

Mortgage structure, household saving and the wealth distribution*

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Abstract

Fixed amortization schedules in mortgage contracts force homeowners to save into illiquid home equity. I show that in an otherwise standard life-cycle model, homeowners rationally respond to mandatory repayments by cutting consumption and increasing precautionary saving in liquid assets. Consistent with this mechanism, I document in Euro area data that younger, poorer homeowners have much higher saving rates than their non-mortgage peers, and allocate a large share of saving to mortgage repayment. The exception is the Netherlands, where interest-only mortgages are common. This complements recent quasi-experimental evidence showing large effects of amortization requirements on saving. A quantitative version of the model reproduces these facts and shows that mandatory amortization increases both home equity and financial wealth accumulation, particularly up to age 40. Wealth-to-income ratios increase by close to a quarter for lower-income homeowners at age 40, while the impact for the highest-income households is minimal. These effects build up over time and have substantial implications for aggregate consumption and wealth: mandatory amortization dampens total wealth inequality, but increases consumption volatility and financial wealth inequality.

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1 Introduction

Mortgage debt repayment is a large component of household saving flows: it accounts for 30% of aggregate household saving in the Euro area and about 25% in the US (Table 1), comparable in size to pension contributions. The standard mortgage contract includes a strict repayment schedule, fixed at origination, that ensures principal is regularly paid down until maturity. If deviating from this schedule is costly and home equity is illiquid – as in most countries, especially in Europe – then mortgages function as a mandated saving plan, with potentially large implications for consumption and saving over the life cycle.

	Mortgage debt repayment	Gross saving	Share %
Euro area	271.8 bi €	894.3 bi €	30%
USA	292.7 bi \$	1190.9 bi \$	25%

Table 1: Aggregate mortgage debt repayment and gross household saving, 2017

Source: HFCS, CEX and national accounts

A recent wave of empirical studies has robustly shown that amortization requirements in mortgages have powerful negative effects on consumption, relative to more flexible repayment schemes (Backman and Khorunzhina, 2024; Bernstein and Koudijs, 2024; Larsen et al., 2024; Vihriala, 2023). But three key questions remain open: (i) can these large effects be rationalized by standard models of consumption and saving? (ii) How do the effects vary over the life cycle and across the income and wealth distributions? (iii) What are the aggregate and distributional implications for consumption and saving, namely on consumption volatility, household welfare, and the distribution of wealth?

In this paper, I make progress on these questions by developing a model of consumption and saving by households who face uninsurable income risk, illiquid housing wealth and a mandated mortgage repayment schedule. The model shows that the large effects found in the literature can be rationalized as responses to tight liquidity constraints, without requiring any behavioral frictions. The mechanism is straightforward. A binding repayment schedule channels fixed amounts from homeowners’ income into illiquid home equity. When refinancing or home equity extraction is inaccessible, this stream of saving is effectively “forced” since, absent such frictions, some homeowners would optimally repay less of their mortgage debt. In response, rational households facing uninsurable income risk require a larger liquid assets buffer, to avoid default or large drops in consumption if income falls. The mechanical effect of repayment rules, together with the amplification of homeowners’ precautionary saving motives, increase homeowners’ saving rate substantially when they have little liquid wealth and/or steep expected income growth – the case of most young homeowners. For older or wealthier households, far from the liquidity constraint, saving and repayment choices will be almost unaffected by mortgage repayment structure.

This simple mechanism generates clear, testable predictions for key outcomes. Mandatory amortization, relative to flexible repayment, will drive young and lower-income homeowners to have larger active saving rates, but higher MPCs. A large fraction of their saving will go to amort-

ization, with the flow into and stock of liquid saving being smaller than under flexible repayment, implying a higher incidence of low-liquidity (“hand-to-mouth”) status at young ages, and little effect for older/high-income owners. Conversely, once mortgages are repaid and home equity is unlocked, we expect to see the opposite, i.e. higher consumption.

I bring forward novel evidence from the Euro area which, consistent with these predictions, suggests a strong effect of mortgage amortization requirements, complementing the preceding empirical evidence, which focuses on short episodes around policy changes. In most of the Euro area, homeownership is prevalent and attained relatively early in life. Conditional on age and income, young owners face higher cash-flow burdens (PTI) than renters, yet their user-cost proxy (interest/income) is lower than rent/income, consistent with ownership being individually optimal despite the tight liquidity constraints faced as a mortgage borrower. I highlight the following three stylized facts from the data.

First, the saving rate of mortgaged homeowners in the Euro area is much higher than non-mortgaged households at the beginning of the life cycle and the bottom of the income and wealth distributions, while for older, richer groups there is no difference between households with a mortgage or not. Second, the burden of amortization is highly uneven: households in the bottom income quintile dedicate up to three times more of their income to mortgage repayment than those in the top quintile. Third, in the Netherlands, the only country in the dataset where interest-only mortgages are common, I observe that the heterogeneity in saving rates among homeowners with interest-only mortgages is similar to non-mortgaged households, rather than their counterparts paying off amortizing mortgages.

Finally, I demonstrate that a quantitative version of the model framework described can successfully reproduce these patterns. The model, solved using modern neural networks methods, is a standard incomplete markets model of consumption and saving, where homeowner households face rich uninsurable earnings risk, use a liquid financial asset to smooth consumption, and decide how to repay their mortgage debt, with realistic mortgage contracts that feature varying flexibility in amortization. Three key results emerge.

First, for the average household, mandatory amortization reduces consumption, especially early in life, dropping by 10% of current income for the average 30-year-old homeowner. The impact remains positive throughout the life cycle, building up such that net wealth (including both home equity and financial wealth) at age 60 is close to 25% higher. However, mandatory amortization also leads to smaller liquid asset buffers, increasing the share of hand-to-mouth households and the average MPC among young homeowners (ages 30-40). Second, and contrary to conventional wisdom, over the life cycle households under mandatory amortization regimes accumulate more of both types of assets: not only illiquid home equity but also liquid financial savings increase, as households eventually build larger precautionary buffers to compensate for tighter liquidity constraints. Third, the model shows the effects are highly heterogeneous: the wealth-to-income ratio for households in the bottom income quintile increases by approximately 25 percentage points under mandatory amortization, while the effect for the top quintile is just 5 percentage

points.

Restricting repayment flexibility is the norm in Europe, for financial stability policy goals. My findings show these potential benefits must be traded off against sizeable costs for young households, for whom such rules reduce consumption smoothing and crowd out investment in financial assets, widening financial wealth inequality and discouraging homeownership (similar to down payment rules). These findings also suggest that the large effects of amortization requirements found in recent empirical literature may not apply to the US, where accessing home equity is relatively frictionless. Finally, by raising both the prevalence and the MPCs of liquidity-constrained homeowners precisely where mortgage balances are large, amortization rules can amplify the transmission of macroeconomic shocks, and contribute to explaining the large, persistent share of ‘wealthy hand-to-mouth’ households in many countries.

Related literature and contribution

This paper, first and foremost, extends the household finance literature on the effects of mortgage contract design, complementing recent empirical work demonstrating that amortization requirements can substantially decrease household consumption. Bernstein and Koudijs (2024) exploit a 2013 policy reform in the Netherlands that increased the cost of interest-only mortgages, until then the prevalent contract form. The mandated amortization led to a one-for-one increase in saving among first-time homebuyers, mainly financed by cuts in consumption. Backman and Khorunzhina (2024) and Larsen et al. (2024) examine the introduction of interest-only mortgages in Denmark in 2003, documenting strong take-up and positive effects on consumption, consistent with an important role for liquidity constraints. Additional evidence from Finland (Vihriala, 2023) and Sweden (Backman et al., 2024) corroborates these results.¹ My paper rationalizes these findings in a standard model of household consumption and saving, leaving a smaller role for behavioral biases driving the results. Further, it traces out the long-run implications of this effect for wealth accumulation by different households, which the empirical literature, mostly based on short time windows of data around policy changes, has not been able to do. My structural modeling approach also allows me to show the implications of this effect for the distribution of financial and housing wealth.

Two recent papers follow a similar approach, deploying rich heterogeneous-agent life-cycle models, to examine related effects of mortgage design on household saving and portfolio decisions. However, they look at different aspects of mortgage structure; and they look at the US/Canada markets, where refinancing and home equity extraction are cheap and frequent, unlike in the Euro area. Balke et al. (2024) show that tighter loan-to-value ceilings mainly shift when households start accumulating a down-payment, whereas Boutros et al. (2024) show that letting borrowers switch among fixed- and variable-rate contracts mainly reallocates interest-rate risk across balance-sheet positions. This paper isolates a different margin. I demonstrate that the

¹The literature has also found positive effects of relaxing down payment requirements on young homeowners’ consumption and housing purchases (Engelhardt and Mayer, 1998; van Horen and Tracey, 2022).

amortisation schedule embedded in the mortgage is a powerful, often binding liquidity constraint for young, low-income, low-wealth homeowners.

My paper also contributes to two other strands of the literature. First, it adds a new channel to the wealth inequality literature e.g. Benhabib et al. (2017, 2019); Hubmer et al. (2021), which shows that wealth inequality dynamics are driven by a combination of income inequality, heterogeneity in returns on wealth, and heterogeneity in saving rates. While previous work has established the role of housing in shaping the distribution of returns (Jorda et al., 2019; Kuhn et al., 2020; Martinez-Toledano, 2023), I introduce a channel that connects housing with saving rate heterogeneity, as amortization requirements raise the saving rate of homeowners at the bottom of the wealth distribution, but do not affect the top.

Second, my paper follows up on a theoretical literature that has been considering the optimal design of mortgage contracts, mainly from the perspective of macro-financial stability (Greenwald, 2018; Campbell et al., 2021; Guren et al., 2021). I demonstrate that, through their effects on saving behavior, the impact of mortgage structure on household consumption and saving is both large and highly heterogeneous. My results suggest that optimal mortgage design must take into account this heterogeneity, and also have potential implications for the literature on designing policies for mandatory retirement contributions.

These findings have important policy implications for macroprudential regulation of mortgage lending, particularly regarding down payment requirements, amortization mandates, and mortgage interest deductibility. My results suggest that while mandatory amortization promotes wealth building, especially among younger and less affluent homeowners, the constraints it imposes on liquidity may carry welfare costs through reduced consumption smoothing. Understanding this tradeoff is essential in designing optimal mortgage regulations.

Structure of the paper Section 2 presents the model framework, explaining the key mechanism at play that drives large effects of amortization requirements. Section 3 presents the data and a series of stylized facts on mortgages and saving rates consistent with mandatory amortization pushing up saving by younger, poorer homeowners. In Section 4, I present the quantitative model and its results on consumption and saving over the life cycle, and the implications for the wealth distribution. Section 5 concludes.

