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Life Expectancy in Ireland since the 1870s

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Abstract: This paper reviews the historical evidence on Irish life expectancy. Although much of the material is broadly familiar, attention is drawn to some lesser-known aspects. These include the reliability of the civil registration data and its implications for measuring life expectancy; the variation in the rate of improvement in life expectancy over the sub-periods between 1871 and 2011; and plausible reasons for it. In recent decades as much as three quarters of longevity gains has been attributable to falling age-specific death rates among the elderly. Given that further reductions in mortality rates among the elderly may be increasingly difficult to deliver, the overall gains in life expectancy in the coming decades may not match those recorded during the first half of the twentieth century.

I INTRODUCTION

Life expectancy is an estimate of the average length of life of a hypothetical cohort assumed to be exposed to the mortality rates observed in a population at a given time.[1] This statistic conveys valuable information about one component of wellbeing. While increased longevity has made a major contribution to rising living standards in countries like Ireland over the past century, this is not reflected in measures derived from the national income accounts. It has been argued that the value of increased life expectancy in the United States over the period 1900-1950 was as large as that of the growth of GDP per capita from all others sources (Nordhaus, 2003).

[1] This is the period life expectancy. Cohort life expectancy is calculated by applying the mortality rates that would be experienced by individuals born in a given year over their lifetime. It can be computed only for cohorts that were born many decades ago, all of whose members have died. No information on cohort life expectancy is included in this paper.

In Ireland (twenty-six counties) a time series of estimates of life expectancy is available dating back to the years following the introduction of civil registration of marriages, births and deaths in 1864. These records, combined with census population data, have been used to construct the life tables that are published in the Central Statistics Office database covering the period from 1871 to 2011.[2]

Given the acknowledged poverty of the Irish population and backwardness of the economy well into the twentieth century, the relatively high life expectancy estimated from the 1870s onwards has evoked some surprise. The Commission on Emigration and Other Population Problems (1954) remarked that "In comparison with other countries the expectation of life in the twenty-six counties is much better than the crude death rate would suggest" (*Report*, paragraph 231). Ó Gráda (1994, p. 242) drew attention to the rapid rise in life expectancy after the Famine. Guinnane (1997, p. 112) stated that "at the turn of the twentieth century the expectation of life in Ireland was about the same as in the United States or England and Wales, and higher than in Germany". McGovern (2016) discusses the lower rates of infant mortality prevailing in Ireland relative to England and Wales in the late nineteenth and early twentieth centuries.

The aim of the present paper is to review the evidence on Irish life expectancy over the period from 1871 to 2011. The next section discusses some important, and often neglected, aspects of the quality of the data underlying estimates of mortality rates and life expectancy. This is followed by an account of the behaviour of life expectancy in Ireland since 1871. Data are presented for 20 sub-periods for males and females separately and decomposed into the contribution of three broad age groups to overall longevity. Section IV briefly compares the Irish experience with that of the United States and England and Wales. The paper concludes with a discussion of the findings.

II DATA ISSUES

Compulsory civil registration of births, deaths and marriages was introduced in Ireland in 1864. It was acknowledged that in the following years there was significant under-recording of vital events. The Registrar General for Ireland repeatedly drew attention to this. In his first Annual Report relating to 1864 he stated:

[2] The Life Tables are constructed from three-year averages of age-specific death rates centered on Census of Population years. Full life tables are available from 1926. For earlier years period life expectancy for selected years is available at http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?maintable=VSA30&PLanguage=0.

> "I consider that many Births, Deaths, and, Marriages have not been registered... notwithstanding the exertions made to induce a general compliance with the law throughout the country, numerous cases of neglect to register births and deaths have been reported to me by the District Registrars" (p. 16).

In his eleventh Annual Report (for 1874) he repeated this warning:

> "I beg here to repeat the observations made in my former Reports, with respect to the working of the Acts for the Registration of Births, Deaths, and Marriages in Ireland, as I regret to state that the numbers of these events registered in 1872 do not show much improvement compared with previous years" (p. 16).

In the sixteenth Annual Report (for 1879) a new Registrar, commenting on the rise in deaths recorded in that year, stated:

> "The excess in the death-rate [in 1879] is not altogether owing to the increased mortality which it implies, much of it being due to the improvement in registration effected through the Burial Returns obtained under the Public Health (Ireland) Acts, 1878-9, the provisions of which, authorizing these Returns, were put into operation in the course of the year..." (pp. 5-6).

However, Dean and Mulvihill (1972 and 1999) showed that under-reporting of deaths remained a serious problem a century later. They estimated that in the 1960s over 7 per cent of deaths were unregistered in the west of Ireland and perhaps 4 per cent nationally. Revisiting the issue in County Mayo in the 1990s they found the rate of under-reporting had risen to 11.5 per cent.[3]

Verrière (1979) is the severest critic of the quality of the historical Irish registration data. He argued that the infant mortality rates obtained from the official registration records for the late nineteenth century were totally implausible ("*parfaitement invraisemblables*") when viewed relative to those prevailing in richer European countries at the time and also inconsistent with the evidence of the Irish population censuses. For example, referring to the whole of Ireland, he calculated from the civil registration records and the 1871 Census returns that the death rate among children aged between one and four years between 1864 and 1871 was 82 per 1,000, whilst the infant mortality rate (children under one) was 96 per 1,000. He claims that "there is a flagrant lack of coherence between these two estimates" (p 332). Believing that deaths among children aged one to four years were more accurately recorded than those among infants aged under one year, he uses a model

[3] The high rates of under-reporting in the west of Ireland should be borne in mind in connection with the claim that life expectancy in the mid-twentieth century was higher in Connacht than in Dublin (Barry, 1941).

life table (Ledermann, 1969) to calculate that an infant mortality rate of 143 per 1,000 is implied by an age one to four death rate of 82. Applying this methodology across counties he finds the "true" infant mortality rate to be 16 per cent above the rate derived from the civil records in Down, 37 per cent in Meath and 59 per cent in Galway: "In short, the under-registration (of infant deaths) appears to be an inverse function of the average level of education" (p. 332). If this is accepted, then both births and infant deaths were significantly under-registered, with the result that the use of the infant mortality rate derived from the civil register to calculate expectancy of life is unreliable.[4] The suggested regional pattern in under-reporting would also lead to an exaggeration of the rural-urban differential in life expectancy that has received attention in previous studies (see Delaney *et al*., 2009).

In fact Verrière believed that even the adjustment outlined above yields an unrealistically low estimate of the infant mortality rate. Using an argument about Ireland's place in the ensemble of European countries, paying particular attention to the English data, he derives higher estimates of the infant mortality rate that suggest the true rate for the whole country was more than 60 per cent higher than the rate based on the civil records. These estimates are reproduced in Appendix A.

The phenomenon of under-registration of births has been shown to have persisted well into the twentieth century. Coward (1982) summarizes his findings as follows:

> The pattern of birth registration between 1916 and 1946 can be divided into three phases. In the first phase, 1916-1926, birth under-registration was in the order of 5-10 per cent, with a relatively large degree of under-registration between 1921 and 1926. The second phase, 1926-1941 was a period of somewhat lower levels of under-registration of less than 5 per cent, calculated as being between 3 and 5 per cent. Finally, the third phase, 1941-1946, was characterised by over-registration (brought about by a sudden change in the incentives to be gained from the registration of births) in the order of 1-3 per cent, with particularly high levels of over-registration in 1942-1944 (p.17).

The incentives that led to the surge in birth registration in the 1940s were the introduction of food rationing in 1942 and of children's allowances in 1944 (Hughes, 1977). If nothing else changed, a rise in the rate of recording births would have led to a fall in the recorded infant mortality rate, but this would have been offset if there were a simultaneous increase in the recording of infant deaths.

[4] The prevalence of children's burial grounds in the west of Ireland is worth mentioning here. The archaeologists list a total of 61 of these – variously known as *lisíní*, *cillíní*, *ceallúnacha* and *calluraigh* – in west Galway alone, generally located in remote areas away from church yards and other structures. While some of these are very old, many remained in use in the nineteenth and into the twentieth century (see Gosling, 1993, pp. 146–155).

While these studies suggest a significant under-registration of infant deaths (and related births) in Ireland in the late 19th and early 20th centuries, they may well exaggerate the extent of the under-registration. Also, if there had been a major problem of under-registration of children who survived infancy, this would have become apparent as people grew to adulthood and even old age when they sought birth certificates for a range of purposes, including eventually applying for an old age pension. Thus the under-registration was probably concentrated on babies who did not survive their first year, affecting both the birth rate and figures on infant mortality.

The Report of the Registrar General for Ireland in 1914 compares infant mortality rates for Dublin and Belfast with data for some major cities in Great Britain. This suggests that the urban infant mortality rate was at the higher end of what was found in Great Britain in the period 1905-1914, with little evidence of under-recording.

Williams and Galley (1995) provide estimates of infant mortality for England and Wales by urban and rural areas which provide a useful comparison. This study shows that the infant mortality rate was much lower in rural than in urban areas of England and Wales, though still somewhat above the average rate recorded for Ireland. The generally lower rate of infant mortality in rural areas reflected the lower infection risk for children living in less crowded conditions.

With a much higher share of the population living in rural areas in Ireland this would explain a lower rate of infant mortality in Ireland. However, the apparent superior performance of Ireland in the late 19th and early 20th centuries probably also reflects under-recording of births and deaths of infants in rural areas, especially in Connaught. However, the under-recording was probably on a smaller scale than suggested by Verrière.

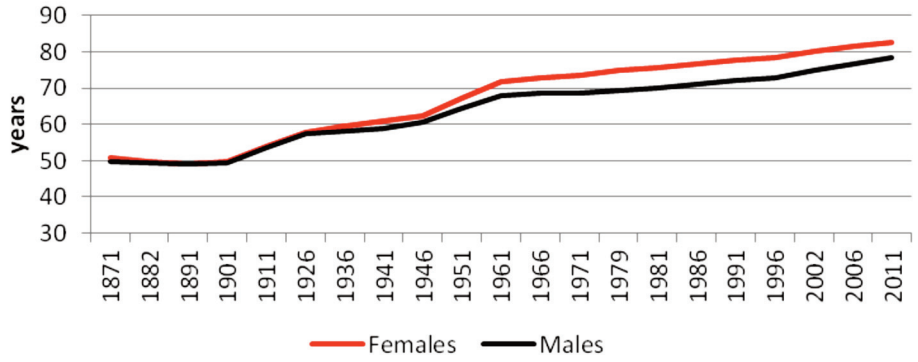
These considerations highlight the need to exercise great caution in interpreting the published infant mortality rates and life expectancy estimates for Ireland in the century following the introduction of civil registration.

III THE TREND OF IRISH LIFE EXPECTANCY 1871-2011

Figure 1 displays the behaviour of life expectancy at birth for males and females over the period 1871-2011, based on the unadjusted civil registration data for the twenty-six counties.

Over the 140-year period life expectancy at birth rose by almost 28.7 years for males and 31.8 years for females. Figure 2 sets out the change in life expectancy per year for each of the 20 sub-periods between the years for which life tables have been compiled. While increases were recorded in all but the first two sub-periods and in the 1970s for males, the rate of increase varied considerably over time. In

Figure 1: Life Expectancy at Birth 1871–2011



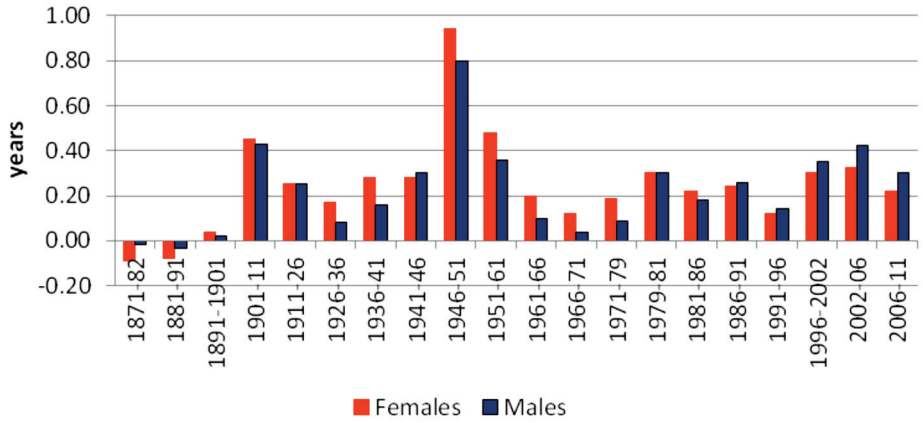
the last quarter of the nineteenth century, Irish life expectancy was quite stable at just under 50 years for both males and females. The absence of any improvement in these years could reflect the increased reliability of the death registration figures resulting in a gradual correction of the over-estimation of life expectancy at the start of the period. In any event, over the course of the twentieth century Irish life expectancy rose dramatically and by the first decade of the twenty-first century it was in the top tier of the international league table, having reached 78.3 years for men and 82.7 for women. For comparison, Norway and Sweden had the highest life expectancy in Europe, at 80 for men and 84 for women.

There are two pronounced spikes in the graph in Figure 2, one in the first decade of the twentieth century, the other in the immediate post-Second World War years. The spike for the period 1946-1951 is very striking. It shows a rise in life expectancy of almost one year (per year) for females. This was followed by another strong improvement in 1951-1956, so that by the end of the 1950s female life expectancy was over nine years higher than it had been in 1946. Male life expectancy rose by seven and a half years over this period. These were by far the largest annual gains recorded over the whole period from 1871 to 2011.

It is tempting to speculate about the reasons for the dramatic improvement in the post-war years. They could include more spending on welfare benefits, such as the introduction of children's allowances in 1944, and the general upgrading of the health services in the 1940s. Delaney *et al*., (2009) comment:[5]

[5] The National Accounts show that public investment in health infrastructure averaged £2 million a year (0.4 per cent of GNP) between 1953 and 1956, falling to only £0.75 million in the subsequent four years.

Figure 2: Change in Life Expectancy at Birth (Per Year)



"The 1947 [Health] Act signified a landmark in Irish policy representing a firm commitment to improve the health of the population. The act envisaged a substantial investment in public health infrastructure, estimated to cost up to £30 million over ten years. There was new legislation in a range of areas, from water supply to sewage disposal, devolution of power to local authorities, a focus on tackling infectious diseases, and a proposed provision of free medical care to mothers, children, and the poor."

Garvin (2004) goes so far as to claim that

"... one of the most advanced medical services in the world, focusing in particular on wide-ranging if somewhat authoritarian programmes of preventive medicine, was put together [by Minister] Browne, [Dr] Deeney and the new Department of Health's medical team" (p. 122).

In Figures 3 and 4 the changes in longevity are decomposed by age groups; from birth to 15 years, from 15 to 64 years, and 65 and over. The importance, both absolutely and relatively, of the contribution of reduced infant and childhood mortality to overall longevity in the first half of the twentieth century is clear from these figures. (No improvement occurred in the last quarter of the nineteenth century, which could reflect improving levels of registration of births and infant deaths.) The absolute increase in longevity among the population aged under 15 years was at its highest in the immediate post-Second World War years and declined rapidly thereafter, tapering away to almost zero after 1981.

Hall (2013) compares trends in mortality in Ireland, Northern Ireland, and England and Wales over the twentieth century. She highlights the improvement in life expectancy for women aged 15-34 in the post-war years. This reflected the fact

Figure 3a: Contribution to Increased Male Longevity by Age Group (Per Year)

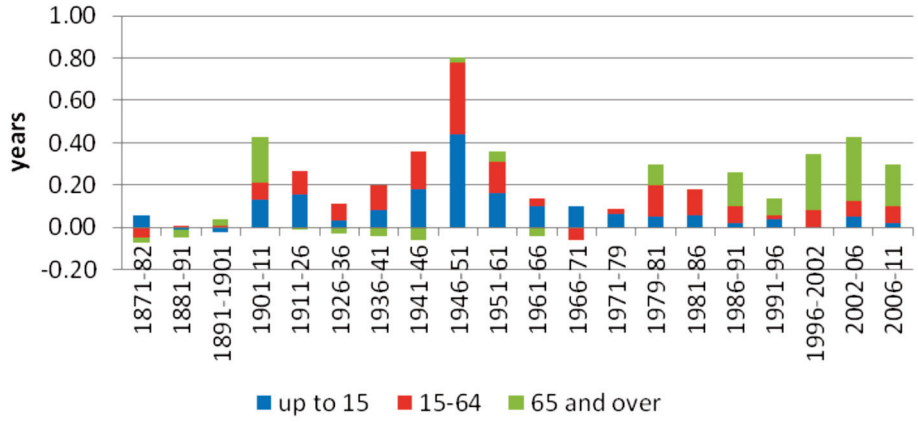
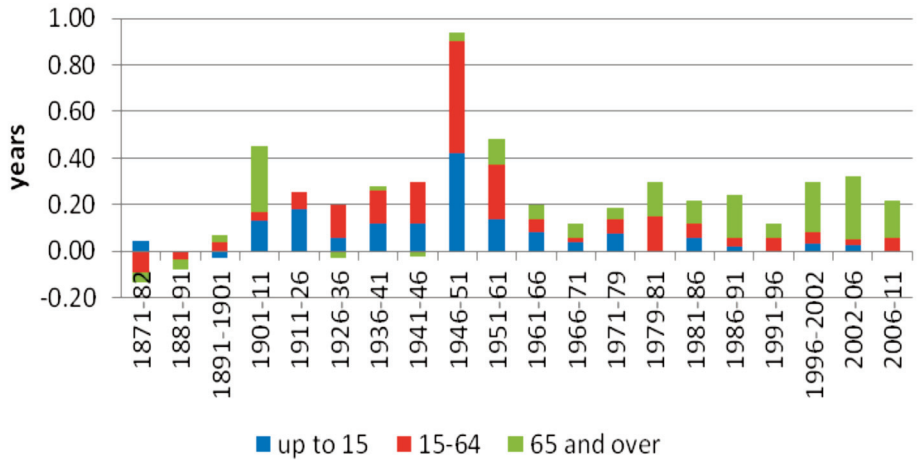


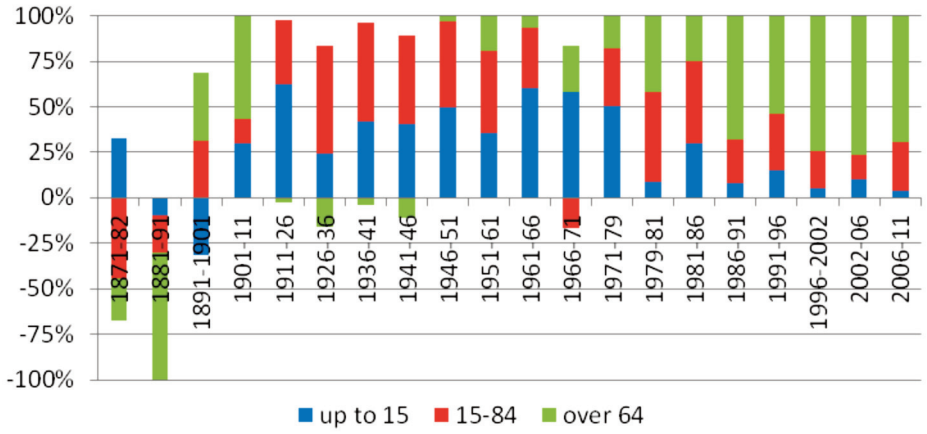
Figure 3b: Contribution to Increased Feale Longevity by Age Group (Per Year)



that life expectancy for this group in Ireland was much lower than in England in the first half of the twentieth century. The improvement in the period 1951-1981 eventually brought life expectancy for this cohort of women into line with that experienced in England and Wales.

If we ignore the dramatic spike occurring in the sub-period 1946-1951, there was a fairly smooth downward trend in the contribution of falling infant and child mortality to overall longevity for both males and females from the early twentieth century through to the first decade of the twenty-first century. Once the virulent

Figure 4: Share of Broad Age Groups in Contribution to Overall Increased Longevity (Per Year)



infectious diseases and insanitary conditions that wrought such havoc among infants and children in past centuries had been largely overcome by the end of first half of the twentieth century, mortality among young people had fallen so low that further medical and public health advances could make little additional contribution to raising overall life expectancy.

The marked improvement in life expectancy among the population aged 65 and over recorded over the period 1901-1911 calls for comment. Overall male life expectancy rose from 49.3 years in 1901 to 53.6 years in 1911, a gain of five months per year. Half of this was attributable to increased longevity among the population aged over 65. Females did even better, with overall life expectancy rising by 4.5 years and life expectancy at age 65 by 2.8 years. Comparable gains in the life expectancy of the elderly were not to be recorded again until after 1996.

It is worth speculating about the factors behind these developments. The early years of the twentieth century were marked by important social and economic change in Ireland (see Meenan, 1970, and Ó Gráda, 1994). During this period the country enjoyed a spell of unwonted prosperity based on rising world food prices and expanding trade. Agriculture flourished following the 1903 reform of the land-tenure system, and with the encouragement of the new Department of Agriculture and Technical Instruction and the burgeoning cooperative movement. Traditional industries also prospered. The poorer areas of the country had benefitted from the work of the Congested District Board since 1891. The social legislation introduced by the Liberal Government after 1906 was also significant, especially the launch of the Old Age Pension in 1908. This was of disproportionate benefit to Ireland with its relatively elderly population, which the new entitlement gave an incentive to exaggerate. The fact that the spike in longevity that occurred over the period

1901-1911 was most pronounced among the older population encourages us to attribute it to the new financial support for those aged over 70, but it is hard to believe that a measure introduced in 1908 could have accounted for all of the reduction in the death rate in 1910-1912 relative to 1900-1902

The age-specific deaths rates for the years from 1900 to 1912 do not shed much light on this issue, as may be seen from the following table:

Table 1 Death Rate Per 1,000 Population Aged 65 and Over, 1900-1913, Ireland (Thirty-Two Counties)

1900	*1901*	*1902*	*1903*	*1904*	*1905*	*1906*	*1907*	*1908*	*1909*	*1910*	*1911*	*1912*	*1913*
108	94	93	96	99	93	93	102	101	105	108	105	67	69

Source: Annual Reports of the Registrar General for Ireland.

While the average death rate among the population aged 65 and over fell from 98 per 1,000 for the years 1900-1902 to 93 for the years 1910-1912, this drop does not seem sufficient to account for the jump in life expectancy at this age shown in the life tables. Moreover, the fall was due entirely to a sharp drop in the death rate in 1912 (which was sustained in 1913).

Over the longer run, the falling rate of mortality among the elderly played an increasingly dominant role in the rise in overall life expectancy. Leaving aside the large and puzzling gain between 1901 and 1911, advances in life expectancy at age 65 and over were negligible until the post-Second World War years, but since then they grew in absolute terms and more markedly in relative importance as the contribution of falling mortality in the younger age groups tapered off. Gains among the elderly have accounted for over half of the gain in overall life expectancy since 1986 and three-quarters since 1996.

The female-male differential in life expectancy is shown in Figure 5 and the change in this differential in Figure 6. These figures bring together the impact of the sex differentials displayed less explicitly in the earlier figures. The differential was small until 1936 but by the end of the 1970s it had risen to five and a half years. It peaked in the 1980s and since then differential improvements in male life expectancy, especially among the elderly, have led to some narrowing of the differential.

The largest changes in the female-male differential occurred in the population aged 15 to 64 years. Women consistently gained more than men in this age group between 1926 and 1979, with the biggest relative gains recorded between 1946 and 1951, when the gap between women's and men's longevity widened by over eight months. As Hall (2013) indicates, this represented a belated catching up compared to England and Wales. It is plausible that the improvements in health and social

Figure 5: Female–Male Differential in Life Expectancy

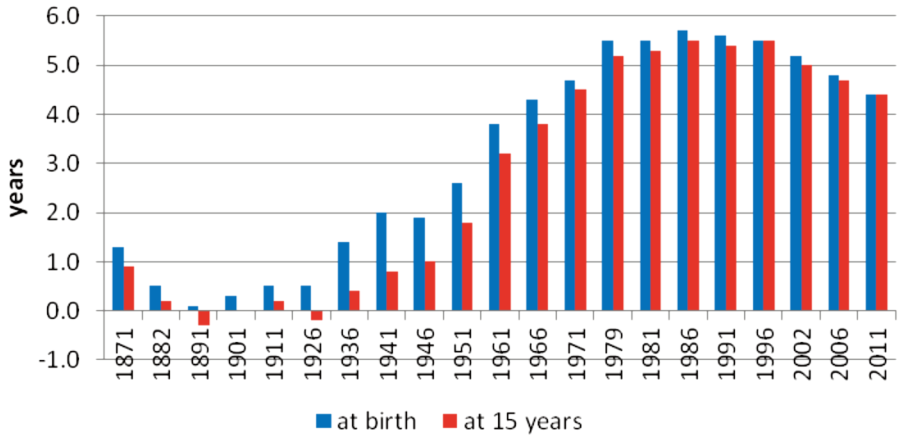
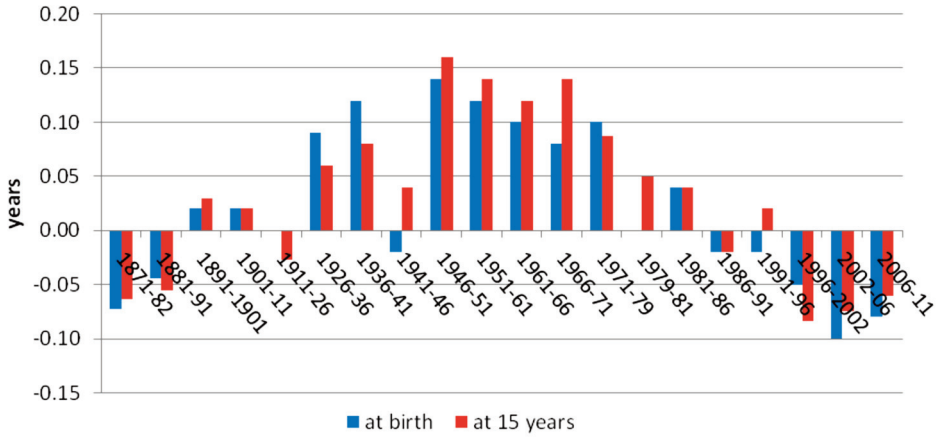


Figure 6: Change in Female–Male Differential in Life Expectancy Per Year



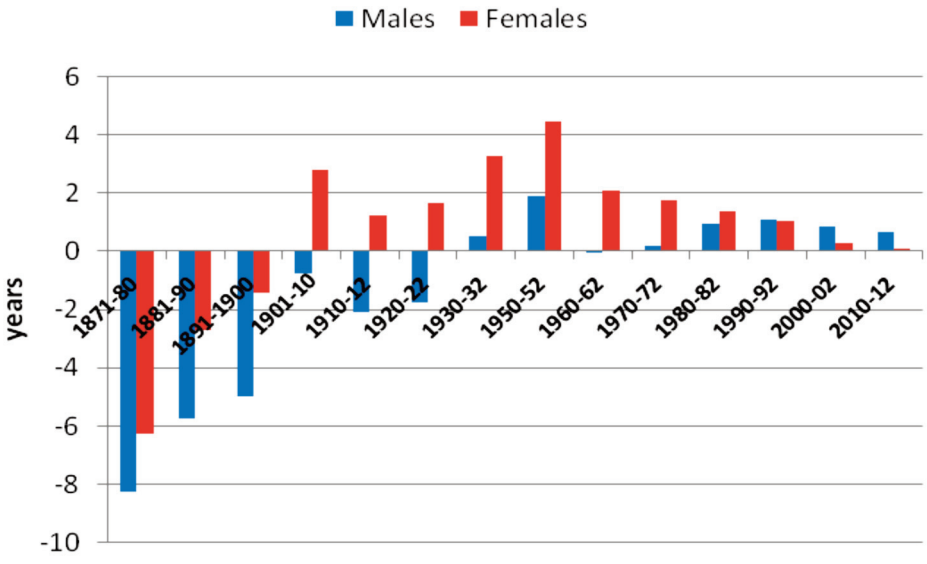
provision introduced in these years were especially important to women of child-bearing age. Some of the relatively poor performance of male life expectancy during the 1950s, 1960s and 1970s may be due to the differential impact of the epidemic of coronary heart disease, which peaked during this period, on males. However, from the mid-1960s, heart disease deaths began a remarkable and steady decline that has persisted to the present (Dalen *et al.*, 2014) and this had a bigger impact on male than on female death rates. In the population aged 65 and over, women gained steadily relative to men over the 90 years from 1901 to 1991, but men's relative longevity recovered somewhat after that.

IV IRELAND IN AN INTERNATIONAL PERSPECTIVE

As noted in the Introduction, despite Ireland's poverty and relative backwardness, earlier commentaries noted that the country has enjoyed relatively high life expectancy since the last quarter of the nineteenth century. In this section a brief comparison with the English and American experiences is presented.

A comparison with England and Wales[6] is shown in Figure 7. As was noted earlier, during the last quarter of the nineteenth century there was a large differential in Ireland's favour. Much of this was due to the exceptionally low infant and child death rates reported for rural Ireland. Verrière's scepticism about the quality of the Irish data, especially in the poorer counties, seems warranted in face of the reported eight-year gap between England and Wales for males in the 1870s, especially given that at this time life expectancy was less than 50 years in both countries. It is plausible that the narrowing of the English–Irish differential in the early twentieth century reflected improved reporting of births and infant deaths in Ireland rather than genuine demographic change. This belief is reinforced by the consideration that the narrowing of the differentials occurred because estimated Irish life expectancy at birth remained static while the corresponding English figure rose.

Figure 7: Differential in Life Expectancy at Birth, England and Wales *Minus* Ireland



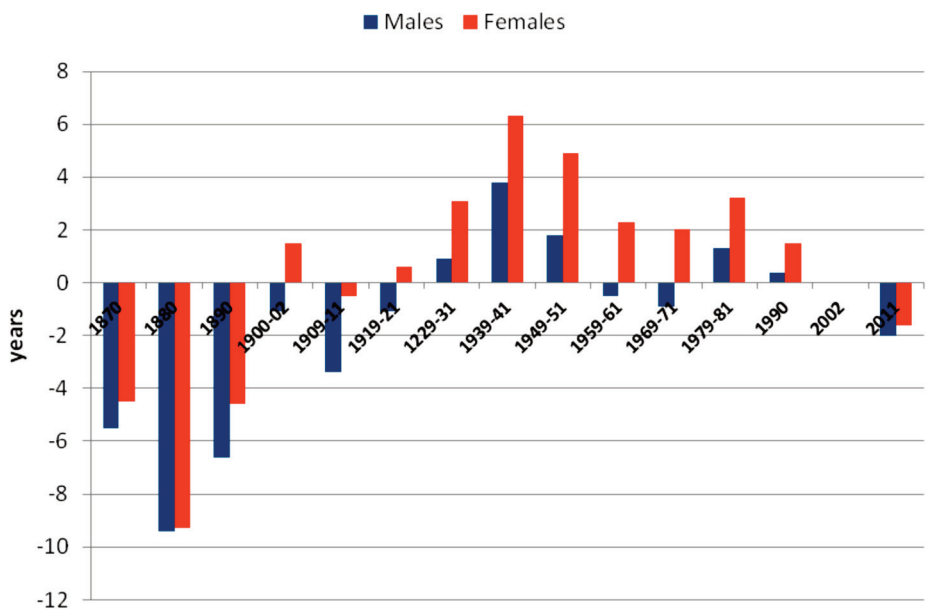
[6] The Irish Life Tables used have been selected to correspond as closely as possible with the dates of those for England and Wales.

After 1901 Irish male life expectancy never deviated from its English counterpart by more than two years and since the 1960s the gap has narrowed to one year or less. The English–Irish differential for females has been more significant, especially early in the twentieth century and between 1930 and the 1970s. The female-male differential in Ireland therefore lagged behind that in England for much of the twentieth century. The impressive gains in Irish female life expectancy noted for the post-war years were matched in England, with the result that not until the early twenty-first century did female life expectancy in Ireland draw level with that in England.

It is of interest to look briefly at the data for the United States of America, a country to which so many Irish people emigrated in the years up to the 1920s. At the outset, attention needs to be drawn to the relatively poor quality of the national demographic data for the US in the nineteenth century. Early estimates of life expectancy were based on incomplete records, relating mainly to the urban areas of New England. A National Registry of Vital Statistics was not launched until 1900 and not complete until 1933. It has been stated that "as a result, the timing and conditions of the demographic transition [in the US] are less precisely known than in countries such as England..." (Hacker, 2010, p. 48).

Figure 8 shows the US–Irish differential in life expectancy since the 1870s. Once again, the large differentials in favour of Ireland at the end of the nineteenth century, for males in particular, elicit scepticism. For most of the twentieth century

Figure 8: Differential in Life Expectancy at Birth, US *Minus* Ireland



the difference between life expectancy for white US males and Irish males was small, although it jumped during the 1930s. The gap also widened for women in this decade. Life expectancy rose appreciably in the US during the Great Depression due to big falls in the rate of road accident and workplace fatalities, while more households became connected to electricity, running water, and sewerage systems, and adopted health-enhancing household gadgets (Gordon, Chapter 4).[7] Ireland has lagged behind on these fronts during the 1930s.

But the most striking feature of the US–Irish life expectancy comparison is the size of the persistent differential in favour of US females between 1930 and 1990. In the 1940s this gap widened to over six years. It remained high in the 1950s and did not taper off until 1990. However, by the start of the twenty-first century both male and female Irish life expectancy exceeded the comparable US figures.

The brief review of Ireland's life expectancy relative to those of England and Wales and the US shows that while the three jurisdictions have travelled on different time paths over the past century and a half, with significant differences between countries in some sub-periods, their life expectancies eventually converged in the region of 80 years for both men and women. This is striking, even surprising, in view of the different standards of living and health care and social welfare structures prevailing in these countries.

IV CONCLUDING REMARKS

This paper presents a review of the historical evidence on Irish life expectancy. Much of the material that has been presented is broadly familiar but attention has been drawn to some lesser-known aspects of the data.

The first of these is the problem of the reliability of the civil registration data and its implications for measuring life expectancy. For many years after the introduction of compulsory civil registration in 1864, under-registration of both births and deaths, and especially infant deaths in rural areas, remained a serious problem. It persisted well into the twentieth century and should be borne in mind when studying both the trend in Irish life expectancy, regional differentials in Ireland, and when making comparisons with other jurisdictions. Despite this caveat, most of the discussion in this paper is based on unadjusted rates derived from the civil registration, but reservations are expressed by the results for the last quarter of the nineteenth century and the 1940s.

A topic that has been highlighted in this paper is the variation in the rate of improvement in life expectancy over the sub-periods between 1871 and 2011. In particular, attention was drawn to two periods of exceptionally rapid increase in life

[7] Ruhm (2000) presents evidence to support the view that more recent recessions also reduced US mortality rates.

expectancy – the first occurring in the first decade of the twentieth century, the second in the immediate post-Second World War years. The first of these was particularly large among the elderly population of both sexes, the second was experienced by both the 15 to 64 year age group, especially women, and the population aged 65 and over.

It is speculated that both of these surges in longevity reflected changes in social policy such as the social welfare reforms brought in by the UK Liberal Government in the first decade of the twentieth century, including the introduction of the Old Age Pension in 1908, and the surge of increased spending on health and welfare by the Irish government during and after the Second World War.

A breakdown of the contribution to longevity attributable to three broad age groups shows the importance of reductions in infant and child mortality in the first half of the twentieth century. In recent decades these rates have fallen to very low levels and made a diminishing contribution to overall longevity. Obviously, the experience of the first half of the twentieth century cannot be repeated and further gains in longevity must be concentrated in the older age groups. Indeed since the late 1970s the preponderance - and in recent decades as much as three quarters - of longevity gains has been attributable to falling age-specific deaths rates among the elderly. It has been argued that despite the frequently-expressed optimism about current progress in medical science, further reductions in mortality rates among the elderly may be increasingly difficult to deliver (Gordon, 2006). If this view proves correct, the overall gains in life expectancy in the coming decades will be much smaller than those recorded during the first half of the twentieth century. However Oeppen and Vaupel (2002) take a more optimistic view, suggesting that a significant further increase in life expectancy may be possible in coming decades.

