UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master degree project in Economics

# Does the price on apartments in Sweden appropriately reflect the loans of the private housing cooperative?


**Erik Gårdbro**
911206-4952


---

Graduate School
Spring term 2017
Master of Science in Economics
Supervisor: Aico Van Vuuren

**Abstract**

This thesis investigates if and how the price on apartments in Sweden reflect the loans of the private housing cooperative during the time period 2007 until 2016, mainly with a fixed effects model. The result displays that increased leverage in the private housing cooperative does not result in a corresponding decrease in price of the belonging apartment. This may be a cause of a combination of determinants, for example a complex system, lack of transparency in the annual reporting and different lending terms between households and private housing cooperatives. Hence, to increase the market efficiency, jurisdiction implementations cannot only be targeted towards buyers but also towards determinants that may reduce the asymmetric information. To really handle the problems, a thorough and extensive overview of the entire housing market is required.

**Keywords:** Price, Loan, Swedish housing market, Cooperative apartments

---

I would like to thank my supervisor Aico Van Vuuren for guidance and useful comments. I would also like to thank SBAB Bank, more specifically Mikael Wårell, Martin Bylin, Karl Rudarp and Tor Borg, for providing data, workplace and good inputs. Lastly, a big thanks to my family and Kim for your support.

# Contents

# List of Figures



# List of Tables

# 1 Introduction

After the financial crisis 2008 and the Euro crisis 2010, many European countries have experienced dropped housing prices (e.g. Spain and Ireland). In Sweden the prices have continued to increase and the debate concerning the Swedish housing market has been intense both in Sweden and abroad (Turk, 2015) since a major drop in prices have spill over effect on the rest of the economy. It may for example reduce the investments which may cause companies to shut down. In turn, this will increase the unemployment ratio which may force households to leave their home. The result from the debate so far in Sweden is new and stricter jurisdictions with purpose to cool down the market and the households' leverage, and hence reduce the risk of a major drop in the price level, which is commonly mentioned as a "bubble" in the debate.

In Sweden, one can divide the housing market into two sub-markets, one for houses and one for cooperative apartments. The third common way to live is by renting where Sweden, in contrast to most other countries, have a regulated renting market. Cooperative apartments are deeded by a private housing cooperative[1] (herein PHC) to a member, where the member owns the right to access the apartment. In general, there is a double leverage effect, where the member has debts (mortgage) and the PHC have debts. When someone becomes a member of a PHC he or she inherits debts from the PHC, meaning that the member is affected by the economic situation in the PHC. The fraction of cooperative apartments is increasing each year (SOU 2017:31) meaning that a large and increasing share of the population is affected by the market structure of PHC's.

The Swedish setup with cooperative apartments is unique and complicated. An important requirement for a market to be efficient is that the participants understand the institutions in the market. A complicated and complex system is likely to prevent the information level to be strong, which harms the efficiency in the market. According to Fama (1970), markets are efficient when prices fully reflect all available information. Since the member is highly affected by the debt of the PHC, the structure and setup requires a high degree of knowledge from all parties involved to understand the economically connections between the member of the PHC and the PHC per se. A report (Stärkt konsumentskydd på bostadsrättsmarknaden, SOU 2017:31)[2] has been ordered by and recently submitted to the Swedish government with purpose to strengthening the consumers (mainly in terms of buyers but also owners and sellers) position in the Swedish market for cooperative apartments. For example, PHC's can use different booking policies, which complicates the ability for a potential buyers to compare PHC's that uses different methods. According to the authors, the economic transparency within the PHC's is not good enough and the market has inefficient characteristics in many aspects (SOU 2017:31).

For example, if one intends to buy a car and is willing to pay 100.000 SEK for the car finds out that the car is a collateral for a debt on the same amount, the buyers willingness to pay will fall to zero. This means that there is likely to be a high or perfect correlation between increased

[1] See definition in the Appendix

[2] Further referred to as (SOU 2017:31)

debt in the PHC and the price of the belonging apartment. I.e. if the market would be efficient, one could expect that if the PCH increase the *loan per square meter* with one SEK, the *price per square meter* for a belonging apartment should decrease with the same amount sine the buyer inherit a share of the PHC's debt.

Despite the fact that so many people are affected by the market structure, earlier research in the field is very limited. One explanation to this may be the unique setup in Sweden. One paper written by Persson & Rosendahl (2012) looks at price determinants for apartments in Sweden. The authors use total debt for the PHC instead of *loan per square meter* as independent variable. However, it is the ratio *loan per square meter* (or another equivalent key performance indicator such as the total loan in relation to the market value) that is of interest, otherwise one cannot compare PHC's with different size. Thus, by using *loan per square meter* instead of total debt, this thesis will hopefully contribute to their research with a more appropriate result. Moreover, in the report (SOU 2017:31) the investigators states that the Swedish market for co-operative apartments is inefficient and that the consumers' position must be strengthened since the buyers' has a weaker position towards the buyer due to asymmetric information. Therefore, this thesis will contribute to their report by empirically testing the market efficiency.

The purpose and intention with this thesis is to analyze the efficiency in the market in terms if prices on apartments in Sweden appropriately reflect the loans of the PHC's. To do this, I will empirically test how a one SEK increased *loan per square* in the PHC affects the *price per square meter* of the belonging apartment.

A fixed effect transformation will mainly be used in the analysis due to its benefits of few assumptions and its permission for correlation between the regressors and the error terms, which is expected due to heterogeneity. By analyzing $object_i$ (a specific apartment) in different time periods, where the PHC have different *loan per square meter* and keeping other variables fixed it is possible to isolate and determine how the *price per square meter* adjusts to an increased *loan per square meter* in the PHC, where theory will suggest a one to one response or even a partial derivative that exceeds one (in absolute value).

The analysis is based on a data set provided by the Swedish government bank (SBAB), containing 87,618 micro observations from households and PHC's among SBAB's customers between September 2007 until December 2016. Due to omitted variables in the initial data set, a subset of 766 observations (122 PHC's) containing additional independent variables i.a. macro variables and the PHC's debt and interest rates in each period of time will be used in the analysis. The data set contains information of the buyer of $object_i$ in time t, such as *gross income* and the buyers *total debts*. Moreover, it contains information of each specific object e.g. the number of *rooms*. Finally, it comprises information regarding the PHC the object belongs to, such as *total debt* and *interest rate* in time t. The debt of the PHC is set in relation to the number of square meter in the PHC to get a more efficient result. The macro variables included in the analysis are conducted from the Central Bureau of Statistics and the Swedish Central Bank.

The thesis will continue in the following order. Section 2 provides literature review followed by theory and theoretical models in section 3. In section 4, all data is described and in section 5 the methods are explained. Section 6 contains the results and section 7 the analysis. Lastly, section 8 displays the discussion and conclusions. All figures and the majority of the tables are attached in the Appendix together with a definition of a private housing cooperative.

# 2 Literature review

The Literature review will begin with describing results from previous research regarding PHC's. Secondly I will provide research regarding the housing market, more specifically how micro and macro variables may affect prices. Third, research concerning behavioral aspects will be described followed by a summation of the report ordered by and submitted to the Swedish government.

## 2.1 Modigliani & Miller theorem

According to Modigliani & Miller's theorem (1958 & 1963) concerning capital structure, a profit maximizing firm should build their capital structure in such a way to minimize taxes, which basically means that since interest rates are deductible, it is beneficial to increase debts and hence reduce equity. In 2011 the aggregated debt level among all Swedish PHC's was approximately 329 billion and the mean interest rate was 3,94%. Since 2007, interest rates are no longer deductible for PHC's whereas they still are for households (Skatteverket, 2007). Due to this fact and assuming that PHC's and households are offered the same lending terms, it implies that if debt would have been shifted from the PHC's to its members, it would have cost the government 324 million per month and the PHC's members would have saved the same amount in terms of lower costs for interest payments (Persson & Rosendahl 2012). The authors use a Log-log regression model, with purpose to determine whether or not the PHC's capital structure affects the price of cooperative apartments. They conclude that the number of *rooms*, *monthly fee*, location within Stockholm and the *size* of the apartment is the main determinants of the price of $object_i$. Yet, they find no significant effect from the PHC's debt level.

