How Will Ageing Affect the Structure of Financial Markets?

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Abstract

The ageing of the world population is an ineluctable process with major economic implications. Whereas there is extensive research on macroeconomic effects and on financial asset prices, there has been more limited systematic research into 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. Our empirical work based on the experience of 72 countries, viewed in the light of the existing literature, suggests 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. Continuation of such patterns during the coming period of ageing have wide-ranging implications for policy-makers and market participants.

1. Introduction

The ageing of the world population is an ineluctable process. It is anticipated that by 2050 one in four people will be aged above 65 at the world level (UN Population Division 2005). This pattern reflects both rising longevity and declining fertility rates over the long term, as well as the exceptional size of the post-war 'baby boom' generation. Such future trends will have major macroeconomic consequences.

The economic literature on demographics is in our view unbalanced. The link between changing demographic structure and conjunctural trends at a macroeconomic level has been widely studied (see for example, Kohl and O'Brien 1998; Turner *et al* 1998; McMorrow and Roeger 2003; Batini, Callen and McKibbin 2006). There is also an extensive literature on the impact of ageing on pension systems and public finance (see Dang, Antolin and Oxley 2001 and McMorrow and Roeger 2002 for recent examples). Researchers in the United States have put a considerable focus on links between demographic trends and financial asset prices (see Poterba 2004 for a recent survey; also Davis and Li 2003 and Brooks, this volume). There has also been work on demographic impacts on saving (see the review in Bosworth, Bryant and Burtless 2004). However, there has been more limited systematic research

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into the impact of demographic changes on individual financial asset volumes and financial market structure more generally.

Accordingly, in this paper we seek to fill the gap by reviewing the literature and undertaking further investigation of the link between demographics and financial market structure.[2] The paper is structured as follows. After assessing a number of stylised facts on financial structure, we attempt to address the issue of the impact of ageing on a number of levels.

First, we use *a priori* economic reasoning in terms of the life-cycle theory of saving, bearing in mind likely developments in ageing. Second, we review the existing literature on demographics and saving, to assess likely changes in financial asset demand and asset prices (including the possible effect of pension funding). Third, we seek to assess econometrically, using cross-country data for up to 72 countries, the impact of ageing on existing financial systems in terms of the volume of assets as well as private saving over the past 40 or so years. This assessment employs the World Bank Financial Structure Database, for both advanced and emerging-market economies (EMEs). We seek to control for a number of factors affecting financial structure (such as pension systems and the level of economic development) in detecting demographic effects without 'omitted variable bias'. In a final section, we estimate equations for demographic effects on external balances using our panel dataset. Policy aspects are highlighted in the conclusion.

2. The Evolution of Financial Systems

As background to assessing the impact of population ageing, it is essential to consider how financial structures evolve as countries develop, and factors that influence such development. It is important to understand what such normal financial development entails so we do not mistake it for an effect of demographic developments, perhaps due to omitting key variables from the econometric specification.

There is a widespread perception, backed by empirical observation, that financial systems go through stages of development. For example, Rybczynski (1997) suggests that one can distinguish bank, market and securitised phases. In the bank phase, all finance is directed through banks, whereas securities markets and institutional investors start to develop in the market phase and become dominant in the securitised phase. Most EMEs are still in the bank phase, although the most advanced – such as South Korea – are moving to a market phase (Davis 2005). Advanced economies are either in the market or securitised phase (where 'securitised' implies a growing importance of securities finance generally rather than just the packaging of loans in the form of securities).

2. Financial market structure can be viewed from several angles, namely in terms of overall size, by institutional sectors (for example, household, corporate, banks and institutional investors) and by instrument (for example, bonds, equities and deposits), as well as on a domestic and international level. A complication is that detailed 'national-balance-sheet' data on all of these aspects is only available for a small number of advanced economies. However, a wider range of countries are covered by the World Bank Financial Structure Database, notably in terms of volumes of equities, bonds and bank assets that we utilise here.

Stylised facts drawn from empirical observation suggest a somewhat more complex pattern (see Allen and Gale 2000), although the idea of these phases remains helpful. On average, as shown by Demirguc-Kunt and Levine (2000), banks, non-banks and stock markets are larger, more active and more efficient in richer countries. This is confirmed by background data on financial structure provided in Tables 1 and 2 for EMEs and advanced economies, respectively. Table 1 shows that for EMEs on average, private credit amounts to the equivalent of 46 per cent of GDP, while stock market capitalisation is equivalent to 44 per cent of GDP, private bond stocks 16 per cent, and public bond stocks are 25 per cent. In contrast, in advanced economies (Table 2) the private credit ratio is 118 per cent of GDP, stock market capitalisation 72 per cent, and the outstanding stocks of both private and public bond markets are equivalent to roughly 50 per cent of GDP.

A further division is between countries at a similar level of development that are market-oriented and those that are bank-dominated (see Table 3). Underlying the relative importance of markets and banks are aspects relating to the role of public information in markets as opposed to private information held by banks, as well as banks' role in corporate governance. The classic distinction is between the US and the United Kingdom on the one hand, and most continental European countries and Japan on the other. In this context, developed economies are themselves bimodal in their financial structure, with the market-oriented Anglo-Saxon countries having larger-than-average securities markets and bank-dominated countries having dominant banking sectors.

Country status in terms of bank or market focus may be partly endogenous; Demirguc-Kunt and Levine (2000) show that in developed economies, stock markets become more active and efficient relative to banks, and that there is some tendency for financial systems to become more market-oriented as countries become richer. On the other hand, Schmidt, Hackethal and Tyrell (1999, 2001) argue that there is path dependence, meaning that a bank-based system such as Germany will not automatically develop into a market-based system, owing to the institutional and legal structure that in a sense cements the bank-based structure in place.

A role for legal traditions in financial development and its link to market or bank orientation has been considered by recent empirical work on law and finance. This aspect appears to affect the relative size of banks and securities markets separate from the stage of economic development. A classification of countries by legal origin is also given in Table 3. La Porta, Lopez-de-Silanes and Schleifer (1999) show that countries with a Common Law tradition, protection of shareholders' rights, detailed accounting, low corruption and no explicit deposit insurance tend to be market-based – and have large institutional investor sectors – whatever their income level. In contrast, countries with a French Civil Law tradition, poor protection of the rights of shareholders and creditors, poor contract enforcement and accounting standards, restrictive banking regulation, high corruption and inflation tend to have underdeveloped banks, markets and institutional investors. The few countries with a German law tradition, which offers strong protection for creditors, tend to have strong bank-based systems, with small institutional investor sectors.

Table 1: Financial Structure within EMEs – 2003

Country	Private credit by deposit money banks and other financial institutions to GDP	Concentration (commercial bank assets, share of top 3)	Net interest margin	Stock market capitalisation to GDP	Private bond market capitalisation to GDP	Public bond market capitalisation to GDP
Argentina	0.118	0.468	0.052	0.624	0.100	0.056
Bolivia	0.486	0.511	0.056	0.173	na	na
Brazil	0.332	0.467	0.120	0.362	0.097	0.426
Bulgaria	0.224	0.468	0.044	0.063	na	na
Chile	0.750	0.591	0.051	0.864	0.194	0.274
Colombia	0.227	0.379	0.061	0.150	0.003	0.253
Costa Rica	0.287	0.591	0.081	0.111	na	na
Czech Republic	0.295	0.702	0.020	0.183	0.072	0.515
Dominican Republic	0.354	0.716	0.139	na	na	na
Ecuador	0.245	0.695	0.074	0.073	na	na
Estonia	0.292	0.982	0.036	0.021	na	na
Fiji	na	na	na	0.342	na	na
Honduras	0.380	0.489	0.081	na	na	na
Hong Kong, SAR	1.519	0.703	0.027	3.733	0.189	0.097
Hungary	0.378	0.540	0.056	0.174	0.034	0.409
Indonesia	0.219	0.534	0.048	0.204	na	na
Kazakhstan	0.189	0.632	0.057	na	na	na
Malaysia	1.327	0.429	0.025	1.414	0.530	0.363
Mexico	0.181	0.590	0.068	0.181	0.025	0.203
Pakistan	0.270	0.551	0.033	0.190	na	na
Panama	na	0.347	0.029	0.235	na	na
Peru	0.213	0.820	0.100	0.244	0.038	0.035
Philippines	0.349	0.430	0.033	0.396	0.001	0.280
Poland	0.281	0.419	0.040	0.153	na	0.291
Russian Federation	na	0.225	0.057	0.411	na	0.020
Singapore	1.132	0.964	0.012	1.360	0.231	0.389
Slovak Republic	0.350	0.674	0.034	0.071	na	na
Slovenia	0.392	0.606	0.032	0.207	na	na
South Korea	1.199	0.478	0.027	0.479	0.504	0.183
Sri Lanka	0.276	0.683	0.037	0.119	na	na
Thailand	0.957	0.522	0.026	0.564	0.156	0.210
Ukraine	0.197	0.490	0.053	0.075	na	na
Uruguay	0.503	0.661	0.066	0.017	na	na
Average	**0.464**	**0.574**	**0.052**	**0.440**	**0.155**	**0.250**

