Wealth-Age Dynamics, the Housing Cycle and the Recession in Spain

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Abstract

Between 1999 and 2007, Spain experienced a pronounced housing boom, with real house prices doubling over the period. The bubble burst in 2007, triggering a five-year recession during which the median income of working-age households fell by 30% below its pre-crisis trend. Concurrently, the wealth-age distribution shifted significantly in favor of older and middle-aged cohorts. To analyze the heterogeneous effects of the housing cycle and recession-induced income losses on household wealth and welfare across cohorts, I develop a quantitative overlapping-generations model with heterogeneous agents, portfolio choice between housing and financial assets, and house price uncertainty. The model shows that the aggregate shocks of the period generated substantial welfare disparities: younger households experienced losses of up to 30% in consumption-equivalent terms, while older cohorts gained by as much as 30%. These shocks explain roughly one-third of the observed rise in intergenerational wealth inequality between 2002 and 2020.

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1 Introduction

At the turn of the millennium, Spain entered an exceptionally large housing cycle, during which housing prices nearly doubled between 1999 and 2008 before sharply reverting to trend in the 2008–2014 period. The collapse of the housing boom coincided with a prolonged recession lasting until 2013, which reduced working-age households' incomes by roughly 30% relative to the pre-recession trend. Over this time, the Spanish wealth–age profile underwent a profound transformation: in 2002, the median household aged 70–79 held about 25% less wealth than a household in its 40s, and those aged 60–69 were about 10% poorer. By 2014, however, the median 70–79 and 60–69 households had become approximately 50% and 110% wealthier than their 40–49-year-old counterparts, respectively.

This paper seeks to connect these two developments, investigating how and to what extent the macroeconomic shocks of this period contributed to the shift in the wealth–age distribution and shaped household welfare across cohorts.

The paper shows that both the recession and the housing cycle affected younger and older households in markedly different ways. First, while the median income of workers declined by roughly 30% below its trend during the recession, retirees' median income remained largely unaffected. Second, the analysis highlights two main channels through which younger households are particularly vulnerable to housing cycles. The first is related to housing market participation: younger households are typically buyers, while older ones tend to remain in their homes. As a result, the young risk purchasing overvalued properties, whereas the elderly may benefit from higher asset valuations when leaving bequests. The second channel operates through differences in portfolio composition. Younger households typically finance home purchases with mortgage debt, which leaves them heavily concentrated in housing assets and thus more exposed to house price fluctuations. A particularly adverse scenario for them arises when they acquire expensive homes during a boom, only to face collapsing house prices a few years later while their debt obligations remain unchanged.

To assess the extent to which the housing cycle and recession-induced income losses contributed to the rise in intergenerational wealth inequality, an overlapping generations (OLG) model with heterogeneous agents is developed. The model features portfolio choice between two assets—a financial asset and housing—along with income and house price uncertainty. The calibration strategy accounts for the non-stationary nature of the 2002 environment: the 2002 wealth data distribution is first discretized, and the model is then simulated forward to 2014, targeting key moments from the 2014 wealth distribution and observed transition rates over the intervening years.

To assess whether the changes in the wealth–age profile were driven by the housing cycle and the recession-induced income losses among working-age households, a counterfactual simulation is conducted in which none of the aggregate shocks take place. The model results indicate that, by 2020, roughly one-third of the increase in intergenerational wealth inequality can be attributed to the macroeconomic shocks of the period, while the remaining share stems from initial conditions in 2002, reflecting pre-existing cohort heterogeneity. A further decomposition reveals that the housing cycle played the dominant role in shaping the evolution of intergenerational wealth inequality.

The analysis then explores whether the observed changes in wealth also translated into welfare effects. The results indicate that welfare impacts were substantial and highly heterogeneous: younger households experienced losses of up to 30%, while older households enjoyed gains of comparable magnitude in consumption-equivalent terms. The welfare gains among the elderly stem primarily from the joy derived from leaving high-valued bequests, rather than from selling properties to finance higher consumption. In contrast, the welfare losses of younger households are driven by reductions in both consumption and housing size, initially due to high housing prices and subsequently as a result of recession-induced income declines, particularly among leveraged homeowners. Overall, the largest welfare losses were borne by cohorts that transitioned from renting to homeownership during the housing boom.

Finally, the analysis reveals that the welfare effects of macroeconomic shocks were heterogeneous not only across cohorts but also within them. The timing of households' housing decisions depends not solely on house prices but also on factors such as household formation dynamics, which are modeled in reduced form through a mobility taste shock. The results show that a difference of merely two years in the timing of home purchase can generate persistent disparities—lasting over a decade—in both housing size and consumption for households that transitioned to homeownership during the boom. Specifically, those who purchased at the peak of the cycle faced reductions of around 10% in housing size and 7% in consumption relative to otherwise similar households who bought earlier.

Overall, the paper argues that cohort luck—or the lack thereof— has had a profound impact on the wealth and welfare of Spain's younger households. It highlights the central role of housing in shaping these outcomes: housing cycles disproportionately affect younger cohorts because they are both in the process of accumulating housing assets and doing so through leverage. This combination amplifies the adverse effects of recession-induced income losses that typically follow the collapse of housing booms.

2 Literature Review

The paper contributes to 3 strands of the literature. First, it complements the literature that examines cohort effects of house price movements such that Glover et al. (2020), Fagereng et al. (2022),Kaplan et al. (2020). Fagereng et al. (2022) use administrative data of housing transactions from Norway and employ a sufficient statistic approach to uncover welfare gains and losses from the rise of house prices. Among their findings, it is that the young mostly lose in terms of welfare gains from rising house prices, while the old benefit. The closest paper is perhaps Glover et al. (2020) who employ a heterogenous agents model to quantify welfare effects from the house price collapse in and the great recession that ensued in the US in 2007. They find that older households lose the most from the collapsing house prices movement, while the young benefit as they will buy cheaper in the future. Young households, however, take a big hit from the recession. I contribute to this literature by evaluating the welfare effects of an entire housing cycle and not only of one-directional house price movements. It turns out that housing cycles yield losses for the young and benefit the elders. On top of that, I provide a mechanism through which the housing cycle in Spain can be associated with the significant and rapid changes in the wealth-age profile, leading to elders becoming richer relative to the young. Kaplan et al. (2020) also employ an OLG heterogeneous agents model to build a theory of a sentiment-driven housing cycle in the US, but they do not evaluate the effects of the cycle on the wealth-age profile and the welfare of the agents. Notice that a dimension distinguishing Spain from the US is that homeownership is much more widespread in Spain (about 80% in Spain in 2002 vs 60% in US in 2001, (SCF)), potentially amplifying the welfare effects.

Second. the paper adds to the literature that examines the heterogeneous effects of the housing cycle and the recession in Spain, which includes Ferreira et al. (2023), Martínez-Toledano (2020),Martinez-Toledano et al. (2019), Arellano et al. (2022), Erosa et al. (2025). Ferreira et al. (2023) employ an OLG model with non-linear income dynamics and a credit tightening shock to account for changes in consumption, debt and tenure changes after the housing burst in Spain. Martínez-Toledano (2020) finds that rich households were able to adjust their portfolio more than poorer households when the housing bubble burst, and Martinez-Toledano et al. (2019) report, among other results, that during the crisis intergenerational income and wealth inequality increased. Arellano et al. (2022), using administrative data, document that young workers were more exposed to income risk during the period 2005-2017. Erosa et al. (2025) also look at the recession in Spain and build a heterogeneous agents model with human capital accumulation to evaluate the income and welfare losses of young workers. The current paper adds to this literature by examining the entire housing cycle and the recession in Spain simultaneously & evaluating their contributions to the wealth-age profile & and on welfare of cohorts.

Lastly, there is a nascent literature that documents that households and individuals face heterogenous returns on wealth and documents their role in shaping wealth inequality and wealth dynamics, including Gabaix et al. (2016), Gabaix et al. (2016), Cioffi (2021). Gabaix et al. (2016) shows that returns heterogeneity is necessary to induce movements in wealth as fast as in the data, and **?** & **?** show that models featuring heterogeneous returns can match the extreme concentration of wealth observed in the US. Cioffi (2021) argues that the rise of wealth concentration could well be an effect of mere luck in asset returns realizations, like stock market returns. In this paper, although I abstract from idiosyncratic returns risk within each asset class, returns heterogeneity is generated through differences in the portfolio composition. It has a particular age dimension because young people take mortgages to finance their home purchases and have to repay these mortgages before retirement.

3 Data

Most of the analysis is based on the cross-sectional dimension of the household wealth survey Encuesta Financiera de las Familias (EFF). The survey is similar to the SCF and forms part of the HFCS (Household Finance and Consumption Survey) in Europe. The first wave was in 2002, and the survey is triennial, with the last wave having been conducted in 2020. As the SCF does, the EFF provides detailed information on the households' financial position and income. The micro-level data will be supplemented by aggregate data on GDP and interest rates available from the Bank of Spain, as well as the house price index provided by Taylor et al. (2018).

In this section, I briefly review the major economic events that shaped the Spanish economy from the 1990s to 2014 and present some key facts that document that the recession and the housing cycle have had heterogeneous effects across cohorts in Spain. I also document that during the 2002-2014 period, covered by the survey, the older households became richer relative to the young. Performing a data-accounting exercises I show that most of the wealth movements for the elders are due to hold-out gains, while active savings are important for the young.

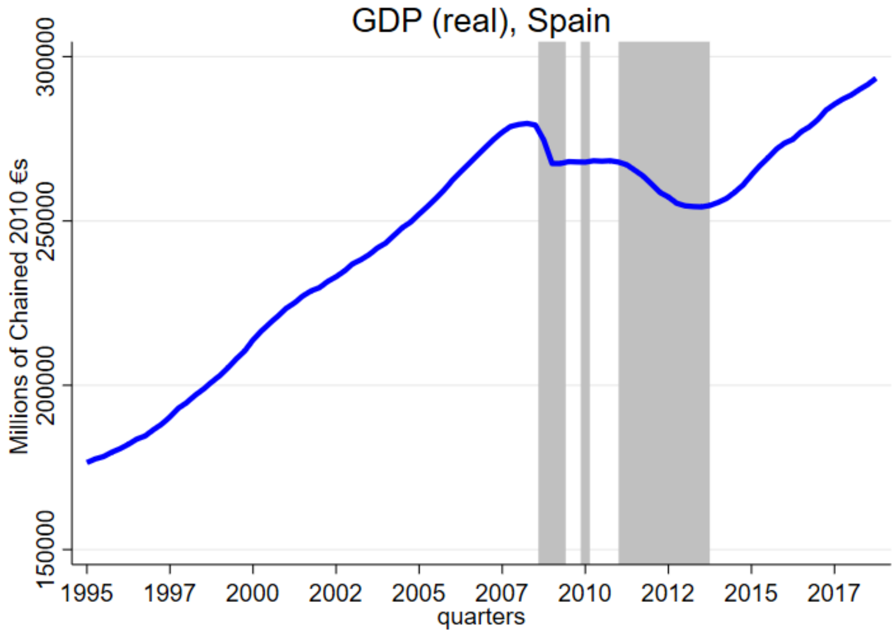


Figure 1: Spain's Real GDP
Spain's real gdp (quarterly, seasonally adjusted) in 2010 constant prices. The shaded areas correspond to recessions defined as "two consecutive quarters of negative growth"

3.1 Heterogeneous exposure to Recession and Housing Cycle across cohorts

Spain faced a severe and protracted recession lasting from 2008 until 2013. According to EFF income data, the burden of this crisis was not shared equally across age groups. The income of retirees was largely unaffected, continuing to grow along its pre-crisis trend. In stark contrast, working-age households experienced a major blow to their labor income, which by 2014 had stagnated at a level 30% below the pre-crisis trend (Figure 2). This income loss proved to be permanent through the last wave of the survey, causing the incomes of workers and retirees to converge.

The second seismic event during these years was a dramatic housing cycle. From 1999 to 2007, real house prices in Spain rose by approximately 100%, only to collapse over the following seven years (Figure 3). The Spanish population is particularly exposed to housing price volatility. This is due to a widespread homeownership rate of around 80% and an ex-

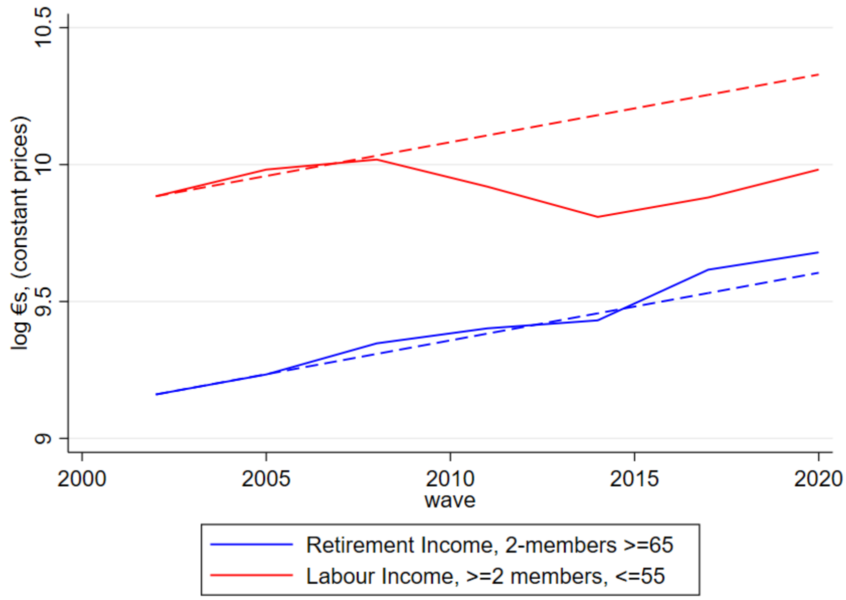
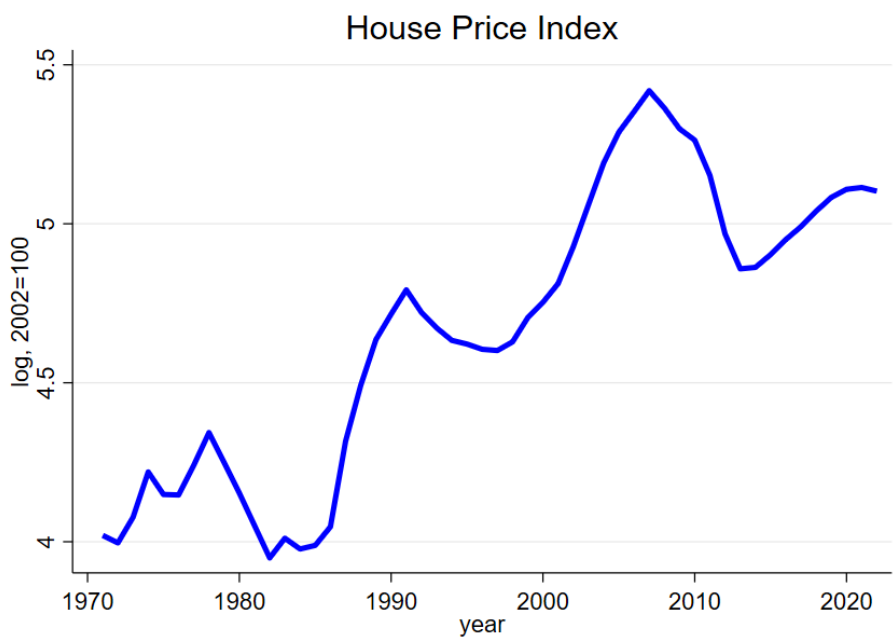


Figure 2: Labour and Retirement Income against the pre-crisis trend

labor income is defined as the sum of wage income, 2/3 of self-employment income and unemployment benefits. Dashed lines correspond to the precrisis (2.5%) trend

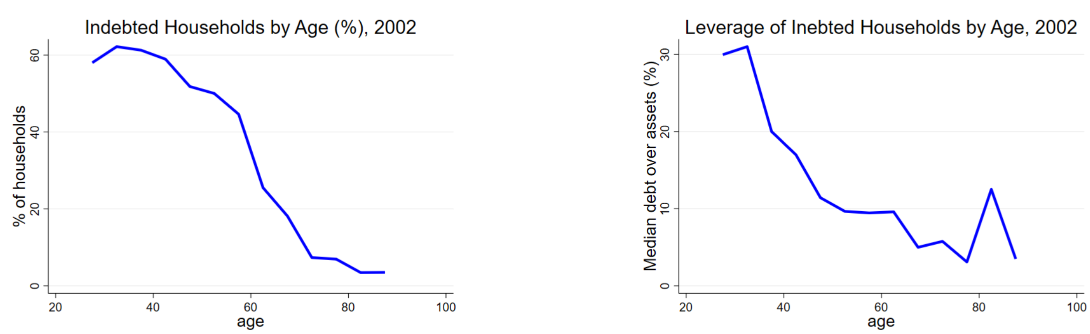
ceptionally high allocation of household wealth to real estate; in 2002, the median household held about 85% of its assets in property.