Hansson & Karlsson (2013) addresses the question regarding capital structure in PHC's with a qualitative study, by interviewing bankers, realtors and PHC's who completed the process of a capital injection from the members. They conclude that in theory there are rational economic reasons to do this if households and the PHC are offered the same lending terms, but in reality there may be obstacles due to e.g. limited possibilities for the members to increase their mortgages. It may also be hard to inform all members about the benefits due to limited financial knowledge among the members. Anyhow, there is also a possibility with diversified capital injections, meaning that the members who have the ability to increase their mortgage or chose to finance the capital injection with others assets, may reduce their *monthly fee*, whereas the members who chose not to attend in the process keep the same *monthly fee* as before. This means that two similar objects in the same PHC can have different fee and thus different *fee per square meter*. Hence, the market value for these object should be different.

The papers from Hansson & Karlsson (2013) and Persson & Rosendahl (2012) are unpublished theses and thus not peer reviewed. However, since the field (market efficiency for cooperative apartments) is a very current issue in Sweden and previous research in the field is limited due to the unique setup in Sweden with cooperative apartments, their contribution is worth to include to have some previous result to compare with.

## 2.2 Housing market

### 2.2.1 Micro variables

Mikhed & Zemčik (2009a) investigates if fundamental factors (such as *buildning costs*, *personal income* and *mortgage rate*) can explain the rapid drop in the U.S. housing prices during 2006. In others words, if prices deviate from its fundamental value and hence converge to adjust for the potential gap. By comparing trends in fundamental factors from 1978 until 2006 with the house price index they conclude that prices deviated from its fundamental value two times during the period of interest, which resulted in major drops. They also predicted a new bubble after 2006, which in hindsight was correct. In another paper, the same authors investigates if house prices reflect the *house related earnings* by comparing the *house prices* and *rents*. They find the same result, major drops in housing prices occurs when prices are higher than its fundamental value, and hence converge towards its fundamental value (Mikhed & Zemčik (2009b).

### 2.2.2 Macro variables

During the period 1970 - 2006, the economic activity in terms of money and credit growth was strong for industrialized countries in combination with major increase in house prices. Due to this, Goodhart & Hofmann (2008) analyze the link between macro variables and the housing market, with purpose to determine which way the causality runs. The variables they include in their models are *money*, *credit*, *house prices* and *economic activity*. Theory says that an increased money supply will cause increased spending and hence higher house prices. At the same time, a permanent increase in house prices will cause home owners to increase their lending with the house as collateral, according to Freidman's (1957) permanent income hypothesis. He argues that consumption is somewhat constant over one's life cycle (consumption smoothing) and not based on the current income stream which is argued by the Keynesian view (Keynes, 1935). I.e. an increase of the value of the initial asset (the house) implies an increased consumption. Goodhart & Hofmann (2008) explore the link between credits and a liberalization of the financial market, where an exogenous change in credit supply will decrease the interest rates and hence affect the discounted value of the property when analogously treating a house or property as any other financial asset. Their analysis is based on a fixed effects model with a panel containing 17 industrialized countries between the period of 1973 and 2006. To test the causal effect, they perform a Granger causality test, and concludes that monetary variables such as the *interest rate* have significant effect on house prices. They also find that house prices affects credit and money growth significantly, which is in line with Friedmans (1957) work regarding the permanent income hypothesis. According Goodhart & Hofmann's (2008) results, they argue that the relationship between house prices and macro (monetary) variables are multi-directional. The link between these variables are stronger from 1985, which is likely due to more liberalized financial markets.

### 2.2.3 Behavioral aspects

One important determinant of the price is the expectation on future prices. If there is a housing bull market, i.e. a positive trend, people are likely to buy a house as an investment and the perceived risk associated with owning a house is lower than in a down trend market. Moreover, first time buyers' worries that they may not afford to buy in the future (time, t+n), instead they decides to buy now (time, t) (Case & Shiller, 2003). Capozza et al. (2002) argues that the information cost in the housing market is high due to a low turnover frequency (compared with e.g. financial assets) and the products are heterogeneous. Hence, the information may be limited and based on historical sales in time periods far back or locations that does not respond to the object of interest. Moreover, they claim that in markets with higher turnover frequency (bigger cities), prices are more likely to adjust and revert to its mean. Case & Shiller (1990) discuss housing market with a similar angle of incidence, where the authors conclude that during the time 1970 until 1987 excessive returns occurred in the housing market in the cities of interest. This implies that one year with increasing prices was followed up by another year of increasing prices, and that some variables such as *real income* and *construction costs* had a significant predictive power on future prices.

#### 2.2.4 Consumer protection (SOU 2017:31)

A recent report (SOU 2017:31) ordered by and submitted to the the Swedish government with purpose to strengthening the consumers[3] position in the market highlights the problem with lack of transparency and inconsistency in the annual reporting among PHC's. There is a problem, especially among newly produced building, with contractors that keeps the booked depreciation too low (i.e. too long depreciation time) in order to keep the *monthly fee* as low as possible, to be able to increase the price of the apartments. Without going into business administration to deep, a deprecation is the decrease in value of a property and its components, which is booked as a cost in the annual report. The cost does not lead to any cash flow but is a pure accounting act which results in a lower result. Since it is defined as a cost, it should be financed by the *monthly fee*. Thus, if the *monthly fee* does not reflect the true cost for depreciation, the PHC must increase the fee or their debts in order to finance costs for repair and maintenance. Today, there are different types of booking principles PHC's can apply, namely the K2- or K3-regulations (Bokföringsnämnden, 2007). The method that is suggested to be mandatory is component depreciation (K3-regulation), where each component has its own depreciation time. The second method implies that all components are summed together which means less transparency than the former. The third approach is progressive depreciation, which was common between 1990 and 2014, where the depreciation increase progressively over time. Yet, this method is not allowed anymore. Hence, by not having any strict rules, the possibility to compare different PHC's economic situation requires a lot of knowledge from the potential buyer. Lack of transparency and no consensus or jurisdiction in which accounting policy PHC's must apply implies market inefficiency according to the report (SOU 2017:31). The report states that the correlation between the PHC's economic situation and the prices of the apartments is low. Furthermore, the assigned investigators suggests that it should be mandatory for PHC's to include a cash flow analysis and provide some compulsory key performance indicators in the annual report such as the *loan per square meter* and *fee per square meter* in order to increase the market efficiency and strengthening the buyers position in the market. The report also suggest regulations that are in favor for the board of the PHC. For example, if one member renovates his or hers apartment

[3]The term "consumer" refers mainly to buyers in the report, yet some suggestions are also targeted to strengthening existing owners, sellers and in some cases the board of the PHC's position

in a way that is harmful for the building, the board must be able to prove that the renovations has damaged the building. In the report, the authors suggest that members must get approval before starting the renovation, in order to reduce the risk of harmful renovations.

# 3 Theory and Theoretical Models

The Theory section will begin with theories regarding how the (asymmetric) tax system in Sweden will advocate that potential buyers willingness to pay will increase if debt is shifted from the PHC towards the members. Secondly I will provide theories regarding market efficiency and how behavioral aspects may be important determinants.

