An analysis of the demographic contributions to population ageing in England and Wales

Alan Marshall, John Read, James Nazroo

Abstract

There is an accepted narrative that a growing elderly population is a consequence of increasing life expectance across the age span and that current levels of pension provision are unaffordable as a result. Our research challenges this claim by demonstrating that the main driver of the projected growth in the older population over the coming three decades is population flow from working ages to retirement ages, with only a small contribution made by increases in longevity post retirement age.

We decompose the projected growth of the older population (defined here using an age 65 threshold) in England and Wales between 2012 and 2042 into three components; improvements in levels of mortality at the older ages (65+), improvements in mortality at the younger ages (0-65) and population flow into old age.

We demonstrate that projected increases in longevity account for only 35% of the projected growth in the population aged over 65 between 2001 and 2041. This is made up of increases in longevity at or above the age of 65, which accounts for 31% of the projected increase in the older population, with improvements in mortality between the ages of 0 to 64 accounting for around 3%.

The remaining 65% of the projected growth in the older population can be attributed to population flow from younger ages. As this group have contributed to their pensions for the duration of their working lives it might be argued that they would not create an additional burden on an appropriately designed pension system.

Introduction

An implicit assumption underlying the claims that current levels of pension provision are not affordable is increasing longevity, and in

particular, increasing life expectancy at retirement age. This assumption is accepted by the mainstream political parties and is used, for example, to justify increases to the state retirement age or the contributions made to pension funds:

> "What lies behind this discussion is that people in this country are living longer. That is a fantastically important beneficial trend for the country, but it also means that we have to ensure that in future the benefits of those longer lives are shared between time in work and time in retirement". Danny Alexander justifying changes to public sector pension on Sky News. 17th June 2011.
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> "One of the things about the state pension being paid at 65 is that that hasn't changed for the best part of a century, and yet over that period people are not just living longer, but living healthier, living longer in retirement and we need a system that reflects that" Steve Webb, Pensions Minister in The Guardian 24th June 2010

In this paper, our primary aim is to assess the extent to which increases in life expectancy at the older ages are the driver for the growth in the older population anticipated in the next 30 years. We decompose the projected growth (2011 and 2042) in the older population into three components; improvements in mortality at the older ages (65+), improvements in mortality at the child and working ages (0-65) and population flow to the older ages during the period 2012 to 2042. If the majority of the increase in older people in the next 30 years is attributable to the flow of population from working ages to retirement, this undermines the argument of the unsustainability of pension provision on the basis of increasing longevity.

Population ageing is a global phenomenon resulting from increasing longevity but also from falling fertility rates that lead to growth of the proportion of the population at the older ages. Additionally, in countries such as the UK, the higher levels of fertility and so called 'baby boom' that followed the Second World War provides an additional (temporary) increase in the elderly population as this cohort begins to move to the older ages. Population ageing is frequently viewed negative impacts on social and economic resources; it is argued that the growth of the elderly population will require additional support that a diminished working age population will be unable to provide (Thane 1989; Jarvis 2000; Harper 2006). Recently in the UK, population ageing has been used to justify both the increases to the

state pension age[1] and the proposed reforms to public sector pensions[2]. The issue appears regularly within the media, for example, the BBC chose population ageing as a key issue in its 2004 'If' series that examined the major future challenges facing the UK (BBC 2004).

A key source of evidence in debates on population ageing and policy around pension provision in the UK are the population projections produced by the Office for National Statistics. These population projections are based on the cohort component methodology (Rowland 2003) which involves 'ageing' on a base population after accounting for the impacts of fertility, mortality and migration. The latest 2012 based population projections use the 2012 mid-year estimates as the base population with information on fertility and mortality from vital statistics of births and deaths and data on migration from GP registration data and International Passenger Survey. Projections of the fertility, mortality and migration components of change are based on a mixture of trend calculations and extrapolation as well as expert opinion. A review of the ONS population projections over the past 50 years found improvements in the estimation of fertility and mortality over time with declines in the accuracy of migration, which is the most unreliable of the components of population change (Shaw 2007). Historically, population projections have been least accurate at the oldest and youngest ages as a result of errors in the projection of mortality and fertility respectively (Shaw 2007). ONS accommodate the uncertainty inherent in predicting the size of the future population through a set of variant projections with different assumptions of fertility, mortality and migration which accompany the principal projection. Further information on the methodology used by ONS to produce their projections is provided elsewhere[3].