Source: World Bank Financial Structure Database

Table 2: Financial Structure within Advanced Economies – 2003

Country	Private credit by deposit money banks and other financial institutions to GDP	Concentration (commercial bank assets, share of top 3)	Net interest margin	Stock market capitalisation to GDP	Private bond market capitalisation to GDP	Public bond market capitalisation to GDP
Australia	0.953	0.664	0.021	0.937	0.341	0.156
Austria	1.037	0.798	0.021	0.172	0.368	0.373
Belgium	0.757	0.830	0.022	0.501	0.394	0.971
Canada	0.989	0.543	0.027	0.885	0.214	0.561
Denmark	1.483	0.852	0.038	0.485	1.193	0.481
Germany	1.174	0.637	0.030	0.370	0.426	0.378
Iceland	1.000	0.975	0.021	0.748	1.326	0.158
Italy	0.825	0.405	0.026	0.375	0.439	0.847
Japan	1.046	0.331	0.017	0.601	0.444	1.207
Netherlands	1.515	0.833	0.018	0.876	0.566	0.446
New Zealand	1.136	0.608	0.024	0.361	na	0.278
Norway	0.952	0.919	0.021	0.368	0.242	0.173
Portugal	1.476	0.838	0.034	0.340	0.282	0.464
Spain	1.113	0.729	0.028	0.714	0.240	0.445
Sweden	1.022	0.967	0.031	0.776	0.401	0.411
Switzerland	1.559	0.903	0.015	2.080	0.403	0.287
United Kingdom	1.413	0.427	0.028	1.199	0.389	0.276
United States	1.736	0.311	0.039	1.175	1.126	0.443
Average	**1.177**	**0.698**	**0.026**	**0.720**	**0.517**	**0.464**

Source: World Bank Financial Structure Database

Table 3: Characteristics of Financial Systems

Country	Legal origin[a]	Bank-based[b]	Market-based[c]	Anti-director rights[d]
Argentina	F	1	0	4
Australia	CL	0	1	4
Austria	G	1	0	2
Belgium	F	1	0	0
Brazil	F	0	1	3
Canada	CL	0	1	5
Chile	F	0	1	5
Denmark	SC	0	1	2
Finland	SC	1	0	3
France	F	1	0	3
Germany	G	1	0	1
Greece	F	1	0	2
Hungary	G	1	0	3
India	CL	1	0	5
Ireland	CL	1	0	4
Italy	F	1	0	1
Japan	G	1	0	4
Malaysia	CL	0	1	3
Mexico	F	0	1	1
Netherlands	F	0	1	2
New Zealand	CL	1	0	4
Norway	SC	1	0	4
Portugal	F	1	0	3
Singapore	CL	0	1	4
South Africa	CL	0	1	5
South Korea	G	0	1	2
Spain	F	1	0	4
Sri Lanka	CL	1	0	3
Sweden	SC	0	1	3
Switzerland	G	0	1	2
Thailand	F	0	1	2
Turkey	F	0	1	2
United Kingdom	CL	0	1	5
United States	CL	0	1	5

(a) F: French; G: German; SC: Scandinavian; CL: Common Law

(b) 1 = bank-based financial system

(c) 1 = market-based financial system

(d) An index aggregating the shareholder rights, formed by adding 1 when: (i) the country allows shareholders to mail their proxy vote; (ii) shareholders are not required to deposit their shares prior to the General Shareholders' Meeting; (iii) cumulative voting is allowed; (iv) an oppressed minorities mechanism is in place; or (v) when the minimum percentage of share capital that entitles a shareholder to call for an Extraordinary Shareholders' Meeting is less than or equal to 10 per cent (the sample median). The index ranges from 0 to 5.

Source: Impavido *et al* (2003)

As regards historical trends, Rajan and Zingales (2000) show that financial development has not been monotonic. The major OECD countries were on some measures more financially developed in 1913 than 1980, with a significant reversal in financial development and financial integration taking place between 1913 and 1950. A tightening of regulation in the inter-war period led to a decline in the size and importance of the financial sector relative to GDP. The imposition of such 'structural regulation' implied that the service provided to the non-financial sector was sub-optimal and economic growth was hindered, with, for example, low deposit rates and rationing of credit to households and small companies. This illustrates the danger of complacency by law-makers in respect of financial development. Meanwhile, financial liberalisation in the 1980s and 1990s has of course tended to improve financial sector efficiency in securities and banking, also leading to increased household borrowing, implying a cost in terms of risk.

With this section as background we now turn to an assessment of the impact of ageing on financial structure.

3. The Likely Impact of Ageing on Total Financial Assets

The main focus of ageing has to be on the relation between ageing and financial asset demand for the personal sector, which is the ultimate holder of financial claims, if one abstracts from foreign claims. Theory suggesting a link between an individual's age, consumption and saving decisions originated with the permanent income hypothesis (Friedman 1957), and the later life-cycle hypothesis (Modigliani and Brumberg 1954; Ando and Modigliani 1963). For an overview of this literature, see Deaton (1992). Saving patterns will in turn affect the aggregate size of the financial system, which is also affected by features such as the presence of pay-as-you-go pension systems.

The permanent income hypothesis, while not explicitly basing saving 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 additional income if they believe it will be sustained. Consequently, if increases in their income are expected to be temporary, they will save rather then increase their consumption. The underlying assumption is that people seek to avoid fluctuations in their consumption when income fluctuates. Furthermore, when actual income is below permanent income, that is, in retirement, they may decumulate wealth.

Following this insight, the life-cycle hypothesis 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 dissave. This involves selling off some of their financial assets, including pension fund decumulation.

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

As regards empirical evidence, at a macroeconomic time-series level Disney (1996) notes that, consistent with the life-cycle hypothesis, saving rates tend to decline in countries where there are a larger proportion of retired people. The changes in saving rates lead to changes in demand for financial assets. Econometrically, a strong effect of demographics on private saving is found by many studies. Pioneering work in this area was by Fair and Dominguez (1991); Attfield and Cannon (2003) apply their work to the UK using a vector-error-correction approach. Masson, Bayoumi and Samiei (1995) find the total dependency ratio to have a significant negative effect on private saving in a panel of both advanced and developing countries, with an elasticity of –1. Later work by Loayza, Schmidt-Hebbel and Servén (2000) suggests that this estimate is lower at around –0.2. McMorrow and Roeger (2003) find an average elasticity of –0.75 across existing studies.

Modigliani (1986) shows life-cycle savings follow a hump-shaped pattern where an investor's asset holdings increase with age and decline after retirement. Higgins (1998) estimates demographic effects via a third-order polynomial in age and finds strong demographic effects; a similar exercise by Bosworth and Keys (2004) finds a peak impact on saving from the age 40–55 cohort and a negative effect from cohorts aged over 70. Al-Eyd, Barrell and Davis (2006) test for demographic effects on consumption over and above the standard determinants (that is, 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 find 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 reflect pay-as-you-go pension schemes in most of Europe.

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 find that retired cohorts do not have negative saving. There is an apparent contradiction between micro and macro evidence which would affect strongly the predictions about personal saving when ageing and asset accumulation takes place.

Poterba (1998) suggests the life-cycle hypothesis cannot be proven by focusing on average cross-section-based asset accumulation profiles for three reasons. First, average figures are distorted by the wealthiest 10 per cent of households, who hold approximately 70 per cent of financial assets. If equities are included, this will raise the number to 90 per cent (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 $A_{\alpha t}$ is individual asset holdings of age α at time t:

$$A_{\alpha t} = \alpha_a + \beta_t + \delta_{t-a} \tag{1}$$

α_a is the age-specific asset demand at age a, β_t is the time-period-specific shift in asset demand and δ_{t-a} is the cohort-specific effect 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.

Poterba and Samwick (2001) estimate the effects of ageing using the US *Survey of Consumer Finances* data and allowing for this critique. They find a 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 reflect precautionary saving or a bequest motive (Hurd 1987; Bernheim 1991). 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.

Whereas our main focus is on personal saving and the related accumulation of financial assets, it is important to add that as the population ages, the public sector will tend to lower its saving, other things equal. This will in turn help to drive external balances as discussed in Section 8. Such trends in public saving are largely driven by the scale of the public pension system in light of ageing and the means of financing adopted (for example, taxation versus debt finance). Recent estimates include those in 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 are particularly threatening. It is this aspect which is encouraging governments to scale down public pension commitments and switch to funding.

