Home ownership and mortgage design: inattention and optimal borrowing decisions with hidden debt

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Abstract

This paper examines the impact of hidden debt in housing cooperatives on household mortgage decisions, property prices, and overall welfare. I find that only 10% of co-op debt is capitalized into apartment prices, creating a price anomaly and an arbitrage opportunity for developers. To analyze this phenomenon, I develop a life-cycle model of household borrowing choice between private and co-op mortgages. I reach three main conclusions. First, part of the price discrepancy can be explained by mortgage design and policy constraints. Co-op mortgages lower transaction prices and down payment requirements, which allow households to retain liquidity over the life cycle. This enhances savings and consumption, and increases household entry to home ownership by 79 percent. Second, co-op mortgages increase overall household debt, are disproportionately chosen by financially vulnerable households, and heighten exposure to systemic risk, leading to a 7-percentage-point rise in default rates. Third, I estimate that household attention to co-op debt is approximately 79%, using a novel structural estimation approach that aligns model predictions with observed data. The findings underscore the need for greater transparency in co-op debt reporting and suggest that policy interventions may be necessary to mitigate financial risks impacting both households and the broader economy.

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The mortgage is the largest liability for most households and represents a significant share of their budget. Yet, growing evidence suggests that households frequently make inefficient mortgage decisions. A well-documented literature finds that households choose suboptimal mortgage types (Campbell and Cocco, 2003, 2015, Campbell, Clara and Cocco, 2021, Andersen et al., 2023), fail to refinance optimally (Berger et al., 2024*b*,*a*, Guren, Krishnamurthy and Mcquade, 2021), and disregard key housing costs (Bradley, 2017, Elinder and Persson, 2017).

There are several possible reasons why households make suboptimal mortgage decisions. Behavioral biases distort household action from optimal decisions. Suggested explanations include rational inattention (Gabaix et al., 2006; Gabaix, 2014), salience effects (Chetty, Looney and Kroft, 2009), financial literacy (Lusardi, 2008, Agarwal et al., 2009), and complexity (Gabaix and Graeber, 2023). However, while most studies focus on private mortgages, an important and overlooked source of mortgage risk is the hidden debt embedded in housing cooperatives (co-ops).

This paper investigates the effects of co-op mortgage debt on apartment prices, optimal mortgage choices, and household welfare. It contributes to the literature in several ways. First, it provides new empirical evidence on the capitalization of co-op debt and its variation over time. Second, it extends research and develops a life-cycle model to quantify how households choose between private and co-op mortgages, subject to borrowing constraints and policy rules. Third, it contributes to the literature on households' financial negligence by estimating a novel inattention parameter for co-op debt.

In Sweden, household mortgages total SEK 4,141 billion (USD $378 billion). In addition, around 20% of the population lives in co-op apartments, where a large share of mortgage financing is held collectively rather than by individual homeowners. These co-op mortgages amount to an additional estimated SEK 578 billion (USD $53 billion) and remain unaccounted for in standard debt measures, even though it amplifies financial leverage.[1]

Despite the scale of hidden co-op debt, both households and lenders appear inattentive to its risk when making borrowing decisions.[2] Research suggests that apartment prices do not

[1]Statistics Sweden (SCB). The estimated size of co-op mortgages is calculated using information on the number of co-op units, the average size of each unit, and the average co-op mortgage per square meter.

[2]A survey conducted by Almenberg and Karapetyan (2014) found that less than one in four households

fully reflect the implicit liability of co-op mortgages, creating a price anomaly in the market values of apartments (Almenberg and Karapetyan, 2014, Hjalmarsson and Hjalmarsson, 2009). Additionally, lenders — who prioritize households' ability to service their debt — typically exclude co-op debt from their mortgage risk assessments when they process loan requests. This lack of awareness has implications not only for individual household financial stability, but also for broader economic risk. Household mortgage mismanagement has been linked to systemic financial instability, as evidenced by its role in the 2008 Global Financial Crisis (GFC) (Mian and Sufi, 2009, 2017, 2011; Agarwal et al., 2014).

Households may fail to properly capitalize co-op debt into housing prices, however, this does not necessarily imply irrationality. Mortgage design matters, and private and co-op mortgages are not perfect substitutes, which previous findings assume. In addition, policy constraints, such as loan-to-value (LTV) limits and amortization rules, need to be considered when choosing between mortgages. A low capitalization rate may be the result of cognitive limitations, incomplete information, or the complexity of comparing different mortgage structures — but it might also reflect a rational trade-off between liquidity, affordability, and costly attention to some element of housing prices.

To analyze this issue, I investigate whether behavioral factors, policy constraints, or rational financial trade-offs drive household mortgage choices.

In the first part of the paper, I re-estimate the effect of co-op debt on market values and disentangle the potential mechanisms driving the effect. I find that only 10% of co-op debt is reflected in apartment prices, a lower capitalization rate than previously estimated. This rate varies over time and correlates with the prevailing interest rates, suggesting that households make trade-offs based on borrowing costs. Yet previous studies emphasize salience as a key factor affecting the estimate. To test the salience hypothesis, I exploit a shock to interest rates in early 2022 and find no significant price difference between high-debt co-ops that disclose their financial situation and those that do not. This suggests that the capitalization rate is not simply a matter of salience but rather a function of mortgage costs and the cognitive effort of updating the information set.

knew the amount of debt their co-op had taken on, and fewer than one in eight knew the interest rate on that debt.

In the second part of the paper, I address this and develop a life-cycle model in which households choose the optimal share of private mortgages and co-op mortgages subject to borrowing constraints, policy rules, and limited attention. The model is estimated using a simulated method of moments (SMM) approach, matching the model's predictions to detailed data from the household and housing market. I find that households' attention to co-op mortgages are approximately 79%, meaning they systematically discount 21% of the true cost of these mortgages.

The introduction of co-op mortgages also creates a selection effect where financially weak households take on higher mortgage risk. Because co-op mortgages reduce down payment requirements, they facilitate home ownership for households with low savings, effectively increasing cash-on-hand for consumption and investment. At the same time, the low capitalization rate inflates the market value and increases household debt exposure. As a result, households with large shares of co-op mortgages experience a threefold increase in default risk over the life cycle, compared to households with strictly private mortgages.

These findings have important policy implications for both consumer protection and financial stability. If households systematically underestimate the risks associated with co-op mortgages, policymakers are motivated to introduce regulations that improve mortgage transparency in co-op debt reporting. Ensuring that co-op mortgage liabilities are accurately disclosed and considered within lending assessments would help mitigate financial risks for households and the broader economy.

The rest of the paper is organized as follows. Section 1 explains the Swedish housing market. The data used is presented in Section 2, Section 3 presents the results for capitalization of hidden debt and presents the estimated cost of non-capitalization. Section 4 introduces a model of optimal mortgage financing, and Section 5 concludes.

1 Swedish home ownership

The two main forms of housing ownership in Sweden are private and co-op ownership. Private ownership is the dominant form of ownership for detached houses and townhouses (henceforth houses) and co-op ownership is the principal form of ownership for apartment buildings. Co-op apartments account for 22 percent of the total housing stock and house 21 percent of households.

1.1 Shared real estate ownership in co-ops

Co-ops are legal entities and as such they can take on debt to finance the construction or renovation of homes, just like individual households. The co-ops then finance these loans through member fees, income from renting space (e.g., for shops or offices), or by reducing other service-related expenses. The residents of the real estate make out both the members and board of the co-op and manage the estate at will.

Importantly, the co-ops own the real estate. When a co-op unit is bought and sold there is no transfer of ownership of the estate. Instead, the household buys a share in the co-op, which grants them a right to inhabit a specific unit. In doing so, they become members of the co-op and assume both benefits and liabilities. Households are free to make improvements and renovations within the unit, but certain modifications and maintenance — such as repairs to sewage and water pipes, windows, the building's exterior, common spaces, and the outdoor area — are the responsibility of the co-op.

To manage long-term costs, most co-ops make financial plans that range over 30 years into the future. These plans set aside fixed savings amounts for renovations in order to smooth maintenance costs over time. In doing so, the co-op functions as a form of insurance for its members. The probability of the pipes breaking in a certain household might be the same under private and co-op ownership, but the expected cost of such a repair is lower in the co-op as the risk is shared among its members.

The longevity and size of the co-op could also enhance its bargaining power when negotiating interest rates with the lender. Since the risk of co-op default is shared among all members, it is generally lower than for individual households. This risk reduction could earn

a discount on interest rates. Additionally, since the co-op members are constantly rotating with each apartment transaction, any defaulting household will soon be replaced by a new one. The expected life-time of co-ops is therefore longer than that of individual households. As a result, co-ops often secure lenient amortization plans with principal repayment extending over hundreds of years.

However, there are conflicting incentives regarding co-op loan amortization. On the one hand, current member households pay the cost of the co-op loans, and these costs decrease as you amortize the loan. On the other, these members effectively pay off a loan that would otherwise be inherited by new members if they move or pass away, shifting the burden to the next generation. If co-op loans are not capitalized into house prices, then current member households may not benefit from making hefty amortization payments if they plan to sell their units.

1.2 Co-op formation

When a new house is built, the contractor in charge forms the co-op. They set out the initial financial plan with a budget for the first few years and decide on the financing scheme of the project.

There are two sources of income for the contractor when selling the residential building: initial member stakes (the market price that households pay) and co-op debt. To maximize profits, the contractor chooses the initial price to charge and the level of debt the co-op will take on. At this stage, the contractor has full control of the co-op and essentially decides the amount of debt the co-op will incur to fund the project.

The optimal balance between price and debt is determined internally or in collaboration with the broker assigned to sell the units. Given the total market value that the contractor wants to extract, increasing the amount of debt in the co-op will require a higher monthly fee to cover mortgage costs. At the same time, the market price must decrease in proportion to the increase in debt. Vice versa if they increase the price, the level of debt can decrease and monthly member fees can be reduced. In the end, it is often the broker's knowledge of local market demand that helps decide whether to set low prices with high fees or high prices with low fees. Once prices and debt levels are established, the contractor sells the

units. The contractor then receives the market prices from households and the co-op loans taken to finance construction.

During the construction process and until enough households have purchased units, the contractor retains full control of the co-op. Once enough households have joined, the control of the co-op is transferred to the members and the contractor exits without further responsibilities. From now on, the new members are responsible for the budget and financial planning of the co-op. They set the member fees, determine savings and services, and may change any aspect of the co-ops set up that were initially determined by the contractor.

1.3 Incoming members and co-op mortgages

When a lender issues a mortgage to a co-op, it has limited or no knowledge of the incoming member households. Mortgage negotiations take place when the contractor is in control of the co-op, making it difficult to assess the risks posed by future member households as these are unknown. This creates uncertainty about the co-op's ability to service their debt. Furthermore, co-op mortgages and private mortgages are handled by separate branches within financial intermediaries. As a result, co-op lenders have no influence on the acceptance or rejection of new members.