For the purposes of this paper the key component of population change is mortality and, in particular, its impact on the growth in the older population. Within academic debate, two opposing views of future mortality are proposed. Olshansky et al. (2001) argue that the long term improvements in life expectancy will not continue because we are approaching the limits of human life expectancy and,

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[1] http://www.theguardian.com/uk-news/2013/dec/05/state-pension-age-raised-to-70-autumn-statement

[2] http://www.theguardian.com/money/2013/may/17/public-sector-pensions-reduced-third

[3] http://www.ons.gov.uk/ons/guide-method/method-quality/specific/population-and-migration/population-projections/methodology---national-population-projections/index.html

additionally, the rise of diseases associated with lifestyle choice such as diabetes, will limit (or reverse) mortality improvements. Conversely, Oeppen and Vaupel (2002) argue against any limits to longevity citing potential breakthroughs in fields of medicine and improvements in medical practice and standards of living as drivers of ongoing mortality improvement. In the 2012-based ONS principal projection, an optimistic stance on future mortality is adopted and the recent and long term declines in mortality are extrapolated into the future, although the rate of mortality improvement is projected to slow.

Although the ONS produce a constant mortality projection within their set of variant projections, they do not produce the set of projection scenarios necessary to answer the question of whether the future older population are growing because mortality is declining or because the cohorts entering old age are larger than has been the case in the past. This distinction has important implications for policy and is an information gap is noted by Professor Phil Rees in his written response to the call for evidence by the House of Lords Committee on Public Service and Demographic Change[4]. In this paper we tackle this question directly which is particularly salient at the time of writing as the Second World War baby boom cohort are now moving into the older ages and will continue to do so during our projection period (2012-2041).

Methods and Data

We decompose the growth in the older population to three components (1. improvements in mortality at the older ages, 2. improvements in mortality at the working and child ages, and 3. population flow from the working ages to the older ages) using a demographic technique which has parallels to that proposed by Bongaarts and Bulatao (1999) and further developed by Rees et al. (2013). We calculate three scenarios of population projections (2011-2041):

1) **Declining mortality (DM) projection** (ONS principal mortality and fertility assumptions, zero migration)
2) **Static older mortality projection (SOM)** (static mortality over the age of 64 as observed in 2013/14 with ONS principal mortality assumptions between 0 and 64, ONS principal fertility assumptions and zero migration)

[4] http://www.parliament.uk/documents/lords-committees/Demographicchange/PublicServiceVol2.pdf (see p872)

3) **Static younger mortality projection (SYM)** (static mortality under the age of 65 as observed in 2013/14 with ONS principal mortality assumptions from 65, ONS principal fertility assumptions and no migration)

Comparison of the size of the population in these three scenarios enables decomposition of the growth in the 65+ population (2011-2041) into the three components as illustrated in table 1.

Table 1: Calculation of components of change in the population aged 65 and over (2011-2041)

Component		Calculation
	Total growth in 65+ population	DM (2041) - Mid year estimate (2011)
1.	Growth in older population attributable to mortality improvements at the older ages	SOM (2041) - Mid year estimate (2011)
2.	Growth in older population attributable to mortality improvements at the younger ages	SOY (2041) - Mid year estimate (2011)
3.	Growth in older population attributable to population flow from the working to older ages	Total growth - (component 1 + component 2)

Our projections are, like those produced by ONS, based on the cohort component methodology, a regularly used and validated demographic technique (Rowland 2003). We start with a base population, provided by the 2011 mid-year estimates, who are aged on to give the population in a subsequent year after subtracting the number of deaths and adding on the number of births. Projections of mortality and fertility are taken from the ONS 2012 based projections for England and Wales.

