A ticking bomb? Leverage in Swedish Housing cooperatives

A study of consumer inattention toward important financing parameters hidden in the BRF

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By: Wilhelm Meyer* and Max Ulmgren**

Abstract: With interest rates on record low levels, concerns about increasing debt levels of home-buyers and BRFs have been raised in media and by *Finansinspektionen.* This paper examines whether Swedish home-buyers properly value the present value of future cash flows associated with the fee and the debt-level associated with the BRF. Further, the study aims to see if there is a difference in valuation based on the salience of these figures, as fee is included in the realtor's ad while debt-level is not. Through the use of a hedonic pricing model, home-buyers' valuation of different characteristics is investigated and quantified. Data covering c.150,000 apartment transactions between September 2012 and April 2018 was provided by Booli and is used to construct the model. The study finds that both the capitalized fee and the BRF debt-level are priced too low by home-buyers at only 55% and 32% of its fair value, respectively. These results highlight the importance of increasing the awareness of home-buyers towards the financial health of the BRF when buying an apartment.

Key words: Hedonic pricing model, Leverage, BRF, Salience, Swedish real estate

Tutor: Cristian Huse

*23748@student.hhs.se

**23747@student.hhs.se

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1. Introduction

For most people, the real estate investment in a home is the largest they will ever make. However, the rationality employed in this investment can be questioned, as the general home buyer is not economically educated. Apart from valuing the object itself, which constitutes a series of characteristics whose values are not observable, consumers need to assess the value of future costs associated with the property.

In Sweden, the general structuring of apartment buildings is that tenants buy a share in an association, the BRF[1], giving the right to live in a specific apartment. As the BRF is generally financed with both equity and debt, for most home-buyers this implies additional debt and related interest costs. These costs, among other joint costs[2], are financed through the monthly fee to the BRF (Bolagsverket, 2016). Today, the visible effects of leverage are smaller than ever as the low interest environment has made the cost of debt decrease significantly.

This paper aims to investigate the attentiveness of apartment buyers in Sweden to the financial stability of the BRF. The study will be executed in two steps, examining factors with different degrees of visibility to the buyer. Initially, the study will focus on the impact of the monthly fee on the price paid. The monthly fee is required to be included in the realtor's ad and is hence visible for all home-buyers. In a second stage, the focus will shift to examine the effect of leverage in the BRF on the price of the apartment. This figure is not mandatory in the ad and hence it requires knowledge about financial statements to be able to calculate this figure.

The approach taken is to use a hedonic pricing model which has its theoretical basis in a consumer utility function. It views the apartment as bundle of goods made up by the different characteristics, whose individual values are unobservable but can be estimated through a multivariate regression. When estimating the buyers' valuation of the fee, a similar approach as the one taken by Myers (2017) is used as all the future cash flows of the fee are capitalized[3]. If apartment buyers are attentive to the fee, an increase in the net present value of the future fee payments should lead to an equal decrease in the price they are willing to pay. When looking at leverage, debt per square meter is used as a regressor[4]. Under the assumption that buyers are

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[1] En: "Housing Cooperative", Sw: "Bostadsrättsförening"
[2] Other joint costs include regular maintenance and heating costs
[3] The cash flows are capitalized as an annuity, where all future cash flows are discounted over an assumed time-period, using a discount rate corresponding to the cost of capital for consumers
[4] Debt per square meter is calculated as total outstanding debt in the BRF, divided by the total living area in all of the apartments that make up the BRF

indifferent to having personal debt or debt in the BRF, an increase in the BRF-debt should again lead to an equal decrease in the price they are willing to pay.

A study of buyers' valuation of financial characteristics relating to the BRF is valuable for a number of reasons. High debt levels in BRFs poise a risk of significantly rising costs for the apartment owner in the event of a rate increase. Investigating buyers' attentiveness to this factor could give an idea of a potential risk for unexpected rising costs associated with an interest rate increase. Further, this essay can hopefully shed light on a possible mispricing of less visible economic factors of the BRF and be of guidance regarding what information should be included in a realtor's ad.

To be able to carry out this study, a collaboration with the Swedish government-owned bank SBAB was initiated. The help from SBAB was valuable since it gave access to important data and insights from their employees. As the study explores a topic that recently received attention, the previous literature on the subject is mostly limited to news articles in Swedish press. Hopefully, this thesis will provide a base for future research and attract further research attention to a subject that is highly relevant to Swedish consumers and governing agencies. Hence, the paper should be considered an early attempt to investigate this area and is subject to certain data limitations.

The paper proceeds as follows. Section 2 gives a background to relevant topics, section 3 discusses previous literature on the subject, section 4 describes the data used in the study, section 5 details the theoretical framework used, section 6 describes the results and section 7 states conclusions and further implications of the study.

2. Background

Economic conditions and corresponding monetary policy in recent years have made it possible for both individuals and corporations to take on leverage historically cheap (See Appendix A9). Further, the structure of housing cooperatives in Sweden creates a situation for Swedish apartment owners where additional leverage is hidden in the BRF. In this section, these topics and their relevance for the study is discussed.

2.1 Macroeconomic factors and Swedish real estate prices

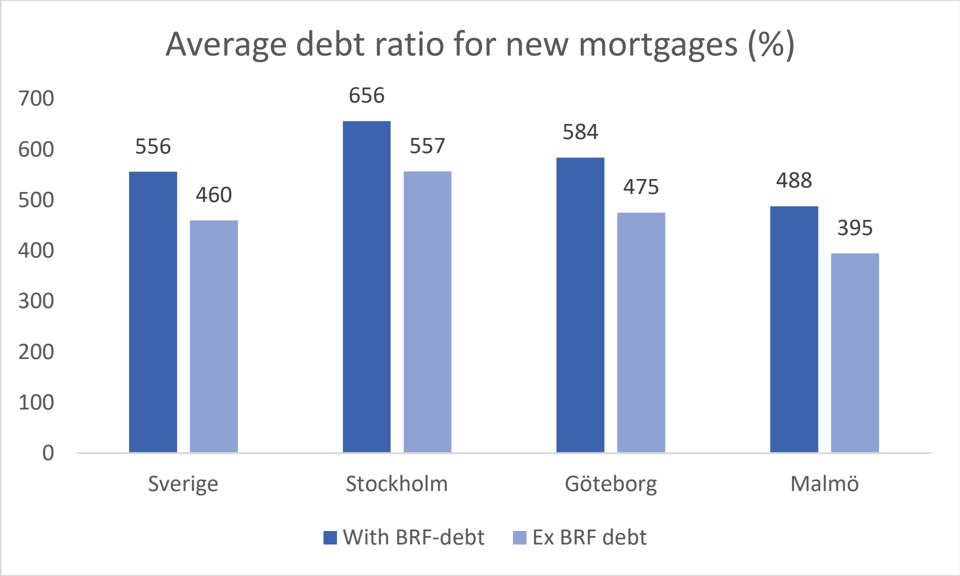
Following the financial crisis in 2008-2009, the Swedish central bank has pursued an expansionary monetary policy with declining interest rates as a consequence (Riksbanken, 2018). This economic environment has made it cheaper to assume debt than ever before.

A report by ESRB from the end of 2016 concludes that real estate prices in Sweden had increased faster than household income during several years. This increase was mirrored by a similar increase in debt levels of Swedish households (See Appendix A10 and A11). The report discusses that the combination of high indebtedness of Swedish households with the substantial increase in real estate prices should be considered a strong warning signal. An economic or financial shock is thought to have adverse effect on the ability of households to service their debts (ESRB, 2016).

Finansinspektionen[5] has reacted to the rising indebtedness of households and increased insecurity about interest rates with measures such as *amorteringskravet*[6]. The aim is to push down leverage of home-owners and decrease the exposure to rising interest rates ("Frågor och svar om skärpt amorteringskrav för hushåll med stora skulder," 2017). Following this measure, the market has cooled and since August prices of apartments have declined ("Svensk Mäklarstatistik," 2018) (see Appendix A11). However, no measures have been taken to push down leverage on BRF-level which posies a hidden interest rate risk for home owners, discussed further in the next section (Åkerman, 2018).

The impact of the BRF debts on the Swedish debt ratio is shown in the graph below[7]:

[5] *Finansinspektionen* is Sweden's financial supervisory authority. Its role is to promote stability and efficiency in the financial system as well as to ensure an effective consumer protection.
[6] Regulation of consumer mortgages that requires households that are highly indebted to amortize at a faster pace.
[7] Debt ratio is calculated as total debt/consumer equity



Source: Finansinspektionen

2.2 Structure of housing cooperatives

Buying an apartment in Sweden implies buying a share in an association with the other apartment owners in the building, the BRF. This gives the right to live in the apartment and responsibility for all matters relating to the apartment itself. However, the members of the cooperation are jointly responsible for affairs relating to all residents in the building, such as maintenance of the roof etc., which are covered by a fee paid by residents (Bolagsverket, 2016). When a BRF is formed the financing is usually a mix of equity and debt. The debt part of the financing give rise to an interest cost which also has to be covered by the residents.

A report from Swedbank and Sparbankerna (2017) states that realtors seldom inform home-buyers about the leverage in the BRF despite possibly large effects on the monthly fee in the event of an interest rate increase. As interpretation of the leverage requires knowledge about financial reports, this information can be hard to achieve, and buyers rather look at the monthly fee which could be misleading. The report argues that an increase from 2 percent (which is a good proxy for current lending rates for a healthy BRF) to 5 percent could double the monthly fee. A rising rate would also increase the interest costs for the private mortgage, something that buyers account for when borrowing money from a bank (Swedbank, 2017). However, as the interest rate on the BRF-loans will increase as well, the effect from a rising fee to cover this may come as a shock to the home owners with an already stressed economic situation.

