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Ageing and asset prices

Előd Takáts[1]

Abstract

The paper investigates how ageing will affect asset prices. A small model is used to show that economic and demographic factors drive asset, and in particular house, prices. These factors are estimated in a panel regression framework encompassing BIS real house price data from 22 advanced economies between 1970 and 2009. The estimates show that demographic factors affect real house prices significantly. Combining the results with UN population projections suggests that ageing will lower real house prices substantially over the next forty years. The headwind is around 80 basis points per annum in the United States and much stronger in Europe and Japan. Based on the analysis, global asset prices are likely to face substantial headwinds from ageing.

JEL classification: G12; J11

Keywords: Ageing, Asset Prices, House Prices

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1. Motivation

Ageing is global. Advanced economies are ageing fast and emerging economies are closely following them. The old age dependency ratio, the ratio of old to working age population, is expected to almost double in the United States by 2050. And ageing is much faster elsewhere. Perhaps Germany and Japan are the best known examples, but ageing is not limited to advanced economies. China will be older, in terms of median age, than the United States by 2025. These ageing economies account for the overwhelming majority of global investable assets. And economic theory suggests that ageing can drive asset prices down. The question naturally arises: What will happen to asset prices? Will ageing lead to a global asset price meltdown?

This paper finds that ageing will affect asset prices significantly negatively, but an asset price meltdown, as predicted in Mankiw and Weil (1989), is unlikely. The paper identifies the impact of ageing through the analysis of house prices. It finds that demographic factors contributed positively to real house prices in many countries in recent decades. For instance, the United States is estimated to have enjoyed around 80 basis points per annum demographic tailwinds in the past forty years compared to neutral demographics. Looking ahead, forecasts of the demographic component for the next forty years, based on United Nations (2008) population projections, uniformly point towards substantial demographic headwinds. For instance, the impact in the United States is estimated to be around 80 basis points per annum. European economies and Japan are expected to face even stronger headwinds. Based on the analysis, global asset prices could face up to a full percentage point lower return per annum than under neutral demographics.

Economic theory, the combination of the lifecycle hypothesis and overlapping generation models, suggests that ageing has straightforward impact on asset prices. The lifecycle hypothesis, originating from Modigliani and Miller (1954), states that consumption-saving patterns vary with age: Individuals borrow when young and in their middle ages they repay these debts and also save for old age. In an overlapping generation model, originating from Allais (1947), Samuelson (1958) and Diamond (1958), the young save for old age by buying assets, while the old sell assets to finance retirement. This asset transfer can happen directly or through institutions such as pension funds. In this setting, the change in the relative size of asset buyers (the young) and sellers (the old), have consequences for asset prices. In particular, the asset purchases of a large working age generation, such as the baby boomers in the United States, drives asset prices up. Conversely, if the economy is ageing, ie the subsequent young generation is relatively smaller, then asset prices decline. A series of detailed theoretical models elaborated the idea further.[2]

Stylized ageing and asset price trends in the United States seem to support the theoretical conclusions (Graph 1). In the last 30 years, during the active years of the baby boomer generation, asset prices have increased massively. Ex-ante real interest rates have fallen

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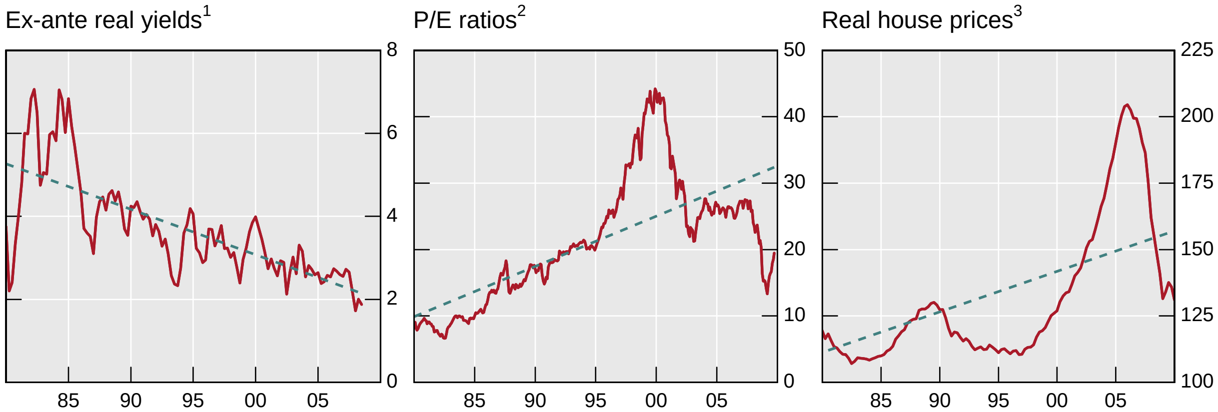
[2] Mankiw and Weil (1989) used this economic reasoning to motivate their empirical research. Yoo (1997) linked explicitly ageing with asset prices, and showed how demographics can generate low frequency price movements. Brooks (2002) in a detailed overlapping generation model showed that the ageing of baby boomers will decrease asset returns by around 100 basis points per annum in the United States. Abel (2003) confirmed that ageing decreases the price of capital, ie it affects asset returns negatively. However, the results suggest that changes are mean reverting and thus transitory. Geanakoplos et al (2004) focused on the stock market. Demographics are estimated to have substantial impact, but stock market peak-to-trough variations are 2-3 times larger than what demography could explain. This confirms that ageing is only one of many factors driving asset prices. Another stream of theoretical literature starting from Auerbach and Kotlikoff (1987) and Auerbach et al (1989) investigate the impact of ageing in a complex setup: on cost of capital, capital flows, wages etc. The findings are in line with the asset pricing literature: ageing affects asset prices negatively as it reduces returns on capital. However, given that this literature does not focus on asset prices explicitly, the models generally do not provide explicit estimates on asset prices.

(left panel), equity P/E ratios increased substantially (middle panel) and also real house prices climbed (right panel). The theory then would imply that asset prices propelled by the boomers' savings will be under pressure when this large generation retires and starts to sell its assets to the relatively smaller subsequent generation.