The cohort component model that fitted is given below:

Let p_t = population at age x (x=0,.....99, 100+ and x=35,...,99, 100+) for sex s (s=1 male and 2 female) in year t (t=2012,.....,2042)

Let $d_{x,s,t}$ = number of deaths at age *x*, sex *s* and in the year *t*

Let $b_{s,t}$ = number of births of sex *s* in the year *t*

We deliberately do not include migration in our projections so as to study the effect of different assumptions of mortality on the growth of

the older population in isolation. However, we have replicated all the scenarios described above with the ONS migration assumptions (2011-2041) which does not alter any of conclusions. We briefly discuss the impact of migration in the results section. Although we include births, based on ONS assumptions of trends in fertility, these play no role in our main analysis which concerns the growth of the older population aged over 65. Those born at the start of our projection period reach an age of 30 at the end of the projection period.

Our projections are produced using the POPGROUP demographic software[5]. Developed at the University of Manchester and now owned by the Local Government Association, POPGROUP is an Excel based package that enables users to produce projections of population (as well as other characteristics) through the cohort component methodology. We use POPGROUP to first replicate the ONS population projections (with no migration assumptions) then run two further projections with the alternative mortality assumptions of the Static Older Mortality (SOM) and Static Younger Mortality (SYM) projections as described above.

Results

Figure one illustrates the age structure of the England and Wales population in 2011. The increased levels of fertility associated with the Second World War are clearly visible as a bulge in the population pyramid around the age of 66. Similarly, we observe a bulge in the pyramid between the ages of 40 and 50 representing high levels of fertility during the 1960s. An 'echo' of the post-Second World War baby boomer cohort is apparent at the younger ages (20-30), comprising the children of the baby boomers as well as the effects of increased immigration which tends to occur at the younger adult ages.

[5] http://www.ccsr.ac.uk/popgroup/

Figure 1: England and Wales population pyramid in 2012 (2012 mid-year estimate)

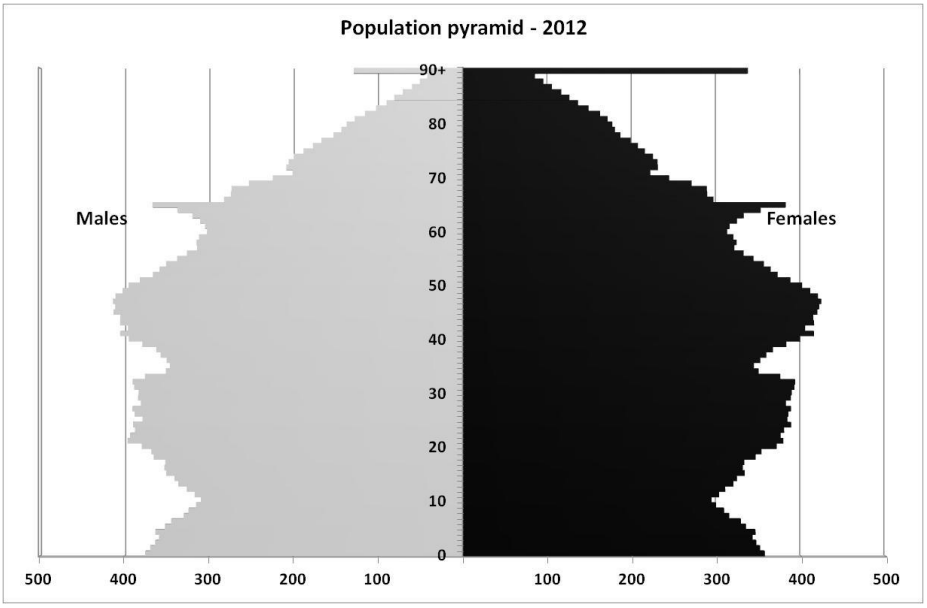


Table 2: Projections of the population aged over 65 in each of the three projection scenarios

	Male	Female	Total
Static younger mortality (2042)	7,504,000	8,706,000	16,210,000
Static older mortality (2042)	6,580,000	7,728,000	14,308,000
Declining mortality (2042)	7,647,000	8,794,000	16,441,000
2012 mid-year estimate	4,317,000	5,326,000	9,643,000

The Declining Mortality projection (DM), that uses the ONS (principal projection) assumptions on future falls in death rates, gives a 68% increase in the population aged over 65 from 9,643,000 in 2011 to 16,210,000 in 2042. In the Static Older Mortality projection (SOM), where mortality rates are held constant at 2013/14 levels for the 65+ ages, we observe a lower projected population total of older people in 2042 (14,308,000) compared to the DM projection. This difference suggests that declines in mortality at the older ages do make a significant contribution to the rise in the 65+ population. However, that there is still a very strong (53%) increase in the number of older people between 2011 and 2041 even when mortality is held constant at the older ages, indicating that other factors are involved. Improvements in mortality rates at the 0-64 age group between 2011 and 2041 have a very limited impact on the growth in the older population as illustrated by the comparability of the population aged

over 65 in the DM and Static Younger Mortality (SYM) projections in 2042.