## 3.1 The asymmetric tax system

Since 2007, interest rates are no longer deductible for PHC's, whereas they still are for individuals (Skatteverket, 2007) meaning that the tax system is asymmetric. I.e. every household are allowed to make interest deductions from their gross income in their yearly declaration which implies that the taxable income is reduced and the tax bill is decreased. There is (in theory) possible to cut costs by shifting debts from the PHC to its members through a capital injection since households have the ability to deduct the cost of interest payments. However, this requires that the interest rate for the individuals, after deductions, is lower than the PHC's interest rates before deductions. Even though the part of the theorem regarding that individuals and corporations are offered the same terms is violated since both cannot make deductions, the part regarding capital structure is still of interest.

As an example, we assume that:

1. The tax level (T) is 30 %
2. The household's gross income in time t: ${Y_{it}}^{\mathrm{h}}$
3. The household's total loan in time t: ${Loan_{it}}^{\mathrm{h}}$
4. The PHC total Loan in time t: ${Loan_{it}}^{\mathrm{PHC}}$
5. The household's interest rate in time t: ${r_{it}}^{\mathrm{h}}$
6. The PHC interest rate in time t: ${r_{it}}^{\mathrm{PHC}}$

$$({Loan_{it}}^{\mathrm{PHC}} \times {r_{it}}^{\mathrm{PHC}}) > \sum({Loan_{it}}^{\mathrm{h}} \times {r_{it}}^{\mathrm{h}} \times (1 - 0.3)) \quad (1)$$

Where ${Y_{it}}^{\mathrm{h}} > ({Loan_{it}}^{\mathrm{h}} \times {r_{it}}^{\mathrm{h}} \times (1 - 0.3))$ since the deductions cannot exceed the income.

I.e. it is beneficial to shift the debt from the PHC towards the members in the PHC and thereof reduce the total cost, if the aggregated mortgage cost for the members at time t (right hand side of equation 1), after deduction is lower than the mortgage cost for the $PHC_i$ at time t (left hand side of equation 1). In practice it implies that each member increases their mortgage at the bank and transfer the money to the PHC who reduces their loan by the same amount.

## 3.2 Willingness to pay

To better understand the setup with cooperative apartment one can make an analogy between a PHC and a government. The national debt is defined as the accumulated budget deficits, on which the government must pay interest rate to its lenders. When the debt level is increasing, so does the cost. To finance the debt, the government must raise taxes, issue bonds, print money (not very likely) or reduce their expenditures (Olsson, 2012). Analogously, a PHC can finance their debt either by reducing their costs, increase the *monthly fee* for its members or ask the members for more capital (a so called capital injection). Either way, this affects the members financially. Thus, when a buyer of a cooperative apartment compares two objects that have the same standard but one PHC have a higher *loan per square meter*, the price is expected to be lower for that object. I.e. a higher *loan per square meter* of the PHC is expected to result in a lower *price per square meter* on the cooperative apartment (ceteris paribus).

As an example, we assume two PHC's, each having one similar cooperative apartment for sale on the market and the potential buyer is indifferent between the objects. Since the potential buyers is indifferent his or hers WTP for such an apartment without any loans would be identical for both apartments, say 50,000 SEK. We further assume that the *loan per square meter* is 10.000 SEK per square meter in $PHC_1$ and 20,000 SEK per square meter in $PHC_2$. Since a new member inherits the debts from the PHC when becoming a member, the buyer is now willing to pay 40,000 SEK (50,000 - 10,000) per square meter for the apartment in $PHC_1$ but only 30,000 SEK per square meter for the apartment in $PHC_2$. According to this example, one can expect that there is a one to one relationship between the WTP and the inherited debt, i.e. if the PHC increase their *loan per square meter* with one SEK, the corresponding decrease in *price per square meter* is expected to be one SEK according to:

$$\frac{\partial(\text{object})\text{Price per square meter}_{it}}{\partial(\text{PHC})\text{Loan per square meter}_{it}} = -1 \tag{2}$$

### 3.2.1 WTP, no deduction differences

To be able to theoretically determine how the price of apartments reflect the loan of the PHC, one needs to calculate the theoretical price response to increased debt. This is done in two steps, where I in the first step assume no deductions differences between households' and PHC's and that a potential buyers willingness to pay per square meter of an apartment without any loans of the PHC is defined as $WTP_\infty$. Moreover, we assume that the potential buyer is willing to pay a certain price per square meter per month ($WTP_M$) that depends on the underlying determinants of the apartments value, such as neighborhood. Lastly we assume that the PHC and households' are offered the same lending terms from the bank, i.e. $r = r^{\text{h}}$.

$$WTP_M = WTP_\infty \times r \tag{3}$$

$$WTP_\infty = \frac{WTP_M}{r} \tag{4}$$

Assuming the the *price per square meter* (P) = $WTP_\infty$ and subtractin the *loan per square meter* (L) on both sides, we en up with:

$$P = WTP_\infty - L = \frac{WTP_M}{r} - L \tag{5}$$

By calculating the partial derivative with respect to L, one can see that in theory there is a one to one (absolute values) relationship between increased *oan per square meter* and *price per square meter*:

$$\frac{\partial(\text{object})\text{Price per square meter}}{\partial(\text{PHC})\text{Loan per square meter}} = -1 \tag{6}$$

I.e. if the PHC increase their *loan per square meter* with one unit, the *price per square meter* of the belonging apartment is expected to decrease with one unit.

### 3.2.2 WTP, with deduction differences

When we include the fact that households' can make deductions with 30 percent whereas PHC's cannot, the situation is different. We still assume that $r = r^{\mathrm{h}}$. In this case, we introduce $\theta$ which is the weight of the members total *loan per square meter* that is inherited from the PHC. Hence, (1-$\theta$) displays the weight of the total *loan per square meter* that is member specific. Algebraically it can be visualized as:

$$WTP_M = WTP_\infty \times \theta \times r + WTP_\infty \times (1-\theta) \times r \times 0,7 \tag{7}$$

where $\theta \times WTP_\infty$ = L (*loan per square meter*) $\rightarrow \theta = \frac{L}{WTP_\infty}$.

This implies that the buyers infinite WTP (i.e. the *price per square meter*) is a function of the weight of the loan that is inherited from the PHC ($\theta$), the interest rate (r) and the willingness to pay each month ($WTP_M$), which is determined by the independent variables. Since $\theta = \frac{L}{WTP_\infty}$ one can substitute $\frac{L}{WTP_\infty}$ into equation 7 and receive:

$$WTP_M = L \times r + (WTP_\infty - L) \times r \times 0,7 \tag{8}$$

$$WTP_\infty = \frac{WTP_M}{0,7r} - \frac{3}{7}L \tag{9}$$

When subtracting the PHC's *loan per square meter* (L) on both sides of equation 9 and rearrange, the theoretical relationship between the PHC's *loan per square meter* and the *price per square meter* for the belonging apartment looks like:

$$P = WTP_\infty = \frac{WTP_M}{0,7r} - (\frac{3}{7} + 1)L \tag{10}$$

By calculating the partial derivative of equation 10 with respect to L, one can see in equation 11 that the asymmetric tax system implies that if the PHC increase their *loan per square meter* with one unit, the *price per square meter* of the belonging apartment is expect to decrease with more than one unit (1.43). Observe that the assumption $r = r^{\mathrm{h}}$ remains.

$$\frac{\partial\text{(object)Price per square meter}}{\partial\text{(PHC)Loan per square meter}} = -1.43 \tag{11}$$

## 3.3 Efficient market

To be able to measure the efficiency it is important to understand the definition of an efficient market. In the financial market, according to the efficient market hypothesis (Fama, 1970), markets are efficient when prices fully reflect all available information. Furthermore, there are three degrees of efficiency. The first is the *weak form* in which prices reflect information based on historical prices. Translated into the housing market, this would imply all historical prices. The second degree, is the *semi-strong form* where the information level is increased to publicly announced information. In the housing market, this type of information could perhaps be politically decisions, such as future jurisdiction concerning amortization or how much one can lend in relation to one's yearly gross income. The last information degree is the *strong-form*, where inside information is included. Hence, prices reflect historical prices, publicly announced information and information that is not available for everyone. In the housing market, this could be information concerning e.g. a new station for the public transport system that could be beneficial in a commuting aspect, and hence increase the prices for houses in a certain area. If this information is not publicly announced and someone who participates in the decision making regarding the station buys a house based on this, one could argue that the information is in strong form (Fama, 1970). Moreover, a seller of an apartment has inside information whereas a buyer does not. Malpezzi (1999) increase the discussion how the efficient market hypothesis can be applied into the housing market, concerning e.g. forecast possibilities and the difference between the housing market and the financial market. The major differences are that the cost for information is higher and the transaction costs are higher in the housing market according to the author. Moreover, the housing market is less liquid and each household consume only one unit which are two determinants that reduce the market efficiency in the housing market.

