	49.00	49.34	49.70	49.00	47.70	46.36
2050	51.18	52.96	54.92	51.18	49.52	47.89
Russian Federation						

2013	41.24	41.24	41.24	41.24	41.24	41.24
2030	44.93	45.08	45.24	44.93	43.97	42.99
2050	44.80	45.88	47.03	44.80	43.18	41.52
Serbia						
2013	44.51	44.51	44.51	44.51	44.51	44.51
2030	46.48	46.80	47.13	46.48	45.40	44.30
2050	46.42	47.75	49.18	46.42	44.50	42.56
Slovakia						
2013	39.74	39.74	39.74	39.74	39.74	39.74
2030	45.85	46.13	46.41	45.85	44.59	43.30
2050	48.01	49.68	51.35	48.01	46.29	44.48
Slovenia						
2013	44.00	44.00	44.00	44.00	44.00	44.00
2030	48.25	48.49	48.73	48.25	47.17	46.08
2050	47.54	49.10	50.75	47.54	45.92	44.30
Spain						
2013	42.43	42.43	42.43	42.43	42.43	42.43
2030	49.23	49.41	49.59	49.23	48.13	47.03
2050	49.24	50.59	52.05	49.24	47.45	45.66
Sweden						
2013	41.91	41.91	41.91	41.91	41.91	41.91
2030	41.53	41.79	42.06	41.53	40.33	39.10
2050	40.47	41.46	42.49	40.47	38.07	35.66
Switzerland						
2013	42.93	42.93	42.93	42.93	42.93	42.93
2030	46.27	46.62	46.98	46.27	44.82	43.34
2050	46.53	48.08	49.68	46.53	44.38	42.15
UK						
2013	40.85	40.85	40.85	40.85	40.85	40.85
2030	42.41	42.67	42.93	42.41	41.12	39.83
2050	41.73	42.84	44.01	41.73	39.42	37.10
Ukraine						
2013	42.89	42.89	42.89	42.89	42.89	42.89
2030	45.99	46.06	46.13	45.99	45.56	45.11
2050	46.13	47.08	48.12	46.13	44.94	43.76

Note: Scenarios are based on the assumptions concerning life expectancies at birth discussed in the text.