The selection of new members is made entirely in the private mortgage division. Households apply for a private mortgage and the lender evaluates their financial stability based on the future income risk and an estimated household budget. This budget includes the households' steady income and transfers, fixed expenses, standard consumption costs for household members, amortization payments, and interest payments. To assess the households' financial resilience, the lender "stress test" the budget against a hypothetical interest rate increase. For the mortgage to be approved the budget must remain in a surplus under the increased rates. This process, known as the "money left to live on" (KALP) calculation, is an industry standard among lenders.[3]

However, there is a caveat in the KALP calculation; co-op member fees are treated as fixed costs. If interest rates rise, co-ops must raise their fee to cover the increased costs of servicing their debt. This creates an indirect effect of interest rate shocks on the households'

[3] "Kvar Att Leva på Kalkylen", KALP

budget going through the co-op — an effect not accounted for in the KALP. As a result, the KALP will overestimate the ability of households to service debt in co-ops with large mortgages.

1.4 Banks, co-ops, and financially weak households

Underestimating total debt exposure creates a selection of financially weaker households into high-debt co-ops. An apartment with a fixed market value can have a financing structure with a high market price and low level of co-op debt, or a low market price with a high level of co-op debt. This creates two important selection mechanisms into co-ops. First, Swedish mortgage regulations mandate a minimum down payment on housing at 15 percent of the transaction price. Apartments with a high share of co-op debt have low transaction prices and therefore require a lower down payment. Households with limited savings or difficulty accumulating capital benefit from higher co-op debt as it lowers the financial barriers to home ownership. Second, households are more likely to get approved on the KALP in high-debt co-ops. The direct effect of an interest rate shock is proportional to the private mortgage, which in turn depends on the transaction price. In high-debt co-ops, the transaction prices are low, reducing the impact of the shock. Additionally, the indirect effect on the co-op mortgage cost is not reflected in the KALP. Taken together, the total effect — both the direct and indirect effects — is smaller in a co-op with high debt. Both of these mechanisms work in favor of financially weaker households and allow them to obtain approval for mortgages that expose them to a greater overall financial risk.

If lenders fail to anticipate the increased financial vulnerability of high-debt co-ops, then they may inadvertently increase the risk of default on both private and co-op mortgages without demanding higher returns. If the longevity and size of the co-ops earn a discount on interest rates, then the risk of attracting financially weak households should increase them. The risk is further compounded if the same lender issues mortgages both to the high-debt co-op and its individual member households.

Households denied mortgages for apartments in low-debt co-ops with comparable market value may qualify for loans in high-debt co-ops, due to the mechanisms discussed above. This exposes the lender to an increased risk as the total debt ratio and sensitivity to systemic

risk of the household are both significantly higher. There is little benefit of sharing the risk among member households if the selection of households is the financially weakest in the market.

2 Housing sales, co-op finances, and household data

For the empirical estimations and model calibration I use data on housing sales, co-op finances, and household characteristics. The data is collected from different sources and merged together in a series of steps to create a unified dataset.

2.1 Sales data

The data on housing sales span the years 2005-2024 and comes from Svensk Mäklarstatistik AB, a data collection company owned by a trade association for brokers.[4] It includes detailed micro transaction records reported by real estate brokers and contains information on the property type (house, apartment, etc.), sales and listing price, sale and possession date, location, and other home characteristics. These include living area, lot size, building construction year, and secondary or supplemental area. It also contains the co-op fee and co-op registration number that will be used to match sales to co-op financial reports. Broker-reported sales account for approximately 95% of all housing transactions in Sweden.

For houses, I also include data from the Property Price Register for full coverage. It is a comprehensive registry of all real estate transactions maintained by Lantmäteriet (the Swedish mapping, cadastral and land registration authority). This registry includes similar information as brokered sales except for the listing information. These transactions are not reported immediately by the brokers when a deal is signed, but are registered when ownership transfer requests are processed by Lantmäteriet after the deal is complete. Therefore the transaction date is recorded with a lag.

In addition to this, I also include taxation value areas from the Swedish Tax Agency (Skatteverket) which provide hyper-local information about land values, building values, and other tax-related housing information.

[4]The data was organized and distributed by Valueguard Index Sweden AB

2.2 Co-op financial reports

The sales transaction data is complemented by a novel dataset on co-op finances, which covers 16,200 of around 29,000 co-ops over multiple years. The dataset is constructed using advanced machine learning techniques for object detection in images and complex structure recognition.

I develop a custom training dataset of annotated images from financial reports and train a feature extraction model to accurately predict the location and structure of the data. The trained model then extracts data from thousands of digitized annual reports and converts them into a panel dataset. The resulting dataset contains financial information on income and debt levels, interest payments and interest rates, rate reset dates, cash holdings, size of the co-op, member fees, and more.

With this data I calculate financial indicators such as net loans per square meter, hypothetical member fees under different interest rate scenarios, market value of apartments (sum or transaction price and unit share of co-op debt), and year-on-year changes in member fees.

2.3 Households

In addition to housing and co-op data, I incorporate information on the individuals residing in the selected homes. This information comes from GeoSweden, a registry-based database compiled by Statistics Sweden and administered by the Institute for Housing and Urban Research (IBF) at Uppsala University. I use a panel of every individual in Sweden over the years 2013-2017 and link households to the sold homes. The registry provides information on individuals location on a 100-meter grid point matched to a specific dwelling, household composition, and individual demographics such as age, capital and disposable income, education level, employment details, and more. This dataset enables the aggregation of household characteristics across varying co-op debt levels and sales prices to create simple moments to target in the structural model estimation.

2.4 Merged dataset and selection

By merging sales records, co-op financial data, and household information, I construct a comprehensive dataset that covers 141 thousand sales transactions and 220 thousand households. To exclude co-ops that have taken on debt for renovations rather than initial construction, I filter out co-ops with buildings older than 15 years. This results in a sample focused on relatively new developments where co-op debt was primarily used to finance construction. Of these, 61 thousand are co-op apartments with detailed information on co-op debt.

For robustness checks I further refine the sample by requiring observations with cash holdings, short-term debt, and separation of total income and member fees, resulting in a sample with 31 thousand observations.

To compare the option of co-op debt financing with strictly private financing, I match co-op owned houses to privately owned houses based on home characteristics, geographic proximity (within the same neighborhood), and the year of sale. This results in a total of 4,554 co-op houses, 8,381 privately owned houses, and 1,871 matched pairs of co-op houses and privately owned houses.

2.5 Descriptive statistics

Table 1 reports sample means for sales, co-op, and household characteristics.

On average, co-op capital costs account for over 20 percent of the income at an average interest rate of 1.6 percent. For much of the sample period, Sweden experienced record low interest rates. By comparison, the average interest rate was 4.5 percent in the years leading up to the sample period and in the last couple of years of the sample. At this higher rate, capital costs would increase to SEK 444 per square meter (USD $4 per square foot), which would require co-op income to rise by SEK 286 per square meter (USD $2.5 per square foot), or approximately 38 percent. For the average apartment, this would translate into an additional annual cost of about SEK 20,000 (USD $1,900) for households. This calculation ignores the fact that other expenses also increase as a result of higher interest rates, further exacerbating the financial situation of both the co-op and the household.

Co-op debt represents roughly 20 percent of the market value of apartments. With a

transaction price requiring a minimum down payment of 15 percent, the relative size of co-op debt to private mortgages amounts to at least 27 percent.[5] This is a substantial share of debt for which households are liable, but is not properly accounted for in the KALP calculation.

Another thing to note is that net debt is slightly greater than gross debt. This means that short-term debt, usually outstanding payments on renovations or improvements, is greater than the liquidity of the co-ops.[6] The surplus short-term debt then needs to be rolled into long-term debt, keeping income constant. This suggests that there is little room for co-ops to counteract increased interest rate shocks by using their liquidity to decrease their debt exposure.

Finally, both the full sample and the subsample are balanced, and I therefore expect low variation due to sample size in the point estimate, although we may lose some precision.

Table 2 summarizes the data on the selection problem discussed in Section 1.4. The data contains 11,142 households that moved in the last year and are split by nominal co-op debt quartiles. The total price per square meter is relatively stable across different levels of debt, and so the market values are, on average, the same across all columns with varying co-op debt and transaction prices. This also indicates that high co-op debt is not a regional or geographic phenomenon.

As predicted, disposable income and capital income decrease with increasing share of co-op debt. This observation reflects the leniency in the KALP towards co-op mortgages and the decreased down payment requirement from lower transaction prices.

In correlation with income, we see that highly educated and natives are more likely to refrain from high levels of co-op debt. The level of education and detailed knowledge of the domestic housing market that natives are more likely to possess, both contribute to

[5]While a fifth of all households live in co-op apartments, they represent a third of all home owners. Considering the total size of Swedish household mortgages to be SEK 4,141 billion and the estimated size of co-op mortgages to be SEK 578 billion, the co-op debt is presumably greater than 27 percent the size of private mortgages.

[6]Sometimes construction costs are in the process of being paid off when ownership of the co-op is transferred from the contractor to incoming member households. The financial statements might then report them as short-term loans to be rolled into long-term mortgages. Some co-ops also take the opportunity to make certain improvements right away, such as setting up fences surrounding the estate, constructing carports or investing in solar panels.

Table 1: Averages of variables

	Full sample	Small sample
Housing Sales Variables		
Price per sqm	47,330.2	45,266.7
Member fee per sqm	694.8	697.0
Residual member fee per sqm		542.6
Living area	69.8	70.8
Number of rooms	2.7	2.7
Building year	2013.3	2012.2
Building age	6.2	6.2
Co-op Variables		
Income per sqm	751.8	788.8
Co-op loans per sqm	10,873.0	10,496.4
Short-term co-op loans per sqm		1,073.4
Liquid assets per sqm		633.7
Net loans per sqm		10,920.9
Interest costs per sqm	157.9	154.4
Interest rate (percent)	1.6	1.6
Total co-op size (sqm)	5,421.7	5,394.6
Local Area Variables		
Target value for standard plot (thousands)	2,721.2	2,822.1
Adjustment amount per sqm	799.4	843.8
Observations	61,468	31,028

the ability to understand, interpret, and calculate the effects of co-op mortgages on the household's budget.

In summary, the market values are roughly the same across co-op debt levels, but member households in high-debt co-ops have much weaker finances. They earn less income, have a lower level of education, and purchase housing with a lower down-payment requirement which increases their total mortgage size.