To sum up, according to an asymmetric tax system where households can make deductions whereas PHC's cannot, one can expect that a one unit increased *loan per square meter* will affects the *price per square meter* of the belonging apartment to decrease with more than one unit. If this is not the case, the theoretical explanation is that PHC's may have other lending terms, and perhaps be able to lend with a $\geq$30 percent lower interest rate than households. The more complex explanation may be an efficient market with low transparency.

# 4 Data

## 4.1 Micro data

The data set is provided by SBAB bank, and contains 87,618 micro observations from household's apartment purchases among SBAB's costumers between September 2007 until December 2016. To start, it contains information concerning the household's situation, including the variables *yearly gross income*, *number of people in the household*, and *aggregated debt* for the household in purchasing moment. Moreover, it contains details of each cooperative apartment ($object_i$), more specifically the *price at the transaction moment*, *number of rooms*, *monthly fee*, *number of square meters* in $object_i$ and which PHC the apartment belongs to. To be able to compare an apartment with e.g. two bed rooms with one with three, the *price* is divided with its number of square meters. Finally it contains information concerning the PHC the apartment belongs to, more precise the *total number of square meters* in the building, *total debt* for the PHC and the *age of the building*. The debt of the PHC is also divided with the total number of square meters in the building, to receive *loan per square meters* for each PHC. Otherwise the comparison between a PHC with 10 apartments and one with 100 is not fair and sufficient. Table 5 in the Appendix displays that the number of *borrowers* and *income* have a high positive correlation (0.74), which is not surprisingly since a household with two persons are expected to have a higher gross income than a single household. Due to multicollinearity issues (i.e. one explanatory variable can be linearly predicted by another), this may bias the result and since number of *borrowers* is a discrete variable the interpretation is more complex, it is omitted in the regressions. The same argument holds for the number of *rooms* and the number of *square meters* in $object_i$ where the correlation is 0.84 (Appendix, Table 5). However, these variables are more interesting for the analysis since both these variables are likely to affect the purchase decision in contrast to the number of *borrowers*. Therefore, both these are included even though the multicollinearity issue may bias the result. One variable that is likely to be an important determinant for prices are the *monthly fee*. However, the *monthly fee* are suppose to cover i.a. interest costs for the PHC, meaning that the loan and *monthly fee* are correlated, which is why the variable per se is not included in the regression.

The variable *age of the building* is divided into decade dummies, with exception for the period 1900 until 1920 that is one period and the period before 1900 that is one period. The regions are divided into four groups namely *Stockholm*, *Gothenburg*, *Malmö* and the *other cities*. A subset of 766 number of observations (122 PHC's) will be used since important information from the PHC's annual report (debt and interest rate at each time period) was not included in the initial data set. To solve this, I manually collected the annual report for each PHC in each year the PHC had an observed turnover of an apartment. The criteria to be included was at least three years of observed turnover of $object_i$, where the maximum number of observation could be up to 10 (i.e. between 2007 until 2016). To increase the reliability in the comparison, the aim was to only include apartments with two bedrooms. It is likely that the *price per square meter* is higher in apartments with one bedroom than in apartments with six bedrooms due to expected diminishing marginal utility of bedrooms. If there were no turnover of a two bedroom apartment in one year I used a three bedroom apartment and as third choice a one bedroom apartment. As depicted in Table 4 (Appendix) the extreme value is six bedrooms, yet the mean value is 2.2. Moreover, the observations with mean *price per square meter* for each PHC in each year was included to avoid bias from potential outliers. The data set is considered as unbalanced since there are not observations of $object_i$ in every period of time between 2007 and 2016.

As mentioned, one can expect that objects with more *rooms* and more *square meter* to have a lower *square meter* since the basic facilities, such as kitchen and bathroom, are the same in an object with 1 room as in one with 4 rooms. Hence, the marginal utility of one more bedroom or one more square meter is likely to be diminishing. Moreover households with higher *income* is likely to be associated with objects with higher *price per square meter* since these households are expected to buy more "high end" apartments. A variable whose effect is harder to predict is *building year*, where the effect may be u-shaped where really old and newly produced buildings is expected to have positive effects on prices. When buildings were built during the beginning of the 19th century, more land was available, meaning that these buildings may have a more centralized location in general which may be part of the explanation to the expected positive effect. Moreover, buildings that are built today are likely to meet market demand and hence adjust for time trends e.g. open spaces and large windows. Thus, buildings built during mid-19th century may therefore not have the best locations nor adjusted for today's standard and demand. Prices in the major cities are likely to be higher with the ranking Stockholm, Gothenburg, Malmö and lastly other cities.

## 4.2 Macro data

The second part of the data contains macro variables which may affect prices. The variables that is included are *GDP growth*, *inflation*, *repo rate*, *unemployment rate*, *construction cost index* at time t. The macro data are collected from the Central bureau of statistics in Sweden except for *repo rate* which is collected from the Swedish central bank. *Unemployment* is herein defined as the share of the population between 15 and 74 years that are able to work and actively are applying for job (SCB, 2017). *Construction cost index* is measured as the average cost per square meter when producing an apartment. The data did not contain information concerning the *construction cost index* for 2016, hence the average increase during the time period 2007-2015 was assumed for 2016. The *repo rate* is determined by the board of the central bank six times in per year (Sveriges Riksbank, 2017), but since all other macro variables are yearly, the *repo rate* is also set as the average for each year. Even though this is a minor simplification, it is not likely to impair or bias the result.

The macro variables that are expected to have a positive effect or correlation with house prices are *GDP growth* and *inflation*, since an increase in these variables are likely to indicate a positive trend in the business cycle. The effect from the *repo rate*, which is the key interest rate and the most important tool for the central bank, is more ambiguous. The most likely hypothesis is that a low *repo rate* implies that the loan costs less money, hence it is relatively more beneficial to own a house/apartment compared with renting. Therefore a reduced *repo rate* will increase demand for money and thus have a positive effect on house prices. Yet, on the other hand one must consider the reasons for the *repo rate* to be low. It is in fact a tool to heat up or cool down the economy. Therefore, a reduced *repo rate* may be an indicator for low economic activity instead. When it comes to the *unemployment* rate, it is likely that higher *unemployment* have a negative effect on house prices, since absence of employment reduces the likelihood to be approved in one's mortgage application. The *construction cost index* is also ambiguous since it is probably the underlying causes that are of interest. Higher costs for production is likely to reduce the willingness to build and hence reduce the supply, which will push prices upwards. On the other hand, the reason for higher costs may be due to high demand for labor and components. Therefore, the index may be an indicator for high economic activity, meaning that it is most likely to be positively associated with housing prices.