Graph 1

Asset prices in the United States



[1] 10 year US government bonds. [2] 10 year average earnings. [3] 1970 = 100.

Sources: Robert Shiller, Haver, Federal Reserve Bank of Philadelphia, and BIS staff calculations.

The correlation between ageing and asset prices, along with the possibility of asset price declines in the near future, motivated many empirical studies to identify the impact of ageing. These empirical studies can be divided into two main groups: (1) single country investigations of financial asset and house prices; and (2) international studies of financial asset prices. Identification is challenging in both case, which prompted this research to use an international sample of house prices.

In case of single country studies, identifying the impact of ageing on asset prices is difficult, because ageing is very slow moving and it has many measures. Essentially, the past forty years offers a single ageing process in most countries. Furthermore, various non-linear measures of ageing are available to fit house price trends. Some studies focused on different age cohorts: Mankiw and Weil (1989) and Hendershott (1991) focused on adult populations; Yoo (1994) and Bergantino (1998) on detailed age cohorts; while Poterba (2004) on prime savers (individuals between 45-60 years of age). Others, for instance, Bakshi and Chen (1994), used average age. These different measures make it very easy, as Brooks (2006) argues, to make the casual and econometric link between ageing and asset prices in a single country study. However, this implies that identification might be questioned. For instance, Engelhardt and Poterba (1991) showed that the demographic factors identified in Mankiw and Weil (1989) for the United States do not fit Canadian house price and demographic data.

International studies can improve on single country studies as several ageing trends are investigated simultaneously. Davis and Lee (2003) found that prime saving cohort size is significantly correlated with asset prices in a seven country sample. Brooks (2006) also extended sample size to include more countries and ageing trends. International studies are also useful to revisit single country results. Ang and Maddaloni (2005) found, for instance, that average age does not predict real returns outside the United States.

However, even international studies using financial asset price data present difficulties, because capital mobility is expected to dilute the impact of ageing. If ageing affects asset prices, investors living in ageing (ie low return) economies should move their assets to more youthful (ie high return) economies until expected returns equalize. Indeed, Higgins (1998) and later studies show that this is exactly what is happening: capital flows from ageing economies to relatively younger ones. Thus, capital flows make it difficult to identify the impact of ageing on financial asset prices.

This paper focuses on international house prices to identify the impact of ageing as precisely as possible. House prices provides better identification than financial asset prices as capital flows are less likely to dilute the link between ageing and asset prices. Cross-border investment in residential housing is much more difficult and consequently much less common than cross-border financial investment. Real house price data collected by the Bank for International Settlements (BIS) covers 22 advanced economies between 1970 and 2009. There is substantial heterogeneity in both house prices and demographics, which provides solid basis for identifying the impact of ageing.

An overlapping generation model is used to identify key asset price drivers theoretically. The model finds that real economic factors and demographic factors drive asset prices. Demographic factors determine the relative size of buyers and sellers in the housing market. Based on the model, two demographic factors are in the focus of the empirical analysis: First, total population, which captures the demographic effect given unchanged ageing structure. Second, the dependency ratio, the ratio of old to the working age population, which captures the demographic effect given a constant population.

The empirical analysis uses a panel regression framework in differences. It finds that both real economic and demographic factors affect house prices significantly. One percent higher real GDP per capita corresponds to around one percent higher real house prices. Similarly, one percent higher population implies around one percent higher real house prices. Finally, one percent higher dependency ratio is associated with around 2/3 percent lower real house prices. The estimated demographic impacts on real house prices reflect the varying ageing processes countries experienced. For instance, the United States is estimated to have enjoyed around 80 basis points per annum demographic tailwinds between 1970 and 2009. Faster ageing countries, such as Germany or Japan, already experienced some headwinds.

The model estimates can be used along with UN (2008) population projections to estimate the future impact of ageing on real house prices. The analysis suggests that house prices will face substantial headwinds in the next forty years. Ageing headwinds will decrease United States real house prices by around 80 basis points per annum compared to neutral demographics. The effect is estimated to be much stronger in Europe and Japan. The results are somewhat larger than most of the existing literature, which found headwinds up to 100 basis points per annum.[3] However, the estimates are still short of the Mankiw and Weil's (1989) asset price meltdown projection, which would imply around 300 basis points per annum real house price decline.

These estimates are not real house price forecasts, but only estimates of the demographic impact on real house prices. As a number of other factors affect these prices, their movements can be very different from those implied by demographics. For instance, both Italy and Korea experienced strong real house price growth in spite of significant estimated demographic headwinds in the past forty years.

The results suggest that global asset prices are likely to face substantial demographic headwinds in the next forty years. The theory is straightforward: House prices are determined jointly with financial asset prices. Hence, if house prices face headwinds, so should financial asset prices. Using the estimated coefficients and global population forecasts, asset prices would face headwinds up to a full percentage point. This headwind is substantial, but based on historical returns would not imply real asset price declines.

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[3] Poterba (2001) found very small effects, while Yoo (1994) found 40; Poterba (2004) 50; Geanakoplos et al (2004) 60; and Brooks (2002) 100 basis points lower returns as a result of ageing in different setups.

Of course, these results need to be read with appropriate caveats. Long run projections, particularly demographic ones, can be mistaken. In Schumpeter's (1943) words: "Forecasts of future populations, from those of the seventeenth century on, were practically always wrong." For instance, public policy consensus expected falling birth rates and population decline even on the eve of the American and British baby boom as Keynes (1937) famous speech illustrates. Furthermore, even if ageing continues as expected currently, social change can affect the relationship between demographics and asset prices. These uncertainties along with the magnitude of ageing related asset prices changes suggest that more research is needed to guide public policy.

The remainder of the paper is organized as follows. The second section introduces the model. The third analyzes the data empirically. The fourth discusses the caveats and the implications for global asset prices. The final one concludes with policy implications.

