Retirement with and without a Hump

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Abstract
Views on retirement may differ depending on how this stage of life is lived. This paper discusses changes in mortality experiences subsequent to retirement. When there are adequate pension arrangements, one would assume retirement would unfold as expected. However, if plans fall short of expectations, there might be changes in mortality experiences. We investigate changing patterns of mortality experiences for a group of Iranian retirees. Indications are that for some, there is an increase in mortality and a fall in expected life, whereas, for others in this group of employees life expectancy might be greater than the average.

Keywords: Mortality, Life expectancy, life table, retirement, pension.

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1. Introduction

Over the past few decades there has been widespread attention on longevity, i.e. the reduction in mortality across all ages and in particular at older ages. However we investigate the adverse mortality change which has apparently been notice in a particular sample of Iranian oil industry employees. It has been noticed that there are two distinct groups among these employees. One group shows longevity improvements while a second group shows deterioration in mortality. Thus in this paper we investigate the existence of such a difference and comment on its plausibility.

Here we elaborate on pillar two of a typical three pillar retirement program that is widely adopted around the world. A shortfall on this pillar which requires mandatory employer sponsored contributions causes the adverse effects we are trying to discuss as an increase in mortality risk subsequent to retirement. A shortfall in this pillar makes post retirement income less than pre-retirement income.

There is a rich literature on post employment mortality experiences. Many discuss mortality variation due to occupation. There are studies that explore the effect of early retirement on mortality. Kuhn et-al (2010) finds a small shortening of expected life for male blue collar workers in Austria. Some papers discuss socio-economic differentials on mortality. These studies mainly investigate the effect of income on life expectancy. But as Snyder and Evans (2002) point out the link between income and life expectancy may be through health where lower income averts health expenditure and thus lowers heath status, thus affecting life expectancy. Actuarial tables have long adopted for variations due to socio-economic differences in population. As evidenced in Klugman (1981) and Roberts (1993), it is well known in the actuarial literature that the financially better off life insurance policy holders live longer. There is also some evidence on improvements in longevity due to intense physical activity as in Teramoto and Bungumb (2010).

The aging literature is vast and studies purporting to explain variation and the extent of life expectancy are numerous. Vaupel and Lundstrom (1994) review much of the early literature on this topic and Braithwaite and Gibson (1987) discuss the impact of retirement on health, thus arguing the effect of post retirement income on health and thus life expectancy.

Luciano and Vigna (2009) state that longevity implies force of mortality changes over time and thus time dependent as well as age dependent. Across cohorts when age is kept fixed, there should be a reduction in force of mortality. The force of mortality is then dependent on two variables, the age and calendar year. Our discussion in this paper surrounds this dynamic structure and we try to show if there is a hump visible in some cohorts at their retirement.

It is worth noting that the hump we are investigating is different from a "jump" as in stochastic specification of Poisson variates where mortality intensity assumes a stochastic random variable. A hump on the other hand is not stochastic but explained by a change around a certain age which exhibits a spread and thus is a distributed increase. The change in mortality is distributed around a period of behavioural change and not a sudden change. Similarly, retirement can take place around a period which

produces a spread or distribution in mortality due to again behavioural changes that some individuals adopt better than others as their circumstances differ.

