

The Impact of Economic Conditions on Mortality over the Lifetime

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1. Abstract

We estimate the impact of economic fluctuations at various ages on longevity. We match cohort mortality tables from Human Mortality Database to economic conditions (i.e. GDP *per capita* and its fluctuations) since birth. Our data covers over 100 birth cohorts born in 1830 and later, in 37 countries with high quality mortality data. Controlling for country-year and birth cohort fixed effects, we find large and significant negative (positive) effects of economic recessions (booms) earlier life on mortality rates at later ages. Further analysis suggests that the economic conditions at different ages have consistent associations with life expectancy but with various magnitudes; economic fluctuations at ages 16-35 have the highest impact on life expectancy. The estimates suggest that eliminating recessions would increase life expectancy by 8.7 years. Finally, the effect of fluctuations appears to be larger for countries with lower government spending or health expenditure.

2. Data

The main dataset used is from the Human Mortality Database (HMD).¹ HMD was created to provide detailed mortality and population data to researchers interested in the history of human longevity. HMD contains original calculations of death rates and life

¹ Website: <http://www.mortality.org/>

tables for national populations (countries or areas), as well as the input data used in constructing those tables.² We download the data of the 37 countries, which contains the death rates and population size of different ages in each year that is covered.

The GDP data are from gap-minder website.³ For almost all the 37 countries in HMD, it collects the GDP per capita by PPP (in international dollars fixed 2005 prices) since 1800. As mentioned above, we then use the Hodrick-Prescott filter with smoothing parameter 500 to de-trend the logarithm of GDP per capita and obtain the cyclical fluctuations for each country⁴ and match the fluctuations to the cohorts at different ages. We verify that unemployment rates, which are only available in recent periods, are highly correlated with GDP fluctuations. Table A1 presents information on the countries we use and on the first year/cohort that is included in our sample for each country.

3. Preliminary Results

3.1. Economic conditions at early life are associated with mortality at later ages

Table 1 shows the OLS results for the associations between economic conditions before 25 and the death rates after 25, weighted by the population size in each country-year-age cell. In each column, fixed effects for age, birth-cohort and country-year have been controlled included. All the standard errors are clustered at country level. The estimates suggest that the economic booms before 25 are negatively correlated with mortality at later ages. The results are consistent with the findings of van den Berg et al. (2006).

² The input data consist of death counts from vital statistics, plus census counts, birth counts, and population estimates from various sources.

³ Website: <http://www.gapminder.org/data/>. The version used is “Income per person (fixed PPP\$) (version 14)”. The full document is available at: <http://www.gapminder.org/data/documentation/>.

⁴ The Figures A1 show the trends and the real GDP per capita over the period in the US and UK.

3.2 Economic conditions over life cycle are associated with life expectancy

Based on the HMD, we calculate the cohort realized life expectancy for each birth-cohort in every country. Because many individuals born in 1940 and later are still alive, their cohort life expectancy cannot be exactly calculated. Therefore we restrict the sample to birth cohorts born between 1830 and 1930.

Table 2 reports the associations between GDP fluctuations and the cohort life expectancy, controlling for the country and birth-cohort fixed effects, and standard errors clustered at country level. Because coverage across countries differs, we also include dummies for the minimum and maximum age that is observed for each birth cohort in the country.

The results show that the economic booms are positively correlated with life expectancy in most of the age groups, with the largest impacts of fluctuations at age 20-40. The gender-specific results in the next two columns show that the impacts of the fluctuations are stronger among women.

Based on the estimation in Table 2, we also predict that the gain in life expectancy if there were no economic recessions. By replacing the negative values in economic fluctuations by zero, the estimates in Table 2 imply that life expectancy would increase by 8.7 years if all the previous recessions were eliminated. The loss is almost in the same magnitude if there were no booms.

3.3 The associations between economic conditions and life expectancy are stronger in countries with lower health expenditure

We estimate the results for the countries with higher and lower health expenditure separately for the consideration that countries with higher expenditure may have a better safety-net for those suffering from the recessions. We collect the information on Health Expenditure/GDP from World Development Index (WDI) Table and divide the countries

into two groups: the proportion is higher than 6.2% or not. We choose 6.2% here because it is the mean value of our sample. For reference, Table A1 reports the proportions of health expenditure and government expenditure in the GDP.

Table 3 reports the results by the health expenditure proportion. The estimates show that all the associations we found in Table 2 are mainly from the countries with lower health expenditure. The first three columns, the results in the higher health expenditure countries, provide no evidence on the association between economic fluctuations and life expectancy.