Table 2: Descriptive Statistics by Co-Op Debt Quartiles

	Q1	Q2	Q3	Q4
			Housing Costs	
Loan Share	11.4%	17.5%	20.1%	25.4%
Loans per sqm	5,816 SEK	8,509 SEK	9,958 SEK	12,534 SEK
	(25.35)	(9.32)	(8.89)	(31.10)
Price per sqm	50,193 SEK	45,276 SEK	43,585 SEK	42,747 SEK
	(309.28)	(331.28)	(298.72)	(320.34)
Total Price per sqm	56,009 SEK	53,785 SEK	53,543 SEK	55,280 SEK
	(307.55)	(329.65)	(298.47)	(324.15)
Avg. Min. Down Payment	536,666 SEK	491,663 SEK	454,915 SEK	408,876 SEK
	(3833.45)	(4164.86)	(3999.48)	(3572.34)
			Education and Place of Birth (Shares)	
Low Education	7.3%	9.0%	9.9%	11.0%
High School Education	29.3%	31.8%	32.8%	34.2%
College Education	39.4%	36.1%	34.5%	32.0%
Advanced Education	1.7%	1.5%	1.4%	1.2%
Sweden	82.6%	83.6%	83.4%	73.5%
Europe outside Sweden	8.1%	8.5%	7.4%	12.4%
Outside Europe	9.3%	7.9%	9.2%	14.1%
			Household	
Disp. Income (Family)	689,162 SEK	647,422 SEK	584,705 SEK	547,667 SEK
	(19130.17)	(16382.96)	(12836.16)	(10198.85)
Capital Income	99,923 SEK	102,828 SEK	94,700 SEK	81,773 SEK
	(4178.40)	(4443.88)	(4419.71)	(4045.06)
Children (0-6)	12.9%	13.0%	13.4%	15.3%
Children (7-15)	6.6%	6.4%	7.8%	8.2%
Children (16-18+)	11.2%	10.0%	9.6%	11.2%

3 Capitalisation rate and cost of hidden debt

Private mortgages have full disclosure. When households borrow directly from the bank they are personally liable for all debt and can observe the size of debt, interest rates, amortization plans, and rate reset dates. Most costs are calculated and presented to the household by the bank and are readily accessible and easily observed.

Co-op ownership opens up the possibility to fund construction costs through shared loans in the co-op. The details of the loans are handled by the co-op, reported in the annual report, and distributed to its members. Unlike the report on private loans from the bank, the annual reports only include total costs and not household-specific costs. It also requires the members, or potentially new members, to read the report in order to inform themselves of the capital costs and mortgage design in the co-op. The details of the loans are also reported only once a year, in contrast to the private loans that are continuously updated at the bank. This creates a small but potentially important hurdle for households in trying to gather up-to-date information about the capital costs tied to a home.

There are two possible limitations to households capitalizing co-op debt into house prices. First, there is a cost of mental accounting to collect and process co-op debt information into the household budget. For the average household, computational exercises that involve potential outcomes and expected future interest rates and costs pose a real challenge. Banks cover this process on the private mortgage, but for the co-op mortgage the leniency in the KALP calculation of the banks leave the responsibility to the household. If households do not have the financial literacy to assess the risk or if the cost of internalizing it is too high, then they may fail to capitalize the co-op debt into house prices. Second, if co-op mortgages are not salient, then households will not account for the incurred costs. Households that do not do their due diligence and read the financial statements to extract the information on co-op loans will not be able to take these costs into account when pricing a home. Low salience of co-op mortgages thus leads households to overestimate the market price of homes conditional on the perceived market value.

Previous studies have documented limited capitalization of co-op debt into apartment prices. Almenberg and Karapetyan (2014) and Hjalmarsson and Hjalmarsson (2009) analyze

co-op apartments in 2006-2009 and 2002-2005, respectively, and report capitalization rates between 30% and 70%. These findings suggest that only a fraction of the co-op debt is reflected in the sales price of apartments.

The underlying assumption in these studies is that households are willing to pay a fixed market value for an apartment and do so by substituting between private financing and co-op debt. However, this assumes perfect substitution between private and co-op mortgages, overlooking key differences in mortgage designs that might be more or less advantageous.

The estimated capitalization rates fall well below the one-for-one trade-off between co-op funding and private funding required to keep market value constant. As a result, this creates an arbitrage opportunity where contractors can increase co-op debt and pocket the proceeds while reducing the market price by less than the added debt, creating financial gains at the expense of households.

In this section, I replicate the findings of previous studies and investigate potential mechanisms for the observed price anomaly. I use the same approach as Almenberg and Karapetyan (2014), observing co-op loans directly. In addition, I expand on their methodology by incorporating more detailed data from the co-op balance sheets to observe both the capital costs of the debt directly and, therefore, the interest rates on the loans. This allows me to deduct the capital costs from the monthly member fee and use the residual fee as a control variable in the regression models.

Including the residual fee provides a better estimate of the financial state and management of the co-op, factors which may also affect the price. Furthermore, by incorporating interest rates on the mortgages I can evaluate the sensitivity of co-op budgets to fluctuations in interest rates. Using the member fee income of the co-op, I calculate the fee increases required to cover capital costs at standard interest rates and identify the thresholds at which co-ops become insolvent solely due to mortgage costs.

3.1 Estimation

I follow the same framework as in Almenberg and Karapetyan (2014) and make three identifying assumptions. First, I assume that homes have a market value, V, that is the sum of the market price, P, and co-op debt, D. Second, I assume that private and co-op debt

are perfect substitutes and should be traded one-for-one holding market value constant, i.e. $P = V - D$. Third, I assume that the market value can be expressed in terms of the observed characteristics of the home in a hedonic model, $V = \mathbf{X}\beta$. We can then express the market price in a regression equation as

$$P_i = \alpha_g + \xi_t + \mathbf{X}_i\beta + \delta D_i + \varepsilon_i \tag{1}$$

where $\mathbf{X}_i\beta$ is a vector of control variables for apartment i, α_g are neighborhood fixed effects, ξ_t are time fixed effects, and ε_i is an error term.

This equation allows us to estimate the level of capitalization of co-op loans captured by the parameter δ. The second assumption implies that if D_i increases by one SEK, P_i must decrease by one SEK, resulting in a theoretical estimate of $\delta = -1$.

Table 3: Capitalisation of co-op debt into transaction price

	Full sample	Small sample			
	(1)	(2)	(3)	(4)	(5)
	Loans	Loans	Residual Fee and Loans	Net loans	Residual Fee and Net Loans
Co-op loans / sqm.	-0.10***	-0.075***	-0.085***	-0.028**	-0.039***
	(0.012)	(0.015)	(0.014)	(0.012)	(0.012)
N	61,165	30,954	30,954	32,456	32,456
Controls	Yes	Yes	Yes	Yes	Yes
Neighborhood x Year FE	Yes	Yes	Yes	Yes	Yes
r2	0.86	0.88	0.88	0.88	0.88

Standard errors in parentheses

Transaction price / sqm. as dependent variable. Covariates include size, number of rooms, year built, land value, average building value, and population

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The estimates from Equation 1 are presented in Table 3. The first column (1) presents the results regressing loans on price per square meter on the full sample, controlling for home characteristics and neighborhood and year fixed effects.

An important determinant of housing prices that is left out is the member fee. The fee is salient to the household and directly affects the household's budget in the KALP. There is, however, a correlation between the member fee and the level of co-op loans as the cost of the loans are financed through the fees. At the same time, co-ops with similar characteristics but different debt levels may have similar fees if the co-op budgets differ. This can be due to differences in income streams, interest rates, or other amenity costs. To control for these potential confounders, I subtract the capital cost from the member fee so that the remaining

residual fee only reflects differences in amenities and co-op financial management.

Another possible determinant of housing prices is the net co-op debt. Liquidity in the co-op can be used to lower the amount of debt and capital costs. However, co-ops are nonprofit organizations who's sole reason to hold cash is to cover future costs. Therefore, net debt should be seen as a short-run measure. Any cash used to pay off current debt will have to be replaced by an increase in debt in the future to cover the costs for which the cash was allocated. Since the sample only includes relatively new co-ops the cash holdings are expected to be quite small compared to the level of debt. As discussed in Section 2.5, the ability of co-ops to temporarily relieve debt is presumably modest.

Constructing these additional control variables require more information which is only available for a smaller subsample. Column (2) therefore reports the same regression as column (1) but on the smaller sample for comparison. Column (3) presents the effect of loans on price per square meter controlling for the residual member fee. Columns (4) and (5) present the results using net debt instead of gross debt both without and with a control for the residual member fee, respectively.

All specifications show low estimates of the capitalization rate of co-op debt. The full sample estimate is only 10 percent. This estimate is much lower than previous studies suggest and far from the theoretical prediction. Almenberg and Karapetyan (2014) report survey results that show that less than a quarter of households know the size of their co-op debt and one in eight have some idea of the amount of debt. Even at such a low rate of informed households, these results hint at something other than salience to explain the low capitalization rate.

The point estimates drop a bit in the smaller sample to 7.5 percent and decrease even further down to around three percent when regressing on net debt. Controlling for the residual member fee increases the point estimates in magnitude to 8.5 and 3.9 percent for gross and net debt, respectively. This suggests that the member fee explains some unique variation in the dependent variable and helps disentangle the effect from co-op debt by removing noise. It is therefore possible that the full sample regression in column (1) is somewhat attenuated.

A potential explanation for the low estimates is the time periods studied. Almenberg and

Karapetyan (2014) study apartment sales in the years 2006 to 2009 and Hjalmarsson and Hjalmarsson (2009) study the period 2002 to 2005. It is possible that the capitalization rates varies over time due to other factors, and housing market conditions may well have changed. To address this, I estimate a modified version of Equation 1 to include heterogeneous time-specific effects δ_t.

$$P_{it} = \alpha_g + \xi_t + \mathbf{X}_{it}\beta + \delta_t D_{it} + \varepsilon_{it} \tag{2}$$

The yearly point estimates from Equation 2 are illustrated in Figure 1.

I find that there is a large variation in the capitalization rate over time. The early years with higher capitalization are in line with previous studies, but estimates drop in 2016 and continue to be low, between 3% and 16% until 2022. The drop in the capitalization rate is strongly correlated with a change in the mortgage interest rate, as can be seen in Figure 2. The three-month mortgage interest rate decreased from 2.5% in early 2014 to 1.5% in 2016 and stayed there until 2022 when it increased to more than 3% at the end of the year.

These results indicate that there is a trade-off between costly debt and costly attention or household accounting, rather than salience. If the salience of co-op debt was low, we would expect the capitalization rate to remain low when interest rates fluctuate. Instead, households react to co-op debt when it becomes costly. This suggests that households do observe the co-op mortgage costs, but choose to ignore them to some degree when they are relatively cheap.

This fits well with models of rational inattention similar to Gabaix (2014) where there is a utility penalty for information acquisition. Households may have some default idea of the size and costs of co-op debt, and when the interest rate is low, the potential error between the default and true costs is small. If the utility loss from this type of error is smaller than the utility penalty of investing time and effort into correcting the default value, then households pay less attention to co-op debt. Conversely, when the costs of having an erroneous default value is large, households pay more attention to co-op debt and correct the default value towards the true value.