Table 3 decomposes the growth in the older population (65+) between 2011 and 2042 to three components of mortality improvements at the older ages (65+), mortality improvements at the younger ages (0-64) and population flow from the working to older ages. A striking result is that two thirds of the growth in the population aged over 65 projected between 2011 and 2041 is attributable to population flow across the old age threshold (65). This finding can be explained by two factors. First, the improved living standards that followed the Second World War have enabled a greater proportion of people to reach old age compared to generations born before the Second World War. Second, the increased levels of fertility that followed the Second World War produced a larger cohort of population (so-called baby boomers) than preceded or followed it. Importantly, each of these factors provide a temporary contribution to population ageing.

Table 3: Decomposition of the change in the population aged over 65 between 2011 and 2041 into components of; mortality improvements at the older ages (65+), mortality improvements at the younger ages (0-64) and population flow from working to older ages

Component of change		Males		Females		Total	
		Number	% of total growth	Number	% of total growth	Number	% of total growth
Total growth in 65+ population		3,330,000		3,468,000		6,798,000	
1	Mortality improvements at the older ages	1,067,000	32.04	1,066,000	30.7	2,133,000	31.4
2	Mortality improvements at the younger ages	143,000	4.29	88,000	2.5	231,000	3.4
3	Population flow from the working to older ages	2,120,000	63.66	2,314,000	66.7	4,434,000	65.2

One factor we do not include in our projections is migration, however, replication of the projections with the Office for National Statistics migration assumptions does not alter the conclusions reported in

tables 2 and 3. Overall, migration leads to very modest net population growth at the older working ages with even less impact at retirement ages and so inclusion of this component of population change leads to a very slight increase in the proportion of projected change in the population aged over 65 attributable to population flow.

An even more striking approach to decomposing changes in the projected 65+ population in 2041 is to consider that of the projected 16,441,000: 9,643,000 (58.7%) would be present if there were no changes in fertility and life expectancy across the relevant cohorts; 4,434,000 (27.0%) additional people will be present as a result of historic changes in fertility and historic improvements in life expectancy prior to age 65; 231,000 (1.4%) additional people will be present as a result of expected future changes in life expectancy prior to age 65; and only 2,133,00 (13.0%) will be present as a result of expected future changes in life expectancy for the age of 65 and older.

Figures 3 and 4 illustrate the projected growth of the total population and the older population (age 65+) respectively. The Declining Mortality (DM) and Static Younger Mortality (SYM) projections result in similar population totals in 2042 (60,402,000 and 59,919,000 respectively) that are larger than that projected in the Static Older Mortality projection (58,269,000). As noted earlier this reflects the more limited impact of improvement in mortality rates on total deaths across the younger ages relative to mortality improvements at the older ages. Whilst the population in the DM and SYM projections appears to level off over the projection period, the SOM projected population actually begins to decline from 2030. Examination of the DM and SOM projected population totals at the older ages (figure 4) reveals greater variation at the very oldest ages (85+) compared to the initial years of old age (65-74). This is because the reductions in mortality rates that are included in the DM projection at the oldest age, and not in the SOM projection, accumulate over the projection period leading to the most pronounced differences in population totals at the very oldest ages at the end of the projection (2042). The differences in the projected totals of older people in the SYM and DM population are very small (not shown in figure 4 for reasons of clarity), an expected result, in that these projections have the same assumptions on older age mortality improvement and essentially the same population flow from younger ages. In short, mortality improvements for the 0-64 age group (from 2012) are small with little net impact on population flow.