However, the impact of these house price movements is not uniform; it affects young and old households very differently. Firstly, their position in the market differs: young households are typically accumulating housing and lose out from high prices, whereas older households may be downsizing or selling, thus benefiting from them. Secondly, and more importantly, their leverage profiles are distinct. Young households finance home purchases with mortgages, resulting in higher debt levels. In 2002, 60% of those aged 30-39 were indebted, compared to less than 10% of those aged 70-79 (Figure 4a). The young were also more heavily indebted, with median leverage ratios above 20% (Figure 4b). Consequently, because they are more leveraged, the wealth of young households is far more sensitive to swings in house prices.



0.5

Figure 3: Real House Prices
The house price index is taken from BIS [1]



(a) Share of households having debtb by age,2002

(b) Median Leverage by age, 2002

Figure 4: Debt and Leverage across age

3.2 Wealth Shift in favor of the Old

During this period, the EFF data reveal a striking shift of wealth towards older households.

To examine the evolution of intergenerational wealth inequality, households are grouped into 10-year age groups, and the median net worth is computed for each age bin. These medians are then normalized by the median net worth of the 40–49 age group, yielding ratios that indicate how much richer—or poorer—the median household in each age bin is compared with the median 40–49-year-old household.

The results, plotted in Figure 5, reveal a pronounced widening of intergenerational wealth disparities over the survey years. In 2002, the median 70–79-year-old household held roughly 25% less wealth than the median 40–49-year-old household; by 2014, it possessed about 50% more. Likewise, the median 60–69-year-old household, which had been 10% poorer than the 40–49 group in 2002, became over twice as wealthy by 2014. The overall wealth–age profile clearly shifted toward older cohorts. Because these developments coincided with the housing boom and subsequent recession, it is crucial to assess the extent to which these macroeconomic dynamics contributed to the observed redistribution.

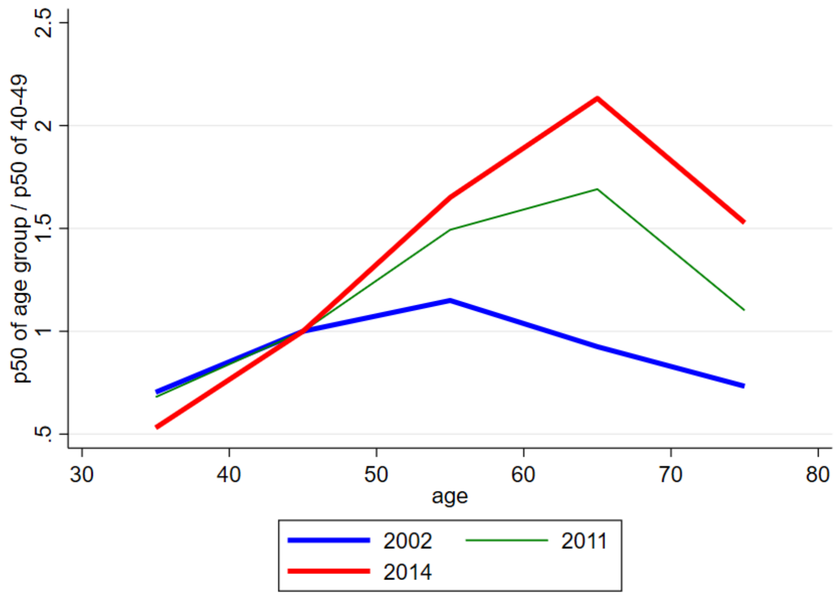


Figure 5: Intergenerational Wealth Inequality

Note: The graph plots the median wealth of 10-years age groups normalized by the median wealth of age group 40-49 for years 2002,2011,2014

3.3 Wealth changes and Holding gains

Because roughly 80% of Spanish households' portfolios consist of housing, housing mobility rates offer a useful proxy for savings behavior over 2002–2014. Standard life-cycle models predict that households accumulate housing when young and divest when old. The survey reports the year of property acquisition, whether properties were purchased or inherited, and whether any property was sold in the year preceding the interview.[2] While this information does not reveal whether a simultaneous sale and purchase reflects upsizing or downsizing, it is informative about the frequency of market participation.

Figure 6a illustrates the proportion of households in 2014 that owned real estate acquired after 2002, distinguishing between purchases made during the boom, the bust, or through inheritance, across 10-year age brackets. In 2014, 59% of households aged 30–39 and 50% of those aged 40–49 owned a property acquired after 2002, compared with only 15% among

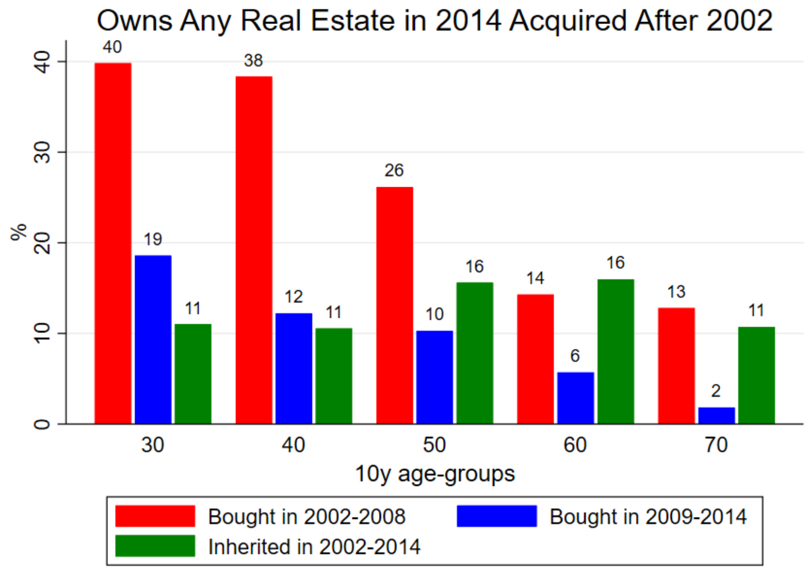
[2]The survey also includes a panel dimension; however, any reporting error in the number of properties owned can overstate mobility rates.

households aged 70–79. Across all age groups, most acquisitions occurred during the boom years, suggesting that many households bought at high prices and later faced wealth losses. Inherited properties between 2002 and 2014 also represent a considerable share, ranging from 11% to 16%, and among older households, inheritances account for roughly half of all properties acquired in that period.

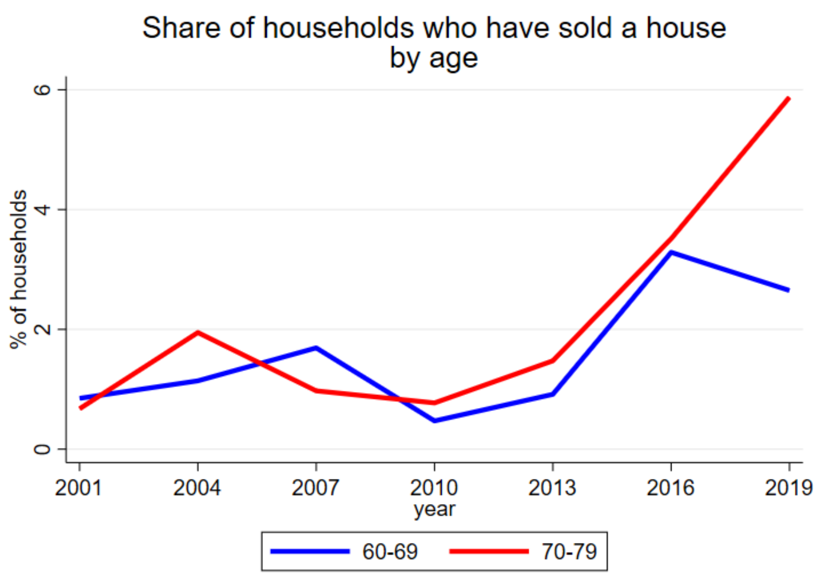
Examining purchase rates provides sufficient evidence of strong participation by younger households in the housing market between 2002 and 2014, but offers less insight into the behavior of older households. Older households may have participated through property sales instead. Figure 6b presents the selling rates of households aged 60–69 and 70–79 across EFF waves. For both groups, the selling rate fluctuated around 1% annually during 2002–2014. A yearly selling rate of 1% suggests that about 12% of households in these age brackets sold a property during this period, and because some may have reinvested the proceeds in another similar property, not all transactions resulted in downsizing.

Because older households have had limited participation in the housing market, some of the observed changes in the wealth–age profile may stem from shifts in housing valuations. To assess the extent to which asset price movements alone account for the wealth changes between 2002 and 2014, an accounting exercise is conducted using data from the 2002 survey to construct a counterfactual 2014 wealth distribution. This is done by (i) revaluing housing assets at 2014 prices, (ii) adjusting non-housing assets for inflation from 2002 to 2014 using the CPI, and (iii) aging all households by twelve years. The resulting changes in median wealth by age and cohort groups in the counterfactual distribution are then compared with the actual changes observed in the data. To remain consistent with the survey data, a survey-based housing price index is employed, defined as the median ratio of the self-assessed market value of the main residence to its size in square meters. This index closely tracks the standard house price index and is consistent across cohorts.

Figure 7a shows the percentage change in median net worth between 2002 and 2014 for ten-year cohort groups, indexed by their age in 2002, based on both the data and the



(a) Selected waves: 2005,2011,& 2014



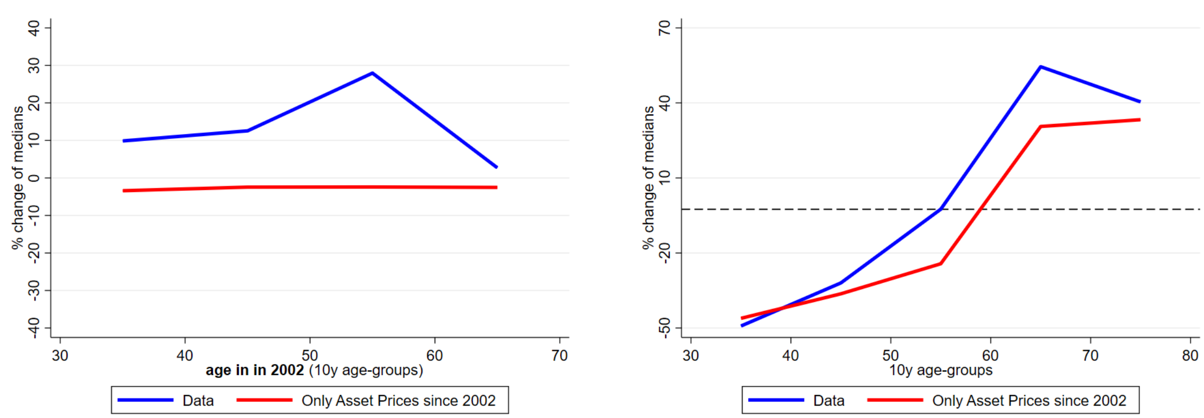
(b) More Waves: 2002,2005,2008,2011,2014,2020

Figure 6

counterfactual exercise. By 2014, the housing price index had nearly returned to its 2002 level (see Figure 3), implying that, under pure asset-pricing effects, cohorts would experience an average decline of about 2% in median net worth. In contrast, the data reveal substantial gains for cohorts aged 30–39, 40–49, and 50–59 in 2002, with increases ranging from 10% to 27%, whereas the 60–69 cohort saw only a modest 3% rise, closely aligning with the counterfactual prediction. This pattern suggests that wealth dynamics among the older cohort are consistent with limited participation in housing market transactions during this period.

The relatively small variation in changes in net worth across cohort groups—ranging from 3% to 27%—contrasts sharply with the substantial differences observed across age groups during the same period (Figure 7b). Comparing households aged 30–39 in 2014 with those aged 30–39 in 2002 shows a 49% decline in median wealth, while older groups, such as the 60–69 and 70–79 cohorts, experienced gains of 5% and 40%, respectively. Although these shifts in median wealth across age groups are sizable, they largely align with what would be expected from pure asset-pricing effects. This correspondence is unsurprising for older households, given their limited involvement in property transactions. For younger households, however, it is noteworthy that despite their active participation in the housing market between 2002 and 2014, their gains in median net worth did not exceed those predicted by asset-pricing dynamics alone.

Figure 7: Wealth Gains in 2002-2014: Cohort and Age-Groups



(a) by Cohort-Groups

(b) by Age-Groups

This section has shown that two major aggregate shocks—the housing bubble and the Great Recession—affected different cohorts unevenly. Over the same period, the wealth–age profile shifted notably in favor of older households. However, several important questions remain unanswered and require modeling of household saving behavior. First, it is crucial to determine to what extent the observed shift in the wealth–age profile between 2002 and 2014 can be attributed to the housing cycle and the recession-induced income losses. Since the wealth survey begins in 2002, wealth data for individuals who were already aged 70 at that time do not capture their earlier life-cycle accumulation, implying that pre-2002 events may have played a similarly important role in shaping the observed trends. Second, what ultimately matters for households is not just changes in net worth but changes in welfare, which cannot be inferred from survey data alone. Thus, adopting a structural model is necessary to quantify the welfare effects of these macroeconomic shocks across cohorts and to disentangle the contribution of each factor through a decomposition analysis.

In the following sections, a quantitative heterogeneous-agent overlapping generations (OLG) model with two assets, calibrated to the data presented above, is introduced and estimated to address these questions.

4 Model

To advance my analysis, I construct an overlapping-generations (OLG) model with portfolio choice between two assets: housing and a financial asset. Prices are exogenous, while households differ in labor productivity, age, and their holdings of housing and financial assets. Young households may take out mortgages to finance home purchases, which must be repaid before retirement. They also face uncertainty both in their labor productivity during working years and in aggregate housing prices. Households' labour and retirement income grow at a constant growth rate g.

4.1 Demographics & Preferences

At time t, cohorts of age j have size $m_{j,t}$, and in each period a new cohort of age j=25 is born. For ease of exposition, the time index will be omitted throughout the remainder of the paper unless required for clarity. Households of age g survive to the next period with probability π_j, being able to live at most J years. They work until age J_{ret}, and they receive a pension afterward. Cohort at time t has a size $m_{j,t}$. Each household is born as a renter and with an initial endowment of financial asset $a_0 Z$ which is drawn from a log-normal distribution, with $log(a_0) \sim \mathcal{N}(\mu_{a_0}, \sigma_{a_0})$. This assumption compensates for the absence of reliable data on parental transfers prior to or at the time of household formation.

At each period, agents receive utility from housing services d_h and a consumption good c. The utility function has the form

$$u_j(c, d_h) = e_j \frac{(\frac{c^\alpha d_h^{1-\alpha}}{e_j})^{1-\gamma}}{1-\gamma}$$

where e_j is an equivalence scale

Once they die, agents receive utility from bequests b equal to

$$\phi(b) = \phi_1 Z^{\alpha(1-\gamma)} \frac{(1 + \frac{b}{\phi_2 Z})^{(1-\gamma)}}{1-\gamma}$$

, where $b = p_h h' + a'$ and Z is a household income scale parameter. The parameters ϕ_1 and ϕ_2 govern the strength of the bequest motive and the extent to which bequests are treated as a luxury good. This formulation follows De Nardi (2004), with modifications to ensure the existence of a balanced growth path.

4.2 Labour Earnings and Pensions

At each period, agents receive earnings $Zy(z, j)$, which depend on their labor productivity z, and their age j. During their working age, labor productivity z follows a Markov Process, while in retirement it remains constant. Z is an income scale parameter, which grows at rate g.

Taxable income consists of labor or pension earnings together with any interest income accrued. Mortgage interest payments are not deductible. Along the balanced growth path, the tax schedule shifts at rate g. Consequently, taxable income y^τ is subject to taxation at the rate $\tau(\frac{y^\tau}{Z})$.

4.3 Housing

Households may either rent or own their homes. Homeownership provides housing services given by $d_h = \chi h$, where $\chi \geq 1$ denotes the preference for homeownership parameter, and homeowners face a discrete choice over housing size h. enters, by contrast, pay a rental price $r_h Z$ and choose housing size continuously. Each period, with probability q, households have the option to buy or sell their houses and pay transaction costs that are equal to the sum of a fraction of the old value of the house and a fraction of the new value of the house, i.e. $c_{h,h',p_h} = \psi_{buy} p_h h' + \psi_{sell} p_h h$.

House prices p_h are equal to $Z\tilde{p_h}$, where $\tilde{p_h}$ is the deviation from trend and $log(\tilde{p_h})$ follows a random walk. Such a specification is consistent with the efficient markets hypothesis, implying that even deep-pocketed agents cannot earn systematic excess returns in either the short or long run.

4.4 Financial Environment

Households are allowed to save into a financial asset that yields an interest rate r_l. When moving, working-age homeowners can borrow up to a fraction of the value of their new house $\kappa p_h h'$ at a borrwoing rate $r_b > r_l$, and have to repay their debt before retirement. Each period, indebted households must make a minimum payment covering interest plus a portion of the principal. This payment is determined using a level-payment amortization formula, under the assumption that the debt is fully repaid by retirement age:

$$p_j^{min}(a) = \frac{r}{1 - (1+r)^{-(J_{ret}-j+1))}} * (-a)$$

. Households that do not move cannot expand their debt. Default is permitted but entails a fixed utility cost d. Following default, both financial and housing assets are reset to zero. This framework incorporates uncertainty in both house prices and labor income, making the default option an essential feature of the model: negative income shocks may render debt repayment infeasible at the same time that falling house prices prevent deleveraging through asset sales.