2 A model of consumption, saving and mortgage debt repayment

Our theoretical framework is based on a standard model of consumption and saving with uninsurable income risk, with the addition of a realistic mortgage contract. We focus, then, on the problem of a recent first-time homebuyer, who has just entered a mortgage contract. Agents start off with some home equity and a small buffer of liquid savings.

2.1 Setup

Time is discrete, and each period t represents one year. Households live and work for J periods, after which they retire. Households maximize expected utility and have time-separable preferences, discounting future utility by factor β .

Consumption

As in Campbell and Cocco (2015), household preferences are separable in housing services and non-housing consumption, and each household consumes a fixed amount of housing h_i . Each period, they derive utility from non-housing consumption:

$$U(c_{it}) = \frac{c_{it}^{1-\gamma}}{1-\gamma},$$

i.e. utility is CRRA, and γ governs intertemporal elasticity of substitution. As explained in Campbell and Cocco (2015), under these assumptions, housing can be disregarded in the household's optimization problem.²

At the end of their working life, households leave a bequest b , deriving some utility from the wealth left over in the last period. I assume that the utility from the bequests is given by the expression, following the standard form introduced by De Nardi (2004) :

$$U(b_{it}) = B \frac{(b_{it} - \underline{b})^{1-\gamma} - 1}{1-\gamma},$$

where B measures the strength of the bequest motive, and $\underline{b}$ reflects the extent to which bequests are a luxury good. As the model represents only the working life, the bequest represents the accumulated savings desired to leave for the retirement phase of the life cycle. The bequest corresponds to the remaining financial assets, subtracted by any remaining mortgage debt outstanding; this amounts to imposing that households must repay the mortgage debt in full at retirement.

Income

Households supply labor inelastically, starting at 30, until they retire at 70 ($J = 40$). They receive exogenous labor earnings given by:

$$y_{it} = \Gamma_t Z_{it} \theta_{it}$$

where Γ_t captures the life cycle profile of earnings, Z is the persistent component of earnings and θ_{it} is the transitory component. As in Carroll and Samwick (1997), and standard in the literature, the permanent component evolves stochastically according to $\log Z_{i,t} = \log Z_{i,t-1} + \log \psi_{i,t}$, where $\log \psi_{i,t} \sim \mathcal{N}(-\sigma_{\psi,t}^2/2, \sigma_{\psi,t})$, and the transitory component is iid, with $\ln \theta_{i,t} \sim \mathcal{N}(-\sigma_{\theta,t}^2/2, \sigma_{\theta,t})$.

²This is because the above preferences are consistent with $U(C_{it}, H_{it}) = \frac{C_{it}^{1-\gamma}}{1-\gamma} + \Lambda_i \frac{H_{it}^{1-\gamma}}{1-\gamma}$ where Λ_i measures the relative importance of housing consumption.

Initial conditions and assets

Households in the model start their life with a house. Inspired by Ganong and Noel (2020), at $t = 0$, agents are endowed with a home with market price P_{i0} and a 30-year fixed rate mortgage with balance m_{i0} . They are further endowed with a certain amount in a liquid risk-free account, a_{i0} . Savings in the risk-free asset yields interest at rate r . The house price may drift relative to the consumption price index at rate g . Beyond the mortgage, households can borrow directly in cash up to θ^A at rate r .

Initial housing and leverage (house size, purchase age, and LTV at origination) are therefore fixed to a common level across households to isolate the repayment rigidity channel. In the data, of course, these objects are heterogeneous. In Section 3 I document this heterogeneity in the data and show that the liquidity and saving patterns emphasized here persist. In ongoing work I endogenize the initial choices; here I study the consequences of amortization rigidity conditional on owning, which is empirically relevant in Euro area markets with high ownership rates and very costly refinancing.

Mortgage contract

At origination, the mortgage cannot exceed a loan-to-value constraint $\theta^M P_{i0}$ or a payment-to-income constraint $\theta^{PI} y_{i0}$, but they are not bound by these constraints thereafter. House prices evolve deterministically according to $g = \Delta \log P$. Households pay interest rate $r + s$ on their mortgage, where s is the mortgage spread.

Each period, households decide on their consumption c_{it} and mortgage debt repayment d_{it} . They cannot increase their debt, so $d_{it} \geq 0$. Households face a mandated repayment schedule which can be represented as a function of outstanding debt and time to maturity, $d_t^* \equiv D^*(m_{t-1}, t)$, where D^* is given³ by the standard annuity formula. The mortgage must be repaid within 30 years or by 70 years of age, whichever comes first.

Deviating from the mandatory amortization schedule is costly. Households incur a proportional transaction cost on the difference between mandated and executed repayment, at rate τ^+ if they wish to prepay their mortgage (increase repayment), and τ^- if they defer repayment or extract home equity. This is summarized by the transaction cost function:

$$\tau(d_t, m_{t-1}, t) = \tau^+ \cdot \max\{0, d_t - d_t^*\} + \tau^- \cdot \max\{0, d_t^* - d_t\}$$

Households default on the mortgage if they do not pay the interest on outstanding debt plus the transaction cost associated with underpayment, in which they incur in a non-pecuniary utility penalty Φ and lose their house.

³ $D^*(m, t) = m(r + s) \left[(1 + r + s)^{(T^M - t)} - 1 \right]^{-1}$, where T^M is the period at which the loan matures.

2.2 The mechanism

To highlight the mechanism at play, before diving into the full household problem let us first focus on a simplified version of the model. Assume there is no prepayment penalty ($\tau^+ = 0$), income is always sufficient to meet the mortgage payment, i.e. $y : y > D^*(m_{t-1}, t) + m_{t-1}(r + s)$, and set the default penalty Φ to be arbitrarily large, such that both incidental and strategic default are excluded. The transaction cost τ_t will be given simply by $\tau^- \cdot \max\{0, d_t^* - d_t\}$.

Consider the intertemporal choice faced by a homeowner in the model over one period. The homeowner solves:

$$\max_{c_t, d_t} u(c_t) + \beta \mathbb{E}_t[V_{t+1}(y_{t+1}, a_{t+1}, m_{t+1})],$$

where $V_{t+1}(\cdot)$ is the continuation value, subject to the conditions:

$$a_{t+1} = (1 + r)[a_t + y_t - (r + s)m_t - d_t - \tau_t - c_t]$$

$$m_{t+1} = m_t - d_t$$

respectively the budget constraint and the law of motion for the mortgage balance.

The FOCs for the household will be given by the usual Euler equation for consumption and an additional intertemporal condition that trades off the marginal value of debt repayment against that of liquid assets:

$$u_c(c_t) = \beta(1 + r) \mathbb{E}_t[V'_a]$$

$$\mathbb{E}_t[V'_m] = \begin{cases} (1 + r) \mathbb{E}_t[V'_a], & d_t \geq d_t^* \\ (1 + r)(1 - \tau^-) \mathbb{E}_t[V'_a], & d_t < d_t^* \end{cases}$$

The transaction cost introduces a wedge in the latter condition. Because of this wedge, there is a region of the state space (a, y, m) where, absent the transaction cost, the household would optimally delay repayment ($d_t < d_t^*$), i.e.:

$$(1 + r)(1 - \tau^-) \mathbb{E}_t[V'_a] \leq \mathbb{E}_t[V'_m] \leq (1 + r) \mathbb{E}_t[V'_a]$$

In this region the transaction cost makes $d_t = d_t^*$ optimal, so holding the states fixed, the homeowner cuts c_t and/or a_{t+1} , consumption and liquid saving, relative to the no-transaction-cost case. Far from the borrowing constraint (high a_t or y_t , low m_t), the shadow value of liquidity is low and the transaction cost becomes locally irrelevant.⁴ The region of the state space where the homeowner chooses to delay repayment narrows, due to the penalty. Anticipating the cost of underpayment, the shadow value of liquidity becomes higher even in states where the transaction

⁴Note that $\mathbb{E}_t[V'_m]$ will be higher than $(1 + r)(1 - \tau^-) \mathbb{E}_t[V'_a]$ even if $\tau^- = 0$.

cost does not apply. The policy function for liquid assets shifts up away from the constraint, so the household consumes less and carries more liquid wealth under mandatory amortization than under a flexible contract, to avoid falling into the delay region.

Role of the mortgage spread. So far we have assumed that the mortgage is expensive, as it pays a positive spread over the risk-free rate, which is the return on the only alternative asset available. In this case, unconstrained households will desire to repay the mortgage as fast as possible, i.e. provided they have a satisfactory buffer of liquid assets to smooth out the effect of shocks on consumption. But if the cost of carrying mortgage debt is low, i.e. if after-tax $(r + s)$ at or below the return on the household's liquid portfolio (e.g. if interest rates go down and the loan is fixed rate, or if there is a risky high-return alternative asset) then even homeowners far from their borrowing constraints would prefer to delay repayment under a flexible contract (hold more liquid assets and amortize less). The under-repayment penalty will then affect a larger set of states: later in life, the amortization requirement would also have an effect, although mainly compositional: higher home equity and lower liquid/risky balances, but with little change in consumption.

Testable predictions

Relative to flexible repayment (e.g., interest-only) or renting, a fixed amortization schedule tightens liquidity constraints. We expect to observe, for younger and lower-income homeowners, lower nondurable consumption and saving flows into liquid assets. The total saving rate (active saving divided by net income) rises, but is dominated by repayment. By contrast, for older or higher-income owners who are far from their borrowing constraints but still far from maturity (so home equity is still 'illiquid'), the under-repayment penalty is locally irrelevant, so we expect small or no effects on consumption. As the mortgage approaches maturity, these effects attenuate, and after payoff the pattern would be expected to reverse: as home equity is unlocked, consumption rises and saving falls.

These flow responses cumulate into stocks. Among young/lower-income owners, rigid amortization reduces liquid asset stocks (higher hand-to-mouth incidence) while raising total wealth over the working life via faster equity accumulation. Among older/richer owners, the stock implications hinge on the mortgage-portfolio spread. In "normal" environments with a positive carry, total wealth is higher under rigid amortization and liquid stocks are at least as large—often larger by mid-life—as households maintain precautionary buffers. In low-spread environments (after-tax $(r + s)$ close to or below the return on liquid/risky assets), even unconstrained owners would under-repay under a flexible contract; the mandatory schedule then crowds out liquid/risky asset accumulation later in life. The prediction is that older/richer amortizing borrowers hold smaller liquid/risky stocks and more home equity than comparable interest-only borrowers, with small consumption differences—precisely the pattern we observe in the Netherlands, where IO borrowers carry larger liquid buffers at older ages.