4. The Likely Impact of Ageing on Demand for Financial Assets

While the life-cycle hypothesis focuses on overall household asset demand, empirical evidence also suggests that households' desired portfolios of specific asset classes would vary with age, which in turn would have a major effect on financial structure. Hence, further work has related to the changing demand for financial assets over the life-cycle. One underlying aspect of this relates to implications for asset holdings 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 life (that is, shifting from equities to bonds). Complementing this, 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 in the future, and shorter duration assets such as bonds being more relevant for older workers (Blake 1997). This would be particularly the case when (private) pensions are paid out as annuities, which are generally backed by bonds. Note that such effects relate on the one hand to directly-held assets but on the other to assets held indirectly via pension funds. They may be partly offset if, as in many EMEs, households are multigenerational, with labour income from younger households in effect supporting pensioners.

Bergantino (1998), looking at cross-sections derived from the US *Survey of Consumer Finances*, finds that young households under 40 usually draw credit from the financial markets by taking out mortgages for buying houses. Bergantino shows 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) show that housing demand is high for those aged 25–40. Thus, again, their borrowings tend to exceed their purchases of financial assets.

Goyal (2001), using aggregate stock market data, looks 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 finds 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 survey data, finds that demand for risky assets, bonds and equities increases with age and decreases after individuals retire. Bergantino (1998) shows that households with heads under the age of 35 generally have near-zero ownership of bonds and stocks. However, he finds a divergence in stock and bond holdings among 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 financial assets make up only 37 per cent of households' total assets, of which 15 per cent are held directly in stocks. Thus, total household assets are mostly non-financial assets, such as primary residences and vehicles, which are not the focus of our current work.

These estimates are subject to the critique pointed out above of mixing cohort and age effects for estimates of the life-cycle based on cross-sectional data. On the other hand, Poterba (1998) shows that holdings of equities decline in old age even allowing for age and cohort effects. Ameriks and Zeldes (2000), who also correct for age and cohort effects using data from the US pension fund TIAA-CREF, note a rapid increase in the proportion of households owning equities, from 33 per cent in 1989 to 49 per cent 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) look at the total asset holdings of individuals both inside and outside retirement accounts and find that behaviour is 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 will fall more than demand for bonds as the population ages.

5. Impacts on Financial Asset Prices

A number of authors have sought to assess whether asset prices will also be put under downward pressure in coming decades by declining saving in advanced economies 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 underlying issue for this paper is the balance between price and quantity effects of changing demands for financial assets. Arguably, in an efficient market excess demand for a certain type of financial asset will lead initially to price rises, but in the longer term to balance sheet adjustments that entail higher issuance of associated claims.

Schieber and Shoven (1994) suggest 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, and associated high real interest rates. Supporting this, Erb *et al* (1997) find a positive correlation in the US between stock returns and the fraction of the population aged 25–45 and 65+ (that is, a negative effect on prices), while those aged 45–65 have a negative effect on returns. Looking at a range of OECD countries and EMEs, they find a positive relation between stock returns and the average age of the population. On the other hand, Brooks (this volume), using an econometric approach, shows estimates suggesting at most a modest decline in equity prices and possibly no decline at all.

Poterba (2001, 2004), although he acknowledges that standard models suggest that equilibrium returns on financial assets will vary in response to changes in population age structure, argues that the rapid meltdown hypothesis is inconsistent with empirical survey data. Consumers decumulate assets at a less rapid rate than the life-cycle hypothesis suggests. This is because the life-cycle model takes no account of the bequest motive and lifetime uncertainty. Hence, although asset demands rose to fuel the 1990s boom, future declines will be modest. However, Abel (2001) using a rational expectations model which takes account of the bequest motive, finds that stock prices are still expected to fall when baby boomers retire, despite high projected asset demands owing to shifts in the supply of capital in response to changes in its price.

Davis and Li (2003) give econometric evidence that demographics have had a significant impact on US, panel and aggregated international stock prices and bond yields, even in the presence of standard additional independent variables. As noted by Poterba (2004, p 15), the Davis and Li study '... moves beyond most of the previous work in 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'. In this context, the age 40–64 cohort has a strong positive influence on equity and bond prices, a support that would be removed as its share of the population declines.

Rather few studies have looked at relative demand for different assets with ageing and its impact on prices. One exception is Brooks (2000) who, using a theoretical overlapping generations model, focuses on the relation between ageing and the demand for equities and bonds, and suggests 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 finds that the bond yield rises from 4.5 per cent to 4.8 per cent as the baby boomers buy equities, then falls to 4.1 per cent as they retire.

Consistent with the point we made above, Neuberger (1999) argues 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.

6. Impacts of Pension Funds on Financial Structure

As noted above, growth of pension funds is likely to accompany ageing and hence, there is an important issue of whether pension reform more broadly affects financial structure. An impact on saving, and hence financial asset volumes, separate from demography would have to rely on the inability of the household sector to offset forced saving via pension funds (for example, due to credit constraints), and also – at a national level – that 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-for-one, as households reduce discretionary saving to offset growth in pension claims. 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, 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, when pension funds are the result of a public program implemented to foster voluntary pension saving.

Meanwhile, at the level of demand for individual financial assets, there is evidence that growth of pension funds accompanies equity market development (Catalan, Impavido and Musalem 2000), as well as entailing rises in the stock of private and public bonds (Hu 2005; Impavido *et al* 2003). In terms of asset prices, 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 (Walker and Lefort 2002).

7. Econometric Analysis of the Impact of Demographics on Financial Structure

In light of the work cited above, in this section we undertake new tests of the hypothesis that ageing affects financial structure. We assess demographic impacts both for aggregates and also for ratios of financial assets. Data are for up to 72 countries from 1960–2002, of which 23 are OECD (that is, advanced) economies, 36 are EMEs and 13 are transition economies.[3] Countries covered are listed in Appendix A.

We use GLS panel techniques with fixed effects. We follow authors such as Walker and Lefort (2002) by adding extra explanatory variables such as inflation, per capita income, urbanisation and openness (average of the ratios of imports and exports to GDP) to estimate equations for financial structure and financial development, so as to avoid the possibility of omitted variable bias boosting the effect of the demographic variables. Openness we consider to be of particular interest, given that it proxies the degree to which a country is integrated in the global economy, which may in turn impact on the effect demographics has on the domestic financial system.

On the other hand, following Arestis, Luintel and Luintel (2004) we do not include some of the standard variables typically entered in cross-sectional cross-country growth regressions such as years of schooling, as well as corruption, social capital, inequality and the rule of law. We consider using panel data with fixed effects will capture any relevant differences in financial structure across countries. We estimate for all economies together, then for the EMEs and advanced economies separately (transition economies are included with EMEs).

The dependent variables are firstly size variables, namely the ratios of bank loans to GDP, M3 to GDP, equity market capitalisation to GDP and bond market capitalisation to GDP, as well as the sum of loans, and bond and equity market capitalisation to GDP (overall size indicator). This aggregate provides a rough total of domestic financial assets, which are held by households either directly or indirectly via financial institutions. Unfortunately, data on bond market capitalisation are not widely available, so the observations for that variable and the total size aggregate are limited. Note also that the equity market capitalisation variable (and to a lesser extent the bond market capitalisation variable) mix price and volume effects of ageing, as the data do not distinguish rises in capitalisation due to new issues from those due to revaluations. Furthermore, we do not have data on housing wealth for a wide range of countries, yet that may be an important complement and determinant of financing patterns that can vary with age.

3. Data are largely from World Bank's *World Development Indicators* and the Financial Structure and Economic Development Database. I am indebted to Yu-Wei Hu for use of the data he has collected.

We also assess a number of financial structure ratios, namely the economy-wide loan to equity ratio, debt (loans plus bonds) to equity ratio and loan to securities (bonds plus equities) ratio. Following the point made above, the loan to equity ratio has the most observations. Finally, we consider two flow ratios, namely the private saving to GDP ratio and (reported in the next section) the external balance to GDP ratio.

Table 4 records results for size variables for the full sample of up to 72 countries. From the coefficient estimated on GDP per capita it is evident that most of the size variables are correlated with economic development – countries with higher living standards also have larger financial sectors, banking assets and liabilities, and equity markets. Only the bond market result is opposite to this. Equally, urbanisation tends to accompany financial development, although the coefficient for equities is insignificant. Inflation is clearly inimical to bond issuance, as would be expected, but not to overall financial sector size or bank loan volume. More open economies tend to have larger banking sectors and equity markets, although the overall size effect is insignificant. Note that the overall size and bond results are based on quite small samples (37 countries and around 400 observations instead of 65 and over 1000 for the others) and hence may be less well-determined than the bank and equity results.