4.5 Inheritance

An essential feature of the model is the transmission of inheritance, which directly influences the savings behavior of younger households. Increases in retiree wealth—arising from house price dynamics, cohort-specific heterogeneity or demographic change—alter the incentives of younger generations, and the model must account for this mechanism. To capture it, I assume that each cohort has a parent cohort 30 years older. At the end of each period, bequests are aggregated across bins of age j+30 and labor productivity z, and then transmitted as flow transfers to households of the same productivity z at age j.

Households are assumed to know the wealth of their parent cohort at productivity level z at the end of the previous period. Because house prices are volatile, they evaluate the average parental wealth W^p at $\tilde{p_h} = 1$, and assume a fraction ξ_{inh} of W^p is housing. They form myopic expectations about the evolution of parental wealth, assuming it grows at the trend rate: $W^{p'} = W^p(1+g)$ [3]

When calculating the expected transfer, children-households they take into account house price uncertainty, cohort sizes $m_{j,t}$'s, and mortality risk. Thus, an individual of age j, labour productivity z at t=0, in t years from now expects to receive

$$E[T_{j+t-30,t}|\tilde{p}_{h,0}] = \frac{m_{j+30+t,t}}{m_{j+t,t}}(1-\pi_{j+t})\big((1-\xi_{inh})W^p(1+g)^t + \xi_{inh}W^p(1+g)^t E[\tilde{p}_{h,t}|\tilde{p}_{h,0}]\big)$$

[3] Given the slow dissaving rates of retirees in both model and data, this assumption is not far from reality. Notice that in this non-stationary framework, rational expectations are intractable, since they would require simulating every possible history of house prices.

, where $E[\tilde{p}_{h,t}|\tilde{p}_{h,0}] = \tilde{p}_{h,0}$ since hosue prices are assumed to follow a random walk.

4.6 Timing

The household's problem is split into two stages. In the first stage, all uncertainty is resolved, the agents observe the wealth of their parent cohort at labor productivity z, and they decide whether to move or not. If they don't move, they carry their financial assets to the second stage (s=a). If they decide to move, they can take a mortgage (if working-age) and enter the second stage with an amount of intermediate financial assets $s \geq \min\{a, -\xi p_h h'\}$. With this model feature, house price fluctuations do not cause the default of stayers, and also heavily indebted households are allowed to smoothly repay their debt by dissaving in housing. In the 2nd stage, agents receive their earnings (labor income/pensions), pay/receive interest on the intermediate financial assets, and decide how much to consume & save into the financial asset a. For simplicity, I denote by $\mathcal{A} = (p_h, Z, W^p)$ the bundle of aggregate states and average-parental wealth, and I omit time t, which is also a state due to the differences in cohorts' population weights, that are taken from data and which affect the transmission of inheritance.

The Bellman equation for the first stage is

$$V_j(a,h,z,\mathcal{A}) = \max\{\underbrace{\tilde{V}_j(0,0,z,\mathcal{A}) - d}_{default}, \underbrace{q * \max_{s,h'}\{\tilde{V}_j(s,h',z,\mathcal{A})\}}_{move} + (1-q) * \underbrace{\tilde{V}_j(a,h,z,\mathcal{A})}_{stay}\}$$

$$s.t.\ \ s + p_h h' + p_h c_{adj}(h,h') = a + p_h h$$

$$s \geq \min\{a, -\xi p_h h'\}\ \ if\ h' \neq h$$

$$s \geq 0\ \ if\ j \geq J_{ret}$$

$$h' \in \mathcal{H}$$

and for the 2nd stage:

$$\tilde{V}_j(s, h', z, \mathcal{A}) = \max_{c,a'}\{u(c, h') + \beta E[\big(\pi_j V_{j+1}(a' + \mathcal{T}_j(\mathcal{W}^p, p'_h), h', z', \mathcal{A}')]$$

$$+(1-\pi_j)\phi(p'_h h' + a', Z')\big)|z, \mathcal{A}\}$$

$$s.t.\ a' + c = s(1 + r(s)) + Zy(j, z) - Z\tau\left(y(j, z) + \mathcal{I}_{(s\geq 0)} r(s)\frac{s}{Z}\right)$$

$$r(s) = r_b\mathcal{I}(s \geq 0) + r_l\mathcal{I}(s < 0)$$

$$(a' - s) + r_b s \geq p_j^{min}(s) \text{ if } s < 0$$

$$a' \geq 0 \text{ if } s \geq 0$$

$$\phi(b, Z) = \phi_1 Z^{\alpha(1-\gamma)}\frac{(1 + \frac{b}{\phi_2 Z})^{(1-\gamma)}}{1-\gamma}$$

$$Z' = Z(1 + g), \mathcal{W}^{p\prime} = \mathcal{W}^p(1 + g)$$

The problem admits a Balanced Growth Path (BGP), along which c*,s*,a* are homogeneous of degree 1 with respect to Z, and h* is homogeneous of degree 0 (see Appendix B.1 for details). My numerical solution builds on the Markov-chain approximation algorithm developed in Bakota and Kredler (2022), extended to account for the rapid dissaving rates at old age featured in the present OLG model and to properly handle the kinks introduced by the discrete housing choice.

5 Calibration

The estimation strategy proceeds in two steps. In the first step, parameters are either estimated directly from the data or assigned standard values commonly used in the literature, whenever possible. In the second step, the remaining parameters are estimated endogenously using the method of simulated moments. Specifically, the initial distribution is taken from the data for the earliest available year, 2002, and the model is simulated forward to 2014, targeting moments from the wealth and housing distributions in 2014, as well as household moving rates.

This approach departs from the conventional practice of estimating moments from a steady-state distribution. Following the methodology of De Nardi et al. (2006), the advantage of this deviation is that it avoids the implausible assumption of a steady state in 2002. Spain had undergone profound structural changes in the preceding decades—including expanded access to higher education, rising female labor force participation, declining fertility rates, the reduction of housing market subsidies, and financial liberalization—making a steady-state assumption unrealistic. Instead, the model economy is initialized from a non-stationary distribution, and parameters are identified from households' consumption and savings decisions over the period 2002–2014.

5.1 1st step estimation results

5.1.1 Demographics

Each agent in the model represents a household in the data, and accordingly I estimate age-specific household survival probabilities directly from observed mortality rates. Specifically, I use sex- and age-specific mortality rates published by the National Statistical Institute of Spain (INE) for 2002, assigning them to each reference person and partner (if present) in the dataset. From these, I compute household-level mortality rates and fit a fourth-order polynomial in household age (defined as the age of the highest earner) to the sample of households aged 50 and above. The resulting function is convex, increasing, and provides a close fit to the data. For simplicity, survival probabilities below age 50 are set equal to one.

In the model, households enter at age 25 and may live up to 100 years ($J = 76$). Regarding population weights $m_{j,2002}$ I use INE data for January 2002 covering all individuals residing in Spain, and assume that household-cohort weights in the model correspond to person-cohort weights in the data. Since the dataset reports the number of individuals from age 0 onward, and households in the model are born at age 25, it contains all the necessary information to determine the size of entering cohorts up to the final simulation year, 2020. The sizes of cohorts for all years after 2002 are determined by the mortality rates and 2002's population weights.

5.1.2 Preferences

To calibrate the equivalence scale $\{e_j\}_{j=1,..,J}$, I first compute OECD equivalence scales for each household in the 2002 EFF survey. These household-specific scales are then regressed on a third-degree polynomial in age, subject to the restriction that households enter the model as couples at age 25 and are singles at age 100 (see Appendix C.1 for parameter details).

The intertemporal elasticity of substitution γ is set to 2 as it is common in the literature. The bequests parameters ϕ_1, ϕ_2 are estimated endogenously, targeting the median and the 75th percentile of wealth among households in the 75–79 age group.

5.1.3 Earnings

Earnings are the product of tfp and labor productivity. The tfp component of earnings Z grows at rate $g = 0.025$, an approximation of long-run growth in Spain in the 40 years before the recession (see Appendix A.2). Labor productivity is the product of a deterministic and stochastic component, i.e.

$$y(z, j) = exp(P(j))exp(z)$$

P(j) for the working-age households is a second-order polynomial of age for $j \leq J_{ret}$, while it is a constant after retirement. To estimate the polynomial P(j) for the working-age, I use households between 30 and 65 years old with no retirement income and positive labour income in the [1st,99th] percentile bracket from the 2002 wave. I define labor income as the sum of wages, 2/3 of self-employment income, and unemployment benefits. For $j >= J_{ret}$, P(j) is a constant and equal to the mean retirement income (including widow benefits) of households aged above 75 years old.

The stochastic component z follows (during working age) an AR(1) process with persistence ρ_z and standard deviation σ_z. After retirement, z is constant and equal to the household's last working-life realization. To calibrate ρ_z, I calculate the persistence of employment-earnings deviations from age-predicted income for households aged 30-55 in the panel dimensions 2002-2005,2005-2008,2011-2014, and I set ρ_z equal to the mean of those. For the standard deviation, I use the households aged 35-55 in the 2002 cross-section, with no retirement income and positive labor income in the [1st,99th] percentile bracket. For pensioners, z is normally distributed with standard deviation σ_p set equal to the standard deviation of retirement income (including widow benefits) of households aged above 75 years old (from the 2002 wave). Households transitioning from working life to retirement keep their rank of labor productivity.

I approximate the AR(1) process numerically using Rouwenhurst's method (Rouwenhurst (1995)) with 5 points.

5.1.4 Taxation

Income taxation is calibrated using the parametric estimation of the Spanish personal income tax from García-Miralles et al. (2019). Taxable incomes y^τ that are above a threshold $\tilde{y}$, are taxed according to tax schedule $1-\lambda_1(\frac{y^\tau}{\bar{y}})^{-\lambda_2}$. The three parameters of the tax function (income threshold $\bar{y}$, tax level λ_1 & tax progressivity λ_2 are calibrated using the estimates of those parameters from García-Miralles et al. (2019) for 2013, (see Table A8 in García-Miralles et al. (2019)). Given that the exemption level $\tilde{y}$ in García-Miralles et al. (2019) is estimated as a multiple of average household income, I impose that it grows at rate g throughout the period covered.

5.1.5 House Prices

Housing prices consist of a trend component and a stochastic one. The trend component equals the tfp growth g. The stochastic one ($\tilde{p}$) is the deviation from trend and its logarithm follows a random walk. The innovation standard deviation is set to its data counterpart in

1971-2017.

$$\ln(\tilde{p}_{h,t+1}) = \ln(\tilde{p}_{h,t}) + \epsilon_{p_h,t+1}, \quad \epsilon_{h,t+1} \sim \mathcal{N}\left(0, \sigma^2_{p_h}\right), \quad \tilde{p}_{h,t} = \frac{p_{h,t}}{Z_t}$$

I employ the BIS house price index to calibrate the stochastic process of house prices. The house prices series (after adjusting with cpi) seems to follow close enough the 2.5% trend in the period 1996-2014 (Figure 8). In the model, I assume that house prices grow at the same rate as labor income, which also seems to be a reasonable hypothesis based on the data (in Figure 8 I use Wage Compensation per Working Age Population as a proxy for labor income per working-age household).

Ideally, the house price index would align with the survey-based measure, which is constructed from the median value of the main residence per square meter.[4] In practice, however, the survey reports substantially higher property values in 2005 and noticeably lower values in 2017 and 2020. To ensure that the model outcomes are directly comparable to the data, I rely on the survey-based index when simulating house prices, interpolating between survey waves as needed.

5.1.6 Interest Rates

In the model, households receive interest on deposits at rate r_d, and borrow at a higher rate $_b$. I use the OECD Short-Term Interest Rate for Spain as the empirical counterpart of the deposit rate, and the one-year Mibor from the Banco de España[5] as the counterpart of the borrowing rate. The two series move closely together and exhibit a sharp decline at the onset of the housing cycle (**??**). The spread between them remains relatively stable, averaging around 2% (1.88 in the post-1990 period). Accordingly, I calibrate the borrowing rate r_b to the mean of the real one-year Mibor over 1999–2014, and set the deposit rate 2% lower.

[4]The methodology for building the survey-based house price index is detailed in Section 3.3.

[5]Tipo de interés. De referencia. Oficiales. Mercado hipotecario. Interbancario. Mibor a 1 año

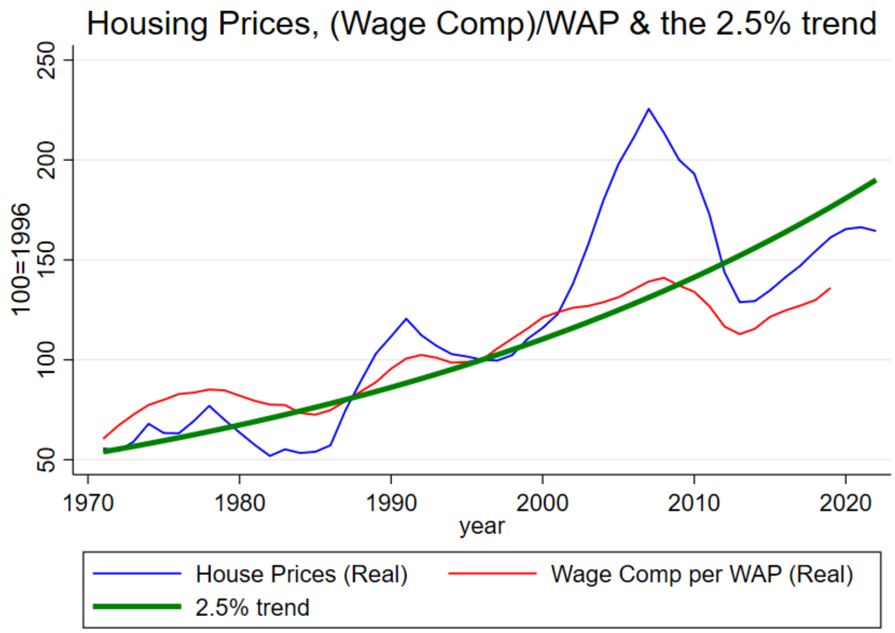


Figure 8: House Price Index, deviations from 2.5% trend
The house Price Index series is taken from BIS, and is adjusted for cpi. The Wage Compensation over WAP population data come from BdE (BDMACRO), after adjusting for inflation using CPI.

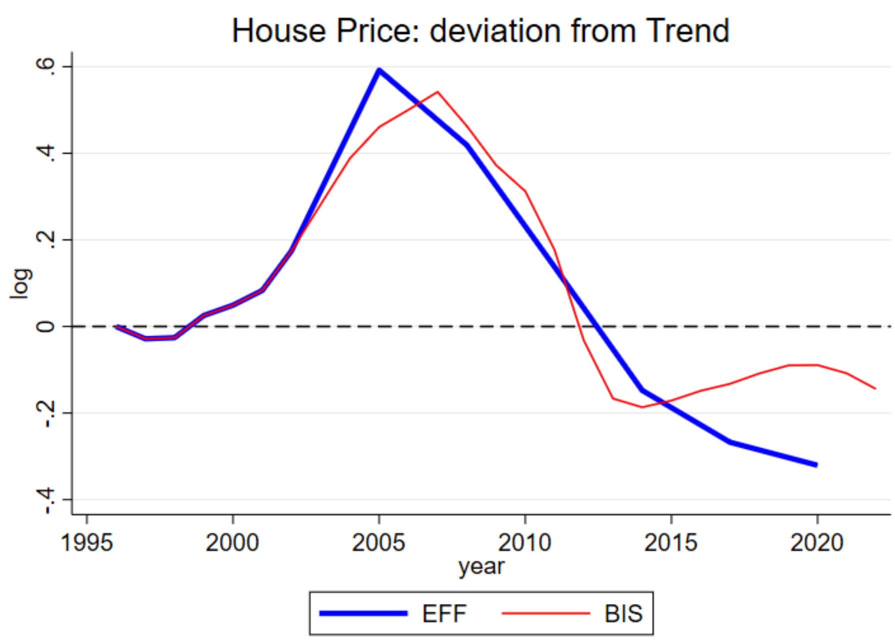


Figure 9: BIS vs EFF-based index
A noteThe EFF-based index is constructed using the median value per sq. meter of the main residence, as reported by households

5.1.7 Borrowing Constraints

Bover et al. (2019) documents that the median loan-to-value (LTV) ratio rose during the housing boom to as high as 95% of the transaction price, before declining to around 80% in the aftermath of the bust. [6] To reflect the relaxation of borrowing constraints in the model, I set the maximum LTV ratio ξ to 0.95 for the boom years (2002–2008) and to 0.8 for the bust period (2009–2014). The change in financial conditions after 2008 is treated as a permanent and unexpected shock.

5.1.8 Recession

In Section 3, I showed that working-age households' (median) earnings suffered a drop in levels during the recession, while (median of) pensioners' earnings were left untouched. Since then, working-age earnings have not recovered to their pre-crisis trend. To incorporate the recession in my model, I replicate the deviation from the 2.5% trend growth of earnings for the working-age households, adjusting the deterministic component of labor productivity accordingly for $j < J_{ret}$ for the years after 2008.