A natural objection is that lower-income households could choose smaller dwellings and smal-

ler mortgages, potentially undoing the liquidity effect. Our predictions are conditional on ownership and the observed contract, and what governs the bite of repayment rigidity is the cash-flow share—payment-to-income (PTI), current LTV, and liquid buffers—rather than house size in levels. In Euro-area markets, several features make effective down-scaling only partially offsetting: (i) indivisibilities and minimum quality/occupancy norms mean households cannot proportionally shrink housing services; due to fixed costs, smaller homes do not imply proportionally smaller house values and mortgage payments; credit constraints push buyers to higher LTV and PTI caps. Empirically, PTI and current LTV are flat to mildly declining across income groups. Thus, while house size adjusts, repayment rigidity remains most binding for lower-income owners, and the mechanism’s predictions should hold.

3 Evidence on mortgage amortization and saving from the HFCS

The Eurosystem Household Finance and Consumption Survey (HFCS) is a representative survey of euro area households, akin to the SCF in the United States, collecting data at the household level with a common methodological framework, that allows for adequate comparison across countries. I use three waves of the survey: Wave 2 (2013-14); Wave 3 (2016-17) and Wave 4 (2020-21). The first wave, from 2010-11, does not contain the information mortgages needed for this analysis.

The main focus of the survey is on household balance sheets, which are captured in great detail, showing the disaggregated portfolio of each household, including different financial instruments, but also non-financial wealth, including housing and business assets. The different liabilities of households are observed as well, comprising both mortgages and other loans to financial institutions. The data includes a high level of detail on these loans, such as amounts, payments and interest rates for individual loans.

The survey also includes some data on consumption and income, although with some limitations. The consumption data includes regular consumption expenditures but also consumption of non-durables, purchases of vehicles and housing rents. The income data includes labor income, various social transfers including public pensions, and capital income (e.g. interests and dividends from financial investments).

In the remainder of this section, I first discuss mortgage institutions in the euro area, focusing in particular on the unique case of the Netherlands; then, I explain how I measure saving rates in this data, and finally, describe how regular amortization can be computed from the variables available in the HFCS.

3.1 Homeownership and mortgage institutions in the euro area

Mortgage markets are relatively diverse across euro area countries, with quite different legislations, commercial practices and macroprudential policy rules in place. An important example is the dominant type of interest rate: in some countries, most mortgages are long-term fixed-rate, similar to the US, while in others, the dominant contract is adjustable rate or fixed with a short

reset period. The markets do share some features, however. With few exceptions, loan maturities at origination are typically between 20 and 30 years, both for first-time and second home buyers.

Most relevant for our purposes is the amortization schedule. Generally, amortization schedules are fixed at the beginning of the loan, in a "French loan" system where the monthly payment is constant (other than interest rate changes) such that the debt repayment component grows over time. With very few exceptions, all mortgages are fully amortizing, i.e. the repayment schedule is set such that the loan will be fully repaid at maturity. The Netherlands is the only euro area country where *interest only* mortgages have traditionally been both allowed by regulation and remain highly popular. In a few other countries, they are allowed in some cases but play a marginal role (EMF, 2019).

Until 2013, where a reform to the mortgage interest tax deduction changed the incentives for new homeowners, almost all mortgage issuance was of this kind in the Netherlands. As of 2017, around 40% of new mortgages, and about three quarters of the outstanding mortgage debt stock, were still interest-only, or a hybrid form (Romano, 2017).

Finally, note that in contrast to the US, refinancing and home-equity extraction are highly costly in most euro area markets over this period. In fact, many countries do not have any financial products allowing for home equity extraction available to common borrowers (EMF, 2019). This market setting, contrasting to the US, is central to the mechanism we study here.

3.2 Measuring saving in the HFCS

The HFCS does not directly record information on household saving flows nor on mortgage amortization. The approach taken here is to, using some simplifying assumptions, calculate these variables based on other quantities reported by households in the survey. Although the resulting estimates suffer from measurement issues and can hardly be taken as precise in terms of levels, the hope is they can provide a sufficiently reliable picture of their distributions.

I restrict the sample to households with heads aged 25–69, excluding retirees and elderly (≥ 70) and dropping the top and bottom 1% of the saving-rate distribution (robustness uses 5%). All statistics use household weights and, where applicable, multiply imputed values combined with Rubin's rules, as appropriate for the structure of this representative survey data.

Household saving is calculated as the residual from income and consumption. Both are not measured easily in the HFCS. I mostly take from the approaches of Slacalek et al. (2020) and Tzamourani (2021) in adjusting the data to obtain a (rough) estimate of household net income and saving flows. The income before taxes data available in the HFCS is adjusted using information on tax wedges by income decile from EUROMOD (2020). Consumption includes nondurables consumption, as reported directly by households, and housing rent paid by non-homeowners. I also deduct interest paid on outstanding debt, to finally obtain a measure of saving flows for each household:

$$S = Y_{net} - C - \text{rent} - i \times \text{debt}$$

where C is nondurable expenditure, and rent represents yearly rent payments on the main residence for renters, for owner-occupiers imputed rent is excluded. The saving rate is simply the ratio of saving flows to net income, $s \equiv \frac{S}{Y_{net}}$. The distributions of saving rates obtained from this procedure, for each wave of the HFCS, are shown in Figure 1.

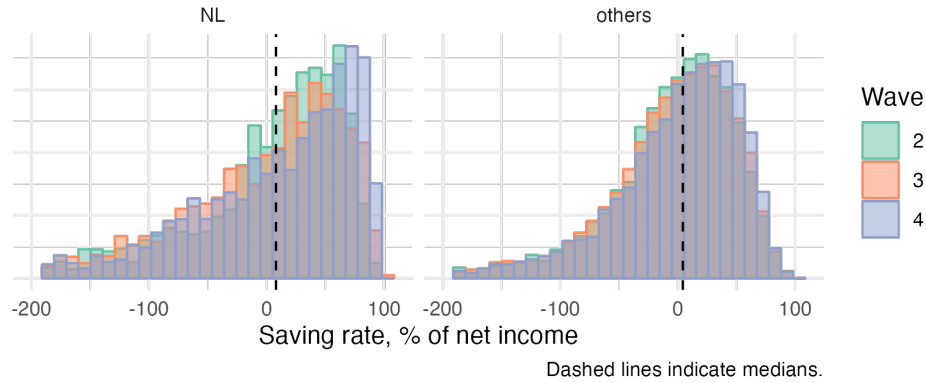


Figure 1: Distribution of saving rates, full HFCS sample, by wave

This figure shows kernel density estimates of household saving rates (as percentage of net income) across different HFCS survey waves, shown in different colors. Left panel: Netherlands. Right panel: Other Euro area countries. Dashed vertical lines indicate median values. Note that in all cases the distributions feature a substantial mass of dissavers (negative saving rates).

The median household saves about 4% of income in the full cross-country sample, and 8% in the Netherlands. There is a long left tail of dissavers, as 46.7% (45.3% in Netherlands) of households do not save or are dissaving. This number is in line with the figures for other regions, and corroborated by the saving rates observed for the Netherlands in the Euro area in their national accounts and the self-reported “ability to save” in the same data (see Appendix A.3).

Descriptive statistics

Table 2 presents summary statistics for the full HFCS sample, detailing financial variables for households across the Euro Area and the Netherlands. The data show the number of observations, and number of households represented (sum of household survey weights), net wealth, yearly net income, and saving rates, computed according to the preceding method, across the three survey waves considered. Dutch households exhibit lower median net wealth and yearly net income compared to their Euro Area counterparts but have far higher saving rates (among those who save). The table also highlights the proportion of the population that saves, i.e. has a positive saving rate, and the percentage of households with a mortgage.

	Netherlands			Other countries		
	Wave 2	Wave 3	Wave 4	Wave 2	Wave 3	Wave 4
# Households (weighted obs.)	7392012	6104344	5996156	129677418	136763861	139091778
# Obs.	1256	2038	2056	65389	69629	64318
Net wealth, average	148214.0	202509.3	243336.8	223489.4	229857.5	292542.6
Net wealth, median	80052.2	84995.8	131608.0	98841.7	100988.2	123621.0
Yearly net income, average	44331.7	59204.7	73290.6	44684.9	45678.3	49017.4
Yearly net income, median	39581.9	49760.9	60989.9	35632.6	36261.1	38119.7
Average saving rate (among those who save)	43.1	46.1	52.5	33.1	34.4	35.6
Median saving rate (among those who save)	12.2	5.1	12.9	1.6	1.7	8.0
% of pop. who save (saving rate > 0)	57.1	52.4	55.4	51.2	51.3	56.2
% of pop. with a mortgage	40.7	50.7	50.2	19.3	19.5	19.7
% of pop. owners	57.6	61.5	61.6	61.6	61.1	62.5

Table 2: Descriptive statistics, full HFCS sample

3.3 Mortgages and amortization in the HFCS

The HFCS contains a great deal of information on households' mortgage loans. For up to 3 different loans, there are details including the purpose of the loan, any previous refinancing, the original and remaining loan amount and maturity, the type (adjustable or fixed) and current level of interest rate.

Importantly, respondents are asked to report the regular monthly payment for their current mortgage loans. Combined with other details of the loans, we can back out what is the amortization amount embedded in that monthly payment, for each surveyed household. Annual amortization for household i is given by:

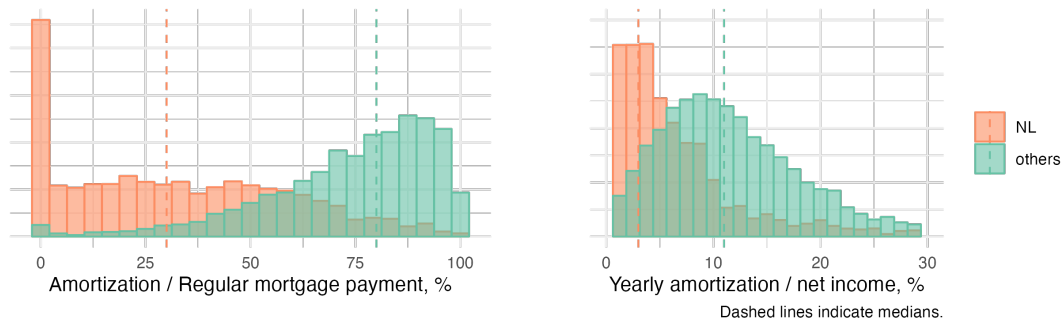
$$\text{amortization}_i = \sum_l \left(12 \times \text{mtp}_{i,l} - r_{i,l} \times D_{i,l} \right), l = 1, 2, 3$$

where mtp is the reported regular monthly payment, r the reported annual interest rate and D the outstanding debt amount, for up to 3 different mortgage loans l . Figure 14 reports the sample distributions of these amortization payments, the left panel showing amortization as a share of the regular payment, and the right as a percentage of household income.