Turning to the demographic effects, a common feature is that the share of the over-65 cohort is significantly positively related to all the size variables. We need to infer causality with caution however, as it may link partly to the fact that countries with higher living standards have relatively larger populations of pensioners. The relative magnitude of the coefficients on the age 40–64 and 65+ variables is of interest. For bonds, it is the over-65 cohort that is most favourable to bond market development, consistent with the idea of greater risk aversion of older people in work cited above. On the other hand, for equities it is the age 40–64 cohort that is most favourable, consistent with higher demand for equities among those in peak years of saving for retirement. The coefficients for M3 and bank lending are similar for the two cohorts. Meanwhile, the age 20–39 cohort is insignificant or negative for most of the equations, consistent with low or negative financial saving by this cohort, but a high demand for bank loans in the form of mortgages, where the lending equation coefficient is positive.

To check for robustness, we add two lagged financial development variables, the pension fund to GDP ratio and the bank lending to the private sector to GDP ratio (Table 4). Most of the demographic coefficients are unchanged. Especially, the bulk of the coefficients on the over-65 cohort variables are still positive and significant, and the pattern for the age 40–64 cohort relative to the over-65s for equities and bonds is as cited above. The exception is that the lending equation has a negative sign for the younger cohorts with the extra variables. Pension funding is shown to entail a larger stock of bonds and equities, and a smaller banking sector, but a larger financial sector overall. Bank lending to the private sector is positively related to overall size (with a smaller coefficient) while there is also, unsurprisingly, a positive relationship with the banking sector variables (where it is more or less a lagged dependent variable).

Table 4: Estimates of Demographic Effects on Financial Structure – Size Variables

	All countries					All countries with financial development variables				
	SIZE	LOANS	M3	EQUITIES	BONDS	SIZE	LOANS	M3	EQUITIES	BONDS
GDPPC	**0.099**	**0.0176**	**0.003**	**0.0084**	**–0.0058**	**0.079**	**0.0072**	**–0.0046**	0.0038	–0.005
	(7.8)	(11.5)	(2.4)	(2.1)	(1.8)	(5.5)	(5.2)	(3.3)	(0.8)	(1.3)
INFLATION	**0.018**	**0.0031**	0.00031	–0.002	**–0.0059**	0.0074	0.00006	–0.00072	–0.0019	**–0.0063**
	(2.0)	(2.6)	(0.4)	(0.6)	(2.5)	(0.9)	(0.1)	(1.2)	(0.6)	(2.7)
URBAN	**0.048**	0.0014	**0.0038**	0.0017	**0.0012**	0.0081	**0.0024**	**0.0036**	–0.0001	**–0.0069**
	(4.2)	(1.6)	(6.0)	(0.6)	(2.4)	(0.6)	(3.4)	(5.6)	(0.1)	(2.1)
OPEN	0.0025	**0.0053**	**0.0044**	**0.0092**	0.0014	0.0045	**–0.0014**	0.0006	**0.0094**	**0.0026**
	(0.7)	(8.4)	(10.3)	(6.8)	(1.6)	(1.4)	(2.8)	(1.5)	(6.1)	(3.0)
20–39	**–0.093**	**0.0056**	0.0014	–0.0063	–0.0062	**–0.06**	**–0.0014**	0.00004	–0.0002	0.0072
	(4.1)	(2.7)	(1.0)	(1.0)	(1.1)	(2.6)	(2.8)	(0.1)	(0.1)	(1.2)
40–64	–0.036	**0.021**	**0.025**	**0.064**	**0.014**	**–0.037**	**–0.0059**	**0.012**	**0.048**	**0.018**
	(1.5)	(7.7)	(14.2)	(8.5)	(2.3)	(6.3)	(2.5)	(6.1)	(5.6)	(2.6)
65+	**0.156**	**0.039**	**0.027**	**0.025**	**0.081**	**0.15**	**0.019**	**0.018**	–0.0082	**0.076**
	(5.2)	(8.4)	(6.9)	(2.1)	(10.3)	(5.2)	(5.6)	(5.0)	(0.7)	(9.7)
PFAGDP(–1)						**1.5**	**–0.011**	**–0.23**	**0.98**	**0.38**
						(6.3)	(3.2)	(6.2)	(9.5)	(6.4)
BANKGDP(–1)						**0.5**	**0.91**	**0.53**	0.057	0.047
						(3.5)	(43.0)	(27.4)	(0.9)	(1.3)
R^2	0.93	0.8	0.87	0.71	0.97	0.95	0.93	0.93	0.77	0.97
Countries	37	71	65	66	37	35	68	62	63	35
Observations	395	2 468	2 160	1 246	419	365	1 937	1 684	1 069	380

Notes: SIZE – loans plus bonds plus equities as a per cent to GDP; LOANS – ratio of loans to GDP; M3 – ratio of M3 to GDP; EQUITIES – ratio of stock market capitalisation to GDP; BONDS – ratio of bond market capitalisation to GDP; GDPPC – real GDP per capita; INFLATION – annual percentage change in the GDP deflator; URBAN – urbanisation ratio; OPEN – average of the export and import to GDP ratios; 20–39 – share of 20–39 age group in total population; 40–64 – share of 40–64 age group in total population; 65+ – share of age group over 65 in total population; PFAGDP(–1) – ratio of pension fund assets to GDP lagged one year; BANKGDP(–1) – ratio of bank credit to GDP lagged one year. Coefficient estimates in bold are significant at the 5 per cent level. *t*-statistics are shown in brackets.

Table 5: Robustness Check Using 5-year Averages and Lags – Size Variables
All countries

	SIZE	LOANS	M3	EQUITIES	BONDS
GDPPC (–5)	**0.00004**	**0.00002**	**0.000004**	**–0.00002**	–0.000003
	(2.5)	(13.5)	(3.0)	(3.6)	(0.7)
INFLATION (–5)	–0.00002	–0.00001	**–0.00001**	–0.00002	–0.000008
	(0.3)	(0.9)	(2.0)	(0.7)	(0.6)
URBAN (–5)	**0.082**	0.00041	**0.0032**	0.00007	–0.0015
	(7.4)	(0.5)	(5.4)	(0.1)	(0.5)
OPEN (–5)	**0.007**	**0.0086**	**0.0053**	**0.016**	–0.00044
	(1.8)	(13.1)	(12.0)	(12.1)	(0.4)
20–39 (–5)	**–0.13**	0.0032	**0.0035**	0.007	–0.00056
	(5.8)	(1.6)	(2.6)	(1.2)	(0.1)
40–64 (–5)	–0.04	**0.029**	**0.034**	**0.086**	**0.019**
	(1.3)	(10.3)	(17.9)	(9.8)	(2.5)
65+ (–5)	**0.19**	**0.026**	**0.025**	**0.077**	**0.089**
	(5.0)	(5.1)	(6.0)	(6.3)	(9.8)
R^2	0.98	0.85	0.9	0.83	0.99
Countries	35	71	65	65	35
Observations	236	2 092	1 748	963	272

Notes: See Table 4; also (–5) indicates a lag of five years

A further robustness check was to change the specification to one where the dependent variable is a five-year average and the lagged variables are the 'initial conditions' at the beginning of each 5-year period (Table 5). We find that the demographic results are remarkably similar. Notably, we again find the relatively greater effect of the age 65+ generation on bonds and the 40–64s on equities, consistent with risk aversion effects. The signs on most of the non-financial variables are also robust.

As regards the size estimates for the EME and advanced economies (Table 6), results are similar despite the differing living standards and levels of financial development, which underpins the results for the full sample of countries. There remain some differences, however. For EMEs, GDP per capita is favourable for financial development except for bond markets, while for the advanced economies there is a negative-sign relationship between GDP per capita and the size of equity markets, possibly reflecting high living standards in some 'bank dominated' countries. Bond market development for advanced economies is not affected by GDP per capita, the level of which is of course fairly common across advanced economies. In this context, note that in advanced economies, the correlation between bonds and government debt is closer than in EMEs, where much of government debt is a bank asset.