This also suggests that households exhibit myopic behavior, responding primarily to present conditions rather than long-term expectations. Over the medium to long run, interest

rates will fluctuate, resulting in the timing of an apartment purchase to significantly influence the market value and transaction price, holding co-op debt constant.

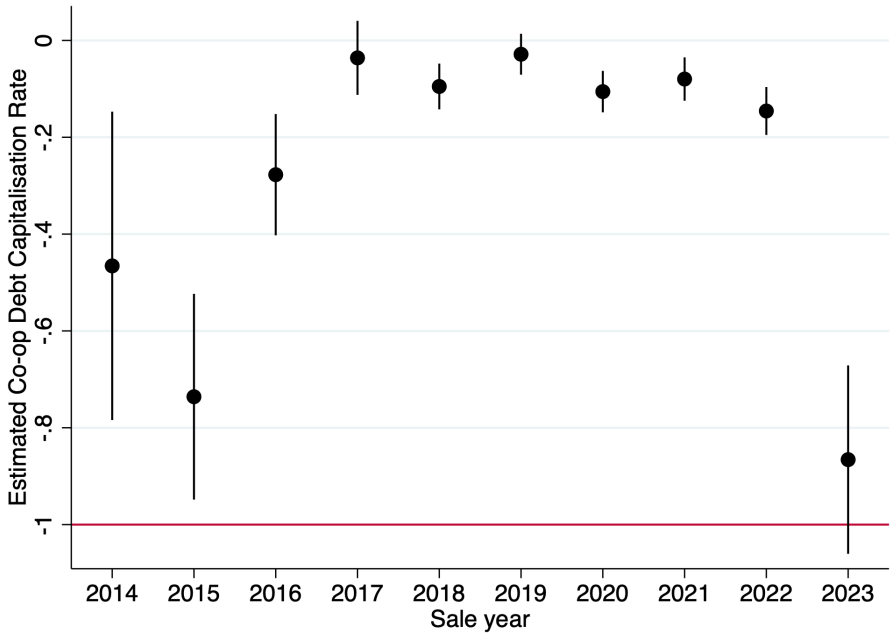


Figure 1: Capitalisation of co-op debt into transaction price, heterogeneous time effects

Notes:

3.2 Increased salience of hidden debt

To further test the salience channel I exploit an exogenous change in the mortgage interest rate and it's effect on co-op member fees. The onset of the Russia-Ukraine war caused a shock increase in energy and commodity prices. As a response to curb inflation, central banks around the world increased interest rates. This affected household budgets through three channels; the direct effect on private mortgages, the indirect effect through member fees to cover the increased cost of co-op mortgages, and the indirect effect through member fees from increased maintenance and amenity costs. Due to a large share of ARM in household debt, interest rate changes are expected to be quickly passed through to household budget expenses, as suggested by Flodén et al. (2021). The two indirect effects will vary across co-ops. Rising energy and commodity prices affect all co-ops and increase maintenance costs independent of level of debt, but the effect through increased cost of co-op mortgages will

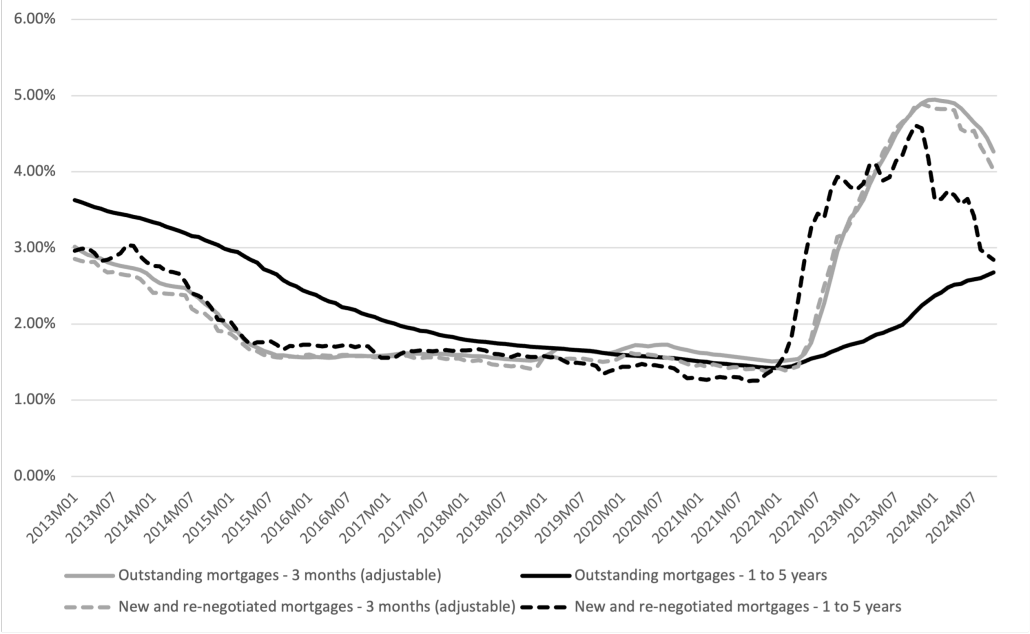


Figure 2: Private mortgage rates by lock period

Notes:

depend on the size of the mortgage and the rate reset date of fixed interest rates.

Varying rate reset dates on co-op loans will cause the interest rate shock to affect co-ops differently. Co-ops with low debt do not need to raise their member fees excessively at any point in time as a response to the increased interest rates. They remain relatively unaffected by an interest rate shock. Co-ops with large amounts of debt need to raise their member fees substantially to service the increase in mortgage costs. This will signal to households that they have high debt, but the timing of the signaling will vary with the rate reset dates on loans. Co-ops with upcoming reset dates on their loans will face the increased interest rates and mortgage costs immediately. On the other hand, co-ops with long rate reset dates on their loans will face increased costs in the future. Since co-ops are run by its member households who want to keep costs down, they are incentivized to wait as long as possible before raising member fees.

This leads to a staggered adoption of increased member fees among high-debt co-ops. In this context, some high-debt co-ops signal their financial situation, making it salient to households, while others do not. If the salience of co-op debt causes the observed price anomaly, we would expect high-debt co-ops that significantly raise their member fees due to

an exogenous interest rate shock to capture households' attention and experience a reduction in market prices following the shock. The year-on-year distributions of changes in member fees, illustrated in Figure 8 in the appendix, reveal a noticeable shift toward substantially larger fee increases after the onset of the war. This effect is even more pronounced in 2024, adding support to a staggered adoption of higher member fees among co-ops.

Identification assumes that all co-ops may raise their fees as a response to increased maintenance costs, but only high-debt co-ops with adjustable rates raise their member fees additionally as a response to the increased mortgage costs. Additionally, I assume that prospecting households have some idea of the fee of apartments they consider buying and would thus observe a change in the fee if it were to occur.

To estimate the effect of increasing the salience of co-op debt on house prices, I use the staggered difference-in-difference approach as defined in Equation 3.

$$P_{itcd} = \alpha_d + \sum_{n \neq -1} \beta^n T^n_{itd} + \gamma_{cd} + \mu_{td} + \varepsilon_{itd}, \tag{3}$$

The 95th percentile increase in the member fee prior to 2022 was 10 percent. Co-ops with above-median debt levels that raised their fee by more than 10 percent in the year 2023 and onward are considered treated. The variables α_d captures dataset specific fixed effects, γ_{cd} capture the co-op fixed effects in dataset d, μ_{td} capture the time fixed effects in dataset d, and ε_{itd} is an error term. Event years are indexed by n so that $n = 0$ is the treatment year and $-10 \leq n \leq 2$. Finally, the parameters of interest β^n are identified by the indicator variables T^n_{itd} for sold objects i in a treated co-op that raised fees by more than 10 percent in time t and dataset d, taking the value one in event year n and zero otherwise. The results of the event study are shown in Figure 3.

The estimated effects on apartment prices are insignificant and vary in sign, fluctuating around a null effect. This suggests that increasing the salience of co-op debt has no effect on house prices. In contrast, the direct effect of increasing the interest rate through private mortgages results in a 12.9 percent decrease in house prices over the same period.[7] It is possible that the change in interest rates increases salience of all co-op debt and that the

[7]The estimated log price effect of a one percentage point increase in the interest rate is -4.93%, multiplied by the average interest rate increase of 2.62% between 2021 and 2024 we get an estimated price drop of 12.9%

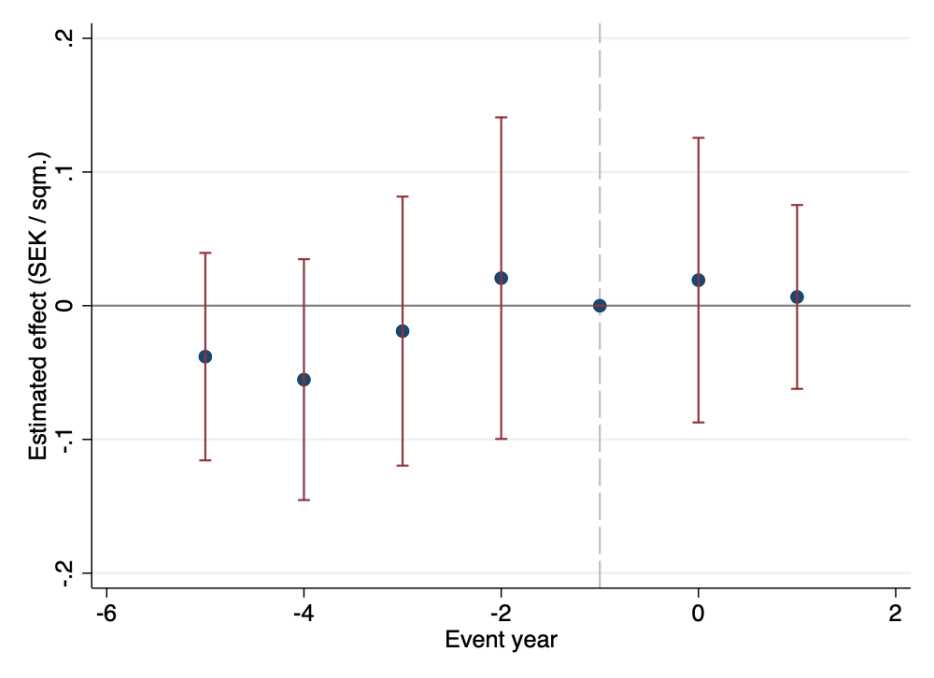


Figure 3: Staggered increase in member fees

Notes:

null effect is due to all co-ops with high debt decreasing in price together. However, this would mean that households do not observe the debt through the fees but rather in the financial statements, which would indicate increased incentives to put in the effort to collect the information when co-op debt becomes costly, lending support to some form of rational inattention with trade-offs between information accuracy and information acquisition costs.