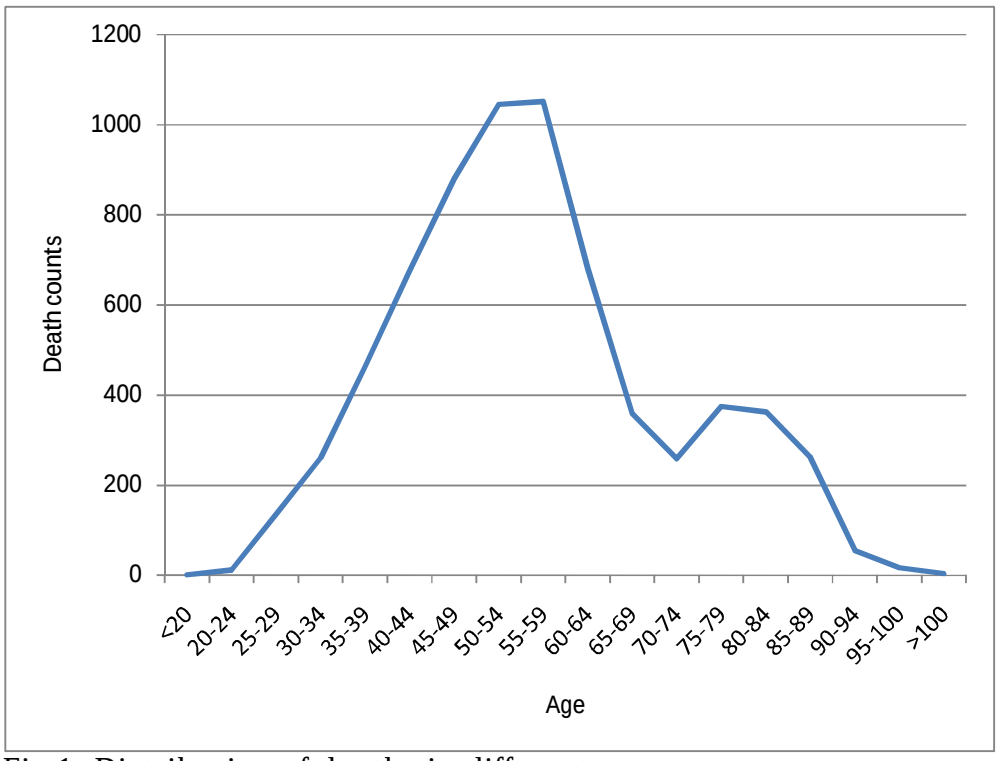

Fig 1: Distribution of deaths in different age groups.

2. What various disciplines say

In most papers on longevity the link runs through health status of individuals. Either income variation is followed by changes in health and thus life expectancy, i.e. from health to income to longevity, or from income to health and to longevity. Even the much discussed cohort or the year of birth effect runs through health conditions for those born with these health advantages. The effects of genetics on longevity are not clear but even hear there seems to be a health effect at work.

There are sociological and psychological theories and models of retirement. These include the retirement impact theory and the goal hierarchy model (see Tyhurst, Salk and Kennedy (1956) and Atchley (1976)).

Tyhurst, Salk and Kennedy (1956) studied the effect of retirement on mortality and life expectancy. They find no evidence for an increase in mortality due to retirement and hence no change in life expectancy on a group of 898 retirees retiring between 1917 and 1954 in Bell Telephone Company in Canadian telecommunication industry. The retirement ages were between 60 and 70 with average retirement age at 63. They do not find any change in mortality due to age at retirement either.

Exposure to work related risks may affect mortality experience of employees during their working lives and thus a cause for changes in their health. Adverse health effects may remain dormant for some time and take

time to emerge. If symptoms of ill health emerge later in life and close to retirement, there may be differences in life expectancies due to occupation. The primary cause for mortality change would then be changes in exposure to risk. Thus there is a question over the existence of mortality improvements among groups of employees. Advances in medicine, improvements in hygiene and better water quality are known to have improved mortality experiences across the world. If this were the case, then there must be differences in mortality experiences among cohorts or the "cohort effect" (Willets, 2004).

However, Attanasio and Emmerson (2001) doubt if there is a causal relation running from health to wealth for a group of individuals they examined. But, we maintain the assumption that poor health may cause shorter life expectancy and lower wealth accumulation.

Christensen and Vaupel (1996) review the medical literature on causes of longevity. They stress that causality from socio-economic conditions to lower mortality is not fully understood, although it is generally understood that health, wealth, education and occupation affect mortality.

Duleep and Jaeger (2011) argue when considering socio-economic factors affecting mortality that the underlying causality is from factors determining investment in human capital. But according to Devasahayam (2005) there are indications that improvements in socio-economic status favour men more than they do women.

3. Is there a cohort effect in our sample?

In studies of mortality experiences, the log rate of mortality shows an accident hump for males at ages when they are young and for females in their child bearing ages. But we are interested to see if there is another hump at retirement? Clearly, there has to be an increase and then a decrease in force of mortality for there to be a hump due to retirement and this is the main issue of investigation in this paper.

However, we are not sure if there are cohort effects as discussed in Willets (2004) or select birth cohorts as in MacMinn and Webber (2011) in our sample. Based on the method suggested by MacMinn and Webber (2011) the cohort effect described in Willets (2004) disappears when relative differences across close cohorts for a fixed age is calculated. This suggests that the cohort effect may be spurious and not real, i.e. path dependent. MacMinn and Webber (2011) further suggest that smoothing methods used for a log linear regression analysis may be "concealing" cohort effects present in raw mortality data. However, the facts remain in doubt in our sample as we discuss later and further analysis is needed to establish differences in mortality experiences among cohorts for a given age.

Cairns et-al (2006, 2007) consider longevity risk, i.e. the concern for higher survival rates than anticipated. But here our concern is the opposite i.e. that survival rates may be lower than predicted life expectancies for a particular population. In the recent past, revisions in Iranian life tables (see Appendix A: Iranian oil industry pension fund life table) have been very few and risks associated with changes in mortality as in longevity, have been a major concern as in many other countries. Thus insurers and pension funds

are facing increasing uncertainty caused by mortality changes and uncertain variation in risk needed for contribution adjustments (Barrieu et-al 2010).