Urbanisation is positive and significant for all of the EME equations, but only for overall size for the advanced economies. Again, urbanisation is comparable across the advanced economies. Openness has a positive effect on financial development

Table 6: Demographic Effects on Financial Structure – Size Variables

	EMEs					Advanced economies				
	SIZE	LOANS	M3	EQUITIES	BONDS	SIZE	LOANS	M3	EQUITIES	BONDS
GDPPC	**0.11**	**0.021**	**0.012**	**0.041**	**–0.023**	**0.1**	**0.018**	**0.006**	**–0.014**	–0.00001
	(2.7)	(6.1)	(5.2)	(5.1)	(3.1)	(5.2)	(8.8)	(3.2)	(2.3)	(0.1)
INFLATION	**0.025**	**0.0028**	0.00025	–0.0023	**–0.0055**	**–0.036**	0.05	–0.072	**–1.7**	**–1.1**
	(2.6)	(2.4)	(0.3)	(0.9)	(3.0)	(3.8)	(0.4)	(1.0)	(3.2)	(4.1)
URBAN	**0.07**	0.00074	**0.0021**	0.0053	**0.0092**	**0.036**	**–0.0075**	**–0.0015**	–0.0059	**–0.009**
	(2.9)	(0.7)	(3.0)	(1.6)	(2.1)	(2.6)	(3.6)	(1.7)	(1.1)	(2.1)
OPEN	–0.004	**0.0067**	**0.0053**	**0.0095**	**0.0024**	0.0065	**0.0025**	–0.0011	**0.011**	**–0.005**
	(0.9)	(9.4)	(11.5)	(7.7)	(2.8)	(0.9)	(1.9)	(0.9)	(3.0)	(2.5)
20–39	**–0.08**	**0.019**	**0.0093**	0.0018	**–0.017**	**–0.17**	0.002	**–0.012**	–0.0012	–0.0027
	(1.9)	(6.9)	(5.1)	(0.3)	(2.2)	(4.2)	(0.5)	(4.3)	(1.0)	(0.2)
40–64	**–0.17**	**–0.0068**	**0.01**	**0.015**	–0.004	–0.077	**0.045**	**0.024**	**0.14**	**0.041**
	(2.8)	(1.8)	(4.1)	(1.8)	(0.4)	(1.1)	(8.5)	(7.1)	(8.6)	(2.1)
65+	**0.61**	**0.041**	**0.037**	0.023	**0.13**	**0.092**	**0.049**	**0.034**	–0.018	**0.069**
	(3.8)	(4.9)	(6.6)	(0.9)	(4.4)	(2.8)	(8.0)	(6.8)	(1.1)	(6.8)
R^2	0.93	0.68	0.83	0.79	0.91	0.92	0.83	0.91	0.66	0.95
Countries	15	48	48	43	15	20	22	16	22	20
Observations	160	1 560	1 562	714	167	227	900	590	524	244

Note: See Table 4

for both sets of countries, although for the overall size regression in EMEs and for overall size and M3 regressions in the advanced economies the coefficients on openness are insignificant, and for the advanced economies the coefficient for the bond market is negative – possibly reflecting lesser fiscal discipline in the more closed economies. Inflation appears to have a more consistent negative effect on financial development in the advanced economies, where it has – for example – a significant negative effect for bonds, equities and overall size. In contrast, it is positive for overall size and loans in EMEs.

In terms of the demographic variables, the age 65+ cohort has a positive and significant effect throughout, except for equities where it is insignificant for both subsets of countries.[4] This is a more telling result than for the full set of countries, given that the advanced economies and EMEs separately have more similar age distributions than when they are pooled together. It suggests that there may indeed be a positive effect of the elderly on the size of financial markets other than equities, consistent with a pattern whereby they switch from equities to safe assets, but the decline in net financial assets is not a sizeable one due to precautionary saving or bequests as also suggested by Poterba and Samwick (2001).[5]

Consistent with this suggestion, the dichotomy of results for equity and bond markets across the age 40–64 and 65+ cohorts again applies, with only the 40–64 coefficient being significant (and positive) for equity market development in both country groups. For the bond market regression, the coefficient on the 40–64s cohort variable is insignificant for EMEs while the coefficient on the 65+ cohort variable is significant for both EME and advanced economy groups. The results confirm that again, there is implied to be a relative switch by the elderly from equities to bonds. Meanwhile, especially for the advanced economies, the coefficients of these sub-groups are comparable (positive and significant) for M3 and bank lending, suggesting that liquid asset holding needs do not change with retirement. Meanwhile the 20–39 cohort is shown to have a negative impact on M3 for the advanced economies, but a positive effect on M3 and borrowing in the EMEs. The contrast for M3 may reflect greater liquidity constraints in the EMEs. Finally, the 20–39 cohort has a negative effect on overall size in both cases, as do the 40–64s for EMEs.

Turning to estimates for financial structure ratios (Table 7), the loan-equity equation has the most countries (67) and observations (1 219). This shows that economic development accompanies growth in securities markets relative to banks, as witnessed by a negative sign on the GDP per capita and on urbanisation. This is consistent with a shift to market orientation as economic development proceeds, as discussed in Section 1. More open countries also have a larger stock of equity funding relative to bank lending, consistent with internationally integrated securities markets. Inflation is inimical to equities as opposed to bank lending. The demographic variables are all negative for this equation, but with the largest value for the 40–64 cohort, consistent with larger relative demand for equities rather than bank liabilities for this group.

4. We note that the lack of significance of equities for the over-65 variable rules out the possibility that results for EMEs are driven by a correlation of longevity with overall development.

5. Of course, the foreign sector may also be an important concurrent investor in these assets, notably in small open economies.

Table 7: Estimates of Demographic Effects on Financial Structure – Ratio Variables

	All countries			All countries with financial development variables		
	LOAN/ EQUITY	LOAN/ SECURITY	DEBT/ EQUITY	LOAN/ EQUITY	LOAN/ SECURITY	DEBT/ EQUITY
GDPPC	**–0.0033**	–0.0008	–0.4	**–0.0069**	0.011	–0.47
	(2.3)	(0.3)	(1.6)	(3.7)	(0.4)	(1.4)
INFLATION	**0.0054**	**0.086**	0.25	**0.0043**	**0.062**	0.13
	(4.7)	(5.3)	(1.4)	(3.9)	(4.8)	(0.7)
URBAN	**–0.0052**	–0.031	–0.21	**–0.0041**	**–0.052**	–0.46
	(5.0)	(1.5)	(0.9)	(3.5)	(2.1)	(1.6)
OPEN	**–0.0018**	**–0.028**	**–0.38**	**–0.0029**	**–0.033**	**–0.42**
	(3.4)	(4.5)	(5.4)	(5.1)	(5.2)	(5.6)
20–39	**–0.0046**	0.018	**1.0**	**–0.0067**	0.012	**1.23**
	(2.1)	(0.4)	(2.2)	(2.8)	(0.3)	(2.7)
40–64	**–0.016**	0.032	**1.6**	**–0.017**	–0.028	**1.61**
	(6.0)	(0.7)	(3.3)	(5.6)	(0.6)	(2.7)
65+	**–0.011**	–0.055	–0.61	**–0.0077**	–0.056	–0.45
	(2.6)	(1.0)	(1.0)	(1.7)	(1.0)	(0.7)
PFAGDP (–1)				**–0.172**	–0.27	2.25
				(4.5)	(0.6)	(0.4)
BANKGDP (–1)				**–0.178**	**0.99**	**5.6**
				(7.7)	(3.5)	(1.7)
R^2	0.71	0.61	0.41	0.73	0.63	0.41
Countries	67	36	36	63	35	35
Observations	1 219	395	395	1 059	365	365

Notes: See Table 4; also, LOAN/EQUITY – ratio of loans to stock market capitalisation; LOAN/SECURITY – ratio of loans to bonds plus equities; DEBT/EQUITY – ratio of loans plus bonds to equity; all ratios expressed in per cent

Meanwhile, for the loan-security ratio there are no significant demographic effects, and for the debt-equity ratio the younger cohorts are shown (on the smaller sample) to favour the development of debt markets (loans and bonds). The equations with the financial development variables show similar patterns for the demographic effects. A large pension fund sector is shown to accompany a larger stock of equities relative to bank loans, as, interestingly, does a larger banking sector. On the other hand, a larger volume of bank loans to the private sector accompanies a higher loan-security ratio and economy-wide debt-equity ratio.

Looking at the ratio results for the separate country groups (Table 8) briefly, the loan-equity ratio is reduced strongly in advanced economies by the high saving 40–64 cohort, who as shown in Table 7 encourage the development of equity markets more than bank loans. In the EMEs it is the 20–39 and 65+ cohort that drive a fall in the loan-equity ratio – the result for all countries in Table 7 was a mixture of these effects.