Focusing on the full cross country sample, pictured in green, we observe that most loans devote a large part of the monthly payment to amortization. The median is about 80%. This is reasonable considering that the overwhelming majority of loans has a standard annuity loan structure, which means that for the last several years of the loan the share of payment going to amortization is very high. Furthermore, this sample focuses on years with relatively low interest rates. Also, the weight of amortization payments on household income seems reasonable, in line with other sources and with mortgage market regulations. The obtained values concentrate around 10%-20% of yearly net income, as shown in Figure 2, across all countries.

The case of the Netherlands, shown in orange in the charts, is starkly different. The high preval-

ence of interest-only mortgages shows up in this data: there is a large bunching at zero, and many households amortize only a small amount in a regular month. The effects of a 2013 policy change that made interest-only mortgages more costly are also visible, as homeowners with mortgages originated after 2013 amortize more (see 13 in Appendix).



(a) Share of regular mortgage payment going to amortization (b) Weight of amortization on household net income

Figure 2: Distribution of amortization in the HFCS

Panel A shows the distribution of the share of regular mortgage payments going to amortization. The Netherlands (orange) exhibits a distinct pattern with a substantial mass at zero, reflecting the prevalence of interest-only mortgages, as opposed to other euro area countries (green). Panel B displays amortization as a percentage of household net income, with the median household in standard mortgage countries dedicating approximately 15% of income to mortgage principal repayment.

Descriptive statistics

Table 3 provides summary statistics for the subset of mortgaged homeowners in the HFCS sample. Mortgaged homeowners, as a group, are younger but are otherwise not very different in terms of income or wealth to the rest of the population. The focus then is on mortgage-related variables. The table details the average housing assets, portfolio share of housing, and characteristics of the primary mortgage, including the outstanding debt as a percentage of housing assets, average remaining maturity, initial maturity, prevalence of variable rate mortgages, current interest rates, and refinancing rates.

	Netherlands			Other countries		
	Wave 2	Wave 3	Wave 4	Wave 2	Wave 3	Wave 4
# Households (weighted obs.)	3011506	3094329	3011440	25063853	26664636	27436748
# Obs.	633	1116	1103	15844	16370	15731
Net wealth, average	185325.2	222784.7	314642.1	254507.1	289997.1	341855.0
Net wealth, median	141981.8	144822.7	227365.2	131948.4	155729.4	184163.4
Yearly net income, average	52900.2	69271.8	89074.0	56670.6	58516.0	62210.6
Yearly net income, median	51869.3	61757.0	80542.5	48168.3	49526.1	52207.4
Average saving rate (among those who save)	45.1	49.6	56.9	35.1	36.2	38.3
Median saving rate (among those who save)	25.8	31.0	46.8	17.5	19.8	27.3
% of pop. who save (saving rate > 0)	65.1	66.4	73.8	65.1	66.5	73.0
Average housing assets	283418.6	290829.9	394957.9	267535.0	293834.2	340644.7
% Portfolio share of housing	78.9	77.7	83.7	82.6	82.5	81.6
Mortgage on main residence						
– Outstanding debt, % of housing assets	62.1	77.5	51.1	50.0	45.1	51.1
– Average remaining maturity, years	–	14.3	15.8	–	14.0	13.9
– Average initial maturity, years	25.5	22.3	24.0	20.1	20.5	21.5
– % of HHs with variable rate mortgages	76.0	92.3	94.4	42.2	40.0	34.8
– Average current interest rate	4.5	3.7	2.8	3.3	2.5	2.0
– % of HHs who refinanced at least once	18.8	17.1	23.0	15.2	22.7	19.3

Table 3: Descriptive statistics, mortgaged homeowners, HFCS

3.4 Stylized facts on consumption and saving rates

This section analyzes the saving rates and amortization patterns across different household types in Europe, focusing on regular mortgaged homeowners, interest-only (IO) homeowners, and other households. I continue to single out the case of the Netherlands, vis-à-vis other countries. To provide a more clear picture, the analysis excludes elderly or retired individuals, representing 22% of observations and 21% of the population, as well as extreme dissavers, 10% of the sample. By examining group means across income quintiles, wealth/income ratio quintiles, and age brackets, I provide a comprehensive view of saving behavior. The primary variable of interest is the active saving rate, defined as saving as a percentage of income. This approach enables a detailed comparison of how different mortgage structures are related to household saving patterns across the wealth distribution.

3.4.1 Saving rates among mortgaged homeowners and other households

Over the income distribution Figure 3 illustrates saving rates (lines) across income quintiles for households in the Euro Area (EA) and the Netherlands (NL). In the EA, saving rates increase with income, with the highest quintile saving approximately 40% of net income, while the lower quintiles save considerably less. In the NL, amortizing mortgage holders consistently save a higher percentage of their net income across all quintiles compared to interest-only (IO) mortgage hold-

ers and other households. Notably, the saving rate gradient is less steep for those with amortizing mortgages, indicating smaller differences in saving rates across income quintiles for this group. The highest quintile in the NL saves nearly 60% of net income among amortizing mortgage holders, whereas IO mortgage holders save about 50%, placing them between amortizing mortgage holders and other households.

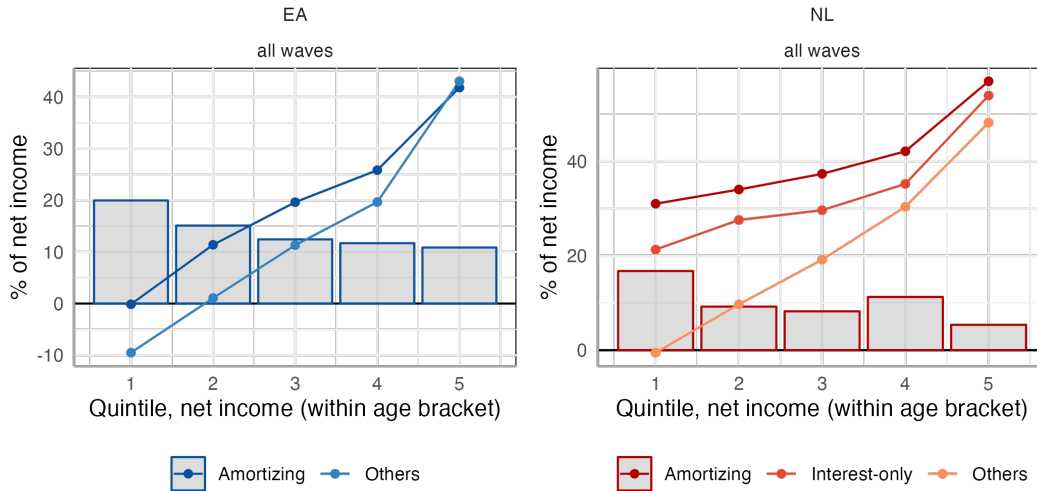


Figure 3: Saving rates over the income distribution

This figure compares saving rates (lines) and amortization payments (bars) across income quintiles. In the Euro Area (left panel), saving rates increase steeply with income among non-mortgaged households, while the gradient is flatter for mortgaged homeowners. In the Netherlands (right panel), households with amortizing mortgages show consistently higher saving rates across income quintiles, with a much flatter gradient, compared to interest-only mortgage holders and non-mortgaged households.

The figure also presents amortization payments as a percentage of net income (columns), which allows for a comparison with saving rates. In both the EA and NL, the share of income dedicated to mortgage debt repayment declines with income. Strikingly, in the EA, amortization consumes a substantial portion of saving flows for all households except those in the top income bracket. On average, mortgaged homeowners in the bottom two quintiles dissave from other assets to save into home equity through debt repayment. While the baseline level of saving rates is higher in the NL, it is evident that households in the top income quintile concentrate much less of their saving in amortization.

Over the life cycle We observe that in the EA, saving rates generally increase with age, peaking around the 50-60 age bracket, with amortizing mortgage holders saving a higher percentage of their net income compared to other households. Notably, the differences across age groups in saving rates are much wider among households who do not have a mortgage. Young mortgaged homeowners save much more than their peers without a mortgage, while for older people having a mortgage does not make much difference in their saving rate. While in part this may be due to selection, as young mortgaged homeowners may have a higher propensity to save ex ante, it can also suggest an effect of the mortgage on their saving behavior.

In the NL, a similar pattern is observed, with small differences in saving across ages, among amortizing mortgage holders. Interest-only (IO) mortgage holders exhibit a saving pattern more similar to non-mortgaged households, showing greater variation in saving rates across age groups. The highest saving rates for IO mortgage holders are observed in the 50-60 age bracket, while younger and older age groups save less.

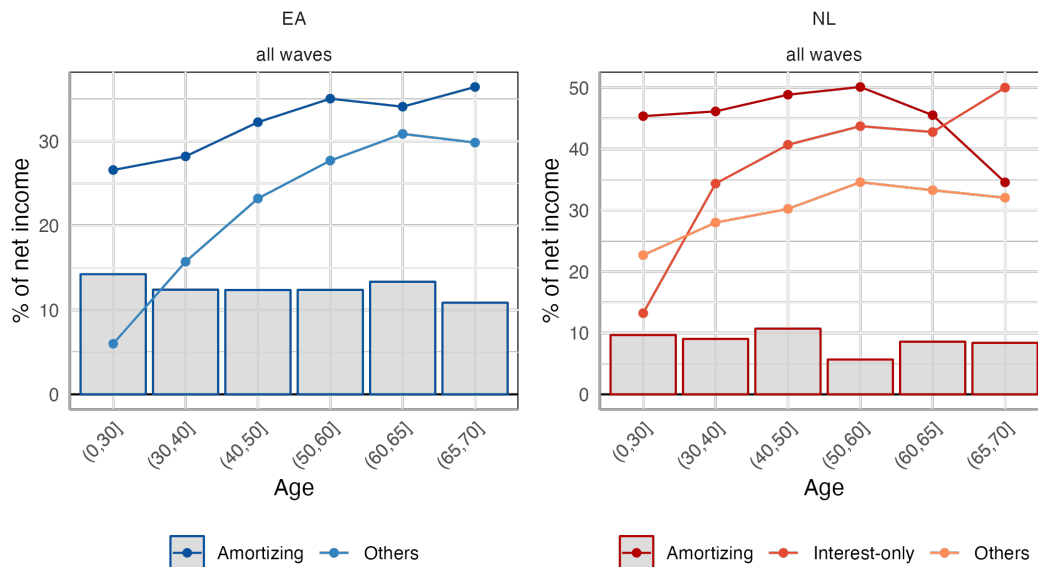


Figure 4: Saving rates over the life cycle

The figure compares saving rates (lines) and amortization payments (bars) over the life cycle. In both the Euro Area (left panel) and Netherlands (right panel), households with amortizing mortgages exhibit more stable saving rates across age groups, while other households show substantial variation. Notably, households with interest-only mortgages in the Netherlands save at much lower rates at the beginning of the life cycle, similar to non-mortgaged households, mostly composed of renters.

Amortization payments as a percentage of net income (columns) decline over the life cycle, but differences are much less steep than between different income groups. Note that as households grow older, they move closer to maturity of the mortgage loan, with the amortization component of their regular payment increasing steeply.

