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Ageing And Financial Markets – A Literature Survey

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AGEING AND FINANCIAL MARKETS – A LITERATURE SURVEY

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Abstract: The ageing of the population, driven by declining fertility and rising longevity, is an ineluctable process with major economic and financial implications. This literature survey seeks to provide an overview of effects of ageing on financial markets, focusing inter alia on effects on household saving and wealth, pension provision, the demand for individual financial assets, consequent effects on financial structure, effects on asset prices and interest rates, consequences for housing, effects on banking and financial stability, and international capital flows. The survey covers both the theoretical and empirical literature. Important underlying aspects are the life-cycle pattern of consumption and saving, and the pattern of risk preferences for older people, which may impact on all these areas. There are important policy implications, and further empirical work is warranted.

Keywords: Ageing, personal finance, securities markets, financial structure, housing, international capital flows.

JEL Classification: D14, J10, O16

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1 Introduction

In common with the rest of the world, the UK is facing a process of demographic ageing which is already underway. Underlying factors are a decline in fertility and a rise in longevity. The latest UN population projections, for example, show that whereas fertility in the UK in 1950 was 2.22 children per woman, by 2023 it had fallen to 1.56 and the "medium" projection is that in 2050 it will remain at 1.55. Meanwhile, whereas longevity (life expectancy at birth – both sexes) in the UK was 68.6 years in 1950, in 2023 it had risen to 81.3 years and in 2050 it is projected to be 85.1. The figures for high-income countries in Table 1 closely parallel those for the UK, while the world population too has undergone a demographic transition, albeit at a lower average level of longevity and with higher fertility. [2] We note that for individual countries the projected pattern will be affected by migration as well as fertility and longevity, but the overall pattern is likely to be accurate.

Table 1: Demographic developments and projections

	1950	2023	2050
Fertility			
UK	2.22	1.56	1.55
High-income countries	3.04	1.47	1.55
World	4.85	2.25	2.1
Life expectancy at birth			
UK	68.6	81.3	85.1
High-income countries	61.8	81.4	85.2
World	46.4	73.2	77.0
Percent of population over 65			
UK	11	19	25
High-income countries	8	19	27
World	5	10	16

Source: United Nations (2024)

In this context, this literature survey seeks to provide an overview of effects of such ageing on financial markets in both theoretical and empirical work in economics and finance. These include effects on household saving and wealth, pension provision, the demand for individual financial assets, consequent effects on financial structure, effects on asset prices and interest rates, consequences for housing, effects on banking and financial stability, and international capital flows. Important underlying aspects are the life-cycle pattern of consumption and saving, and risk preferences of older people for lower-risk assets, which may impact on all these aspects.

[2] Indeed, in the OECD the average annual birth rate in the 1970s was 1.4% but by 2015, this had fallen to 0.4% and the UN forecasts that by 2050, population growth rate in advanced economies will be negative (Rachel and Summers, 2019). Simultaneously, mortality rates have been decreasing and life expectancy has been increasing: among others, Kontis et al., (2017) predict that increases in life expectancy will be observed across a range of OECD countries, including the Americas, central and Western Europe, Asia and the Pacific.

We note that the literature has effectively been in two "waves", with most of the foundational work being done in the period 1995-2005. While some research continued in the interim, interest has grown again since roughly 2015, with the approach of actual ageing and its effects becoming more apparent in the data and in policy concerns. We have sought to cover the range of literature in the light of these patterns.[3]

Note also that although we have sought to subdivide the literature, there are considerable overlaps in many of the papers, which may for example forecast effects of ageing on both volumes and prices of assets. Furthermore, there are at times tensions and contradictions between the results of theory models and empirical work with micro data and macro data.

It should be noted that the bulk of work on demographics and financial markets has been done on US or cross-country panel data. In considering the application of the results to countries such as the UK, it needs to be considered whether there are substantive differences in behaviour, notably with the US. Interestingly, analysis of retirement wealth trajectories[4] in Blundell et al (2016) show remarkable similarities in data between the UK and US from 2002 e.g. in terms of the median wealth of retirees, life expectancy from age 70+ and median income of retirees. A similar percent of elderly desiring to make bequests was also observed, while even medical expenses were considered to be similar, since in each country the main concern is care/nursing home costs and US pensioners benefit from Medicare. There remained some differences; UK retirement incomes tended to be better inflation-indexed; also UK households accumulated wealth in retirement over the 2000s, while US ones decumulated, but this is thought to relate largely to house price rises and the greater illiquidity of UK housing in terms of equity release mortgages etc.

The survey is structured as follows; in Section 2 we look at the relation of ageing to saving, Section 3 looks at effects on the stock of wealth, Section 4 looks at implications of pension provisions from ageing, Section 5 examines the relation of ageing to quantities of financial assets and Section 6 examines the corresponding effects on prices. Section 7 looks at ageing and interest rates, Section 8 at the likely developments in housing, Section 9 at banking and Section 10 at international capital flows. Section 11 considers applications of the literature to future financial market developments. The conclusion provides a summary, addresses some specific questions on market developments, looks at some potential regulatory policy issues raised and suggests areas for future research.

2 The likely impact of ageing on household sector saving

The main focus of ageing effects on financial markets has to be on the relation between ageing and financial asset demand for the household sector, since they are the ultimate holders of financial claims, if one abstracts from foreign claims. For a general overview of household finance research, see Gomes et al (2021).

Theory suggesting a link between an individual's age, consumption and saving decisions originated with the permanent income hypothesis (Friedman 1957), and the life-cycle hypothesis (Modigliani and

[3] Note that the coverage of the earlier wave of research draws in part on Davis (2006). A further review of wider effects of demographics can be found in Roy (2022), while an overview of theoretical and empirical work on household finance is in Gomes et al (2021).

[4] Note that both datasets exclude the value of social security pensions and annuitised private pensions.

Brumberg (1954) and Ando and Modigliani (1963)). For an overview, see Deaton (1992). Saving patterns will in turn affect the aggregate size of the financial system, although the latter is also affected by asset prices, the bank- or market-orientation of the financial system[5] and features such as the presence of pay-as-you-go or funded pension systems (Section 4).

The permanent income hypothesis, while not explicitly basing saving and consumption on age, has the insight that an individual's consumption is likely to depend on permanent rather than current disposable income. People will only consume if they believe their income is sustainable. Consequently, if increases in their income are expected to be temporary, they will save rather than increase their consumption. The underlying assumption is that people seek to avoid fluctuations in their consumption when income fluctuates, including after retirement. Furthermore, when actual income is below permanent, i.e. in retirement, they may decumulate.

Following this insight, the life-cycle theory of consumption suggests that early in one's life, consumption may well exceed income, as individuals may be making major purchases related to buying a new home, starting a family, and beginning a career. At this stage in life, individuals may borrow based on their expected labour income in the future (human wealth), if financial markets are sufficiently developed and liberalised. In mid-life, these expenditures begin to level off while labour income increases. Individuals at this point will repay debts and start to save for retirement in equities, bonds, pension schemes, etc. At retirement, income normally decreases, and individuals may start to dis-save. This involves selling off some of their financial assets, including pension fund decumulation.

Both theories of optimal consumption imply that consumption will be smoothed out through an individual's lifetime, with corresponding borrowing followed by accumulation of financial assets then decumulation in retirement. In the context of ageing, the life-cycle is a crucial background, as it implies that personal saving will rise when the high saving group grows, then fall as the population ages, and a larger proportion of individuals enter the low- or negative-saving age groups.

As regards early empirical evidence, at a macroeconomic time series level, Disney (1996) noted that, consistent with the life-cycle, saving rates tend to decline in countries where there are a larger number of retired people. The changes in savings cause declines in demand for financial assets.

Econometrically, a strong effect of demographics on private saving has been found by many studies. Pioneering work in this area was by Fair and Dominguez (1991), who also introduced the use of polynomials to estimate effects of the entire age distribution. This is considered superior to using age-groups as it includes the entire age distribution and avoids issues of correlation between age groups. Using US data over 1954-88, they found that prime-age people consume less of their income (saving is higher) than for the young and old, as predicted by the life-cycle hypothesis.

Attfield and Cannon (2003) applied the Fair and Dominguez (1991) approach to the UK over a very long dataset (1856-1996) using a vector-error-correction approach and again found results consistent with the life-cycle hypothesis. Masson et al (1995) found the total dependency ratio (young plus elderly as a proportion of the total population) to have a significant negative effect on private saving in a panel of both advanced and developing countries, with an elasticity of -1, i.e. a 1% rise in the dependency ratio reduces private saving by 1%. Later work by Loayza et al (2001) reduced this estimate to around -0.2. McMorrow and Roeger (2003) found an average elasticity of –0.75 across existing studies.

[5] The question of orientation refers to whether most corporate finance is conducted via bank lending as historically typified by Germany and Japan, or whether it is done via equity and bond issue as traditionally in the UK and US.

Modigliani (1986) showed life-cycle savings follow a hump-shaped pattern where an investor's asset holdings increase with age and decline after retirement. Higgins (1998) sought to estimate demographic effects via a third order polynomial in age and found similar strong life-cycle effects on saving; a similar exercise by Bosworth et al (2004) found a peak impact on saving at 40-55 and a negative effect from cohorts over 70.

Al-Eyd, Barrell and Davis (2006) tested for demographic effects on consumption over and above the standard determinants (i.e. income and wealth), using the age cohorts 20-39, 40-64 and 65+ relative to the population in 15 countries (EU excluding Luxembourg plus US). They found a strong positive effect on consumption from the 20-39 cohort, but no differential between the middle aged and elderly, as would be expected if the latter draw down savings to pay for retirement. This in turn may link to pay-as-you-go pension schemes in most of Europe, which "protect" financial asset accumulation to some degree from life-cycle effects.

Koga (2006) sought to understand reasons for a sharp decline in Japanese saving in the 1990s, using an error-correction cointegrating approach. He found it consistent with the life-cycle model, with the impact of each age group being described by a hump-shaped curve. Factors driving saving other than the demographic effect were relatively minor.

Cavallo et al (2018) considered the demographics-saving relation in Asia and Latin America over 1963-2012. They found that lower dependency rates and greater longevity had been associated with higher domestic saving rates in Asia but not in Latin America. This in turn implies that only the former region benefited from a "demographic dividend" of a savings boost, despite very similar favourable demographic developments - that is, a lower dependency ratio driven by lower fertility and increased longevity, which entails a rising labour force and potential buildup of human capital. Possible reasons for lower saving in Latin America were thought to be lack of adequate savings instruments, lack of trust in financial institutions and high costs of doing business with banks. This is despite the widespread introduction of pension schemes across the region, following the model of Chile.

Akin and Yavuzaslan (2019) assessed the effects of some quite diverse determinants on national saving in Eastern European countries over 1996-2017, using panel cointegration. They found a positive long run relationship between the female labour force participation rate, the urbanization rate, the population growth rate, and savings, while the old and young dependency rates had a negative impact on savings, consistent with the life-cycle pattern. Life expectancy was insignificant. Declining populations due to emigration and low fertility, besides rising elderly dependency, suggest downward pressures on saving in those countries

Whereas the above work focuses on time-series macroeconomic data, there is also a large literature on life-cycle household saving using cross-sectional survey data, notably in the US (see the survey in Bosworth et al (2004)). A significant number of these studies have found that the retired cohorts do not decumulate financial assets and may also not have negative saving. There is an apparent contradiction between micro and macro evidence which would strongly affect the predictions about financial markets when ageing and asset accumulation takes place. Similar patterns may hold in the UK, as shown for example by Blundell et al (2016), referenced in Section 1. This point is discussed further in Section 3 below.

Concerning consequences of saving patterns, the relationship between economic growth and longer life-expectancy may be nonmonotonic so that initially, improvements in longevity can increase growth via saving but further increases in lifespan are associated with lower growth (Zhang, Zhang and Lee, 2003). They identify two channels by which lower mortality can impact on growth via savings and

capital investment, one of which relates to the structure of capital markets. Firstly, there is the normal direct impact of increased life expectancy on savings, whereby agents save more to protect their consumption in retirement. The second channel occurs where imperfect annuity markets exist, and agents are unable to access insurance to cover themselves against all states of nature. In these circumstances, the insurer faces an asymmetric information problem since individuals have more information on their morbidity factors that impact their life expectancy. This creates an adverse selection problem which insurance companies respond to by underproviding insurance (Feldstein, 1990). The inability to access annuities means agents are unable to distribute their wealth (and thus consumption), according to their post-retirement uncertainty (i.e. unexpected liquidity shocks). In response, individuals prudently restrict their consumption prior to and during retirement leading to unconsumed savings on death, which are then left to working family members as accidental bequests, as discussed further in Section 3 below.