Table 8: Demographic Effects on Financial Structure – Ratio Variables

	EMEs			Advanced economies		
	LOAN/ EQUITY	LOAN/ SECURITY	DEBT/ EQUITY	LOAN/ EQUITY	LOAN/ SECURITY	DEBT/ EQUITY
GDPPC	–0.00021	–0.025	–0.35	–0.0007	–0.009	**–0.39**
	(0.4)	(0.2)	(0.3)	(0.5)	(0.7)	(2.5)
INFLATION	**0.0054**	**0.071**	0.27	**0.44**	**0.027**	**20.0**
	(4.3)	(2.9)	(1.0)	(3.2)	(4.5)	(2.7)
URBAN	**–0.0073**	**–0.137**	0.13	0.0003	0.012	–0.095
	(4.5)	(2.2)	(0.2)	(0.2)	(1.4)	(0.8)
OPEN	**–0.0015**	**–0.028**	**–0.54**	**–0.003**	**–0.018**	**–0.14**
	(2.3)	(2.4)	(4.1)	(3.2)	(4.1)	(2.7)
20–39	**–0.0071**	0.17	**2.6**	–0.0004	0.016	0.027
	(2.0)	(1.6)	(2.1)	(0.1)	(0.6)	(0.1)
40–64	0.0011	**0.43**	**4.2**	**–0.029**	–0.029	0.1
	(0.2)	(2.8)	(2.4)	(7.0)	(0.7)	(0.2)
65+	**–0.05**	**–1.1**	–7.3	–0.0007	–0.011	–0.22
	(4.0)	(2.6)	(1.6)	(0.2)	(0.5)	(0.9)
R^2	0.69	0.57	0.33	0.78	0.83	0.77
Countries	44	15	15	22	20	22
Observations	696	160	160	515	227	227

Note: See Tables 4 and 6

We finally highlight some results for private saving using demographic effects, as shown in Table 9. Note that this includes corporate as well as household saving. Given this area has been widely researched (see Section 5), we do not put a major emphasis on these results. Nevertheless, it is notable that strong and consistent demographic effects are detected for all countries and both subgroups, with a range of financial structures. The results are in turn consistent with the life-cycle hypothesis (although the results do not *prove* the life-cycle pattern holds for each individual cohort, since the aggregate macro data show the average age behaviour of a range of cohorts).

In each case, the coefficients on the 20–39 and 40–64 cohort variables are positive for private saving, and the 40–64 cohort always has a larger coefficient. For EMEs, the coefficient on the 20–39 cohort variable is positive and significant (and also for all countries) but in the advanced economies, the 20–39 cohort variable is insignificant, which may reflect heavy borrowing in financially liberalised economies, while the 20–39s face liquidity constraints in EMEs. Meanwhile, the over-65 cohort has a consistently negative and significant impact on saving, across all country groups. The contrast with some of the positive results for financial asset accumulation may reflect the existing stock of wealth that this cohort has built up, and positive revaluations that will not be reflected in private sector saving. Finally, whereas the size of the pension sector has no effect on private saving, there is a tendency for countries with large bank lending to the private sector to have lower private saving also.

Table 9: Estimates of Demographic Effects on Financial Structure – Flow Variables

	Private saving/GDP				External balance/GDP			
	All countries		EME countries	Advanced countries	All countries		EME countries	Advanced countries
	(1)	(2)			(1)	(2)		
GDPPC	0.0006	0.00075	**0.0068**	–0.00023	**0.3**	**0.24**	**0.14**	**0.24**
	(0.8)	(0.8)	(3.8)	(0.5)	(9.5)	(4.9)	(1.7)	(7.5)
GROWTHPC	**0.0008**	**0.0006**	0.00031	**0.0026**	**–0.059**	**–0.056**	**–0.09**	**0.09**
	(2.8)	(2.0)	(0.8)	(6.9)	(2.9)	(2.4)	(3.6)	(2.1)
INFLATION	0.00043	0.0001	0.00046	**0.063**	0.028	0.03	0.023	**–0.074**
	(1.5)	(0.3)	(1.3)	(3.1)	(1.0)	(1.1)	(0.7)	(3.8)
URBAN	**–0.00095**	–0.00067	**–0.0015**	0.0005	0.021	–0.0026	0.039	–0.014
	(2.4)	(1.3)	(2.6)	(1.1)	(1.1)	(0.1)	(1.5)	(0.5)
OPEN	**0.001**	**0.0019**	**0.00072**	**0.0015**	0.019	0.013	–0.011	**0.15**
	(4.4)	(6.2)	(2.3)	(4.9)	(1.4)	(0.7)	(0.7)	(7.2)
20–39	**0.0045**	**0.0023**	**0.0052**	0.00064	0.0033	0.045	–0.0047	–0.048
	(5.5)	(2.2)	(3.5)	(0.8)	(0.1)	(0.8)	(0.1)	(0.7)
40–64	**0.0067**	**0.0048**	**0.0094**	0.0019	**0.021**	**0.029**	**0.37**	0.056
	(4.9)	(2.6)	(3.7)	(1.6)	(3.5)	(3.4)	(3.8)	(0.6)
65+	**–0.011**	**–0.0079**	**–0.022**	**–0.0046**	**–0.59**	**–0.35**	**–0.63**	**–0.41**
	(5.3)	(3.3)	(4.4)	(3.5)	(5.8)	(2.8)	(3.2)	(4.3)
PFAGDP (–1)		0.021				–0.22		
		(0.9)				(0.2)		
BANKGDP (–1)		**–0.031**				**–1.65**		
		(2.5)				(2.1)		
R^2	0.6	0.62	0.53	0.76	0.57	0.6	0.56	0.55
Countries	59	53	35	22	71	68	48	22
Observations	1 398	1 103	830	560	2 600	1 950	1 663	928

Notes: See Table 4; also, GROWTHPC – annual growth rate of GDP per capita

Overall, we conclude from this preliminary empirical work that there are indeed detectable demographic effects on financial structure, which can be expected to have important implications for the future. Among other things, there is a switch from equities to bonds between the 40–64 and 65+ cohorts, as well as a positive impact of the older cohorts on banking and overall size of the financial sector. Saving regressions show a strong positive effect for the 40–64 cohort and negative for the 65+ one, consistent with other work in this area. So in an ageing economy, a financial system may well become more bond- as opposed to equity-based, and somewhat larger overall, while also facing declining inflows of saving.

This is an area which clearly warrants further research. Further work could assess different specifications, notably using lagged dependent variables for the financial structure variables, which would in turn necessitate using the Generalised Method of Moments method for estimation.

8. Impacts of Ageing on Cross-border Financial Claims

In open economies, ageing will also impact on the external balance, depending on the path of investment. In this context, most studies suggest that investment rates will fall with ageing, which would temper the increase in external deficits from lower saving. For example, Cutler *et al* (1990) suggest that total investment may fall with ageing, given the reduced need for capital with a smaller workforce; they also envisage a fall in the rate of return on capital from 6.7 per cent in 1990 to 3.5 per cent in 2025. Disney (1996) shows a significant negative relationship between the elderly dependency ratio and fixed capital growth over 1977–1992 in 24 OECD countries. Blommestein (1998) again sees falling investment as likely to occur as the labour force shrinks and the capital-labour ratio rises, depressing returns to new investment. Higgins (1998) estimates that the cohort aged 15–24 has a peak positive effect on investment earlier than the peak positive effect on saving due to the 30–45 aged cohort.

Bikker (1996) focuses directly on balance-of-payments effects of ageing and finds that the effects in OECD countries may be to move the current account towards a surplus as long as national saving is boosted by ageing, which seems possible as long as the 'baby boom' generation remains at work. But once people in this generation retire and begin to dissave, this could turn around.

In the light of this work, we undertook panel estimates for the external (current account) balance, bearing in mind that it is a product of public as well as private sector behaviour, and of investment as well as saving. These are also reported in Table 9. Looking first at the non-demographic effects, higher GDP per capita tends to push countries' current accounts towards surplus, in the full group as well as the EMEs and advanced economies separately. Rapid income growth tends to reduce current account balances, but interestingly not for the advanced economies, where high inflation pushes countries towards external deficits. As regards demographic effects, the 20–39 cohort is not in any case a significant influence on the external position. The 40–64 cohort tends to encourage a surplus position, albeit not significantly for the advanced economies. This is plausible in the light of high saving by this group, and also a likely beneficial effect on government saving (higher tax

receipts than expenditure needs). The 65+ generation is associated with a tendency to deficit in the external position in all cases, consistent with lower private saving as discussed above as well as pension and health expenditures by government with less offsetting tax inflows. Finally, whereas the pension sector has no effect on the external position, there is a tendency for countries with large bank lending to the private sector to have deficits. This may of course reflect private investment financed by such lending, as we now go on to discuss.

On balance, our results suggest that the pattern of ownership of financial claims will shift relatively from advanced economies towards EMEs as the former age more rapidly, although later ageing of the EMEs will tend to redress the balance. These suggestions are supported by various macroeconomic projections as summarised below.

9. Global Macroeconomic Projections

Illustrating the overall outcome of these ageing patterns, and giving further clues about changes in financial structure with ageing, Turner *et al* (1998) provided a simulation of the global effects of population ageing (focusing both on changing population growth and age structure), using the OECD's international dynamic general equilibrium macro-model MINILINK. Reflecting the declining labour supply with ageing, economic growth is forecast to decline to 0.25 per cent per annum in Japan, 1 per cent in Europe and 1.4 per cent in the United States by around 2030. The slowdown in growth reduces investment needs directly. Furthermore, a decline in the weight of the OECD in the world economy tends to shift OECD current accounts towards a surplus (and hence saving-investment balances) as non-OECD imports rise faster than OECD import demand. The US, Europe and Japan all generate current account surpluses of 2–3 per cent of GDP up to 2025, as saving is initially boosted by the high proportion of high-saving age groups while growth potential and hence investment weaken, thus building up net external assets which help to buttress GNP. They thus build up ownership of global financial claims, including those on EMEs.