The low rate environment has made it possible for both BRFs and home-owners to assume more leverage than ever. Worries about this development gave rise to *amorteringskravet* but no similar measure has been taken to regulate debt levels at BRF level. However, concerns about large amount of debt in BRFs and home-buyers' unawareness of this have been risen in media. The most alarming figures are found when studying newly developed projects where debt levels often reach or exceed 15 000 SEK/sqm ("Bostadsköpare riskerar att få skyhöga skulder i nya projekt | SvD," 2018). Consequently, it is interesting to study further to what extent leverage in BRFs is considered by home-buyers.

3. Previous Literature

3.1 The Hedonic Pricing Model

The idea of a hedonic pricing model to capture the extrinsic and intrinsic characteristics affecting the value of real estate builds on the findings by Rosen (1974). He built his thesis on Lancaster's consumer theory, which modelled behavioural finance to understand consumer choices (1966). Rosen argued that a property can be viewed as a bundle of goods, whose internal values are not observable. He furthermore introduced the concept of using multivariate regression of a larger sample in order to capture these unobservable effects and consequently predict the market value of a property relative others in the sample.

3.1.1 Empirical issues

As the hedonic pricing function has been widely used in the pricing of real estate, both in academics and more practical situations where traditional valuation methods fall short, i.e. in the absence of predictable cash flows (Monson, 2009), there is a strong base of previous literature. Summarizing this plethora of research, a paper by Chin and Chau points out key empirical issues; choice of functional form for the regression, segmentation of the housing market and choice of explanatory variables (2003).

Regarding the choice of functional form, Rosen (1974) did not suggest a specific form, but rather advocated a "goodness-of-fit" criterion which has been widely used. The likelihood ratio test is often used to assess differences between models, and Box-Cox transformation has been widely used. For this thesis however, Box-Cox transformation will be avoided, due to several shortcomings shown by later research. For instance, Cassel and Mendelsohn found that while the Box-Cox transformation may increase the fit of the model, it may reduce the accuracy in predicting the individual coefficients (1985). Furthermore, Linneman argued that it is not a suitable method when dealing with dummy variables, which are not strictly positive (1980).

The second empirical issue brought up by Chin and Chau is with regards to the segmentation of the housing market. Linneman argues that too broad a sample will bias estimates (1980), while a to narrow definition will generate an inferior model with more imprecise estimates, as not all information is used. Hence, the segmentation should incur as broad a sample as possible, but exclude extreme values not explained by observable characteristics. Myers for instance drops 0.5% of the highest and lowest prices, as well as areas with fewer than 10 observations (2017). Regarding the choice of which variables to include in the model, there is a risk of over-and under-specification, as the impact of the variables can never be directly observed. Due to limited data, the main issue for this thesis is under-specification, i.e. producing an inadequate model due to omitted-variable bias. However, as Butler (1982) suggests, given that the aim is not to accurately predict the value of a specific property, a set of key variables is sufficient.

3.1.2 Application to the housing market

The application of hedonic pricing models to the real estate market rests, as described by Chin and Chau (2003), on several assumptions. Most crucial are the assumptions of homogeneity and perfect market conditions. It could definitely be argued that apartments are not homogenous products, affected by several unobservable attributes, which would distort the model. Also, pricing is highly subjectable to changes in demand and supply within subsectors, which would make prediction of future prices using past prices difficult. However, Chin and Chau deem these assumptions reasonable on a large scale, stating that fixed effects can control for unobservable characteristics and that the market can be considered large enough to operate sufficiently effective (2003).

3.2 Consumer pricing of future cash flows

To delve deeper into consumer pricing of specific characteristics, research has modelled future cash flows associated with an investment against the transaction price, to deduce consumers' understanding and pricing of these. Myers (2017) has presented a paper in this area, which examines how consumers capitalize future energy costs when purchasing a house. The idea is that, as the energy costs correspond to future cash flows, a correct capitalization of these should affect the purchase price perfectly at a -1 coefficient (γ), when used as a regressor (F_{jat}), as per equation below[8]:

$$U_{ijat} = \eta\left(w_i - H_{jat} - \gamma F_{jat}\right) + \boldsymbol{X}'_{ja}\,\tilde{\beta} + \tilde{\xi}_{ja} + \tilde{\lambda}_{at} + \varepsilon_{ijat}$$

Myers assumes an infinite time horizon, arguing that consumers view these costs as associated with the lifetime of the house. Other papers have looked into the capitalization of different costs associated with car purchases, e.g. fuel and tax. These generally use the lifetime of the car as a

[8] Where U denotes the utility for consumer i, buying house j in neighbourhood a at time t at price H. The investment utility is associated with future cash flows, F, certain observable and unobservable characteristics, $\boldsymbol{X}$ and ξ, a time-geographic fixed effect λ as well as individual consumer taste ε. It can be compared to the outside option of not buying an apartment, w, based on the marginal utility of money, η

time horizon (Allcott & Wozny, 2012; Sallee, West, & Fan, 2016). With regards to the discount factor, Myers argues that her result of a c.8-10% corresponds to a reasonable discount rate, citing previous research into the car market (Allcott & Wozny, 2012; Sallee et al., 2016). Huse and Koptyug (2017) use a discount rate of 5% when studying capitalization of taxes and fuel for the Swedish car market, referring to current loan rates.

3.3 BRF background

As described above, BRFs are a cooperative form of housing that is mainly present in Sweden and the other Nordic countries (Brostrand, 2007). As a factor of this, and due to its generally low-risk form, previous literature in this area is scarce. Several factors, including increasingly levered BRFs, expected interest rate increases and a stressed real estate market, has brought new attention to this area in the last year. However, the literature on the subject is limited to popular media, and more thorough research is yet to be carried out.

A bachelor thesis from 2013 published at the Royal Institute of Technology in Stockholm looks at a similar issue. The thesis investigates whether the net assets in the BRF are valued properly when an apartment is transacted. The thesis uses a small sample of 47 transactions in the area Östermalm in Stockholm. The study does not find any connection between the net assets in the BRF and the final price. However, the limited scope of the study allows for further exploration of the area (Biörck, 2013).

4. Data

In this section the data used to construct the hedonic pricing model is described. The different data sources and which data they contributed are presented. Further, data management is elaborated on and variables used are introduced. Data was provided through the collaboration with Swedish mortgage bank SBAB.

4.1 Booli

Booli is the largest site in Sweden providing data on real estate for sale and transaction prices as well as valuations of property and is a subsidiary of SBAB. As Booli collects information on different properties such as size, rooms, floor etc. their data provides a good foundation to build a hedonic pricing model (Booli). It is not possible to access Booli's database directly, but they agreed to help with the extraction of data through the collaboration with SBAB.

The Booli dataset consists of all transactions of apartments recorded by Booli since 2006[9]. This made up a total of 240,689 individual transactions where the characteristics considered by Booli to be relevant when valuing apartments where included. The dataset was cleared of observations dated earlier than September 2012 since values on many variables were missing and the number of observations each year were few for older data.

4.2 SBAB

SBAB is a Swedish bank which is fully owned by the Swedish government with the focus to provide mortgages to Swedish individuals as well as loans to BRFs and real estate companies (SBAB). In 2017 the bank had a 7,96% share of the market for lending to private mortgages ("SBAB vill ta marknadsandelar 2018: "Starkare än någonsin" 2018). When granting mortgage applications SBAB collects data regarding the financial stability of the BRF as well (Kuhl, 2018). In the model, debt per square meter will be used as a measure for the debt level of the BRF, which is something that SBAB has collected on all mortgages since 2012.

The dataset from SBAB consists of 79,213 observations recorded from mortgages provided by SBAB to individuals between 2012 to 2017. Within this dataset 12,268 BRFs were represented

[9] Booli collects its data through the scraping of real estate listings. Hence, only objects sold via real estate agencies are represented in the sample

over the 5 years. Of these, 10,244 were BRFs that were also present in the Booli dataset, allowing for matching between the two.

4.3 Data management and variables

Initially, the two datasets were matched using the BRFs' organization number as the overlapping variable. This presents an issue with regards to timing, as the data was collected at different points in time. Under the assumption that leverage for individual BRFs has not changed substantially over the time-period, the Booli data was matched with the latest available entries in the SBAB data, which hold higher quality (Kuhl, 2018). Furthermore, time-variance in the monetary market was handled through the introduction of SCB's Consumer Price Index (SCB, 2018).

In accordance with previous literature, extreme values were excluded from the analysis. As the objective is not to give a full picture of the Swedish housing market, but rather examine the impact of certain variables, this is not deemed to negatively impact the results. Hence, the highest and lowest 1% of transaction prices per square meter are dropped. This implies dropping observations of below 5,580 SEK and above 111,111 SEK per square meter.

5. Theory and Methodology

In this section, the hypothesis development and theoretical approach is described. In order to determine how consumers value different characteristics of an apartment, a hedonic pricing model is used. A regression analysis is used to test the model and then examine the impact of different characteristics on the price a buyer is willing to pay. In a first stage, the potential impact of the capitalized fee will be studied closer. Further, the model will be configured to evaluate the effect of leverage in the BRF.

5.1 Hypothesis development

When buying an apartment, different characteristics will determine the attractiveness and hence the price a buyer is willing to pay. Attractive characteristics such as a higher floor or a good location should make the apartment more expensive and vice versa. When there is debt in the BRF, the portion of debt in the BRF associated with the apartment should be considered. As this is technically a transfer of debt from the individual to the cooperation, i.e. a financing choice, the level of debt per square meter should be added to the price paid by the consumer. You could even argue that current taxation policy makes it more attractive to have private leverage than mutually in the BRF[10].