Over the wealth distribution In the EA, saving rates rise with wealth, peaking at around 35% of net income in the highest quintile, while lower quintiles save significantly less. The differences in saving rates across wealth quintiles are more pronounced among non-mortgaged households compared to those with amortizing mortgages, indicating more consistent saving behavior for the latter. In the NL, amortizing mortgage holders exhibit stable saving rates across wealth quintiles. Conversely, interest-only (IO) mortgage holders show a saving pattern similar to non-mortgaged households, with greater variation across wealth quintiles. The highest saving rates for IO mortgage holders occur in the top wealth quintile.

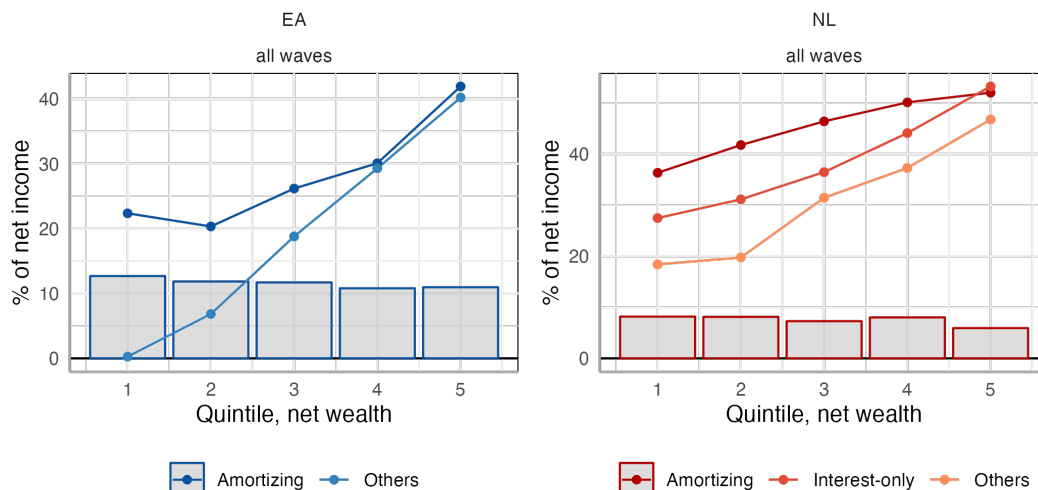


Figure 5: Saving rates over the wealth distribution

This figure compares saving rates (lines) and amortization payments (bars) by wealth quintile. The gradient of saving rates across wealth quintiles is substantially flatter for households with amortizing mortgages in both regions. In the Netherlands (right panel), the difference between households with interest-only mortgages and those with amortizing mortgages is striking, with the former being closer to the saving rates of non-mortgaged households.

The figure also shows amortization payments as a percentage of net income (columns). In both the EA and NL, the share of income dedicated to mortgage repayment decreases with wealth. Younger households, typically lower in the wealth distribution, allocate a substantial portion of their income to amortization.

3.5 Stylized facts on mortgage and wealth stocks

Figure 6 shows the average remaining balance of the main-residence mortgage (as a share of the initial value of the loan) against time to maturity. In the general Euro area sample, it basically reflects standard mandatory amortization schedules, with balances declining steadily toward zero. In the Netherlands, we observe that households with an interest-only or partially interest-only loan (most households) leave a substantial part of the loan unpaid until very close to maturity, while fully amortizing loans decline along the usual path. This matches the institutional facts and the model's flexible-repayment benchmark.

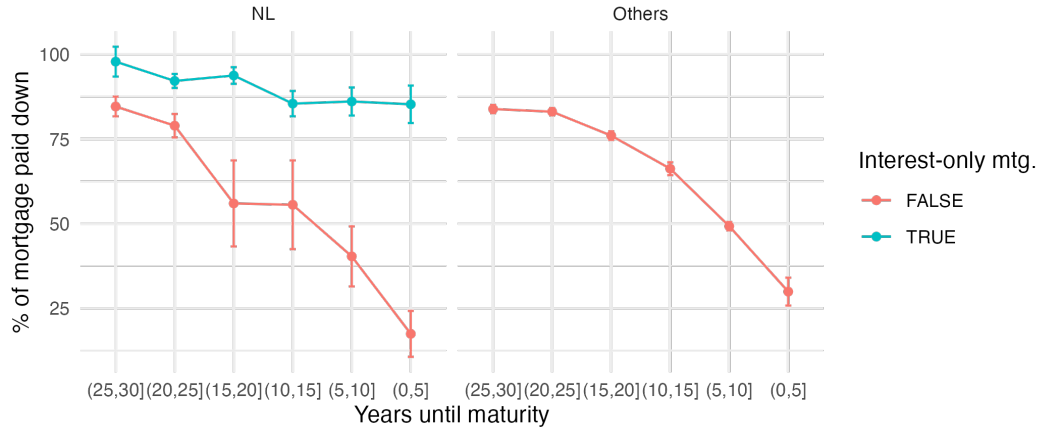


Figure 6: Outstanding mortgage balance and maturity in the data

This figure shows the average remaining mortgage balance, as percentage of original loan amount, and time to maturity of the main residence mortgage in the HFCS data. In the Netherlands (left panel), interest-only mortgages (red) maintain high balances until near maturity, while amortizing mortgages (blue) gradually decline to zero. In other Euro area countries (right panel), interest-only mortgages are very rare and not shown. Whiskers show 95% confidence intervals.

Figure 7 then shows liquid assets relative to net income by time to maturity. In the Netherlands, IO borrowers accumulate substantially larger liquid buffers as maturity approaches, compared to fully amortizing borrowers. In other euro-area countries (right panel), where IO contracts are rare, liquid assets rise much less steeply. This pattern is consistent with the mechanism's composition margin: when repayment is flexible and the after-tax mortgage carry is low relative to households' portfolio returns, unconstrained (older/richer) homeowners optimally under-repay and hold more liquid assets, whereas under rigid amortization they are tilted into illiquid home equity, leaving smaller liquid balances at similar horizons to maturity. The gap in late-life liquidity between IO and amortizing Dutch borrowers, alongside small consumption differences at these ages, is exactly what the model predicts for the low-spread case. This makes sense considering that the tax treatment of interest-only mortgaged made them very cheap to hold in the Netherlands.

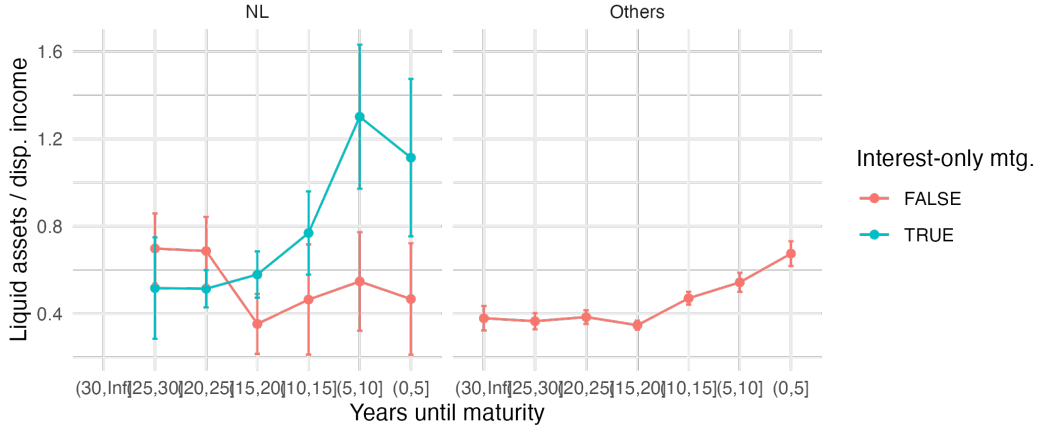


Figure 7: Liquid wealth and outstanding mortgage maturity in the data

The figure shows liquid asset holdings (as a ratio of disposable income) by time to maturity of the main residence mortgage in the HFCS data. Netherlands households with interest-only mortgages (blue line, left panel) accumulate substantially higher liquid assets as they approach maturity, compared to households with amortizing mortgages (red line). This pattern is consistent with higher saving in liquid assets. In other Euro area countries (right panel), interest-only mortgages are very rare and not shown.

The comparison underscores the model’s capacity to rationalize observed patterns in debt repayment and wealth accumulation. This gives greater confidence in the model’s predictions for distributional outcomes, which we analyse in the next subsection.

Taken together, Figures 6 and 7 anchor two sides of the mechanism in the data: the repayment path (IO keeps balances high; amortization reduces them) and the portfolio response (IO borrowers carry larger late-life liquid buffers; amortizers hold more housing equity). This supports the view that our earlier flow results for young/low-income owners (liquidity tightening, higher MPCs) coexist with a later-life composition effect under flexible contracts. We quantify these forces in the model next.

4 Quantitative model: implementation, calibration, and counterfactuals

This section implements the mechanism in a calibrated life-cycle model and uses it to quantify the effects of repayment rigidity on consumption, liquid buffers, and wealth accumulation. The environment mirrors Section 2 but is parameterized to euro-area conditions and HFCS moments. We discipline the model with (i) the aggregate private-wealth-to-income ratio, (ii) age profiles of income and saving, (iii) mortgage institutions (initial LTV, maturities, spreads), and (iv) the empirical weight of amortization in household cash flows. We then conduct a simple counterfactual design comparing two repayment regimes: a flexible benchmark (no frictions to delaying principal; interest-only is feasible) and a rigid regime that enforces the scheduled annuity amortization. Initial conditions reflect the empirically relevant case for first-time buyers—high leverage and thin liquid buffers. We report life-cycle profiles and heterogeneity across income groups, and we read the results through the sufficient statistics highlighted by the mechanism: the cash-flow

burden (PTI), current LTV, liquid wealth, and the mortgage–portfolio spread. Finally, we relate the model’s predictions to the cross-sectional facts in Section 3, including the late-life composition differences between amortizing and interest-only borrowers in the Netherlands.

4.1 Environment and recursive problem

The basic structure of the model was presented in Section 2. We summarize the dynamic problem faced by the household here. Each period, each household i solves (i subscripts dropped for clarity):

$$\begin{aligned} V_t(S_t) &= \max_{C_t} E_0 \left[\sum_{t=0}^T u(S_t, C_t) \right] \\ \text{s.t.:} \\ S_{t+1} &= m(S_t, C_t, Z_t) \\ C_t : c_t &\geq 0, d_t \geq 0 \\ S_t : a_t &\geq 0, m_t \geq 0 \end{aligned}$$

where S_t are state variables and C_t controls, and initial conditions will be given by the endowment $\{A_{i0}, M_{i0}\}$. The initial permanent income and house price levels are normalized to $Z_{i0} = P_{i0} = 1$ for all i .