Table 1 summarizes the calibration strategy for the exogenous parameters

[6] For loans exceeding 80% of the appraised value, banks are subject to higher capital requirements. As Bover et al. (2019) highlights, the expansion of lending during the boom was facilitated by inflated appraisal values, which were on average 30% above transaction prices.

Parameter	Description	value	source
$\{\pi_j\}_{1,...,J}$	Survival Probabilities	see text	INE & EFF
α	Share of non-housing expenditure	0.77	Eurostat
γ	IES	2	standard
$\{e_j\}_{1,...,J}$	Equivalence scale	see text	oecd eq.scale & EFF
$P(j)$	deterministic productivity	see text	EFF
ρ_z	Stochastic productivity, persistence	0.9	EFF
σ_z	Stochastic productivity, s.d.	0.58	EFF
μ_p	pensions, mean	8.87	EFF
σ_p	pensions, s.d.	0.49	EFF
g	tfp growth	0.025	Appendix A.2
$[\lambda_1, \lambda_2, \bar{y}]$	tax schedule parameters	[0.8970,0.1252,42%]	García-Miralles et al. (2019)
ζ	Borrowing-deposit rates wedge	0.02	OECD BdE
$[R_b^H, R_b^L]$	Borrowing Rates	[7.3%,1.9%]	BdE
ρ_{p_h}	Housing Prices, persistence	0.92	calculations using Taylor et al. (2018)
σ_{p_h}	Housing Prices, s.d.	0.23	calculation using Taylor et al. (2018)

Table 1: Exogenous Parameters
Note:House Prices and earnings are reported in logs

5.2 Endogenously Calibrated Parameters

There remain 9 free parameters which are calibrated using the method of simulated moments. These are the discount factor β, the share of non-housing consumption in utility α, the probability of being allowed to move q, and the housing services of being at the 0-housing gridpoint, u_0, the default penalty d, the bequests parameters ϕ_1, ϕ_2 & the parameters that regulate the distribution of initial endowments μ_{a_0}, σ_{a_0}. These parameters are calibrated by targeting cross-sectional moments from 2014 and moving rates in boom and bust.

The discount factor β, affects mostly the median networth at middle-age (40-49,50-59 and 60-69), while the mean of the initial endowment distribution, μ_{a_0} affects the median networth of young households aged 30-39, and phi_1, which regulates the level of the bequest motive, affects the median networth of older households, aged 70-79. The standard deviation of the initial endowment distribution σ_{a_0} and the luxury-good parameter of bequests ϕ_2 are used to target the 75th percentile of networth at age 30-39 and 70-79. Notice that initial endowments have to be calibrated endogenously, since intra-household transfers cannot be observed in the data and the model assumes that all households are born at age 25.

The share of non-housing consumption in utility α is used to match the median housing of households aged 40-49 and the default penalty d the share of indebted households aged

Parameter	Description	Targeted Moment	Estimated Value
β	disc. factor	Networth-age distribution p50	0.82
ϕ_1	Warm Glow level	Networth-age distribution, p50,p75	600
ϕ_2	Warm Glow luxury	Networth-age distribution, p50,p75	50
α	Utility Share of Non-Housing	Housing 40-49, p50	0.4
d	default penalty	Leverage of 40-49s	2500
μ_a, σ_a	Initial Endowment	Networth-age distribution, p50,p75	(70,1.4)
χ	preference for homeownership	Share of Renters (30-39 & 30-79)	2
q	taste shock	Moving Rates for 30-39 (average 2002-2005, 2009-2014)	0.18

Table 2: Endogenously estimated parameters
Note: Data moments are taken from the 2002 distribution & reported in thousand euros.

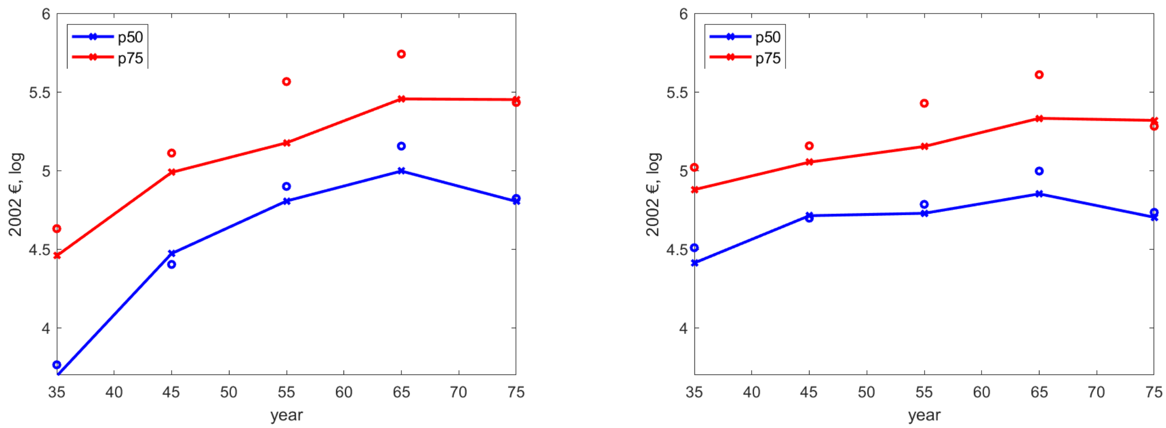
40-49. The utility of owning no housing is calibrated to match the share of renters aged 30-39 and aged 30-79.

As discussed in section Section 3.3, moving rates are not directly observable in the data. What can be measured are the annual rates at which households acquire or sell properties, though these figures do not reveal whether a household is upsizing, downsizing, or simply relocating to a dwelling of similar value. To calibrate the probability q of being allowed to move, I adopt the simplifying assumption that households aged 30–39 never downsize. This assumption makes the observed acquisition rates an upper bound for upsizing among this group. Based on this, I target the upsizing rates of households aged 30–39 during both the boom (2002–2005) and bust (2009–2014) phases of the housing cycle.

The expected share of housing,ξ_{inh}, in the wealth of the parent cohort, $\mathcal{W}_p$, evaluated at trend house prices $\tilde{p}_h = 1$, is calibrated to match the average share of housing in model's total wealth over the simulation period 2002–2014. This results in a housing share of 80%, closely aligned with the empirical data.

Using the calibration procedure described above, the model closely replicates the median wealth-age and housing-age profiles in 2014, as shown in Figure 10. The largest deviation is a 15% overestimation of median wealth for households aged 60–69 in 2014. By contrast, the model has more difficulty matching the 75th percentile of wealth and housing for the 50–59 and 60–69 age groups, which are underestimated by roughly 35%. This outcome is not unexpected, given that the model omits several features relevant to wealth inequality, like business capital, and that the number of targeted moments exceeds that of free parameters.

Accordingly, the discussion of results will focus on the median household. The model is doing also fairly well in targetting the rest of moments, as evidenced in Table 3.



(a) Wealth across Age, 2014

(b) Housing Value across Age, 2014

Figure 10: Targeted Moments: Median Wealth and Housing Value across 10-year age-groups in 2014

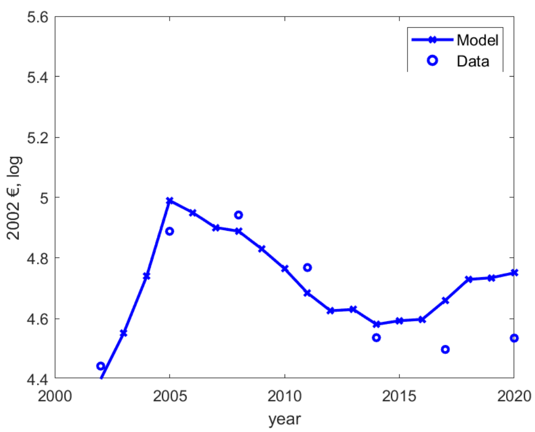
Moment	**Model**	**Data**
Share Lev 40s	45.6%	43%
MovRate 30s Boom	6.9%	7.2%
MovRate 30s Bust	3.3%	4.4%
Share Renters 30s	28%	27.7%
Share Pop.	16.2%	19%

Table 3: Targeted non-wealth moments: comparison between model and data

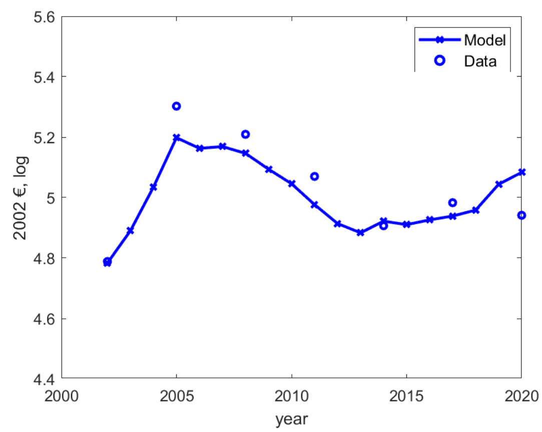
6 The Baseline Economy

In this section I show that the model reproduces the movements of wealth and housing in 2002-2014 across cohorts, establishing that the model is a suitable laboratory to perform a decomposition analysis of wealth movements and welfare analysis. Notably, the model successfully replicates the movements in wealth not only in 2002-2014, but in the entire 2002-2020 period.

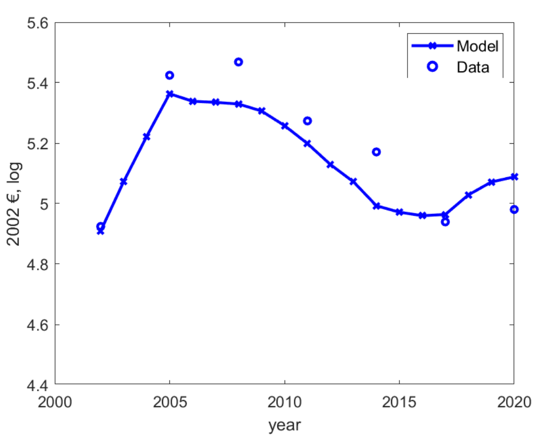
Section 6 illustrates the evolution of median net worth across 10-year cohorts in the model compared with the data. Since housing accounts for roughly 80% of household portfolios, the trajectory of median net worth is closely tied to house price dynamics—rising sharply between 2002 and 2005, declining steadily until 2014, and recovering more gradually thereafter. The model replicates particularly well the median net worth of households aged 30–39, 40–49, and 60–69 in 2003, with close alignment through 2014. The model does especially well in tracking the median networth of households aged 30-39, 40-49 and 60-69 in 2002, especially until 2014. In 2014, the largest deviation is an underestimation of 17% of median wealth of cohort aged 50-59 in 2002, which is responsible for the underestimation of households aged 60-69 in 2014 (Figure 10a). For 2017 and 2020 it overstates the median wealth of those aged 30-39 in 2002 by about 20%, but for the rest of the cohorts for which data are available, the overestimation is limited, about 10%, which is a notable success.



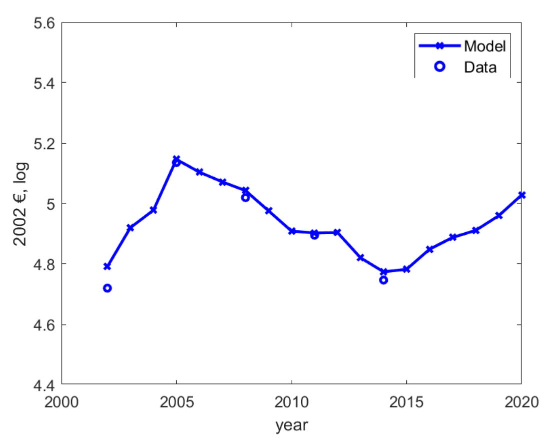
(a) Aged 30-39 in 2002



(b) Aged 40-49 in 2002



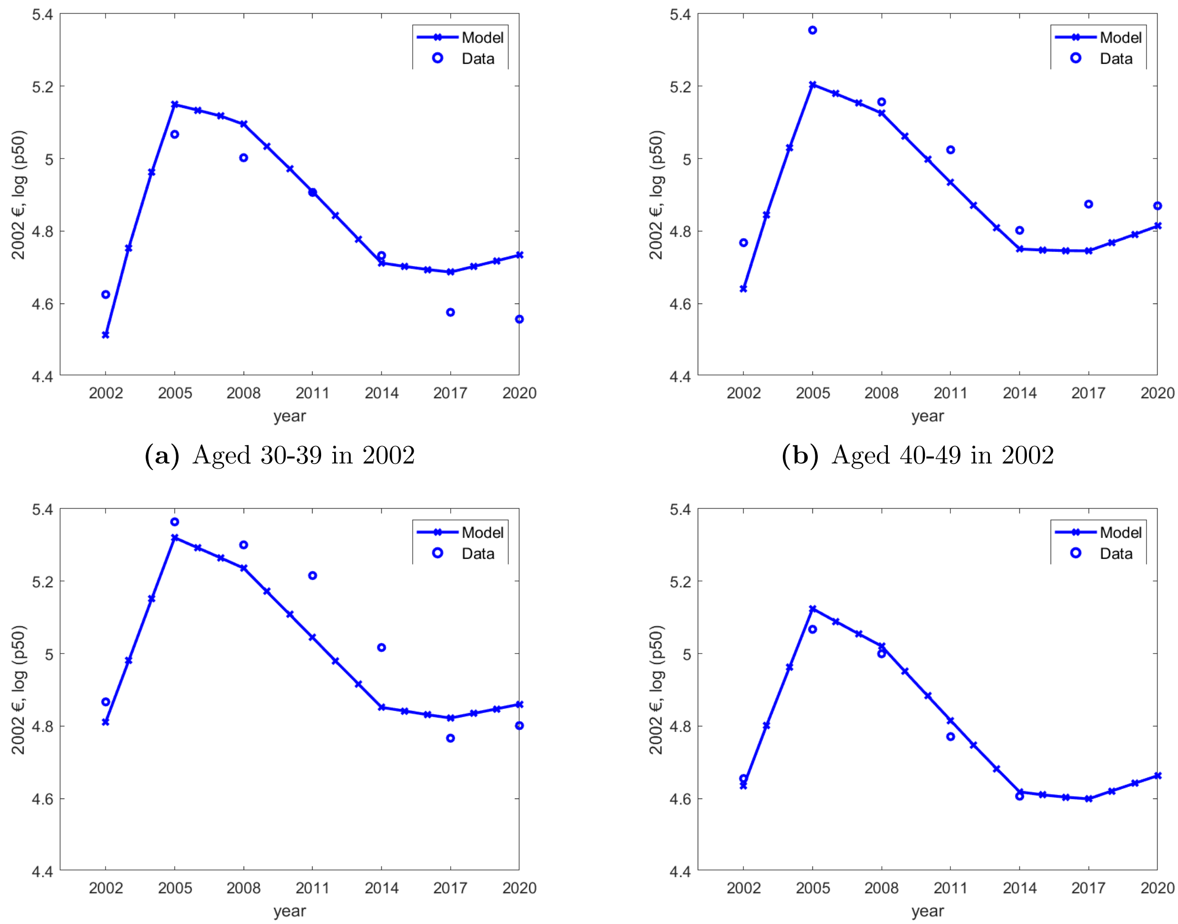
(c) Aged 50-59 in 2002



(d) Aged 60-69 in 2002

Note: The y-axis refers to the median wealth of 10-year age-groups in log 2002 €s. Cohorts are indexed by their age in 2003.

As expected, the model also fares well at predicting housing values by cohort, as demonstrated in Section 6. Again, it fares best for cohorts aged 30-39,40-49 and 60-69 in 2002, especially until 2014. The overestimation in median wealth of the 30-39 cohort in 2020, as well the underestimation of median wealth for the 50-59 in 2014 are both explained by misses in the median housing values.



(a) Aged 30-39 in 2002

(b) Aged 40-49 in 2002

(c) Aged 50-59 in 2002

(d) Aged 60-69 in 2002

Figure 12: Housing Value by cohorts
Note: The y-axis refers to the median Housing Wealth of 10-year age-groups in log 2002 €s. Cohorts are indexed by their age in 2002

As previously shown, a notable strength of the model is that, although the targeted moments are drawn from the 2002–2014 period, it still provides reasonable predictions of median net worth for cohorts beyond 2014. In particular, the model reproduces the wealth-age profile

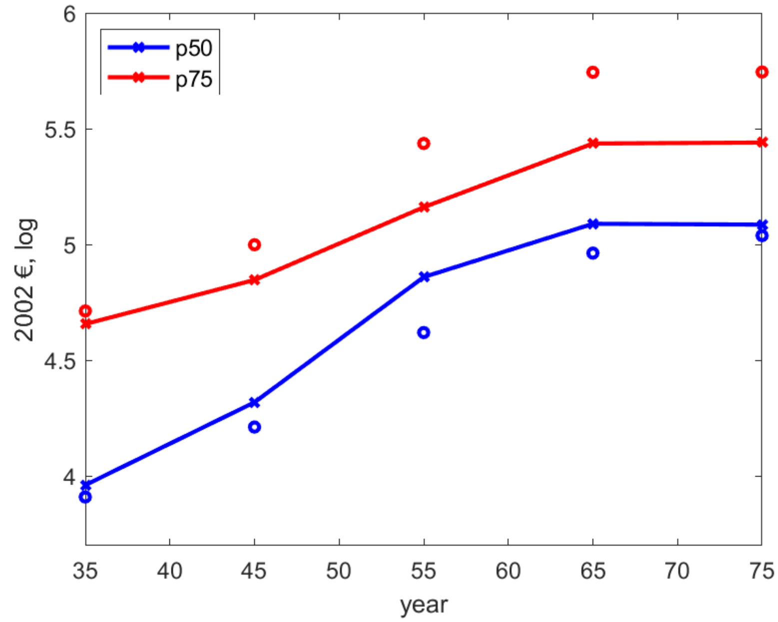


Figure 13: Wealth-Age Profile: 2020

in 2020 relatively well, as illustrated in Figure 13. The largest deviation is a 27% underestimation for households aged 50–59, while performance across other age groups remains strong, with differences ranging from a 5% overestimation for the 30–39 cohort to a 15% overestimation for the 60–69 cohort.