We note that these issues arise generally when annuity purchase is voluntary, as it is now in the UK. The issue is not present in the same way when purchase is compulsory as was historically the case in the UK, since then the insurers can be confident of having a complete distribution of risks.

Bloom et al., (2007) note that typically, simple life-cycle models assume savings rates are not endogenous to life-span so that instead of impacting saving rates directly, agents who expect to live longer simply increase their working years. In reality, macro and micro evidence shows there are four channels by which longer life-expectancy are likely to change the saving rate across the economy; first, insurance against ill health which may reduce working ability, second, a positive wealth effect from more employment-years via wage growth and compound interest on earning assets, third, counteracting imperfect annuity products which prevent holders from spending their wealth if they die prematurely and fourth, social security structures which incentivise shorter working lives.

The authors note that evidence for agents saving more as insurance against ill health in later years is not compelling, as the “compression of morbidity” in later life counteracts the fact that expectations of illness induce workers to retire accordingly. Instead, according to medical evidence, morbidity is likely to be suppressed until later years due to medical and public health interventions.

In this context, Crimmins (2004) notes that US, Canadian, UK and French citizens who lived longer in the 1970s suffered with more disabilities than elderly populations in the 1980s. By the 2000s, she concludes that wellbeing has improved in key aspects of health, with people who live longer suffering from fewer disabilities, lower loss of mental and physical functionality and more agents reporting themselves to be in better health. Such trends suggest that workers may not retire as early as before, and thus may adjust their savings patterns accordingly. On the other hand, there may be a lag, as expectations of ill health matter for financial decision making among the public; the public may not become aware of the medical evidence for some time.

Regarding wealth effects, Bloom et al. (2007) note that where real interest rates remain positive, a given agent will benefit from higher compound interest if they earn and save more by working longer hours, especially when economic growth and technological progress raise wage rates. These richer retirees can save more during their working lives and can afford early retirement with the consequence being downward pressure on interest rates (Section 7). This may not operate in the same way if real rates are negative, but this has not typically been the case for more than short periods.

Since premature death is a random variable, some savers who are unable to reap the benefits of accumulated savings will face a lower effective return on their savings (Kalemli-Ozcan and Weil, 2010). Hence when life expectancy increases, the incentive to save more and retire early also increases, since the effective return on savings is improved. Premature death is more likely when morbidity is high

and, in such cases, instead of saving for early retirement the population will respond by working longer. The authors define these two opposing incentives as the "uncertainty effect" and the "horizon effect". The uncertainty effect dominates when workers believe their longevity may be cut short and hence saving for leisure in retirement may be inefficient. The horizon effect causes workers to retire early and to fund their retirement via increased life-cycle savings. The authors find that due to the increase in life expectancy in developed economies over the last century, the horizon effect dominates the uncertainty effect. Although the study does not formally model the impact of these effects on labour supply and interest rates, as noted previously, earlier retirement may put downward pressure on interest rates (Section 7).

Carvalho et al (2016) highlight the fact that that the nature of public provisions of pensions (Section 4) also impacts on agents' savings decisions and thus interest rates (see also Section 7). In countries where retirees are covered by post-retirement government transfers, they would have less need to save. This is more likely to be the case in Europe where public pensions provide the majority of pension finance for retirees, as compared to the US where retirement is more self-funded through savings. The UK is in an intermediate position, although we note that the social security replacement rate (state pension/earnings at retirement) in the US is higher than the UK, despite the "triple lock".[6] In this context, it is worth noting that traditionally UK funded pensions have been invested in equity to a greater extent than elsewhere due to prudent person rules on investment as opposed to portfolio restrictions, but also consistent with the need for high returns to compensate for a low social security replacement ratio. More recently, the pattern has been blurred by the closure of private DB funds, which, as shown in the Box 1, currently hold a large proportion of bonds in their portfolios.

Carvalho et al (2016) go on to note that for transfers in the case of public pensions to match the larger volume of retirees due to an ageing population, output would have to keep pace, and this is only possible via higher levels of saving and capital accumulation which further depresses interest rates. In cases where agents fear that their public pension payments will be reduced due to the state's inability to keep pace with the financial demands of an ageing population, they are more likely to accumulate private life-cycle savings which exacerbates downward pressure on interest rates. This could nevertheless engender a virtuous circle for growth.

The above studies show the complexities involved in re-designing life-cycle models to accommodate the multitude of demographic and behavioural changes that arise from a rapidly ageing population. Calibrations based on these models today may not hold in future due to country-specific variations in the underlying parameters, implying that constant re-calibration and re-design of models will be necessary. Two examples from the UK that could be relevant are that 40% of UK student loans will never be repaid and banks accepting mortgage repayment beyond 70, both are inconsistent with the usual life-cycle pattern.

3 Ageing and personal sector aggregate wealth

Whereas the section above largely considered saving as a flow, a separate issue is the determinants of the stock of household wealth. Household net wealth is certainly determined partly by saving but also by asset prices, portfolio choices and asset disposal. Accordingly, wealth may follow a form of life-

[6] Estimates suggest that the US replacement ratio (social security pension/average earnings at retirement) is 40% while the UK remains around 30%.

cycle pattern but this may be different from that of saving per se, and it is wealth as well as saving that are the key determinants of effects on financial markets.

Bergantino (1998), looking at cross-sections derived from the US Survey of Consumer Finances, found young households under 40 usually draw credit from the financial markets by taking out mortgages for buying houses. Bergantino showed that households aged 40–60 tend to provide credit to financial markets, via employer and personal pension accounts. Those households which are over the age of 60 tend to withdraw from the financial markets as a result of using accumulated assets to fund consumption at retirement. Mankiw and Weil (1989) found housing demand is high for those aged 25-40. Thus, again, their borrowings tend to exceed their purchases of financial assets.

Using US micro data, Poterba (1998) suggested the life-cycle hypothesis cannot be proven by focussing on asset accumulation profiles that are based on average cross-sectional data. First, average figures are distorted by the wealthiest 10 percent of households who hold approximately 70 percent of financial assets. If equities are included, this will raise the number to 90 percent (see Poterba and Samwick (1995)). Second, micro data typically omit social security wealth and wealth in defined benefit pension funds, which are important aspects of asset accumulation and decumulation from the point of view of individual households. Third, there is a problem in using cross-section data to evaluate the life-cycle hypothesis or project asset demands, in the style of Yoo (1994) and Bergantino (1998) since they mix age and cohort effects, as discussed by Poterba (2001). The associated problems can be described using equation (1) where A_{at} is individual asset holdings of age α at time t:

$$A_{at} = a_a + b_t + d_{t-a} \quad (1)$$

a_a is the age-specific asset demand at age a. b_t is the time-period-specific shift in asset demand and d_{t-a} is the cohort-specific effort for asset demand for those born in the period t-a. 'Cohorts' are a linear combination of age and time. With panel or repeated cross-section data, it is possible to estimate two effects, but it is impossible to estimate all three effects in the same model or estimation

Cohorts may have markedly different patterns of saving, borrowing and portfolios affecting financial markets, due for example to experiences of bad or good financial market conditions early in the life-cycle (see Fagereng et al (2017), discussed in Section 5 below). Also relevant may be aspects such as rising levels of tertiary education across successive cohorts, or changes in public pension policy that may affect some cohorts but not others.

Poterba and Samwick (2001) estimated the effects of ageing using the US Survey of Consumer Finances data allowing for this critique of omitting cohort effects. They found the hump shape for net worth but not for net financial assets, which level-off in old age. The levelling-off of net financial assets could link to precautionary asset holding or a bequest motive (Hurd (1990), Bernheim (1991)). This effect is widely noted in the literature. Note that the difference between net worth and net financial assets is mainly residential property; at least in the US[7] individuals may trade down in housing thus generating the hump shape for net worth. Issues relating ageing to housing are considered in Section 8. On the other hand, Bosworth et al (2004) suggest there may be intergenerational interactions missed by even such micro studies, and problems of heterogeneity leading to difficulty in aggregating micro studies

[7] As noted by Blundell et al (2016) evidence for this is less clear for the UK. See also Bee Cribb and Emmerson (2025b).

Blundell et al (2016) find a lack of decumulation in the UK even by those aged 70-74; housing tends to be retained in retirement unlike in the US (partly due to house price increases) although also financial assets are decumulated less rapidly than in the US.

Whereas recent work has thus noted that elderly people do not decumulate wealth, on average, there remain many who have no assets at retirement, as shown in work by Poterba, Venti, and Wise (2011). They report that almost half of their US sample died with virtually no financial assets, and that they lived exclusively on their Social Security income. A similar pattern is likely to hold in the UK, where 11% of pensioners have no financial assets and 27% less than £1500. 25% of pensioners have no private pension and 40% for the bottom two quintiles of the income distribution for pensioners (Campaign for Ageing Better 2024). Older retirees may therefore not have been prepared to face any unusual or unexpected expenses had they lived longer.

Others however, do retain large volumes of assets through retirement till death, for reasons such as health expenditure concerns and life span uncertainty, as noted by Yogo (2016), a paper considered further in Section 5. Another reason is planned bequests, as investigated inter alia by Ameriks et al (2011) and the papers cited below.

As noted in Section 2, accidental bequests can be significant and yet are not regularly incorporated in basic life-cycle models (Huggett, 1996). As a result, calibrations based on these historically simple models generate disparities between wealth and savings rates predicted by the models and those that are actually observed. Since individuals have precautionary motives for saving, accidental bequests will raise intergenerational wealth transfers above the levels that are modelled in simple life-cycle frameworks. This will also be the case in the absence of insurance markets.

Kotlikoff and Summers (1981) used historical data to show that life-cycle savings account for a small proportion of capital stock in the US. Over the period 1900 – 1974, they found that the major determinant of capital accumulation is the intergenerational transfers of wealth. They noted a major drawback of life-cycle models is the assumption that agents homogeneously save for retirement in their younger years whereas in reality, transfers of wealth between spouses or generations are important factors that should be accommodated.

A recent UK paper by Nolan et al (2022) gave some international comparisons of wealth transfers. Receipt of an inheritance varied from 17% in the US to 30% in Britain, with Germany, France, Italy and Spain between. Substantial gifts were most frequently reported in France and Germany, (17% and 13%), with Britain and Italy at 9% and 7% and very few gifts are seen in the cases of Spain and the US. As regards the size of the transfers (inheritances plus gifts), Britain was the lowest with a median transfer of $48,100 (in 2010 US dollars) with France at $59,400 the US being $68,000 and the other Europeans over $100,000. The mean transfer is far above the median at $179,000 in Britain due to some very large transfers. Regressions showed a strong relation in all countries of transfers to existing household wealth, suggesting that the transfers contribute to inequality. Points similar to those above from Kotlikoff and Summers (1981) arise.

The effects anticipated for interest rates discussed in Section 7 link closely to the issue of ageing and wealth, since predictions of downward pressure on interest rates rely on expectations that ageing will still accompany rises in saving and asset holdings across the combined age groups.

4 Ageing, saving and pension funds

Whereas our main focus is on personal saving and related accumulation of financial assets, it is important to add that as the population ages, the public sector will tend to lower its saving and increase its expenditure, ceteris paribus. For example, projections from the Office for Budget Responsibility are for state spending on payments to pensioners to rise from 5.6% to 9.6% of national income over the next 50 years (Cribb et al 2023).[8] The discounted present value of UK state pension liabilities in 2018 was estimated at around £4.8 trillion (224% of 2018 GDP), to which can be added £1.2 trillion for unfunded public pensions (ONS 2021).