Some of the characteristics are easier for the buyer to observe than others, for example size, floor and fee are easily found in the ad. However, in order to find the leverage in the BRF the buyer has to calculate this from the financial statements which requires some financial knowledge. As there is no requirement to show this figure in the ad and realtors in Sweden primarily represent the seller[11], the incentive to present a high leverage ratio is low. However, the fee must be presented in the ad and will always be available to the buyer. These conditions have led to the following two hypotheses:

Hypothesis 1: The net present value of future fee payments is correctly priced by Swedish apartment buyers, implying that adding one SEK to the capitalized fee should decrease the apartment price by one SEK.

[10] Current Swedish taxation law includes the *ränteavdrag*, which allows individuals to deduct interest rate costs from their taxable income for debt costs up to 100,000 SEK per year

[11] The realtors should be impartial, but given that they work on commission, they have a strong incentive to favour the seller

Hypothesis 2: Leverage in the BRF is not sufficiently priced by Swedish apartment buyers, implying that adding one SEK to the BRF debt per square meter will decrease the apartment price by less than one SEK.

5.2 Hedonic pricing model

To address the research question, an adequate model to predict housing prices has to be developed using the available data. An apartment can be decomposed into characteristics which sum up to the expected price, making it comparable to a bundle of goods. The value of these characteristics cannot be individually observed; however, a hedonic pricing model can be used to estimate the impact of the characteristics on the price. The characteristics (hereafter called variables) used are described below.

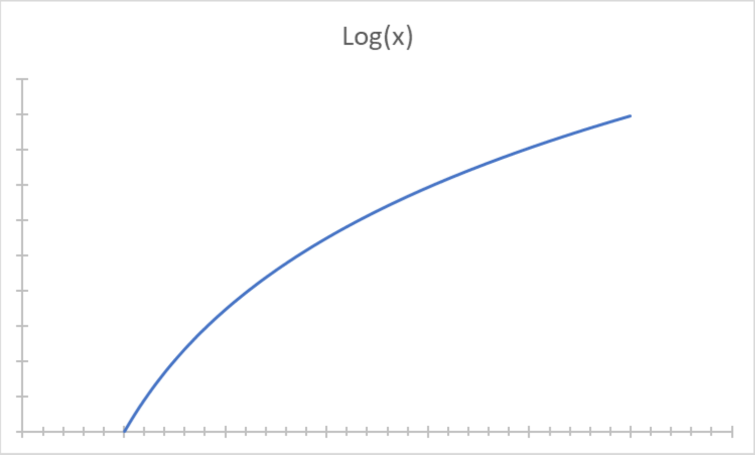
5.2.1 Variables

Price per m^2

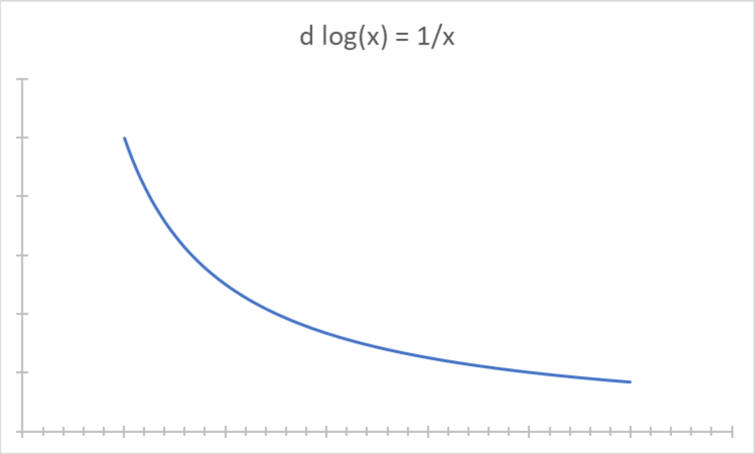
Actual transaction prices for sold apartments (nominal), used as dependent variable in the regression. The regression is run using price per square meter, in order to increase comparability between objects.

Size in m^2

In a standard hedonic pricing function, the size of the property is usually the single most important characteristic. Here, the hedonic pricing function is used to predict price per m^2 for comparability reasons. Hence, the effect of the size is not as obvious as in the case of a strict price regression. Had the price-size relationship been perfectly linear, the price/m^2 regression would not need size as a regressor. However, it can be argued that the marginal benefit of extra size declines with the size of an apartment, which can be estimated using a logarithmic function.



Furthermore, the price/m^2 quota can be seen as the incline of a price-size regression. Hence, regressing this dependent variable for size should give a relationship that approximates the derivate of the prize-size relationship. Therefore, in order to properly regress price/m^2, the size variable is transformed into the derivate:



$$dlog(size) = \frac{1}{size}$$

Practically, the variable *dlsqm* is generated in Stata as the inverse of size as per above.

Yearly fee per m^2 (indexed to 2018-03 using CPI)

The monthly fee residents pay to the BRF viewed over a year and indexed forward by a consumer price index to offset inflation over the sample period. A higher yearly fee should have a negative impact on transaction price, and if properly capitalized have a coefficient of -1 (Myers, 2017). This is discussed further below.

Number of rooms

The number of rooms in an apartment is an important characteristic of an apartment and should hence influence the transaction price. In general, smaller apartments are valued at a higher price per m^2. However, as the regression is run using price/m^2, it could be argued that the effect is the opposite, as a larger number of rooms for an apartment of the same size allows more people to live in it. Different approaches to this variable are tested, including the use of a fixed effect.

Floor

The floor location of an apartment affects living conditions, as the lower floors are associated with e.g. street noise, and the higher with view etc. However, the linearity of this relationship is again doubtful. For instance, the price impact of moving from the 1st to the 2nd floor is likely to be substantially larger than corresponding difference between the 3rd and 4th floor. Furthermore, the impact of this variable is affected substantially by the existence of features that are unobservable in the sample, such as the existence of an elevator. Hence, an alternative approach is tested, where floors are assigned fixed effects.

Construction year

The construction year of an apartment affects the price, where older apartments are dependent on the architectural period, whereas newer apartments can be assumed to hold a higher standard based on age. Hence, observations have been divided into construction decades, which are used to assign fixed effects in the model.

Geographical fixed effects

The geographical location of the apartments is a key variable affecting the price, especially when looking at data from all of Sweden where prices differ significantly. For March 2018 apartments in central Stockholm were on average more than twice as expensive per square meter than apartments in the country in general (Svensk Mäklarstatistik, 2018). Prices can also differ significantly within smaller areas as many factors on micro level also have an impact. Closeness to amenities such as public transportation, green areas and schools, nearby large roads or a nice view are all examples of characteristics that will affect the price.

To account for this in the model, the geographical parameter will be handled as a fixed effect variable. In this way, unobservable factors within each geographical area can be controlled for. If allowed by the data, fixed effects on BRF-level is preferred. This would help account for all specific and otherwise unobservable characteristics associated with a specific BRF, that are time-invariant.

However, there is a trade-off between having good geographical accuracy with small areas or larger areas with more data points. The available data includes, apart from BRF; zip code and parish. From these variables, observations can be categorized into 9,643 unique BRFs, 3,439 zip codes or 441 parishes. These different options will be tested in order to find the most suitable model for the purpose of the study.

Time fixed effect

To control for time variations in the Swedish real estate market, fixed effects for the 68 months in the sample are included in the model.

5.2.2 Theoretical framework

The hedonic pricing function has its theoretical basis in a consumer utility function, where a certain consumer *i* has a utility U_{ijat} from buying an apartment j in area a at the time *t*, which will be reflected in the price she is willing to pay, *P*, and the present value of future cash flows associated with the property, ϕ. The utility can also be seen as a function of different characteristics for the apartment, X_{ja}, and fixed effects for the location and point in time:

$$U_{ijat} = P_{jat} + \gamma\phi = \boldsymbol{X'}_{ja}\beta + \lambda_{at} + \varepsilon_{ijat}$$

The error term ε_{ijat} corresponds to unobservable home attributes, as well as individual consumer taste. γ is interpreted as the extent to which consumers value the discounted cash flows, i.e. the fee to the BRF. If subtracted from both sides of the equation, $\gamma\phi$ can be used as a regressor in the hedonic pricing function.

$$P_{jat} = \gamma\phi + \boldsymbol{X'}_{ja}\beta + \lambda_{at} + \varepsilon_{ijat}$$

Hence, if consumers fully value the fee, γ should approach -1. In relationship to Hypothesis 1; if γ is significantly less negative than -1, the hypothesis will be rejected as consumers do not price the fee fairly.

5.2.3 Fee estimator

With regards to discounting the fee, two major assumptions are required; discount rate and time horizon. The fee in itself is observable as the actual yearly fee, F, in a BRF at the point of sale[12].

[12] Constructed as the monthly fee * 12

The regressor is modelled as a NPV of future fee payments:

$$\phi_{jat} = \sum_{i=t}^{T} \delta_i * F$$

Where δ_i represents discount factor for a year *t*, based on the discount rate *r*, summed for the time horizon *T*. Using the annuity formula under the assumption that F remains constant, this sum can be calculated as:

$$\phi_{jat} = \sum_{i=t}^{T} \delta_i * F = \frac{1-(1+r)^{-T}}{r} * F$$

As discussed under previous literature, Myers uses an infinite time horizon, arguing that consumers should consider the full lifetime of the property. This assumption finds further support for this thesis, as the fee does not reflect an individual house, but the maintenance of an active organisation, which looks to continue its operations. Concerning the discount rate, previous literature has used values between 5 and 10 % (Huse & Koptyug, 2017; Myers, 2017). Due to the current macroeconomic situation with low interest rates, a real rate of 5 % is assumed for this thesis.

