Historical Analysis of Population / Mortality Rate Changes in the UK

by John Read

Introduction

This paper is a sequel to the earlier paper (Radstats 111 Read) dealing with the UK population and considers the population from the basis of the total reported population from 1953 on a five and single year of age basis as opposed to mortality rate variations.

The results of the study were to say the least interesting, stretching over the time period from 1971 to 2015, extendable to 1920 t0 2045 and showed actual fluctuations around 600,00 with defined population surges up to 950,00 which occur periodically and move with time linked to age.

There are four major surges (possibly five), starting from birth in 2020, probably associated with WWI, one in 1946, the WWII baby boom and then a major one in 1940, associated with the increase in survival currently occurring, the final one, of a different source, starts in 2004 and is associated with the recent increases in nett migration. There is also a possible regression wave starting around 1983, but this is not dominant at present.

The population of the United Kingdom has been experiencing dynamic changes over the past 80 years, which was assumed to be occurring in an orderly and uniform manner, however comparison with actual changes occurring, particularly mortality rate, showed this was more complex than originally believed.

This historical analysis study of the UK population with age over time has been carried out as a part of the population progression over the past 80 years and its effect on the current problem of the ageing population and future population trends.

The English and UK population have been well documented in village records of births, deaths and marriages and then in more detail in the

ten year census from 1858 to finally complete statistical detail in modern computer records using the powerful cohort projections.

However the power of age and time analysis has apparently not been used to consider the full impact together of these techniques, or if so has not been analysed adequately to bring out the joint outcomes. The basic data consists of UK population data over age and time, increased by birth and reduced by death, in the last 80 years this has been stretched in time by increased survival and added to by nett migration changes.

Background

Increased population flow and its implications were identified in an earlier publication (Marshall et al, Radstats), but at that time were confused with the WWII baby boom, which although significant was the persistence with time, due to higher survival, in the under 65 population, although it was part of these changes and still persists today.

Major reductions of some 50% in mortality rates have occurred, which have had cumulative effects with age and time, reaching age 50 at the turn of the century and progressing on from then. There was also the impression of population over-estimation and mortality under-estimation.

The ageing population was considered as a function of time with forward projections assessing the economic problems of the redistribution over the ages and emphasis on the growth of the elderly. The latest 2015 life tables show a slowing down of this wave and the 2015/2014 ratio shows little change, suggesting the transition to new steady state conditions of constant mortality rates.

This contradicts the assumptions of the uniform and orderly progress of mortality rate reduction and population increase, that changes are not uniform over the age distribution and a time limit of at most 20 years to such changes, whilst the population flow progresses through the system.

This could give a simpler explanation on the effect of the population changes now occurring, the the presence of a reduced mortality wave progressing with age is that of a cumulative population wave meeting the resistance of the mortality attrition barrier of rapidly rising

mortality rates of old age or even just the penetration of rate change into this barrier.

More simply, the population is increasing due to improved lifestyles and this builds up steadily with age and time to form a tidal wave of larger population which meets the resistance of old age, where it dies out. This is now occurring but has some 20 odd years before the flow passes age 65.and finally subsides, as shown in the population projections, which stabilise at a new level at lower ages.

It should be emphasised that the results are based on actual historical basic data of population and life tables published by ONS, whose use is fully acknowledged' They reflect what is actually happening without assumption modification, although any interpretation, represents the author's opinion and conjecture.

Methodology

Basic sound data on mortality rates qx and population were obtained from ONS and were analysed using techniques mainly of direct and ratio comparison of one, five and ten years from 1951 and population 1953 and single year of age fromm1971. Forward and historical projections using the standard cohort component methodology were also carried out. As these used historical data, no other assumptions were made except for forward projections in time which are clearly stated.

The study started off with England and Wales data going back to 1858, but due to high internal migration was changed to the UK. The comparisons were carried out using the ONS 2014 Life Tables which had full tables back to 1980-82 which were updated to 2015 and population from 1981 and the ONS 2014 values.

Analysis of UK Population Wave Progression 1953- 2015

The analysis against age showed similar results for various average age bands with time with loss of information as one increased data range but with simplifying displays and one therefore has to choose the least complex to illustrate the point being made.