This pattern of expenditures will in turn help to drive external balances as long as private saving does not rise to compensate. One mitigating factor reducing pressure on public finances of social security pensions could be migration (Berger et al 2016)[9], but in the long run migrants also age and tend to adopt fertility similar to the domestic population so the benefit is temporary. Trends in public saving are largely driven by the scale of the public pension system in the light of ageing and the means of financing being adopted (e.g. taxation versus debt finance, see Dang et al (2001) and McMorrow and Roeger (2002)).

Debt finance would imply a greater fall in public saving. Rapid increases in the proportion of the population over 65 (the dependency ratio) combined with generous social security pension schemes may in particular threaten to generate an unsustainable growth in public debt. Even if a crisis does not occur, greater public debt issuance tends to raise interest rates and hence the debt burden. It is this aspect which is encouraging governments to scale down public pension commitments and switch to funding (for an early analysis of pension reform see World Bank (1994)). Tax finance will be less threatening to the fiscal position[10] but owing to the disincentive effects of higher tax rates, economic growth may be lower than for debt finance, depending on the cost of the latter.

A key problem is that the age of retirement has not in most advanced countries adjusted to demographic realties. In the 1970s on average, OECD populations retired at 67.6 years and by 2030, despite rises in statutory retirement ages, the average age of retirement is expected to still be 67.5 years. Given the increases in life-expectancy and reduction in morbidity factors, the number of years an individual spends in retirement will almost double when comparing the 1970s (when people spent 10.5 years in retirement) against the 2030s when individuals are expected to spend 18.3 years in retirement. Also given population ageing, this will also have major implications for savings and investment as agents adjust their life-cycle budgeting choices accordingly (Rachel and Summers, 2019). National saving will be lower, that will in turn tend to put downward pressure on investment.

Meanwhile, growth of pension funds is likely to accompany ageing. Evidence on the importance of pensions for the UK in the overall picture of wealth and savings outlines in Sections 1-3 can be gauged from the fact that in 2014-16 private pension wealth was £5.2 trillion (48% of the total), outstripping residential property (£4.2 trillion – 38%) and net financial wealth other than pensions (£1.5 trillion – 14%) (Butterworth 2019). The fact that pension funds account for a significant proportion of household wealth means a proportion of asset allocation has historically been driven by professional

[8] The authors note that the UK is, however, in a better fiscal position on this issue than many western European countries, with less public spending on state pensions and more favourable demographic trends.
[9] They found that future projected immigration flows are equivalent to 14.3 % points labour income taxes in Austria, 7.3 points in Germany, 6.2 points in the UK and 1.7 points in Poland in 2060.
[10] Because taxation can rectify the public saving imbalance that necessitates debt issuance when pension expenditure increases.

asset managers and not individuals. Now the growth of defined contribution funds means there is more direct control by individuals than hitherto, who may be too cautious in investing (so-called reckless caution, such as leaving funds in bank deposits), leading to lower pensions.

In this context, there is hence an important issue whether pension reform more broadly affects financial structure. Consider the impact of introduction of pension funds on individuals who are saving in line with their life-cycle preferences. If they can borrow freely then an increase in saving due to pension funds could be offset by a rise in borrowing. However, they might not simply reduce other forms of saving one-to-one since pension saving is not a perfect substitute for liquid saving, being unavailable up to retirement. But if households are unable to offset forced saving via pension funds due to credit constraints, then overall saving may rise, particularly for those who would not otherwise have saved. This also applies at a national level if any rise in personal saving is not offset by falling public saving.

As reviewed in detail in Davis (2005, 2006) and Davis and Hu (2006), there is evidence that pension fund growth raises personal saving, but not one-to-one, as households reduce discretionary saving to offset growth in pension claims. Positive effects on saving are particularly marked where credit markets are imperfect (limiting borrowing) or for lower income individuals who are less creditworthy or who do not have other assets to decumulate. Meanwhile, as discussed above, public dissaving may partly or wholly offset rises in personal saving at a national level, especially if the transition from pay-as-you go to funding is financed by debt issuance as opposed to higher taxes.

On the other hand, Lopez-Murphy and Musalem (2004) using a panel of 43 industrial, and developing countries find evidence suggesting that the accumulation of pension fund financial assets might indeed increase national saving, when these funds are the result of a mandatory pension program. The boost to personal saving is thus greater than the dissaving of the public sector due to reform. By contrast, national saving might be unaffected if pension funds are the result of a public program, implemented to foster voluntary pension saving.

The effect of pension contributions on saving may differ between groups in the population depending on employment status. For example, Mastrogiacomo et al (2023) showed that in the Netherlands, there is a displacement effect of pension contributions on discretionary saving of −37% for employed people and of −61% to −77% for self-employed people. The higher displacement effect for the self-employed is explained by the fact that self-employed workers are more aware of their pension accrual, or lack thereof, because there is no employer who organizes and (partly) pays this for them.

In terms of asset prices, Walker and Lefort (2002) show using a panel of 33 emerging market countries, that pension fund growth accompanies a decreased dividend yield and increased price to book ratio, as well as lower equity price volatility, implying a drop in the cost of capital. Huynh et al (2006) focusing on Australian data and using a VAR model with cointegration found that both the 40-64 age cohort and the stock of superannuation (pension fund) assets boost share prices in the long run. They used real GDP, inflation and interest rates as control variables.

Meanwhile, at the level of demand for individual financial assets, there is evidence that growth of pension funds accompanies equity market development (Catalan et al 2000), as well as entailing rises in the stock of private and public bonds (Hu 2005, Impavido et al 2003). The current pattern of UK pension fund investment is shown in Box 1 below.

BOX 1 – UK PENSION FUND INVESTMENTS

UK pension fund investment can be divided between assets held by private defined contribution (DC) funds, private defined benefit (DB) funds and public defined benefit funds. A key issue is that private DB funds are largely closed to new members so hold increasingly shorter duration assets. Public DB and private DC are both generally "open", so their asset holdings reflect fund maturity (proportion of retired to working members) as well as some effect of individual preferences in private DC schemes. The data below are from ONS "Funded occupational pension schemes in the UK: July 2019 to March 2024: Reference table" Excel sheet, dated for March 2024, the latest available at the time of writing.

Table 1: Total assets of UK pension funds (£bn)

	Private DC	Private DB	Public DB
Pooled investment vehicles	256	417	314
Direct investments	32	764	232
Insurance	0	145	2
Total	**289**	**1,327**	**547**

Table 2: Distribution of pooled investment vehicles (percent)

	Private DC	Private DB	Public DB
Equity	34	15	59
Fixed interest	11	30	21
Property	3	5	8
Mixed asset	36	13	2
Hedge	-	5	2
Private equity	-	4	3
Money market	4	6	1
Other	12	21	5
Total £bn	**256**	**417**	**314**

It can be seen from Table 1 that private DC schemes are relatively small, but rapid growth can be expected as ageing progresses and given the effect of automatic enrolment, especially if minimum contributions were to increase. Private DB will tend to shrink since they are closed to new members (or totally closed) while public DB funds will continue to grow, unless there is a change of policy. Private DC funds are mainly invested in pooled investment vehicles, which also predominate to a lesser extent in public DB funds. Private DB funds are largely invested in directly-held assets, but also insurance (which are annuitized schemes bought out by insurance companies).

The pooled investments (Table 2) are more held in equities for private DC and public DB funds, while private DB funds are more in bonds. This is to be expected as the duration of liabilities is increasingly shorter in closed funds like most private DB. Private DB also hold a proportion in "other assets" which include cash, commodity/energy, structured products, unknown and with profits. Private DC funds hold a third of their pooled funds in mixed assets (such as a mix of equities and bonds).

Direct investments (Table 3) are not available separately from ONS for private DC and DB funds, but as shown in Table 1, this item is small for private DC funds, so the "private" column is largely private DB funds. Overall, private funds are largely invested directly in bonds (public and corporate) while public DB funds are more in equity instruments (equities and unquoted private equity). Concerning maturity of gilts, the private DB funds and public DB funds both hold mainly index-linked gilts (65% and 82% of gilts respectively). The remainder of public DB funds' gilts are long maturity (over 15 years), this is also true for private DB funds except for 6% of their gilts held at shorter maturities.

Separate estimates in Table 4 from Pension Policy Institute (2024) of overall asset allocation show that both DC and public DB funds hold over 50% in equities and similar shares of bonds of 24%.

There is a difference in terms of alternative assets, which are 18% for public DB funds and only 3% for DC funds. The offset is that DC funds hold 17% cash while public DB funds hold 7%. The former may be suggestive of "reckless caution" by individuals, which risks to lead to lower pensions.

Note that these data do not show whether the assets held are domestic or foreign. A large proportion of UK pension assets are thought to be in foreign assets, a practice believed to reduce risk according to the "global portfolio" paradigm. Pension Policy Institute (2024) suggests that UK assets account for 19% of private DB fund investments, and as little as 6% of public DB and 8% of private DC. Since the UK weight in the global portfolio is around 4%, there is only a small amount of "home bias" remaining for the public DB and private DC funds. This strategy is clearly considered by funds to be consistent with "prudent person" investment.

Table 3: Direct investments of UK Pension funds

	Private DB And DC		Public DB	
	£bn	%	£bn	%
Cash and cash equivalents	60	*8*	13	6
Short-term debt securities	7	*1*	3	1
Long-term debt securities[9]	534	*67*	41	18
of which:				
Central Government bonds (including UK Government Gilts)	394	*49*	27	12
Corporate bonds	115	*14*	11	5
Equities	71	*9*	91	39
Property	22	*3*	12	5
Unquoted private equity and alternatives	81	*10*	68	29
Other investment balances (receivables)	11	*1*	1	0
Any other assets	11	*1*	2	1
	797		232	
Illiquid Assets				
Illiquid assets as a proportion of total assets, excluding derivatives	11		22	

Table 4: Estimated overall asset allocations

	DC schemes		Public DB		Private DB	
	£bn	%	£bn	%	£bn	%
Bonds	251	24%	115	24%	619	55%
Equities	585	56%	252	51%	125	11%
Cash	178	17%	35	7%	219	20%
Alternatives	31	3%	89	18%	161	14%

Source: Pension Policy Institute (2024)

Besides affecting financial markets, ageing and pension fund growth may require financial innovations to help pensioners cope with market developments, particularly where annuity-like contracts (such as social security and defined benefit funds) are not available. Mitchell (2018) lists several desirable

innovations, which are based on US experience but are clearly relevant elsewhere. For longevity risk there could be risk exchange between annuity and life insurance providers; mortality swaps; longevity bonds; sharing of mortality shocks in a risk-pooling fund; with-profit payout life annuities. For health shocks, there is a need for long-term care insurance. For wealth shocks, it may be helpful to have reverse mortgages; risk sharing in defined contribution funds between workers and retirees; and more inflation-indexed assets. Development of financial literacy will be crucial, as will allowance for decline in cognitive abilities with age.

An analysis of the issues for retirement income risk raised by the rise of defined contribution pensions in the UK is given by Bee, Cribb and Emmerson (2025a and b). There being no requirement to annuitise since 2015, pensioners face the challenge of managing the investment of a lump sum received on retirement. The key issue is choice of the optimal rate of drawdown of the funds received. The option of downsizing or equity release from owner occupied housing being unpopular and little used makes this choice even more important. Risks, as noted above, include longevity risk, investment risk and risk of cognitive decline which people are poorly equipped to deal with. A model of "flex then fix" with drawdown up to a certain age and then annuitisation of the remained is seen as a possible way forward as a non-compulsory default option. Access to pension pots should be at a later age than at present and tax systems should not encourage lump sum withdrawals early in retirement.

A further issue in pensions is inequality. Evidence suggests that the UK suffers from considerable inequality in terms of pension income and wealth, so-called "pension gaps". For example, Butterworth (2019) shows that UK 60-65 year olds on average could expect a "modest income" on average, but there are difference between the upper and lower halves of the distribution. Wealthier individuals in the top half could expect a modest or comfortable retirement income, while among poorer individuals in the lower half, more than half would fail to attain a minimum income standard. Overall, only 41% of individuals would achieve a retirement income equivalent to 60% of median earnings. Background to this pattern is that 30% of 20-80 year olds have little or no wealth overall.