Fig 2. Crude mortality rates for different cohorts.

Fig 3. Log mortality rates for different cohorts.

Cairns, Blake and Dowd (2008) show that while there has been a fall in mortality across all ages, at some specific ages in some periods, specifically at age 65, there seems to be no change in mortality. Our attention has been in this age group where we think people retire and majority of retirement takes place. In particular we are interested to see if there is a rise in mortality subsequent to retirement which commonly takes place at age 65. Although their evidence does not indicate that there is a rise in mortality at 65 in different years.

On the other hand, Cairns et-al (2010) consider differences in mortality rates in two populations. This corresponds with our analysis of variation in mortality rates among employees. Thus we investigate the following hypothesis:

Hypothesis 1: There are no differences in mortality rates among oil employees.

It may be worth considering the model developed by Helligman and Pollard (1980) where an accident hump is included in their general model. Dellaportas et-al (2001) describe their model and compare results. This is to ask whether there is another hump at retirement. While Gaille (2012) suggests that over time and gradually the accident hump, which has been part of all mortality experiences, will disappear, here we are suggesting that a new hump may be forming around the retirement age. The accident hump may be declining due to improvements in risks during early adulthood, but risks and uncertainties associated and emerging in old age are on the rise.

Richards (2008) discusses cohort effects by comparing probabilities of death for consecutive cohorts, i.e. $q_{b-1,x+1}/q_{b,x}$ Thus if there are variations in survival among cohorts, then the ratio of their death probabilities (or survival probabilities) should indicate variation over time. According to Richard (2008) the cohort effect is so apparent for population of England and Wales, that a single years experience would show the effect.

According to Willets (1999) annual mortality improvement rates for men in England and Wales have been the greatest for the 60 to 65 years age group during 1960-1997(see Graph 1). While average annual improvement rates for men in England and Wales have been the greatest for the age group 45-59 during 1960-1997 (see Table 4, 1.8%). But he estimates improvements in life expectancy for men aged 65 (i.e. at retirement age) that

have changed very little between 1901 and 1961. Whereas the annualised mortality improvement rates have the highest increase of 3.2% during the 1990's for men in the age group 60-69. As Willets (1999) point out, the mortality improvement in England and Wales have been aging, i.e. shifting to older age groups. However this improvement in mortality rates for men in their 50's and 60's i.e. close to their retirements have been largely due to mortality reductions due to "cancer, heart disease and stroke".

4. Conclusions

This paper tries to find out if there has been any mortality worsening for a group of Iranian oil employees. However, we suggest further investigation into the effect of major causes of mortality for middle aged men are needed. There may have been increases in the so called "three big killers" in our sample of oil employees that have caused changes in mortality experiences. Thus we need to see if there are relationships between mortality experiences and the major causes of death in order to see what is causing the apparent hump at retirement. For this we have to investigate the relevant data to see if there has been any change in behaviour, either dietary, smoking, stress or physical activity among the newly retired men that is causing an increase in mortality.

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Appendix A: Iranian oil industry pension fund life table.