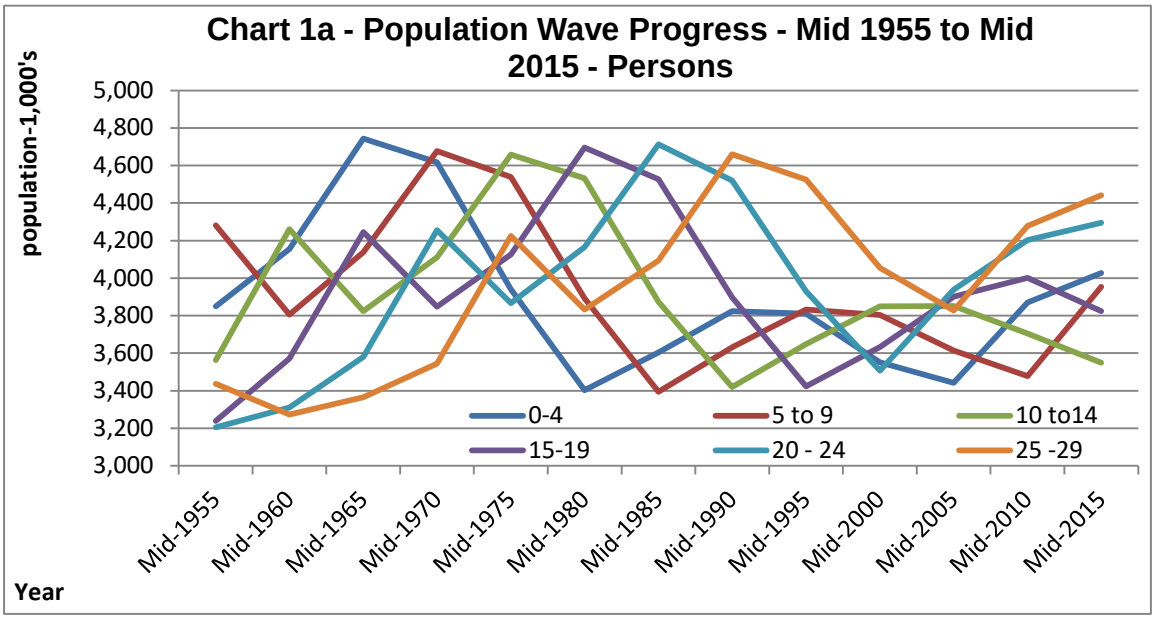
The single year of age band, gave the absolute data and are given for two age bands 35-39 and 50-54 which illustrates the main surges

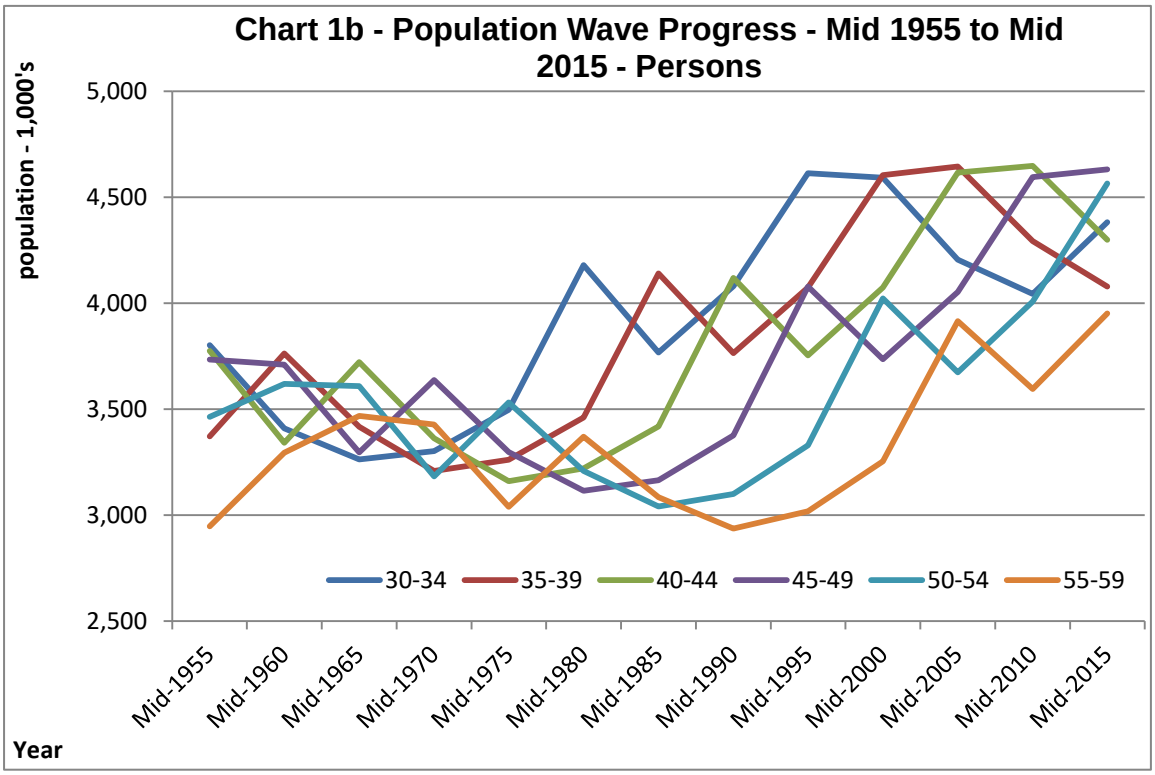
occurring and gives actual population values. The main five year results are spread over three charts from the age range 0 - 4 up to 80 - 84 over the time period from 1953 to 2015 for each chart, this was carried out to avoid data confusion and show the time age progression more clearly. Effectively age and time are interchangeable in these charts below age 55 and age range should be deducted from year to give possible date of origin, unless linked to a significant event.