3.3 Cost of hidden debt - extensive margin

Previous studies have only looked at co-op apartments where almost all co-ops have some level of debt. This means that they rarely observe the market value directly as the market price. In this section, I exploit the fact that in recent years there has been a lot of new construction of houses within neighborhoods where some are co-op owned and some are privately owned. For co-op owned homes, the market value will be sum of the market price and debt, as with apartments. This is the compensation that the contractor extracts when selling homes for the first time. But for privately owned homes, the market value is the market price, with no hidden debt.

If we assume full capitalization of co-op debt, then the ownership type can be seen as a form of packaging of the good decided by the contractor, and it should have no other effect on the market value of the home. The housing services provided are assumed to be the same regardless of ownership type. For this to be true, we need to further assume that there is no systematic preference for co-op versus private ownership in terms of the differences discussed in Section 1.

If co-op debt is not fully capitalized, then we can capture the level of price discrepancy between having the option to finance through co-op mortgages or not using a dummy for ownership type, $T = \mathbb{1}\{ownership = private\}$. Using propensity score matching of co-op houses to privately owned houses within the same neighborhood and sale year, we get pairs of houses with similar characteristics and market values but with different sets of mortgages. Under these assumptions, we can rearrange Equation 1 to

$$P_i + D_i = \alpha + \mathbf{X}_i\beta + \sigma T_i + \varepsilon_i \tag{4}$$

where the market value is on the left-hand side of the equation and the parameter of interest σ captures the price discrepancy between co-op ownership and private ownership from hidden debt. Assuming identical market values within matched pairs of houses and full capitalization of co-op debt, we expect σ to be equal to zero. Table 4 shows the results regressing Equation 4 first on the market price only, P, and then on the market value, $P + D$.

Columns (1) and (2) present the results under the assumption that D_i is zero for all ownership types. It shows that private ownership is more expensive in terms of market prices, which is the transaction price that households pay to acquire the house. This is the salient part of the cost of the house that is financed by the down payment and private mortgages. The lower price for co-op ownership is partly a mechanical effect of the real estate brokers' decision to set a low market price with co-op member fees. The existence of the fee itself would support the lower price on co-op houses in terms of households' budgets, but it does not necessarily reflect whether households observe the amount of co-op debt.

Columns (3) and (4) show the estimates of σ for the full equation, including co-op debt D_i. The market value of privately owned houses are on average between 10 and 15 percent lower

Table 4: Private vs co-op ownership town house.

	Market price - log		Market value - log	
	(1) OLS	(2) PS matching	(3) OLS	(4) PS matching
Private ownership	0.12***	0.17***	-0.15***	-0.10***
	(0.042)	(0.015)	(0.039)	(0.013)
N	12720	1871	12720	1871
Controls	Yes	Yes	Yes	Yes
Neighborhood x Year FE	Yes	Matched	Yes	Matched
r2	0.56	0.069	0.62	0.036

Standard errors in parentheses

Covariates include size, number of rooms, year built, land value, average building value, and population

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

per square meter compared to co-op houses. This is a significant amount of money, on average between SEK 410,000 to 560,000 (USD $37,500 to $51,200). Part of it can be explained by the transaction fee of 1.5% of transferring the privatly owned estate between households. As mentioned in Section 1.1, co-ops rotate members but do not transfer ownership of the estate, and therefore avoid this fee. But that still leaves approximately 11% in an unexplained price discrepancy.

This creates a substantial arbitration opportunity for contractors. The cost of setting up a co-op is relatively small in comparison to the estimated gains. In a perfectly competitive market we would expect firms to shift to producing co-op financed houses or to increase the price of privately owned houses to extract the premium.

In addition to the monetary markup, the contractor also benefits from improved cash flows. Extracting funds through co-op mortgages allow contractors to front load payments before all units are sold. When selling private ownership units, the contractor receives a 10 percent down-payment at signing and then the remaining 90 percent at completion of the project when households move in. Co-op ownership allows the contractor to extract the co-op mortgage at an earlier stage, alleviating the cash flow from the project and the liquidity of the contractor.

Finally, it is not clear in what direction prices shift from switching ownership types.

Private ownership generally permits more freedom to the household while co-op ownership shares risk and allows for free-riding. Households that favor freedom and responsibility, and who are not credit constrained, would value private ownership higher. Households who would like to reduce housing obligations and prefer forced savings and expense smoothing would value co-op ownership higher. There are benefits and drawbacks with both ownership types and there is no clear preference among households for one over the other.

3.4 Credibility of identifying assumptions

The findings in this section, and previous studies, rely on simplifying assumptions that may be too lenient. Specifically, we assumed a fixed market value of apartments and treated private financing and co-op mortgages as perfect substitutes, interchangeable on a one-to-one basis.

However, actual private and co-op mortgage designs have distinct advantages and disadvantages. First, the private mortgage is recorded as a capital cost in households' tax returns and is tax deductible at a rate of 30 percent. Co-op mortgages, however, are not tax deductible for the co-op or individual members. Second, factors such as risk sharing, co-op longevity, and the expected financial stability of member households can influence the co-op's interest rates. The data reveal that co-op mortgages typically have longer rate reset dates and higher average interest rates than private mortgages. These differences in capital costs directly impact households' willingness to pay for housing. Third, amortization policies affect both future capital costs and household liquidity. Private mortgage regulation mandates that households amortize two percent of the principal annually down to an LTV ratio of 50 percent. Co-op mortgages, on the other hand, have significantly longer amortization plans and sometimes pay no amortization at all. This introduces liquidity effects that were not taken into account. Finally, the level of co-op debt affects the market price and in turn the down payment required to purchase a home. High co-op debt reduces the upfront payment and facilitates market entry for credit constrained households.

There are limitations in the data that prevent us from analyzing these effects in a reduced-form framework. In particular, it lacks information on household cash savings and the size of their private mortgages. Furthermore, if there are liquidity effects then these will likely

be dynamic over the life-cycle of the household. Households trade consumption and savings over time depending on the states of the world in which they are in, or expect to be in.

To overcome these limitations, I develop a quantitative model of household's optimal borrowing decisions with private and co-op mortgages.

4 A model of optimal mortgage choice

In this section I develop a quantitative model of the life-cycle consumption and savings decision for households purchasing an apartment. Specifically, I study the decision on endogenous mortgage allocation to finance housing consumption.

All households prefer to buy an apartment — there is no decision to buy versus rent — and I assume that households demand a fixed level of housing services to suit their needs, $\bar{h}$. The household then remains in the house and does not change the demand for housing services in response to income shocks. The households have CRRA preferences and consume all goods other than housing, C_t. Since the size of the house and the utility derived from it is fixed in every period, I omit it from the objective function. In the last period, households sell their apartment and leave a bequest W_T that is the net housing value.

Households then maximize the expected utility

$$V_{t_0} = E \sum_{t=t_0}^{T} \beta^{t-1} \frac{C_{it}^{1-\rho}}{1-\rho} + \beta^T \phi \cdot \frac{W_{iT}^{1-\rho}}{1-\rho} \tag{5}$$

where β is the time discount factor, ρ is the coefficient of relative risk aversion, ϕ is the strength of the bequest motive, and T is the terminal age.

Households live for 75 periods between ages $t = 25$ and $t = 100$ and work for 40 years. Household i receives an exogenous uninsurable disposable income Y_{it} until age 65 when they retire and receive a safe pension income for the rest of their life.

Working life income is made up of a deterministic part (g_t) and a stochastic part (z_{it}) with both permanent (v_{it}) and transitory (ω_{it}) income shocks.

$$
\begin{aligned}
y_{it} \equiv \log\left(Y_{it}\right) &= g_t + z_{it} + \omega_{it} \quad \forall t \leq 65 \\
z_{it} &= z_{it-1} + v_{it} \quad \forall t \leq 65
\end{aligned}
\tag{6}
$$

The deterministic income g_t follows a hump-shaped age profile fitted to disposable income data in GeoSweden. The permanent income shock v_{it} and the transitory income shock ω_{it} are normally distributed with mean at -0.5 of its variances σ_v^2 and σ_ω^2, respectively.

Pension income is a replacement rate of $\lambda = 0.8$ of the last working age earnings, which reflects the Swedish pension system.

$$
Y_{it} = \lambda \cdot \exp\left(g_{65} + z_{i65}\right) \quad \forall t > 65 \tag{7}
$$

In addition, disposable income has two boundaries that mirror the Swedish welfare system. First, social income insurance complements disposable income in working life so that it never falls below the lower bound $\underline{Y}$. Second, retirement income is capped at $\overline{Y}$ to reflect the fact that there is a maximum income that contributes to the pension.

The households then face a choice of mortgage shares, d_h and d_c, to finance the purchase of housing. All households invest the minimum down payment (δ) on housing of 15 percent. They can then choose to finance the remaining part completely through private mortgages, $D_{h,0} = d_h P_0 \bar{h}$, or with some level of co-op mortgages, $D_{c,0} = d_c P_0 \bar{h}$, where $P_0 \bar{h}$ is the market value of the housing in the first period and $d_h + d_c = 0.85$.

Interest rates comprise a systematic part (r_t), which is the central bank reference rate, and an idiosyncratic part (ϵ_k) which is a type-dependent markup set by lenders. The interest rate ($i_{t,k}$) follows a stochastic process

$$
\begin{aligned}
r_t &= (1 - \rho_r)\bar{r} + \rho_r r_{t-1} + \nu_t \\
i_{t,h} &= r_t + \epsilon_h \\
i_{t,c} &= r_t + \epsilon_c
\end{aligned}
\tag{8}
$$

where $\bar{r}$ is the long-run mean of the interest rate, ρ_r is the persistence parameter ($0 \leq \rho_r \leq 1$), ν_t is a white noise interest rate shock $\nu \sim \mathcal{N}(0,\, \sigma_\nu^2)$, and $\epsilon_h \leq \epsilon_c$ to match data.

In each period, households pay the interest on the outstanding mortgages and an amor-

tization rate (γ) of two percent on the principal of the private mortgage until the principal is paid back in full. In addition, the household also pays maintenance costs (κ) of three percent of the current housing value ($H_t = P_t\bar{h}$) in each period. This maintenance cost makes sure the house depreciates at the same rate regardless of initial mortgage financing, that maintenance costs follow housing prices, and that maintenance is not financed by increasing the co-op mortgage over time.

The household expenditure for housing in each period is then

$$c_t = i_{h,t}D_{h,t}\left(1-\tau\right) + i_{c,t}D_{c,t} + \gamma D_{h,0} + \kappa H_t \tag{9}$$

where subscripts h and c denote private mortgage and co-op mortgage variables and parameters, respectively, τ is the tax reduction on private capital costs, and $D_{h,0}$ is the size of private mortgage at $t = 0$, or the principal.