The states are $s_t = (y_t, a_t, z_t, m_t)$, where y_t, z_t are exogenous and a_t, m_t endogenous. y and z are transitory and permanent income, evolving as described above. d is an exogenous mortgage debt repayment dependent on the outstanding mortgage and t . The control variables here are c_t, d_t , consumption and mortgage debt repayment.

Each period, states will evolve according to m , which contains the laws of motion for the states, which following for the above description of the model, are:

$$\begin{cases} \log y' = \log z' + \sigma_y \varepsilon_y, & \varepsilon_y \sim N(-\frac{\sigma_y^2}{2}, \sigma_y^2) \\ \log z' = \log z + \log \Gamma(t') + \sigma_z \varepsilon_z, & \varepsilon_z \sim N(-\frac{\sigma_z^2}{2}, \sigma_z^2) \\ a' = (1+r)(a+y-(r+s)m-d-\tau-c) \\ m' = m-d \end{cases}$$

with the transaction cost given by $\tau^+ \cdot \max\{0, d_t - d_t^*\} + \tau^- \cdot \max\{0, d_t^* - d_t\}$, where as before d_t^* is given by the standard annuity formula.

4.2 Solution method: dynamic programming with neural networks

Solving this model consists of finding the policy function $\pi(s_t) \equiv \pi(t, y_t, a_t) = \tilde{\pi}(t, y_t, a_t, \theta)$ that will provide the optimal consumption and mortgage repayment (controls) conditional on current period income and assets (states).

I employ a deep neural network approach, based on work by de la Barrera and de Silva (2024), following methods proposed by Duarte et al. (2021, 2024). Traditional dynamic programming techniques face challenges in high-dimensional state spaces due to the curse of dimensionality, especially when incorporating rich income processes. The neural network approach overcomes these limitations by approximating the policy function directly. Even though the current version of the model could be solved with more traditional numerical methods techniques, I apply the neural networks approach from the outset as it can more easily scale to future extensions of the model with house-price and interest-rate risk.

The method finds the optimal policy function $\pi(X_t, M_{t-1}, Z_{t-1})$, given initial conditions $\{A_{i0}, M_{i0}\}$, that ensures the above value function holds, in expectation, every period up to T . This policy function is parameterized as a fully connected feedforward neural network $\tilde{\pi}(X_t, M_{t-1}, Z_{t-1}, \Theta)$, where Θ is a vector of network parameters. Then, the loss function

$$L(\Theta) = -V^{\pi^\Theta}(\Phi_0) = -E \left[\sum_{t=0}^T \beta^t u(C(\Phi; \Theta)) \mid \Xi_0 \right]$$

is minimized with respect to Θ to find the optimal lifetime policy function, using stochastic gradient descent with the Adam optimizer. The neural network architecture consists of five hidden layers with 500 nodes each, using tanh activation functions for the hidden layers and a sigmoid activation function for the output layer. This architecture results in approximately 1.25 million parameters to be optimized.

4.3 Exercise

The household begins their life with some home equity, due to the initial down payment. This means they begin their life at the loan-to-value constraint:

$$M_{i0} = \theta^M P_0$$

and almost no liquid asset, as an example of the situation of a homeowner who used up its savings to make the necessary down payment. The model household starts off with liquid assets worth 1 month of permanent income:

$$A_{i0} = \frac{P_{i0}}{12} = \frac{1}{12}$$

The first exercise consists of comparing two extreme scenarios for the repayment friction:

1. *No restrictions*: households can choose their optimal repayment path ($\tau^+ = \tau^- = 0$)
2. *Forced amortization*: households are forced to stick to the mandated repayment scheme ($\tau^+ = \tau^- = +\infty$, in practice the problem loses one control, D_t , and one state M_t , as it now becomes exogenous).

These scenarios are both extreme: in the first, access to home equity and the path of debt repayment are completely free; in the second, they are absolutely immutable. In reality, the situation is typically somewhere in between. A third scenario, currently in progress, will implement transaction costs consistent with data for the Netherlands and other Euro area countries.

4.4 Calibration

Table 4 reports parameter values used in the model. The model considers only the working life, agents begin their lives at 30 and retire at 70. The discount factor $\beta = 0.96$ allows to attain a simulated aggregate private-wealth-to-income ratio in line with the value of 3.1 observed in the 2017 wave of the HFCS for the average country. A coefficient of relative risk aversion $\gamma = 5$ is taken from Duarte et al. (2020). Earnings risk follows Cagetti (2003). Bequest preferences are set such that the median household holds net financial wealth equal to 1.5 times yearly income by retirement. The safe return is fixed at $r = 3\%$, the euro-area long-run average documented by Jordà et al. (2019). Finally, a 50-basis-point mortgage spread anchors borrowing costs at the euro-area median reported in EMF Hypostat (2019). The borrowing limit in the liquid account is set at zero, as a simplification allowed by the observation that credit card and other unsecured debt (excluding auto loans) is small in the Euro area data, as observed in the HFCS (and unlike the US setting). The initial LTV of mortgage loans is set at 80% in the model. This simple assumption matches exactly in line with the Euro area average LTV at origination in 2016 (Lang et al., 2020).

Description	Value	Target moment	Source
Life time in the model (T)	40	Working life 30–70	–
Discount factor (β)	0.96	Wealth–income ratio $W/Y = 3.1$	HFCS 2017 micro data
Risk aversion (γ)	5	Average MPC = 0.22	Duarte et al. (2020)
Bequest motive parameters ($\underline{b}$)	1.5	Wealth at retirement	HFCS 2017 micro data
Bequest motive parameters ($\bar{b}$)	0	Normalization	–
Variance of transitory shocks (σ_y^2)	0.05	Earnings shocks (transitory)	Cagetti (2003)
Variance of permanent shocks (σ_z^2)	0.01	Earnings shocks (permanent)	Cagetti (2003)
Riskless rate (r)	0.03	Long-run real safe rate	Jordà et al. (2019)
Mortgage spread	0.005	EA median fixed-rate spread	EMF Hypostat (2019)
Borrowing limit, liquid (θ^A)	0	Normalization	–
Borrowing limit, mortgage LTV (θ^M)	80%	Euro area average	Lang et al. (2020)

Table 4: Model parameter values

4.5 Debt repayment and wealth accumulation under different amortization regimes

This subsection examines how mandatory amortization affects household consumption and saving over the life cycle. By simulating household consumption decisions under different mortgage

regimes, we explore the implications for saving and wealth accumulation over the life cycle and, as a consequence, for the distribution of wealth. I report three sets of objects: (i) flows (consumption, liquid saving, total saving), (ii) stocks (liquid assets, home equity, total wealth), and (iii) heterogeneity over the life cycle and over the distribution of income and wealth.

4.6 Life cycle saving patterns

Baseline consumption and saving profile

We first discuss the average profiles of consumption and saving over the life cycle predicted by the model. Permanent income follows a simple age profile of steady growth until age 50 and stagnation there after. Figure 8 shows the average age profiles of consumption, and of the saving rate. This represents the mean across simulated agents, conditional on age, for a population of 10,000 simulated agents. The dashed line represents the scenario with unrestricted repayment, where households optimize their repayment schedules without constraints, while the solid line reflects the constrained scenario of fixed, mandatory amortization schedules.

In the unrestricted model, consumption, plotted as a ratio to initial permanent income, follows a smooth pattern with a constant rate of growth over the life cycle. The average household in the model is able to smooth consumption well. Instead, when they are restricted by a mandated amortization schedule, agents consume less – up until the moment that the mortgage is paid off, and home equity is ‘unlocked’ after 30 years, the maturity of the loan. Consumption then jumps up as agents are finally able to use up the accumulated wealth in home equity.⁵

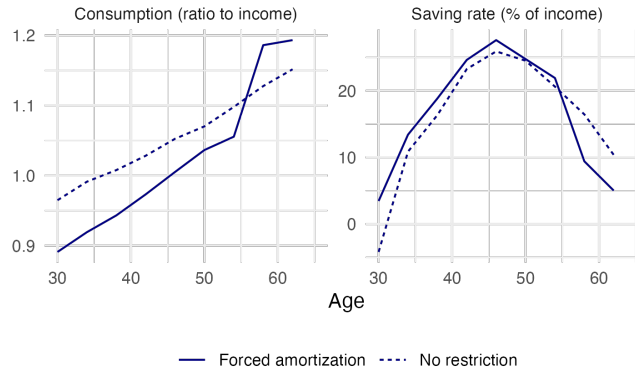


Figure 8: Life cycle income and consumption patterns in the model

This figure compares model-predicted consumption and saving rates under flexible repayment (dashed lines) versus mandatory amortization (solid lines). Left panel: Consumption-to-income ratio over the life cycle shows lower consumption under mandatory amortization until mortgage maturity. Right panel: Saving rates are higher under mandatory amortization throughout most of the life cycle, with the gap largest for younger households.

Figure 8 also shows, in the second panel, what the preceding consumption pattern means for the average saving rate over the life cycle. In the model households have low saving rates in the

⁵Note that in this model, the housing services consumed correspond exactly to the implicit rent made from the housing asset, so they have a net zero effect on the saving rate.

beginning of life, and then these grow steadily over the working life, as income also grows. The saving rate then begins to decline once income stagnates.

The impact of mandatory amortization

If forced to amortize, households save much more in the first few years. The saving rate is even negative in the first 2 years – households on average risk being very close to the liquid borrowing constraint. Although the gap narrows after the first few years, constrained households continue to save more than in the unrestricted case until mortgage maturity, after which they save substantially less.

The higher saving rates occur because young homeowners must (i) offset the portion of income locked in home equity, and (ii) maintain additional liquid buffers as the mandatory payment tightens their liquidity constraint. Later in life, households in the model draw down on the savings built via home equity. All of this can be observed in Figure 9, which shows, from left to right, the average life cycle patterns of the mortgage balance, of net wealth as a percentage of income, and of liquid wealth-to-income, respectively.