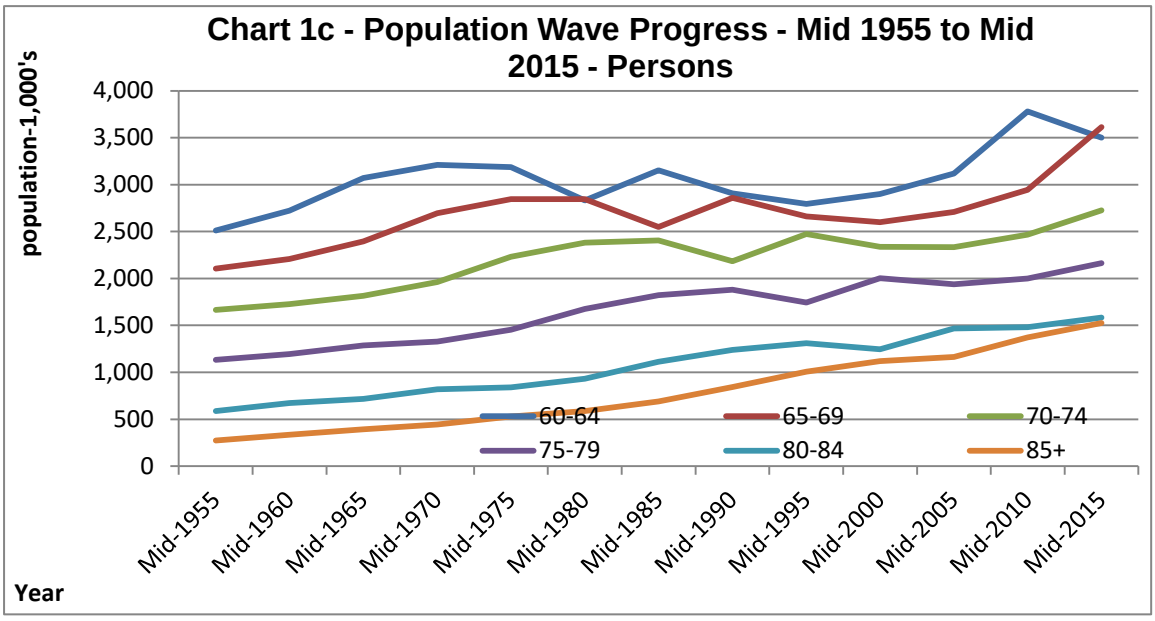
The charts are initially difficult to comprehend due to their repetitive nature, overlap and reverse time imaging; they track each age group from 0-4 over the full time scale and its progress through time. They clearly show the persistence of low mortality rates and high survival of change at ages below 55 and the absence of decay in the single increased population wave.

Chart 1a shows three distinct waves which progress steadily through charts b and c with little attenuation until age 55 is reached, when the mortality attrition barrier of old age starts to take real effect, although there are earlier signs from age 35.

The first sharp triangular peak originated around 1920 from WWI, reaching age 65 in 1985; the second larger more rounded peak occurred in 1946, probably part of the WWII baby boom is at 65. The main large population flow peak, which has a 25 year bandwidth and the bulk of the population increase, is around 1940 and will not pass through age 65 until 2030+.