# 5 Method

## 5.1 Descriptive statistics and Assumptions

The main approach to determine the impact from increased leverage in private housing cooperatives on apartment prices is to treat the data as panel. Panel data is an approach where the same object or individual is observed in recurrent periods of time. The first step in the analysis is to provide descriptive statistics to get an overview of the structure of the data. The main difference between an OLS model and a fixed effects model is that in the fixed effects model, the regressors are assumed to be correlated with the error terms, which is a violation of one of the Gauss Markov assumptions regarding the OLS structure.

To test the hypothesis concerning the potential convex u-shaped effect from the *building year*, i.e. that there is higher demand for older and newly produced buildings the *building year* is divided into decade dummies with exception for the period 1900-1920 that is one period and all building that are built before 1900 is considered as one group. Moreover, to display how the variables *price per square meter*, *fee per square meter* and the PHC's *loan per square meter* is affected by the *building year*, three different scatter plots are conducted to visualize the relationship.

In this thesis, the same apartment ($object_i$) is observed several times between 2007 and 2016, where the *price per square meter* of $object_i$ is the dependent variable of interest and the PHC's *loan per square meter* is the main independent variable of interest. All variables are in absolute values. Each PHC's annual report for each year has been manually penetrated and information concerning the PHC's total debt and interest rate in time $t$ has been collected and connected to the purchasing moment of $object_i$. This implies that it is possible to observe how the price of $object_i$ is being affected by changes in *loan per square meter* for its PHC, when holding all other variables constant. Since the annual report with its information was not provided in the initial data set from SBAB, 122 PHC's was selected to be included in the analysis. As explained earlier, the criteria to be included was i.a. at least three years of observed turnover of $object_i$, where the maximum number of observation could be up to 10.

### 5.1.1 Panel - Descriptive statistics

The individuals in the data set are each specific apartment ($object_i$) and the time dimension is the *Year* of the selling moment. The independent variables can be divided into three different categories which is the "varying regressors", "time invariant regressors" and "individual invariant regressors". The varying regressors are explanatory variables that varies over time and are specific for each $object_i$. The included varying regressors in the model are *loan per square meter* and *interest rate* for the PHC $object_i$ belongs to. Moreover, the *income* for the buying household is considered as varying. The time invariant regressors, are object specific variables who does not vary over time, hence they will be removed in fixed effects (within) transformation. In this thesis $object_i$ is considered as the same if the objects belong to the same PHC. The last category is the individual invariant variables, which means variables that vary over time, but are not specific for each object, hence $\kappa_{it}$=$\kappa_t$ for all objects. Variables with these characteristics are

*GDP growth rate*, *unemployment rate*, *inflation*, *repo rate* and the *construction index*, in other words the included macro variables.

Table 2 and 3 summarize the data and will provide the mean, standard deviation, minimum value and maximum value for each variable. The purpose is to determine if there is any missing data and to get and overview of the variables. Next step is to provide inferential statistics to be able to analyze how apartment prices reflect the loan of the PHC it belongs to. To start, there are three different variations when it comes to panel data. The first is the "overall variation", which basically means that there is variation over time and individuals (objects in our case). The second is the "between variation", meaning that the variation is between objects. The third variation type is the "within variation" which implies that the variation is over time, within objects. Algebraically, the three different variations are calculated as:

Overall variation

$$s_O^2 = \frac{1}{NT-1} \sum_i \sum_t (x_{it} - \bar{x})^2 \tag{12}$$

Between variation

$$s_B^2 = \frac{1}{N-1} \sum_i (\bar{x}_i - \bar{x})^2 \tag{13}$$

Within variation

$$s_W^2 = \frac{1}{NT-1} \sum_i \sum_t (x_{it} - \bar{x}_i)^2 \tag{14}$$

Where $\bar{x}$ is the overall mean, $\bar{x}_i$ is the individual mean.

As one can see, the overall variation is calculated by subtracting the overall mean ($\bar{x}$) from each individual variable at time t. The between variation i determined by taking the individual mean ($\bar{x}_i$) minus the overall mean ($\bar{x}$), hence there is no time dimension and the coefficients will be interpreted as when the independent variable exceeds the population average with one unit the dependent variable will change $\beta$ unit(s). In the within variation, we are not interested in comparing objects, but only the difference within each $object_i$ over time by taking each individual variable at time t, minus the object specific average ($\bar{x}_i$).

### 5.1.2 Pooled OLS estimator

The pooled model does what the model indicates, i.e. pool the data set together, which means that the model does not consider any within nor any between variation. Therefore, it will provide constant coefficients, hence no difference between objects and no object specific intercept. Basically it means that it ignores the panel data structure and applies the OLS (Gauss Markov) assumptions where the regressors are assumed to be uncorrelated with the error terms. Algebraically the model looks like:

$$y_{it} = \omega + \mathbf{x}'_{it}\beta + \epsilon_{it} \tag{15}$$

The $\beta$ and $\omega$ is constant and individual invariant. $\mathbf{x}'_{it}$ is a column vector of the all included independent variables, both varying, time invariant and individual invariant.

In general, by using logs instead of a linear model, the problem with heteroscedasticity, i.e. non-constant variance in the error terms are reduced (Wooldridge, 2015). However, since I am interested in the absolute value of the partial derivative, one must keep the variable in their linear form to be able to estimate how a one SEK increased *loan per square meter* in the PHC is reflected by the *price per square meter* in the belonging apartment. The variance is expected to increase due to this, which is adjusted by using robust standard errors. Since all variables are in linear form, the interpretation will be a one unit increase in the independent variable will affect the dependent variable by $\beta$ unit(s). Yet, the model is expected to be inconsistent due to expected heterogeneity.

#### 5.1.3 Fixed effects (within) estimator

As mentioned earlier, there will be variables and attributes that are specific for each object and thus will have a determinant effect on the *price per square meter*, but are unobserved. Examples of such a variable can be the distance to the city, floor number or view from the balcony. Therefore, we assume that there is heterogeneity across the objects, and that these individual specific effect can be assigned to each object (i.e. the regressors are correlated with the error terms). We will refer to the unobserved fixed effects as alpha ($\alpha_i$), which will be the object specific intercept in the first part of the fixed effects (within) transformation. The benefits with this model and the reason why this is the main model of interest is that it exclusively uses the variation within each object. Hence, it corrects for the time fixed heterogeneity and removes unobserved fixed effects ($\alpha_i$) by a transformation (equation 19 and 20). Moreover, the model makes fewer assumptions regarding the structure of the data than e.g. the OLS model, which makes it useful when the independent variable(s) of interest are time varying. The problem with omitted variable bias is hence reduced since all observed and unobserved fixed effects are consciously removed.

$$y_{it} = \alpha_i + \mathbf{x}'_{it}\beta + \epsilon_{it} \tag{16}$$

As one can see in equation 16, each object have their own intercept in contrast to the pooled model. However, the $\mathbf{x}'_{it}$ is the same vector of explanatory variables as in the pooled model.