5.3 Regression

Initially, the multivariate regression is based on the standard OLS (Ordinary Least Squares) method. If this proves insufficient, a goodness-of-fit approach will be adopted to find an alternative, in line with previous literature on the subject.

With regards to the discussion of impact from the floor and rooms above, three different equations are tested. The base equation uses a fixed effect variable for both floor and number of rooms, where the floor variable gives a fixed effect for the bottom three floors and one for floors of four and beyond. Number of rooms are divided into one, two, three or more rooms; as four rooms is sufficient to house a full family and hence the value added by more rooms is highly variant. To test whether these transformations improve the model, these dummies are substituted for linear variables for rooms and floor in equation (2) and (3), respectively.

For the geographical fixed effect, three methods are used with regards to the trade-off discussed above. A broader equation that uses parishes is compared to more narrowly defined ones using zip codes and BRF fixed effects, where zip code is used as the base case. The risk of using parish is that the model has too poor an explanatory value, whereas the downside of more narrowly defined ones is that there may not be enough diversity between transaction in smaller fixed effect, which may soak up other effects and distort the model as a whole.

5.4 Development to examine leverage

After initial testing of the capitalized fee coefficient, the model will be further developed to test for the second hypothesis. This implies adding a variable to test for apartment buyers' attentiveness to debt level in the BRF. The test will be based on the same hedonic pricing model as previously used with the exception of a breakdown of the fee variable.

5.4.1 Construction of Leverage variable

As a measure for leverage in the BRFs debt per sqm will be used. However, a problem of multicollinearity arises as the fee to some extent is explained by the leverage in the BRF (Appendix A8). Considering the following equation explaining the fee that relationship becomes clearer. The yearly fee f per square meter can be broken down to yearly heating costs per square meter e, yearly maintenance costs per square meter m and yearly interest costs per square meter i.

$$f = e + m + i$$

In turn, the interest cost i per year will be a function of the debt level and interest rate paid by the BRF as per below where r denotes interest rate and d denotes interest-bearing BRF-debt per square meter.

$$i = r * d$$

The debt-related element needs to be eliminated from the fee in order to avoid collinear variables which in turn would lead to coefficients which are hard to interpret. Consequently, a new, debt-adjusted fee variable fc is introduced as per below.

$$fc = f - i = f - (r * d) = e + m$$

No data on interest rates for individual BRFs was available and hence a proxy needs to be used for the interest rate paid r. For this study, r is estimated to 2,55% which was found to be the average interest rate paid by BRFs in a study concluded by Allabrf, a company specialized in evaluating BRFs' financial health (ALLABRF, 2016).

5.4.2 Regression of Leverage

Again, the multivariate regression is based on the standard OLS (Ordinary Least Squares) method. The original Hedonic pricing function is used as a base, re-stated below.

$$P_{jat} = \gamma\phi + \boldsymbol{X}'_{ja}\beta + \lambda_{at} + \varepsilon_{ijat}$$

However, after adjustments an updated model explaining the price P the apartment buyer is ready to pay is developed. $\gamma\phi$ has been replaced by $\eta D + \gamma\phi_c$, where D denotes debt per sqm and ϕ_c is the sum of future expected non-debt-related cash flows.

$$P_{jat} = \eta D + \gamma\phi_c + \boldsymbol{X}'_{ja}\beta + \lambda_{at} + \varepsilon_{ijat}$$

γ can be interpreted as buyers' valuation of future expected cash flows not relating to debt. Added is also the coefficient η which can be interpreted as buyers' sensitivity to an added SEK per sqm in BRF-debt. With reservation for minor pros and cons with choosing between adding to personal debt or BRF-debt, η should approach -1 if buyers are fully valuing an additional SEK of debt in the BRF. Hence, Hypothesis 2 will be rejected if the coefficient η cannot be significantly separated from -1.

6. Results

6.1 Model Specification

In this section, the basic model to test for capitalization of fee and assessment of leverage is developed. In practice, the specification of the different regressors is variated, to examine the kind of relationship that best explains the price. As per discussion above, the use of dummy variables for number of rooms and floor is tested below. The initial model showed heteroscedasticity according to the BP test (Appendix A0)[13], which showed that the model explains the residual at the 1% significance level. Therefore, all regressions are run using clustered standard errors by the geographical fixed effect variable, which corrects for this error.

VARIABLES	(1) pricesqm	(2) pricesqm	(3) pricesqm
ϕ	-0.554***	-0.554***	-0.554***
	(0.0221)	(0.0206)	(0.0222)
1 / sqm	1.018e+06***	983,607***	1.016e+06***
	(20,279)	(17,470)	(20,302)
2.rooms(d)	2,593***		2,555***
	(181.1)		(180.4)
3.rooms(d)	4,605***		4,551***
	(261.0)		(260.7)
4.rooms(d)	5,860***		5,845***
	(330.6)		(330.6)
1.floor(d)	-1,417***	-1,394***	
	(68.87)	(67.94)	
2.floor(d)	-687.3***	-650.0***	
	(67.56)	(67.20)	
3.floor(d)	-248.1***	-220.0***	
	(73.79)	(73.13)	
4.floor(d)	1,322***	1,316***	
	(97.47)	(97.01)	
rooms		1,697***	
		(81.71)	
floor			275.2***
			(23.10)
Constant	19,721***	19,319***	19,387***
	(850.3)	(866.8)	(857.3)
Observations	143,271	143,199	143,271
R-squared	0.944	0.944	0.943
Zip code FEs	(0.000)***	(0.000)***	(0.000)***

*Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Note: The model is based on absorbed fixed effects per zip code, the joint F-test for which turned out significant at the 1% level. Full regression run as per appendix A1.*

[13] The Breusch-Pagan test predicts residuals using the regression results and plots them against the explanatory variables. As the F-test deems the relationship significant, the model can be considered heteroscedastic

Upon examination of the table above, it can be concluded that all three models give a strong (and equal) explanatory value R^2. Furthermore, the floor and rooms variables are significant in both their specifications. Preferred going forward is the fixed effects. The rationale for this is that it is rather the relative floor in a building that matters to determine the price. For the number of rooms, the same logic can be argued, as the marginal benefit of more than four rooms is highly dependent on the object and buyer. Following this reasoning and upon examination of the fixed effects, the linearity of the variables can be questioned. Hence, model (1) is used as a basis going forward.

6.2 Consumer pricing of capitalized fee

Model (1) above shows significance for the capitalized fee at the 1% level, saying that it is definitely impacting consumer valuation of the real estate in the sample. Furthermore, the coefficient of -0.554 can be interpreted as consumers, under the assumptions of this thesis, being willing to pay 0.554 SEK less per capitalized SEK in the fee.

Comparing this figure to the premise that capitalized fee and purchase price should have a relationship corresponding to an equal trade-off, this can also be interpreted as consumers valuing the fee at c.55% of its fair value. However, this conclusion is reliant on the assumptions of a 5% discount rate at an infinite time horizon, which are discussed in detail below.

6.3 Robustness

In the development of the model, some assumptions have been made regarding level of geographic precision and capitalization of the fee. If these assumptions are not in line with actual conditions, that could seriously impact the reliability of the model. The following tests aim to check the robustness and impact on the model of these assumptions.

6.3.1 Geographical precision

In the dataset it was possible to use different delimitations for geographical location of the apartments. It was decided to use geographical fixed effects to control for unobservable characteristics within each geographical area. As discussed earlier, if allowed by the data, a finer fragmentation is preferred. The model above uses geographical fixed effects on Zip code-level. Below aims to check the robustness of the results by holding the model constant but changing geographical fixed effects to parish and BRF.

VARIABLES	(1) Parish	(2) Zip Code	(3) BRF
ϕ	-0.746***	-0.554***	-0.568***
	(0.0412)	(0.0206)	(0.0845)
Constant	24,978***	19,319***	33,414***
	(1,910)	(866.8)	(4,914)
Observations	142,972	143,199	143,203
R-squared	0.919	0.944	0.934

*Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Note: Full regression model run as per appendix A1. See Appendix A2

As seen above, none of the two other fixed effects give severely different results. The BRF-fixed effects give similar values for both R^2 and the capitalized fee. Parish gives a slightly more negative value of the coefficient but with a lower R^2, suggesting that zip- and BRF-results should be more accurate. Neither gives a value for the coefficient of -1, supporting the result that Swedish apartment buyers do not fully consider the economic effect of the capitalized fee.

6.3.1 Discount rate for capitalization of fee

Choosing a discount rate for capitalization of the fee demands an estimation of the valuation of money in the future by Swedish apartment buyers. This is something that will differ between individuals due to factors such as individual preferences, borrowing constraints, etc. The Euler equation which is derived from the intertemporal budget constraint gives a theoretical background to this; where u' denotes utility, c denotes consumption, β is the preference for consumption in the future compared to today and R is the interest rate.

$$u'(c_{today}) = \beta(1+R)u'(c_{future})$$

The assumptions about β and R will determine the discount rate an individual applies to the capitalization. For the purpose of this essay, an aggregate average discount rate is assumed for the population based on current interest rate levels in Sweden and rates used in previous studies. Below is a table testing the impact of a change in the rate used on the results.