Lastly, because the model matches the wealth-age profiles well over 2002–2020, it also captures the rise in wealth inequality between age-groups during this period. **??** shows median wealth by 10-year age-groups, normalized to the median wealth of the 40–49 group, in both the model and the data. The model reproduces the increase in the ratio of medians for the 70–79 age-group relative to the 40–49s, rising from 0.7 in 2002 to 1.4 in 2014 and 2.1 in 2020—very close to the data values of 0.7, 1.5, and 2.3, respectively. Similar patterns hold for other age-groups, though the model predicts somewhat lower intergenerational inequality in 2014, when looking at age bins 50-59 and 60-69, reflecting the misses in the wealth-age profile for those age-bins (see Figure 10a).

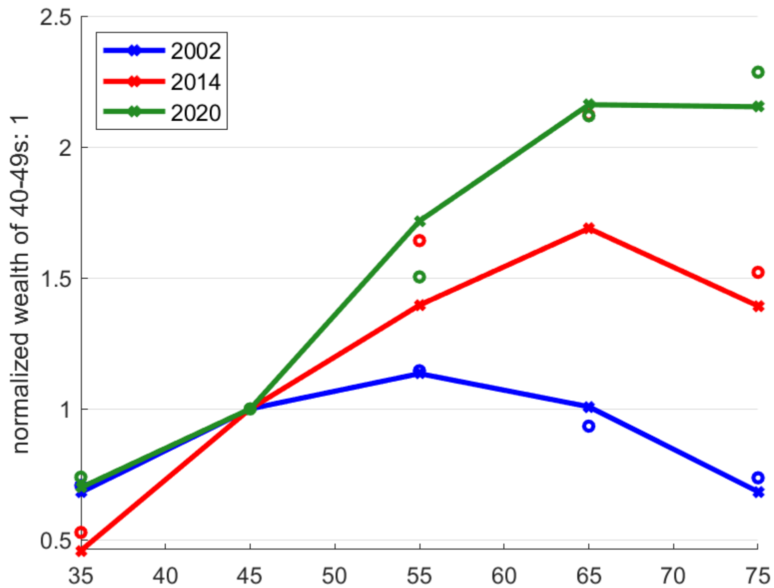


Figure 14: Age Redistribution
Note: The y-axis refers to the median networth of 10-year age-groups normalized by the median networth of 40-49s. The line semgents correspond to model's predictions ,while the dots to the data.

7 Quantitative Experiments

Having established that accurately replicates the data from 2002–2020 when accounting for house price paths, recessionary income effects, and changes in the Loan-to-Value (LTV) ratio, I now examine the extent to which aggregate macroeconomic shocks during this period influenced household behavior across cohorts, and by extension, intergenerational wealth inequality and welfare.

To isolate these effects, I construct a 'Business-As-Usual' (BAU) counterfactual. In this scenario, working-age incomes do not drop post-2008, the maximum LTV ratio remains fixed at 80% during both boom and bust, and house prices grow at trend g starting from their 1996 level ($\tilde{p_{h,t}} = 1 \quad \forall t$)

I decompose the overall effect by activating each channel individually against this baseline. The three channels are: (1) 'Income Losses' (a sequence of unexpected, permanent negative shocks to working-age income); (2) the 'LTV Expansion' (an increase from 0.8 to

0.95 during the 2002–2008 boom); and (3) the 'Housing Cycle' (the realized path of house prices). It is important to note that because the economy does not begin from a steady state in 2002, the BAU counterfactual may still exhibit changes in intergenerational inequality. In other words, the wealth-age profile might evolve even in the absence of the modeled aggregate shocks.

To understand the mechanics of each channel, I first analyze housing accumulation across cohorts over the 2002–2020 period under the four scenarios. I then explore the implications for wealth accumulation and, finally, welfare.

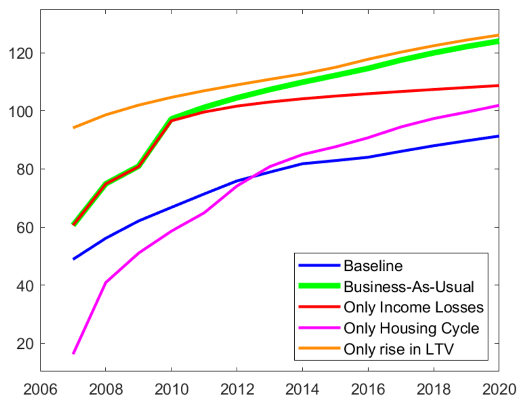
7.1 Housing accumulation

Housing represents the dominant asset in Spanish household portfolios, accounting for approximately 80% of wealth during the studied period. Because households utilize housing both as an illiquid savings vehicle and as a source of utility—through consumption services and bequest motives—analyzing housing accumulation is a crucial first step toward understanding the broader impact of aggregate shocks on wealth and welfare. Section 7.1 plots the evolution of median housing stocks (at constant 2002 prices) by 10-year cohorts over the 2002–2020 period. In the baseline scenario, all cohorts accumulated less housing than they would have under the 'Business-As-Usual' (BAU) counterfactual. The impact was most pronounced among the youngest cohorts: by 2020, those aged 20–29 in 2002 held approximately 25% less housing than they would have in the absence of macroeconomic turbulence. Older households were less affected; those aged 50–59 in 2002 ended the period with housing holdings only 10% lower than the BAU baseline.

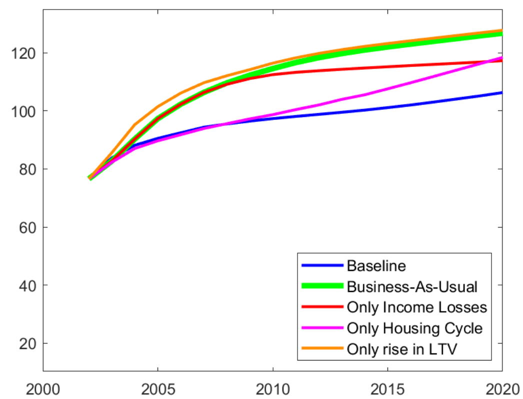
For all cohorts, high house prices during the boom were the primary constraint on housing accumulation. The 'Only Housing Cycle' counterfactual alone effectively replicates the median housing paths for the 30–39, 40–49, and 50–59 cohorts (aged as of 2002) until 2014. After 2014, house prices fell below trend; notably, this allowed the 30–39 and 40–49 cohorts to partially converge toward their 'Business-As-Usual' (BAU) levels. For example, the 40-49 cohort narrowed the gap from 10% in 2012 to 2% in 2020. However, this recovery did not extend to the cohort aged 50–59. For this group, the period of above-trend prices coincided with the final years of their working lives, preventing them from catching up to the BAU baseline during retirement.

The dynamic differs significantly for the youngest cohort (aged 20–29 in 2002). Under the 'Only Housing Cycle' counterfactual, their housing stock would have been approximately 40% lower than the BAU level between 2007 and 2010—falling notably below the actual baseline. Although below-trend prices after the bust allowed them to regain some ground, their housing stock remained roughly 19% below the BAU scenario. The factor that prevented their holdings from collapsing even further during the boom was the increase in the LTV ratio from 80% to 95%. Indeed, had the LTV expansion been the only shock ('Only Rise in LTV counterfactual'), the median housing stock for this cohort would have exceeded the BAU level by 20% before 2010. Thus, the LTV expansion helped moderate the decline in housing holdings for the 20–29 cohort. The LTV rise also had a slight positive effect on the accumulation of the 30–39 cohort, but its impact on older cohorts was negligible."

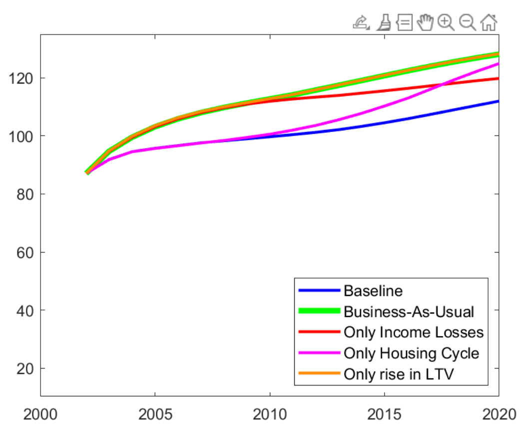
The mechanism driving the recession's impact is straightforward. Because the recession induced a permanent drop in working-age incomes while leaving retiree incomes intact, the 'Only Recession' counterfactual shows no change in the housing holdings of households who were retired or nearing retirement in 2008. For younger cohorts, however, the income shock led to a reduction in housing stock post-2008. Notably, by 2020, the decline in housing attributed to the recession was larger than that caused by the housing cycle for all cohorts aged below 49 in 2002, amounting to a drop of approximately 10% below BAU.



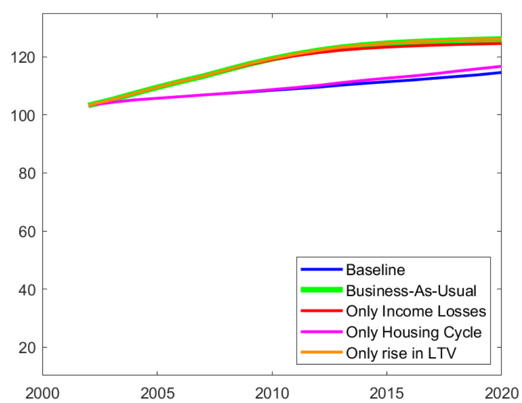
(a) Aged 20-29 in 2002



(b) Aged 30-39 in 2002



(c) Aged 40-49 in 2002



(d) Aged 50-59 in 2002

(e)

Figure 15: Decomposition Analysis: Housing Value by cohorts, constant 2002 prices
Note: Each graph depicts the evolution of median housing by 10-year cohorts for each counterfactual. The y-axis reports the value of housing in 2002 constant house prices (thousands €s). For the cohort aged 20-29 in 2003, values are reported only after 2007, which is the year the youngest members of the cohort turn 25.

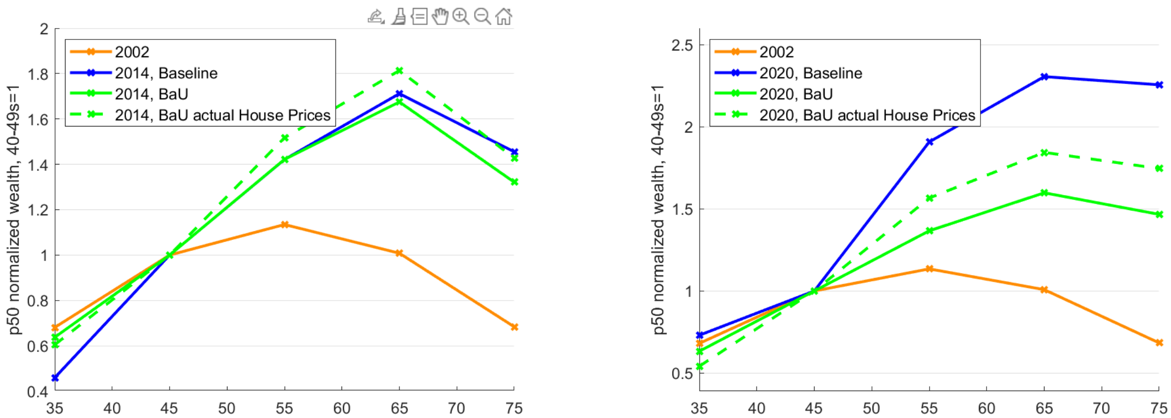
7.2 Intergenerational Wealth Inequality

As demonstrated in Section 3.2, the direction of intergenerational inequality reversed between 2002 and 2020. The 70–79 age cohort shifted from being 25% poorer than the 40–49 cohort to being 50% richer. Was this reversal driven by the heterogeneous impact of macroeconomic shocks across cohorts? To answer this, I use the model to examine how wealth accumulation per age group would have evolved had the economy remained on a stable trajectory. Section 7.2 depicts intergenerational wealth inequality under both the 'Baseline' and 'Business-As-Usual' (BAU) counterfactuals for 2014 and 2020. Since house prices in the BAU scenario are fixed at $\tilde{p}_h = 1$, it is instructive to evaluate BAU wealth using both counterfactual and actual house prices to ensure a comparable valuation.

For 2014, the results indicate that intergenerational inequality would have increased to similar levels even without the modeled macroeconomic shocks. The notable exception is the 30–39 cohort: in the BAU scenario, their median wealth relative to the 40–49 cohort remains on par with 2002 levels. This difference arises because, in the baseline, this cohort entered the housing market for the first time during the boom, purchasing assets at inflated prices.

By 2020, however, the divergence becomes more significant. Under the BAU scenario (evaluating wealth at actual house prices), intergenerational inequality would have been much less pronounced. Specifically, the median household aged 70–79 in 2020 would have been 74% richer than the median 40–49 household, compared to 110% richer under the Baseline. This implies that the model explains approximately one-third of the observed rise in intergenerational inequality from 2002 to 2020. The remaining portion would have occurred even in the absence of the modeled aggregate shocks, driven instead by initial conditions— i.e. cohort heterogeneity already present in 2002.

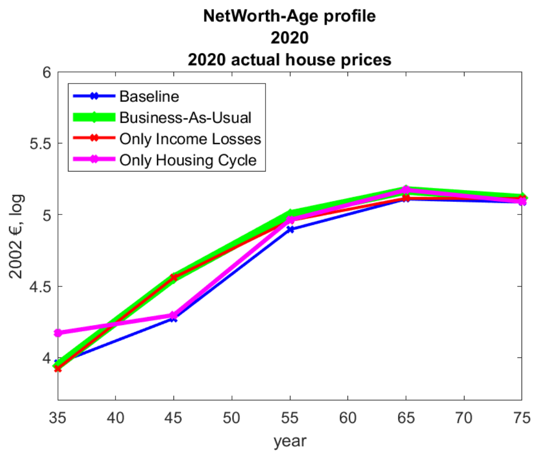
I proceed to identify the drivers of rising intergenerational inequality by plotting the 2020 median profiles of wealth, housing, and financial assets in Figure 17. I focus on 2020 as this is when the divergence between the 'Business-As-Usual' (BAU) and Baseline scenarios is most



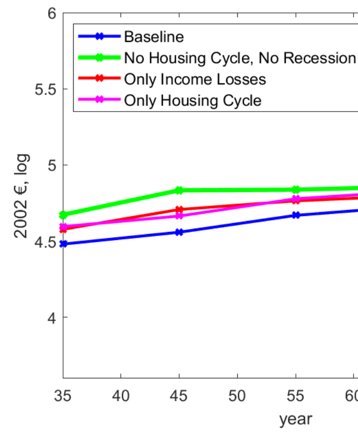
(a) 2002-2014 **(b)** 2002-2020

Figure 16: Intergenerational Wealth Inequality
Note: The y-axis corresponds to the median wealth of each 10-year age-group normalized by the median networth of 40-49s for each counterfactual. Under "BaU actual House Prices", wealth is evaluated at actual house prices in 2014 and 2020 across counterfactuals, while under "BaU" $p_h \tilde{=} 1$ is used.

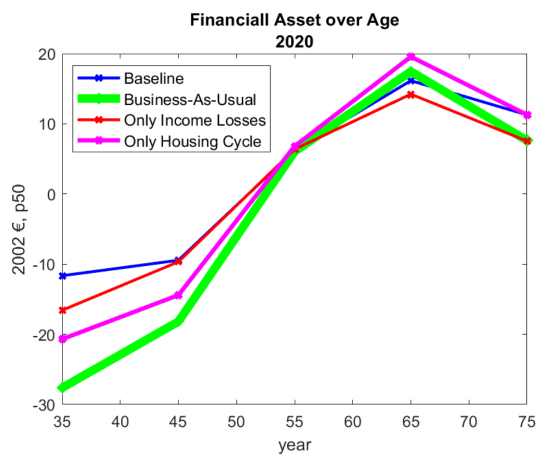
pronounced. The figure displays these profiles for the Baseline, as well as the 'Housing Cycle,' 'Income Losses,' and BAU counterfactuals. To facilitate comparison, wealth is evaluated using actual 2020 house prices across all scenarios. Notably, the housing cycle alone explains the majority of the changes, driving the wealth of the 40–49 age group down by approximately 29%. Portfolio composition plays a crucial role in this result. While the quantity of housing held by the 40–49s is similar under both 'Only Income Losses' and 'Only Housing Cycle,' the financing structure differs. In the recession scenario ('Only Income Losses'), households reduce both their housing purchases and their borrowing. In contrast, under the 'Only Housing Cycle' scenario, households accumulate similar amounts of housing stock but incur significantly higher debt, as they purchase at above-trend prices. In the Baseline scenario, the median 40–49 household holds less debt but also significantly less housing (33% less than in BAU), resulting in a total wealth decline comparable to that of the 'Only Housing Cycle' scenario. Finally, it is worth noting that under the 'Only Housing Cycle' scenario, the median household aged 30–39 in 2020 would have been 28% wealthier than in the BAU and Baseline scenarios. This cohort would have benefited from low house prices without suffering the income drops associated with the recession. Interestingly, the wealth levels for this age group are similar in the BAU and Baseline scenarios; in the Baseline, the reduction in housing asset value is offset by a corresponding reduction in debt.