Figure 3: Total population (1000s) in each projection (Declining Mortality, Static Older Mortality and Static Younger Mortality)

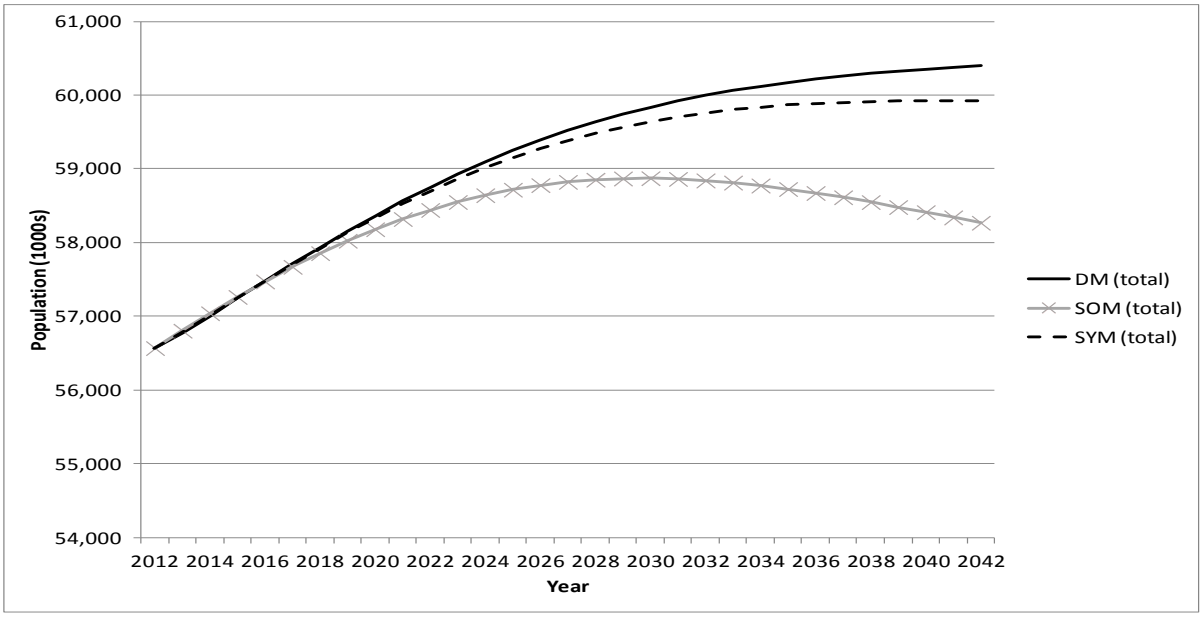
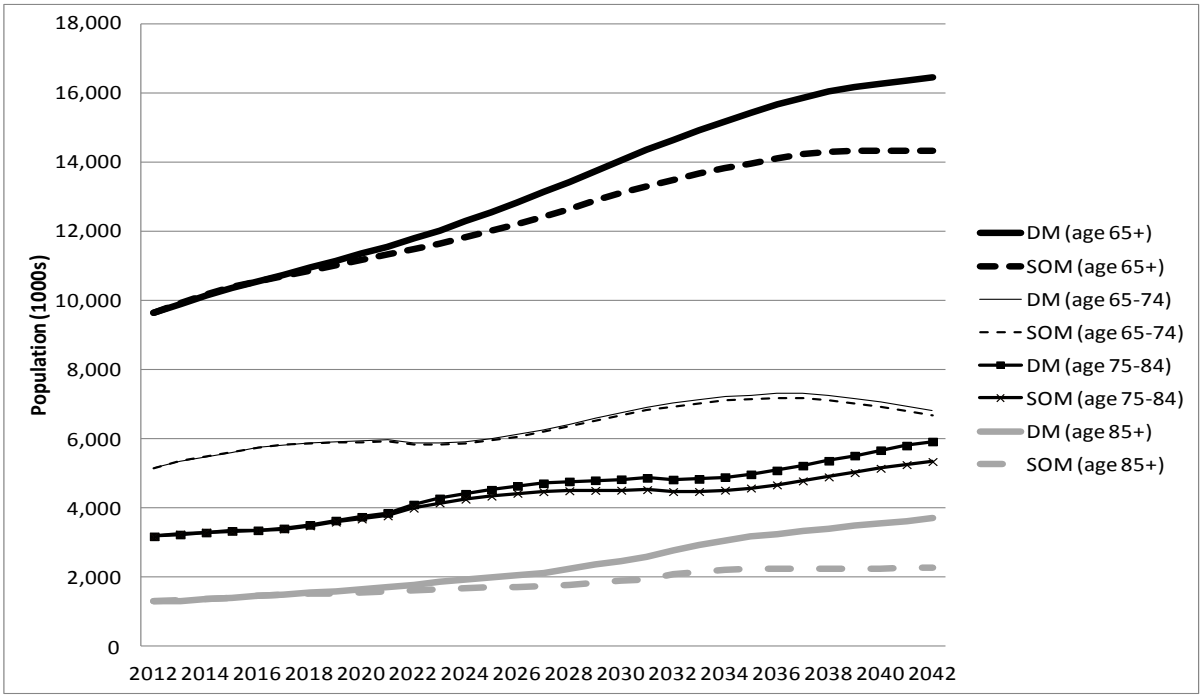