2. Model

2.1. Benchmark model

Setup

A small overlapping generation model is set up with lifecycle. Identical agents live for two periods. Young agents work and have exogenous work income, but they need to save to consume in old age. Saving is done through a divisible fiat asset. The agents' utility function (U) can be written as follows:

$$U = \ln(c_t^Y) + \beta \ln(c_{t+1}^O) \tag{1}$$

where ln(.) is the natural logarithm, c^Y is consumption when young, and c^O is consumption when old, β is the discount factor and t is the time period index.

Agents maximize their utility function subject to the resource constraint:

$$c_t^Y + \frac{c_{t+1}^O}{1+r_t} \leq y_t^Y \tag{2}$$

ie consumption when young (c^Y) and the discounted value ($1/(1+r_t)$) of consumption when old (c^O) is weakly less than exogenous work income when young (y^Y). The interest rate (r_t) will be determined endogenously – and will describe asset price evolution.

Now, introduce asset markets. Agents trade the single, divisible and otherwise useless fiat asset (K), which is priced at p_t at time t. Young agents buy a_t share of the asset at unit price p_t. Hence, the budget constraint could be rewritten as follows:

$$y_t^Y = c_t^Y + p_t a_t \tag{3}$$

Using the fact that agents are identical, individual savings are equal to the per capita ($1/n_t$) value of assets (p_tK) in equilibrium. Hence, (3) can be rewritten as follows:

$$y_t^Y = c_t^Y + p_t \left(\frac{K}{n_t} \right) \tag{4}$$

where n_t denotes the size of the current generation.

Then at time $t+1$ the now old agents sell the asset at price p_{t+1} and use the proceeds for consumption:

$$c_{t+1}^{O} = p_{t+1}\left(\frac{K}{n_t}\right) = \frac{p_{t+1}}{p_t}\left(\frac{p_t K}{n_t}\right) = (1+r_t)\left(\frac{p_t K}{n_t}\right) \tag{5}$$

Equation (5) shows that old age consumption depends on initial savings (p_tK/n_t) and returns on these savings ($1+r_t$).

For notational ease, exogenous demographic growth (d_t) can be expressed as follows:

$$n_{t+1}^{Y} = (1+d_t)n_t^{Y} \tag{6}$$

Exogenous economic growth (g_t) rate can be expressed similarly:

$$y_{t+1}^{Y} = (1+g_t)y_t^{Y} \tag{7}$$

The standard transversality condition finalizes the description of the system:

$$\forall t : \frac{p_t K}{n_t} \le y_t$$

Solution

The benchmark model's solution is straightforward. Combining the first order condition:

$$c_{t+1}^{O} = \beta(1+r)c_t^{Y}$$

with the resource constraint (2) yields individual consumption when young:

$$c_t^{Y} = \frac{y_t^{Y}}{1+\beta} \tag{8}$$

In the next step equilibrium asset prices can be determined at time *t* by separately writing up individual savings and investments (equation 9). The left side shows savings when young as the difference between exogenous work income when young and consumption when young determined in equation (8). The right side shows investment when young as determined in equation (4):

$$y_t^{Y}\left(1-\frac{1}{1+\beta}\right) = \frac{p_t K}{n_t} \tag{9}$$

Similar steps can be used to determine the next period ($t+1$) saving and investment values when young:

$$y_{t+1}^{Y}\left(1-\frac{1}{1+\beta}\right) = \frac{p_{t+1} K}{n_{t+1}}$$

Using the demographic factor from equation (6) and the real economic factor from equation (7) yields:

$$y_t^{Y}(1+g_t)\left(1-\frac{1}{1+\beta}\right) = \frac{p_{t+1} K}{n_t(1+d_t)} \tag{10}$$

Dividing equation (10) by equation (9) determines asset price evolution in terms of real economic and demographic factors.

$$1+r_{t+1} = \frac{p_{t+1}}{p_t} = (1+g_t)(1+d_t) \tag{11}$$

The intuition is straightforward and it is linked to asset demand. Assets will be worth more if the next generation is wealthier or larger, because then this next generation will demand more assets to save for their own old age. The real economic factor captures the effect of wealth and the demographic factor the effect of generation size.

2.2. Extensions

To illustrate the benchmark model's robustness on asset price drivers, it is shown that real economic and demographic factors remain key asset price drivers under three alternative scenarios as well.

Constant elasticity of intertemporal substitution

The constant elasticity of intertemporal substitution (CES) provides a more realistic utility function to investigate intertemporal decisions. Recall that the utility function is as follows:

$$u(c) = \frac{c^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$$

Solving the model with CES utility function relies on similar steps as solving the benchmark model and it is left to the reader. The resulting asset price evolution is very similar to the benchmark model:

$$1+r_t = \frac{\left[1+\left((1+r_t)\beta\right)^{-\sigma}(1+r_t)\right]}{\left[1+\left((1+r_{t+1})\beta\right)^{-\sigma}(1+r_{t+1})\right]}(1+g_t)(1+d_t)$$

Asset returns remain function of real economic factors and demographic factors as in (11). However, in the CES setup agents also shift consumption intertemporally based on asset returns. Hence, if asset price returns are low, agents would respond by saving less and consuming more today. The larger the intertemporal elasticity (σ), ie the less agents prefer to smooth consumption, the more the results would deviate from that of the benchmark model. Nevertheless, aside from this consumption shifting, asset price returns are driven by real economic and demographic factors.

Housing utility

Housing provides utility and the benchmark model could be straightforwardly extended to include utility from asset ownership. Rewrite the utility function with housing consumption (h_t>0) also providing utility:

$$U = \ln(c_t^Y h_t) + \beta \ln(c_{t+1}^O)$$

The utility maximization is now subject to two, young and old age budget constraints. First, young age expenditure on non-housing consumption and housing is weakly smaller than work income at time *t*:

$$c_t^Y + h_t p_t \le y_t^Y$$

Note that p_t denotes the price of real housing unit here. Second old age non-housing consumption is financed by the selling of the housing unit at *t+1*:

$$c_{t+1}^O \le h_t p_{t+1}$$

Following the steps in the benchmark model, which are again left to the reader, the asset return conditions are as follows:

$$1+r_t = \left[\frac{1+\beta p_{t+1}}{1+\beta p_t} \frac{2+\beta p_t}{2+\beta p_{t+1}} \right] (1+g_t)(1+d_t)$$

Again, real economic growth and demographic factors remain key drivers of house price growth as in the benchmark model.