(a) Wealth over Age



(b) Housing Value over Age

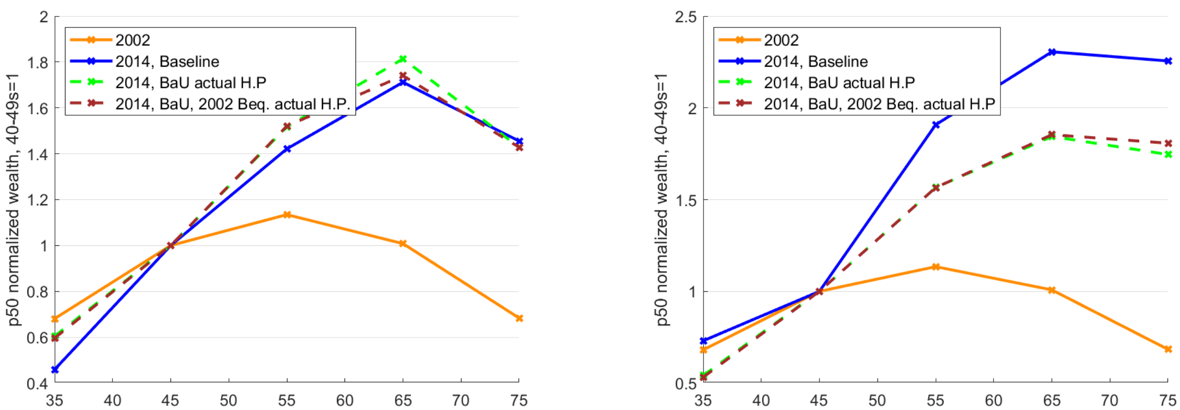


(c) Financial Assets over Age

Figure 17: Wealth, Housing and financial Assets Over Age

Before attributing the entire rise in intergenerational wealth inequality to aggregate shocks, it is important to examine whether part of it stems from the influence of bequests on young households' saving behavior. In the model, bequests evolve with demographic patterns and cohort heterogeneity in initial conditions as of 2002. Anticipating substantial inheritances, younger households have an incentive to reduce their savings. The model captures this mechanism to some extent, since it incorporates households' expectations regarding future transfers.

To assess the role of this channel, I construct a counterfactual in which received bequests are fixed at their 2002 levels, and households' expectations about parental cohort wealth at each age j and labor productivity z are anchored to the 2002 distribution. As shown in Figure 18, the impact of this channel is negligible, with predictions that closely mirror those of the baseline (BAU) scenario.



(a) 2002-2014 **(b)** 2002-2020

Figure 18: Intergenerational Wealth Inequality, constant 2002 Bequests

Given the finding that the model does not fully attribute the inversion of intergenerational wealth inequality (2002–2014) to the modeled shocks, it is necessary to discuss the calibration strategy. The cohort aged 70–79 in 2002 lived through a vastly different economic environment, turning 30 in the 1950s and retiring in the 1980s. Comprehensive micro-data for that era is non-existent, and the Spanish economy has since undergone structural changes in financial conditions and housing policy. Consequently, the common approach of assuming a steady state in 2002 would be a strong—and likely erroneous—assumption that would fail to match the targeted moments. Instead, by initializing the model with the actual 2002 wealth distribution, I successfully match the moments without requiring a historical reconstruction of the pre-2002 period. This is crucial because the results indicate that significant cohort heterogeneity already existed prior to 2002.

Overall, the model supports a compelling narrative regarding wealth-age dynamics between 2002 and 2020: while the current young were certainly hit hard by the Recession and housing cycle, the driving force of the rise in intergenerational wealth inequality is that the current elderly are significantly wealthier than the previous generation of elderly people was in 2002.

7.3 Welfare Analysis

In this section, I analyze the heterogeneous welfare effects of macroeconomic shocks from 2002 to 2020 across different age cohorts. I measure these effects in terms of consumption equivalents, which reflect the outcomes most relevant to households. The results reveal a stark divergence that is not apparent in measures of intergenerational wealth inequality: young households faced welfare losses equivalent to a 30% reduction in lifetime consumption, while older households experienced welfare gains of up to 30%.

7.3.1 Consumption Equivalent setup

In the model, a household's utility is derived from three components: consumption of a non-housing good, housing services, and bequests left upon death. To compare the welfare impact of a counterfactual scenario (”cf”) against the ”Business-As-Usual” (BaU) simulation, I calculate a consumption equivalent, λ_{CE}. This metric is the percentage increase or decrease in the BaU path of consumption, housing, and bequests required to make a household indifferent between the two simulations.

Specifically, the welfare ($\mathcal{W}_y$) for a household in a given state at year y is the discounted, survival-probability-weighted sum of utility over its remaining lifespan, as defined in Equation 1:

$$\mathcal{W}_y\left(\left\{c_t^{cf}, h_t^{cf}, b_t^{cf}\right\}_{t=y}^{t=y+(T-j)}\right) = \sum_{t=y}^{t=(y+T-j)} \beta^{t-y} \left(\tilde{\pi}_{s,t}\; u(c_t^{cf}, h_t^{cf}) + (1-\tilde{\pi}_{s,t})\; \phi(b_t^{cf})\right) \tag{1}$$

with $\tilde{\pi}_{s,t} = \prod_{i=j}^{i=(j+(t-y))} \pi_{s,i}$ being the probability the agent is alive at year t and $\{c_t^{cf}, h_t^{cf}, b_t^{cf}\}_{t=y}^{t=y+(T-j)}$ the consumption/bequests plan for an agent at state $(a, h, z, j, \mathcal{A})$ in year y under the simulation "cf". Notice that to each state $(a, h, z, j, \mathcal{A})$ at year y and counterfactual "cf", corresponds a different consumption-bequests plan, but for ease of exposition I choose to suppress the state and index by year t instead. Expectations over the idiosyncratic component of labor ability (z) have also been suppressed for the same reason. Then, the consumption equivalent λ_{CE} is implicitly defined by the equation.

$$\mathcal{W}_y\left(\{c_t^{cf}, h_t^{cf}, b_t^{cf}\}_{t=y}^{t=y+(T-j)}\right) = \mathcal{W}_y\left(\{\lambda_{CE}\ c_t^{BaU}, \lambda_{CE}\ h_t^{BaU}, \lambda_{CE}\ b_t^{BaU}\}_{t=y}^{t=y+(T-j)}\right)$$

To complete the framework, two methodological assumptions must be clarified. First, the base year (y) for calculating consumption equivalents is cohort-dependent: it is set to 2002 for individuals aged 25 or older in that year, and for younger cohorts, it is the year they turn 25. Second, the analysis requires assumptions for the post-2020 period. In all counterfactuals, the Loan-to-Value (LTV) ratio is fixed at 0.8, and house prices are projected using the stochastic process defined in Section 5.1.5. Furthermore, in the "Only Recession" and "Baseline" scenarios, the income gap for working-age households relative to the pre-crisis trend is assumed to be permanent, remaining at its 2020 level indefinitely.

7.3.2 Welfare Analysis: Baseline Results

To understand the welfare consequences of macroeconomic uncertainty, I begin by calculating the welfare gains or losses of the "Baseline" simulation relative to the "Business-As-Usual" (BaU) scenario, measured in consumption equivalents. A consumption equivalent λ_{CE} greater than 1 signifies that a household would prefer the "Baseline" world, and would require a $(\lambda_{CE} - 1) * 100\%$ increase in their lifetime consumption and bequest plan to be indifferent to remaining in the BaU simulation. This same exercise is repeated for the "Only Recession," "Only Housing Cycle," and "Only Rise in LTV" simulations. The results for all

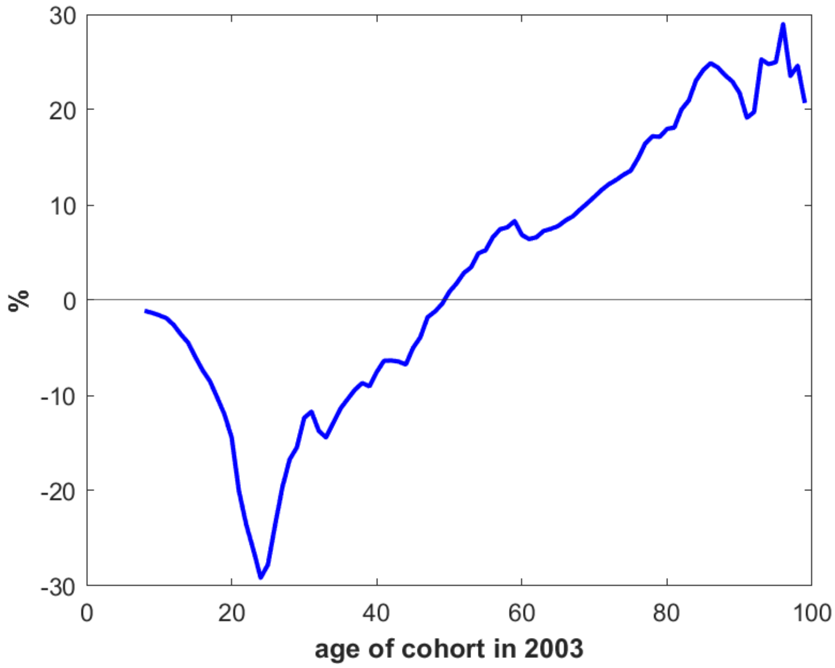


Figure 19: Welfare Gains/Losses: Baseline

counterfactuals are presented in Figure 19.

A first glance at the results reveals a stark heterogeneity in welfare gains and losses across different age groups. While older cohorts benefited significantly from the macroeconomic shocks of the period—by up to 30% in consumption equivalent terms—younger cohorts endured welfare losses of up to 30%. The pattern of these effects is strongly correlated with age. The losses are most severe for the cohort aged 24 in 2003. From this peak, the impact becomes less negative in both directions: for younger cohorts, losses decrease down to -1% for those aged 9, the youngest cohort simulated, and for older cohorts, losses also decrease, eventually turning into gains from age 50 onwards. These gains continue to increase with age, with the maximum benefit recorded for the cohort aged 96 in 2003 (29%). The fluctuations in the welfare curve arise from noise in the discretized 2002 data distribution and from non-convexities in the value function due to the discrete housing choices. It is worth noting that these effects are substantially larger than those typically found in the literature using representative-agent business cycle models (see also Erosa et al. (2025)).

7.3.3 Welfare Analysis: Decomposition

To understand the distinct impacts of the housing cycle, the recession, and the rise in LTV ratios, I conduct a decomposition analysis by activating each channel one at a time.

Only Housing Cycle: The results are plotted in Figure Figure 20. When we isolate the housing cycle, a clear U-shaped pattern of welfare effects emerges across age groups. Cohorts younger than 15 in 2003 would have experienced welfare gains of up to 7%. In contrast, those who were in their twenties suffered significant losses of up to 10%. Cohorts aged 30-45 faced only minor losses (no more than 2%), while older cohorts saw welfare gains that, from age 52 onwards, entirely account for the gains in the main "Baseline" simulation.

The mechanism behind this U-shape is straightforward: above-trend house prices harm those accumulating housing and benefit those decumulating or leaving bequests, with the opposite holding true for below-trend prices. This explains why cohorts entering the housing market after the 2011 bust benefited, while those aged 20-29 in 2003 were penalized for buying during the boom. As shown in Figure **??**, middle-aged cohorts also scaled back housing investment due to high prices, which explains their more limited welfare losses. For older cohorts, however, utility from bequests is the most important channel. A simulation isolating this effect, plotted in Figure 21, demonstrates that the increased "warm-glow" utility from higher-valued estates can, by itself, explain the entirety of the welfare gains for cohorts over 50.

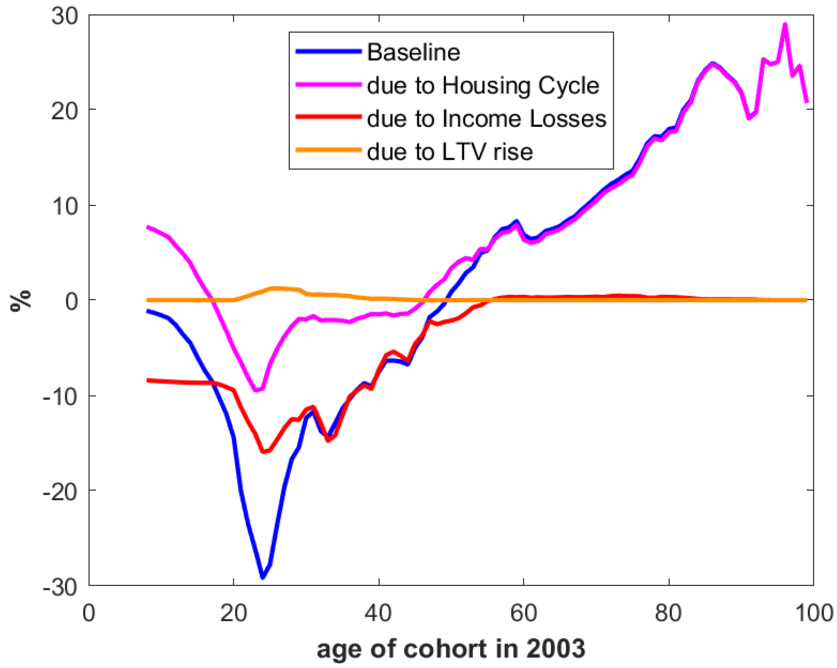


Figure 20: Welfare Gains/Losses: Baseline and Decomposition

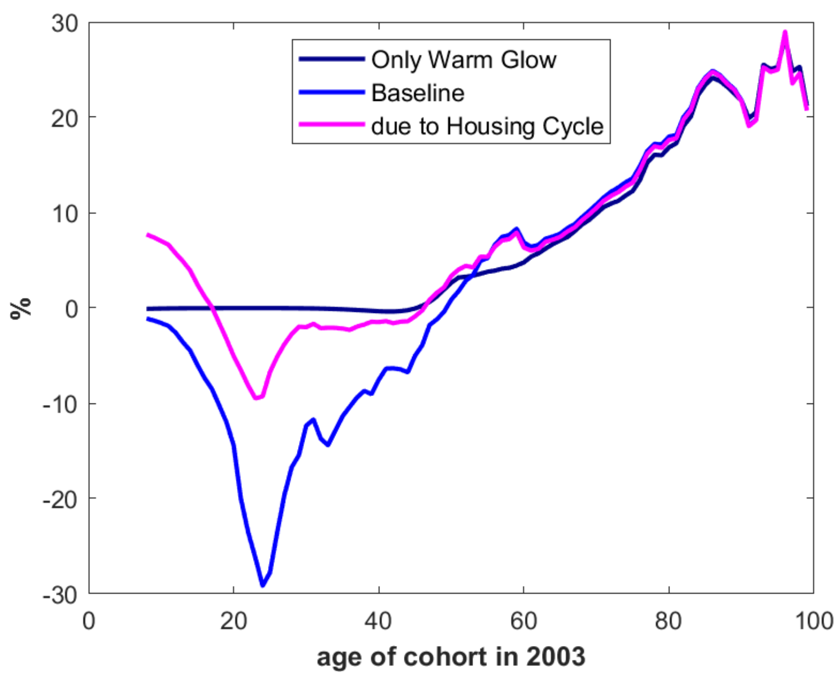
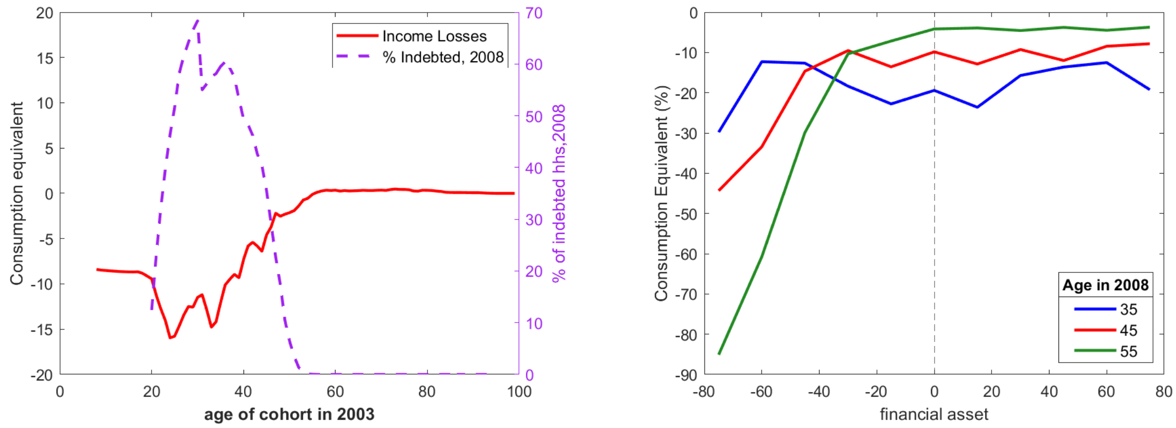


Figure 21: Welfare Gains/Losses: Housing Cycle and the Warm Glow

Only Income Losses: As illustrated in Figure 2, the recession induced a 33% decline in the income of working-age households compared to the pre-crisis trend, while the income of retirees was unchanged. This naturally concentrates the welfare losses on younger cohorts, with retired cohorts suffering no impact. The permanent nature of this income shock explains why the welfare losses are so substantial, around 8% for the youngest cohorts.