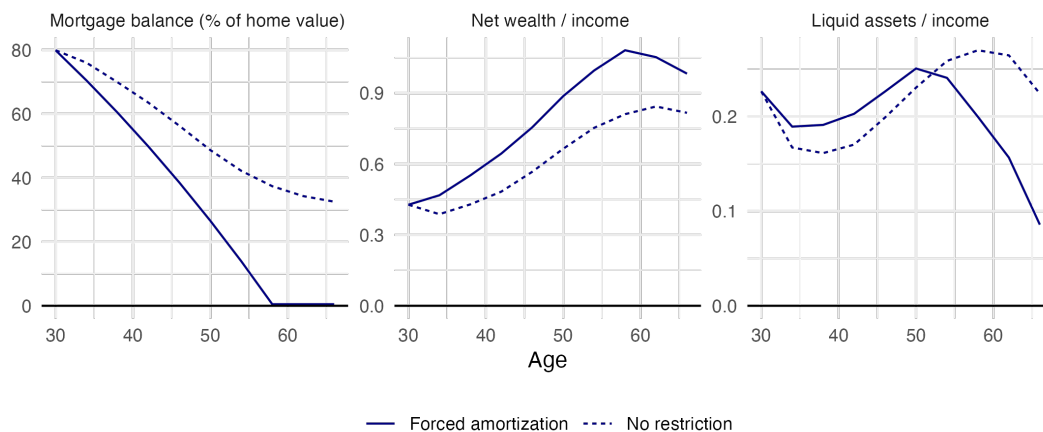


Figure 9: Life cycle saving patterns in the model

Comparison of model-predicted mortgage balances, net wealth, and liquid assets under flexible repayment (dashed lines) versus mandatory amortization (solid lines). Under mandatory amortization, households repay mortgages faster (left panel), accumulate substantially more wealth relative to income (center panel), and maintain higher liquid asset buffers (right panel), reflecting increased precautionary saving motives.

The effects of mandatory amortization on consumption translate into patterns of wealth accumulation over the life cycle. The left panel of Figure 9 shows that the optimal repayment pattern for the average household is slower than mandated, and involves leaving a substantial portion of the loan, just over 30%, still to be paid at the time of retirement. With mandatory amortization, on average repayment is faster and is concluded before the 30 years of the loan maturity – as the households who are better off i.e. have high income windfalls, make some prepayments.

The higher saving of households in the mandatory amortization case naturally leads to more wealth accumulation over the life cycle. The average household under mandatory amortization

accumulates wealth equivalent to roughly 100% of income by age 60, compared to 85% under the unrestricted scenario. The tighter constraints faced by households lead to higher saving for precautionary reasons during the working life. After that, although constrained households show lower saving rates, they still reach retirement with a markedly higher wealth-income ratio.

In environments with a low after-tax mortgage carry (as in the Netherlands for many cohorts), the model predicts that interest-only borrowers carry larger late-life liquid balances and lower home equity than amortizing borrowers with similar PTI/LTV, with small consumption differences—the exact pattern documented in Section 3.5.

Differences across income groups

The effects of mandatory amortization vary over the income distribution. Figure 8 plots the saving rate, the share of wealth invested in housing, and the liquid assets-to wealth ratio across model permanent-income quintiles (i.e. persistent over the life cycle). Amortization affects mainly the saving rate of lower-income homeowners: in the bottom income quintile, mandatory amortization increases saving rates by approximately 12 percentage points compared to the flexible repayment regime. This heterogeneous response reflects the differential burden that fixed mortgage payments impose across income levels. Lower-income households, closer to their liquidity constraints, if required to make mandatory payments they reduce consumption and increase saving in liquid assets. Higher-income households can more easily accommodate mandatory payments by shifting the composition of saving, without substantially altering their consumption-saving decisions. While income-richer households keep their desired liquid savings buffers and make their mortgage repayments, poorer households save comparatively more, increase their net wealth, i.e. including housing assets and deducted from mortgage debt, but end up with smaller liquid savings.

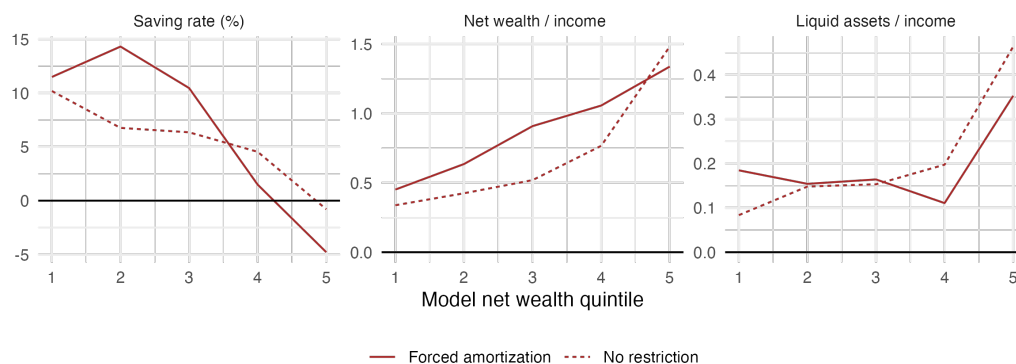


Figure 10: Saving patterns over the income distribution in the model

Model predictions for households across income quintiles show that mandatory amortization (solid lines) induces higher saving rates for lower-income households (left panel) compared to the flexible repayment regime (dashed lines), while for higher income groups the effect abates, even reversing at the top. The portfolio share of assets invested in housing is higher with mortgage amortization, for households across the income distribution (center panel). Liquid asset holdings (right panel) are higher across the income distribution, but more so for richer households.

The resulting pattern shows a flattening of the saving rate gradient across income quintiles under mandatory amortization—lower-income households are "forced" to save at rates closer to those of higher-income households, reducing the typical positive correlation between income and saving rates observed in the unconstrained scenario.

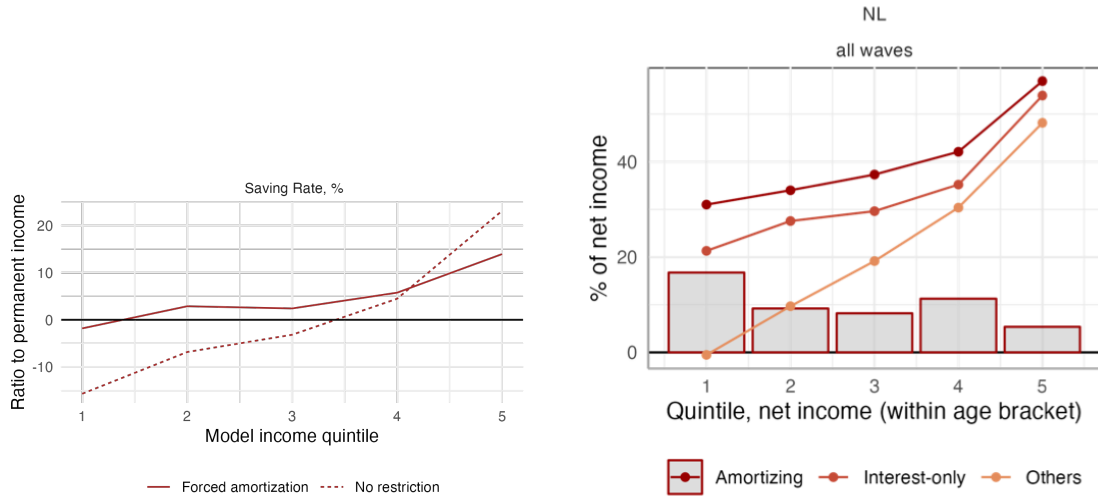
4.7 Implications of amortization for the wealth distribution

Here, we look at the implications of the amortization regime for the wealth distribution, comparing outcomes across different household income and wealth groups.

Heterogeneity over the income distribution

Finally, Figure 11 depicts differences across income groups both in the model and in the data. In the model (left panel), I rank agents by permanent-income quintile conditioning on age, so that any variation in saving rates across quintiles is not driven by life-cycle income profiles. Again, I compare the two scenarios of mandatory amortization vs. full flexibility. Under the former scenario, households in the bottom income quintile increase their saving rates by roughly 12 percentage points relative to the flexible regime, while those in the top quintile slightly decrease their saving rate. The curve of saving rates is markedly flatter under amortization, due to the previously discussed stronger effects of mortgage-induced saving for lower income homeowners.

In the right panel, I recall a comparable picture from the HFCS data for the Netherlands, which shows a similar pattern: among households in each income quintile, amortizing mortgage holders save substantially more than those homeowners who accessed an interest-only mortgage contract (and that households without a mortgage). In the lowest quintile, for example, amortizing borrowers in the Netherlands saved 30 percent of their income on average, well above the 20% saving rate for interest-only homeowners. By contrast, in the top quintile, all three groups have high saving rates (40–50 percent). Homeowners with an amortizing mortgage still show the highest saving rates, but the difference to interest-only borrowers becomes insignificant. This mirrors the model's prediction that mandatory amortization raises saving rates more for poorer homeowners. The comparison suggests that this mechanism can, to some extent, rationalize the clear difference observed in the data.



(a) Saving rates across income quintiles in the model (b) Weight of amortization on household net income

Figure 11: Saving rates over the income distribution – model and data

The left panel refers to the model-predicted saving rate (percentage) under mandatory (solid) vs. flexible (dashed) amortization, by income quintile (age = 50), while the right panel shows the corresponding comparison recalling the HFCS data for the Netherlands in Section 3, comparing the saving rate (percentage) across income quintiles (conditional on age), for mortgaged households with interest-only and amortizing loans, and non-mortgaged households.

Wealth distribution

The baseline model produces differences in wealth accumulation across households, depending on their initial permanent income draw and following histories over the life cycle. While this is not enough to generate a full realistic wealth distribution in the model, we can use this to measure how the different patterns in wealth accumulation over the life cycle, depending on the mortgage regime, would generate differences across households with income levels. It should be kept in mind that, at this stage, differences in wealth are more correlated with age than in the data.

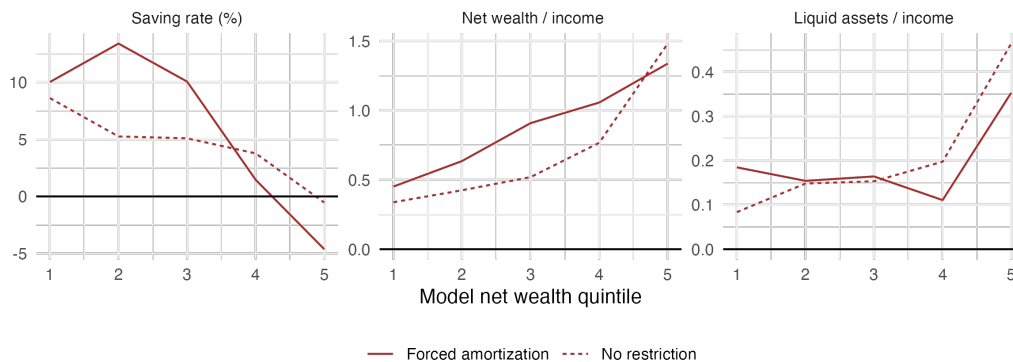


Figure 12: Saving patterns over the wealth distribution in the model

Model-predicted differences in saving and wealth accumulation across wealth quintiles under mandatory amortization (solid lines) versus flexible repayment (dashed lines). Left panel: Saving rates are higher for lower wealth quintiles under mandatory amortization but converge or reverse for higher quintiles. Center panel: Net wealth-to-income ratios show more equal distribution under mandatory amortization. Right panel: Liquid asset holdings relative to income follow a similar pattern, with mandatory amortization leading to more precautionary saving among lower wealth households.