The savings/pension gap raises important issues in the context of ageing, especially if future rates of return are far lower than in the past (as suggested by WEF (2017)) but also because individuals are increasingly being directed to defined contribution pensions with low contribution rates of around 5%. Such schemes require the individual to be their own investment manager, actuary and insurer, which the vast majority of individuals are simply not able to fulfil. Furthermore, women have larger pension gaps than men, not only due to broken working careers from childbearing but also underestimation of longevity. One result may be that they take inadequate levels of risk in their pension funds (Apicella and De Georgi 2023). For all these reasons, the gaps found in Butterworth (2019) are likely to grow considerably and may raise important policy issues.

5 The likely impact of ageing on demand for individual financial assets

While the life-cycle hypothesis focuses on overall household saving and asset demand, empirical evidence also suggests households' desired portfolios of specific asset classes would vary with age, which in turn would have a major effect on financial structure as ageing proceeds. This is as shown by the references in this section such as micro work by Fagereng et al (2017), Yogo (2016) and Yuan (2022) and macro work by Davis (2006). Such work has related to the changing demand for financial assets over the life-cycle. One underlying aspect of this relates to implications for asset holding of the life-

cycle pattern of borrowing and repayment, as well as pension accumulation. Another aspect of the underlying theoretical view is that risk aversion may vary over the life-cycle, with individuals seeking lower risk late in the life-cycle (i.e. shifting from equities to bonds).

Complementing this, it is commonly suggested that the duration of assets would appropriately change over the life-cycle, with long-duration assets such as equities being more appropriate for young workers saving for pension claims far into the future, and shorter-duration assets such as bonds being more relevant for older workers (Blake 1997). This would be particularly the case when pensions in payment are annuities, which are generally backed by bonds. Note that such effects relate to both directly-held assets and to assets held indirectly via pension funds. They may be partly offset if, as in many emerging market economies, households are multigenerational, with labour income from younger households in effect supporting pensioners. Also, generous social security schemes may impinge on this pattern.

As explained in Fagereng et al (2017), and in line with Merton (1971), one explanation for the desire for lower risk with old age is the importance of human capital (the discounted stream of future wage income) relative to accumulated wealth. If shocks to wage income are uncorrelated with stock market returns, the deterministic component of wage income (i.e. abstracting from periods of unemployment etc.) mimics the payoff of a risk-free asset. For a given level of human wealth, younger households with low levels of financial wealth have a relatively large amount of future income from risk-free assets (relative to their financial wealth) and are thus incentivised to invest more aggressively in equities than wealthier households. When agents grow older, the capitalised value of labour income drops with age, and households compensate for this drop in bond-like wealth by reducing their relative holdings of risky financial assets.

As regards empirical work, Goyal (2001), using aggregate US stock market data, looked at the effect of cohort size on outflows from the US equity market, defined as the difference between the value weighted stock market return (NYSE, AMEX and NASDAQ) including dividends and the percentage increase in stock market capitalisation. He found that outflows are related to a rise in the size of the cohort aged 65 and over, and inflows are linked to the size of the cohort aged 45-64, suggesting that a rise in the over-65 cohort will reduce the net supply of equity finance.

Yoo (1994) using US survey data found demand for risky assets, bonds and equities increases with working age and decreases after individuals retire. Bergantino (1998) showed that US households with heads under the age of 35 generally have near zero ownership of bonds and stocks. However, he found a divergence in stock and bond holding of older households. Ownership of stocks for those over 55 tends to decrease more rapidly than for bonds. He attributes this to possible cohort effects and risk aversion. It is also noteworthy that in the US, financial assets make up only 37% of household's total assets, of which 15% are held directly in stocks. Thus, total household assets are mostly non-financial assets, e.g. primary residences, whose link to ageing is discussed in Section 8.

Brooks (2000), using a theoretical overlapping generations (OLG) model, focuses on the relation between ageing and the demand for equities and bonds in the US, and suggested that there will be excess demand for bonds and excess supply of equities in coming decades, with a modest decline in the returns on the retirement savings of baby boomers. He found that the bond yield would rise from 4.5% to 4.8% as the baby boomers buy equity then fall to 4.1% as they retire.

Box 2 provides an understanding of the structure and operation of OLG models.

BOX 2: GENERIC FEATURES OF OVERLAPPING-GENERATIONS MODELS

Besides empirical work using standard econometric techniques, the literature on ageing uses a workhorse model for assessing economic impacts known as the Overlapping Generations Model (OLG). Such models typically allow for optimisation by households in terms of their lifetime consumption and saving patterns, as well as labour supply, such as to maximise utility over an expected lifetime. Usually, each household is assumed to have a "life-cycle pattern" of initial borrowing in young adulthood, followed by saving in later life up to retirement, with dissaving in retirement, which together smooth consumption over the lifetime. Corresponding to this savings pattern, assets are built up over the working life to be available to support consumption in retirement. There is commonly a choice between a risky and non-risky asset, holdings of each of which will vary according to a utility function which generally assumes that risk aversion rises with retirement. Along with overall asset accumulation and macroeconomic developments, these will drive returns on assets (equities and bonds/cash).

Labour is provided throughout working life and ceases at retirement, thus generating a pattern of income from labour in working life, which may rise with age. Households then use capital income from assets and/or sale of assets in retirement to maintain consumption. The model then allows for separate calculations of lifetime economic activity by each birth cohort (hence "overlapping generations"). A larger birth cohort driven by fertility will have a greater effect and a smaller one a lesser effect on aggregate quantities and prices in the economy, while longevity will impact on the whole equilibrium (e.g. via higher saving in working life).

The models are usually calibrated with coefficients typically found in national accounts, empirical work or from other theoretical work, and then solved iteratively by typical calculation methods used for multi-equation macroeconomic models such as Gauss-Siedel. Paths can be generated over the past (to test the realism of the model) and forecasts over the future (demographic projections are quite accurate since most of the population is "already alive").

Accordingly, such models typically generate a pattern of aggregate consumption, saving, asset accumulation, risky and non-risky asset demand, corresponding asset returns and labour supply over the period of ageing. This can in turn be linked to capital accumulation (in a closed economy framework) or also the current account and net foreign assets (in an open economy). Particularly when the focus is on asset returns, the models may be calibrated to advanced countries together or even the whole global economy, given international capital mobility. Assumptions regarding uncertainty of labour income and returns on risky assets may vary.

Extensions to the basic model may include a corporate sector that maximises profits and invests capital from household accumulation, with capital generating GDP along with labour supply; a pay-as-you-go pension run by the government and financed by taxes on labour income; inclusion of housing as a risky asset that also generates consumption (imputed rent of owner-occupation); perfect or imperfect foresight on the part of households about demographic developments; allowing for children; and desired or unanticipated bequests by households. It is worth noting that such models will not usually account for the full range of economic behaviour, but only the component generated by demographics (business cycle shocks, technological progress etc. will also be important in actual economic developments).

Early estimates cited above Box 2 are subject to the critique pointed out in Section 3 above of mixing cohort and age effects for estimates of the life-cycle based on cross sectional data. On the other hand, Poterba (1998) showed that holdings of equities decline in old age even if age and cohort effects are allowed for. Ameriks and Zeldes (2000), who also correct for age and cohort effects using data from

the US pension fund TIAA-CREF, noted a rapid increase in the proportion of household owning equities, from 33% in 1989 to 49% in 1998 as the baby boom generation increased in size. This is consistent with high equity holdings by the high-saving middle age group. But they also note that half of Americans do not hold any wealth in the stock market.

Bodie and Crane (1997) looked at the total asset holdings of US individuals both inside and outside retirement accounts and found that behaviour was in line with economic theory and the "best advice" of investment professionals. They hold a proportion of cash that declines with wealth and a proportion of equities that declines with age and rises with wealth. Consistent with this, Brooks (2000) suggests that given the need to finance annuities, demand for equities would fall more than demand for bonds as the population ages.

Fagereng et al (2017) used a uniquely comprehensive annual dataset on asset holdings available for the whole population in Norway (1995-2009), which is used by the authorities for tax purposes. The aim was to assess risk preferences over the life-cycle and what factors could determine it. Due to the unique data, they are able to capture age effects (the life-cycle), time effects (stock market conditions) and cohort specific patterns (which may make a cohort experiencing good market conditions at an early stage more ready to invest). The stylised facts they found are that individuals rebalance portfolios away from equities as they approach retirement and exit the stock market completely after they retire. To explain this pattern, a standard model of the life-cycle requires that risk aversion be quite high, that there be small annual costs[11] of participating in the equity market and that there be a positive probability of a major stock market crash, in line with historic experience. The last point affects the elderly most as they depend most on income from assets, with no wage income to offset it.

Yogo (2016) focused more closely on the portfolio choice of individuals in retirement, with an analysis of US patterns in a life-cycle model. Retirees face health depreciation and choose between consumption, health expenditure and to allocate assets between bonds, stocks and housing. The model allows for expected health, health expenditures (allowing for Medicare insurance) and retirement income from social security and defined benefit pension funds. The model captures stylised facts: First, the portfolio share in stocks is low overall and is positively related to health, especially for younger retirees (as they have a longer time horizon[12]). Second, the portfolio share in housing is negatively related to health and falls in age, again in line with time horizons. Third, the portfolio share for retirees in bonds mirrors that in housing, thus being positively related to health for younger retirees and rising with age. A pension reform leads to a shift from housing and equity to bonds. Health expenditure is seen as a form of investment in health capital, and implicitly another form of asset since out-of-pocket expenses are higher for those in poor health.

The applicability of Yogo's analysis to the UK is imperfect due to the existence of the NHS which offers superior insurance to Medicare. However, the requirement for payment for social care in the UK as well as concern about waiting times for non-urgent surgery leading to incentives to take private interventions can be seen as related to these results.

Liu and Poonpolkul (2020) devised an overlapping-generations model for an economy with idiosyncratic production shocks. Their model can capture interactions of macroeconomics and financial markets in a production economy. Borrowing costs, labour income and production risk affect

[11] They may be safekeeping costs by banks for shares as well as information costs of keeping up with market developments.

[12] The horizon effect arises from the claim on future income which is implictly a form of illiquid bond, which for workers is largely labour income but for healthy retirees is pension income in good health.

life-cycle portfolios. Ageing entails a rise in the aggregate capital-labour ratio and reduces returns on risk-free bonds and risky capital. The bond market shrinks due to lower returns, while capital changes depending on the driver of ageing. Capital falls with fertility declines (due to lower labour supply) but rises when longevity increases (retirees save more), affecting financial structure.

Whereas most of the portfolio-choice literature looks economy-wide, Adhikari et al (2021) tested for a different capital structure for US publicly listed firms, depending on the proportion of women and senior citizens in the area in which they are headquartered. An underlying aspect is that US firms access finance at least initially from local investors, either via bank deposits and lending, local investors in equity or local bias of bond funds. In fact, analysis of data at county level from decennial censuses 1980-2010 shows that greater predominance of women and elderly people is related with greater debt financing for local firms owing to more conservative investment approaches. This relation to leverage is even more the case for firms unable to access public bond markets, with lower tangible assets and in high-income counties. Firms in such conservative areas were better able to cope with crises such as that of 2008.

Most studies of ageing look at advanced countries, especially the US, but ageing is significant elsewhere also, notably in China where the one-child policy up to 2015 boosted ageing considerably. Yuan et al (2022) looked at patterns of asset holdings in the 2015, 2017 and 2019 China Household Finance Surveys. While such an analysis is vulnerable to only looking at age effects and not cohort effects, the patterns are consistent with those elsewhere, notably in finding a decline in risk preference among the elderly, in terms of risky asset participation, depth of participation (percent of assets) and diversity in types of risky assets. Financial literacy among the elderly lessens these declines in risky asset holding, while being in rural areas and with children increases them. It is suggested that factors underlying risk aversion for the elderly, besides income volatility, include increased health risks and cognitive decline.

Davis (2006) assessed the impact of demographic changes on financial asset volumes and financial market structure more generally, as driven by age-related household saving and asset allocation decisions. Empirical work based on the experience of 72 countries, viewed in the light of the existing literature, and with control variables GDP per capita, urbanisation, openness and inflation, suggested that demographic changes have had a detectable impact on financial structure. Ageing tends to benefit bond markets relative to equity markets, while depressing private saving and external balances, albeit not sharply reducing the overall size of the financial sector[13]. Continuation of such patterns during the coming period of ageing have wide-ranging implications for policymakers and market participants.