Table 1. Associations of Economic Fluctuations with mortality at later ages (Older than 25)

VARIABLES	(1)	(2)	(3)
	Dependent variable: Death rates		
	All	Men	Women
GDP Fluctuation at birth	-0.142*** (0.0305)	-0.0757** (0.0293)	-0.260*** (0.0676)
GDP Fluctuation 1-5	-0.238*** (0.0449)	-0.223*** (0.0426)	-0.322*** (0.0835)
GDP Fluctuation 6-10	-0.378*** (0.0732)	-0.303*** (0.0616)	-0.595*** (0.173)
GDP Fluctuation 11-15	-0.436*** (0.0689)	-0.451*** (0.0796)	-0.529*** (0.142)
GDP Fluctuation 16-20	-0.460*** (0.0835)	-0.515*** (0.141)	-0.546*** (0.166)
GDP Fluctuation 21-25	-0.276*** (0.0627)	-0.321** (0.125)	-0.351*** (0.114)
Observations	208,678	208,530	208,664
R-squared	0.953	0.956	0.945
Mean of Y	1.511	1.653	1.385
SD of Y	2.850	2.888	2.926
<i>Covariates controlled for</i>			
Age FE	Yes	Yes	Yes
Birth cohort FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes

Note: Robust standard errors in parentheses are clustered at country level. Weighted by population size. Year: 1850-2009; Birth year: 1820-1975; Age: 25-100. Number of countries: 37.

The countries/regions include Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Chile, Czech Rep., Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, Ukraine, United Kingdom and United States.

*** p<0.01, ** p<0.05, * p<0.1

Table 2. Life expectancy and Economy Fluctuations in Life-Cycle

VARIABLES	(1)	(2)	(3)
	All	Cohort life expectancy at age 20	
		Male	Female
GDP Fluctuation at birth	9.021*** (3.172)	12.47*** (3.897)	6.793** (2.839)
GDP Fluctuation 1-5	16.38*** (3.429)	11.72*** (3.734)	21.37*** (3.732)
GDP Fluctuation 6-10	28.09*** (6.393)	19.95*** (6.748)	37.70*** (6.631)
GDP Fluctuation 11-15	34.55*** (6.375)	22.35*** (6.916)	48.20*** (6.949)
GDP Fluctuation 16-20	39.93*** (8.258)	22.87** (9.498)	58.20*** (8.261)
GDP Fluctuation 21-25	44.88*** (8.811)	26.00** (11.04)	64.58*** (8.466)
GDP Fluctuation 26-30	46.97*** (10.24)	28.05** (12.63)	65.64*** (9.876)
GDP Fluctuation 31-35	47.19*** (10.99)	26.77* (14.31)	67.86*** (10.02)
GDP Fluctuation 36-40	43.09*** (11.36)	25.25* (14.63)	60.79*** (10.33)
GDP Fluctuation 41-45	32.71*** (10.86)	16.33 (14.65)	48.79*** (9.197)
GDP Fluctuation 46-50	21.93** (10.19)	9.822 (13.40)	33.83*** (8.593)
GDP Fluctuation 51-55	18.44** (8.692)	9.671 (11.29)	26.64*** (7.700)
GDP Fluctuation 56-60	1.456 (7.335)	-6.493 (9.408)	9.239 (5.897)
GDP Fluctuation 61-65	-5.645 (6.659)	-10.87 (8.241)	-0.876 (5.874)
Observations	2,513	2,513	2,513
R-squared	0.968	0.956	0.973
Mean of Y	57.41	57.80	56.95
SD of Y	18.44	16.04	21.09
<i>Covariates controlled for in both panels</i>			
Birth cohort FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
GDP mean level of life-cycle	Yes	Yes	Yes
Minimum Age observed in cohort	Yes	Yes	Yes
Maximum Age observed in cohort	Yes	Yes	Yes

Note: Robust standard errors in parentheses are clustered at country-year of birth level.

*** p<0.01, ** p<0.05, * p<0.1

Birth year: 1830-1930; Those aged between 20 and 100 are kept when calculating life expectancy.

Cohorts with minimum age larger than 60 are dropped. Number of countries: 37.

Table 3. Associations of Economic Booms with mortality at later ages (Older than 25), by government expenditure or health expenditure