Figure 4: Projected older population (1000s) in each projection (Declining Mortality, Static Older Mortality and Static Younger Mortality) distinguishing age bands of 65+, 65-74, 75-84 and 85+



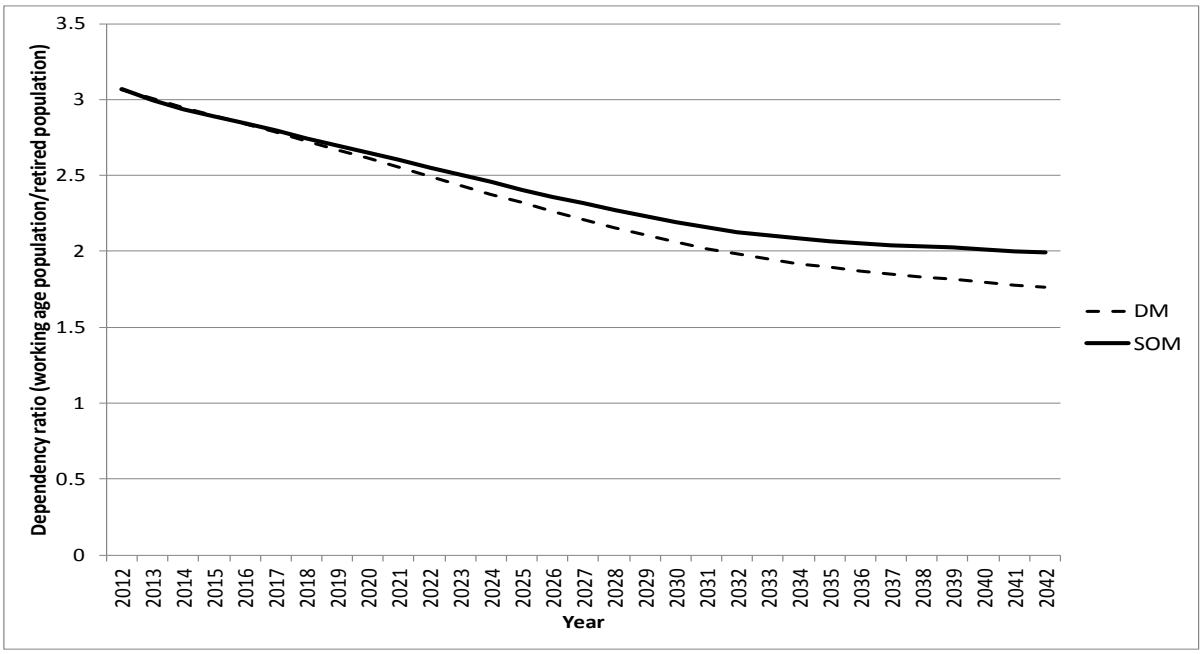
Note: For clarity we display the DM and SOM projections only. The SYM projection gives very similar results to the DM projection

Finally, we report the young person and older person dependency ratios from each of the projections which give the ratio of those at working age to those in retirement and childhood respectively. Declining mortality rates lead to reductions in the older dependency ratio from 2.7 working age adults to each older person in 2012 to 1.7 working age adults to each older person in 2042 under the DM projection. The extent of the projected decline in the older person dependency ratio is not dissimilar to that under an assumption of static mortality rates at the older ages. In 2042, the SOM projection predicts 1.9 working age adults to each older person. Figure 5 also illustrates the known, but rarely reported observation that the older person dependency ratio is expected to level off during this century; population ageing is not an issue expected to continue indefinitely.