6 Impacts of ageing on financial asset prices

Ageing will affect asset prices as well as volumes. A number of authors have sought to assess whether asset prices have been driven upwards by the rise in “prime savers” in recent decades, and also whether they will be put under downward pressure in coming decades by declining saving due to ageing in OECD countries, implicitly affecting the real interest rate or the risk premium. Particular focus has been put on the concept of a “meltdown” of equity prices when the baby-boom generation retires. The balance of the literature suggests that a meltdown is unlikely, although there is a need for

[13] Note that size is a gross and not net measure unlike saving. Hence financial development and innovation may drive this result, where more advanced countries have older populations.

work taking in the latest data and appropriate methodologies, see also the survey in Thenuwara et al (2017).

Schieber and Shoven (1994) suggested that given the correlation of ageing in OECD countries, and the likely decumulation of defined benefit pension fund assets, there could be widespread falls in asset prices, linked to high real interest rates. Supporting this, Erb et al (1997) found a positive correlation in the US between the fraction of the population of years 25-45 and 65+ to stock returns (i.e. a negative effect on prices), while those 45-65 have a negative effect (boosting prices). Looking at a range of OECD and EME countries, they found a positive relation of stock returns to the average age of the population. [14]

On the other hand, Brooks (2006), using a panel econometric approach with data from 1900-2005 for 16 advanced countries showed estimates suggesting at most a modest decline in equity prices and possibly no decline at all. He criticised work that looks at arbitrary age groups and summarises the age structure with a third order polynomial as in Fair and Dominguez (1991). In Australia, Canada, New Zealand, the United Kingdom and the United States, evidence suggested that real financial asset prices may continue to rise as populations age, consistent with survey evidence noted in Section 3 showing that households continue to accumulate financial wealth well into old age, and do little to run down their savings in retirement.

Although Poterba (2001, 2004) acknowledged that standard models suggest that equilibrium returns on financial assets will vary in response to changes in population age structure, he argued that the rapid meltdown hypothesis is inconsistent with empirical survey data. Consumers decumulate assets at a less rapid rate than the life-cycle suggests. This is because the life-cycle model takes no account of the bequest motive and lifetime uncertainty, as noted in Section 3. Hence, although asset demands rose to fuel the 1990s boom, future declines will be modest.

Contrary to this, Abel (2001), using a rational expectations model which took account of the bequest motive, found stock prices are still expected to fall when baby boomers retire despite high projected asset demand. Whereas a baby boom increases stock prices, stock prices are rationally anticipated to fall when the baby boomers retire, even though consumers continue to hold assets throughout retirement. The exact path followed by prices depends on the supply as well as the demand for capital, and rational expectations of agents on both the supply and the demand side.

Davis and Li (2003) provided panel estimates of the empirical relationship between demographics and asset prices in a variety of OECD country groups over the period 1950-2004 and in a later unpublished version tested further for demographic effects on equity prices in the G-5 over 1870-2004. Unlike most extant work, they adopted an international as well as US focus, including key non-demographic variables in the specifications, such as trend GDP growth, differences from trend, the real long rate, monthly average real share price volatility, and the lagged dividend yield. They also examined long-run as well as post-war asset prices. Results indicated a significant impact of demographics on equity prices and real bond yields. An increase in the fraction aged 40-64 tends to boost real equity prices and reduce real bond yields. A corollary is that a decline in this cohort in coming decades may tend to weaken the impact, underlining market risks of sole reliance on fully funded pensions. However, strong results were not found for the 65+ age group.

[14] Note that in common with other early papers, this paper only employs demographic variables on the right hand side and does not control for other relevant factors such as technological developments driving higher productivity and returns.

As noted by Poterba (2004), the Davis and Li (2003) study "moves beyond most of the previous work by including control variables for non-demographic factors that may affect asset prices, such as the rate of economic growth, the inflation rate, and the recent volatility of the equity market. The findings are robust to the inclusion of these control variables." To our knowledge, no further studies have taken this approach.

Ang and Maddaloni (2005) used panel estimation to assess the link between equity risk premiums and demographic changes using a long sample for the US, Japan, UK, Germany, and France (1900-2001) and a shorter sample (1970-2001) for 15 countries. Controls included consumption growth and the term spread. They found demographic variables significantly predicted excess returns internationally. Notably, faster growth in the fraction of retired persons significantly decreases risk premiums, a result inconsistent with much of the literature quoted here, although it does not apply to the UK where the effect is positive in line with theory, nor in the US where the effect is insignificant. This demographic predictability of risk premiums is strongest in countries with well-developed social security systems and lesser-developed financial markets (such as France, Germany and Japan).

However, Kim and Moon (2023) criticise use of cross-country panel data as in Ang and Maddaloni (2005) to assess demographic impacts on the equity premium, because such data may be subject to cross -sectional dependence. They use estimators proposed by Pesaran (2006) that allow for such dependence[15]. In fact, they found that there was little demographic effect on equity premia if such dependences are allowed for in 17 advanced countries from 1950-2015.

Neuberger (1999) argued that the increase and subsequent decrease in flows during ageing will be balanced by rises and falls in equity issues, with little effect on prices and returns. This suggests that there could nevertheless be a substantive impact on financial structure.

Furthermore, since financial markets tend to be efficient and forward looking, and because demographic changes are slow moving and predictable, a market meltdown could be forestalled with rational expectations of future effects of demographic changes. Yoo (1997) criticised existing empirical studies as they did not include forecasts based on expectations. Results may be biased as to the magnitude of demographic effects on asset prices and the turning points of the likely effect. This is illustrated in his work. A static expectations OLG model produced a rise in asset prices of 32% in the first 15 years whilst a 'perfect foresight' model produced a rise of only 19%. The retirement of baby boomers was projected to have depressed asset prices sooner, at 8 years earlier, i.e. around 2002 rather than 2010. Nevertheless, asset prices also deviated from the "no baby boom" path under the assumption of "perfect foresight".

The possible implications are further illustrated by Poterba (1998), who suggested that if capital goods last longer than one period and as demographic shifts are predictable as soon as the size of a birth cohort is revealed, a well-functioning asset market could price these capital goods so that their current market price would equal the expected present discounted value of future earnings. In this case, adjustment to asset prices will have taken place when the cohort became public information, i.e. when they were born in early 1960's, rather than when they reach middle age in the 1990's.

[15] The common correlated effects mean group (CCEMG) estimator and the common correlated effects pooled (CCEP) estimator. The former is calculated as the average of individual country-specific common correlated effects estimators and considers the relationship between demographic changes and equity premium to differ across countries. On the other hand, the latter restricts those individual coefficients to be the same in our panel data models (Kim and Moon (2023): 638)

Since these patterns were not observed, it poses a challenge to rational expectations and may justify an implicit adaptive expectations approach. Nevertheless, Poterba allowed for the possibility that although agents were unaware of demographic effects over his sample, they will in the future be sensitised to them, thus weakening the forecasting power of equations based on adaptive expectations.

In this context, a widely referenced paper by Geanakoplos et al (2004) developed OLG models to explain how demography can affect stock and bond returns even in the face of fully informed, rational agents. According to a comment by the IMF (2004, p151), "This is because only living generations trade in financial markets at a point in time, meaning that differences in the demand and supply of financial assets—a reflection of differences in size across generations—cannot be arbitraged away ahead of time." Geanakoplos et al (2004) suggested that the 20 year periods of high and low fertility witnessed by the US in the 20th century correspond to patterns in equity returns. Results are similar when the model is extended to include children, social security and bequests as well as endogenous capital, shorter time periods an uncertainty in wages and dividends.

A substantive result of their paper was that the ratio of 40-49s to 20-29s (the middle aged/young or MY ratio) had a negative effect on the price-earnings ratio and explained a significant part of its variation. When the MY ratio is small there will be excess demand for consumption by a large cohort of young people. When it is large, there will be excess demand for saving by a large cohort of middle aged. Adjustments in the price/earnings ratio ensure that this adjustment occurs. Meanwhile the rate of return on equity shows some relation to the change in the MY ratio. However, while these results held for the US, and to some extent France and Japan, they did apply to the UK and Germany.[16]

This effect of MY on the dividend/price ratio is a point further established by Favero et al (2011) in an empirical dynamic discount setting consistent with an overlapping generations model as proposed by Geanakoplos et al (2004). They suggested that MY is an information component that determines long-term stock market fluctuations after short-term volatility subsides. In their work, it does indeed determine the long-term dividend/price ratio, enabling prediction of long-term, stock market returns and long-term market returns adjusted for dividend growth, but not long-term dividend growth. The latter requires addition to the model of the Lettau and Ludvigson (2005) variable modelling excess consumption relative to its equilibrium value.

Using this so-called MY ratio further, Gozluklu and Morin (2019) introduced an OLG model of equity and bond yields that has a cash-in-advance constraint. They focused on subcomponents of the bond yield, namely real bond yields, expected inflation and the inflation risk premium. Going beyond Geneakoplos et al (2004), their model suggested that inflation and the inflation risk premium as well as real asset returns are correlated with the MY ratio, and demographic changes affecting nominal yields mainly through real bond yields, and hence, on average, nominal bond yields and real stock yields comove positively at generational frequencies. However, this co-movement turns negative in a few states of the world, depending on monetary regime switches and income shocks, and empirical results are weaker outside the US.

A point that can be made about empirical work on the MY ratio is that there is no impact of older cohorts separately on financial asset prices. On the one hand, effects of older cohorts may be proxied by the MY ratio, on the other, the datasets are mostly from periods when the size of the older cohorts remained relatively small.

[16] We note non-US countries would be more likely influenced by global trends and hence the relation of asset price trends to domestic demographics would tend to be less marked.

In an empirical model, Arnott and Chaves (2012) assessed effects of ageing on equity and bond returns as well as real per capita GDP growth for 22 countries and a 60 year time sample. Rather than using age groups in line with earlier work, they used a polynomial function (devised by Fair and Dominguez (1991)) which covers the whole distribution of population across age groups, as noted above. Bond and equity returns were measured relative to domestic cash, as arbitrage equalises returns on cash for an investor who is currency hedged. Five-year nonoverlapping data were used to focus on long-term trends.

Equity and bond returns, as well as GDP growth, were found to be boosted by the size of the working age cohorts (30-64). While the elderly and the young exert a downward pressure on returns since they have negative or low saving, the young tend to boost per capita GDP owing to effects on productivity. Effects of retirees on bond returns are less than for equities, as retirees shift to lower risk assets, even as they also decumulate. Changes in demographic shares show similar patterns for GDP but shift the peak in returns to the right, as the peak change in a cohort precedes peak size. Projections for advanced countries suggest a decline in GDP growth and a rise in bond yields, while country results for stocks are mixed.

Quayes and Jamal (2016) used US data from 1950 to 2010, with a demand and supply model of the equity market where price is determined simultaneously with demand (proxied by daily trading volume). Long-run cointegrating relations were found between equities and demographics. They found that the prime age cohort boosts the equity price/dividend ratio, while the retired cohort reduced them, in each case reflecting effects on asset demand. A structural break with a larger effect was found when the first generation of baby boomers reached prime earning in the early 1990s, while equity prices were also affected negatively by inflation and budget deficits.

Park (2010) unlike earlier papers, employed a nonparametric approach based on the Fourier Flexible Form representation (a probability density function), which relates variations in the entire age distribution to the normalized stock price under a flexible functional form. The main findings of this paper are that there is a significant positive impact from prime working-age consumers on the stock price, and that this impact is robust for all G5 countries (France, Germany, Japan, the UK and the USA), consistent with the life-cycle model.

Another approach to demographics and equity returns is to look at the industry returns of firms that focus on products applicable to certain age groups as demographic structure changes. It looks at cross section returns rather than time series ones. This is undertaken by DellaVigna and Pollet (2007). They constructed industry demand forecasts based on the predicted demographic structure (which can of course be accurately forecast using cohort size, mortality and fertility tables) and the age group products (like toys, beer etc.) these products are most sold to. They then related them to US market data over 1939-2003. They found that a one percentage point forecast annual demand growth due to demographics leads to a 5-10 percentage point rise in equity returns. These forecasts only work over a long horizon of 5 to 10 years, but short-term demographic forecasts do not predict equity returns. The suggestion is that investors are inattentive to forecasts beyond 5 years.