VARIABLES	(1) r=2.5%	(2) r=5%	(3) r=7.5%	(4) r=10%
ϕ	-0.277***	-0.554***	-0.830***	-1.107***
	(0.0103)	(0.0206)	(0.0309)	(0.0412)
Constant	19,319***	19,319***	19,319***	19,319***
	(866.8)	(866.8)	(866.8)	(866.8)
Observations	143,199	143,199	143,199	143,199
R-squared	0.944	0.944	0.944	0.944

*Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Note: Full regression model run as per appendix A1. See Appendix A3

As seen above, an increasing rate makes the NPV fee coefficient decrease to approach -1. This implies a possibility that rather than Swedish apartment buyers not fully pricing the capitalized fee, there may be that the estimated discount rate was too low. That would instead imply that the average Swedish home buyer has a lower preference for money in the future than estimated. Holding all other assumptions constant, a rate between 7.5 and 10 % implies a coefficient of -1. However, as the Swedish government bond rate (10yr) at this point is around 0,8% (24 apr 2018) and has been on a low level during a long time, this seems like an unlikely high preference for money today.

6.3.3 Time period used for capitalization of fee

The time period for the discounting is also a factor affecting the capitalized value of the fee. A longer time frame leads to a higher capitalized value and hence implies a less negative coefficient. In the paper by Myers, an infinite time frame is used since houses are deemed to be a very long-lived asset. The same logic was applied to apartment buildings when assuming an infinite time horizon in this paper. However, if apartment buyers are actually capitalizing the fee over a shorter time frame, this will have an impact which is tested for in the table below.

VARIABLES	(1) 25 years	(2) 50 years	(3) 75 years	(4) Infinite
ϕ	-0.786***	-0.606***	-0.568***	-0.554***

	(0.0292)	(0.0226)	(0.0211)	(0.0206)
Constant	19,319***	19,319***	19,319***	19,319***
	(866.8)	(866.8)	(866.8)	(866.8)
Observations	143,199	143,199	143,199	143,199
R-squared	0.944	0.944	0.944	0.944

*Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Note: Full regression model run as per appendix A1. See appendix A4

As seen above, a shorter time frame gives a more negative coefficient. However, the effect is smaller than when changing the discount rate and the coefficient is not significantly impacted above horizons of 50 years. This suggests that errors in assumptions relating to time frame are not deemed likely to have impacted the results significantly.

6.3.4 Sensitivity analysis

To complete the above analysis of the capitalization assumptions, a sensitivity analysis was conducted to evaluate whether the consumer inattention was found as a result of biased and poor assumptions. As can be seen below, the results show that unless these assumptions take relatively extreme proportions, the conclusion holds.

	r=2.5%	r=5%	r=7.5%	r=10%
25 years	-0.60	-0.79	-0.99	-1.22
50 years	-0.39	-0.61	-0.85	-1.12
75 years	-0.33	-0.57	-0.83	-1.11
Infinite	-0.28	-0.55	-0.83	-1.11

Note: The table shows variation in γ following changes in the discount rate and capitalized time horizon, based on the model used in appendix A1. See appendix A5.

6.4 Test for leverage in the BRF

To test for the impact of BRF debt, a new regression model is run, including the debt per square meter as a regressor. As described in the theoretical framework, this is complicated by the fact that the fee variable includes a debt component. To adjust for this, a proxy interest rate of 2.55% is used to remove debt costs from the fee, generating the fictive variable Fc. The net present value of this variable, ϕ_C, is consequently used as a regressor in combination with the debt variable, D[14].

	(1)
VARIABLES	pricesqm
ϕ_c	-0.534***
	(0.0229)
D	-0.319***
	(0.0198)
Constant	19,213***
	(864.7)
Observations	143,199
R-squared	0.944

*Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Note: Full regression model run as per appendix A1.

From these results, several conclusions can be drawn. Firstly, the coefficient for ϕ_C is approximately the same as the coefficient for ϕ. This is theoretically rational as both represent future cash flows that should be priced similarly. The slight change in coefficient is most likely a factor of the remaining autocorrelation with the additionally introduced variable, D.

As per theory, if consumers value D correctly – i.e. view it a neutral financing choice – the coefficient should be -1. The yielded coefficient of -0.319 speaks to a mispricing of the debt. Compared to the theoretical coefficient of -1; this, less negative, coefficient indicates that consumers prefer leverage in the BRF and only value this debt at 32%.

6.4.1 Interest rate sensitivity

As the interest rates for individual BRFs are not directly observable, it is of importance to examine what happens to the model if the proxy rate is varied around the base case. The model is run with three different proxy rates below, which infers two conclusions.

1. The proxy rate does not affect the NPV of fee excluding interest rate, as the interest component has been eliminated.
2. The debt variable is strongly affected by the interest rate, which indicates that a large of its impact on consumer pricing depends on the cost associated with debt.

[14] Outstanding BRF debt / total living area in BRF

VARIABLES	(1) r=2%	(2) r=2.5%	(3) r=3%
ϕ_c	-0.534***	-0.534***	-0.534***
	(0.0229)	(0.0229)	(0.0229)
D	-0.260***	-0.314***	-0.367***
	(0.0197)	(0.0197)	(0.0201)
Constant	19,213***	19,213***	19,213***
	(864.7)	(864.7)	(864.7)
Observations	143,199	143,199	143,199
R-squared	0.944	0.944	0.944

*Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Note: Full regression model run as per appendix A1.

This result is also coherent with the rationale between these two variables. The interest rate does not affect the coefficient for ϕ_C, as this variable represents cash flows that should be valued equally. However, the impact of the variable D changes substantially, since the changes in r affect how D is reflected in actual cash flows.

6.5 Limitations

6.5.1 Omitted variable bias and misspecification

When designing the hedonic pricing model, the variables included in the dataset limits which parameters are possible to include in the model. This implies that factors which have an explanatory value for pricing apartments may have been lost since data on these were not available. This issue raises a concern for omitted variable bias. This would in turn attribute the effects of these missing variables to the coefficients of the present parameters. The geographic fixed effect on zip-level level were introduced to hopefully correct for some of these unobservable factors. However, an approach with fixed effects for individual apartments would maybe have been even better to find apartment-specific unobservable factors if the data had allowed for this analysis[15].

6.5.2 Time-variance of leverage data

Another potential concern is the possible measurement error when combining apartment transaction data with BRF leverage data. As mentioned in earlier sections, the debt data and apartment transaction data were fetched from different data sources, Booli and SBAB. As these only provide snap shots of the data that had to be combined when the two datasets were merged, there is a risk that leverage data is not fully accurate as to the point of the sale. Hence, there is a measurement error of the debt per square meter which could bias the estimates in the model.

6.5.3 Using a proxy for interest rates

The analysis of leverage impact on consumer pricing relies on the proper separation of debt costs from the monthly fee, which is achieved using interest rates and debt levels. Due to data limitations, the individual interest rates are not observable. Hence, a proxy rate corresponding to the average effective rate for BRFs in 2016, 2.55%, was used (ALLABRF, 2016). If the accurate interest rate of a BRF i can be described as r_i, this simplification generates an additional error term in the fictive fee component, ε_i, equal to the difference between the actual and fictive interest rate:

$$fee_i = c_i + D_i(r_i) = c_i + D_i(0.0255 + \varepsilon_i)$$

Hence, the fictive fee component, which is used as a regressor, has an error term:

$$fee_{ic} = c_i + D_i\varepsilon_i$$

However, this only affects individual observations, and assuming that this error term is evenly distributed around the mean, it should not impact the conclusions substantially.

6.5.4 Non-cost fee components

Another issue that possibly distorts the results with regards to the fee regressor is the existence of non-cost components that affect this cash flow. Most prominently, BRFs are likely to amortize on their loans. As this will increase the fee but should not be priced in the purchase of

[15] Myers uses object specific fixed effects, which controls better for this variable. However, this requires several observations per apartment/house. The relatively short time-frame of this thesis restricts this option, and zip-code fixed effects are preferred as the alternative removes a large part of the sample

an apartment, it creates an unobservable effect that biases the model toward finding consumer inattention toward the fee. A sensitivity check with regards to this issue is performed below.

The sensitivity analysis examines how large effect different amortization rates have on the fee. As this component should not be priced negatively by the consumers, a corresponding amount of consumer inattention should be considered an accurate pricing of the fee. As the amortization levels correspond to a relatively low share of the fee, and the found consumer inattention is as high as 45 %, the conclusion holds up to this test. By scaling the found consumer inattention of 55.4% (Appendix A1) toward the cost-part of the fee (excluding amortization), the corresponding consumer pricing of the actual monthly cost can be seen in the second row of the table below. Hence, consumer inattention is prevalent even if BRFs amortize as much as 2 % of their total debt per year.

Amortization rate	**0.5%**	**1.0%**	**1.5%**	**2.0%**
% of yearly fee	2.8%	5.7%	8.5%	11.3%
Implied pricing of fee (γ)	57.0%	58.7%	60.5%	62.5%

7. Conclusion and Implications

In this section, the two hypotheses are revisited and discussed. The findings for both are compared, and a joint conclusion is drawn. Furthermore, the economic impact of the findings will be handled, and future research areas suggested.

7.1 Capitalization of fee

Hypothesis 1: The net present value of future fee payments is correctly priced by Swedish apartment buyers, implying that adding one SEK to the capitalized fee should decrease the apartment price by one SEK.

Under the assumptions of the study, it is found that while the capitalized fee has a substantial impact on consumers' willingness to pay, they do not price this component correctly, but rather value it at around 55% of its fair value. This is in line with what previous research has found regarding consumers' ability to capitalize future costs regarding home utilities (Myers, 2017) as well as fuel and tax costs for cars (Allcott & Wozny, 2012; Sallee et al., 2016). Given the similarity in these results across cost types, this mispricing is likely a consequence of consumer inattention toward future costs, and the lacking knowledge of how to value these.