Interestingly, the most severely affected group was not the very youngest, but rather cohorts aged 20-39 in 2003. Their key characteristic was being highly leveraged when the recession struck. Figure 22a directly links these two factors, depicting a positive correlation between a cohort's share of indebted households in 2008 and its corresponding welfare loss. To corroborate this, Figure Figure 22b plots welfare losses against financial assets for households of different ages, holding housing and productivity constant. It confirms that heavily indebted households suffer higher losses. This result mirrors the plight of young households who, after taking on mortgages, were confronted with a permanent 33% income reduction. This squeezed their disposable income after debt payments far more than that of debt-free households. Furthermore, the obligation to repay debt before retirement exacerbates the situation, meaning that for a given level of debt, older households face greater welfare losses due to their shorter time horizon for debt repayment [7].

[7]For positive or slightly negative financial assets, welfare losses are smaller for older households, since they will soon retire and their pensions are not affected by the Recession.



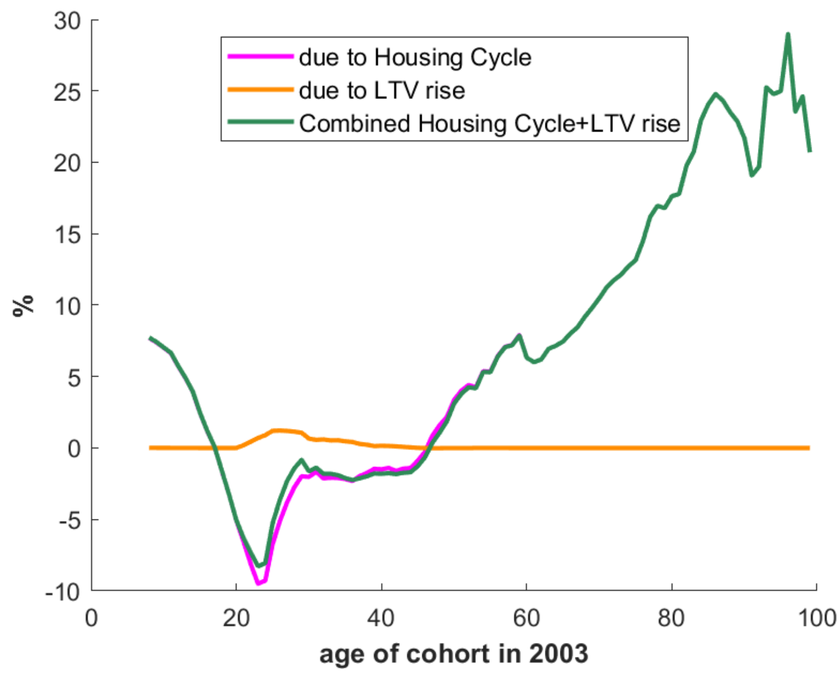
(a) Welfare Losses and Share of Indebted Households **(b)** Welfare Losses across age and debt

Figure 22: Income Losses and Leverage
Note: Panel (b) Plots the welfare losses against financial assets for cohorts of different age in 2008, conditioning on median labor productivity and housing of about 75 thousands evaluated at $p_h = 1$.

Only Rise in Loan-To-Value ratio: In the absence of the housing boom's high prices, the period's lenient lending conditions would have had only slightly positive welfare effects, as shown in Figure 20. However, without the higher LTV ratio, housing accumulation by young households would have collapsed (Figure 15a). This prompts the question: did the rise in the LTV ratio also offset the welfare losses caused by the housing cycle?

Figure 23 plots the welfare effects from a counterfactual in which both channels of the rise in LTV and the housing cycle are turned on, against each channel individually. The results demonstrate that the lenient financial conditions offered little relief, mitigating the welfare losses of young cohorts by no more than one percentage point.

Figure 23: Welfare Gains/Losses: Housing Cycle and the Rise in LTV



7.4 Intra-Cohort Heterogeneity: The Long-Term Effects of Home Acquisition Timing

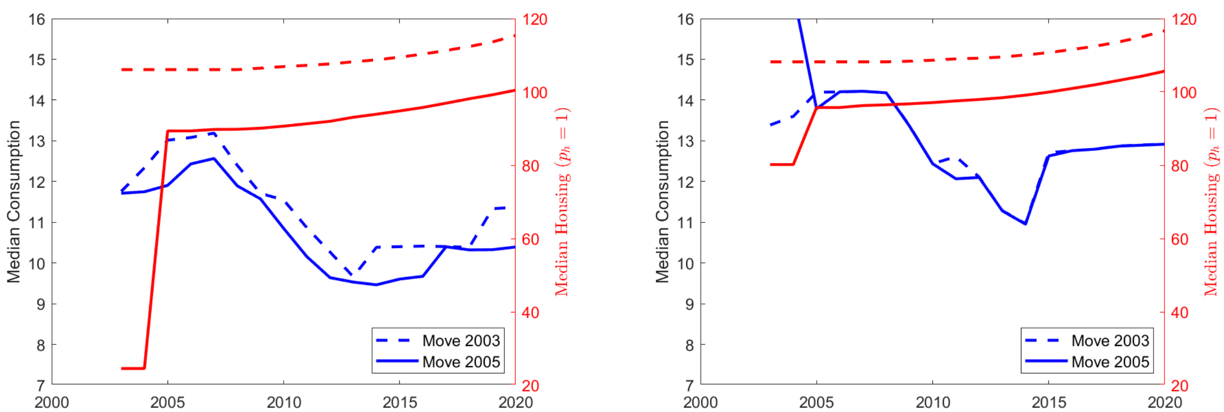
Having established differences in average welfare across cohorts, I now demonstrate the considerable heterogeneity within cohorts. This variation is caused by the binary taste shock q that allows households to move only in certain periods, capturing exogenous events like family changes or migration. To demonstrate this, I simulate two scenarios for cohorts aged 29 and 39 in 2003. In the first scenario, households can move in 2003 and after 2003 they can move with probability q. In the second, they are prevented from moving until 2005, the peak of the housing bubble. They are allowed to move in 2005, and after 2005 they are allowed to move with probability q. The median housing and consumption paths for each case are shown in Figure 24.

The results show that for the 29-year-old cohort, who were renters at the start, the timing of their first home purchase was critical. Those forced to wait until 2005 bought a 15% smaller house than those who bought in 2003, and this size gap remained above 10%

for the next 15 years. Their median consumption was also permanently reduced by about 7%. This lasting damage is explained by two factors: first, they paid more for a smaller asset due to peak prices; second, they entered the recession with a larger mortgage balance, which amplified the negative income shock.

By contrast, the median 39-year-old was already a homeowner at the end of 2002. While delaying a move to 2005 still meant acquiring a 9% smaller house than they would have in 2003, the impact on their consumption was temporary. Since they were upgrading rather than buying for the first time, their new investment and the associated debt were less significant than for the younger cohort, insulating their long-term consumption from the timing of the move.

Figure 24: Long-Term Effects of Home Acquisition Timing



(a) Cohort aged 29 in 2003

(b) Cohort aged 39 in 2003

Each panel plots the median consumption (blue, left axis) and median housing (red, right axis) for a specific cohort under two mobility scenarios. The first scenario (dashed line) allows households to move in 2003 and with probability q thereafter. The second scenario (solid line) prohibits movement until 2005, allows movement in 2005, and afterwards movement is also permitted with probability q. The left and right panels show results for cohorts aged 29 and 39 in 2003, respectively.

8 Conclusion

This paper provides empirical evidence that the housing cycle and the recession had heterogeneous effects across cohorts. While median working-age households experienced substantial income losses during the recession—around 30% below the pre-crisis trend—retirees' median incomes remained largely insulated. The analysis also shows that younger households were far more active in the housing market during the boom years, whereas retirees mostly refrained from adjusting their housing positions. In the aftermath of the housing market collapse and throughout the recession, the wealth–age profile shifted significantly in favor of older households.

Using a heterogeneous agents model of life-cycle saving that incorporates housing and house price uncertainty, the study identifies the mechanisms through which these macroeconomic shocks shaped the wealth–age distribution and assesses the extent to which the model can account for the observed patterns. The framework is then employed to quantify the resulting welfare effects across cohorts.

The model explains roughly one-third of the observed increase in intergenerational wealth inequality, attributing the remainder to pre-2002 cohort heterogeneity. The results indicate that the housing cycle was the main driver behind the wealth redistribution across cohorts.

The welfare effects of these shocks are substantial and vary markedly across generations. Younger cohorts experienced losses of up to 30%, primarily due to purchasing homes at inflated prices and then facing significant income declines while still repaying their mortgages. In contrast, older households benefited from welfare gains of comparable magnitude, largely as a result of leaving bequests in the form of high-valued housing.

Finally, the analysis shows that the timing of home purchases had lasting consequences. Households that transitioned from renting to homeownership in 2005 endured more than a decade of lower outcomes—around a 10% reduction in median housing size and a 7% decline in median consumption—relative to their peers who became homeowners just two years earlier.

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Appendix

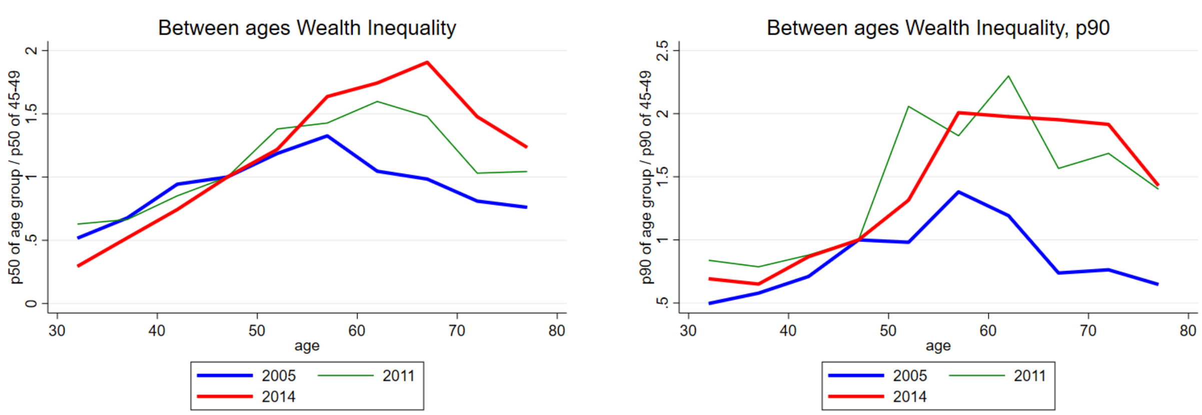
A Data

A.1 Accounting for the changes at the top

?? documents that the median elder household has become richer relative to the median aged 40-44 household. In this section I show that the change in the wealth-age profile has not affected only the median household but also the top 10% of wealth. Moroever, increased wealth inequality between ages is the dominant factor behind the increased prevalence of elder households ($\geq$70 yeas old) among of the richest top 10% of households in Spain after 2008.

A.1.1 Intergenerational Wealth Inequality at the 90th percentile of wealth

Figure 25b plots the ratio the 90th percentile of networth of a certain 5-year age bind, over the 90th percentile of networth among households aged 40-45, for different years. In 2002, the 90th percentile of wealth among aged 70-74 households was 25% less than the the 90th percentile of wealth among households aged 40-44. But in 2011 and 2014, the 90th percentile among the 70-74s was respectively 70% and 90% higher than the 90th percentile of wealth among the households aged 40-44. In other words the shift of the wealth-age profile in favour of the old ahs occurred not only at the median but also at the top of the wealth distribution.



(a) Median **(b)** p90

Figure 25: Wealth Redistribution across ages: at the Median and at the 90th percentile

A.1.2 The age composition at the top 10% of wealth

A striking feature of the data is that since 2011, a large share of the richest households in Spain are elders ($\geq$ 70 years old). In 2002 only 1 in ten households in the top 10% of wealth were above 70 years old and 30% of the households were above 60 years old (Appendix A.1.2).

However, in 2011 the share of households above 60s years old in the top 10% of wealth had risen to more than half, and a quarter of the households were above 70 years old. The same trend has occurred at the top 5% of wealth, with the shares of above 60 years old and above 70 years old rising from 10% & 30% in 2002 to 22% and 50% in 2011 respectively (Appendix A.1.2).

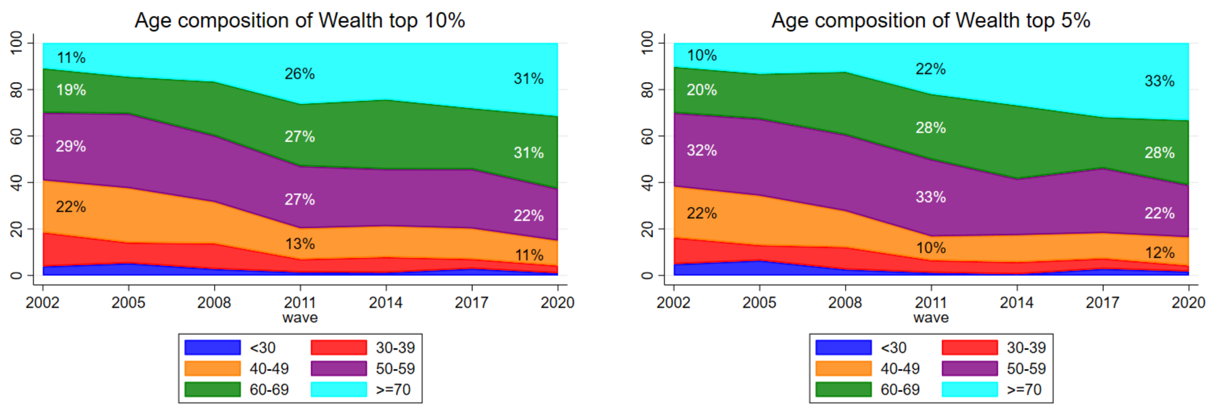


Figure 26: Age Composition at the top of Wealth

These changes in the age composition of the top wealth groups reflect the rise in intergenerational wealth inequality that is observed across the wealth distribution. To demonstrate this point, I pursue an accounting exercise that decomposes the evolution of wealth inequality in (i) demographic change, (ii) changes in intra-age inequality, and (iii) changes in inter-age inequality. In other words, the larger share of elders at the top of wealth in 2011 maybe the outcome of 3 factors; (i) the share of elders in the population has grown, (ii) the distribution of wealth within age groups has changed (e.g. the right tail of wealth distribution has become fatter among elders) or (iii) the elders have become richer relative to the young.

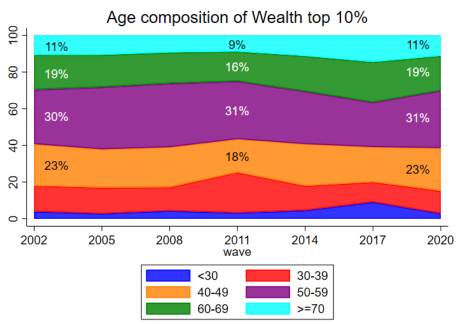
Notice that the survey provides information with respect the age of the households, their networth and a weight. For each wave w, I split households into 7 age-groups ($< 30, 30-39, ...70-79, \geq 80$), and for each age-group I split the intra-age group into 20 wealth bins. This way, there are 7*20 age-quantile groups (j,q) for each wave. Let med_{wh}: the median wealth of age group h, at wave w and χ_{wqj}: the ratio of median wealth of age-quantile group (j,q) h, at wave w over med_{wj}. Then for each observation i, in age-group j, quintile group q at wave w, I construct a counterfactual networth

$$nw^{cf}_{ijwq} = \frac{med_{2002j}}{med_{wj}} * \frac{\chi_{2002qj}}{\chi_{wqj}} nw_{ijwq}$$

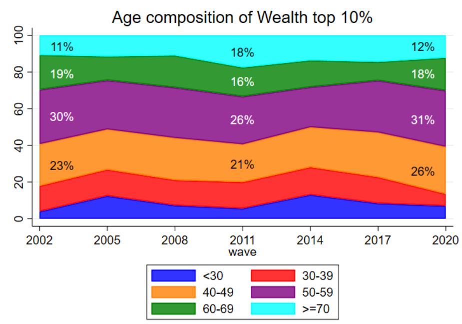
and a counterfactual weight $weight^{cf}_{ijw} = \frac{\textit{Share of group j in 2002}}{\textit{Share of group j in w}} weight_{ijw}$.