Figure 12 examines the effects of mandatory amortization on wealth accumulation patterns for different wealth quintiles in the model. The model predicts that under mandatory amortization, wealth accumulation is more evenly distributed across wealth groups. This result is driven by the disproportionate increase in precautionary saving among lower-wealth households, who face tighter liquidity constraints and are compelled to save a significant share of their income into home equity.

Differences in overall wealth are subdued with mandatory amortization, as shown in the central panel of the Figure. These results suggest that mandatory amortization flattens wealth inequality, in the classic sense of net worth inequality, by disproportionately increasing saving rates among lower-income households. The implications for liquid wealth accumulation, and therefore for the distribution of financial wealth, are more nuanced.

Households at the bottom of the wealth distribution, who are predominantly younger, possess more financial wealth under mandatory amortization. The additional precautionary motive leads them to save more. At the other end of the wealth distribution, the situation is reversed; richer households accumulate less financial savings under mandatory amortization than they do in the unrestricted model. This suggests that the gains from the higher financial saving later in life under the unconstrained scenario are concentrated among the richest households. Overall the results suggest that, also in terms of financial wealth inequality, mandatory amortization leads to a more equal distribution.

Future research Work is in progress to upgrade the framework in three directions that together yield a far more precise mapping from contract design to distributional outcomes. First, the next step is to add heterogeneity in discount factors, following Krusell and Smith (1998), as this single modification will allow to replicate the observed spread of saving rates and the joint distribution of liquid and illiquid wealth (excluding the very top). The model will be extended to include housing

consumption explicitly in household preferences and allow for different levels, i.e. different sized houses, as well as the option to rent. Housing choice will also become explicit, to track the full portfolio response to mortgage design. This will also allow me to verify that the liquidity strain created by front-loaded amortisation is not undone by an ex-ante shift in the housing decision. Because purchase and refinancing remain subject to the same frictions documented in Section 2, the constraint can bind even when the extensive margin of housing is available. Afterward, a third risky asset will be introduced, to take into account the trade-off between repaying costly mortgage debt or investing in risky equities with potentially higher return.

Finally, rather than the simple knife-edge cases examined here, with fully mandatory amortization pitched against fully flexible repayment, alternative mortgage structures will be explored, namely simulating the effects of flexible repayment schemes, such as countercyclical payments (e.g., Guren et al., 2023), and comparing their distributional consequences to those of mandatory amortization.

5 Conclusion

This paper shows that the mandatory fixed amortisation schedule embedded in standard mortgages has quantitatively important implications for saving behavior, in particular for younger homeowners with lower income and wealth, and for the wealth distribution.

I first brought forth evidence suggesting that the effects of mandatory amortization on saving are stronger for poorer and younger homeowners. Using data from the HFCS, I documented previously unexplored patterns in mortgages and saving rates across Euro Area countries. Saving rates increase substantially over the income and wealth distributions, and over the life cycle. In the Euro Area, saving rates increase with income, with a less steep gradient for mortgaged homeowners, particularly those with amortizing mortgages. Across age groups, saving rates rise with age, peaking in the 50-60 age bracket, and show greater variability among non-mortgaged households. Tightly connected to the life cycle, saving rates also increase with wealth, with differences being much flatter among mortgaged homeowners.

This paper argues that fixed amortization schedules, the norm in mortgage contracts in most countries, may be an important factor driving these patterns. To explore this, I single out the case of the Netherlands, where interest-only (IO) mortgages are prevalent, in the empirical analysis. Notably, IO mortgage holders exhibit saving patterns more akin to non-mortgaged households, with lower saving rates and greater variation across groups. I take those findings as suggestive of a potential role of the amortization schedule in shaping differences in household saving behavior.

Subsequently, I use a quantitative model of consumption, saving and mortgage debt repayment to illustrate how these patterns in saving rates are consistent with a role of the amortization schedule. The key mechanism is the large precautionary saving motives faced by young households at the beginning of their life, who face mandatory amortization but also have low liquid savings. Young households, facing a restriction forcing them to save a fraction of their income into

an illiquid asset (home equity), optimally save more to compensate for that restriction, building up liquid saving buffers closer to what would be optimal in their case.

The model presented in this paper demonstrates that saving rates for less affluent and younger homeowners would be markedly lower if it were less costly to deviate from the standard mortgage contract. Importantly, these results emerge from fully rational optimization under constraints and do not require any behavioral biases or information limitations, distinguishing this work from much of the recent literature on this topic. This approach allows the implications of this mechanism to be more easily integrated with state-of-the-art models of the aggregate economy.

My results have wide-ranging policy implications. Decision makers considering relaxation or tightening of mortgage lending standards must take into account that down payment requirements and amortization schedules (as well as, implicitly, maturities) have significant effects on the saving rates of homeowners. This has relevant aggregate and distributional implications – for aggregate saving, macroeconomic stability, and wealth inequality. More broadly, my results lend support to policies promoting first-time homebuyers, popular in many countries (notably in the US). The notion of the ‘mortgage piggy bank’ – the idea that homeownership is a powerful wealth-building device – is widely disseminated among financial advisors and the general population. However, the impact of such policies on an aggregate scale has lacked, until now, theoretical and empirical backing. This paper provides both – through indirect evidence and a clear mechanism that supports a strong effect of mortgage contract design on saving by poorer, younger homeowners.

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A Saving and amortization checks

A.1 Amortization for mortgages before and after 2013

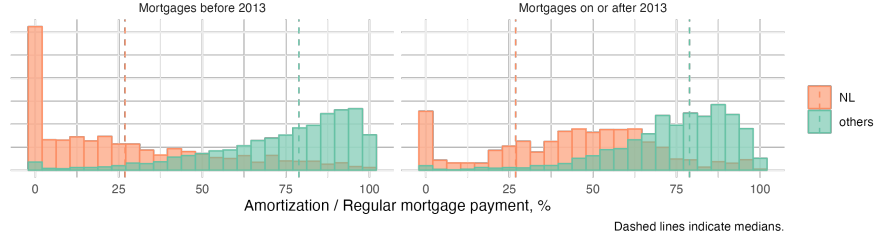


Figure 13: Distribution of amortization in the HFCS, mortgages before and after 2013

	Netherlands	Other
Mortgages before 2013	30.1	1.7
Mortgages on or after 2013	11.8	1.0

Table 5: Percentage of obs. where amortization is less than 5% of the regular payment

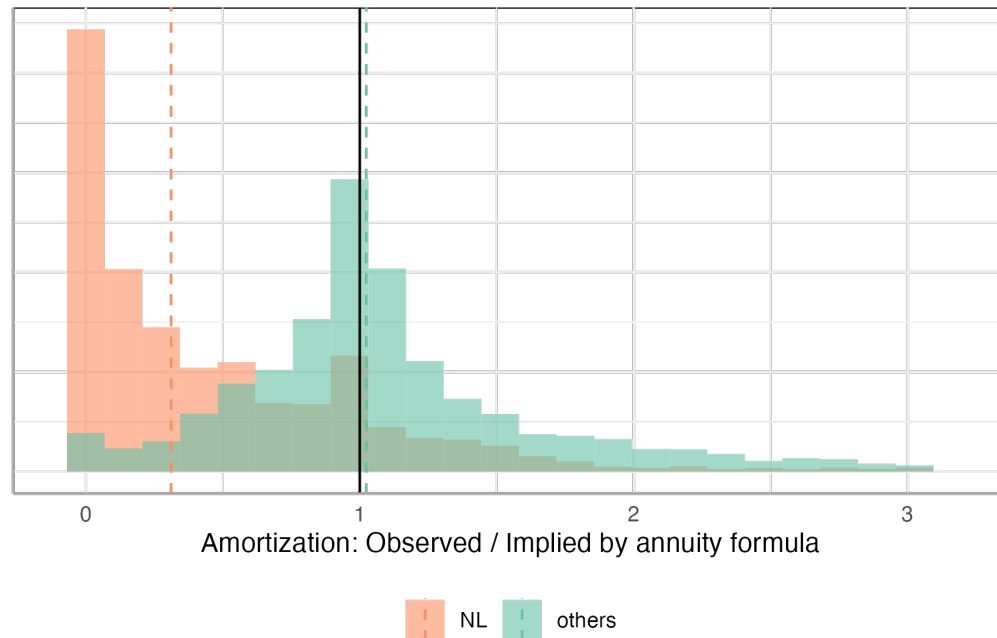
A.2 Amortization calculated via annuity formula

An additional check I performed is to verify that, at the household level, the amortization amounts are consistent with those implied by the standard annuity formula, given the interest rate and residual maturity of the corresponding loans. In other words, we should observe $\frac{\text{Amortization observed}}{\text{Implied repayment}} \approx 1$, where the implied repayment is given by the standard annuity formula as follows:

$$\text{Implied repayment at } t = \text{Outstanding debt} \times r \times \left(\frac{1}{1 - \frac{1}{(1+r)^{T-t}}} - 1 \right),$$

where r is the loan interest rate and T its residual maturity. This is illustrated in Figure 14 below, where I compute the ratio between the observed amortization and the amount implied by the annuity formula as above. Normally, in most countries, amortization payments increase slightly over time: monthly overall payments, rather than amortization amounts, are fixed in the terms of the loan. Therefore, other things equal, we would expect this measure to be slightly below 100% for the typical household.

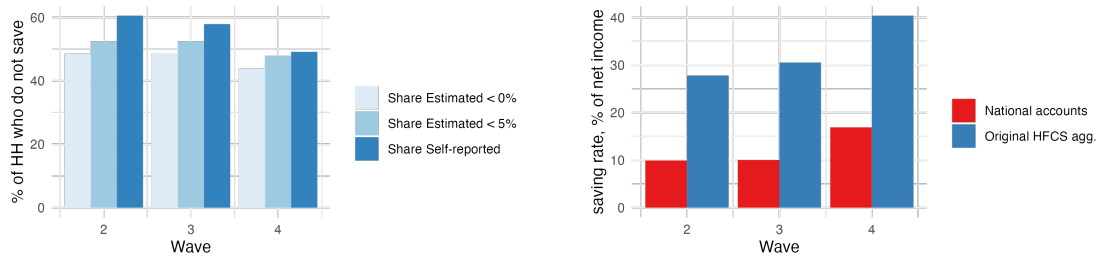
The results of this exercise are shown in the histograms of Figure 15.



Note: Dashed lines indicate country group medians.

Figure 14: Histogram of the weight of amortization in regular mortgage payments, HFCS wave 3
Note: dashed lines indicate the group median. The solid line marks 100%.

A.3 Saving rates



(a) Percentage of HH who do not save under estimated saving rates and according to responses to a question on ability to save
(b) Aggregate saving rates in National Accounts and as implied by the HFCS

Figure 15: Statistics of saving rate measure compared with external benchmarks