This conclusion relies on two key assumptions for the capitalization of the fee, namely time horizon and discount rate. These have been heavily debated in previous research and there is no obvious choice. As the base case for this analysis, the conservative 5 % rate is used, over an infinite time horizon. To test the importance of these assumptions, a sensitivity analysis was conducted showing that unless these assumptions take extreme proportions, consumer inattention is found. Hence, a conclusion can be drawn: While apartment buyers consider the monthly fee as an important component, they do not fully comprehend its value as a series of future cash flows and the hypothesis is rejected.

7.2 Pricing of leverage

Hypothesis 2: Leverage in the BRF is not sufficiently priced by Swedish apartment buyers, implying that adding one SEK to the BRF debt per square meter will decrease the apartment price by less than one SEK.

Testing of the second hypothesis was prone to somewhat higher data limitations, as the interest rates to adjust the monthly fee for debt costs were not directly observable. Using proxy rates, however, it could be shown that while leverage has an impact on pricing of apartments, it is not valued correctly according to economic theory, nor considered to the same extent as the capitalized fee. Hence, the second hypothesis is accepted. It could be argued that an additional SEK in leverage should correspond to at least one SEK less in purchase price, as it constitutes a neutral financing choice. This theoretical effect is magnified by the current tax policy in Sweden, which allows people to deduct 1/3 of personal debt costs[16] (Skatteverket, 2018). This policy should increase the willingness to assume private debt, which speaks further to the conclusion on consumers being highly inattentive to debt levels in the BRF. This conclusion has several implications, as it speaks to a broad mispricing of apartments on the Swedish market. For instance, it gives cause to question the credit restrictions that Swedish government agencies have invoked on consumers to push borrowing down. These were introduced in June 2016 and March 2016 and require consumers to amortize at an increased pace if the private debt outsizes 50% of the apartment value or 4.5x the annual income of the household, respectively (Finansinspektionen, 2017). Seeing that the less salient debt on the BRF side of the apartment is not accurately priced, there is a prevailing risk that further consumer credit restrictions without corresponding actions on the BRF side will merely result in debt being reallocated to the BRFs.

7.3 Joint conclusions

When comparing the results from the two studies, there is an apparent difference in how consumers value components that in theory should be treated as equal. As per the hypotheses, the key difference in how consumers face these components is the salience. While the monthly fee (however not capitalized) is visible in all real estate listings, the debt component requires substantial effort and economic understanding to find out. Consumers have to open the annual statement for the BRF, sum outstanding debt and divide by number of square meters in the BRF; an exercise challenging to most people without an economic education. Salience has been proven to have substantial impact on valuation of cash flows in previous research (Huse & Koptyug, 2017). The results of this thesis advocate that consumers are generally not performing this analysis, which invokes the discussion on whether this is a reasonable requirement. Consumer decision making could likely be improved by requiring realtors to display this

[16] Up to 100,000 SEK

information in an accessible and comparable form, i.e. BRF debt per square meter.

7.4 Future literature

As this thesis must be considered an early stab into this area, there is substantial developments to further examine this issue and its consequences. The findings of this thesis rely on several assumptions and simplifications, made necessary by data and resource limitations. Hence, additional research to confirm the findings should aim to include information on the areas where this thesis falls short. The introduction of observed interest and amortization rates would strengthen the credibility of the findings. To further expand on the area, studying how the pricing of these variables are affected by exogenous variables, such as credit restrictions or changes in salience, would add understanding from a macro perspective. For instance, this subject has received a lot of attention in media over the beginning of 2018, which should increase consumer attention to this component. It will also be of high interest to follow what happens to these effects as interest rates increase, which will increase the salience of the debt component as consumers face increased actual costs.

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Appendices

Appendix A0

VARIABLES	(1) s1s
Constant	-2.885e+07***
	(4.619e+06)
Observations	143,271
R-squared	0.143
Prob > F	0.000

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix A1

VARIABLES	(1) pricesqm	(2) pricesqm	(3) pricesqm
ϕ	-0.554***	-0.554***	-0.554***
	(0.0221)	(0.0206)	(0.0222)
1 / sqm	1.018e+06***	983,607***	1.016e+06***
	(20,279)	(17,470)	(20,302)
2.rooms(d)	2,593***		2,555***
	(181.1)		(180.4)
3.rooms(d)	4,605***		4,551***
	(261.0)		(260.7)
4.rooms(d)	5,860***		5,845***
	(330.6)		(330.6)
1.floor(d)	-1,417***	-1,394***	
	(68.87)	(67.94)	
2.floor(d)	-687.3***	-650.0***	

	(67.56)	(67.20)	
3.floor(d)	-248.1***	-220.0***	
	(73.79)	(73.13)	
4.floor(d)	1,322***	1,316***	
	(97.47)	(97.01)	
1900.decade	-811.7	-858.2	-774.3
	(537.5)	(536.7)	(536.4)
1910.decade	-1,620***	-1,661***	-1,554***
	(602.2)	(604.0)	(601.0)
1920.decade	-3,225***	-3,393***	-3,186***
	(573.4)	(570.5)	(573.5)
1930.decade	-4,949***	-5,010***	-4,924***
	(572.4)	(571.9)	(570.3)
1940.decade	-6,164***	-6,084***	-6,121***
	(581.4)	(580.6)	(580.4)
1950.decade	-7,098***	-7,041***	-6,966***
	(593.1)	(593.4)	(592.0)
1960.decade	-7,505***	-7,497***	-7,351***
	(593.6)	(594.3)	(592.5)
1970.decade	-7,448***	-7,426***	-7,277***
	(611.8)	(611.5)	(610.2)
1980.decade	-7,151***	-7,108***	-6,925***
	(635.7)	(628.7)	(635.5)
1990.decade	-6,978***	-6,982***	-6,757***
	(691.4)	(692.5)	(691.4)
2000.decade	-3,657***	-3,610***	-3,401***
	(637.3)	(637.9)	(636.9)
2.month	232.4	233.7	247.7
	(356.1)	(359.0)	(364.0)
3.month	541.7	523.7	504.9
	(363.2)	(365.6)	(372.3)
4.month	461.7	463.4	471.2
	(432.6)	(437.1)	(439.6)
5.month	642.3*	645.0*	614.0*
	(361.5)	(363.9)	(369.0)

6.month	1,690***	1,680***	1,619***
	(370.5)	(372.9)	(377.9)
7.month	2,112***	2,127***	2,058***
	(358.7)	(360.0)	(366.9)
8.month	2,245***	2,233***	2,211***
	(352.6)	(354.6)	(361.4)
9.month	2,926***	2,920***	2,905***
	(354.5)	(356.1)	(362.7)
10.month	3,072***	3,088***	3,067***
	(367.0)	(369.0)	(374.8)
11.month	4,115***	4,104***	4,116***
	(393.1)	(395.0)	(401.0)
12.month	3,747***	3,740***	3,744***
	(359.3)	(359.9)	(366.1)
13.month	3,626***	3,616***	3,612***
	(347.6)	(350.0)	(355.5)
14.month	3,970***	3,982***	3,925***
	(352.8)	(352.9)	(360.8)
15.month	4,359***	4,362***	4,076***
	(342.2)	(344.3)	(350.8)
16.month	4,757***	4,742***	4,405***
	(363.1)	(363.7)	(371.2)
17.month	5,634***	5,624***	5,209***
	(346.8)	(348.1)	(354.6)
18.month	5,795***	5,797***	5,296***
	(353.0)	(354.4)	(362.0)
19.month	6,308***	6,271***	5,780***
	(351.8)	(354.0)	(361.0)
20.month	6,418***	6,417***	5,990***
	(357.3)	(358.9)	(365.5)
21.month	6,895***	6,897***	6,460***
	(344.7)	(345.3)	(352.8)
22.month	6,863***	6,853***	6,437***
	(357.1)	(358.8)	(365.0)
23.month	8,433***	8,441***	8,016***

	(374.4)	(375.5)	(381.6)
24.month	8,591***	8,585***	8,142***
	(353.8)	(354.9)	(361.7)
25.month	8,966***	8,943***	8,513***
	(354.4)	(355.0)	(361.9)
26.month	9,300***	9,318***	8,872***
	(351.5)	(352.8)	(359.0)
27.month	9,705***	9,735***	9,217***
	(357.3)	(358.3)	(365.9)
28.month	10,046***	10,048***	9,561***
	(361.7)	(363.3)	(370.2)
29.month	11,154***	11,128***	10,633***
	(372.5)	(373.5)	(379.2)
30.month	11,780***	11,764***	11,206***
	(372.9)	(374.5)	(381.0)
31.month	13,569***	13,544***	12,913***
	(373.3)	(374.2)	(383.2)
32.month	14,264***	14,265***	13,599***
	(375.2)	(376.7)	(383.8)
33.month	13,787***	13,792***	13,163***
	(369.3)	(370.7)	(379.7)
34.month	13,614***	13,607***	12,969***
	(375.1)	(376.0)	(384.2)
35.month	14,553***	14,526***	13,876***
	(399.1)	(400.2)	(409.6)
36.month	15,757***	15,729***	15,092***
	(397.8)	(399.7)	(408.1)
37.month	16,277***	16,271***	15,621***
	(400.4)	(402.6)	(410.8)
38.month	16,571***	16,561***	15,898***
	(397.3)	(398.8)	(406.9)
39.month	16,321***	16,313***	15,691***
	(389.8)	(391.4)	(399.4)
40.month	15,949***	16,006***	15,288***
	(413.7)	(412.0)	(423.2)