On the other hand, eventual downwards pressures on public and private saving are greater in the OECD than elsewhere, generating – in combination with exchange rate appreciation – current account deficits for the three OECD regions after 2025. The balance of ownership of global financial assets would tend to switch at this point from OECD countries to EMEs. As world investment in this simulation falls less than saving, world real interest rates are expected to rise slightly, reinforcing the decline in investment. Reflecting differing returns to capital, interest rates are higher in EMEs than in the OECD. The authors note that higher saving in OECD countries could generate quite different results, with lower real interest rates and consequently higher investment and capital-labour ratios. There would also be greater net external assets, boosting OECD GNP via inflows of interest, profits and dividends.[6]

6. The return on such investments will depend on factors such as labour and product market reforms in the EMEs as well as the overall size of such flows from the OECD (if the flows are sizeable enough, they will depress the return to capital in the EMEs).

McMorrow and Roeger (2003) concur that the EU and Japan will run current account surpluses for some time, but expect the US to run ongoing deficits, reflecting growth differentials and an assumption that the absorptive capacity of slow-ageing EMEs is limited. Their projection, unlike that of Turner *et al* (1998) thus implies that the bulk of cross-border claims will remain within the OECD region during that region's ageing phase. They also note that such a continued concentration of capital flows within the OECD is more likely to generate downward pressure on rates of return and a risk of bubbles.

Finally, Batini *et al* (2006), using a dynamic intertemporal general equilibrium model, again find slower growth and a current account deterioration for the developed economies as the elderly run down assets in retirement. Interestingly, more rapid productivity growth (in terms of catch-up with the US) can markedly reduce the loss in growth from ageing, and related current account balances.[7]

10. Conclusions

Summarising the paper, we noted initially that financial structure is intimately related to the stage of development and legal structure of an economy. We then highlighted that, in line with the life-cycle hypothesis, overall personal saving is likely to rise then fall as ageing proceeds, thus impacting on the size of financial claims and overlaying standard patterns of financial development. Existing work also shows that ageing tends to accompany an initial shift into securities followed by a relative shift from equities to bonds, as well as a fall in household debt. There has been extensive work on securities prices and ageing, much of which suggests that ageing will depress equity prices, albeit modestly. Finally, most analysis suggests that ageing will accompany rising current account surpluses in the advanced economies followed by deficits, largely driven by changes in saving albeit also affected by demographic effects on investment.

Our own empirical work suggests that demographic changes have had a detectable impact on financial structure in both advanced economies and EMEs and will continue to do so in the future if current relationships continue to hold. The similar results for the two subgroups suggest that this may indeed be the case (as advanced economies can be viewed as akin to EMEs at a later stage of ageing and economic growth). Ageing tends initially to benefit equities (as the 40–64 cohort grows) but then as the 65+ cohort becomes predominant, it will benefit bond markets relative to equity markets. Banking tends to benefit from large cohorts aged 40–64 and 65+. Finally, a rise in the 65+ cohort also tends to depress private saving and external balances, albeit not reducing the overall size of the financial sector.

Policy-relevant issues, also necessitating further research, that are raised by the effect of ageing on financial market structure include the following:

- What will be the balance between price and quantity effects on financial markets as the asset demands of the household sector evolve with ageing? If there is a

7. See Davis (2006) for a review of existing work and new estimates of the impact of age structure on productivity, as well as that of pension funding.

'meltdown' will there be pressure on governments to accept some of the burden of adjustment which would otherwise fall directly on holders of defined contribution pension funds?

- How should government financing evolve to meet the changing demands of the household sector in terms of asset risk? Should they issue bonds linked to longevity to overcome uncertainty over demographic changes?
- How will companies cope with the changing demand for bonds and equities from the household sector during ageing? Will there be an initial fall in debt-equity ratios followed by a rise – leading to heightened bankruptcy risk at a time when economic growth may also be sluggish? Or could asynchronous demand for bonds and equities by advanced economy and EME households flatten out this pattern?
- Saving has seen a decline in many advanced economies after financial liberalisation, as household sectors have undertaken heavy borrowing and relied on rising asset prices (notably house prices) to maintain wealth-income ratios. Can this continue as the population ages, and how will ageing, borrowing and house prices interact?
- Is it plausible that banking sectors will be relatively unaffected by ageing, as implied by the empirical results?
- Will there be difficulties in dealing with major cross border flows, initially from advanced economies to EMEs and later reversed, which are also likely to drive shifts in exchange rates and even financial instability (Davis 2002). Why are such flows not occurring now? In other words, why are EMEs financing the advanced economies via foreign exchange reserves? Can EMEs absorb the potential volume of advanced economy claims in the short term (McMorrow and Roeger 2003) and what are the economic and political implications of major shifts later by EMEs into creditor status, when their economic development will be much more comparable to that of the advanced economies than it is now? Will cross-border EME asset demand help attenuate any pressures cited above for changes in asset prices and composition of assets in advanced economies?
- How should financial regulation adapt to the changing patterns of financial stocks and flows foreshadowed in this work?
- How will the changing structure of finance interact with growth in conjunction with ageing? There is an extensive literature on finance and growth (see Beck and Levine 2004 and Davis and Hu 2004 for example), while there is also emerging evidence that ageing may affect growth (such as Davis 2006 who looks at a possible impact on total factor productivity).
- Will past patterns, which were estimated over periods when pension systems were more pay-as-you-go-based, change as pension funding becomes more important? Will the switch from defined benefit to defined contribution pension funds change saving, and its composition between debt and equity claims (for example, as risk-bearing households under defined contribution schemes become more cautious)?

Appendix A: List of Countries Utilised in Econometrics

EMEs	Transition economies	Advanced economies
Algeria	Bulgaria	Australia
Argentina	China	Austria
Bolivia	Croatia	Belgium
Brazil	Czech Republic	Canada
Chile	Hungary	Denmark
Colombia	Kazakhstan	Finland
Costa Rica	Latvia	France
Dominican Republic	Poland	Germany
Ecuador	Romania	Greece
Egypt	Russian Federation	Iceland
El Salvador	Slovak Republic	Ireland
Fiji	Ukraine	Italy
Honduras	Vietnam	Japan
Hong Kong, SAR		Luxembourg
India		Netherlands
Indonesia		New Zealand
Israel		Norway
Jordan		Portugal
Malaysia		Spain
Mexico		Sweden
Morocco		Switzerland
Nigeria		United Kingdom
Pakistan		United States
Panama		
Paraguay		
Peru		
Philippines		
Singapore		
South Africa		
South Korea		
Sri Lanka		
Thailand		
Tunisia		
Turkey		
Uruguay		
Venezuela		

References

Abel AB (2001), 'Will Bequests Attenuate the Predicted Meltdown in Stock Prices When Baby Boomers Retire?', *Review of Economics and Statistics*, 83(4), pp 589–595.

Al-Eyd A, R Barrell and EP Davis (2006), 'Determinants of European Consumption – A Panel Approach', National Institute of Economic and Social Research, mimeo.

Allen F and D Gale (2000), *Comparing Financial Systems*, MIT Press, Cambridge.

Ameriks J and SP Zeldes (2000), 'How Do Households Portfolio Shares Vary with Age?', Columbia University and TIAA-CREF Working Paper.

Ando A and F Modigliani (1963), 'The "Life Cycle" Hypothesis of Saving: Aggregate Implications and Tests', *American Economic Review*, 53(1), Part 1, pp 55–84.

Arestis P, AD Luintel and KB Luintel (2004), 'Does Financial Structure Matter?', The Levy Economics Institute of Bard College Working Paper No 399.

Attfield CLF and E Cannon (2003), 'The Impact of Age Distribution Variables on the Long Run Consumption Function', Bristol University Discussion Paper No 03/546.

Batini N, T Callen and WJ McKibbin (2006), 'The Global Impact of Demographic Change', IMF Working Paper No WP/06/9.

Beck T and R Levine (2004), 'Stock Markets, Banks, and Growth: Panel Evidence', *Journal of Banking and Finance*, 28(3), pp 423–442.

Bergantino SM (1998), 'Life Cycle Investment Behavior, Demographics, and Asset Prices', Doctoral dissertation, MIT Department of Economics.

Bernheim BD (1991), 'How Strong Are Bequest Motives? Evidence Based on Estimates of the Demand for Life Insurance and Annuities', *Journal of Political Economy*, 99(5), pp 899–927.