Social security

The model can also be extended to entail social security provision. Let's assume that S percent of working age individuals income is automatically transferred by the government to the current old. Furthermore, assume that this transfer is not fully sufficient for intended old age consumption, ie agents would want to have higher consumption in old age than what social security guarantees.

Following the steps of the benchmark model, first recognize that young age consumption remains unchanged as described in (8). This implies that only private savings (s_t) are affected:

$$s_t = \left(\frac{\beta}{1+\beta} - S \right) y_t^Y$$

Using the same steps, the next generation's private savings is given by:

$$s_{t+1} = \left(\frac{\beta}{1+\beta} - S \right) y_t^Y (1+g_t)$$

The ratio of the above two equations yields, as in the benchmark model, asset price returns:

$$r_{t+1} = \frac{p_{t+1}}{p_t} = \frac{s_{t+1} n_{t+1}}{s_t n_t} = \frac{\left(\frac{\beta}{1+\beta} - S \right) y_t^Y (1+g_t) n_t (1+d_t)}{\left(\frac{\beta}{1+\beta} - S \right) y_t^Y n_t} = (1+g_t)(1+d_t)$$

Under social security provision asset price evolution exactly follows the benchmark model. The intuition is straightforward: social security acts as an implicit investment and yields the same returns (based on demographic and economic factors) as fiat the asset.

2.3. Implications

According to the theoretical model real economic and demographic factors drive asset prices. As for the real economic factor, real GDP per capita provides a natural and straightforward measure. However, for robustness additional economic factors are also considered later.

The demographic factor in the model describes the size difference between two successive working age generations. This can be divided further into size and composition effects. First, total population captures the size effect, ie the demographic factor given unchanged age structure. If the age structure is unchanged, then larger current population implies that current asset buyers are more numerous than past asset buyers. Second, the old age dependency ratio, the ratio of old to working age population, captures the composition effect. If the population size does not change, the relative increase of old age cohort compared to working age cohort implies that the relative size of sellers compared to buyers increases. In sum, total population and old age dependency ratio capture together the demographic factor.

3. Empirical analysis

3.1. Data

The empirical analysis uses real housing price data compiled by the Bank for International Settlements (BIS) from national data. The database covers 22 advanced economies between 1970 and 2009: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United States, and the United Kingdom.

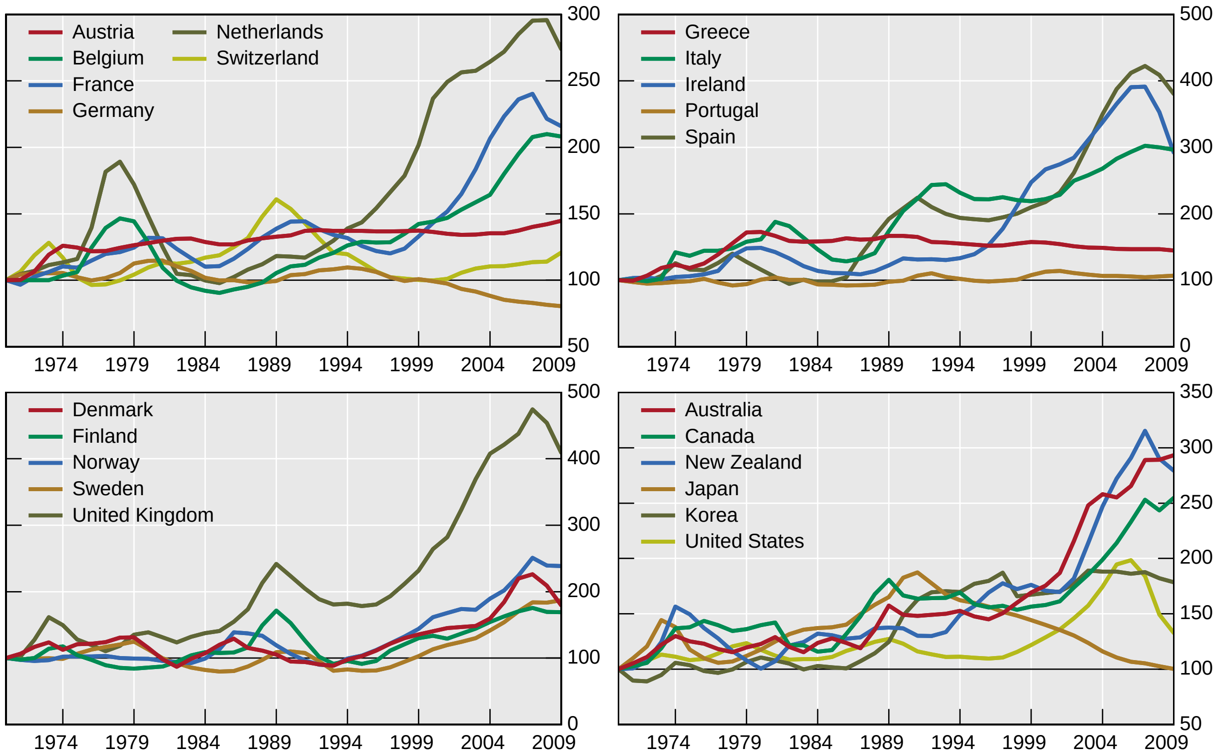
The real house price database shows high level of heterogeneity (Graph 2). Economies are grouped geographically: Central Europe (upper left panel), European Periphery (upper right panel), Northern Europe (lower left panel) and Non-European economies (lower right panel). Apparent heterogeneity, both across and within regions, is useful for identification.

In many cases house price evolution seems to be consistent with the theoretical projections. Some well-known ageing countries, such as Germany, Japan or Switzerland, experienced smaller price gains than the average. On the other hand, relatively young and fast growing economies, such as Australia, Canada or New Zealand, have seen massive price increases. However, the graph also suggests that there are exceptions. For instance, fast ageing Italy and Korea has also experienced robust price growth. Hence, regression analysis is needed to identify the impact of economic and demographic factors on real house prices.