41.month	17,291***	17,275***	16,638***
	(394.0)	(395.4)	(404.4)
42.month	17,680***	17,665***	17,051***
	(401.0)	(402.1)	(410.5)
43.month	17,972***	17,969***	17,317***
	(398.7)	(399.8)	(409.8)
44.month	18,033***	18,031***	17,373***
	(380.4)	(382.0)	(389.9)
45.month	16,918***	16,925***	16,270***
	(378.7)	(381.1)	(388.3)
46.month	16,146***	16,133***	15,489***
	(378.8)	(380.4)	(388.9)
47.month	17,005***	16,972***	16,328***
	(398.2)	(400.0)	(407.9)
48.month	17,806***	17,812***	17,128***
	(383.3)	(383.6)	(393.1)
49.month	18,496***	18,476***	17,842***
	(396.6)	(398.0)	(405.8)
50.month	19,085***	19,075***	18,429***
	(398.6)	(400.6)	(408.6)
51.month	19,047***	19,061***	18,396***
	(389.1)	(390.6)	(398.8)
52.month	19,304***	19,305***	18,623***
	(410.6)	(413.2)	(419.6)
53.month	20,654***	20,678***	20,000***
	(403.7)	(405.4)	(412.1)
54.month	20,787***	20,811***	20,140***
	(405.6)	(405.8)	(416.1)
55.month	21,057***	21,061***	20,390***
	(405.2)	(406.7)	(414.8)
56.month	20,762***	20,770***	20,111***
	(398.2)	(400.0)	(406.4)
57.month	20,854***	20,866***	20,210***
	(399.7)	(401.1)	(409.4)
58.month	20,215***	20,223***	19,562***

	(393.5)	(394.9)	(402.6)
59.month	20,432***	20,433***	19,814***
	(410.4)	(411.7)	(419.9)
60.month	21,287***	21,265***	20,648***
	(404.2)	(406.2)	(414.1)
61.month	20,445***	20,451***	19,779***
	(388.3)	(390.4)	(398.6)
62.month	19,364***	19,346***	18,660***
	(380.7)	(382.2)	(390.4)
63.month	17,883***	17,884***	17,183***
	(372.0)	(373.7)	(381.7)
64.month	16,846***	16,840***	16,141***
	(368.9)	(370.3)	(378.3)
65.month	17,826***	17,806***	17,125***
	(371.6)	(372.8)	(380.2)
66.month	17,411***	17,411***	16,734***
	(366.3)	(367.7)	(375.5)
67.month	16,944***	16,943***	16,249***
	(365.5)	(367.2)	(374.4)
rooms		1,697***	
		(81.71)	
floor			275.2***
			(23.10)
Constant	19,721***	19,319***	19,387***
	(850.3)	(866.8)	(857.3)
Observations	143,271	143,199	143,271
R-squared	0.944	0.944	0.943

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The model is based on absorbed fixed effects per zip code, the joint F-test for which turned out significant at the 1% level.

Appendix A2

VARIABLES	(1) Parish	(2) Zip Code	(3) BRF
ϕ	-0.746***	-0.554***	-0.568***
	(0.0412)	(0.0206)	(0.0845)
Constant	24,978***	19,319***	33,414***
	(1,910)	(866.8)	(4,914)
Observations	142,972	143,199	143,203
R-squared	0.919	0.944	0.934

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Full regression model run as per appendix A1.

Appendix A3

VARIABLES	(1) r=2.5%	(2) r=5%	(3) r=7.5%	(4) r=10%
ϕ	-0.277***	-0.554***	-0.830***	-1.107***
	(0.0103)	(0.0206)	(0.0309)	(0.0412)
Constant	19,319***	19,319***	19,319***	19,319***
	(866.8)	(866.8)	(866.8)	(866.8)
Observations	143,199	143,199	143,199	143,199
R-squared	0.944	0.944	0.944	0.944

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Full regression model run as per appendix A1.

Appendix A4

VARIABLES	(1) 25 years	(2) 50 years	(3) 75 years	(4) Infinite
ϕ	-0.786***	-0.606***	-0.568***	-0.554***
	(0.0292)	(0.0226)	(0.0211)	(0.0206)
Constant	19,319***	19,319***	19,319***	19,319***
	(866.8)	(866.8)	(866.8)	(866.8)
Observations	143,199	143,199	143,199	143,199
R-squared	0.944	0.944	0.944	0.944

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Full regression model run as per appendix A1.

Appendix A5.1 (25 years)

VARIABLES	(1) r=2.5%	(2) r=5%	(3) r=7.5%	(4) r=10%
ϕ	-0.601***	-0.786***	-0.993***	-1.220***
	(0.0223)	(0.0292)	(0.0369)	(0.0454)
Constant	19,319***	19,319***	19,319***	19,319***
	(866.8)	(866.8)	(866.8)	(866.8)
Observations	143,199	143,199	143,199	143,199
R-squared	0.944	0.944	0.944	0.944

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Full regression model run as per appendix A1.

Appendix A5.2 (50 years)

	(1)	(2)	(3)	(4)
VARIABLES	r=2.5%	r=5%	r=7.5%	r=10%
ϕ	-0.390***	-0.606***	-0.853***	-1.117***
	(0.0145)	(0.0226)	(0.0317)	(0.0415)
Constant	19,319***	19,319***	19,319***	19,319***
	(866.8)	(866.8)	(866.8)	(866.8)
Observations	143,199	143,199	143,199	143,199
R-squared	0.944	0.944	0.944	0.944

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Full regression model run as per appendix A1.

Appendix A5.3 (75 years)

	(1)	(2)	(3)	(4)
VARIABLES	r=2.5%	r=5%	r=7.5%	r=10%
ϕ	-0.328***	-0.568***	-0.834***	-1.108***
	(0.0122)	(0.0211)	(0.0310)	(0.0412)
Constant	19,319***	19,319***	19,319***	19,319***
	(866.8)	(866.8)	(866.8)	(866.8)
Observations	143,199	143,199	143,199	143,199
R-squared	0.944	0.944	0.944	0.944

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Full regression model run as per appendix A1.

Appendix A5.4 (Infinite time horizon)

	(1)	(2)	(3)	(4)
VARIABLES	r=2.5%	r=5%	r=7.5%	r=10%
ϕ	-0.277***	-0.554***	-0.830***	-1.107***
	(0.0103)	(0.0206)	(0.0309)	(0.0412)
Constant	19,319***	19,319***	19,319***	19,319***
	(866.8)	(866.8)	(866.8)	(866.8)
Observations	143,199	143,199	143,199	143,199
R-squared	0.944	0.944	0.944	0.944

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix A6

	(1)
VARIABLES	pricesqm
ϕ_c	-0.534***
	(0.0229)
belsqm	-0.319***
	(0.0198)
Constant	19,213***
	(864.7)
Observations	143,199
R-squared	0.944

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Full regression model run as per appendix A1.

Appendix A7

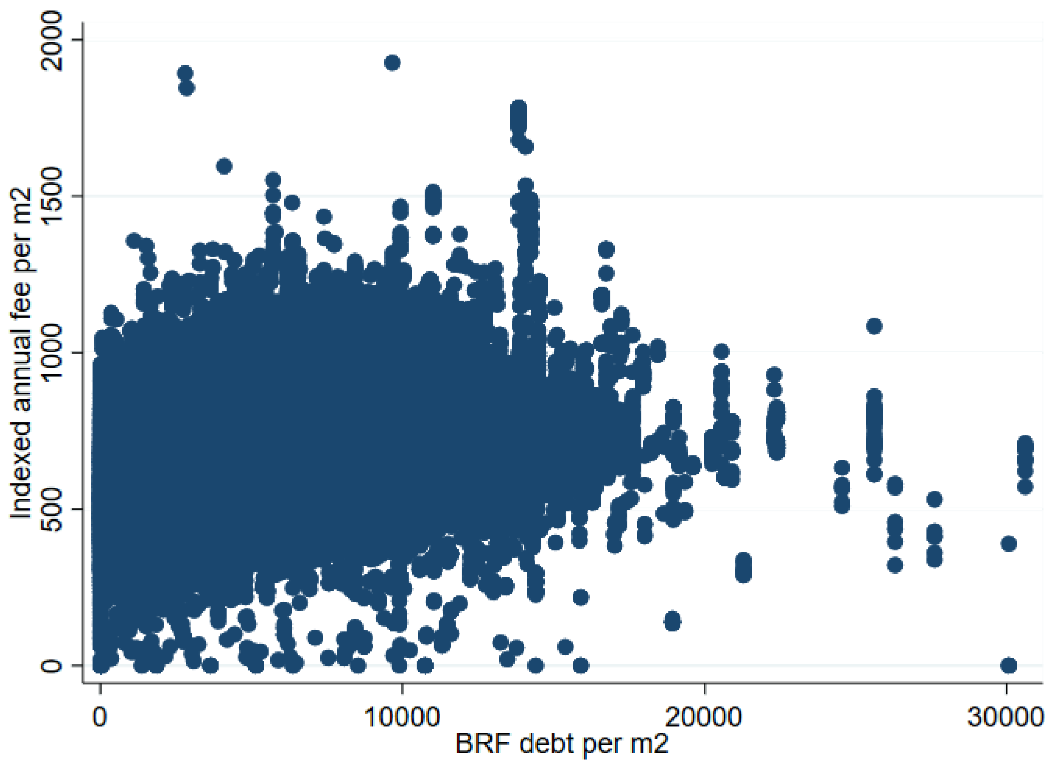
	(3)	(4)	(5)
VARIABLES	pricesqm	pricesqm	pricesqm
ϕ_c	-0.534***	-0.534***	-0.534***
	(0.0229)	(0.0229)	(0.0229)
belsqm	-0.260***	-0.314***	-0.367***
	(0.0197)	(0.0197)	(0.0201)
Constant	19,213***	19,213***	19,213***
	(864.7)	(864.7)	(864.7)
Observations	143,199	143,199	143,199
R-squared	0.944	0.944	0.944