Households then optimize the objective function in Equation 5 subject to the static budget constraint

$$X_t \geq A_t + C_t + i_{h,t}D_{h,t}\left(1-\tau\right) + i_{c,t}D_{c,t} + \gamma D_{h,0} + P_t\bar{h}\kappa \tag{10}$$

Where X_t is cash-on-hand and A_t is household investments in stocks and bonds. Borrowing — apart from mortgages with an apartment as collateral — is not allowed, which implies $A_t \geq 0$. Furthermore there are mortgage constraints imposed by banks

$$0 \leq D_{h,0} \leq (1-\delta)(1-d_{c,0})P_0\bar{h} \tag{11}$$

that state that the private mortgage cannot exceed the value of the apartment that is not funded by down payments or co-op mortgages. Since households can leverage their housing investment with mortgages and back load principal payments to retain liquidity, the mortgage constraint will bind at the maximum as long as the net position in assets and mortgages is positive.

Cash-on-hand and private mortgages then evolve according to

$$X_{t+1} = (1 + r_{e,t+1})\, A_t + Y_{t+1} \tag{12}$$

$$D_{h,t+1} = D_{h,t} - \gamma D_{h,0} \tag{13}$$

where $r_{e,t}$ is the return on investments, and co-op mortgages have infinite horizon such that there is zero amortisation on the principal $D_{c,t} = D_c \forall t$.

Housing prices evolve stochastically according to

$$\begin{aligned} P_{t+1} &= (1 + r_{h,t})\, P_t \\ (1 + r_{h,t}) &= \exp(\mu_p + \eta) \end{aligned} \tag{14}$$

where μ_p is the long run average return on apartment prices and η is an i.i.d. normally distributed shock with mean at -0.5 of its variance.

The household problem is then solved by dynamic programming with the following Bellman equation

$$V_t\left(A, z, \omega, \nu, P\right) = \max_{[C, d_c]} \left\{ \frac{C_{it}^{1-\rho}}{1-\rho} + \beta \mathrm{E} V_{t+1} \right\} \tag{15}$$

where the state variables are age, assets A, permanent and transitory income components, z and ω, the interest rate component ν, and housing price P.

4.1 Calibration

In this section, I describe the parameterization procedure of the model. Most parameters are chosen to match the details of Swedish households and the housing market, while others are derived from previous studies.

The household preference parameters are set according to previous studies. The time discount factor β is set equal to 0.945 and the coefficient of relative risk aversion ρ is set equal to 2. In the structural estimation, I will allow both β and ρ to vary to study the robustness of the inattention estimate.

The terminal net housing value (W_t) is not that different between high levels of co-op

debt and low levels of co-op debt. House price appreciation diminishes the relative size of the fixed nominal co-op mortgage, so the share of the co-op debt in the value of the house goes to zero as $T \to \infty$. The strength of the bequest motive (ϕ) is therefore set to a low value of 0.5.

The institutional parameters of the housing market are set according to policy requirements. The minimum down payment requirement (δ) as a share of the market price is 0.15 after a reform in 2010.[8] The tax reduction (τ) on capital costs from interest payments is 0.3 up to SEK 100,000 (USD \$9,151) and then 0.21 on exceeding capital costs. There is a mandate that households amortize 2 percent down to an LTV ratio of 50 percent on private mortgages, but statistics show that households amortize on average 2 percent across all LTV ratios.[9] Therefore, I keep the amortization rate (γ) at 0.02 for all periods until the principal is paid back in full to match the data. Maintenance costs (κ) as the share of the value of the apartment is set to 0.03 to counteract depreciation — which is usually estimate to be one percent per year — and cover amenity costs such as garbage collection, landscaping, or joint areas such as laundry rooms.

Disposable income has a floor ($\underline{Y}$) of SEK 80,000 (USD \$7,300) which is the minimum income of an unemployed job seeker in Sweden. The maximum income in the working period that forms the basis of the pension ($\overline{Y}$) is set to SEK 600,000 (USD \$55,000) and the replacement rate (λ) is set to 0.8 to match the average compensation rate for 2014-2019.[10]

The interest rates are divided into three components; the central bank reference rate, the private interest rate markup, and the co-op interest rate markup. The reference rate ($\bar{r}$) is set to 0.03 to match the long-run average rate in Sweden between 1994 and 2023. The private and co-op interest rate markup is estimated from the sample period between 2011 and 2023. The average mark-up in this period was 0.011 for private mortgages (ϵ_h) and 0.013 for co-op mortgages (ϵ_c).

All parameter values are reported in Table 5.

[8] FI Dnr 10-1533

[9] Den svenska bolånemarknaden 2022, Finansinspektionen

[10] Reporting of lifetime income profiles, the Swedish Pensions Agency 2021

Table 5: Parameter values

Description	Parameter	Value
Discount factor	β	0.945
CRRA coefficient	ρ	2.0
Bequest motive	ϕ	0.5
Down payment ratio	δ	0.15
Tax discount rate	τ	0.30
Amortisation rate	γ	0.02
Maintenance cost share	κ	0.03
Replacement rate in retirement	λ	0.80
Pension basis income upper bound	$\overline{Y}$	600
Income lower bound	$\underline{Y}$	80
Standard dev. of permanent income shock	σ_v	0.0713
Standard dev. of transitory income shock	σ_ω	0.1000
Long run reference rate	$\bar{r}$	0.030
Private interest rate markup	ϵ_h	0.011
Co-op interest rate markup	ϵ_c	0.013
Persistence coefficient	ρ_r	0.83
Standard dev. of interest rate shock	σ_ν	0.013
Return on assets	r_e	0.02
Return on housing	μ_p	0.040
Housing price standard dev.	σ_η	0.015

4.2 Solution and simulation

I solve the model numerically using the standard approach of backward induction. The level of co-op debt share affects the interest payments, amortization payments, down-payment, and in turn starting liquid assets. To find the optimal co-op debt share, the model is solved for a grid of possible values ranging from 0% to 30%, with steps of ten percentage points, to match the distribution in the data.[11] The household problem is then solved for each co-op debt share across all possible discretized state spaces starting at $T + 1$ to find the optimal decisions. The stochastic process of the income shocks is approximated using the Gauss-Hermit quadrature over five possible outcomes.

When a solution is found, I simulate 10,000 households with varying combinations of initial state values and solve for their optimal action. Each household uses the optimal policy function to find the choice of co-op debt share, consumptions, and savings, conditional on their initial state. Once the optimal co-op debt share has been chosen, the household stays within this state for the remainder of their life. The households are then subject to both aggregate and idiosyncratic shocks and adapt consumptions and savings accordingly. Aggregate shocks are the interest rate, house prices, and return on assets, while permanent and transitory income shocks are idiosyncratic.

In each time period, households use their cash-on-hand and pay for housing costs, consumption, and save in assets. If the household budget runs a deficit, the household is forced to sell their co-op apartment, enter the rental market, and remain there for the rest of their life.

Mortgage default in Sweden does not release households from debt. If the bank forces a foreclosure or short sale, the bank will deduct the proceeds from the sale from the debt owed and nothing else. Households can therefore default, lose their home, and still owe debt to the lender. For this reason, the process of running a deficit will be regarded as a default on the loan as the household cannot borrow to finance mortgage payments or borrow without collateral. The household therefore sells the home and exits home ownership to clear debt.

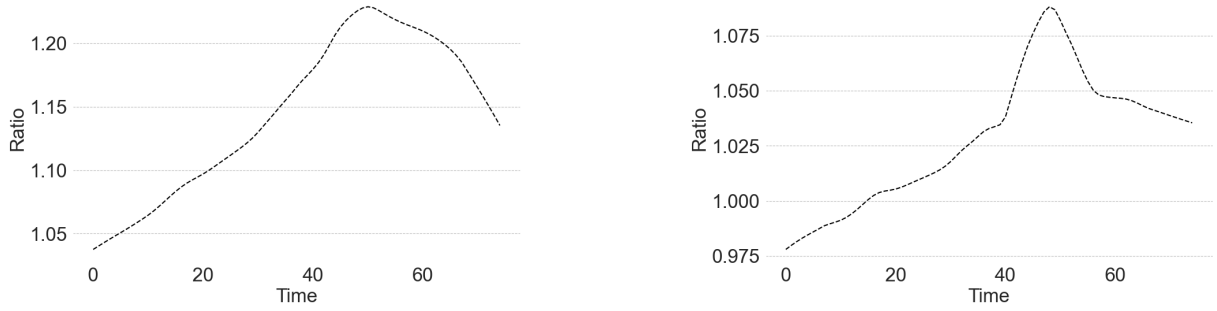
[11] See Figure 9 in the Appendix

4.3 Optimal mortgage choice

Strictly private financing always requires a higher down payment than some share of co-op mortgage financing. Without the possibility of financing through the co-op, some households are excluded from home ownership. Other households have a preference for a low level of co-op debt, given their income and assets, but are constrained due to the down payment requirements and pushed into taking on more co-op debt than optimal.

The baseline model shows that allowing for co-op mortgages increases home ownership by 79% over strictly private financing. Among households who could afford private financing, approximately 9% switch to co-op mortgages when they become available to alleviate liquidity. The effects of switching are illustrated in Figure 4. We see that the decreased down-payment requirement increases the ability to save in assets from start and accumulate cash-on-hand over the life cycle, increasing consumption and welfare.

Almost all households find it optimal to use private financing if not credit constrained by the down payment, but only 50% of home owners afford it and the rest are pushed into some share of co-op mortgages.



(a) Avg. Cash-on-Hand (b) Avg. Consumption

Figure 4: Benefits of Co-Op Debt Over the Life-Cycle

Notes: Ratio 'With Co-Op Debt' over 'No Co-Op Debt'. Average values for group of individuals who switch financing strategies. The plots represent the ratio of two different scenarios; one in which the individuals have no access to co-op mortgages ('No Co-Op Debt'), and the other when they do have the access to co-op mortgages and optimally switch means of financing ('With Co-Op Debt'). The comparison is made within individuals across scenarios.

Among households that finance privately, approximately three percent run a deficit and default within the life cycle. For households with co-op mortgages, the default rate is close to 10%. The difference in default rates highlights the additional risk these households' expose

themselves to and its effect on their ability to service debt under income uncertainty and interest rate risk.

Defaults are most likely to occur when households are vulnerable to economic shocks. Figure 5 highlights two key periods with spikes in defaults: the first five years of home ownership and the transition to retirement. In the early years, households usually lack sufficient savings as they have not yet built up a buffer stock, which makes them particularly sensitive to negative income shocks. This is especially true for households with greater total debt exposure. Similarly, income shocks just before retirement disproportionally affect households in high-debt co-ops. Co-op capital costs do not disappear completely as co-op mortgages are not amortized, unlike private mortgages where mortgage costs disappear once the principal is paid in full.