age	q_x	l_x	d_x	L_x	T_x	e_x
20	0.000115245	99,911	12	99905	5941499	59.47
21	0.000128279	99,899	13	99892.5	5841594	58.47
22	0.000142787	99,886	14	99879	5741701	57.48
23	0.000158935	99,872	16	99864	5641822	56.49
24	0.00017691	99,856	18	99847	5541958	55.5
25	0.000196916	99,838	20	99828	5442111	54.51
26	0.000219185	99,818	22	99807	5342283	53.52
27	0.00024397	99,796	24	99784	5242476	52.53
28	0.000271557	99,772	27	99758.5	5142692	51.54
29	0.000302263	99,745	30	99730	5042934	50.56
30	0.000336438	99,715	34	99698	4943204	49.57
31	0.000374475	99,681	37	99662.5	4843506	48.59
32	0.000416811	99,644	42	99623	4743843	47.61
33	0.000463928	99,602	46	99579	4644220	46.63
34	0.000516368	99,556	51	99530.5	4544641	45.65
35	0.000574731	99,505	57	99476.5	4445111	44.67
36	0.000639683	99,448	64	99416	4345634	43.7
37	0.000711968	99,384	71	99348.5	4246218	42.73
38	0.000792412	99,313	79	99273.5	4146870	41.76
39	0.000881933	99,234	88	99190	4047596	40.79
40	0.000981553	99,146	97	99097.5	3948406	39.82
41	0.001092406	99,049	108	98995	3849309	38.86
42	0.001215757	98,941	120	98881	3750314	37.9
43	0.001353007	98,821	134	98754	3651433	36.95
44	0.001505716	98,687	149	98612.5	3552679	36
45	0.001675618	98,538	165	98455.5	3454066	35.05
46	0.001864638	98,373	183	98281.5	3355611	34.11
47	0.002074914	98,190	204	98088	3257329	33.17
48	0.00230882	97,986	226	97873	3159241	32.24
49	0.002568993	97,760	251	97634.5	3061368	31.32
50	0.002858357	97,509	279	97369.5	2963734	30.39
51	0.003180159	97,230	309	97075.5	2866364	29.48
52	0.003537997	96,921	343	96749.5	2769289	28.57
53	0.003935861	96,578	380	96388	2672539	27.67
54	0.00437817	96,198	421	95987.5	2576151	26.78
55	0.004869822	95,777	466	95544	2480164	25.9
56	0.005416232	95,311	516	95053	2384620	25.02
57	0.006023393	94,795	571	94509.5	2289567	24.15
58	0.006697927	94,224	631	93908.5	2195057	23.3
59	0.007447149	93,593	697	93244.5	2101149	22.45
60	0.008279126	92,896	769	92511.5	2007904	21.61
61	0.009202752	92,127	848	91703	1915393	20.79

62	0.010227817	91,279	934	90812	1823690	19.98
63	0.011365088	90,345	1027	89831.5	1732878	19.18
64	0.012626384	89,318	1128	88754	1643046	18.4
65	0.014024663	88,190	1237	87571.5	1554292	17.62
66	0.015574103	86,953	1354	86276	1466721	16.87
67	0.01729019	85,599	1480	84859	1380445	16.13
68	0.019189797	84,119	1614	83312	1295586	15.4
69	0.021291264	82,505	1757	81626.5	1212274	14.69
70	0.023614468	80,748	1907	79794.5	1130647	14
71	0.026180886	78,841	2064	77809	1050853	13.33
72	0.029013637	76,777	2228	75663	973043.5	12.67
73	0.032137511	74,549	2396	73351	897380.5	12.04
74	0.035578962	72,153	2567	70869.5	824029.5	11.42
75	0.039366079	69,586	2739	68216.5	753160	10.82
76	0.043528502	66,847	2910	65392	684943.5	10.25
77	0.048097299	63,937	3075	62399.5	619551.5	9.69
78	0.053104773	60,862	3232	59246	557152	9.15
79	0.058584208	57,630	3376	55942	497906	8.64
80	0.06456952	54,254	3503	52502.5	441964	8.15
81	0.071094834	50,751	3608	48947	389461.5	7.67
82	0.078193947	47,143	3686	45300	340514.5	7.22
83	0.085899694	43,457	3733	41590.5	295214.5	6.79
84	0.094243203	39,724	3744	37852	253624	6.38
85	0.103253043	35,980	3715	34122.5	215772	6
86	0.112954273	32,265	3644	30443	181649.5	5.63
87	0.123367408	28,621	3531	26855.5	151206.5	5.28
88	0.134507322	25,090	3375	23402.5	124351	4.96
89	0.146382129	21,715	3179	20125.5	100948.5	4.65
90	0.158992073	18,536	2947	17062.5	80823	4.36
91	0.172328495	15,589	2686	14246	63760.5	4.09
92	0.186372913	12,903	2405	11700.5	49514.5	3.84
93	0.201096303	10,498	2111	9442.5	37814	3.6
94	0.216458631	8,387	1815	7479.5	28371.5	3.38
95	0.232408694	6,572	1527	5808.5	20892	3.18
96	0.248884329	5,045	1256	4417	15083.5	2.99
97	0.265813009	3,789	1007	3285.5	10666.5	2.82
98	0.283112855	2,782	788	2388	7381	2.65
99	0.30069403	1,994	600	1694	4993	2.5
100	0.318460493	1,394	444	1172	3299	2.37
101	0.336312032	950	319	790.5	2127	2.24
102	0.3541465	631	223	519.5	1336.5	2.12
103	0.371862139	408	152	332	817	2
104	0.389359886	256	100	206	485	1.89
105	0.406545558	156	63	124.5	279	1.79

106	0.423331792	93	39	73.5	154.5	1.66
107	0.439639692	54	24	42	81	1.5
108	0.455400097	30	14	23	39	1.3
109	0.470554453	16	8	12	16	1
110	1	8	8	4	4	0.5

Authors own estimations.