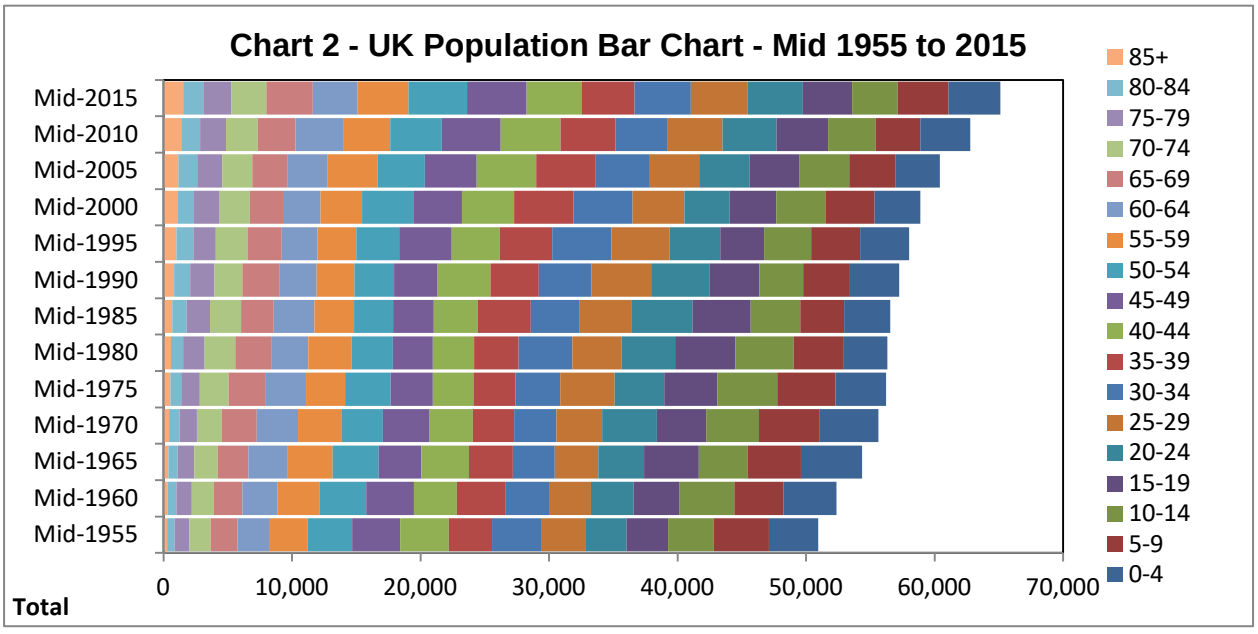
These charts can be used for projecting forward and backward in time for any event, trough or peak and used to confirm forward projections in time. The 1980-84 graph shows the first indication of decay of the first wave size, although all show the decline in population numbers after age 55, with chart 1c showing the change after 65 has remained unaltered for many years.

The start of a new migration wave is just discernible in the 20-24 and 25-29 age graphs shown from 2011 onwards and dealt with earlier and a new regression wave of positive mortality rate is expected from current living styles but difficult to detect from existing records.

Looking at these in more detail, in age order, but starting with chart 1c the 65 to 85+ age group, we can see the decline in numbers that is occurring and the early 1920 first peak that decays from 3,300 at 65 in 1984 to 1500 at 84 in 1984. At the same time the WWII baby boom has reached its peak in 2011 numbering 3,800 and is just passing through the age 60 to 75 time period.

Moving on to 1b, covering the middle age group 30 to 59, we can see the three stages of the repetitive surges in population starting with the triangular 1920's boom on the LHS, with the WWII baby boom in the centre and the major survival increase on the RHS. This then takes us on to 1a, 0 to 29 age group where we see the baby boom and survival groups intermingled with the steady state cyclical variations thereafter and the more recent migration wave (age 20-29), starting apparently in 2006.