Graph 2

Real house prices in advanced economies

1970 = 100



Source: BIS data.

Historical and projected demographic data, such as old age dependency ratio and population size, are taken from the UN Population Database (2008). The IMF WEO and IFS database is used for real GDP per capita data.

3.2. Panel regression

The panel regression analysis explains real house price evolution using the three variables identified in the theoretical section (Table 1). Real GDP per capita is used for the economic factor. Old age dependency ratio and total population are used for the demographic factor.

The regression is run on differences and not on levels due to concerns on trending variables and unit root. In fact, the variables seem to be difference stationary, ie exhibit unit roots in levels, but not in differences. The details of unit root testing are shown in Table A1 and A2 in the appendix. Time fixed effects are used to capture unobserved global common factors, such as monetary policy settings or supply shocks.[4]

The panel regression analysis confirms that economic and demographic factors affect real house prices significantly (Table 1). Despite the weakening effect of differencing, all independent variables are significant. Real GDP per capita and old age dependency are significant at 1 percent level, while total population at 10 percent level. The sign of the coefficients is right and their size is reasonable. The coefficients are interpreted as elasticities, as the regression is on log differences. The elasticity of real house prices with respect to real GDP per capita and total population is around unity, ie one percent higher real GDP per capita or total population implies one percent higher real house prices. The elasticity of old age dependency ratio is negative, one percent higher old age dependency ratio implies around 2/3 percent lower real house prices.

Table 1

Real house prices

Benchmark model

	Observa-tions	R-squared	Real GDP/capita	Total population	Old age dependency
Benchmark model	176	0.42	1.0017*** (5.26)	0.9984* (1.81)	-0.6625*** (-3.19)

*, **, *** coefficient significant at 10, 5, and 1 percent significance level, respectively. In parenthesis t-statistics.

Panel regression in log-differences. Data from 22 advanced countries over 1970 and 2009. Five year interval data with a constant, and fixed time effects. Using end-2009 data for 2010. Dependent variable: difference in logged real house prices. Independent variables: differences in logged real GDP per capita, old age dependency ratio (old age population / working age population) and total population.

Sources: Bank for International Settlements, United Nations Population Projections, IMF WEO and IFS

Note that the benchmark model does not include long run interest rates due to endogeneity concerns. Many studies which aim to estimate equilibrium house prices, such as the IMF WEO (2008), rely on long run interest rates. Indeed, it would seem logical that house price evaluation – as any discounted cash flow based asset price valuation – would be linked to the long run interest rate. However, if ageing drives asset prices, then in equilibrium ageing should also drive the ex-ante long run real interest rate. Hence, the regression would measure the impact of ageing directly through the demographic factors and also indirectly through long term interest rates. This would in principle bias the results. Nevertheless, the question of long run interest rate is investigated in the sensitivity analysis.

[4] Country fixed effects are not used because differencing already removes any level effects. Furthermore, given that ageing is very slow moving (for each country there is essentially one ageing process), country fixed effects in differences could easily assume the impact of ageing.

The coefficient estimates are not only significant, but also very robust to various changes to the specification (Table 2). As discussed before, long run interest rates are often used in house pricing models. Including them the estimates does not change the coefficient estimates much (M4). Similarly, adding short run interest rates (M5), equity prices indices (M6) or inflation (M7) does not change much the three key coefficient estimates. Neither restricting the sample period (M8-10) affects the results substantially. The demographic coefficients are also robust for using lagged GDP (M11) and omitting the time fixed effect (M12). Furthermore, restricting the sample to exclude any given individual country does not change the results materially. In sum, the results seem to be robust to a large number of changes to the model specification.

Table 2

Real house prices

Sensitivity analysis

Models	Observa-tions	R-squared	Real GDP/capita	Total population	Old age dependency
M1	176	0.36	0.9931***		
M2	176	0.38	0.9536***	1.2074**	
M3	176	0.40	1.0371***		-0.7069***
Benchmark model	**176**	**0.42**	**1.0017*** **	0.9984*	**-0.6625*** **
M4 (long rates)	168	0.48	1.1458***	1.0482*	-0.6765***
M5 (short rates)	164	0.47	1.1113***	1.3047**	-0.6965***
M6 (share price)	161	0.47	1.1960***	1.1897**	-0.7078***
M7 (inflation)	176	0.42	0.9981***	1.0788**	-0.6562***
M8 (1970-2005)	154	0.43	0.9858***	1.1897**	-0.6946***
M9 (1980-2010)	154	0.45	1.1711***	1.1192*	-0.7435***
M10 (1990-2010)	110	0.47	1.2317***	1.1207	-0.8099***
M11 (lagged GDP)	154	0.33	0.1897 1)	1.2757*	-0.6396***
M12 (no fixed effect)	176	0.21	1.0773***	1.1321*	-0.5100***

*, **, *** coefficient significant at 10, 5, and 1 percent significance level, respectively.

Panel regression in log-differences as in Table 1. Additional dependent variables: M4: differences in long term (10 year) interest rates, M5: differences in the short term interest rates, M6: log differences in the equity index, M7: log-differences in the price index, M8-10: restricting the sample period as indicated, M11: using five year lagged GDP per capita, M12: not using time fixed effects. Note 1) Real GDP per capita lagged five years.