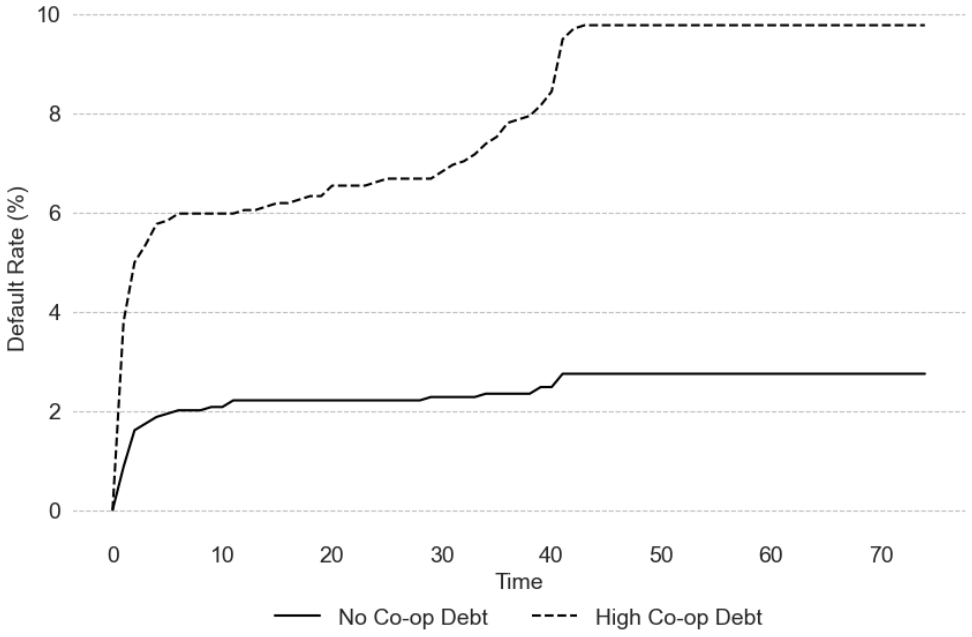


Figure 5: Default Rates Over Time

Notes: Households default when their housing costs exceed their cash-on-hand and they run a deficit in the static budget constraint. This reflects the no borrowing constraint without collateral and that households can not free themselves of debt by defaulting on mortgage payments if the net housing value is negative.

4.4 Attention parameter and structural estimation

The capitalization rate of co-op debt into housing prices investigated in Section 3 can be seen as a case of pricing under inattention as in Gabaix (2019). Specifically, Equation 1 can

be restated in the form

$$V = P + D^s \tag{16}$$

where $D^s := mD + (1-m)D^d$ is the subjectively perceived value of co-op debt (D) by the household, D^d is the household's default value — or the prior mean — of D, and $m \in [0, 1]$ is the attention variable.

When attention is low ($m \to 0$) the household shifts the subjectively perceived value towards the default value. The previous analysis, as well as the results of the survey mentioned, suggest $D^d = 0$ so that we can rewrite Equation 16 into

$$V = P + mD \tag{17}$$

which is a rearrangement of what we estimated using Equation 1 with $\delta \equiv m$. The interpretation is that households fully observe the market price they decide to pay, but are to some degree inattentive to the size of co-op debt when estimating the market value of an apartment. This will cause variations in market values on identical homes with varying levels of co-op debt.

However, this equation yields an inattention to the mortgage size, and not an inattention to household costs. Depending on the mortgage design, the household may face the same costs and welfare by substituting private financing and co-op mortgages at an unequal rate if they are not perfect substitutes. This would lead to variations in market value that are perfectly rational for the household. The low capitalization rate of co-op debt into housing prices is not necessarily an estimate of low salience or inattention in itself. To measure household inattention to co-op debt, we need to look at the co-op mortgage cost in the households' budget.

As proposed by Gabaix (2019), one way to measure inattention is by comparing it with optimal action. The baseline model assumes rational agents that act on the information available, including co-op debt costs. The household's solution in this model is the normatively correct action, or the answer to mortgage financing with private and co-op debt. However, the model suggests a lower optimal share of co-op debt compared to the distri-

bution in the data. In reality, households favor co-op debt to a much higher degree. Data moments on the mortgage cost-to-income shares and the loan-to-income ratios are too high in co-ops with large amounts of debt compared to low-debt co-ops. This means that some households with strong finances who should optimally choose private mortgages are instead choosing the more expensive co-op mortgages. One possible explanation for that is that they do not fully account for the true cost of co-op debt.

To reconcile the model to the data, I extend the model to incorporate inattention to co-op costs. Co-op capital costs enter the household optimization problem in Equation 10. Like before, mortgage costs can be decomposed into a directly observed cost and a subjectively perceived cost. The private mortgage cost is calculated by the lender and, therefore, is directly observed for all households. The co-op mortgage cost, on the other hand, is subjectively perceived with some inattention to the true value and a default expected value of zero. Analogous to the previous case, we can rewrite the subjectively perceived co-op mortgage cost using $D^d_{c,t} = 0$:

$$\begin{aligned} i_{c,t} D^s_{c,t} &= i_{c,t} \left(m D_{c,t} + (1-m) D^d_{c,t} \right) \\ &= i_{c,t} m D_{c,t} \end{aligned} \tag{18}$$

Replacing this into Equation 10 gives the household's static budget constraint with inattention to co-op debt.

$$X_t \geq A_t + C_t + i_{h,t} D_{h,t} \left(1 - \tau\right) + m \cdot i_{c,t} D_{c,t} + \gamma D_{h,0} + P_t \bar{h} \kappa \tag{19}$$

Additionally, we need to account for the fact that the market value varies with the level of co-op debt. In Section 3 we found that the capitalization rate of co-op debt into the market value of apartments is approximately 10 percent, but varying over time. When the share of co-op debt increases in the model, the amount of total debt should also increase as households do not decrease private financing one-to-one. To implement this into the model, I calculate the nominal private funding and co-op debt needed to hold a hypothetical market value fixed at varying levels of co-op mortgage shares. The hypothetical market value is the perceived market value under low capitalization, and thus the true market value is allowed

to vary. Households then optimize as before given the new constraints and debt levels.

4.4.1 Identification

The inattention parameter in the model is estimated together with households' preferences using household and sales data. Specifically, I will estimate the coefficient of relative risk aversion and the discount factor, along with inattention.

I divide households by co-op debt shares into quartiles and target the LTI ratio excluding co-op mortgages, the total LTI ratio including co-op mortgages, and the initial mortgage cost-to-income ratio in each quartile. This gives me a vector $\mathbf{m}$ of $4 \cdot 3 = 12$ moments to target.

A higher risk aversion means that households are less likely to expose themselves to increased debt in the co-op and volatile capital costs, reducing the LTI ratios. It also increases precautionary savings, which decrease the budget for housing expenses. A high discount factor increases the importance of consumption later in life when private mortgages are paid back in full, reducing the demand for co-op mortgages and decreasing the total LTI ratio. Finally, a low attention parameter increases the total LTI ratio as well as increases the initial mortgage cost-to-income ratio.

I solve the model for a set of combinations of the parameters of interest (ρ, β, and m) and calculate the vector of simulated moments $\hat{\mathbf{m}}(\rho, \beta, m)$. I then use SMM to find the set of parameters $\hat{\boldsymbol{\theta}} = \left[\widehat{\rho}, \widehat{\beta}, \widehat{m}\right]$ that minimize the square of the distance between the true and simulated moments in the objective function

$$\left(\mathbf{m} - \widehat{\mathbf{m}}\left(\rho, \beta, m\right)\right)' \mathbf{W} \left(\mathbf{m} - \widehat{\mathbf{m}}\left(\rho, \beta, m\right)\right) \tag{20}$$

where $\mathbf{W}$ is the inverse of the covariance matrix of the empirical moments.

To simplify convergence, I assume that the model implied moments $\widehat{\mathbf{m}}^j$ can be approximated using a third-order polynomial function of the parameters of interest. I regress each simulated moment j on the parameter set i using the following stacked equation

$$\widehat{\mathbf{m}}^j = \boldsymbol{\Theta}\boldsymbol{\delta}^j + \boldsymbol{\varepsilon}^j \tag{21}$$

where $\boldsymbol{\Theta}$ is a matrix containing all polynomial terms of (ρ_i, β_i, m_i), $\boldsymbol{\delta}^j$ is a coefficient vector specific to moment type j, and $\boldsymbol{\varepsilon}^j$ is the error vector for moment type j. I then use the resulting parameter coefficients $\boldsymbol{\delta}^j$ to predict $\widehat{\mathbf{m}}^j\left(\boldsymbol{\theta}, \boldsymbol{\delta}^j\right)$ to minimize the objective function.

4.4.2 Results

I start by estimating the preference parameters under the assumption of full attention, i.e. fixing $m = 1$. #TBD. The results are presented in Table 6

Next, I estimate all three parameters of interest assuming there is no price discrepancy distorting the size of mortgages, i.e. holding V fixed. #TBD.

Finally, I allow the market value of housing to vary with co-op debt shares, incorporating the reduced-form findings in Section 3.1. Column (3) presents the results, showing that households' estimated attention to co-op mortgage costs is 79%. This relatively high estimate suggests that co-op debt offers meaningful benefits in terms of mortgage design that makes its prevalence and use rational to households.

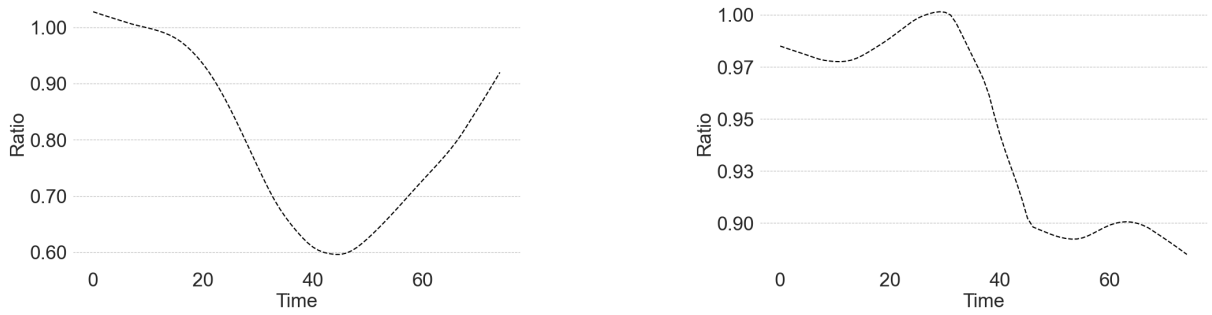
Table 6: Estimated model parameter.

	Preference parameters	All parameters	
	(1)	(2)	(3)
Attention parameter	1.000	#TBD	0.793
Discount factor	#TBD	#TBD	0.882
Relative risk aversion	#TBD	#TBD	#TBD
Targeted moments	12	12	12
Market Value	Fixed	Varying	Varying

Notes: The attention parameter in Column (1) is fixed to 1 and not estimated.