Robust standard errors in parentheses

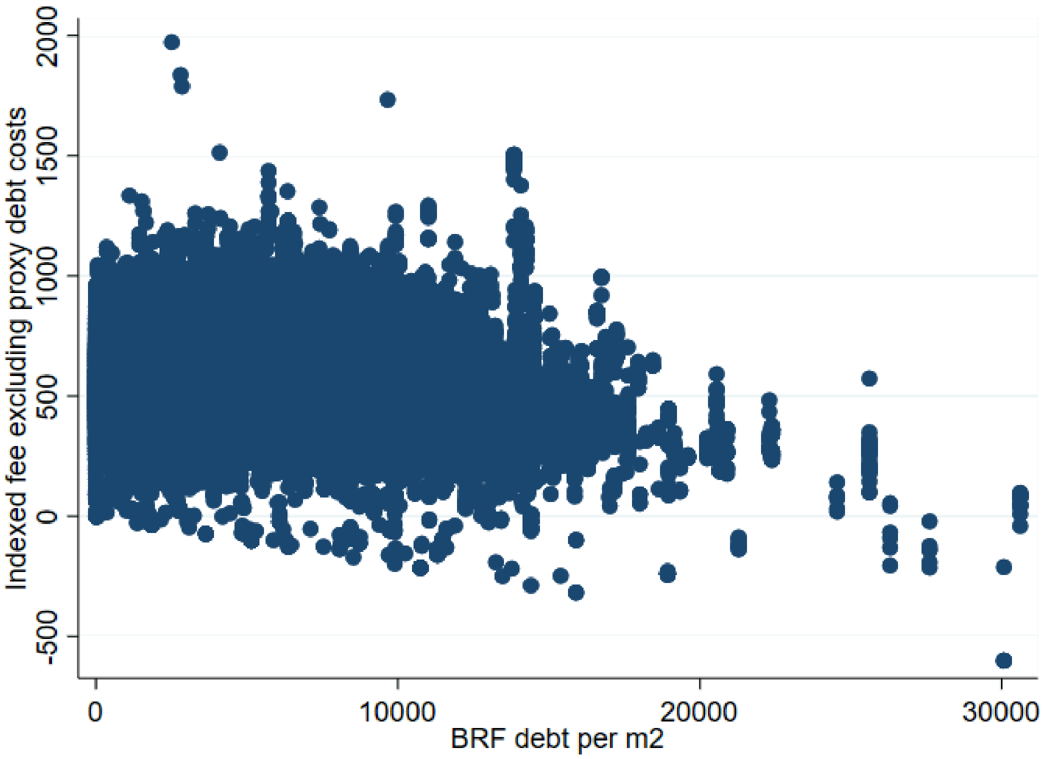
*** p<0.01, ** p<0.05, * p<0.1

Note: Full regression model run as per appendix A1.

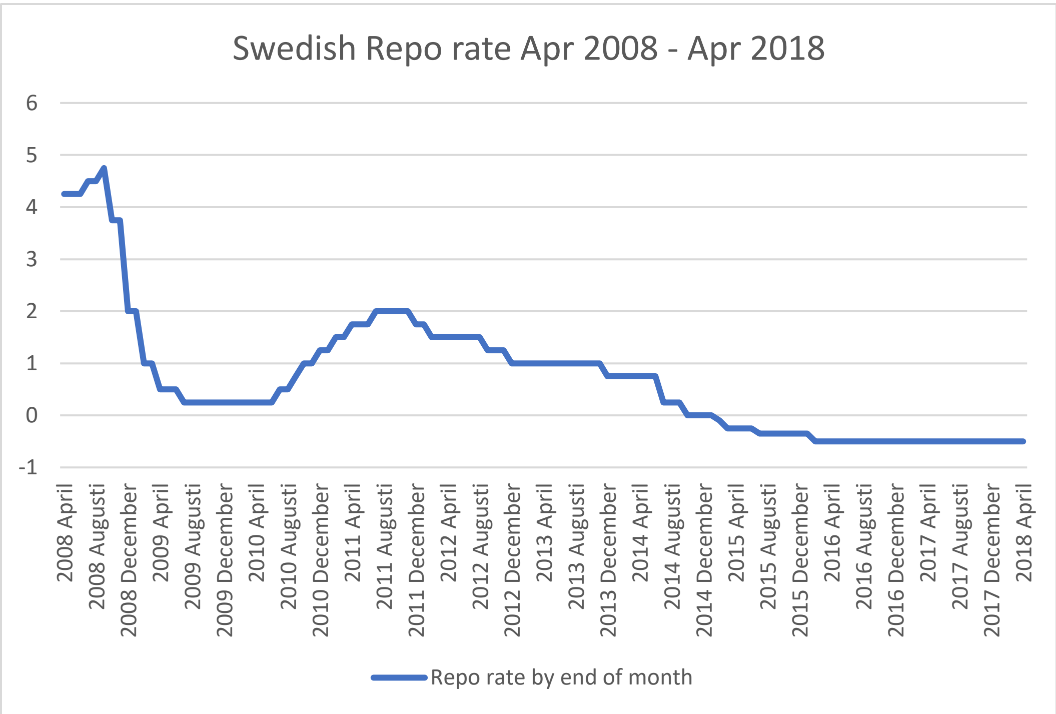
Appendix A8.1



Appendix A8.2

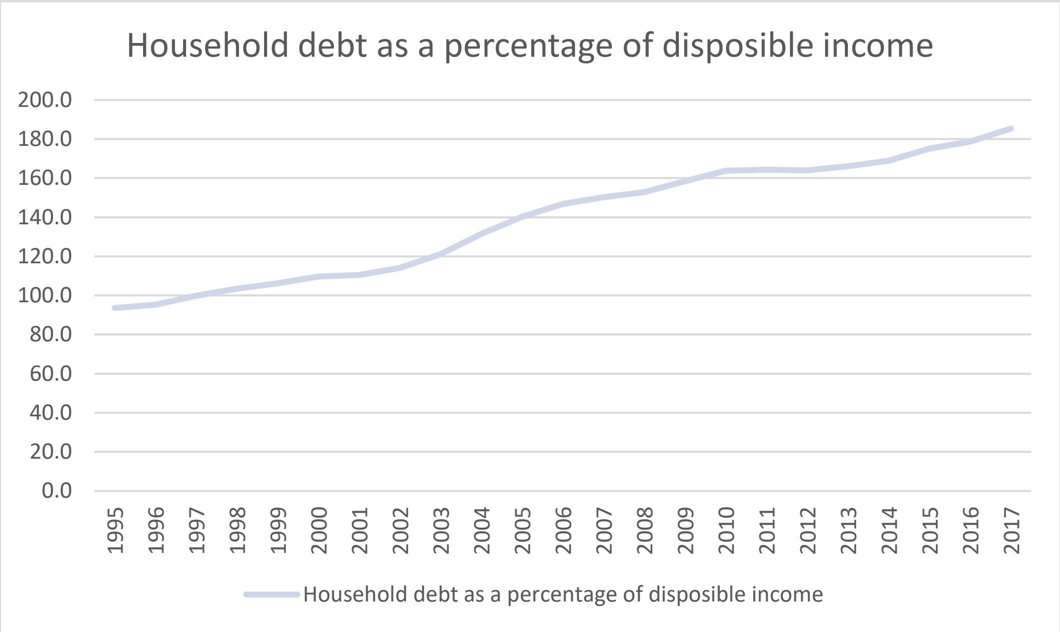


Appendix A9



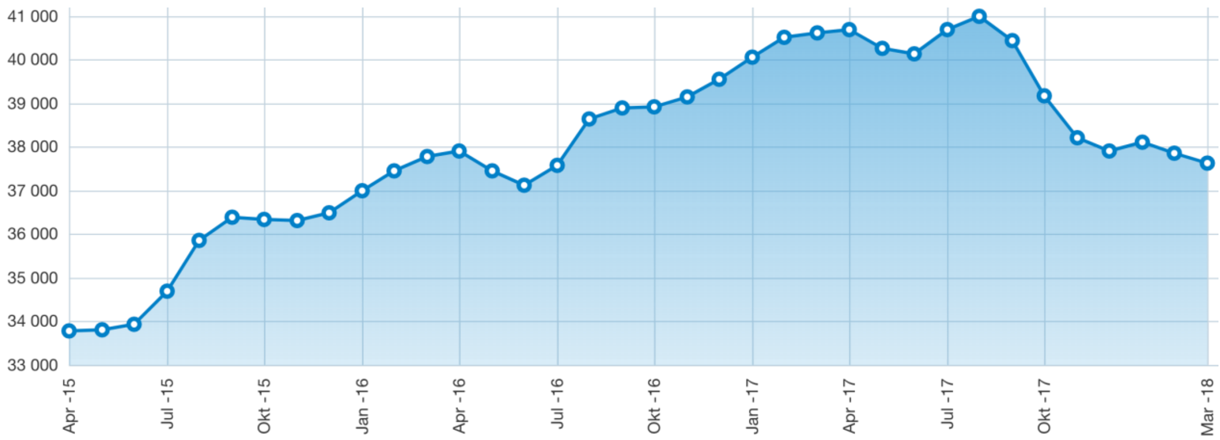
Source: Riksbanken

Appendix A10



Source: SCB

Appendix A11



Source: Svensk Mäklarstatistik