The fixed effects (within) estimator predicts how a one unit (SEK) change from the object specific average in the independent variable affects the dependent variable for $object_i$ and thus eliminates the fixed effects ($\alpha_i$). Algebraically, the fixed effects (within) transformation is conducted in three steps (Wooldridge, 2015):

Step 1, regress the *price per square meter* for $object_i$ in period t on the independent variables of interest:

$$y_{it} = \text{price per square meter}_{it} = \zeta c'_i + \gamma z'_{it} + \alpha_i + \delta\kappa'_t + \epsilon_{it} \tag{17}$$

Step 2, regress the time average *price per square meter* for $object_i$ on the independent variables time averages:

$$\overline{y}_i = \overline{\text{price per square meter}}_{it} = \zeta\bar{c}'_i + \gamma\bar{z}'_i + \bar{\alpha}_i + \delta\bar{\kappa}'_t + \bar{\epsilon}_{it} \tag{18}$$

Step 3, subtract equation 18 from equation 17 for each t:

$$y_{it} - \overline{y}_i = \gamma(z_{it} - \bar{z}_i)' + \delta(\kappa_t - \bar{\kappa}_t)' + (\epsilon_{it} - \bar{\epsilon_{it}}) \tag{19}$$

or

$$\ddot{y}_{it} = \gamma(\ddot{z}_{it})' + \delta(\ddot{\kappa}_t)' + (\ddot{\epsilon}_{it}) \tag{20}$$

In equation 20, $\ddot{y}_{it}$ is the time-demeaned data on y. $c_i'$ is a column vector of variables that are time invariant and object specific, e.g. number of *square meter* in $object_i$. $z_{it}'$ represents all variables that are specific for each object and vary over time such as the PHC's *loan per square meter*. Alpha ($\alpha_i$) are the unobserved variables that are constant over time, thus they disappear in the transformation together with the observable time invariant regressors since $c_i$-$\bar{c}_i$=0. Furthermore, kappa ($\kappa$) are the variables that are observable and vary over time, but are not specific for $object_i$ such as *inflation* and *GDP Growth*. Gamma ($\gamma$) is here the main parameter of interest and displays the apartments price response to increased leverage in the PHC. In this thesis, it is not a problem that observable fixed regressors drops out in the transformation, since the independent variable of interest vary over time.

Another common test when using panel data is the first-difference estimator, where one can see how the dependent variables change from one period to the next according to:

$$y_{it} - y_{it-1} = \gamma(z_{it} - z_{it-1}) + \delta(\kappa_t - \kappa_{t-1}) + (\epsilon_{it} - \epsilon_{it-1}) \tag{21}$$

The data set is unbalanced in the sense that it does not contain observations in each year, we will not use this estimator. In general, it is important to analyze why the data set is unbalanced. In case of observing e.g. the *yearly profit* for a specific number of firms over time, and some firms drops out due to bankruptcy, the result will be biased since only the surviving firms will remain. Yet, the main variable of interest in this thesis is object specific and time varying, hence there are no major problem with unbalanced data (Wooldridge, 2015). The whole data set was not used in the panel data analysis due to the fact that some PHC's did not have transactions of apartments recurrent time periods and the PHC's debt and interest rate for each time period was not included in the initial data set. Therefore, some PHC's were consciously omitted and there is a small potential bias in the sense that only the PHC's with higher turnover frequency is included. However, the most likely explanation to the fact that some PHC's have a higher turnover frequency is that these have a higher amount of apartments. For every cross-sectional observation in the transformation one degree of freedom is lost due to time-demeaning, which means that at least two time periods are required to be able to use the fixed effects (within) transformation. Only objects with at least three recurrent time periods are included to improve the significance of the result. Since the fixed effects model takes individual specific effects into account, the interpretation of the coefficient will be different from the pooled model. For an explanatory variable in linear form a one unit increase from its object specific mean implies a $\beta$ change in the dependent variable. Thus, the change is not in general as in the pooled model, but a change from the object specific average. Another calculation that is of interest is Rho ($\rho$) which will specify how much variation is explained by individual specific effect. R-squared will be interpreted as how much the time variation in the regressors explain the time variation in our dependent variable. (Wooldridge, 2015)

### 5.1.4 Random effects estimator

In the Random effects model, $\alpha_i$ is no longer assumed to be correlated with its regressors, hence the variation is considered as random instead of fixed. This means that $\alpha_i$ is included in the error terms instead of being the intercept, i.e. $\varepsilon_{it} = \alpha_i + \epsilon_{it}$. The regression will therefore look like:

$$y_{it} = \mathbf{x}'_{it}\beta + (\alpha_i + \epsilon_{it}) \tag{22}$$

As one can see, there are no object specific intercept. By calculating the variance of the error terms, we can determine Rho ($\rho$), which basically is the share of the error terms variance that is due to individual specific effects. In other words, a higher Rho (when it approaches 1) implies that the individual specific effects increases, which is strived, and the variation can be assigned to each object. Rho is calculated as:

$$\rho_\varepsilon = \frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_\epsilon^2} \tag{23}$$

In equation 23, one can see that when the individual specific effect ($\sigma_\alpha^2$) is large, Rho gets closer to one. The random effects transformation looks similar to the fixed effects transformation, however since the error terms are no longer assumed to be correlated with the regressors the equations looks like:

$$y_{it} - \hat{\lambda}\bar{y}_i = (1 - \hat{\lambda})\mu + \beta(x_{it} - \hat{\lambda}\bar{x}_i)' + \upsilon_{it} \tag{24}$$

where

$$\hat{\lambda} = 1 - [\frac{\sigma_\epsilon^2}{\sigma_\alpha^2 + \sigma_\epsilon^2}]^{1/2} \tag{25}$$

and

$$\upsilon_{it} = (1 - \hat{\lambda})\alpha_i + (\epsilon_{it} - \hat{\lambda}\bar{\epsilon}_i) \tag{26}$$

Thus, in contrast to the fixed effects (within) transformation, random effects subtracts a fraction ($\hat{\lambda}$) of the time average, which depends on equation 25. Hence, the model takes into account variables that are constant over time. This implies that if lambda-hat ($\hat{\lambda}$) is equal to 1, equation 24 is equal to the fixed effects (within) estimator. Yet, if lambda-hat is equal to 0, equation 24 is the same as the pooled OLS estimator. However, since we are mainly interested in an explanatory variable that varies over time and that our regressors are likely to correlate with the unobserved effects, the fixed effects model is hopefully better suited. Observe that in equation 125 and 24, the vector of x-variables contains all regressors, i.e. varying, time invariant and individual invariant. (Wooldridge, 2015)

### 5.1.5 Hausman test

To determine whether or not to use the fixed effects model or random effects model we use a Hausman-test, where the test basically test if there are significant differences between the two different estimators by:

$$H = (\hat{\beta}_{RE} - \hat{\beta}_{FE})'(V(\hat{\beta}_{RE} - \hat{\beta}_{FE}))(\hat{\beta}_{RE} - \hat{\beta}_{FE}) \tag{27}$$

The the right hand side displays a matrix taking the difference between the random effects and fixed effects coefficients, multiplied with a variance-covariance matrix. Hence, if $\hat{\beta}_{RE} = \hat{\beta}_{FE}$ the model becomes zero, meaning that there a no differences between the estimators. On the other hand, if there are significant differences, the fixed effect estimator is more appropriate and we may therefore reject the null hypothesis. (Wooldridge, 2015)

# 6 Results

## 6.1 Descriptive statistics

To start, the first figures provide descriptive statistics in order to get an overview of the distribution and overall trends of the included variables. First of all, Figure 1 (Appendix) depicts the yearly trends for *price per square meter*, *PHC's interest rates*, *repo rate* and *loan per square meter*. The mean *price per square meter* is increasing from 28,000 SEK per square meter to 53,600 SEK during the period of interest. This is also visualized in Figure 2 (Appendix), where one also can see that the mean *fee per square meter* is increasing from 43 to 60 SEK per square meter during the time period. Both *repo rate* and *PHC's interest rate* is decreasing during the years, and the correlation between these two variables is 0.51. Even though the mean interest rate is decreasing, the mean *loan per square meter* seem to be constant over the period. The green lines in the figures displays the mean values and the red lines displays the fitted values. To determine how the *building year* affects or correlate with *fee per square meter*, *price per square meter* and the PHC's *loan per square meter* the variable is depicted on the X-axis, with the *building year* on the Y-axis (Figure 3). In the upper right graph, one can see that regarding *price per square meter* the effect is somewhat u-shaped, where older and newer buildings have a higher mean than the buildings that are built during the mid-19th century. In the same figure, yet in the upper left graph, one can see that there seem to be a positive correlation between the *building year* and *fee per square meter*, indicating that older PHC's have higher ability to keep the *monthly fee* low. In the lower graph in Figure 2, the relation between *building year* and *loan per square meter* shows that older PHC's have lower *loan per square meter* than newer buildings.