Bikker JA (1996), 'National Savings, the Current Account and Aging Population: A Pension Fund Model', *Economic and Financial Modelling*, 3(1), pp 3–20.

Blake D (1997), 'Pension Funds and Capital Markets: Necessary, but not Sufficient Vehicles for Delivering the Pension Promise', Cass Business School Pension Institute Discussion Paper PI-9706.

Blommestein H (1998), 'Ageing-Induced Capital Flows to Emerging Markets Do Not Solve the OECD's Basic Pension Problem', in H Blommestein and N Funke (eds), *Institutional Investors in the New Financial Landscape*, OECD, Paris, pp 349–362.

Bodie Z and DB Crane (1997), 'Personal Investing: Advice, Theory and Evidence', *Financial Analysts Journal*, 53(6), pp 13–23.

Bosworth BP, RC Bryant and G Burtless (2004), 'The Impact of Aging on Financial Markets and the Economy: A Survey', The Brookings Institution, mimeo.

Bosworth BP and B Keys (2004), 'Increased Life Expectancy: A Global Perspective', in HJ Aaron and WB Schwartz (eds), *Coping with Methuselah: The Impact of Molecular Biology on Medicine and Society*, The Brookings Institution, Washington DC, pp 247–276.

Brooks R (2000), 'What Will Happen to Financial Markets When the Baby Boomers Retire?', IMF Working Paper No WP/00/18.

Catalan M, G Impavido and AR Musalem (2000), 'Contractual Savings or Stock Market Development: Which Leads?', World Bank Social Protection Discussion Paper No 0020.

Cutler DM, JM Poterba, LM Sheiner and LH Summers (1990), 'An Aging Society: Opportunity or Challenge?', *Brookings Papers on Economic Activity*, 1, pp 1–56.

Dang TT, P Antolin and H Oxley (2001), 'Fiscal Implications of Ageing: Projections of Age-Related Spending', OECD Economics Department Working Paper No 305.

Davis EP (2002), 'Institutional Investors, Corporate Governance, and the Performance of the Corporate Sector', *Economic Systems*, 26(3), pp 203–229.

Davis EP (2005), 'The Role of Pension Funds as Institutional Investors in Emerging Markets', Brunel University Public Policy Discussion Paper No 05-18.

Davis EP (2006), 'Pension Funding, Productivity, Ageing and Economic Growth', paper presented at the Deutsche Bundesbank Third Conference of the Monetary Stability Foundation on 'Challenges to the Financial System – Ageing and Low Growth', Frankfurt a.M, 6–7 July.

Davis EP and Y Hu (2004), 'Is There a Link between Pension Fund Assets and Economic Growth? – A Cross-Country Study', Brunel University Public Policy Discussion Paper No 04-23.

Davis EP and Y Hu (2006), 'Funding, Saving and Economic Growth', in GL Clark, AH Munnell and JM Orszag (eds), *The Oxford Handbook of Pensions and Retirement Income*, Oxford University Press, Oxford.

Davis EP and C Li (2003), 'Demographics and Financial Asset Prices in the Major Industrial Economies', Brunel University Public Policy Discussion Paper No 03-07.

Deaton AS (1992), *Understanding Consumption*, Oxford University Press, Oxford.

Demirguc-Kunt A and R Levine (2000), 'Bank-Based and Market-Based Financial Systems: Cross-Country Comparisons', paper presented at the World Bank Conference on 'Does Financial Structure Matter?', Washington DC, 10–11 February.

Disney R (1996), *Can We Afford to Grow Older?*, MIT Press, Cambridge.

Erb C, B Harvey, R Campbell and TE Viskanta (1997), 'Demographics and International Investments', *Financial Analysts Journal*, 53(4), pp 14–28.

Fair RC and KM Dominguez (1991), 'Effects of the Changing U.S. Age Distribution on Macroeconomic Equations', *American Economic Review*, 81(5), pp 1276–1294.

Friedman MA (1957), 'A Theory of the Consumption Function', Princeton University Press, Princeton.

Goyal A (2001), 'Demographics, Stock Market Flows and Stock Returns', UCLA Anderson Graduate School of Management Working Paper.

Higgins M (1998), 'Demography, National Savings and International Capital Flows', *International Economic Review*, 39(2), pp 343–369.

Hu Y (2005), 'Pension Reform, Economic Growth and Financial Development: An Empirical Study', Brunel University Public Policy Discussion Paper No 05-05.

Hurd MD (1987), 'Savings of the Elderly and Desired Bequests', *American Economic Review*, 77(3), pp 298–312.

Impavido G, AR Musalem and T Tressel (2003), 'The Impact of Contractual Savings Institutions on Securities Markets', World Bank Policy Research Working Paper No 2948.

Kohl R and PS O'Brien (1998), 'The Macroeconomics of Ageing, Pensions and Savings: A Survey', OECD Economics Department Working Paper No 200.

La Porta R, F Lopez-de-Silanes and A Schleifer (1999), 'Corporate Ownership around the World', *Journal of Finance*, 54(2), pp 471–517.

Loayza N, K Schmidt-Hebbel and L Servén (2000), 'What Drives Private Saving around the World?', *Review of Economics and Statistics*, 82(2), pp 165–181.

Lopez Murphy P and A Musalem (2004), 'Pension Funds and National Saving', World Bank Policy Research Working Paper No 3410.

Mankiw NG and DN Weil (1989), 'The Baby Boom, the Baby Bust, and the Housing Market', *Regional Science and Urban Economics*, 19(2), pp 235–258.

Masson PR, T Bayoumi and H Samiei (1995), 'International Evidence on the Determinants of Private Saving', IMF Working Paper No W95/051.

McMorrow K and W Roeger (2002), 'EU Pension Reform – An Overview of the Debate and an Empirical Assessment of the Main Policy Reform Options', European Commission Economic Paper No 162.

McMorrow K and W Roeger (2003), 'Economic and Financial Market Consequences of Ageing Populations', European Commission Economic Papers No 182.

Modigliani F (1986), 'Life Cycle, Individual Thrift, and the Wealth of Nations', *American Economic Review*, 76(3), pp 297–313.

Modigliani F and R Brumberg (1954), 'Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data', in KK Kurihara (ed), *Post-Keynesian Economics*, Rutgers University Press, New Brunswick, pp 388–436.

Neuberger A (1999), 'Long Term Savings Flows and the Capital Markets', Morgan Stanley Dean Witter *Global Pensions Quarterly*, 2(1).

Poterba JM (1998), 'Population Age Structure and Asset Returns: An Empirical Investigation', NBER Working Paper No 6774.

Poterba JM (2001), 'Demographic Structure and Asset Returns', *Review of Economics and Statistics*, 83(4), pp 565–584.

Poterba JM (2004), 'The Impact of Population Aging on Financial Markets', NBER Working Paper No 10851.

Poterba JM and AA Samwick (1995), 'Stock Ownership Patterns, Stock Market Fluctuations, and Consumption', *Brookings Papers on Economic Activity*, 2, pp 295–372.

Poterba JM and AA Samwick (2001), 'Household Portfolio Allocation over the Life Cycle', in S Ogura, T Tachibanaki and DA Wise (eds), *Aging Issues in the United States and Japan*, University of Chicago Press, Chicago, pp 65–103.

Rajan RC and L Zingales (2000), 'The Great Reversals: The Politics of Financial Development in the 20th Century', OECD Economics Department Working paper No 265.

Rybczynski TM (1997), 'A New Look at the Evolution of the Financial System', in J Revell (ed), *The Recent Evolution of Financial Systems*, Macmillan Press, London, pp 3–15.

Schieber SJ and JB Shoven (1994), 'The Consequences of Population Aging on Private Pension Fund Saving and Asset Markets', NBER Working Paper No 4665.

Schmidt RH, A Hackethal and M Tyrell (1999), 'Disintermediation and the Role of Banks in Europe: An International Comparison', *Journal of Financial Intermediation*, 8(1–2), pp 36–67.

Schmidt RH, A Hackethal and M Tyrell (2001), 'The Convergence of Financial Systems in Europe: Main Findings of the DFG Project', University of Frankfurt, mimeo.

Turner D, C Giorno, A de Serres, A Vourc'h and P Richardson (1998), 'The Macroeconomic Implications of Ageing in a Global Context', OECD Economics Department Working Paper No 193.

UN Population Division (2005), *World Population Prospects: The 2004 Revision*, United Nations, New York. Available at <http://esa.un.org/unpp/>.

Walker E and F Lefort (2002), 'Pension Reform and Capital Markets: Are There Any (Hard) Links?', World Bank Social Protection Discussion Paper No 0201.

Yoo PS (1994), 'Age Dependent Portfolio Selection', Federal Reserve Bank of St. Louis Working Paper No 94-003A.