However, households still discount 21% of co-op mortgage costs, leading them to overestimate the financial benefits. As a result, they face higher-than-expected monthly expenses, which impacts their consumption and savings over the life cycle. Additionally, the perceived affordability of co-op mortgages misleadingly ushers financial stable households to shift toward co-op mortgages as they appear cheaper than what they are. While the overall default rates remain relatively unchanged, the welfare of households that switch from using strictly

private mortgages to include co-op mortgages declines. Figure 6 illustrates this welfare loss for switchers when inattention is in effect.



(a) Avg. Cash-on-Hand (b) Avg. Consumption

Figure 6: Welfare Loss of Co-Op Debt With Inattention

Notes: Ratio 'With Co-Op Debt' over 'No Co-Op Debt'. Average values for group of individuals who switch financing strategies. The plots represent the ratio of two different scenarios; one in which the individuals have no access to co-op mortgages ('No Co-Op Debt'), and the other when they do have the access to co-op mortgages and optimally switch means of financing ('With Co-Op Debt'). The comparison is made within individuals across scenarios.

The accuracy of the model is illustrated in Figure 7. Here, the target moment values, $\bar{\mathbf{m}}$, are compared with the predictions of the simulated model, $\widehat{\mathbf{m}}\left(\widehat{\rho}, \widehat{\beta}, \widehat{m}\right)$, and to the baseline calibration $\widehat{\mathbf{m}}\left(\bar{\rho}, \bar{\beta}, 1.0\right)$. We see that the greatest improvement in simulated moment accuracy is made in the total LTI ratios across quartiles. These are the moments that govern the size of co-op mortgages relative to private mortgages and income, where the attention parameter is most influential.

The high attention estimate necessitates a low discount factor, with a point estimate of $\beta = 0.882$, which is somewhat lower than standard estimates in life-cycle models. When households opt for co-op mortgages, their total mortgage size increases. This also shifts the bulk of mortgage costs to the latter part of the life cycle for households in high-debt co-ops. To rationalize this pattern, households need to discount future consumption more heavily, implying a stronger preference for immediate consumption, making them impatient. Additionally, financially weak households select into high-debt co-ops. Tight liquidity constraints necessitate precautionary savings, but co-op mortgages relax these constraints in the early periods by back loading payments to later in life. As a result, households with the highest debt-to-asset ratios — who enter home ownership with minimal initial wealth — consume more in the short term, further reducing the estimated discount factor.

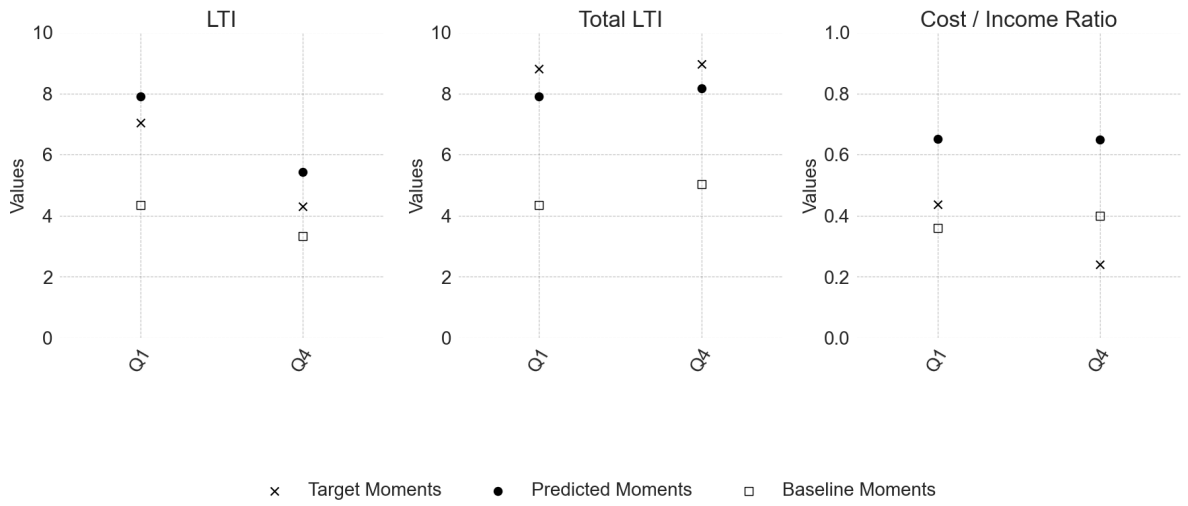


Figure 7: Target, Predicted, and Baseline Moment Values

Notes: Predicted moments use the estimated optimal parameter set $\begin{bmatrix} \widehat{\beta} \\ \widehat{m} \end{bmatrix} = \begin{bmatrix} 0.8815 \\ 0.7929 \end{bmatrix}$ and baseline moments use the parameter set $\begin{bmatrix} \bar{\beta} \\ \bar{m} \end{bmatrix} = \begin{bmatrix} 0.9450 \\ 1.0000 \end{bmatrix}$.

This type of myopia supports the time-varying results in Section 3.1. We saw significant fluctuations in the capitalization rate of co-op debt into housing prices that were strongly correlated with the interest rate, indicating short-term behavioral adjustments to mortgage costs.

4.5 Extensions and robustness

5 Conclusion

Buying a home is a large financial undertaking that requires the attention of households. When contractors use complex mortgage designs with co-op debt, they cause households to price homes incorrectly. Not only does hidden co-op debt create an anomaly on market values of apartments and an arbitrage opportunity, but households also favor the more expensive co-op mortgage to finance the purchase of apartments.

Part of the price discrepancy can be explained by mortgage design. Private and co-op mortgages are not perfect substitutes, and the trade-off between them affects credit constraints both in the short-run and the long-run. The life-cycle model illustrates that there are substantial benefits to co-op mortgages, specifically for credit-constrained households. It

alleviates the down payment requirements and increases consumption over the life cycle as well as facilitates market entry to home ownership.

However, it also increases systemic risk in two ways: through increased total debt and through the selection of financially weak households into the highest debt levels, both of which contribute to an increase in default rates.

Furthermore, the model suggests household attention to co-op mortgages to be 79% of its full impact on the households' budget. In other words, households systematically discount part of the costs of co-op mortgages, thereby making them appear more attractive relative to private mortgages. This turns the potential welfare benefits of co-op debt into welfare losses for inattentive households who alter their optimal mortgage allocations. This result is consistent with the literature on rational inattention where households trade off between the direct cost of debt and the cost of mental accounting.

These findings have implications for policy reforms on the housing market. First, incorporating co-op mortgage into the KALP calculations used by lenders to approve mortgages would help lower the total risk exposure and mitigate the selection problem that amplifies financial vulnerabilities. Second, including co-op mortgage costs together with the private mortgage information already available to households could decrease the cognitive burden of mental accounting. This would align households' default assumptions about co-op debt with its actual financial impact, leading to improved mortgage decisions.

These reforms are particularly important for lenders as they are otherwise allowing households to increase their risk without adequately adjusting their risky returns. It is unclear why lenders are allowing this type of selection and risk-pooling in co-op apartments, and to model their role in the mortgage market remains a subject for future research.

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A Figures

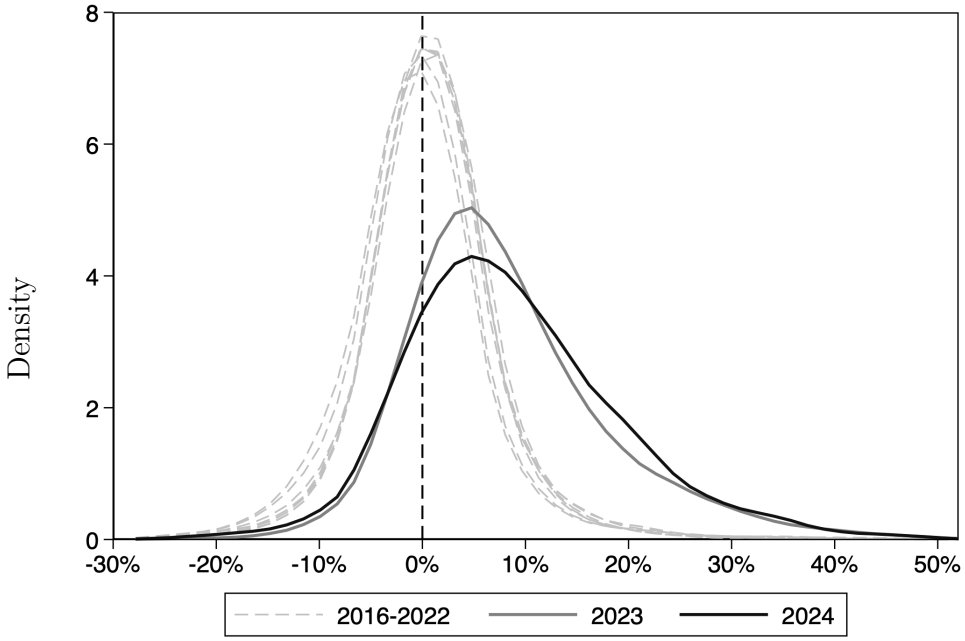


Figure 8: Distribution of year-on-year changes in member fee

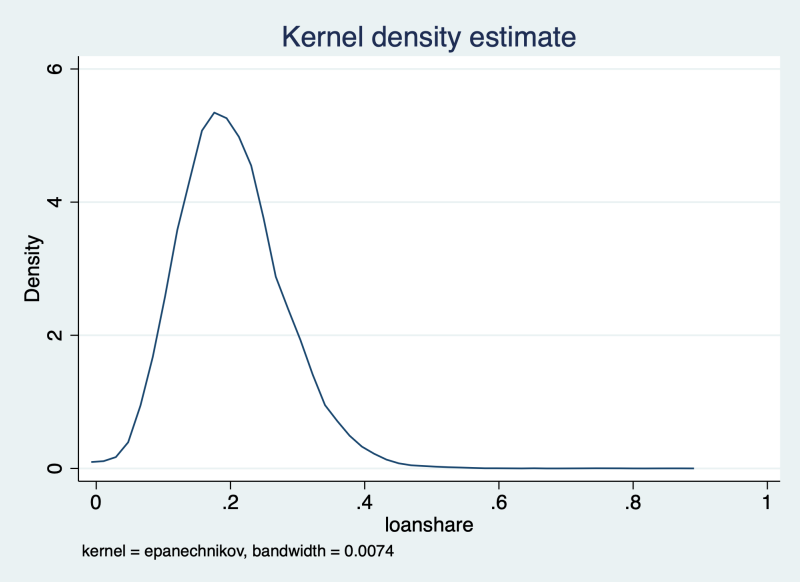


Figure 9: Distribution of co-op debt share of market value

Notes: