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Mental Accounting in the Housing Market

Johan Almenberg and Artashes Karapetyan

Mental Accounting in the Housing Market*

Johan Almenberg[†] and Artashes Karapetyan[‡]

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Abstract

We use a survey to identify a consumer bias with regard to different sources of debt-financing. Less salient debt may generate psychological benefits. This should be weighed against the possible economic costs of a sub-optimal capital structure, but low levels of financial literacy make it unlikely that all households perceive the full economic costs. As a result there is a bias in favour of less salient debt. In a market with limited scope for arbitrage this consumer bias is likely to generate inefficiencies. We examine such a market in both theory and practice. The predictions of our model are given strong support by market data.

Keywords: household finance, mental accounting, co-op, capital structure

JEL codes: D12, G14, G21, G32

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1 Introduction

Households face many choices that require financial judgment. This judgment relies on numeracy skills and on previous experience with financial products. When financial judgment falls short of the mark, households may make sub-optimal decisions. In some cases, failing to optimize entails a negligible cost; in other cases, this cost is large. Depending on the market in question, agents that make sub-optimal decisions may or may not affect the market equilibrium.

This paper examines certain aspects of a decision faced by many households: making a debt-financed acquisition of a home. We use a survey to identify a consumer bias with regard to debt-financing, and suggest some plausible causes of the bias. Next, we use a simple two-type model to examine how biased consumers may affect prices in equilibrium. Finally, we show that market data support the predictions of our model.

Debt is at the heart of household finance. It allows for Pareto-improving equalization of intertemporal marginal rates of substitution, as households incur debt during less affluent parts of their life-cycle and pay off the debt during more affluent times. The core arguments of the associated optimization problem are the cost of capital and the individual's expected income path. For many households, their home represents the bulk of their assets, and their mortgage contract is the most important financial contract they ever enter into (Campbell and Cocco, 2003). Sweden, which is the focus of our study, is no exception: real estate amounts to over 70% of household assets (Campbell, 2006) and the total amount of mortgages outstanding is equivalent to almost 60% of GDP.¹ Despite this, there has been little research focusing on household mortgage choice. Instead, the existing research into mortgages has largely focused on mortgage-backed securities.

The Swedish market for owner-occupied apartments offers an opportunity to study how households perceive capital structures. A key feature of this market is that all apartments are organized as co-operatives (hereafter: “co-ops”).² Condominiums are not permitted.³ The co-ops can, and typically

¹Source: Swedish Bankers' Association.

²Source: Statistics Sweden.

³In a condominium, apartments belong to their respective inhabitants. Co-op apartments, by contrast, are owned by a legal entity – the co-op itself – which in turn is owned by the co-op members. The resident owns an exclusive right to inhabit their co-op apartment. Unlike in some other countries, Swedish co-ops have very weak screening

do, take on debt. The cost of servicing the debt is passed on to the co-op members as a part of a monthly or quarterly fee that also includes service and maintenance costs. Since condominiums are prohibited, we avoid the endogeneity problem that arises when comparing co-ops and condominiums in cities or countries that allow both.

In this large market, which represents about one fifth of Swedish households, households debt-finance the purchase of a home in two ways. They can take out a large personal loan and buy a share in a co-op with low leverage, or take out a smaller personal loan and buy a share in a co-op with high leverage. The two sources of debt-financing are substitutes. In theory, under the appropriate conditions, it should not be possible to add value to an apartment by changing its capital structure – analogous to a familiar result in corporate finance (Modigliani and Miller, 1958).

The presence of two sources of debt-financing poses a challenge to household optimization. A consumer who is choosing between different apartments now also makes a choice between different capital structures. Assessing the value of an apartment conditional on the amount of debt held by the co-op is demanding in terms of financial literacy and numeracy, not least since the relative cost of the two sources of debt has varied over time.

Currently, interest payments on individually held debt are tax deductible, whereas interest payments through the co-op are not. This discrepancy makes debt-financing through the co-op almost 50% more expensive than individually held debt. In a frictionless market, debt would immediately be substituted toward the cheaper source. In practice, many households may be slow to optimize co-op capital structures. Debt held by the individual household is arguably more salient – harder to ignore – than debt held collectively by the co-op. The co-op fee is typically not itemized, so in order to ascertain what share of the fee is used to service co-op debt, a co-op member must make his own calculations based on the co-op’s annual report. This is demanding in terms of financial literacy.

The effects of cost salience and limited financial literacy do not play a part in the standard intertemporal optimization problem. In practice, however, these factors may have important effects on economic behavior. If households experience disutility from awareness about their degree of indebtedness, the less salient source of debt would carry a non-pecuniary advantage. In this case the value of an apartment may well be affected by its capital structure. In

rights.

addition, households that find it difficult to calculate the relative advantages of the two sources of debt-financing may underestimate the costs of a sub-optimal capital structure.

Our survey data indicate that many consumers do not have a clear understanding of the optimization problem at hand. We find a pervasive tendency to compartmentalize the two sources of debt-financing. Most survey participants were well-informed about their individually held debt, but poorly informed about the debt held by their co-op. Strikingly, the vast majority have *never* thought of the two forms of debt as being, to some extent, substitutes. If our sample is reasonably representative, this suggests that a sizable fraction of the market is at best characterized by a boundedly rational understanding of the co-op capital structure. These findings are highly consistent with a scenario in which financial literacy, numeracy, and salience jointly produce a systematic bias in the market, in favour of co-op debt. In our view, the difficulty many households have in understanding the co-op capital structure may go a long way in explaining why such debt is still prevalent, despite being considerably more costly.

We have good reasons to expect the bounded rationality of some fraction of market participants to affect prices in equilibrium. There are certain conditions under which individual mistakes need not distort prices in the long run. In financial markets, for examples, arbitrage offers sophisticated investors the opportunity to profit from mis-pricing by naive investors. Alternatively, competition may drive firms to reveal competitors' exploitation of consumers' mistakes, in order to gain market share. Neither of these factors are likely to apply to the case at hand. The Swedish market for apartments is characterized by rent control and other restrictions on renting out apartments. This amounts to a major limitation on arbitrage opportunities. Converting owner-occupied apartments into rental apartments would typically entail a significant financial loss. When each household owns a single apartment at a time, transactions costs from moving make it unlikely that arbitrage will correct prices, or that any household could internalize the benefits from "educating" the market.

We present a simple two-type model of this market. Both types – naive and sophisticated agents – solve the same optimization problem, but naive agents systematically underestimate the relative cost of co-op debt. Sophisticated agents, by contrast, correctly perceive this relative cost. As a result, naive investors have a more favorable attitude toward capital structures where more of the debt is held by the co-op and less by the individual house-

hold.

The model predicts a muted market response to changes in the relative price of the two sources of debt. If naive agents constitute a sizeable fraction of the market – and our survey suggest this is indeed the case – then an increase in the relative price of co-op debt will have a smaller effect on the relative price of high-debt co-ops than if the entire market consisted of sophisticated agents.

We test this hypothesis against market data by using a natural experiment, in the form of a large sample of apartment sales around the time of an unexpected reform in October, 2006. The reform removed a tax that was paid by co-ops with low debt levels, but not by co-ops with high debt levels. As a consequence, the relative cost of servicing co-op debt increased dramatically, making co-op debt almost 50% more costly than individually held debt. In an efficient market, this change should have had a negative effect on the relative price of apartments in high-debt co-ops compared to apartments in low-debt co-ops. Our analysis of sales data shows that while the relative price change for high-debt/low-debt apartments has the right sign, the effect was small and far from statistically significant. Given the large sample size, we conclude that the data provide a strong indication that the market response to this natural experiment was, at best, muted – in line with the prediction of our model.

The rest of the paper is organized as follows. In Section 2, we review some of the related literature. In Section 3, we describe the survey and report its results. In Section 4, we present our model of a market where sophisticated and naive consumers interact in the market for owner-occupied apartments. In Section 5, we test the prediction from the model, using a large sample of apartment sales. Section 6 concludes.

2 Related literature

Our paper examines how the lower salience of co-op debt, together with limited financial literacy, may generate a consumer bias leading to widespread mispricing in the housing market. This line of reasoning fuses several strands of research, primarily within public economics, behavioral economics, and household finance. In this section, we outline some of the most relevant literature on salience and financial literacy. We briefly discuss under what general circumstances consumer bias may be expected to affect markets in

equilibrium. We also review some of recent behavioral studies of the housing market.

2.1 Salience

In economics, the term “salience” is used to emphasize that all costs are not equally transparent. A cost is salient if it is relatively visible, transparent, and hard to ignore. In our model, naive agents are biased toward co-op debt, which is less salient for at least two reasons. First, the responsibility for dealing with the debt is delegated to the co-op board. Second, the debt payments are included in a monthly service charge from the co-op, which is not itemized. Our survey results, presented in section 3, show that individuals are considerably more aware of their personal debt than of the debt held by their co-ops, consistent with co-op debt being less salient.

Salience has been addressed extensively in public economics. Buchanan (1967) conjectures that the government sector may grow in part through finding new, less salient ways of raising revenue. A prominent example is income tax withholding, which makes the taxation of labor less visible to employees, who do not have to make the payments themselves. Another example is social security taxes, which make taxation less lucid by conflating insurance and redistribution. When taxpayers underestimate the cost of government services, demand for government services increases: there is “fiscal illusion”.⁴

Empirical work in public economics has shown that tax salience can have large effects on individual behavior. Finkelstein (2007) studies the effects of introducing electronic road toll collection, which is a less salient levy than cash payment. She finds that toll rates increase by about 20-40%, and the short-run elasticity of driving (with regard to toll costs) decreases in absolute value. Chetty et al (2007) find that demand elasticity for alcohol is greater with regard to changes in the excise tax, which is included in the displayed price, than to changes in the sales tax, which is not. In a parallel field experiment, a tax-inclusive price was posted below the ordinary price tag for selected goods in a grocery store. Scanner data revealed an 8% reduction in sales for products with tax-inclusive prices, relative to control products and control stores. And yet a survey conducted at the same time shows that the consumers were well-informed about sales taxes, suggesting that their results are driven by the salience of the tax, and not by ignorance of the tax.

⁴Buchanan attributes this term to Puviani (1903).

2.2 The pain of payment

While the public economics literature on salience has focused largely on taxation, this concept can be applied to any type of cost, including the pre-tax price. A parallel literature in consumer finance looks at how the salience of the payment itself affects consumption. In a series of field experiments, Soman (2006) finds that consumption is increased when payments become less transparent. His interpretation of this finding is that consumers experience a “pain of paying” and that the pain is smaller not just for lesser amounts but also for less apparent payments.⁵ Soman uses consumer interviews to rank payment methods by transparency. Cash is considered the most salient, since the money is measured out physically and the exact amount is articulated. Check payments are slightly less salient, but the amount still has to be spelled out in writing. Card payments are deemed to be considerably less salient, and automated payments the least salient.⁶

Empirical evidence from consumer finance research indicates that the salience of payments has real consequences for consumption patterns. Soman (1999) finds that credit card users are more likely to underestimate, or forget entirely, the amount spent on a recent purchase. Prelec and Simester (2001) find that subjects paying by credit card bid more for a prize. The reported effect is large – around 100% – and does not appear to be driven by liquidity constraints.⁷ The participants were MBA students at a prestigious business school, making it hard to attribute this result to low levels of financial literacy.

The research on salience in consumer finance points to a deeper behavioral dimension of the consumption decision, namely the voluntary disassociation of payment and consumption. Prelec and Loewenstein (1998) suggest that consumers may devise strategies for optimizing this “decoupling” of costs and benefits. Less salient payment methods facilitate this separation, thus “anaesthetizing” the consumer from the painful payment. This conjecture is supported by Knutson et al (2007), who use functional magnetic resonance

⁵Soman attributes the term “pain of paying” to Zellermayer (1996).

⁶“Cash is the most transparent form of payment – when one pays by cash, one sees exactly what they are paying. (...) At the opposite extreme, a completely opaque (non-transparent) form of payment might be a payroll deduction that one is not even aware of.” (Soman, 2006, p. 175.)

⁷In two of the experiments, the prize was a pair of tickets to a sporting event; in one experiment, a banner. The average bid increased by 113% and 76% respectively, for the tickets, and 59% for the banner, when subjects were told they would pay by credit card. (The variation is between-subject.)

imaging (fMRI) to show that the purchasing decision activates two separate regions in the brain. The nucleus accumbens is activated by the anticipated gain (the enjoyment of the good), whereas the insula is activated, and the mesial prefrontal cortex is deactivated, by excessive prices. The latter two regions are associated with anticipated loss, suggesting that consumers experience a real “pain of paying”.

Some financial arrangements may lend themselves more easily to the decoupling of costs and benefits. When consumers choose between co-op apartments, they are also choosing between different capital structures. Prelec and Loewenstein (1998) suggest that changes to the composition of an individual’s balance sheet may have hedonic effects even when the economic effects are negligible. It is possible, and in our view plausible, that some consumers add value by choosing a particular capital structure even when the economic benefits are small or negative.

The decoupling of costs and benefits is a particular case of a more general phenomenon: the “mental accounting”, whereby individuals compartmentalize elements of their consumption and the associated expenditures into mental accounts, following personal rules or heuristics (Thaler, 1985). This compartmentalization puts limits on the fungibility of money, and gives rise to apparent inefficiencies, as “individuals fail to undertake some internal arbitrage opportunities that in principle could increase utility” (Thaler, 1985, p.212). These inefficiencies stem from the treatment of different elements of consumption and expenditure as belonging to different realms, and not as arguments of a single all-encompassing optimization problem. We argue, on the basis of our survey results, that this is an apt description of consumer behavior in the Swedish market for owner-occupied apartments.

Mental accounting may serve multiple purposes: on the one hand, it can be a tool for self-control that helps boundedly rational individuals make reasonably good judgments (Thaler and Sunstein, 2008); on the other hand, it allows individuals to picture financial matters in a more palatable but potentially inefficient way. There is much room for conflict between the two goals, as an accurate representation is not necessarily the one that makes the individual the most happy in the short run (Prelec and Loewenstein, 1998). In effect, there is a trade-off between economic efficiency and “hedonic efficiency”.

The mental accounting model in Prelec and Loewenstein (1998) predicts that individuals would choose to pre-pay for consumption, because debt is

particularly unpleasant – what the authors term “debt aversion”.⁸ But individuals do not always have this option. For housing, the savings required for pre-payment may preclude purchasing a home for a large part of an adult’s life. An alternative strategy is to mentally separate a debt from the good for which it was incurred. Kamleitner and Kirchler (2006) study how loan users mentally integrate or separate debt-financed consumption and payment of the debt. They find a one-way connection from the loan to the good: the loan is associated with the good, making it more palatable, but the good is not associated with the loan, and hence it is not tainted by the associated debt. The authors describe this as “hedonically efficient”. Given the prevalence of such behavior in credit markets, it seems highly plausible that prospective apartment buyers would be attracted to a balance sheet mechanism that allows them to make part of their mortgage less salient.

2.3 Financial literacy

If co-op debt is less salient, and if consumers get disutility from salient debt, then they raise their utility by choosing co-op debt over more salient, individually held debt. If co-op debt is more costly, however, consumers should weigh the psychological benefits of less salient debt against the economic costs. In practice, this entails having a clear understanding of the co-op capital structure and of the current tax breaks. At the most practical level, it also involves some calculations. We have reasons to believe that a non-negligible fraction of consumers will struggle with some, or all, elements of this process. Taken together, the psychological benefits of less salient debt and the inability to assess the costs of a sub-optimal capital structure may generate a consumer bias in favour of co-op debt.

Research on financial literacy sheds more light on the limited ability of many consumers to critically evaluate financial problems or financial products. With regard to consumer finance, two plausible causes of mistakes are (1) a lack of familiarity with certain financial products, and (2) numeracy skills that are inadequate for some financial calculations. A rapidly growing body of research within household finance in general and financial literacy

⁸“In the traditional economic analysis of consumer choice, consumers are assumed to finance expenditures so as to minimize the present value of payments. (...) The psychological reality of payment decisions is more complicated... The first and perhaps most obvious complication is that debt is unpleasant.” (Prelec and Loewenstein, 1998, p.5)

in particular offers insights into both these factors. The findings in this research area make it increasingly difficult to assume that households do not make mistakes, even in relation to relatively simple financial products.

There is ample evidence that many consumers have low levels of numeracy and a poor understanding of financial products. Banks and Oldfield (2006) show that in a large sample of UK citizens close to retirement, a considerable fraction are unable to perform even the most basic financial calculations.⁹ In their sample, numeracy is positively correlated with education and negatively correlated with age. Lusardi and Mitchell (2007a) use a similar US sample to evaluate the determinants of wealth close to retirement. Two thirds of the sampled individuals have *never* tried to figure out how much they need to save for their old age. In a broader sample of US consumers, Hilgerth, Hogarth and Beverly (2003) find that less than half of the respondents report using a spending plan or budget. Recent research by the Office for National Statistics indicates that half of the adult population in the UK does not have an understanding of basic mathematical concepts beyond addition and subtraction (cf. Miles, 2003). Lusardi and Mitchell (2007b) summarize the results from a number of other surveys, and conclude that poor financial literacy is a widespread problem, in the US and elsewhere: “Many households are unfamiliar with even the most basic concepts needed to make sensible saving and investment decisions” (Lusardi and Mitchell, 2007b, p.1). They find large differences between demographic groups, pointing to a link between financial literacy and inequality.¹⁰ Financial literacy has also been found to decline strongly with old age (Laibson et al, 2008; Lusardi and Tufano, 2008).

A striking illustration of how widespread low numeracy might be is the so called “lottery question” used by Banks and Oldfield (2006) and Lusardi and Mitchell (2007a). The question reads as follows: “If 5 people all have the winning number in the lottery and the prize is 2 million dollars, how much will each of them get?” In both samples, only just over half of the respondents were able to answer the question correctly.¹¹ We use a simplified version of this question in our own survey. As reported in Section 3.4., our results are broadly in line with theirs.

⁹The data in question is the 2002 wave of the English Longitudinal Study of Ageing (ELSA). The numeracy question included in our survey, and reported in section 3.4., is based on one of their questions.

¹⁰The problems of low numeracy skills and low levels of financial literacy is particularly severe for Hispanics, blacks, women, and those with low levels of education.

¹¹Banks and Oldfield (2006): 50.8%; Lusardi and Mitchell (2007a): 55.9%.

Consumers with a poor understanding of financial products can protect themselves by opting out of various markets. Mounting evidence is suggesting, however, that non-participation is no panacea. For a start, households may not realize that they are ill-equipped to make a particular financial decision: Lusardi and Mitchell (2007b) find strong signs of over-confidence, with households often overestimating their understanding of financial matters. The lack of sophistication of many consumers who choose to participate in financial markets, and the importance of cost salience, is illustrated by a number of recent experiments involving mutual funds. In one experiment, 50 current mutual fund investors were offered a choice of 36 different combinations of load and management fee (Wilcox (2003)). Investors typically choose between funds with a highly salient front-end load and no-load funds with higher, but arguably less salient, fees. Wilcox finds that investor choices systematically overweight the more salient front-end loads, in direction contradiction to normative economic theory.¹² In a similar experiment, Choi et al (2006) let subjects allocate an endowment across four S&P 500 index funds with no active management but different fee structures. Subjects were rewarded based on the subsequent performance of their portfolio.¹³ Participants were Harvard undergraduates and Wharton MBA students. One would expect them to be financially literate and have high numeracy skills. Despite this, the vast majority inappropriately attached a lot of importance to returns since inception, which for index funds depends only on the inception date. Meanwhile, they neglected the negative impact of high fees: 95% of the participants failed to minimize fees. This is consistent with Alexander et al (1998), who find that in a large survey sample of real-world mutual fund investors, 81% could not give an estimate of the expenses of their mutual funds, not even for the largest mutual fund in their holdings.¹⁴ Only 16% thought that higher fees were negatively correlated with lower net returns, whereas 20% thought the correlation was positive. (At the time, the cor-

¹²Specifically: if an investor aims to hold the fund for X years, then a 1 basis point increase in the annual fee is approximately tantamount to an X basis points increase in the load. Wilcox (2003) finds that this rate of substitution for annual fee versus up-front fee is about 2:1, despite a reported average holding time of 17 years. Not one out of 50 participants in the study reported a rate of substitution greater than 3.

¹³The investments were intermediated by the experimenters and the rewards only based on returns; thus the choice of fund was “unbundled” from the services provided by the fund.

¹⁴A majority (57%) also report that they did not know any of the expenses of their largest fund at the time of purchase either.

relation between fees and net returns was negative. See Alexander et al, 1998, p.310). 40% of those surveyed said they never used the mutual fund prospectus.

Low levels of numeracy and financial literacy can have serious consequences for individual financial well-being. Banks and Oldfield (2006) find a strong correlation between numeracy and pension savings (level and form). They also find a strong positive correlation between numeracy and wealth, and between numeracy and owning shares or owning a private pension. The correlations are robust to a number of controls, including other measures of cognitive ability. The most numerate are also considerably more likely to be well-informed about their pension arrangements. Lusardi and Mitchell (2007a) report a strong correlation between planning for retirement and net wealth. Planning, in turn, is largely carried out by the more financially literate. Lusardi and Tufano (2008) find systematic evidence that individuals with lower levels of financial literacy transact at higher costs. Stango and Zinman (2008) find that individuals who are more prone to payment/interest bias tend to borrow more and save less. In a South African field experiment, Bertrand et al (2005) show that financially irrelevant information can be an important determinant of consumer borrowing. A short-term loan offer differed in the interest rate offered and in terms of other, non-economic framing (what the authors term “psychological manipulation”). The non-economic manipulations had a sizeable average effect on the take-up rate, equivalent to half a percentage point change in the interest rate – implying that consumers that are affected by irrelevant information may be paying a high price for this.

2.4 Do irrational agents affect equilibrium prices?

While individual mistakes clearly affect individual outcomes, it is less evident that irrational actors can affect the market equilibrium. Some market conditions under which this may occur are described by Akerlof and Yellen (1985), who characterize equilibria where the presence of non-maximizing behavior, alongside standard maximization, results in a first-order change in equilibrium values, but only second-order small losses for the non-maximizers. In such cases, they argue, mistakes may go uncorrected. Russell and Thaler (1985) offer a broader description of conditions under which mistakes may prevail in equilibrium: costless arbitrage may not be possible, and evolutionary forces (the selection and propagation of advantageous strategies) may

be weaker for households than for firms: “quasi rationality is rarely fatal” (Russel and Thaler, 1985, p.1074). In their view, the classical response, that competition will make irrationality irrelevant for equilibrium, only holds in “very special cases, probably rarely observed in the real world.” (Russell and Thaler, 1985, p.1071). We note that rent control prevents large scale arbitrage in the Swedish market for co-op apartments. Moreover, mispricing in this market is unlikely to drive individual households out of the market altogether, i.e., there is little selective pressure on household behavior.

In some cases, market forces will correct for mistakes and reach the rational equilibrium. This might not necessarily be the case, however. For example, if a firm is exploiting a widespread psychological bias, a competitor may inform the public about the bias and hence reveal the exploitation. Under certain market conditions, however, it is not profitable for the competitor to educate the clients of other firms. In this case, de-biasing will not occur – there is a “curse of de-biasing” (Gabaix and Laibson, 2006; see also Russel and Thaler, 1985). Because of the size of the Swedish market for owner-occupied apartments, and the limits on arbitrage, we find it unlikely that any agent would be able to internalize the benefits of educating naive agents in this manner to the extent where it would offset the costs of doing so.

There is mounting empirical evidence of systematic sub-optimization in financial markets. Ausubel (1991) reports a large and persistent discrepancy between credit card rates and the cost of funds. Despite excellent potential to be a competitive market, and thus to function as a continuous spot market for credit, credit card lending rates were highly sticky throughout the 1980s despite large fluctuations in the costs of lendable funds. Search and switch costs appear insufficient to explain the phenomenon: the average consumer in the sample has a \$250 surplus to be extracted by switching to a competitive rate. Ausubel also points out that credit card marketers have reported a much greater sensitivity to the more salient annual fee than to a less salient hike in the interest rate.

Stango and Zinman (2008) document a widespread and systematic misunderstanding of the interest rate associated with a given principle and loan repayment schedule – what they term “payment/interest bias”. They attribute this to the difficulties many individuals have with exponentiation. The authors emphasize that the use of fuzzy math – heuristics for dealing with complex mathematical problems – is common, and that this just happens to be an instance where the fuzzy math is systematically biased in one direction

– toward saving less and borrowing more. In Stango and Zinman (2007) use variation in enforcement of the Truth in Lending Act (TILA) across time and between lenders to show that lenders exploit payment/interest bias by shrouding their interest rates.

Wilson and Waddams Price (2006) find that a large share of consumers do not switch to the cheapest provider in the UK energy market. Aggravating matters further, many of those that switch do so incorrectly, incurring higher costs as a result. This is not easily explained by search costs.

2.5 Behavioral factors in the housing market

It would not be possible to address behavioral research on the housing market without mentioning the work of Robert Shiller (for an overview, see Shiller, 2005). For decades, Shiller has been studying individual attitudes toward the housing market with the assumption that these attitudes need not be rational in a narrow, economic sense. In particular, individuals are prone to both wishful thinking, as in the form of extrapolation of positive price trends, and errors. Shiller stresses that housing prices, in aggregate, need not be efficient.

Some recent empirical work in real estate finance lends support to the hypothesis that irrational actors may affect equilibrium prices in the housing market. This work tests for particular biases that have been documented in economics and psychology, such as loss aversion (Genesove and Mayer, 2001), and money illusion (Brunnermeier and Julliard, 2005).¹⁵

Both of these studies find that psychological biases have significant explanatory power when it comes to understanding housing market dynamics. Psychological biases may even have more explanatory power than traditional economic variables: Genesove and Mayer note that a large part of the effect of liquidity constraints reported in a previous study disappears when controlling for loss aversion.

A market in which psychological variables are important determinants of behavior is unlikely to be perfectly rational. Brunnermeier and Julliard (2005) explicitly link their analysis to housing market bubbles, in that nominal interest rates closely follow the trends in mispricing, whereas the real interest rate does not. Moreover, the loss aversion effect reported in Genesove

¹⁵For experimental/survey evidence and a general discussion of loss aversion and money illusion, see, respectively, Kahneman and Tversky (1991) and Shafir, Diamond, and Tversky (1997).

and Mayer (2001) is larger for owner-occupants than for investors. This suggests that the resulting inefficiencies could be even larger in Sweden, where the market for owner-occupied apartments is completely dominated by owner-occupants.

Determining the right price for a house or an apartment is a complicated task, as is the selection of an optimal mortgage. Given this, it is not surprising that in addition to indications of systematic biases, there is also mounting evidence of ignorance and outright mistakes in the housing market. Miles (2003) reports a large share of the UK mortgage market is characterized by bounded rationality and myopia, including a survey that found 10% of respondents did not even know if their mortgage was variable or fixed rate (see Miles, 2003, p.45). Consumers do not have a good understanding of the products, and focus very heavily on the current, moving rate. Risk profiles of mortgage products play a secondary role. In the US, households are slow to refinance their debt in the face of declining interest rates and particularly slow to do so if they have low levels of financial literacy (Campbell, 2006). The costs are large: about 1/5 of households pay more than 2% above the current interest rate. These costs are too high to be easily explained in terms of transaction costs. Campbell (2006) also reports indications that many households choose their mortgage product (fixed rate or adjustable rate) on non-economic grounds.

If individuals struggle with choosing the right mortgage when there is only one source of debt, then we find it highly plausible that mistakes will flourish in a market where there are two sources of debt and co-ops differ with regard to their capital structure.

3 A survey of co-op residents

As a prelude to our analysis of the market for co-op apartments, we conducted a survey of co-op residents that allowed us to better understand how individuals view the apartment financing problem. Participants were asked about their mortgages and about the debt of their co-ops. We also asked them if they had considered the possibility of substituting individually held debt for the co-op debt. They were also asked some questions testing how well they understood the regulations regarding co-ops. In particular, we checked whether they were aware of the tax shield difference between the two sources of financing. We asked some general background questions, including how

long they had lived, and were planning to live, in their apartment. We also asked a question intended to check their numeracy skills. The following section focuses on our key questions and the associated findings. We would like to emphasize that the purpose of the survey was to look for indications of mental accounting, or some other bias, that would lead our sample of co-op residents to have a less-than-fully-rational view of the co-op capital structure. It is beyond the scope of this to identify the determinants of such behavior.

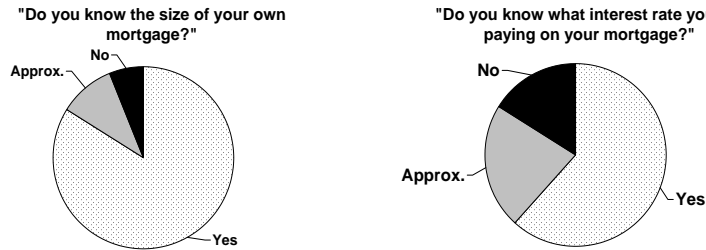
The survey was conducted in February 2008, at the main train station in Stockholm. Participation in the survey was conditional on owning, and being resident in, a co-op apartment. 100 individuals took part in the survey, which lasted approximately 3 minutes. Participants were rewarded with a lottery ticket worth approximately USD4. The mean age of the participants was 45 years, with a minimum of 17 and a maximum of 77. The sex ratio of participants was exactly 1:1. All but one of the participants had graduated from high school, and about two thirds of the sample had attended university. Approximately one third of the participants had current or previous experience of being on the board of a co-op.

Below we present our four main findings from the survey. (1) Respondents had a high awareness of the size of their mortgage and the interest rate they pay on it. (2) By contrast, respondents had a low awareness of the size of co-op debt, and the interest rate paid by the co-op. (3) Respondents were highly aware of the tax shield differential between individually held debt and co-op debt. (4) Most respondents had never thought about the possibility of substituting individually held debt for co-op debt.

3.1 Debt awareness

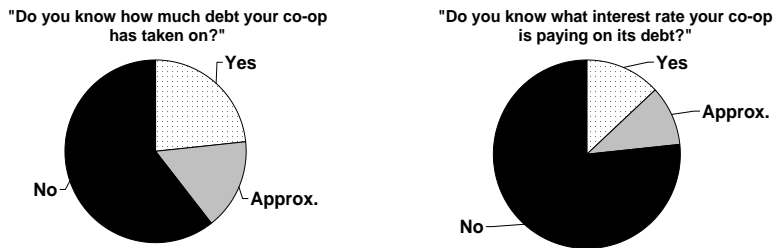
We asked survey participants if they knew the size of their own mortgage, and the interest rate they were paying. As shown in Figure 1, the great majority knew the exact size of their mortgage and the exact interest rate they were paying. Of those that did not know the exact numbers, about half knew them approximately. Only 5% of the participants in the survey did not even approximately know the size of their mortgage, and only 13% did not even approximately know the interest rate on their mortgage.

Figure 1
Awareness of own mortgage size and interest rate



By contrast, only a minority of the participants in the survey knew how much debt their co-op had taken on, or what interest rate the co-op was paying. 60% of respondents did not even approximately know how much debt their co-op had, and 76% did not even approximately know the interest rate the co-op was paying.

Figure 2
Awareness of co-op debt size and interest rate

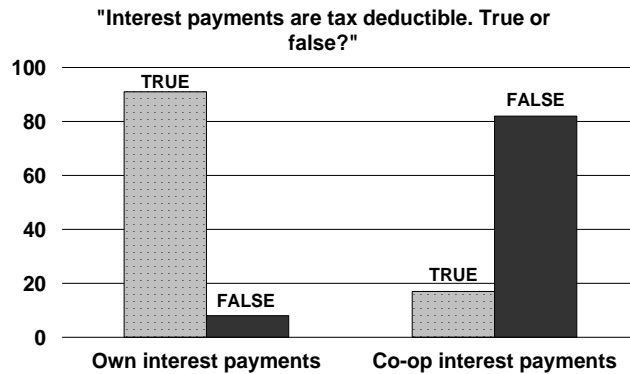


These findings lead us to conclude that debt awareness is considerable higher for individually held debt than for co-op debt, despite the fact that both sources of debt-financing are paid for by the co-op resident. This pattern is entirely consistent with our conjecture that a large fraction of the population may be compartmentalizing co-op debt in a less than fully rational manner. Such mental accounting would imply that for many consumers, co-op debt does not enter into calculations of the value of an apartment in an appropriate way.

3.2 Tax shield awareness

At the time of writing, interest payments on household mortgages are tax deductible. For interest payments up to a specified threshold, 30% of the payment may be deducted from the individual's income tax. For interest payments in excess of this amount, the deduction is 21%.¹⁶ By contrast, interest payments on debt held by a co-op are not tax deductible. The Swedish mortgage market is highly competitive, so the difference between the interest rates faced by co-ops and individuals is negligible. Assuming no difference in gross interest rates, the net cost of capital raised through the co-op is r , whereas the net cost of capital raised through an individually held mortgage is $0.7r$. If individuals are well-informed about the difference with regard to the tax shield, they should seek to reduce co-op debt in favour of individual debt. Debt substitution of this kind has not been occurring to any great extent. In the survey, we investigated the possibility that individuals simply were unaware of the tax shield differential. This does not seem to be the case.

Figure 3
Awareness of tax shields



As shown in Figure 3, a great majority of respondents were aware of the fact that interest payments on their own mortgages are tax deductible. The great majority were also aware of the fact that interest payments made through the co-op, as a part of the monthly fee, are *not* tax deductible. 91% correctly identified the first statement as true, and 82% correctly identified

¹⁶At the time of writing, the threshold is SEK 100,000, equivalent to about USD 12,500.

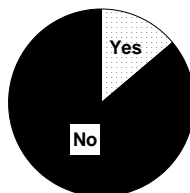
the second statement as false.¹⁷ We conclude on the basis of this that there is a high awareness of the tax shield differential between the two sources of financing.

3.3 Awareness of debt substitution

To a large extent, debt held by the co-op and debt held individually by its members are substitutes.¹⁸ In our survey, we wanted to investigate to what extent co-op residents were aware of this.

Figure 4
Awareness of debt substitution

"Have you ever considered replacing co-op debt with debt held individually by the co-op members?"



As shown in Figure 4, the awareness of the possibility of substituting co-op debt for individually held debt was very low. 86% of respondents had *never* considered the possibility of doing this. Individuals with experience of being on the board of a co-op were more than twice as likely to have thought about this (22% versus 9%). The difference is marginally significant (Pearson chi-squared test; p -value 0.076).

¹⁷The option "I don't know" was not offered. Uncertain individuals were asked to indicate which response they thought was more likely to be correct.

¹⁸They are not perfect substitutes, for several reasons. (1) Some households may face credit constraints that prevent them from borrowing directly from the bank. (2) Co-op debt has limited liability in the case of default. The nature of the Swedish mortgage market makes (1) an unlikely explanation for a widespread bias toward co-op debt. Moreover, for loan-to-value ratios of 80% or less (2) is not a convincing explanation. Large price increases in recent years imply that LTV ratios are typically much lower.

3.4 Numeracy

At the end of the survey, we included the following question: “How much is 2 million divided by 5?”. This question is a slightly simplified version of the so called “lottery question” used by Banks and Oldfield (2006) and Lusardi and Mitchell (2007) and discussed in section 2.4. The question is intended to test the respondents’ numeracy skills. Respondents were given as much time as they needed to answer the question. If they came up with the wrong answer, but then corrected themselves, we still counted this as a correct answer. Even under these conditions only 67% of respondents were able to answer the question correctly. This figure will probably strike some readers as surprisingly low, but it is actually slightly *higher* than the fraction of correct answers found in the two previous studies that use the lottery question (50.8% and 55.9% respectively). The difference may be explained in part by the slightly simpler phrasing in our survey, or by the fact that participation in our survey was conditional on owning an apartment, which may be positively correlated with numeracy skills.

We wish to emphasize the poignancy of this finding: as we have mentioned, our sample consisted of adults owning, and residing in, co-op apartments. One third of the sample were unable to divide 2 million by 5 without using an aid. In our view, this suggests that many individuals who face quite complicated financial decisions may not have adequate skills for making anything like the optimal decision. Taken together with our other survey findings reported above, this makes it highly plausible that a sizeable fraction of co-op residents will be making sub-optimal financial judgments about co-op capital structures, which is a considerably more complicated problem.¹⁹

As a word of caution, we note that the survey does not prove that seriously flawed decisions are being made. Nonetheless, we have shown that when given the opportunity to reveal their full understanding of the problem at hand, a reasonably representative sample of apartment-owners failed to do anything of the sort. Rather, the survey results are highly consistent with our conjecture that a considerable share of market participants do not have an economically sound understanding of co-op capital structures.

¹⁹Our measure of numeracy is positively correlated with awareness of the substitutability of debt, but the correlation (0.16) is not very strong.

4 A simple model of the co-op market

4.1 Modeling Consumer Bias

Mental accounting and low levels of financial literacy can give rise to economic behavior that departs from the predictions of standard economic models. This raises the question of whether a formal model should aim to take such behavioral considerations into account – and if so, how? One crucial distinction is whether such behavior is deemed to be irrational. In economics, behavior is typically described as rational if it confirms to the predictions of normative theory, i.e., economic theory that states what the individual ought to do. But economic modelling itself does not require such rationality. According to one influential definition, a positive theory of economic decision-making is one which generates good predictions regarding economic behavior (Friedman, 1953).

When the departures from normative theory are systematic, the behavior is “quasi-rational” in the sense of being predictably irrational (Thaler, 1980; Russell and Thaler, 1985; Ariely 2008). A widespread psychological bias is exactly the kind of systematic deviation from normative prediction that lends itself to economic modelling. Such models should be thought of as extensions of, and complements to, standard normative models.

We have reason to believe that there is a systematic bias in the market for owner-occupied apartments, in favour of co-op debt. This debt has the advantage of being less salient, which may give rise to psychological benefits. Calculating the cost of choosing co-op debt over individually held debt is demanding in terms of financial literacy. This makes it unlikely that all households fully understand the costs of co-op debt. Together these factors are likely to result in a biased perception of the relative cost of the two sources of debt financing.

One approach for modelling quasi-rational behavior is to treat it as a mistake that occurs when the agent converts raw information into a budget set (Russell and Thaler, 1985). This allows for a distinction between individual differences in (1) preferences, (2) information, and (3) the mapping from the real world to the mental representation of a budget constraint. Having arrived at a not-quite-accurate budget set, the agent optimizes in the same way that a fully rational agent would.

The model outlined in this section follows a similar approach: we assume that some buyers – the “naive” agents – have a biased perception of the

relative cost of the two sources of debt financing. In the model, the bias takes the form of an additional psychological cost associated with individually held debt. Aside from this, both naive and sophisticated buyers solve the same optimization problem.

4.2 A model with two types

There is a continuum of agents on $[0, 1]$ that each decide on purchasing an apartment. For simplicity, we assume that all agents finance their purchases through debt. There are two sources of debt-financing, individually held debt and co-op debt, and we allow for convex combinations of the two. Throughout the following analysis, we will refer to individually held debt as *equity* and to debt held through the co-op as *debt*.

Let the gross interest rate r be the same for both equity and debt. Suppose that the cost of capital is tax deductible for equity but not for debt, and that all agents understand this difference when considering the optimal capital structure. Letting τ denote the tax rate, the net cost of a unit of capital raised as equity is $(1 - \tau)r$.

In essence, all agents solve the same maximization problem, but some agents use an incorrect mapping from the information set to the budget set. They get disutility from the higher salience of equity, and fail to perceive the economic costs of the resulting sub-optimal capital structure.

We model this bias as a psychological cost c_j that is proportional to the interest paid on equity. Fraction α of all agents are *sophisticated* (type $j = 1$) and do not perceive a psychological cost. Fraction $1 - \alpha$ are *naive* (type $j = 2$) and do perceive a psychological cost.²⁰ The net benefit b_j associated with equity is the tax shield less the psychological cost, where the cost is modeled as a convex function of the amount of equity E :

$$b_j E \equiv r\tau E - r(1 - \tau)c_j E^2 \tag{1}$$

where $c_1 = 0$ and $c_2 > 0$.

The initial purchase is financed through a combination of equity and debt, i.e., the agents chose capital structures for their apartments. Normalizing the sum of debt and equity to 1, we can denote the capital structure associated

²⁰Alternatively, this could be modeled as a psychological *benefit* from the less salient co-op debt. Since we are only concerned with the relative cost of the two debt sources, such an approach is equivalent to ours.

with a given equity level as $\{E, 1 - E\}$, where E represents the fraction of equity.

Because the net cost of equity differs from the net cost of debt, the price of an apartment depends on its capital structure. The price is given by the function $P(E)$. Agents are not financially constrained.²¹

Once the initial capital structure is chosen it cannot be changed. Each type chooses the capital structure that maximizes their benefits throughout their lives, taking into account the possibility that they will sell the apartment in the future to an agent of a different type. Thus the relative supply of apartments with the two different equity structures is determined by the interaction of the two types of agent in the marketplace.

Sophisticated agents choose the capital structure $\{E_h, 1 - E_h\}$, and naive agents choose $\{E_l, 1 - E_l\}$. We show that $E_h > E_l$. The relative supply of apartments with high and low equity structures is determined by α .

In order to choose an apartment, agents make $m = 2$ searches at the beginning of period 2. We assume that when searching an agent views one apartment of either capital structure type. Our results do not hinge on this assumption - all we need is that apartments are sufficiently idiosyncratic that a full separation, whereby either agent type trades only with itself, does not occur. This realistic feature of the housing market is captured through the (separately additive) idiosyncratic utility v_i , uniformly distributed on $[-V, V]$, that an agent receives when matched with an apartment.²² For simplicity, we assume that agents do not anticipate this in the first period.

Agents live for two periods. At the beginning of period 1 they make their initial purchase for which they choose a capital structure that maximizes their benefits throughout their lives. After living in the apartment for one period, agents search for new apartments at the beginning of period 2. If they find an apartment that suits them even better they trade. If not, they remain in the same apartment in the second period.

²¹We will abstract from the following aspects: (1) Co-op screening. The co-op has veto rights over new members, but in Sweden these rights are very weak. (2) Pros and cons of the co-op versus other forms of ownership. In Sweden, owner-occupied apartments are without exception organized as co-ops. The condominium ownership structure is not permitted. Thus, we take the co-op ownership structure as exogenously given. (3) Default. Rising prices over the last decade have resulted in lower LTV-ratios for co-ops. When the leverage is moderate, default is highly unlikely. For this reason we will abstract from the difference between the two forms of financing in the case of default.

²²The model is tractable for a general number of searches, but this does not offer further insight.

4.3 Determining the price

We solve for the equilibrium by backward induction. First, we see how agents decide on trading their apartments once they have chosen capital structures. Next, we solve for the first period, in which agents choose capital structures anticipating their likelihood of moving to a new apartment and the future resale value of their initial purchase.

4.3.1 Period 2: Trading

The equilibrium price equates supply and demand for apartments of both types of capital structure. The supply of E_h and E_l apartments depends on α and is determined in period 1. Below, we calculate the demand in several steps.

By assumption each agent considers one apartment with high equity and one with low equity. Both types may settle for an apartment with high or low equity, whichever gives them the higher utility given the realization of the random variable v . Suppose for simplicity that the individual utility of monetary payoff M is $u_i(M) = M$. Then an agent of type j will trade their initial purchase for an apartment of equity level E_h if

$$v_i^a - P_h + (E_h)b_j > v_0 - P_0 + (E_0)b_j \quad (2)$$

and

$$v_i^a - P_h + (E_h)b_j > v_i^{a'} - P_l + (E_l)b_j \quad (3)$$

where a' denotes the low equity apartment, and a the high equity apartment. P_h and P_l are the prices of high and low equity apartments, respectively. The parameter b_j is the net benefit of equity as defined above. It includes both the psychological cost and the value of the tax shield. Condition (2) states that the agent will move to a new apartment if the sum of the utility from living in the new apartment and the net benefits associated with its capital structure, less the cost P_h of purchasing the new apartment, is greater than what the agent earns by staying in the initial purchase (subscripts 0).

The probability that a sophisticated agent trades a high equity apartment for another high equity apartment in the second period is

$$P_1^h \equiv P\{v_i^a - (P_h) + E_h b_1 > v_i^{a'} - (P_l) + E_l b_1\} \times P\{v_i^a > v^0\} \quad (4)$$

where the last term is calculated from (1) for type $j = 1$.

Similarly, the probability that the agent will stay in their current E_h apartment is

$$P_1^0 \equiv P\{v^0 - (P_h) + E_h b_1 > v_i^{a'} - (P_l) + E_l b_1\} \times P\{v_i^a < v^0\} \quad (5)$$

The total demand by agents of type $j = 1$ for high equity apartments is $\Pi_1^h = P_1^h + P_1^0$.

The probability that naive agents will move from low equity apartments to high equity apartments can be calculated in the same manner. The equilibrium price equates supply and demand in the market for high equity apartments:

$$\alpha \Pi_1^h + (1 - \alpha) \Pi_2^h = \alpha \quad (6)$$

where α is the proportion of sophisticated agents, as before. Similarly, the equilibrium price equates supply and demand for the low equity apartments:

$$\alpha \Pi_1^l + (1 - \alpha) \Pi_2^l = 1 - \alpha \quad (7)$$

where $\Pi_2^l = P_2^l + P_2^0$, analogous to the total demand for high equity apartments.

Proposition 1 *The equilibrium price of high equity apartments is given by*

$$P_h = P_l - 2\alpha V + V + (E_h - E_l)(rt - (1 - \alpha)c_2(1 - r)\tau(E_h + E_l)) \quad (8)$$

Note that the price is decreasing in the psychological cost c_2 , which causes the price of high equity apartments to be lower than the price of low equity apartments.

Proof: See Appendix A.

This is consistent with our survey finding that many agents indeed do not consider substituting equity for debt, even though they understand the tax advantages of equity. The prevalence of such behavior in the market decreases the price of high equity apartments compared to what one would observe given the favorable tax treatment of equity relative to debt.²³

Proposition 2 *The price response to a change in the tax advantage of equity relative to debt is smaller, in absolute terms, when some agents are naive.*

²³Note that the price differential is not necessarily decreasing with α .

Proof: In an economy without naive agents, i.e., when $c = 0$ and/or $\alpha = 1$,

$$\frac{\delta(P_h - P_l)}{\delta\tau} = (E_h - E_l)r \quad (9)$$

which is larger, in absolute terms, than the response that the model predicts when $c_j > 0$ for at least one type j , and $\alpha < 1$:

$$\frac{\delta(P_h - P_l)}{\delta\tau} = -(E_h - E_l)(r - (1 - \alpha)c(1 - r)(E_h + E_l)) > -(E_h - E_l)r \quad (10)$$

In other words, if there are naive agents in the market, then we expect equilibrium prices to be less responsive to a change in the relative cost of the two sources of financing. We explore this hypothesis in the first empirical analysis section.

4.3.2 Period 1: choosing capital structure

When choosing capital structures, agents maximize their tax benefits, less the psychological cost of equity, and the expected gain or loss from trading in the second period. In addition, each type of the agent chooses an optimal capital structure taking into account the optimal choice of the other type.

Proposition 3 *Naive agents choose a lower level of equity, relative to sophisticated agents, when determining their capital structures in period 1.*

Proof Naive agents weigh the tax benefits of equity against the psychological cost:

$$\max_E r\tau E - rE - (1 - E)r - cE^2 \quad (11)$$

From the first-order condition we get the optimal level of equity for naive agents:

$$E_l = \frac{r\tau}{2c} \quad (12)$$

while sophisticated agents prefer not to hold any debt at all, so $E_h = 1, D_h = 0$ ²⁴

²⁴One could internalize the optimal choice of equity by imposing a nonlinear cost of raising it. While such an assumption would be innocuous and more realistic, it does not add insight in our model, since our interest lies in the workings of the trade in period 2 for *any* high and low equity apartments chosen by agents.

4.3.3 Extension: a dynamic model

Proposition 4 *If naive agents dominate the market, an increase in the psychological cost parameter c results in an decreased probability of moving. This effect is stronger for naive agents. The probability of staying in the current apartment is given by*

$$P_1^0 = \frac{V + x_1^h}{4V} = \frac{2V\alpha + (1 - \alpha)c(1 - r)t(E_h^2 - E_l^2)}{4V} \quad (13)$$

for type $j = 1$, and

$$P_2^0 = 0.5\left(1 - \frac{V + x_2^h}{2V}\right) = \frac{2V(1 - \alpha) + \alpha c(1 - r)t(E_h^2 - E_l^2)}{4V} \quad (14)$$

for type $j = 2$. Sophisticated agents are more likely to stay in their current apartments because of the naive agents psychological cost if the naive agents dominate ($\alpha < 0.5$), because

$$\frac{\partial P_1^0}{\partial c} \geq \frac{\partial P_2^0}{\partial c} \quad (15)$$

Proof See Appendix A.

The intuition for this result is that when a large number of prospective buyers dislike the high equity apartments, sophisticated agents will not receive enough compensation from selling in relation to the expected gains. In a dynamic model, this translates into sophisticated agents staying longer in their apartments when the market is dominated by naive agents. Indeed, if apartments can be traded in every period, the lower probability of trade in each period means that the likelihood that an agent finds an appropriate apartment for trade is lower with any (finite) number of periods. We test the conjecture that sophisticated agents stay longer in their apartments in the second empirical analysis section.

5 Empirical analysis

5.1 Sales data

If all agents in the market are sophisticated, co-op debt should be fully capitalized in apartment prices. Increasing an apartments share of co-op debt

should lower the price by the same amount. We conjecture that this is not an accurate description of the Swedish market for co-op apartments. Our survey findings suggest that a boundedly rational view of co-op capital structures may be pervasive in the market. In this section we use a large sample of market data to shed more light on this conjecture.

Due to the particular legal status of Swedish co-ops, there is no centralized, publically available data on their capital structures. Instead, we use the monthly fee, which we can observe in our data set, as a proxy for co-op debt. While heterogeneity with regard to the service flow provided by co-ops makes this proxy variable less than perfect, we have reason to believe that it is still reasonably good. There are a few firms in Sweden that specialize in analyzing co-op annual reports, including the balance sheets. One of these firms, Boreda AB, allowed us to estimate the correlation between the fee/m² and co-op debt/m² on their data for 2007. The correlation coefficient for this subsample is about 0.40. When controlling for year of construction (as we do in the following analysis), the correlation rises to about 0.66. On the basis of this, we assume that the correlation between the monthly fee/m² and debt/m² is reasonably strong also in the national sample of sales data used below.

Since we do not directly observe debt, we cannot measure how debt affects prices by simply regressing price/m² on fee/m². If the service flow in the co-op is positively correlated with the co-op fee, then the effect of a higher fee on prices is ambiguous. As a result, a regression coefficient on the co-op fee does not lend itself to a straight-forward interpretation.

Instead, we make use of a natural experiment to examine whether co-op debt is capitalized in a rational manner. On 16 October 2006, the government unexpectedly announced that it would abolish a supplementary housing tax levied on co-ops. At the time, all co-ops were required to pay a basic housing tax amounting to 0.5 percent of the assessed value of the property. In addition to the basic housing tax, co-ops paid a 28 percent tax on the imputed rent, calculated as 3 percent of the assessed value, *less co-op interest payments*. The enactment date of the tax change, 1 January 2007, was disclosed at the time of the announcement.

The crucial aspect of the reform is that had different effects for co-ops with high and low leverage. Interest rate payments made by the co-op were deductible against this tax. Hence co-ops with high fractions of debt did not pay the tax, and would not be affected by the reform. By contrast, co-ops with little or no debt would enjoy considerable cost reductions as soon as the

reform was implemented at the end of the year.

Forward-looking, rational consumers should have anticipated that co-ops with low leverage would either (1) reduce their monthly charges in the future, or (2) maintain the same monthly charge but increase the flow of services. Thus, in an efficient market we would expect a positive price effect for apartments in low debt co-ops. To separate this effect from general price movements, we focus our attention on changes in the *relative* price of low debt and high debt co-ops around the time of the reform. In an efficient market, this relative price should have changed in favour of co-ops with low levels of debt.

We test this hypothesis using market data on apartment sales from the fourth quarter of 2006, around the time of the reform. The data was provided by the Swedish association of real estate agents, and contains detailed information on more than three thousand apartment sales that took place throughout the country within a ± 30 day window of the reform. The data distinguishes between the transaction date and the moving date. We use the former to divide the sample into pre-reform and post-reform sales. The data also allows us to control for a number of apartment characteristics, including the monthly fee, apartment size, the number of rooms, what floor, the age of the building, whether the building has an elevator, and the location. Location is measured at the municipal level.

5.2 The econometric model

We fit a hedonic model with the sales price as the dependent variable. We include the co-op fee per square meter as an explanatory variable, as well as a dummy variable for being a post-reform sale, and an interaction term for the co-op fee and the post-reform dummy. The fee, which we can observe, is a proxy for co-op debt, which we do not observe. Co-ops with higher fees are assumed, *ceteris paribus*, to have higher debt levels. We can write our econometric model as

$$y_i = \delta_0 + \beta_1 fee_i + \beta_2 post_i + \beta_3 fee_i \times post_i + \mathbf{X}'\boldsymbol{\delta}_i + \varepsilon_i \quad (16)$$

where the dependent variable, y , is the sales price (per m^2), fee is the (annualized, per m^2) co-op fee, $post$ is a dummy variable indicating a post-reform sale, and \mathbf{X} is a vector of apartment characteristics.

We are primarily interested in the coefficient β_3 . More debt should result

in a lower price both before and after the reform, but the negative effect of co-op debt should be larger after the reform, which made such debt more costly relative to equity. The coefficient β_3 captures this difference-in-difference.

5.3 A rational benchmark

In this section, we estimate a benchmark value for β_3 in a market where all agents are rational. For a rational agent, the utility flow from an apartment is not affected by the co-op's capital structure. Hence the flow cost that a rational individual is willing to pay for the apartment should be the same regardless of the capital structure. Letting V , D , and E denote the value of assets, debt and equity, and a , b , and c their respective cost, we can write this condition as

$$\begin{aligned}\bar{a}\bar{V} &= \bar{b}D + \bar{c}E \\ \Rightarrow E &= \frac{\bar{a}}{\bar{c}}\bar{V} - \frac{\bar{b}}{\bar{c}}D\end{aligned}$$

The first derivative of E w.r.t. D gives the marginal rate of substitution between debt and equity such that the agent is indifferent between different capital structures:

$$MRS_{D,E} = \frac{\partial E}{\partial D} = -\frac{\bar{b}}{\bar{c}}$$

Before the reform, $b_0 \approx c_0 = (1 - \tau)r \Rightarrow MRS_0 \approx 1$. After the reform, $b_1 > c_1 \Rightarrow MRS_1 > 1$. More precisely, $b_1 = r$ whereas $c_1 = (1 - \tau)r$ as before, implying

$$MRS_1 = \frac{r}{(1 - \tau)r} = \frac{1}{(1 - \tau)}$$

In other words, the post-reform marginal rate of substitution for a rational individual is such that a marginal increase of one unit of debt reduces equity by $1/(1 - \tau)$ units. The fee, however, is a proxy for the interest payment on the debt, rD , not the principal D . We must adjust for this when estimating the coefficient β_3 . In the simplest of worlds, a marginal increase of one unit of interest paid implies an additional $1/r$ units of debt. It follows that the marginal rate of substitution between interest payments on co-op debt and the level of equity is given by

$$MRS_{rD,E} = \frac{1}{(1 - \tau)} \times \frac{1}{r} = \frac{1}{(1 - \tau)r}$$

We know that $\tau = 0.3$. Reasonable estimates of r for the second half of 2006 are in the range of 0.05, approximately corresponding to STIBOR + 2%. Table 1 below shows a range of estimates of our rational benchmark, i.e., the effect size if the market responded efficiently to the reform.

Table 1
Estimating a rational benchmark

r	$1/(1-\tau)$	Pre-reform $MRS_0 = 1/r$	Post-reform $MRS_1 = 1/r * 1/(1-\tau)$	Rational benchmark $\beta_3 = MRS_1 - MRS_0$
0.04	1.43	25.00	35.71	10.71
0.05	1.43	20.00	28.57	8.57
0.06	1.43	16.67	23.81	7.14

5.4 Regression results

We fit equation (16) to sales data within a window of ± 30 days of the announcement of the reform. In addition, we fit the model to more narrow windows of 10 and 20 days. A more narrow window reduces the scope for other, background variables, e.g., macroeconomic variables, to bias the results, but also results in a smaller sample. The estimates for the key variables are reported in Table 2.

Table 2
Effect of fee on price per m^2

Variable	Window:	(1) 10 days	(2) 20 days	(3) 30 days
Co-op fee		-21.22 (0.000)***	-19.50 (0.000)***	-18.37 (0.000)***
Co-op fee*post-reform		2.71 (0.383)	-1.18 (0.583)	-1.84 (0.298)
Post-reform		-1,506.27 (0.420)	982.86 (0.449)	1,338.56 (0.213)
Additional controls		Yes	Yes	Yes
Constant		61,472.20 (0.000)***	59,583.03 (0.000)***	56,795.03 (0.000)***
Observations		1105	2182	3052
R^2		0.84	0.83	0.83

Robust p-values in parentheses. **significant at 5%; ***significant at 1%

For the 10-day window the coefficient on the interaction term, our key variable of interest, has the wrong sign and is not statistically significant. For the 20 and 30 days windows, the coefficient on the interaction term has the appropriate, negative sign, but despite the large sample size and high R-squared, it remains far from statistically significant. This suggests that the market did not react efficiently to the reform, in the sense of prices that incorporate all available public information. This finding is consistent with our survey results, which suggest that a large fraction of the market may not have a good understanding of the co-op capital structure.

Consistent with the prediction of our model, we are unable to reject the null hypothesis that there was no relative price change following the reform. The sales data for the period preceding and immediately following the reform do not indicate that market capitalizes co-op debt in an efficient manner. While it is not possible to prove a negative, the large sample size and good explanatory power of our regressions using the sales data suggest that what efficiency might be in the market is weak at best.

5.5 Robustness check: supply effects

Price is set by demand *and* supply. It is possible that supply changes affected the equilibrium price, perhaps offsetting a change in demand. We check this by comparing the mean and variance of fees observed during the 30 days preceding the reform with those observed during the 30 days immediately following the reform.

As table 3 shows, there was little difference between the two periods with regard to the mean and variance of the annual fee variable. The mean declined slightly and the variance increased marginally. A two-sample *t*-test is unable to reject the null hypothesis of equal means (*p*-value: 0.52). The equality of variance between the two periods is tested using the Levene statistic. We are unable to reject the null hypothesis of equal variance (*p*-value: 0.99).

Table 3
Equal distributions before and after the reform

	Pre-reform	Post-reform	Statistic	H ₀	<i>p</i> -value
Mean	600.5	597.3	<i>t</i> -test	Equality of means	0.23
Standard deviation	139.7	141.0	Levene	Ratio of standard deviations = 1	0.50

5.6 Survey data

The extended version of our model predicts that for a range of α , sophisticated agents will be less mobile. Our survey data offers an opportunity to test this hypothesis. One of the survey questions was how many years the respondent expected to reside in their current apartment. Responses ranged from less than one year to “for the rest of my life”.²⁵ In order to examine whether duration of residence was correlated with sophistication regarding the capital structure, we needed some measure of sophistication. The survey also included a question about whether the individual had ever thought about the two forms of debt as being, to some extent, substitutes. We use a positive answer to this question as a proxy for being sophisticated.

There is a considerable difference between naives and sophisticates in our sample with regard to how long they expect to stay in their apartments. The former expect, on average, to stay for 7.2 more years, whereas the latter expect to stay more than twice as long, 14.7 years. Our sample is small: only 14 of the 100 respondents replied positively to the question about debt substitution. Moreover, the apparent correlation could be driven by other variables. To shed more light on the statistical significance of this finding and on the role of other variables, we regress the expected residency on a number of controls, including age, sex and education. We also control for how long the respondent had already lived at their apartment. We can write this regression as

$$y_i = \beta_0 + \beta_1 \text{residency}_i + \beta_2 \text{age}_i + \beta_3 \text{sex} + \beta_4 \text{education} + \varepsilon_i \quad (17)$$

Table 4 presents the results from fitting equation (17) to our survey sample. Column (1) shows the estimated correlation from a simple regression without controls, and column (2) shows the regression estimates when we include the controls.

²⁵In the latter case, a numerical value was imputed according to the formula $A=B-C$, where A is the imputed value, B is a constant representing a “normal” expected lifespan, and C is the respondents age at the time of the survey. For the results presented below, $B=85$. Additional regression with $B=80$ and $B=90$ can be found in Appendix X. Our analysis is not particularly sensitive to the selected value of B, although for $B=90$ the p -value is a little over 0.05.

Table 4

Sophistication is positively correlated with expected length of stay

	(1)	(2)
Sophisticated	7.51 (0.010)**	7.01 (0.043)**
Years of residency so far		-0.23 (0.060)*
Age		0.30 (0.000)***
Male		-0.92 (0.636)
University		-1.37 (0.461)
Constant	7.21 (0.000)***	-1.94 (0.514)
Observations	100	100
R ²	0.09	0.24

Robust *p*-values in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%

In the simple regression without controls, the (positive) coefficient on “Sophisticated” is highly statistically significant. When we include the control variables, the explanatory power increases considerably, but the coefficient on “Sophisticated” remains similar in magnitude - implying that sophisticated individuals stay for about 7 years longer, on average - and continues to be statistically significant. While one should be cautious when drawing inference from such a small sample, this finding nevertheless provides support for the model’s prediction.

6 Discussion

We have used a survey to identify a consumer bias and shown that it can have economically significant effects for individual welfare as well as equilibrium prices, in both theory and practice. The bias in question is the tendency to compartmentalize two closely related sources of debt as if they were not part of the same financing problem. Looking at the market for owner-occupied apartments, we argue that the lower salience of co-op debt, in combination

with low levels of financial literacy, gives rise to a bias in favour of co-op debt. Because many households do not fully comprehend co-op capital structures, they do not fully perceive the costs of failing to optimize the composition of their debt. As a result, the distortionary effects of lower salience are left largely unchecked.

The bias gives rise to sub-optimal capital structures, and may thereby impose substantial costs on individual households. We offer the following numerical example. Following the 2006 reform, co-op debt became almost 50% more costly than individually held debt. In 2007, the average price of a Stockholm apartment was about SEK 2 million. Suppose an apartment trades at this price, and the co-op has a debt/equity ratio of 1:2. Then the co-op debt associated with the apartment amounts to SEK 1 million. At current interest rates, a household with SEK 1 million in co-op debt could reduce their monthly lending costs by about SEK 1,250 by replacing co-op debt with household debt, equivalent to about 6% of the average pre-tax monthly wage.²⁶

The prevalence of biased consumers appears to distort market prices in equilibrium. We examine market data before and after an unexpected reform in 2006. If the market was perfectly efficient, we would expect a relative price change in favour of co-ops with low leverage. Despite the large sample size and high explanatory power of our regression, we do not observe this. We observe an effect with the correct sign, but it is small in size and far from statistically significant. The model presented in Section 4 predicted a muted response to a change in the relative cost of the two forms of debt. Our econometric results are consistent with this prediction.

A bias that leads to sub-optimal capital structures and the mispricing of co-op debt in the housing market may be aggravated by consumers' sluggishness to respond to changes in relative prices. The tendency to adhere disproportionately to the choice that does not require active change has been described as "status quo bias" (Samuelson and Zeckhauser, 1988). When households are uncertain about what constitutes the optimal strategy they may turn to their surroundings for guidance. This can exacerbate the sluggishness: "[U]nsophisticated households tend to use whatever financial contracts are standard in a particular country, possibly because they follow the lead of relatives and neighbors." (Campbell, 2006, p. 34). Herding behavior

²⁶Source: Statistics Sweden. SEK 18,000 \approx USD 2,200. The example is based on an interest rate of 5%.

of this kind would also explain why different types of mortgages are standard in different countries. For example, fixed-rate mortgages constitute the vast majority of mortgages issued in the US, yet hardly exist in the UK (Miles, 2003).

What economic policies might mitigate the bias and its effects on market equilibrium? It is quite possible that regulation could go some way in reducing the scope for costly mistakes in this market. Regulation, however, often comes at the cost of imposing restrictions on all participants in the market. It is important to consider both costs and benefits of different policy options. To give an example, the problem of sub-optimal capital structures could clearly be dealt with by simply banning co-op leverage. We believe this to be an unwise policy choice. Short term debt is a convenient way for co-ops to distribute unforeseen expenditures, such as the need to adjust the premises to fit new building laws, over slightly longer time periods. Banning such debt might protect naive consumers, but also imposes an inconvenience cost on all consumers in the market.

Ideally, regulation should make it easier for consumers to make economically sensible decisions while still leaving the final choice to the consumer. This way regulation is kept at a minimally intrusive level. This regulatory approach to household finance has been described as “libertarian paternalism” (Thaler and Sunstein, 2003, 2008) or “asymmetric paternalism” (Camerer et al, 2003). The aim is to target naive consumers without imposing welfare-reducing restrictions on sophisticated consumers.

We suggest two policies that would reduce the scope for mistakes without significant infringements on consumer choice. First, the co-op monthly fee could be itemized so that it is readily apparent what fraction of the fee is used for service and maintenance on the one hand, and interest payments on the other hand. This increases the salience of co-op debt and makes the capital structure more transparent. Second, real estate agents could be encouraged to disclose the co-op debt associated with an apartment in their advertisements. This information can be inferred from a co-op’s annual statement. It is unlikely, however, that consumers will read annual statements and make the necessary calculations at the early stages of choosing an apartment. Providing the information in the advertisement itself would serve as a timely reminder to the consumer that the value of assets is the sum of equity and debt, and facilitate quick comparisons between apartments with different capital structures.

Both policies would be inexpensive to implement and would help con-

sumers make more informed decisions. We believe that both the first and second suggestion would be well suited to field experiments, and encourage further research along these lines. There is also a third, far more costly, policy option that has the potential to greatly reduce the cost of failing to understand co-op capital structures: making interest payments on co-op debt tax deductible on par with individually held debt. Aside from political economy considerations, it is hard to see an economic rationale for the current asymmetry. Finally, we note that some existing regulations – notably, rent control and other restrictions on letting co-op apartments – exacerbate the effects of the bias on market equilibrium, by preventing arbitrage by sophisticated consumers. A discussion of the merits of rent control are beyond the scope of this paper, but we recommend that our findings be taken into account in a cost-benefit analysis of the current system.

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Appendix A

Proof of Proposition 1

Denote

$$x_j^h = P_l - P_h + (E_h - E_l)rt - (E_h^2 - E_l^2)c_j \quad (\text{A.18})$$

The probability that an agent of type $j = 1$ will prefer a high equity apartment over a low equity apartment is the sum of two terms:

$$P_1^h \equiv P\{v_i^a - (P_h) + E_h b_1 > v_i^{a'} - (P_l) + E_l b_1\} \times P\{v_i^a > v^0\} \quad (\text{A.19})$$

The probability that the agent will stay in their current E_h apartment is

$$P_1^0 \equiv P\{v^0 - (P_h) + E_h b_1 > v_i^{a'} - (P_l) + E_l b_1\} \times P\{v_i^a < v^0\} \quad (\text{A.20})$$

Denote $\Pi_1^h = P_1^h + P_1^0$.

Therefore, with the above notations

$$P_1^h = \frac{1}{2}P\{x_1^h + v_i^a > v_i^{a'}\} = \frac{1}{2} \int_{-V}^V \frac{1}{2V} \frac{V + x_1^h + v}{2V} dv \quad (\text{A.21})$$

$$= \frac{1}{2} \left(\frac{1}{2} + \frac{1}{2V} \frac{1}{4V} (x_1^h + v)^2 \Big|_{-V}^V \right) = \frac{1}{2} \left(\frac{x_1^h}{2V} + 0.5 \right) \quad (\text{A.22})$$

It is simple to show that the second probability is equal to the first, so $0.5\Pi_1^h = P_1^h = P_1^0$

Thus, the equilibrium conditions will solve

$$\alpha\Pi_1^h + (1 - \alpha)\Pi_2^h = \alpha \quad (\text{A.23})$$

in the market for high equity apartments and

$$\alpha\Pi_1^l + (1 - \alpha)\Pi_2^l = 1 - \alpha \quad (\text{A.24})$$

in the market for low equity apartments. It follows that

$$\alpha(x_1/2V + 0.5) + (1 - \alpha)(x_2/2V + 0.5) = \alpha \quad (\text{A.25})$$

Noting that $\Pi_j^h = 1 - \Pi_j^l$, we get that the market for low equity apartments clears as well.

Plugging in the values for x and multiplying both sides by V we get

$$P_l - P_h + (E_h - E_l)(rt - (1 - \alpha)c_2(1 - r)\tau(E_h + E_l)) + V = 2\alpha V \quad (\text{A.26})$$

Similarly, for low equity apartments we get

$$P_h - P_l + (E_l - E_h)(rt - (1 - \alpha)c_2(1 - r)\tau(E_h + E_l)) + V = 2(1 - \alpha)V \quad (\text{A.27})$$

Proof of Proposition 3 The probability that an agent of type $j = 1$ stays in their current apartment is

$$P_1^0 = \frac{V + x_1^h}{4V} \quad (\text{A.28})$$

For an for an agent of type $j = 2$ the probability is

$$P_2^0 = 0.5\left(1 - \frac{V + x_2^h}{2V}\right) \quad (\text{A.29})$$

Plugging in x_1^h for $P_l - P_h$ we get $x_1^h = 2V\alpha - V + (1 - \alpha)c(1 - r)t(E_h^2 - E_l^2)$ and $x_2^h = 2V\alpha - V - \alpha c(1 - r)t(E_h^2 - E_l^2)$, implying that for $j = 1$,

$$P_1^0 = \frac{V + x_1^h}{4V} = \frac{2V\alpha + (1 - \alpha)c(1 - r)\tau(E_h^2 - E_l^2)}{4V} \quad (\text{A.30})$$

and for $j = 2$,

$$P_2^0 = 0.5\left(1 - \frac{V + x_2^h}{2V}\right) = \frac{2V(1 - \alpha) + \alpha c(1 - r)\tau(E_h^2 - E_l^2)}{4V} \quad (\text{A.31})$$

Note that

$$\frac{\partial P_1^0}{\partial c} = \frac{(1 - \alpha)(1 - r)\tau(E_h^2 - E_l^2)}{4V} \geq \frac{\partial P_2^0}{\partial c} = \frac{\alpha(1 - r)\tau(E_h^2 - E_l^2)}{4V} \quad (\text{A.32})$$

as soon as $\alpha \leq 0.5$