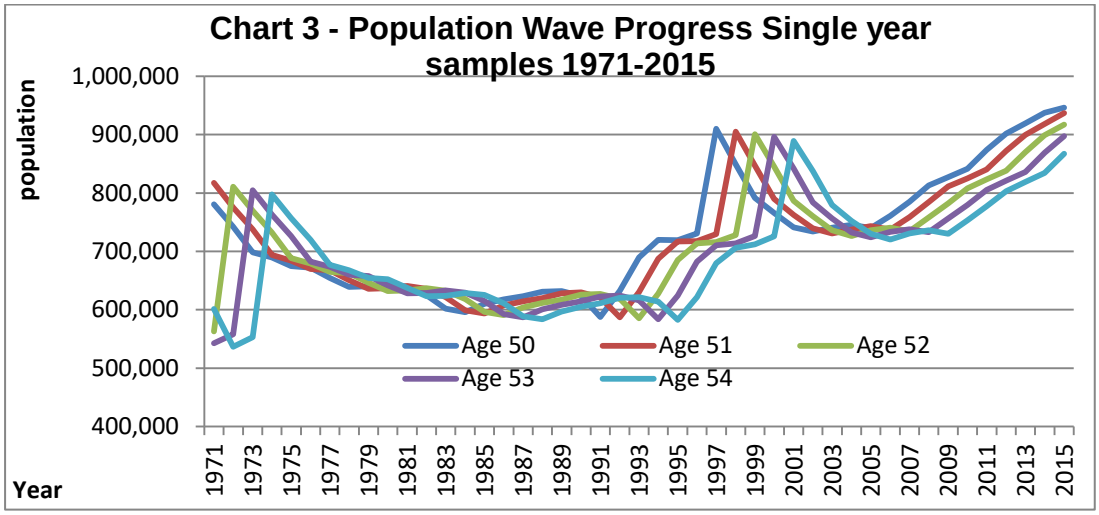
The charts are summarised in chart 2, which gives the whole picture from 1955 to 2015 and age 0 to 85+ in an extended bar chart for the whole population at 5 year intervals, this chart is more decorative than informative but gives an overall impression of the age progression.