7 Ageing and interest rates

The potential impact of ageing on interest rates and the consequent effects on scope for monetary policy can be seen as a subset of work on saving, asset prices and demographics.

Carvalho et al (2016) assessed the effect of the demographic transition at a global level on equilibrium real interest rates. They noted three channels by which effects on interest rates can arise, longevity which increases saving for a longer retirement, effects of lesser population growth on capital per worker which reduces rates due to a lower marginal productivity of capital, and a higher old age dependency ratio also arising from lower population growth, which raises rates due to lower saving and higher consumption. In a life-cycle model they found that the rise in longevity is the crucial factor, with the other two effects arising from lower population growth offsetting each other. In developed countries the overall effect of the demographic transition from 1990-2014 was estimated to reduce interest rates by 1.5 percentage points. Offsetting this would require a recovery of productivity growth from 1% to 2% per year, or an undesirable ballooning of government debt to 210% of GDP.

In later work by Carvalho et al (2023), similar results in terms of the dominance of longevity were obtained from a three-country life cycle model with imperfect capital mobility and country-specific demographic trends. Global factors dominate domestic ones to the extent that financial integration proceeds. Empirical work tends to support this hypothesis on impact of integration, while as in the earlier work, the key demographic factor is life expectancy in determining real interest rates.

Looking at EU experience since 1990, Ferrero et al (2019), using a panel VAR model, found that demographic effects (increase in the elderly dependency ratio) account for downward pressure on real interest rates which is forecast to continue. This is thought to be consistent with a "secular stagnation" view of the 2010s, as opposed to it being a "financial cycle". Saving of those close to retirement is high, while investment is low as the labour force is declining, both of which tend to lower interest rates (although if old people dissave it has an opposite effect).

Gagnon et al (2021), showed that in an overlapping generations model of the US, demographics can help explain two features of what was thought to be the "new normal" prior to the pandemic, namely lower GDP growth and lower real interest rates (in each case declining by one percentage point), as well as the previous rise from the 1960s to the 1980s. Key underlying aspects are trends in labour supply, savings and the capital-labour ratio. So, for example, the fall in fertility in the 1960s and 1970s, which afterwards slowed labour supply growth, affected GDP growth negatively more recently. Meanwhile declines in both fertility and mortality over the 1960s and 1970s contributed to lower real interest rates in recent years, driven particularly by a higher capital-labour ratio despite concurrent declines in aggregate investment.

Vlieghe (2022), from the Bank of England MPC, provided research suggesting that the UK is two-thirds of the way through a demographic transitional effect on interest rates, as more people enter the group with high asset holdings. He also showed that debt, income inequality and wealth inequality may also contribute to low interest rates. His measure was the neutral interest rate when output is at potential and inflation at target. It is argued that the major effect on interest rates comes from the stock of wealth held by the population and not the flow of saving. Accordingly, people's high desired stock of assets dominates any decline in the saving of older people.

Holding life-cycle profiles of asset holdings constant and allowing for ageing, (the compositional effect[17] of ageing as highlighted by Auclert et al (2024) referenced below) the stock of wealth per capita has been rising since 1990 and is not expected to decline even by 2100. Since the elderly hold relatively more safe assets, as shown in Section 5 (Yogo (2016), Fagereng et al (2017)), the impact on short-term rates is greater than that on equity returns. To cope, monetary policy will need either to push rates below zero when needed or generate inflation, although rises in the retirement age may also be helpful in raising the "neutral rate".

[17] There may be additional effects on asset holdings as people realise that longevity is increasing also.

Obstfeld (2024) argued
in line with the literature above that long term real interest rates will remain low in the future. The key demographic effect is from longevity, as it drives increases in saving and retirees tend to save more than the life-cycle model suggests owing to precautionary and bequest motives. Other factors depressing real rates include subdued economic growth driven by lesser labour force growth with ageing as well as geopolitical fragmentation and uncertainty depressing investment and raising precautionary saving.

A counter to the general expectation of lower interest rates comes from Goodhart and Pradhan (2020). They contend that the recent pattern of declining interest rates and low inflation was a consequence of growing effective global labour supply, as China absorbed rural populations into productive industries. They argue that this process has ended with the rapid ageing of the Chinese population. Globally there will be a shortage of labour, especially due to the needs for care workers for the rising numbers of elderly. This in turn will lead to inflation and higher interest rates. Underlying this, they predict that lower growth will lead saving to fall (both by households and governments) while investment rises relative to saving to seek to maintain productivity (and for the green transition), also driving up loan rates. Indeed, Obstfeld (2024), while arguing that long rates will on balance tend to fall due to higher private saving, acknowledges in line with Goodhart and Pradhan (2020) that higher public debt could crowd out capital and push interest rates higher, not only for health and pension expenditure as discussed in Section 4, but also due to military expenditures.

One counter argument to Goodhart and Pradhan (2020) is that the authors seem to dismiss the possibility of further effective labour supply from India and Africa (McNicholl 2021), while Obstfeld (2024) argues that the effects of the boost to global labour supply from China had worked themselves out by 2010.

8 Ageing and the demand for housing assets

In an early study, Mankiw and Weil (1989) found empirically that US housing demand is high for those aged 25-40, and contemporary cohort size partly explains the behaviour of house prices. Their paper predicted a marked decline in house prices by 47 percent between 1990 and 2010 as baby boomers retired, based on the 1980 census data in the US. But in fact, house prices continued to rise. The error was to confuse age and cohort effects, as the baby boomers had higher trajectories of housing consumption than previous generations so did not “trade down” as predicted.

Cerny, Miles and Schmidt (2010) proposed a calibrated overlapping generations model including ageing, housing and pension reform. This contrasts with much of the literature in the field of ageing, which tends to neglect housing as an asset. Housing is unique as it is both an asset and consumption good and has much more limited international trade than for securities, implying domestic demographic effects can be much more substantial. It is also more important in terms of size in most household’s balance sheets than financial assets, and is available as collateral for lending in a way than is less the case for financial assets.

People decide in their model whether to buy or rent property and borrow against it, as well as receiving labour income (or in retirement, a state pension), and deciding whether to hold safe or risky financial assets. House prices are affected by domestic developments (including housing supply as well as demand) but equity prices are determined globally. In common with other OLG models, the

outcome is a buildup of financial assets over the working life followed by reduction in retirement, but with some retained for bequests. This is preceded by a rise in debt that is decumulated over the working life. Owner occupation peaks around 60 years of age but does not decline greatly till late in retirement. Over time, the flow of aggregated saving declines due to more elderly people from ageing. Owner-occupation and house prices both increase in future years, but the stock of financial assets rises more.

These patterns are affected by hypothetical pension reforms such as a reduction in real pensions or a rise in retirement age. The former boosts the housing market further, as people have more income in working life, due to lower taxes on labour income to pay pensions. Financial asset demand also rises, to a somewhat greater extent. Later retirement also boosts housing demand as people have more lifetime income, but saving for (and in) retirement is lower. There is less need to accumulate wealth for retirement and gross financial assets are lower, although higher lifetime income means net worth is higher. Current generations lose in welfare terms from lower pensions, but future generations benefit from lower taxes since public pensions are lower, particularly if mortgages are freely available.

Lisack et al (2021) prepared an overlapping generations model of the advanced countries that includes house prices and household debt as an output as well as real interest rates. It was suggested that the impact of ageing on the macroeconomy is driven mainly by the rise in longevity and not changes in fertility; longevity drives increases in wealth as individuals seek to provide for a longer time in retirement. This in turn reduces the real interest rate and raises the capital-labour ratio. Ageing accounts for 75% of the fall in the interest rate over 1980-2015 and the fall is forecast to continue. It is found that along with interest rate falls, demographics account for 80% of the fifty percent increase in real house prices from 1970 till 2008, and also the doubling of household debt/GDP ratios, as the young needed to borrow more to buy more expensive houses. Housing as an alternative store of value to capital moderates the fall in real interest rates due to ageing.

One caveat in this paper is whether people will save more to allow for longevity (they assume "perfect foresight"). Also, whether the "stalling" of longevity in recent years is prolonged and what its implications will be. There is no rental sector (although this omission may not affect the overall path of the economies) or government pension scheme.

Some empirical studies of house price determination include demographic variables which will be affected by ageing. For example, Igan and Loungini (2012) modelled real house price changes as a function of disposable income, working-age population, equity prices, credit, and the level of short- and long-term interest rates, all in first-difference form. The change in the working age population was significant and positive for house prices. Davis et al (2011) in line with but also broadening the literature, used real personal disposable income, the real long rate, real household liabilities, real gross financial wealth, the unemployment rate, log real housing stock and those aged 20–39 as a share of population (the main house buying cohort) for a panel of advance countries. The 20-39 group was significant in boosting house prices, although only for the "Anglo Saxon countries" such as the UK, US and Canada.

Takats (2012) used data on 22 developed nations from 1970-2009, using panel estimation in differences to allow for unit roots in the data. Real GDP per capita growth (positively), the change in the elderly dependency ratio (negatively) and the change in population (positively)[18] were significant in affecting real house price growth, showing both economic and demographic effects. Over the sample, demographics accounted for 0.3% annual increases over the sample. Using demographic

[18] Gevorgyan (2019) also found a positive effect of population growth for 59 countries up to 2018, but she does not test for other demographic variables, so there may be omitted variables bias.

projections, the author concluded that population aging over the next four decades may erode real housing values by about 0.8% per annum, though there was little danger of a housing price ”meltdown”, not least given the likely offsetting effect of economic growth. It would also depend on migration and housing supply.

Jaeger and Schmidt (2017) follow up on the estimates of Takats (2012) with a longer time period (1950-2012) in 13 developed countries. They added life expectancy to test the positive effect found theoretically in Lisack (2021). Age structure is modelled with a polynomial that sums to zero as in Fair and Dominguez (1991). Testing also allows for reverse causality from house prices to fertility. The polynomial shows a negative effect of the over-65 cohort and a positive effect of pre-65s, but no relation to life expectancy or population size contrary to Lisack (2021) and Takats (2012) respectively. The total effect of demographics has been to depress house prices, even in the past years, but this has been compensated by GDP growth, except in Japan from 1990-2010. Hence, ageing plus subdued growth might lead to actual falls more widely in the future.

Arestis et al (2017) looked at house price determinants in 17 OECD countries over 1970-2013, with a particular focus on demographic effects (age groups 25-44 “first time buyers”, 45-64 “trading up” and 65+ “trading down”). Their paper, unlike Takats (2012), assessed effects country-by-country using the Autoregressive Distributed Lag bounds test for cointegration. Other determinants were real personal disposable income, housing investment and unemployment. The results showed different demographic effects between countries, with, for example, the US having long-run and short-run positive effects from the two working age groups but no effects from the retiring group. Australia, by contrast, has short- and long -run negative effects from the retired group. No demographic effects were detected for the UK – the authors suggest this is due to foreign buyers, but financial liberalisation effects may also be at work.

9 Ageing, banking and financial stability

Whereas there are a range of articles on other financial-market topics relating to ageing, to our knowledge there are rather few in the finance literature relating to ageing and banking. This suggests an area for further research.

Bertlemann et al. (2014) looked at the impact of demographic change on German savings banks, in both the former East and West of the country. Their dataset was of no less than 2.4 million accounts in 11 banks over 2006-7. These areas both featured a shrinking but also an ageing population. Population decline implies a diminution of the customer base (unless market exploitation can be increased), while ageing implies a change in composition from young to old.

Projecting up to 2025, they found that ageing boosts the profitability of banks, more than overcoming the negative effects of population decline, because the German banks obtain much more profitability from the elderly than younger age groups, even allowing for differences in portfolio composition (more time deposits and less loans). The elderly are less likely than the young to shop around and change banks for a better return, and banks may seek to offer good terms to young people to get long-term loyalty. This is despite the elderly typically not having loans outstanding. This result is based on demographic projections plus the single cross-section pattern of profitability, which may have varied over time.