Sources: Bank for International Settlements, United Nations Population Projections, IMF WEO and IFS

3.3. Demographic impact

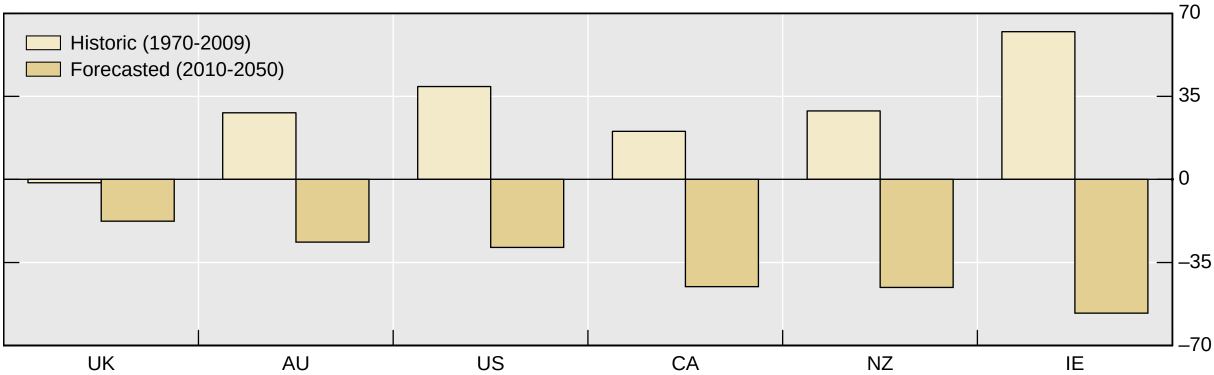
The benchmark model's demographics coefficients can be used to characterize both the historic and projected demographic impact on house prices. The demographic component of past price changes can be calculated directly. The UN (2008) population projections can be used together with the model coefficients to estimate the demographic impact on house prices up until 2050.

In English speaking countries it seems that baby boomer purchases drove up house prices in the past, while their sales will drive real house prices down in the future (Graph 3). In the past forty years, these economies have experienced the positive impact of ageing. As baby boomers reached working age and started buying housing, they pushed up property prices. According to the estimates, the baby boom generation increased real house prices by around 40 percent in the United States compared to neutral demographics in the past forty years. This corresponds to around 80 basis points per annum demographic tailwinds. Estimated demographic tailwinds were substantial for most other English speaking countries as well except for the United Kingdom.

Graph 3

Demographic impact on housing

English speaking countries (percent)



AU = Australia; CA = Canada; UK = the United Kingdom; IE = Ireland; NZ = New Zealand; US = the United States.

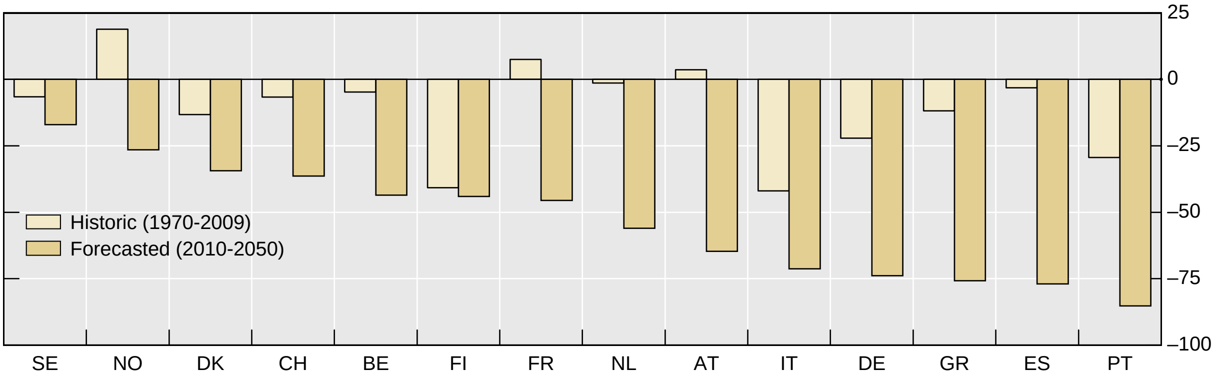
Source: Author's calculations.

However, these economies are projected to experience the negative impact of ageing from 2010 onwards. As baby boomers age, they would reduce their housing stock – and thereby depress prices. The estimates suggest that demographic factors would reduce US housing prices by around 30 percent compared to neutral demographics in the next forty years. This corresponds to around 80 basis points per annum demographic headwinds. Other English speaking countries would face similar headwinds. Again demographic effects seem to be the most moderated in the United Kingdom.

Graph 4

Demographic impact on housing

Continental Europe (percent)



AT = Austria; BE = Belgium; CH = Switzerland; DE = Germany; DK = Denmark; ES = Spain; FI = Finland; FR = France; GR = Greece; IT = Italy; NL = Netherlands; NO = Norway; PT = Portugal; SE = Sweden.

Source: Author's calculations.

The estimates suggest that demographic headwinds arrived earlier to continental European economies than to English speaking countries (Graph 4). In fact, over the past forty years most continental European economies faced demographic headwinds. For instance, demographic factors reduced house prices ceteris paribus by around 20 percent in Germany (around 60 basis points p.a. headwind) and around 40 percent in Italy (130 basis points p.a. headwind). Even the largest estimated tailwind of 40 basis points p.a. of Norway is only around half of the corresponding US figure.

Looking ahead, the projected future demographic headwinds are also stronger in continental Europe than in English speaking countries. The unweighted average impact is around 50 percent marginal decrease (around 200 basis points p.a. headwinds). Germany and Italy are estimated to face headwinds around 300 basis points. The forecasted declines are even stronger for fast ageing Japan and Korea.

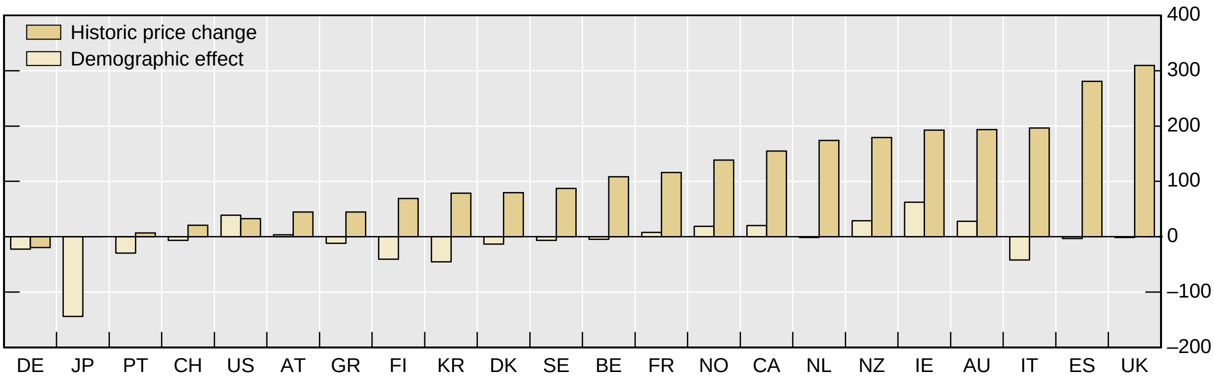
Though some of these headwind estimates are very large, it must be emphasized that they are marginal demographic impact estimates and not absolute house price change estimates. Hence, they are not directly comparable to the absolute asset price meltdown forecasted in Mankiw and Weil (1989).