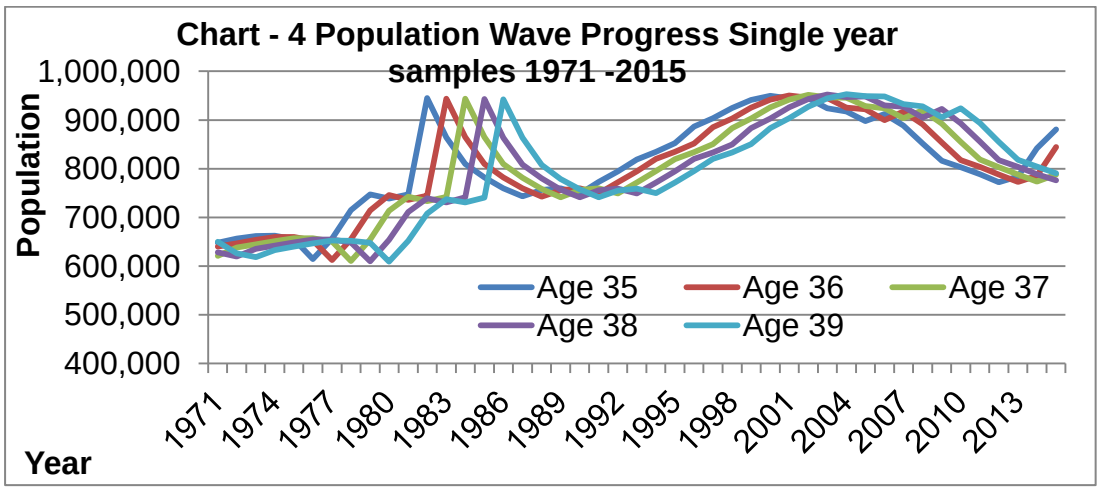


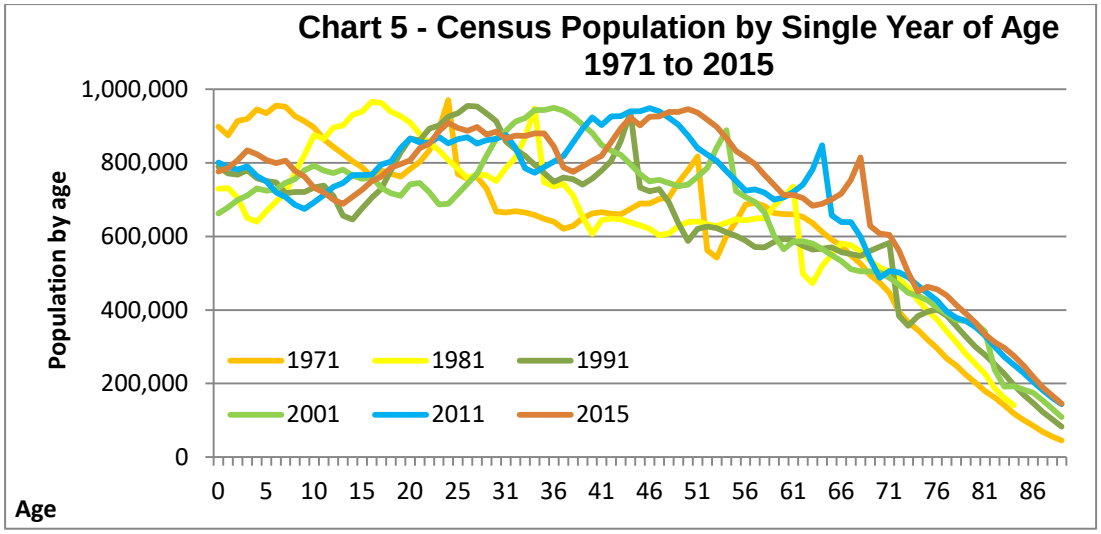
Single Year Curves - 1971 to 2015

This data gives the progression by single year of age which shows the same characteristics but in more detail and therefore more difficult to present, but giving actual annual values and sharper peaks, we therefore are presenting two sample which show the main three surges of population.

Chart 3 shows the two WW surges at age 50-54 with sharply rising fronts peaking at 800,000 and 900,000, levelling out at 600,000, whilst chart 4 shows the WWII baby boom interrupting the larger survival rise at age 35-39. The earlier curves (50-54) show slightly lower values with the WWII baby boom and survival reaching 930,000 and baseline at 630,000 (35-39), both WW curves show a 6.3 years duration although the earlier curve has a longer decay.



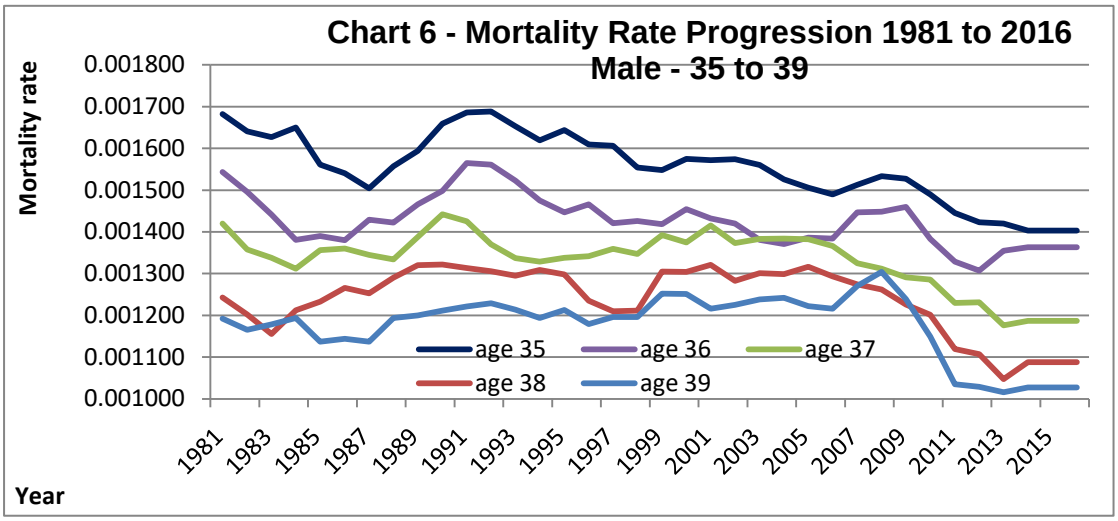




The survival curve starts in 1940 and continues on to 1977 over some 34 years, peaking in the 35-39 series in 2000 and will pass 65 in 2030. Chart 5 gives the age distribution curves for single year of age for the census years from 1971 and 2015, the main points of interest are the little change in annual age value and the mortality attrition tail off from age 50.

Mortality Rate Progression

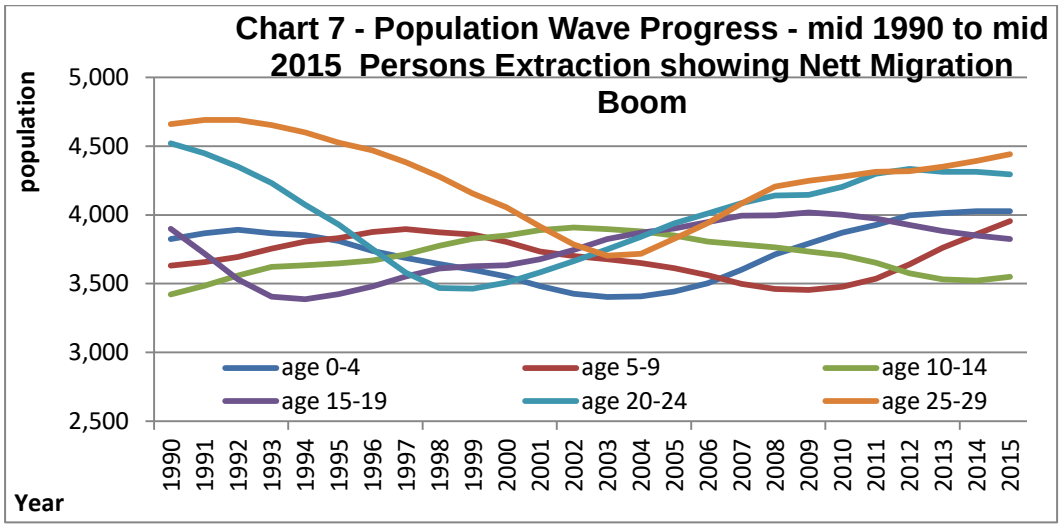
Chart 6 shows the age 35 to 39 progress of mortality rate from 1981 to 2016, which follows the population in reverse with qx reducing as population increases, although there is little correlation with chart, particularly for females, which show a steady drop in mortality rate.



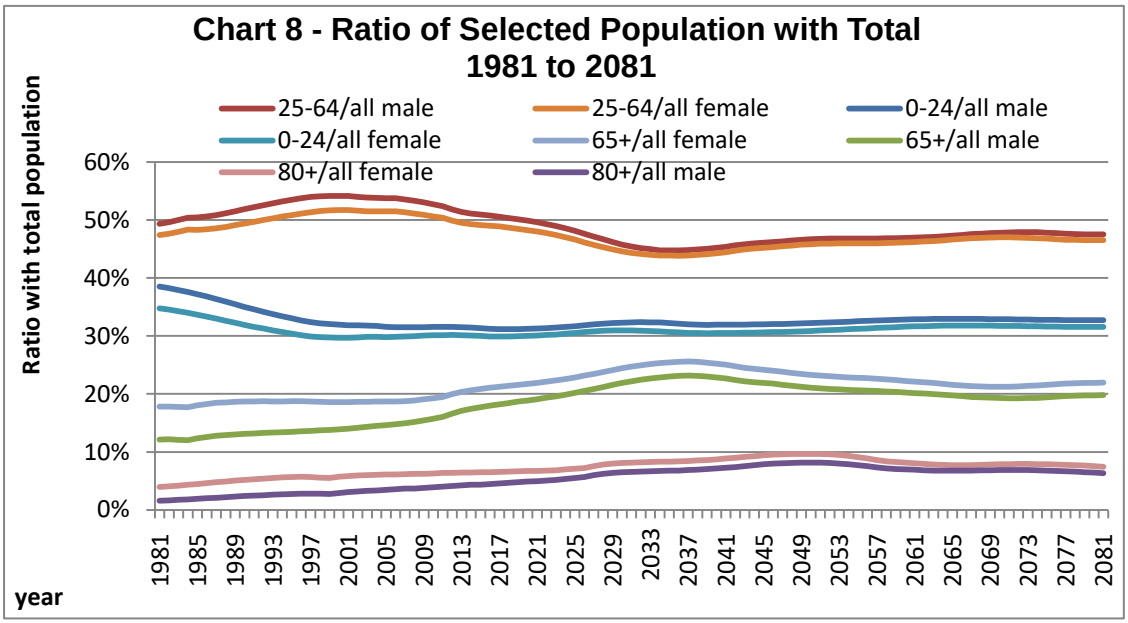
However mortality rate drops progressively over the whole chart both by age and time with ratios of 86% in time from 1981 to 2015 and from age 0 to 55, suggesting survival improvement is continuing over this period.

Net Migration

Migration is playing an increasingly important part in population considerations, with nett migration reaching levels at 50% of birth rate with the higher fertility rates in migrants, however age distribution is in a narrow band from 18 to 32, peaking sharply at age 25. This has major social implications now, but will not affect the elderly for some 40 years as shown in the chart, This is clearly shown in chart 7 as a deviation from the normal expected path starting around 2004-2006 and continuing to rise as opposed to the normal variation shown earlier.



The projections were extended to 2081 and are shown in chart 8 as the ratio of selected to total population of infants and students age 0 to 24, working population 25 to 64 and retired of 65+ and 80+ with time for constant qx. The 0-24 curves are virtually constant at 31% from 2015 rising slightly. The 25 to 64 ratio drops steadily from a peak of 54% in 2000 to 44% in 2037 then rises slowly thereafter to 47%, male and female are very similar over these periods.



The 65+ curves rise steadily to a peak of 26% in 2038 for female with male peaking lower at 23% at the same time, this is a rise of 6% from 2015, then both drop slightly thereafter; the 80+ curves peak 15 years later at 9.6% and 8.3% a rise of 3% from 2015. Actual total population values are for male 27,411, 30,539, 32,102and female 28,946, 30,973, 32,184 for the years 1981, 2015 and 2038, and these rises are the effect of aging on the elderly population.

Overall Position

In the 1930's and early 1940's a major change occurred to the UK population in that those born in 1940 began to live longer, surviving to greater ages and increasing the population. The reasons are not clear, but appeared to be associated with austerity years, nutrition and activity combined with medical advances and the change was connected to pregnancy, birth and the first year of life.

Something fundamental happened at that time with DNA, genes or some other factor in pregnancy to change population survival, causing major mortality rate reductions not previously experienced and the resultant survival of the population below age 65.

This process moves with age through time, developing progressively and has just reached the ages of 60 and 70 and will progress for another 30 years but on a decaying scale with the decline of elderly age. It leaves behind a steady state of low mortality rates up to the age

of 50, where the mortality attrition of rapidly rising mortality rates occurs (subject of a further publication).

The population progression by age clearly shows this happening with repetitive charts showing the steady cumulative growth from 1940 to 1965, steadying out and then declining to 1977, repeating for each year of age. There is poor correspondence with mortality rates but these have been reducing steadily, reaching low values so that population changes do not decay until after age 50.

It is generally accepted that this survival, up to 80 to 90% at age 65, is independently continuing indefinitely, but these results do not support this and the latest life tables show constant mortality over the whole age range with forward projections showing a limit to final 65+ female population at 26% by 2036 and 80+ at 10% of total population by 2051. Lower ages, stabilise out at 600 to 650,000 once the surge has passed with population surges up to 950,000 for single year of age.

There are many matters that need explaining in these results, which need repeating with single year of age data back to 1930 for population, mortality, mortality rate and in and out migration.

Conclusions

The study is based on basic data released by ONS giving population numbers from Census and projection data in a five year of age form from1953 and single year of age from 1971 to 2015 and should therefore reflect what is actually occurring to the UK population progression. It is an analysis by age of this data.

It was not quite what was expected, showing repetitive data progressing through time with age in a simple manner, virtually unimpeded by decay, showing major increases in numbers associated with external events overlaying a basic background level.

The first two of these are world war baby boom increases in fertility of short term duration, these are followed by a larger more sustained survival increase running for some 25 years. Against all current expectations, this also appears to be birth related, with the rise accumulating from birth additions.

The simplest explanation is changes in living conditions from 1940 produced longevity changes in pregnancy and first year of birth, which

build up population cumulative increases over the next ten to 25 years. The mortality rate changes once established were persistent from thereon, but had completed their population changes and progressed slowly thereafter under a new steady state which moved steadily through the population ages until reaching the mortality attrition barrier where they decayed..

A wave of increasing mortality rate is still possible without affecting mortality rate unduly in the initial stages, if it is spread over a wide age range and not too intense, where its build up would be unnoticed. This is also associated with the mortality/population correlation, which only appears to occur when the action is abrupt.

Survival increases were expected to build up steadily over the age range and health related advances, which apparently is not occurring, similarly the setting of a peak maximum is also unexplained. The newly developing nett migration increase is still developing and was expected from age 20-29.

The latest 2015 life tables show no change in mortality rates over the whole age range, suggesting a new steady state may have been reached until the survival wave reaches 65+ and possible reactions start again.

Besides the obvious short term fertility based WW increase in population, the major survival increase starts in 1940 and accumulates to 1965 where it peaks and starts to reduce; this could be the start of a regression wave associated with obesity and indolence, which counteract the increased survival. However there are also signs that the latest generation are taking a more active, healthy and responsible attitude to their living standards to continue the trend to greater longevity.

However the new higher levels of retired population will still create major problems requiring drastic action on elderly provision in some form of self-provision whilst in work, by an earned benefit scheme with designated individual Funds. The study also raises major questions which need attention, of significance is the socio-economic reliance of life expectancy predictions on elderly projections.

References and Acknowledgements

ONS reports used :- copy of nltuk1315life table 2015; UK Population Estimates 1838 – 2015

The Elderly Population in 2014 John Read -Radstats 111 2016

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