An article offering some demographic effects, albeit not directly linked to ageing, is Hartmann-Wendels et al (2009) on new account fraud effects on bank risk. New account fraud results from identity theft or simply falsification, despite banks' counter measures. The demographic effect shows that it is those in age group 35-44 that are most likely to commit this crime, other indicators are being blue collar workers, men and foreigners. If data were available, it would be interesting to see what the demographics are for victims of fraud (as opposed to those who commit it), which may be more likely the elderly.

Davis (2002) discussed financial stability risks arising from ageing, with a main focus on the unsustainable pay-as-you-go systems in Continental Europe, failure of which could cause fiscal crises affecting the financial system, including banks holding government bonds as assets. But he also noted that in funded pension systems, ageing will mean banks may face lesser demand for their deposit services as saving is increasingly made via institutional investors, and mortgage demand may fall. This may in turn create risk-taking incentives for banks, as was seen in the 1980s during the initial process of securitisation when highly-rated corporates turned to securities markets.

The 2022 crisis in the UK government bond market driven by Liability-Driven-Investment strategies was arguably not a one-off but another event in a series of market-liquidity events in debt markets driven by institutional investors that could become yet more common as ageing proceeds and institutional investors grow larger (Davis, 2008). They will be larger in themselves with ageing and more focused on debt than equity instruments. Earlier such events include the Russia-LTCM crisis of 1998 as well as market-liquidity aspects of the Global Financial Crisis.

Macunovitch (2010) linked demographics to economic downturns (more severe than the regular business cycle) that are sufficiently extreme to provoke financial crises such as those in Latin America in the 1980s and early 1990s, Asia in 2008-9 and the global crisis of 2008-9, as well as the "lost decade" in Japan. These all entailed major falls in asset prices as well as banking crises and economic downturns.

The suggestion is that a neglected aspect driving the precise timing of the crises is a decline in aggregate demand driven by turning points in the size of the 15-24 age cohort (either domestically or in the US as the major trading partner), which led to bankruptcies and in some cases reversals of capital flows. This cohort is highlighted as leading to new household formation – its size drives not only GDP positively but also the current account and investment negatively. The strong positive effect on consumption tends to increase imports, thus impacting the current account, while it drains funds from capital formation to consumption thus reducing investment. Data covered 155 countries over 1960-2004 with lagged population shares to avoid endogeneity. Estimations used the polynomial approach of Fair and Dominguez (1991).

10 Ageing and international capital flows

The liberalisation of financial systems since the 1970's has given rise to rapid international integration of financial markets, even affecting a large market such as the US. This could reduce considerably the domestic link between demographic structure and financial asset prices and imply that largely global demographics and asset prices are relevant. This is the case to the extent that investors no longer invest largely domestically but rather hold the "global portfolio" as is evidently the case for UK pension funds (see Box 1). Accordingly, the effect of demographics on asset demand that is highlighted in the

literature would be dissipated worldwide, and only global demographics (weighted by wealth) would be significant.

Of course, some countries' investors may choose or be obliged by regulation to invest domestically, in which case the local demographic effect on asset markets would remain. Even with "global portfolio" investment, there would remain effects arising from ageing's effects on local macroeconomic developments, but these are of second order compared to the direct effects of ageing on asset demand.

In this context, the "meltdown" highlighted in Section 6 above, driven by domestic or advanced-country demographics, might be attenuated by the growing maturing and wealth of populations of emerging market economies (EMEs) such as China and India.

Reisen (1998) pointed to both the offsetting patterns of saving and the diversification benefits arising from EMEs as helpful in ensuring adequate returns on OECD pension funds that invest in EMEs. On the other hand, evidence from research of US equity markets by Brennan and Cao (1997) found investors have a strong "home bias" at the time of writing, despite advantages of the international diversification in equity markets. This implies markets were still segmented, because domestic investors possess cumulative advantages over foreign investors in terms of their domestic equity markets (see French and Poterba (1991) and Kang and Stulz (1994)). For bonds, Poterba (1998) suggested there are vast cross-border flows, suggesting a weaker link from domestic asset prices to demographics. Moreover, correlations between stock markets had grown even at the turn of the millennium (Davis 2003). The data for UK pension funds shown in Box 1 is suggestive of much greater integration and virtually non-existent "home bias".

Auclert et al. (2024) sought to assess the general-equilibrium effects of ageing on global imbalances, along with wealth accumulation and expected global asset returns. They highlighted that, as suggested above, for an individual small country there is no impact of ageing on asset returns in an integrated global capital market since the small economy faces a global rate of return determined by global demographics, and it is too small to affect that global return. Individual asset holdings are also invariant except to age. Using an overlapping generations approach, population forecasts and household surveys for 25 countries, they were able to assess how changes in age distribution affect the wealth-GDP ratio and thus predict returns.

These predictions are that ageing will increase global wealth-GDP ratios, lower global asset returns and widen global imbalances over coming decades. The fall in returns is explicable by the fact investment declines due to ageing more than saving does, an aspect that they contend is missed by papers suggesting future rises in interest rates such as Lane (2020) and Mian (2021). And wealth continues to rise, since the old hold more than the young and do not decumulate (Section 3).

Due to differences in demographics across countries, advanced countries such as the US and Germany will face declining net foreign assets while India's will rise markedly up to 2100. Results do not vary much when risk preferences of the elderly are varied, and bequests, individual saving and the tax-and-transfer system respond to ageing. But rising government debt may counteract the effect of ageing on asset returns, while boosting the effect on wealth/GDP.

Looking historically, they contend that demographics have contributed significantly to the decline in returns and rise in wealth seen in recent decades, but this is complemented by shifts in asset demand (from falling productivity growth and rising inequality) and asset supply (from automation/technology, rising debt and profit margins).

Sposi (2022) constructed a model of the current account that integrates a saving-investment (overlapping generations) approach to imbalances with a focus on international trade, trade frictions and comparative advantage. While the "savings-investment" approach, as in Auclert et al (2024) cited above, tends to focus on net trade flows, the "international trade" approach incorporates gross flows and cross-country borrowing and lending. The model was calibrated across 28 countries for the period 1970-2014. Different demographic patterns were found to give rise to capital flows due to differences in saving and labour supply. It was found that demographics are a key driver of imbalances, such that a one-year increase in a country's mean age boosts its current account by 0.4% of GDP, while imposing a common global demographic pattern would change capital flows by 3% of GDP.

In an empirical model of current account imbalances, Koomen and Wicht (2022) estimated the effect of demographics using a polynomial across the population age distribution as in Fair and Dominguez (1991). This matches the work of Arnott and Chaves (2012) on asset returns, cited above in Section 6. The model embeds such demographic effects (based on a polynomial) into the IMF's External Balance Assessment (EBA) model. The EBA model calculates "optimal" current account balances warranted by fundamentals. The existing model did incorporate some demographic variables (such as the dependency ratio, fertility rate and population growth rate), but it was argued that omitting detail on the whole age distribution leads to false inferences due to poor modelling.

Results showed that although demographics affect both saving and investment, the saving channel was seen to dominate. In a 49-country panel over 30 years, it was found that a larger young (5-24) cohort tends to cause a lower current account, while a larger older working age cohort (45-69) boosts the current account. In future, as in other work cited in this Section, advanced countries are projected to run deficits instead of surpluses as the old age cohorts dominate, while emerging market economies do the opposite. Migration and pension reform may attenuate such patterns, however.

11 Applications to financial market developments

This section seeks to show how the theoretical and empirical work provided in the sections above can be used to address specific issues relating to financial market developments. These are generally applicable to advanced economies with ageing populations but especially those with market-based financial systems such as the UK.

11.1 Ageing and the evolution of financial structure

We note that although effects of ageing are found widely in the literature cited in this review, the precise timing of related shifts in financial structure is hard to judge as it is dependent on market perceptions as well as fundamentals.

In the literature, it is suggested that although there will be a decline in saving by those who are actually retired, this may be more than offset in terms of aggregate saving by increased saving by those anticipating a longer retirement due to longevity. Furthermore, in terms of the overall demand for financial and real assets, this will be further overlaid by precautionary saving in retirement (e.g. in case of care home needs) and bequest motives. Asset price increases for equities and housing may also drive a wedge between saving and changes in wealth. Accordingly, wealth may be more buoyant than patterns of saving suggested by life-cycle models.

The results of estimates for prices of non-financial assets (e.g. property) are that a larger elderly cohort restrains housing demand, as is the case for equities. But in both cases, the literature does not suggest an outright decline. It may be added that house prices are much more likely to respond to specific features of UK demographics than equities, since the latter are much more internationally traded. A key role will be played by housing supply in the UK, which if limited will give rise to further upward pressures on house prices in future, also depending on the scale of net migration.

As regards relative demand between real and financial assets, it seems that housing demand would fall less than for financial assets as the elderly cohort grows. This is due to risk preferences, and the need for housing as a producer of consumer services as well as an asset, as well as the illiquidity of housing.

Holdings of bonds and equities may be direct or held via pension funds. For the latter there is not always direct control by the individual. For defined benefit funds the asset allocation is typically done by professional managers, and this is also the case for many defined contribution plans although the latter are also driven by individual choices.

That said, the literature suggests that the elderly age group would seek lower-risk returns with shorter maturities of financial assets to provide a stable retirement income (e.g. government bonds or bank deposits over riskier assets such as equities). This will have an impact on scope for issuance and relative prices of bonds and equities. However, it could be partly offset by greater accumulation of equities by those anticipating greater longevity and still of working age, and by cross-border demand in a globalised financial market.

The risk preference within bonds would suggest a relative shift in demand from riskier corporate bonds to government bonds. Concerning maturity/duration, it is clear that some pensioners will prefer shorter dated stock, but this might be offset by a revival of annuities demand with higher yields, and demands from working age savers (directly and via pension funds). Pension funds tend to focus on long maturity or indexed gilts.

The main driver of pension fund investment distribution is fund maturity (the ratio of pensioners to workers in the fund), so funds with older members will tend to hold more bonds and younger ones more equities. Ageing will tend to shift pension funds towards more bonds. In the case of defined benefit (DB) funds this shift to bonds has been accelerated in the UK by funding regulations that do not apply to defined contribution (DC) funds. We find that DC funds invest broadly similarly in terms of risk with public DB funds (although the former use pooled funds more), but private DB funds are much lower risk due to their being mostly closed and running-down. Holdings of UK assets by pension funds is much lower than in the past, being below 10%, except for private defined benefit funds which are mostly closed to new entrants.

We note that government bond markets may be more risky than in the past owing to the high level of debt/GDP ratios already attained, and which ageing may drive yet higher. The 2022 bond market crisis was an illustration, although it would only affect individuals if they chose to liquidate bonds before maturity during the crisis period. Nevertheless, the fundamental difference between bonds and equities will continue to imply the former are lower risk and hence more attractive to elderly cohorts (held directly or via pension funds). International investment in bond markets would reduce concentration of risk from specific UK developments.

11.2 Ageing and resilience of financial markets

Since it is not clear that markets and investors always perceive the effect of demographics, then although securities market adjustment to ageing per se appears to be taking place fairly smoothly, it cannot be ruled out that abrupt shifts could occur in the future as markets "realise" the effect of ageing. This is the case not least given the possible overvaluation of equities at present, and the realisation of growing pressures on fiscal positions (and future bond issuance) to pay for social security pensions.

There may be threats to financial stability from the banking sector. For example, if low interest rates prevail, as is widely suggested by most of the literature. There would be pressure on margins that could lead to increased risk taking in lending for example. Pressure to raise non-interest income may lead to risky portfolio trading as well as fee income, while the latter may also be vulnerable to misselling of financial products. Overall pressures on profitability may be aggravated if there is a declining demand for banking services, e.g. as more mortgages have been paid off when the elderly cohort dominates.

The current account is forecast to deteriorate with ageing, implying a risk of future currency crises. This pattern is forecast for the UK in common with other advanced countries where ageing is most advanced. Meanwhile developing and emerging market countries with younger populations will tend to run surpluses.

Various innovations/growth markets may be needed for the growing elderly cohort to protect against risks to which they are exposed. There would be a need for vigilance in terms of the properties of such innovations since they have by definition not been tested in a range of market conditions. Market liquidity driven crises as in the Global Financial Crisis and the recent crisis in Liability Driven Investment are often linked to innovations. Such market liquidity crises could become more common in the context of ageing.