House prices can grow substantially in spite of strong demographic tailwinds (Graph 5). Some country examples are especially instructive. The United Kingdom experienced one of the highest price gains in spite of the tiny negative demographic contribution. Italy and Korea enjoyed strong house price growth in spite of substantial demographic headwinds. This illustrates the strong role of other, non-demographic factors. In particular, the graph shows that demographic headwinds do not necessarily translate into real house price declines.

Graph 5

Real house prices change and demographic impact

1970-2009 (percent)



AT = Austria; AU = Australia; BE = Belgium; CA = Canada; CH = Switzerland; DE = Germany; DK = Denmark; ES = Spain; FI = Finland; FR = France; GR = Greece; IE = Ireland; IT = Italy; JP = Japan; KR = Korea; NL = Netherlands; NO = Norway; NZ = New Zealand; PT = Portugal; SE = Sweden; UK = the United Kingdom; US = the United States.

Source: Author's calculations

In sum, the estimates suggest that real house prices will face substantial headwinds over the next forty years due to ageing. Though the results do not imply absolute real price declines, they suggest that in the next forty years house prices in advanced economies will face a more difficult environment than in the past forty years.

4. Discussion

4.1. Caveats

The results and especially the projections are subject to a number of caveats, which need to be considered explicitly. Obviously, heterogeneity should be a general concern given the size of the panel. Even if differencing in the panel regression can address many issues, individual country estimates are unlikely to reflect all the specifics.

Changes in housing market structures also imply that results need to be interpreted with care. For instance, Gleaser et al (2004) discuss how housing construction faces increasing supply constraints in the United States, especially on the coasts. This implies that responsiveness to the identified demand variables (such as our economic and demographic factors) grew over time there. Other countries might have experienced different trends, which suggest that country specific and short run estimates should be treated cautiously.

Similar problem arise as lifestyle changes affect the link between demographics and real house prices. Average household size declined in many countries as marriage and cohabitation starts later in life and divorce happens more often. Though smaller households require smaller homes than larger one, the decline in household size would still imply higher housing demand due to economies of scales in housing. Similar lifestyle changes, such as increasing preference for second houses, could also have affected the results.

The above issues identified for the historical impact estimates are also relevant for projections. Heterogeneity suggests caution on individual country projections. Construction constraints and lifestyles are also likely to evolve in the future. In addition, projections are also subject to further caveats.

Most importantly, long run projections and estimates should be treated very cautiously as their track record is dismal. Technology and economic relationships can and do change often with complex and unforeseen second round effects. Even demographic trends can change unexpectedly and the current consensus on ageing might prove to be wrong. True, demography has a very strong momentum, in Drucker's (2003) words it is "the future that has already happened". However, it is not written into stone. For instance, both the American and British baby boom was largely unexpected. The prevailing consensus, expressed in Keynes (1937) and Schumpeter (1943), expected low and falling birthrates on the eve of the boom.

In addition, the projected scale of ageing is unprecedented suggesting caveats on extrapolating current trends. Even if ageing happens along the current consensus, economic relationships which held in a moderately ageing environment might break down - or intensify.

Furthermore, there are two ongoing economic trends which are likely to affect the estimated impact of ageing on asset prices in the opposite direction. First, advances in technology and health are likely extend working age and redefine old age in the future. Though the analysis treats everybody over 65 years as old, working age could be extended in the future, as workers remain healthy longer and physically demanding jobs are replaced by more knowledge intensive jobs. This would mitigate the negative impact of ageing on asset prices.

Second, old age entitlement, such as pensions and health care benefits, are likely to be cut in most advanced economies. Private corporations, facing intense competitive pressures, have already phased out of defined benefit pension plans – and replaced them with much less generous defined contribution systems (Willett, 2010). In the government sector ageing related entitlement spending is currently set on an unsustainable path as Cecchetti et al. (2010) shows. Hence, lowering old age government benefits seems to be inevitable. Consequently, the next old generation might have to run down their assets in old age more aggressively than previous old generations as their private and public entitlements would be much less generous. This would exacerbate the negative impact of ageing on asset prices.

4.2. Asset price implications

The results can be used to think about the wider implications for asset prices. Asset prices are determined jointly, hence, the results in real house prices have implications for financial asset prices. Ageing affects the cost of shifting consumption from the present to the long term future, ie the long term, ex-ante real interest rate. Combined with inflationary expectations the long term, ex-ante real rates set long term bond yields. Bond yields in turn determine equity prices through setting the discount factor for future dividend streams. Finally, bond yields also affect house prices. They determine affordability, by setting the monthly mortgage payment; and also underlying value, by setting the discount rate for the future implicit rent stream.

The joint determination of asset prices implies that the impact of ageing, identified in real house prices, should also surface in financial asset prices as well. However, the mapping between real house and financial assets is not linear. There are three major differences between the pricing mechanisms which need to be considered:

First, financial assets are purchased later in life and sold earlier than housing assets. The difference seems to arise from the different nature of these assets. Financial assets are purely investment goods, whereas housing is both consumption and investment good. Consumption motives, such as housing needs of family formation, often affect housing purchases – and are absent in financial asset investment. Typically, housing assets are bought earlier and run down later in life than financial assets as Yang (2009) documents. Given these lifecycle differences demographic factors would affect financial assets later in the upside and earlier in the downside.