REFERENCES

Barry, Colm A.,1941. “Irish regional life tables”, *Journal of the Statistical and Social Inquiry Society of Ireland*, Vol. XVI No. 5, 1941/1942, pp1-18.

Commission on Emigration and Other Population Problems, *Reports*, Dublin, 1954.

Coward, J., 1982. “Birth Under-Registration in the Republic of Ireland during the Twentieth Century”, *The Economic and Social Review*, Vol 14, No. 1, October, pp. 1-27.

Dalen J. E., J. S. Alpert, R. J. Goldberg and R. S. Weinstein, 2014. “The Epidemic of the 20th Century: Coronary Heart Disease”, *American Medical Journal*, Vol. 127, No. 9, pp. 807-12.

Dean, G. and C. J. Mulvihill, 1972. “The registration of births and deaths in Ireland”, *Journal of the Irish Medical Association*, Vol. 65, No. 5, 101-105.

Dean, G and C. J. Mulvihill, 1999. “Non-registration of deaths as a source of error in mortality data in the Irish Republic”, *Irish Journal of Psychological Medicine* 16(1):16-17.l.

Dean, G. and H. McLoughlin, 1980. “The registration and certification of deaths in the West of Ireland”. *Irish Medical Journal*, 73(7), 269-270.

Delaney, Liam, Mark McGovern and James P. Smith, 2009. "From Angela's Ashes to the Celtic Tiger: Early Life Conditions and Adult Health in Ireland", *Journal of Health Economics*, 30(1), 1-10.

Garvin, Tom, 2004. *Preventing the Future: Why was Ireland so Poor for so Long?* Dublin: Gill and Macmillan.

Gordon, Robert J., 2016. *The Rise and Fall of American Growth*. Princeton and Oxford, Princeton University Press.

Gosling, Paul, 1993. *Archaeological Inventory of County Galway: Volume 1: West Galway*, Dublin: The Stationery Office.

Guinnane, Timothy, 1997. *The Vanishing Irish: Households, Migration, and the Rural Economy in Ireland, 1850-1914*, Princeton University Press, Princeton NJ.

Hacker, J. David, 2010. "Decennial Life Tables for the White Population of the US, 1790-1900", *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, Vol. 43, No. 2, pp. 45-49.

Hall, Mary, 2013, "Mortality in Ireland 1901 to 2006", *British Actuarial Journal*, Vol. 18, part 2, pp. 436-451.

Hughes, J., 1977. "Estimates of Annual Net Migration and their relationship with series on Annual Net Passenger Movement: Ireland 1926-67", Dublin: The Economic and Social Research Institute, Memorandum Series No. 122.

Ledermann, Sully, 1969. *Nouvelles table-types de mortalité,* Paris: Cahiers INED, No. 53.

McGovern, Mark E., 2016. "Progress and the Lack of Progress in Addressing Infant Health and Infant Health Inequalities in Ireland during the 20th Century", Statistical and Social Inquiry Society of Ireland, Barrington Lecture. www.ssisi.ie/McGovern_Infant_Mortality.pdf.

Meenan, James Francis, 1970. *The Irish Economy since 1922*. Liverpool University Press, Liverpool.

Murphy, Kevin M. and Robert M. Topel (eds.), 2003. *Measuring the Gains from Medical Research: An Economic Approach*, Chicago: Chicago University Press for NBER.

Nordhaus, William D., 2003. "The Health of Nations: The Contribution of Improved Health to Living Standards", in Murphy and Topel (eds.), 2003.

Ó Gráda, Cormac, 1994. *Ireland A New Economic History 1780-1939*, Oxford: OUP.

Oeppen, Jim and J. James Vaupel, 2002, "Broken Limits to Life Expectancy", *Science*, Vol. 296, Issue 5570, pp. 1029-1031.

Registrar-General Of Marriages, Births, And Deaths In Ireland. *Annual Reports*, Dublin. www.cso.ie/en/statistics/birthsdeathsandmarriages/archive/annualreportsonmarriagesbirthsanddeathsinirelandfrom1864to2000/#d.en.64549.

Ruhm, C. J., 2000. "Are Recessions Good For Your Health?" *Quarterly Journal of Economics*, Vol. 115, pp. 617-650.

Verrière, J. 1979. *La population de I'Irlande*, Paris: Mouton.

Williams, Naomi and Chris Galley, 1995, "Urban-rural Differentials in Infant Mortality in Victorian England", *Population Studies*, Vol. 49 pp. 401-420.

APPENDIX A:
Alternative estimates of Irish (32 counties) infant mortality, 1861-1940

TABLE A1: Estimates of Infant Mortality Rate (per thousand), 1871-1901

Period	*1861-1870*	*1871-1880*	*1881-1890*	*1891-1900*	*1901-1910*	*1911 1920*	*1921-1930*	*1931-1940*
Based on civil registration data	96	97	96	102	99	92	74	71
Verrière's estimates	179	160	149	140	125	122	95	78

Source: Verrière, 1979, Tableau III.1.