The term $\frac{med_{2002j}}{med_{wj}}$ reverses any changes in between-age inequality that have occurred between 2002 and w, the term $\frac{\chi_{2002qj}}{\chi_{wqj}}$ reverses the intra-age changes in wealth inequality and the counterfactual weights correct for demographic change. The resulting distribution by accounting is similar to the 2002 wealth-age distribution, since all changes are reversed (Figure 27a).

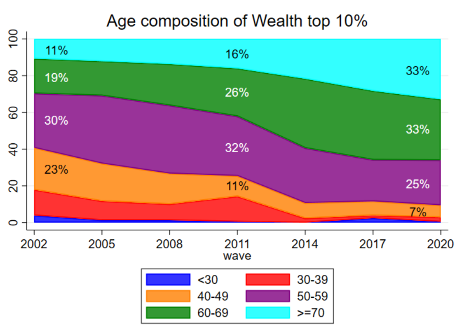
In order to isolate the impact of each of the 3 drivers, I adjust only for one of the changes at once. The result of this exercise is that reversing the changes in between-ages wealth inequality (by adjusting the median of each age group) is almost all that matters. Reversing only the changes in between-ages wealth inequality implies a counterfactual share of above 60s at the wealth top 10% of 34% in 2011 and 30% in 2020, comparing to 53% and 62% in the Data (Figure 27e). By contrast, reversing the changes only in intra-age wealth inequality results in a rise of the share of above 60% in the wealth top 10% of 42% in 2011 and 66% in 2020, while by adjusting only for demographic change, these numbers are 49% & 57%.



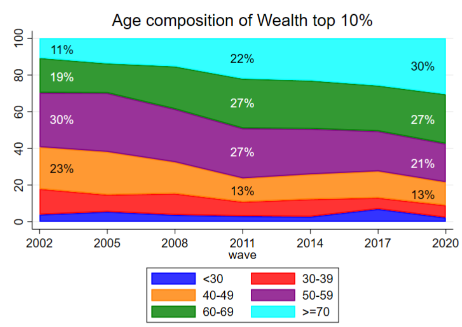
(a) All Changes Reversed



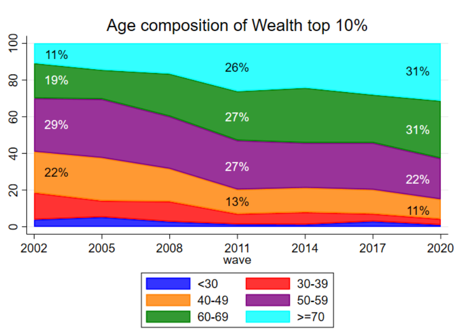
(b) Reverse changes in Inter-Age inequality



(c) Reverse changes in Intra-Age inequality



(d) Reverse changes in demographics



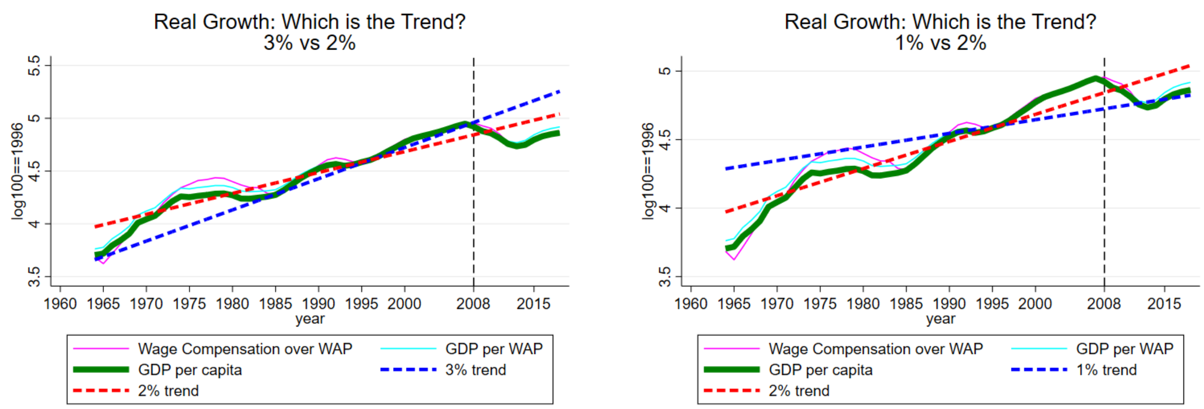
(e) Data

Figure 27: Age Composition at the top: An accounting Exercise

A.2 Trend Growth

In both Data and Model I assume that the economy grows at the 2.5% trend. In this subsection I show that this is a realistic assumption.

I consider 3 measures of growth: GDP per capita, GDP per Working Age Population (WAP) and wage compensation per WAP. Figure 28a plots these measures against the 2% and 3% trend. THe 3 measures mostly commove, especially from the 80s onwards, and it's not discernible by eye if the 2% or 3% trends describes better the time series. On the other hand, the 1% trend seems a bad assumption (Figure 28b).



(a) Trend Growth: 2% & 3 %

(b) Trend Growth: 1% & 2 %

Figure 28: Growth Measures and Trend
The 3 measures of grwoth considered are GDP per capita, GDP per WAP & (total) Wage Compensation per WAP. Data come from BdE and all measures are deflated using the CPI (OECD). Panel (a) plots these measures against the 3% & 2% trend, while panel (b) does the same against the 2% & 1% trend.

As seen in Figure 28a, the evolution of all 3 measures features considerable short-run deviations from the long-run trend, which makes the estimation of the long-run trend sensitive to base effects. To delve into this issue, I regress the log of GDP per capita (the longest available series) on year, selecting all subperiods of the form y-2007 with $y \in [1967, 2006]$. Figure 29 plots the estimates against the starting year (y). Almost all of the estimates are between 2% and 3%, with the mean estimate being 2.56%. Taking all information into account, I conclude that the 2.5% growth trend is a realistic assumption.

A.3 Reported House Prices

A valid concern when interpreting the changes in median assets and networth is that elder households do not update their house prices after the burst of the housing cycle. To dispel this concern I calculate the median reported price per square meter of the main residence for different cohorts in 2008 and 2014. The percentage drop is similar for households across cohorts between 2008 and 2014 (around 35%), and the same is true for the percentage change of the median assets (Figure 30).

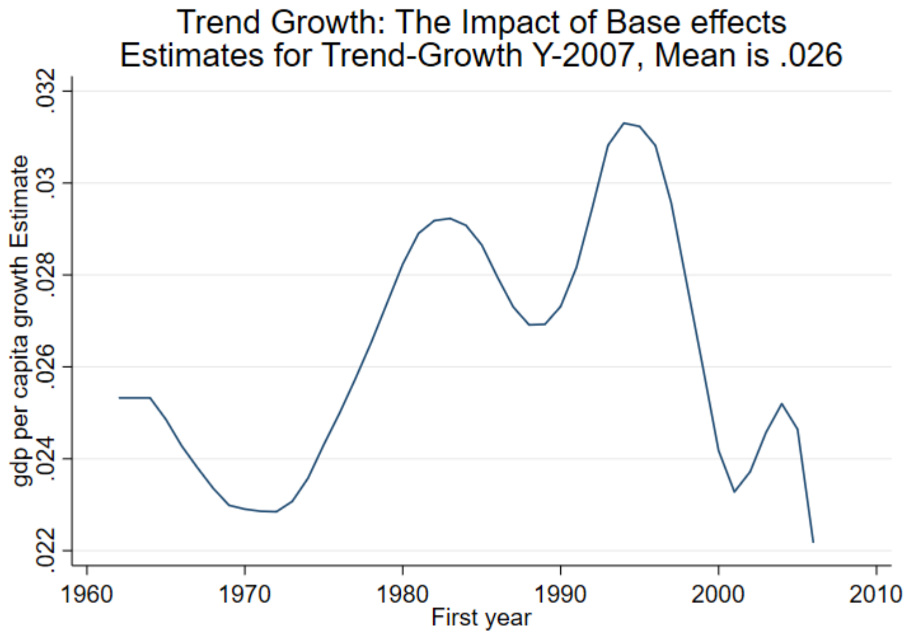


Figure 29: Trend Growth: The Impact of Base Effects

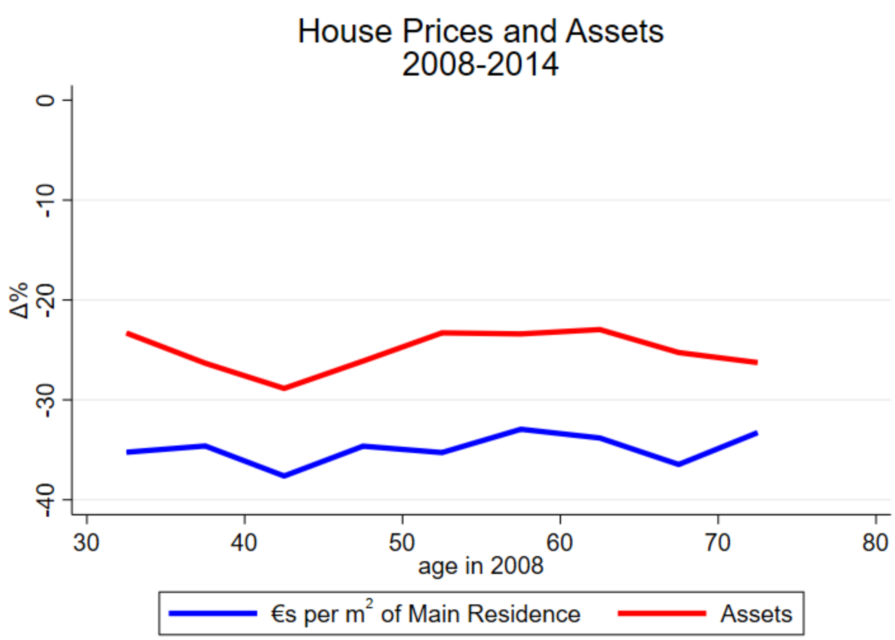


Figure 30: Change in median House Prices (€s per m^2 and Assets across cohorts

B Model

B.1 Existence of Balanced Growth Path

To prove the existence of a Balanced Growth Path, I first need to merge the two stages of the problem into 1:

$$\textit{for j=1,2,....T:}\quad V_j(a,h,z;\mathcal{A}) = \max_{c,a',s,h'} \left\{ e_j \frac{\left(\frac{c^{\alpha}h'^{1-\alpha}}{e_j}\right)^{1-\gamma}}{1-\gamma} + \right.$$

$$\left. \beta E[\left(\pi_j V_{j+1}(a',h',z',\mathcal{A}') + (1-\pi_j)\phi_1 Z'^{\alpha(1-\gamma)} \frac{\left(1+\frac{a'+p_h' h'}{\phi_2 Z'}\right)^{(1-\gamma)}}{1-\gamma}\right)|z,\mathcal{A}] \right\}$$

$$s.t.\ \ s + p_h h' + p_h c_{adj}(h,h') = a + p_h h$$

$$s \geq \min\{a, -\xi p_h h'\}\ \textit{if}\ h' \neq h, \quad s \geq 0\ \textit{if}\ j \geq J_{ret}$$

$$a' + c = s(1+r(s)) + Zy(j,z) - Z\tau\left(y(j,z) + \mathcal{I}_{(s\geq 0)} r(s)\frac{s}{Z}\right)$$

$$r(s) = r_b\mathcal{I}(s \geq 0) + r_l\mathcal{I}(s<0)$$

$$a' \geq min\{0, s\}$$

$$V_{T+1}(a,h,z;\mathbf{A}) = 0\ \forall a,h,z,\mathcal{A}$$

Rewriting the problem with $\tilde{x} = \frac{x}{Z}$ for x=c, a', s, p_h, it follows that (i) the returns function is homogeneous of degree $\alpha(1-\gamma)$ wrt Z and (ii) the constraints are independent of Z. From this it follows that the model features a balanced growth path and the Bellman Equation can be written with only normalized variables:

$$\textit{for j=1,2,....T:}\quad V_j(\tilde{a},h,z;\mathcal{A}) = \max_{\tilde{c},\tilde{a'}}, \tilde{s}, h' \left\{ e_j \frac{(\frac{\tilde{c}^{\alpha}h^{1-\alpha}}{e_j})^{1-\gamma}}{1-\gamma} + \right.$$

$$\left. \beta(1+g)^{\alpha(1-\gamma)} E\left[\pi_j V_{j+1}(\tilde{a'},h',z';\mathcal{A}') + (1-\pi_j)\phi_1 \frac{(1+\frac{\frac{\tilde{a'}}{(1+g)}+\tilde{p'}_h h'}{\phi_2})^{(1-\gamma)}}{1-\gamma}|z,\mathcal{A}\right]\right\}$$

$$s.t.\ \ \tilde{s} + \tilde{p}_h h' + \tilde{p}_h c_{adj}(h,h') = \frac{\tilde{a}}{(1+g)} + \tilde{p}_h h$$

$$\tilde{s} \geq \min\{\frac{a}{(1+g)}, -\xi\tilde{p_h}h'\}\ \textit{if}\ h' \neq h, \quad \tilde{s} \geq 0\ \textit{if}\ j \geq J_{ret}$$

$$\tilde{a'} + \tilde{c} = \tilde{s}(1+r(\tilde{s})) + y(j,z) - \tau\big(y(j,z) + \mathcal{I}_{(\tilde{s}\geq 0)} r(\tilde{s})\tilde{s}\big)$$

$$r(\tilde{s}) = r_b\mathcal{I}(\tilde{s} \geq 0) + r_l\mathcal{I}(\tilde{s}<0), \quad \tilde{a'} \geq min\{0,\tilde{s}\}$$

$$V_{T+1}(\tilde{a},h,z;\mathbf{A}) = 0\ \forall \tilde{a},h,z,\mathcal{A}$$

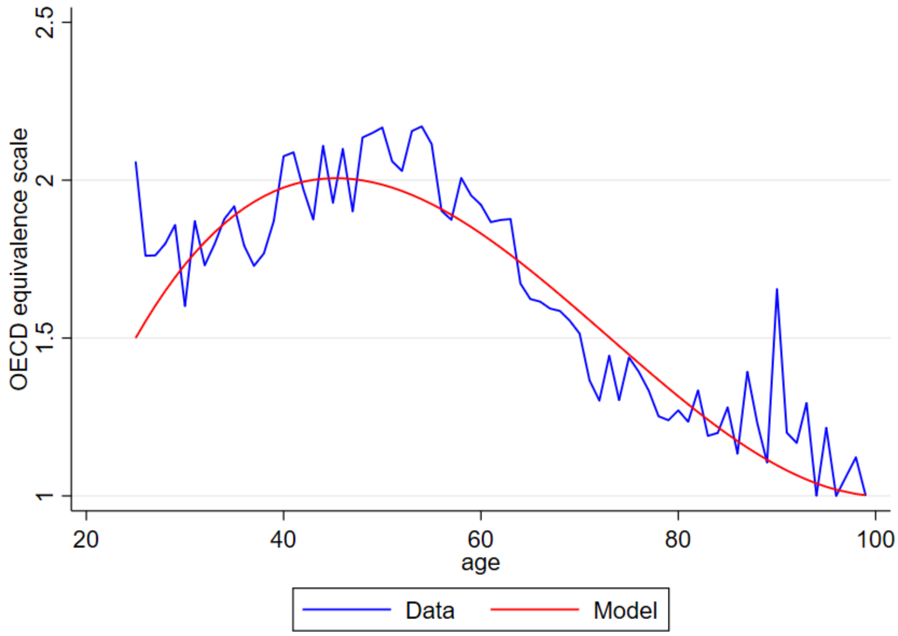
Therefore, along the Balanced Growth Path, c*,s*,a* are homogeneous of degree 1 with respect to Z and h* is homogeneous of degree 0 with respect to Z (for details see Appendix B.1)

C Calibration

C.1 Equivalence scale

The estimated coefficients of the polynomial are [-1.1235,0.16255,-0.0026, 0.00001]. Figure 31

Figure 31: Equivalence Scale: Model & Data



I use the oecd equivalence scale. The Data line are means of equivalence scale for each age. I impose in the model that households are born with 2 members at 25 years old and at age 100 they are single-membered.

C.2 Housing Grid

I use 10 points for the housing homeonwers' grid. To calibrate these points, I first allocate households with positive housing wealth from the 2002 wave into 10 deciles of housing wealth and set the last 10 grid points equal to the 10 median of the deciles. (In other words, equal to the 5th,15th,25th,..., and 95th percentiles of housing wealth). I then divide by $\tilde{p}_h$ to obtain the gridpoints.

The resulting housing grid for homeowners is:

$$[24.45, 41.35, 56.70, 75.93, 87.45, 101.24, 126.55, 151.85, 202.47, 345.00]$$

(Numbers are rounded to the second decimal)