Second, financial asset ownership are much more concentrated than that of housing assets. Differences in asset concentration have implications for old age asset run-down. Wealthier individuals are much less pressed to run down their asset holdings than less affluent ones in order to finance old age consumption. Hence, ownership concentration implies that financial asset prices might be less responsive to ageing related pressures than real house prices.

Finally, financial assets prices are more driven by global than local demographics. Purchasing property is a local affair, while financial investment is globalized. Hence, global demographics, weighted by purchasing power, are relevant for financial assets. As the world is ageing slower than advanced economies, global financial assets might face smaller downward pressure than advanced country house prices. However, emerging economies are also ageing fast, in the case of China and Central Europe faster than the United States. Hence, any “global solution” (Siegel, 2005) depends crucially on the currently poor young regions: Africa, the Arab world and the Indian subcontinent.

In sum, the impact of ageing on financial assets is similar to housing, but (i) it might arise earlier, (ii) it could be somewhat weaker, and (iii) it is affected by global ageing patterns.

Combining global ageing forecasts and the model coefficients suggests that financial assets prices would face around a full percentage point per annum demographic headwinds over the next forty years. This headwind estimate is subject to both upside and downside risks. On the upside, asset concentration implies that ageing affects financial asset prices less than real house prices, which would mitigate the headwinds. On the downside, the relative poverty of younger regions implies that headwinds could be much stronger as the young regions’ asset demand would be relatively weak. Finally, the demographic drag in financial asset prices could arise somewhat earlier than in real house prices due to lifecycle pattern differences.

In a historic context, this asset price impact would be large, but would not imply long term real asset price declines, not to mention asset meltdowns. The United States stock market has averaged an annual real return of 6.8 percent between 1802 and 2006 (Siegel, 2008). Shaving off around one percentage point from this return would be substantial, but does not seem to have catastrophic implications.

5. Conclusion

Economic theory suggests that ageing affects asset prices negatively. As ageing economies account for the overwhelming majority of global investable assets, the question arises naturally: What will happen to asset prices?

The paper aims to answer this question. The impact of ageing is identified using house price data from 22 advanced economies between 1970 and 2009. The results suggest that ageing will lower real house prices compared to neutral demographics over the next forty years in all countries in the sample. The estimated ageing impact is relatively mild in the United States with around 80 basis points per annum headwinds. The drag is estimated to be much larger in most of continental Europe and in Japan. This finding is at the high end of earlier empirical estimates, but does not constitute an asset price meltdown. It is important to reiterate that the findings do not imply absolute real house price declines, as real house prices are affected by many other factors which could well compensate for the demographic headwinds.

Given that financial asset are priced in equilibrium with housing markets, the headwinds estimated on real housing prices are likely to affect the returns on financial assets as well. Estimating the exact effects is not trivial and should be subject to further research. Yet, it seems that headwinds as high as a full percentage point per annum are possible over the next forty years. Again, this headwind would be significant, but would not imply any asset price meltdown.

These asset price headwinds suggest that private and public pension systems are very similarly challenged by ageing. Public, pay-as-you-go pension system benefits are becoming increasingly unsustainable as fewer workers are supposed to support increased number of retirees in the near future. This paper highlights that private pension schemes face very similar challenges as ageing reduces asset prices. This is not very surprising, if we view different pension systems as different means for the same goal: intertemporal consumption shifting. Pay-as-you-go systems shift consumption by legal mandate. Private pension funds undertake the same shift by voluntary asset transactions. The challenges are similar if the next generation is relatively smaller. Public pay-as-you-go systems will not find enough net contributors, while private pension funds will not find enough buyers for their accumulated assets. This implies that privatizing pension provision might not be the panacea for ageing related challenges.

Asset price headwinds could also be relevant when thinking about financial stability. Advanced economies, households, private institutions and the public, have accumulated substantial debt in the past few years. The results of the paper suggest that the assets financed by this debt could come under long run pressure. In particular, long run asset price headwinds could complicate the unwinding of leveraged financial positions. As for the future, this possibility suggests continued vigilance against the further build up of such positions.

Furthermore, the results are also relevant when thinking about government debt sustainability. Two ageing related effects on government fiscal positions are well-understood. First, ageing will increase government expenditures, especially pension and health care spending. Second, ageing will slow economic growth as labor supply growth slows and in many cases reverses. Both of these factors will exacerbate government debt sustainability challenges. This paper highlights a third negative effect. Lower asset prices imply that long run interest rates will face upward pressure in the future. These higher long term interest rates would make debt sustainability even more challenging.

In sum, this paper found that ageing is likely to affect future asset prices substantially negatively, though asset price declines, let alone a meltdown, are unlikely. The impact seems to be strong enough to think about its implications in pension provision, financial stability and government debt sustainability.

Appendix

Unit root tests

The panel series seem to have unit root in levels as Table A1 shows.

Table A1

Unit root tests for levels

Probabilities

Tests	House prices	Real GDP per capita	Old age dependency	Total population
Levin, Lin & Chu t*	1.0000	1.0000	0.0003	0.0000
Im, Pesaran and Shin W-stat	1.0000	1.0000	0.9898	0.9611
ADF - Fisher Chi-square	0.9981	1.0000	0.9966	0.9556
PP - Fisher Chi-square	1.0000	1.0000	1.0000	0.0000

Null hypothesis is that the process has unit root.

Sources: United Nations Population Projections, Worldbank, IMF WEO and IFS, and national data

However, the unit root disappears in first differences as Table A2 details.

Table A2

Unit root tests for differences

Probabilities

Tests	House prices	Real GDP per capita	Old age dependency	Total population
Levin, Lin & Chu t*	0.0000	0.0096	0.0000	0.0000
Im, Pesaran and Shin W-stat	0.0203	0.0044	0.0005	0.0006
ADF - Fisher Chi-square	0.0011	0.0020	0.0001	0.0005
PP - Fisher Chi-square	0.0000	0.0000	0.7847	0.9035

Null hypothesis is that the process has unit root.

Sources: United Nations Population Projections, Worldbank, IMF WEO and IFS, and national data

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