## 6.2 Panel data -Inferential statistics

Table 2 and 3 (Appendix) provides descriptive statistics containing the mean, standard deviation, minimum- and maximum values for each regressors (except the decade dummies) to get an overview of the data. For example, during 2007 and 2016, the mean *unemployment* was 7.7 percent, the mean *inflation* was 0.85 percent and a majority (82 percent) of the observations are located in Stockholm. The mean *price per square meter* summed up to 38,128 SEK and the mean *loan per square meter* for the PHC is 5,386 SEK.

### 6.2.1 All models

To get an overview of the results, Table 1 contains all models described in the method section. Reading from the left, the first model is the pooled OLS, followed by the between estimator, fixed (within) estimator and lastly the random effects model. In none of the models, an increase in *loan per square meter* for the PHC has a significant effect on the *price per square meter* for the belonging apartment. The *price per square meter* in linear form is the dependent variable in all models in Table 1.

| | (1) Pooled OLS | (2) Between | (3) Fixed | (4) Random |
|---|---|---|---|---|
| Loan per square meter | -0.121 | -0.151 | 0.308 | -0.0642 |
| | (-0.79) | (-0.59) | (0.47) | (-0.21) |
| PHC interest rate | -642.7 | -1973.2 | 464.7 | 39.55 |
| | (-1.54) | (-1.70) | (1.12) | (0.11) |
| Gross income | 0.254*** | 0.804*** | -0.0420 | 0.0953*** |
| | (9.56) | (9.56) | (-1.94) | (4.14) |
| Object square meter | -455.5*** | -694.3*** | | -402.3*** |
| | (-10.16) | (-5.86) | | (-10.14) |
| Number of rooms | 2507.0** | 366.8 | | 3527.3*** |
| | (2.60) | (0.14) | | (4.47) |
| Gothenburg | -6425.3** | -5003.6 | | -5712.1 |
| | (-3.09) | (-1.27) | | (-1.25) |
| Stockholm | 8716.2*** | 5731.4 | | 10311.1*** |
| | (6.56) | (1.95) | | (4.27) |
| Malmo | -13951.6*** | -8171.2 | | -15115.0** |
| | (-5.08) | (-1.95) | | (-3.00) |
| GDP Growth | 103.2 | 558.2 | -1.874 | 96.26 |
| | (0.57) | (0.35) | (-0.01) | (0.89) |
| Unemploument | -5334.8*** | -1778.2 | -6916.4*** | -6322.1*** |
| | (-6.80) | (-0.43) | (-10.09) | (-10.98) |
| Inflation | 1618.1* | -693.3 | 2143.1*** | 1700.5*** |
| | (2.01) | (-0.11) | (3.55) | (3.62) |
| Repo rate | -5383.4*** | -2746.0 | -7433.1*** | -6293.3*** |
| | (-7.49) | (-0.59) | (-10.45) | (-11.10) |
| Construction_index | 0.746*** | -0.268 | 1.030*** | 0.875*** |
| | (3.77) | (-0.22) | (7.26) | (6.73) |
| Numer of observations | 768 | 768 | 768 | 768 |
| R-squared | 0.704 | 0.855 | 0.550 | |
| adjusted R-squared | 0.695 | 0.818 | 0.545 | |
| Rho | | | 0.796 | 0.387 |
| Theta | | | | |

*t* statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1: Regression Output, All models

### 6.2.2 Pooled OLS Estimator

In the Pooled OLS estimator (first column from the left in Table 1), the data is not treated as panels, but pooled and regressed. As one can see in the table, a higher *loan per square meter* for $PHC_i$ which is the main variable of interest have no significant effect on the dependent variable. A one percentage point higher *interest rate* for $PHC_i$ does neither have any significant effects on the *price per square meter*. Bigger apartments seem to have a lower *price per square meter* compared to smaller, probably due to diminishing marginal utility of size. Hence, one more square meter implies that the *price per square meter* decreases with 455 SEK, and the effect is significant. Anyhow, apartments with more *rooms* have higher *price per square meter* which is somewhat a contradiction to the former result. The result that *gross income* have a positive effect implies that households with higher *income* buys more expensive apartments. Regarding the regions and decay dummies, objects in Stockholm have highest *price per square meter*, followed by Gothenburg and Malmö. As concluded earlier, there seems to be a u-shaped effect of the year of the building, where older and newer have a less negative impact on the dependent variable (Appendix, Table 4).

Regarding the macro variables, Table 1 depicts that a one percentage point increase in *GDP growth* have no significant effect on the *price per square meter* for $object_i$. Moreover, a higher *unemployment* rate indicate a lower predicted *price per square meter* for $object_i$, where a one percentage point increase *unemployment* rate is associated with 5.335 SEK decrease in the dependent variable (ceteris paribus). The effect of the *repo rate*, which is highly correlated (0,77) with *inflation* (se Appendix, Table 7), have a negative significant correlation or effect on the *price per square meter*. Hence if the Central Bank decides to increase the *repo rate* by one percentage point, the *price per square meter* of $object_i$ decreases by 5.383 SEK. *Constuction index* and a higher *inflation* on the other hand have a positive impact on the *price per square meter* where a one unit increase in the *construction index* implies a 0.76 SEK increase in the *price per square meter* for $object_i$ and one percentage point higher *inflation* is associated with 1.618 SEK higher *price per square meter* on average. According to the R-squared and adjusted R-squared, approximately 70 percent of the variation in the dependent variables is due to the variation in the explanatory variables.

#### 6.2.3 Between estimator

The result from Table 1 displays if the *loan per square meter* exceeds the overall average with one unit (one SEK) it has no effect on the *price per square meter*. The two micro variables that have a significant impact on the *price per square meter* is *gross income* and *number of square meter*, where a one SEK higher income than the overall average indicates that the households willingness to pay is increasing with 0,8 SEK per square meter. If the object have one more square meter than the overall average, the *price per square meter* is expected to decease with 694 SEK, due to diminishing willingness to pay for one extra square meter. Regarding the macro variables, this model displays no significant effects, since there is no overall variation. If the data set would have been balanced, all macro coefficients in the between estimator would have been zero. Yet, when having an unbalanced data set, the individual invariant coefficients becomes biased.

#### 6.2.4 Fixed effects (within) estimator

In Table 1, the fixed effects (within) estimator is presented in the third column from the left. As explained in the method section, the effect is compared with the object specific average, hence, all variables that are time-invariant (both observed and unobserved) are consciously removed. The model predicts that when a PHC's *loan per square meter* exceeds the object specific average with one unit it it has no significant effects on the *price per square meter* on the belonging apartment. This contradict the theory, and the result indicates that the price of apartments does not appropriately reflect the loan in the PHC it belongs to. According to the table, the result is insignificant meaning that there is neither a one to one relationship, nor a price response with 1.43 (in absolute values) that was expected in the theory, if we assume that households and PHC's are offered the same interest rates and asymmetric tax rules (in terms of deduction possibilities). Neither of the other two control variables of micro characteristics (*PHC interest rate* and *Gross income*) are statistically significant.