Concerning necessary innovations at a micro level to ensure household resilience, for longevity risk there could be risk exchange between annuity and life insurance providers; mortality swaps; longevity bonds; and sharing of mortality shocks in a risk-pooling fund, "flex to fix" for DC pensions ensuring annuities after drawdown; with-profit payout life annuities. For health shocks, there is a need for long-term care insurance. For wealth shocks, it may be helpful to have reverse mortgages; risk-sharing in defined contribution funds between workers and retirees; and more inflation-indexed assets.

11.3 Ageing, the financial sector and economic developments

The patterns suggested, of somewhat lower equity demand and higher bond demand, suggest reduced funding for riskier borrowers but increased ability for governments to borrow and make public investments (all else held equal). Firms will need to offer more debt and less equity financing and thus may be somewhat more fragile than would otherwise be the case. This pattern may favour capital-intensive and slow-growing firms rather than "unicorns".

The implications of ageing for economic growth are outside the range of the literature review as it is focused on financial markets (see for example Miles (2023)), but the main point is that there will be a lower labour supply as more people retire, which is a vital component of the production function. The other components, the stock of capital and technical progress, may not readily be able to compensate, so a lower-growth scenario is the most realistic. For example, lower demand for equities may limit

scope for innovations that drive productivity gains. One potential offsetting factor could be that transfer of wealth via inheritance which could open up funds for company formation/investment/house purchases etc. Finally, as noted by Miles (2023) maintaining consumption may actually be easier for a stable than a rising population as there is less need for capital accumulation requiring higher saving

12 Conclusions

We have found in the literature that there are widespread effects of ageing affecting financial markets, that can be expected to intensify as ageing progresses. These include effects on household saving and wealth, pension provision, the demand for individual financial assets, consequent effects on financial structure, effects on asset prices and interest rates, consequences for housing, effects on banking and financial stability, and international capital flows.

In this concluding section, we briefly summarise some of the main results before going on to explore matters arising in respect of regulation and incentives, and suggesting some specific areas where further empirical research is warranted.

12.1 Key results of the literature

- Advanced countries like the UK, in common with the rest of the world, are undergoing a demographic transition due to declining fertility and rising longevity. The pattern of ageing and its effects on financial markets has been the subject of extensive empirical and theoretical analysis which can give important evidence about future prospects and issues. While most of the literature is US or cross-country based, we consider its applicability to the UK and other advanced countries to be reasonably direct. (Introduction – Section 1.)

- Saving follows a life-cycle pattern of being low or negative (involving borrowing) in young adulthood, followed by high saving up to retirement and negative saving thereafter. This is the case for theory models, empirical work with micro data and with macro data. Ageing will increase the weight of the elderly, suggesting a decline in saving, ceteris paribus. (The likely impact of ageing on household sector saving – Section 2)

- While total wealth follows a similar pattern to saving up to retirement, the elderly do not on average appear to decumulate financial assets in the way the life-cycle pattern would suggest. This may be due to planned or unanticipated bequests and from precautionary motives. Real assets may also be maintained as trading down/equity release is not so common as theory would suggest. Aggregate wealth may also be boosted by higher saving of working cohorts due to longevity increases. (Ageing and personal sector aggregate wealth – Section 3.)

- Pension systems will affect financial systems whether they are pay-as-you-go or funded. Pay-as-you-go will tend to reduce public sector saving, with potential risks to fiscal sustainability, while funded pensions may raise household saving and may lead to greater investment in risky assets. Considering the complexity of defined contribution pension withdrawal in light of longevity risk, development of financial literacy will be crucial, as will allowance for a decline

in cognitive abilities with age. There are major gaps in pension provision across society and also between men and women. (Ageing, saving and pension funds – Section 4.)

- Individuals tend to switch from higher-risk to lower-risk assets at the time of retirement. As the elderly cohort grows, this may have an impact on financial asset volumes and financial market structure more generally, with greater relative demand for lower-risk assets and wider economic implications. (The likely impact of ageing on demand for individual financial assets – Section 5.)

- Equity and bond prices can be influenced by demographic patterns as well as volumes. While there is widespread evidence that a boost to prices can arise from a large middle-aged cohort, the evidence of negative effects on asset prices from an increase in the size of the elderly cohort is much less clear. Global effects on securities are likely to exceed national ones for an open economy like the UK. (Impacts of ageing on financial asset prices – Section 6.)

- There is considerable evidence that ageing tends to put downward pressure on short term interest rates. However, the effect is long-term and may not have been a prime cause of low rates in the 2010s; some counter-arguments can be adduced suggesting there will be higher short-term rates in the long-term. One question is whether the low interest and inflation rates are due to ongoing shifts in local and global demographics or specific aspects of the one-off expansion of the labour force in China. (Ageing and interest rates – Section 7.)

- Demographic effects are detectable for housing as well as financial assets, with the working population tending to drive prices up while retired groups restrain it. National effects on house prices are likely to exceed global ones, since there is much less cross-border trading than for securities. (Ageing and the demand for housing assets – Section 8.)

- The literature on demographic effects on banking is scanty, but there is evidence that age patterns may have an important influence on profitability and fraud. Financial-stability risks may arise inter alia from fiscal difficulties and shifts in asset demand from banks to institutional investors. (Ageing, banking and financial stability – Section 9.)

- Analyses of ageing are often undertaken in a closed-economy framework, but considering global effects is more appropriate, implying balance of payments current accounts and capital flows are and will be deeply affected by differing demographic patterns across countries. (Ageing and international capital flows – Section 10.)

- The literature can provide a helpful framework for considering potential future developments in financial markets. This includes trends in individual asset markets, resilience of markets and institutions and effects on the real economy arising from changes in financial markets driven by demographic trends (Application to financial market developments – Section 11.)

12.2 Potential policy and incentive issues arising

In this section we note a number of issues which we suggest arise from the results of the literature and which may illustrate relevant aspects of behaviour and incentives that may warrant attention by regulators. While some points are specific to the UK, most are of general relevance across advanced countries, notably those with funded pension systems.

Given the expected pattern of saving (Section 2), how will financial institutions cope with a larger proportion of negative saving by retirees? Will it affect profits and hence give incentives for fee rises or risk taking? Will extended student loan repayments lead to inadequate retirement saving? If new medication (e.g. weight loss drugs) lead to an extension of longevity, how will it be ensured that saving is sufficient?

Given the variability in wealth accumulation prior to retirement (Section 3), in what way do firms deal differently with those with large, medium and small wealth in retirement? Notably, can regulation ensure those with small savings are treated and advised appropriately? More generally, what issues of financial inclusion are raised by ageing? Concerning the growth in bequests, is there a need for specific regulation for advice and best practice in terms of customers in receipt of large bequests?

Can housing be made more liquid for the elderly to aid their financial sustainability in retirement? Does it point to a need for re-examining regulation of equity release or reverse mortgages? What are the obstacles to trading down, equity release etc. and are they amenable to regulatory action? (See also points on housing regulation below.)

Regarding pension investment (Section 4), is there a tension between government desire to raise availability of risky assets via pension funds and the need for the elderly/those near retirement to have lower risk portfolios? Should best-practice recommend global rather than local investment, in light of the effects on risk? Can more risk-sharing between age groups be included in defined contribution funds?

Is there a deterioration in annuities market value-for-money since the abolition of compulsory annuity purchases, offering a further disincentive to using DC pension assets for annuity purchase, and thus exposing individuals to heightened longevity risk? Are annuity providers put at risk by potential rises in longevity due to weight-loss drugs?

A number of issues arise in respect of risk protection, risk exchange between annuity and life insurance providers; mortality swaps; longevity bonds; sharing of mortality shocks in a risk-pooling fund; with-profit payout life annuities, option to “flex then fix” in DC funds during drawdown (for longevity shocks). Long-term care insurance (for health shocks). Reverse mortgages; risk sharing in defined contribution funds between workers and retirees; and more inflation-indexed assets (for wealth shocks).

Will pension gaps lead to increased risk taking in defined contribution pensions? Indeed, should higher-risk be encouraged to reduce gaps, not least given the danger that self-invested pensions may take insufficient risk? Should intermediaries encourage individuals to raise contribution rates (especially from the 5% minimum).

In light of saving, wealth and pension issues, how can the issues of understanding of finance be handled? Notably, how can individuals be helped to understand the trade-offs between immediate income and longevity in drawdown? Could AI play a role in advice? What view should be taken of the suggestion of “flex then fix” (Bee, Cribb and Emmerson 2025b).

Another key aspect is how to handle issues of cognitive decline and the increasing need for individuals with powers of attorney to handle finance on behalf of individuals. Rather than considering over-65s as a homogeneous group, should firms have different regulatory guidance for “young elderly” (65-80) and “older elderly” (80+).

In the context of the likely development of relative asset demands (Section 5), to what extent do pension funds and asset managers prompt a shift to lower risk (e.g. in "lifestyle" funds) as retirement approaches? Is that something to be encouraged by regulators? Or should they highlight the volatility of bond markets seen in 2022 and potential fiscal deterioration in the future? Can bank deposits offer a safer source of low risk assets than gilts, and what would be the implications of reducing scope to invest ISAs in bank deposits? Will there be a shortage of risk capital as ageing proceeds?

Concerning asset prices (Section 6), should a view be taken whether local equity and bond markets are driven partly by local demography or are they subject mainly to global influences? In that light, what are the implications for appropriate financial advice – should international investment be seen as the baseline?

If the literature suggesting permanently low interest rates is correct (Section 7), how will banks cope with further prolonged periods of low short rates, which tends to narrow interest rate margins and may enhance risk taking? What will be the impact on fees and trading income?

In light of the analysis of ageing and housing (Section 8), does regulation of mortgage lending warrant review, in case of issues such as age-discrimination in mortgages (which is forbidden in the US) and issues in trading down/equity release (as noted above)?

Do banks tend to exploit elderly customers in the way suggested in Germany (Section 9)? Are there conduct-of-business issues if this is the case? Do demographic changes boost demand for banking services, on balance? Is there any systemic risk from the homogeneous elder population? Also, how does a financial crisis affect the living quality for the elder population?

In light of likely deterioration of the current account (Section 10), what are the implications for capital flows affecting financial institutions and the desirability of international investment by individuals and institutions? Will desirability of international investment be affected by current challenges to international trade from tariffs etc. and possible segmentation of international capital markets?

12.3 Further warranted empirical research

In light of the literature, we suggest a number of areas where further empirical work is warranted:

1 Estimating the relation of ageing to house prices and mortgage lending (Davis et al 2011), to assess likely patterns of mortgage demand and risks of house price decline in the time of ageing. Such research would inter alia probe whether countries such as the UK are outliers and thus less vulnerable to downward demographic pressure on house prices with ageing, due to immigration and very inelastic housing supply.

2 The link of ageing to financial structure (Davis 2006), to assess which types of financial institutions and markets are likely to expand or decline as ageing proceeds. Declining sectors would need particular attention since pressure on profitability can give rise to risk-taking and malpractice incentives.

3 Evaluating ageing and effects on bank performance – risk and profitability (using institution and sector data). To our knowledge, no work has been done in this area to date comparable to work on macroprudential policy, risk and profitability such as Davis et al (2022) and Chan et al (2023). Will there be a negative effect on banks from a larger share of elderly, or are they likely to benefit? Effects

of interest versus noninterest income is also relevant, not least since fee income reduces risk while trading income tends to increase it (Davis et al 2024).

4 Demographic effects on systemic risk – probing the link of ageing to banking crises (Barrell et al (2010) and more recently Davis et al (2020)). This could also look at other indicators of banking sector risk such as the aggregate Z-score, and also the link of ageing to fiscal difficulties that in turn give rise to banking problems (the so called deadly embrace that highlights the interconnectedness and potential for crises between a nation's sovereign debt and its banking system).

5 The effect of ageing, bond and equity prices (Davis and Li 2003) using data from 1870-2023 as well as postwar (most existing studies use short and not so up to date datasets). This issue is central to the discussion of ageing and has implications for pensions, corporate and government finances as well as risks to markets and institutions.

6 Testing of the saving/demographic effect which could involve estimation of an appropriate consumption function which incorporates effects of demographics, as well as standard determinants such as real personal disposable income, financial and real wealth, interest rates and unemployment (Ay-Eyd, Barrell and Davis 2006).

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