Table 4: Younger person and older person dependency ratios in 2012 and 2042 under each projection (Declining Mortality, Static Older Mortality, Static Younger Mortality)

	2012	2042 – DM	2042 - SYM	2042 - SOM
Younger person dependency ratio	2.76	2.73	2.72	2.73
Older person dependency ratio	2.95	1.69	1.70	1.91

Figure 5: **Projected older person dependency ratio between 2012 and 2042 under the Declining Mortality and Static Older Mortality projections**



Discussion and conclusions

The key finding of this paper is that almost two thirds of the increase in the older population (65+) in England and Wales that is projected between 2012 and 2042 stems from the current population age structure and the movement of the baby boom population across the old age threshold during the projection period (taken here as age 65). Projected improvements in mortality at the older ages make a significant but lesser contribution to the growth in the older population accounting for most of the remaining third of the projected growth in the 65+ population. The projected declines in mortality at the younger ages (0-64) have a minor impact on the projected growth in the population aged over 65.

It is important to view the population ageing that we project in England and Wales with historical and an international perspective. Population ageing is not a new phenomenon nor a permanent one. In the UK in 1891 there were 12 working age people for every person aged over 64 compared to 4 working age people for each person aged over 65 in 2001 (Mullan 2004). Society coped adequately with the population ageing over this period, with increased support to the elderly through state-funded pensions, health provision and many other services, partly because increases in productivity outstripped the growth in retirees. We and others, demonstrate that the rate of population ageing is expected to level off during the course of this century (Lanzieri 2011), in part reflecting the temporary contribution of the baby boom cohort to population ageing. Within an international setting, the extent and rate of population ageing in the UK is not particularly unusual. For example, according to the UN World Population Prospects 2012 report (UN 2013) the older person dependency ratio[6] in the UK is projected to rise from 28 in 2015 to 40 in 2040. This very comparable to that observed in Europe where the older person dependency ratio is expected to that rises from 26 to 42 between 2015 and 2042. However, there are many countries with higher older person dependency ratios. For example, Japan, the third largest world economy, is already successfully managing a population that is as elderly in structure as that expected in the UK in 2040. Japan is projected to have a dependency ratio of 44 in 2015 which will rise to 65 in 2040.

The use of the old age dependency ratio itself reflects a rather pessimistic view of older people who, within this statistic, are

[6] Defined as the number of people aged over 65 to every 100 at working ages

considered to be no more than a drain on society. This ignores the fact that most elderly people live independently and contribute, often in invisible ways, for example, through voluntary work, helping out with family childcare and personal consumption. Conversely the working age population are considered a homogenous group of 'contributors'. No consideration is given to factors such as unemployment which can have a significant impact on the welfare budget.

The projections that we report rely on the ONS principal projections and associated assumptions on improvements in mortality. What will actually happen to levels of mortality is an area of academic debate with faster improvements in mortality or deterioration in levels of mortality plausible for reasons discussed in the Introduction. However, our analysis is clear that the current population age structure in England and Wales will ensure that population flow plays an important role in the growth of the older population.

In conclusion, we illustrate that the baby boom cohort are the main driver of the projected growth in the older population over the coming 30 years from 2012. This finding has important implications for debates around the sustainability of pension provision and the statutory age of retirement which in the UK, and in many other countries, is expected to be increased. A common theme running through arguments to reduce the generosity of pension provision, such as those illustrated in the introduction, is that pensions are unsustainable because people are living longer in old age. We illustrate here that this argument is misleading and inaccurate; the main driver of the growth in the older population over the coming 30 years is certainly not increasing longevity at the older ages. This cohort have contributed to their pensions for the duration of their working lives and so it might be argued that they would not create an additional burden on an appropriately designed pension system.

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Alan Marshall, John Read and James Nazroo

Cathie Marsh Centre for Census and Survey Research