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Cohort life expectancy at age 20					
	Government Health expenditure >= 6.2% GDP			Government Health expenditure < 6.2% GDP		
	All	Men	Women	All	Men	Women
GDP Boom at birth	-1.783 (1.927)	-3.542 (2.463)	0.0936 (1.354)	6.399** (2.382)	9.457*** (3.133)	4.664** (2.167)
GDP Boom 1-5	-5.055 (6.158)	-8.231 (5.474)	-1.019 (7.131)	15.15*** (3.252)	12.88*** (3.655)	17.42*** (3.636)
GDP Boom 6-10	-9.798 (10.48)	-16.24 (10.75)	-2.390 (11.02)	28.40*** (6.860)	21.66*** (7.345)	36.33*** (7.180)
GDP Boom 11-15	-7.976 (14.53)	-17.29 (14.89)	2.165 (15.08)	32.36*** (9.015)	20.90* (10.25)	44.98*** (9.132)
GDP Boom 16-20	-6.901 (19.21)	-17.60 (20.19)	4.738 (19.12)	34.42** (12.41)	16.39 (14.42)	52.46*** (11.84)
GDP Boom 21-25	-5.366 (20.11)	-14.91 (22.05)	4.850 (19.73)	35.87** (15.99)	13.79 (18.60)	57.04*** (15.10)
GDP Boom 26-30	-4.782 (23.25)	-12.82 (26.23)	2.949 (21.37)	31.38 (18.89)	9.114 (22.07)	52.32*** (17.72)
GDP Boom 31-35	2.052 (22.67)	-5.900 (25.51)	9.675 (20.97)	31.62 (21.77)	8.376 (23.37)	54.23** (21.76)
GDP Boom 36-40	0.744 (21.85)	-5.001 (25.07)	5.811 (19.82)	31.79 (23.87)	10.46 (25.45)	53.35** (23.59)
GDP Boom 41-45	1.016 (19.03)	-2.790 (22.30)	3.655 (16.99)	23.61 (21.26)	5.701 (21.96)	42.61* (21.54)
GDP Boom 46-50	-0.828 (16.53)	-3.754 (20.20)	1.395 (14.27)	12.62 (19.46)	-1.325 (19.29)	27.26 (20.38)
GDP Boom 51-55	2.115 (10.36)	3.045 (11.84)	-0.151 (10.06)	11.40 (16.73)	-1.914 (15.99)	25.06 (18.05)
GDP Boom 56-60	-2.351 (8.124)	-1.964 (9.547)	-3.740 (7.503)	-2.403 (9.395)	-13.77 (9.128)	8.776 (10.77)
GDP Boom 61-65	-2.431 (6.229)	-0.385 (6.712)	-4.982 (6.601)	-4.360 (6.052)	-11.42* (6.464)	2.134 (7.252)
Observations	1,253	1,253	1,253	1,178	1,178	1,178
R-squared	0.983	0.977	0.985	0.977	0.968	0.981
Mean of Y	57.46	57.22	57.59	57.56	58.56	56.52
SD of Y	17.03	15.13	19.17	19.71	16.86	22.76
<i>Covariates controlled for</i>						
Birth cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses are clustered at country level. Weighted by population size. Birth year: 1830-1930; Those aged between 20 and 100 are kept when calculating life expectancy.

*** p<0.01, ** p<0.05, * p<0.1

The government expenditure and health expenditure are based on the data 1998 - .

Table A1. Country summary

Country/Region	Obs	Min year	Min birth year	Gov Exp/ GDP	Health Exp/GDP
Australia	8394	1921	1821	0.34	0.05
Austria	5768	1947	1847	0.49	0.07
Belarus	4556	1959	1859	0.37	0.04
Belgium	12777	1850	1820	0.49	0.07
Bulgaria	5768	1947	1847	0.37	0.04
Canada	8293	1921	1821	0.39	0.06
Chile	1085	1992	1892	0.20	0.03
Czech Rep.	5465	1950	1850	.	.
Denmark	12979	1850	1820	0.54	0.08
Estonia	4556	1959	1859	0.33	0.04
Finland	11834	1878	1820	0.50	0.06
France	12388	1850	1820	0.51	0.08
Germany	1530	1990	1890	0.44	0.08
Hungary	5465	1950	1850	0.47	0.05
Iceland	13080	1850	1820	0.42	0.07
Ireland	5465	1950	1850	0.36	0.05
Israel	2160	1983	1883	0.47	0.05
Italy	11769	1872	1820	0.50	0.06
Japan	5667	1947	1847	0.36	0.06
Latvia	4556	1959	1859	0.35	0.03
Lithuania	4556	1959	1859	0.34	0.04
Luxembourg	4455	1960	1860	0.38	0.06
Netherlands	13080	1850	1820	0.46	0.06
New Zealand	5515	1948	1848	0.40	0.07
Norway	13080	1850	1820	0.41	0.07
Poland	4657	1958	1858	0.41	0.04
Portugal	6475	1940	1840	0.44	0.06
Russia	4319	1959	1859	0.29	0.03
Slovak Republic	5465	1950	1850	0.39	0.05
Slovenia	2160	1983	1883	0.43	0.06
Spain	9528	1908	1820	0.40	0.06
Sweden	13080	1850	1820	0.55	0.07
Switzerland	11949	1876	1820	0.35	0.06
Taiwan	3445	1970	1870	.	.
Ukraine	4556	1959	1859	0.37	0.03
United Kingdom	8293	1922	1822	0.42	0.06
United States	7081	1933	1833	0.35	0.06

Figure A1. Real GDP per capita and Smoothed value over the year in the US and UK (1800-2009)