Regarding the macro variables, one can see that all variables except *GDP growth* have significant effect on the dependent variable. If the *unemployment* is exceeding the object specific average with one percentage point, the average *price per square meter* is expected to decrease with approximately 6,900 SEK. This was expected, since a higher *unemployment* will cause a drop in the demand for buying apartments. Potential buyers that are unemployed will not be approved in their mortgage application and due to higher uncertainty of future cash flow, households will seek living that does not require any need for down payment or risk of price drops. An *inflation* level that is one percentage point higher than the object specific average indicates that the *price per square meter* is increasing with 2,143 SEK. This indicates that the variable is an indicator of a positive trend in the economy, where consumption is increasing and also the willingness to pay and invest. A *repo rate* that exceeds the overall average with one percentage point is associated with lower *price per square meter* with 7,433 SEK. This is likely due to an indirect increased mortgage costs for the household, since the banks costs are positively correlated with the variable. Lastly, a one unit higher *construction index* displays an expected increase in the *price per square meter* with one unit. As expected, this index is also an indicator of a positive trend in the business cycle, where demand for labor and the underlying components for construction is positively correlated for buyers willingness to pay and invest, which causes prices to increase. Since the macro variables are not object specific, the effects from these are more or less the same as the other models as displayed in Table 1 except the between estimator. Another important result is rho, which determines how much variation is explained by individual specific effect. In our case, rho ($\rho$) equals 0.796 meaning that approximately 80 percent of the variation is explained by individual specific effect.

#### 6.2.5 Random effects estimator

In the Random effects estimator in Table 1, one can see that the percentage of the variation due to object specific effects, displayed by Rho ($\rho$) is 39 percent. A *loan per square meter* that exceeds the object specific mean does not have a significant negative impact on the dependent variable, meaning that a one SEK higher *loan per square meter* is not reflected in the price of the belonging apartment. The macro variables seem to have somewhat the same impact on the dependent variable as the other models, except the between estimator due to natural causes. The estimated lambda ($\hat{\lambda}$) sums up to 0.62 meaning that we are leaving less of the unobserved effects in the error terms, which means that there seems to be heterogeneity and hence correlation between the explanatory variables and the unobserved effects.

#### 6.2.6 Hausman test

The Hausman test in Table 7 (in the Appendix) tells us that there are significant differences between the models and we may reject the null hypothesis. This implies that fixed effects (within) estimator are more appropriate. Hence, the fixed effects (within) estimator will provide the most accurate estimation of the effects from the regressors on our dependent variable due to heterogeneity and correlated regressors and error terms.

# 7 Analysis

As stated, the fixed effects estimator is proved to be most appropriate according to the Hausman test which means that there is significant heterogeneity across objects and the unobserved fixed effects are correlated with its regressors. This result violates the Gauss Markov assumption regarding correlation between the regressors and the error terms meaning that the pooled OLS model is proven to be inconsistent (Wooldridge, 2015). Therefore, the result from the fixed effects model will be used in the analysis.

In the results section I concluded that if the PHC increase their *loan per square meter* with one unit above the object specific average, it does not have a significant effect on the *price per square meter* for the belonging apartment. This result contradicts the theoretical model in section 3.2 where the price of the apartment was expected to reflect the loan of the PHC. More specifically, assuming that households and PHC's are offered the same lending terms ($r = r^{\mathrm{h}}$) and both or neither are allowed to make make deductions one would expect a one to one relationship between increased *loan per square meter* and *price per square meter*. Yet, taken into account the fact that since 2007 Sweden applies different deduction rules, the asymmetric tax rules implies that an increased *loan per square meter* with one unit is expected to result in a reduction in *price per square meter* with more than one unit if we still assume that households and PHC's are offered the same interest rates. Since the data set contained observations from 2007 and forward, the theoretical expected response was 1.43 (absolute value). So, how come the result is insignificant and not significantly different from zero? The theoretical explanation to this is that the assumption that $r = r^{\mathrm{h}}$ is violated. If this is violated, it implies that the subtraction step in equation 7 to receive equation 8 is not allowed. Since this is a theoretical model, I made the assumption that $r = r^{\mathrm{h}}$. The reason that the assumption is likely to be violated is probably that PHC's are being offered lower interest rates than the households/members is due to better bargaining power. Moreover, one of the most common key performance index for banks are the return on equity (ROE), which is a measure of profitability in relation to invested capital. When $\theta$ in section 3.2.2 is increasing it implies that the total loan of the PHC is increasing, meaning that the ROE for the bank is likely to increase, since the cost for administrating a loan is somewhat constant and independent of its size. Therefore, one large loan is more profitable than many small loans. This means that the bank is able to offer the PHC a lower interest rate and still make the same profit. If it is the case that PHC's are offered more than 30 percent lower interest rate than households on average, debt should not be shifted to the members but rather shifted towards the PHC, meaning that $\theta$ is increasing in equation 7. Unfortunately, the data set did not contain information regarding the buyers/members interest rate. Otherwise a comparison between PHC's and the members interest rate and a more extensive analysis regarding capital structure could have been made.

To expand the analysis, one can discus how a shift in debt may affect the equilibrium and the parties that may be affected by this. Assuming a scenario where $r = r^{\mathrm{h}}$ and the existing deduction differences, a shift in debt from the PHC towards the members would imply that the members reduce their monthly costs whereas the bank receive the same interest payments. The party that is damaged is the government that is the one subsidizing the deductions. However, in this scenario the fact the ROE for the bank may be different even though the interest rates are likely to be higher for households and PHC'c is neglected. The result from this study displays that it is not proved to be beneficial to shift the debt towards the members. Assuming that the banks prefer one large loan than many small in terms of ROE maximization, this result may indicate that banks are aware that if they would offer the same interest rate to household and the PHC, a shift in debt may occur, which may impair their profitability due to many small loans.

The result from this thesis raises the question why the unique setup with cooperative apartment and PHC's is still that popular in Sweden. The result from this thesis highlight the fact that the reality contradicts the theory, which shows that consumers are not able to fully understand the complex structure. This stress the need for consumer protection in the market in line with (SOU 2017:31) since a potential buyer is "required" to have financial knowledge to be able to form a rational decision of the value of the apartment. When adding the fact that PHC are allowed to use different booking policies, the transparency in the market is even more reduced. In my opinion I think it is surprising that condominiums is not more common, where the member actually own the apartment and therefore is not dependent by the loan of the PHC. Even though there may be many benefits with a cooperative apartment, the member is restricted in many aspects that a owner of a condominium is not. When the fraction of apartment buildings that transforms into PHC is increasing, the risk of bad management and maintenance of the buildings are increasing. After all, the board consist of the selected members who does not contain the right competence in all cases. One likely explanation that condominiums are not that common is the regulated rent market in Sweden. In cooperative apartment a member cannot sublet the apartment without permission from the board, whereas an owner to a condominium (in many other countries) can freely sublet and set the rent which causes a more functioning market than in Sweden. Yet, with the existing rental restriction the demand for condominiums is likely to remain low.

# 8 Discussion and Conclusion

This thesis proves that prices of apartments does not reflect the loan of the PHC's the apartment belongs to. The most likely explanation is that PHC's are offered more than 30 percent lower interest on average than households meaning that it is more beneficial to shift debt towards the PHC's and not the other way around as theory predicted. However, the fact that the relationship is not predictable impair the market efficiency. In addition, lack of transparency and inconsistency in the reporting from the PHC's reinforce the inefficiency which harms the parties in the market.

The fact that the buying decision in the market for houses and apartments are different from financial markets in many aspects e.g. buyers only buys one good and higher degree on heterogeneity is likely to remain. Thus, to increase the efficiency one must focus jurisdictions implementations on variables that are possible to change and not only targeted toward the buyers. The most important suggestion in the report (SOU 2017:31) to increase the transparency and thus the efficiency is to implement a strict policy regarding the booking policy among PHC's where all must use the same booking method, otherwise one compares apple with pears. Even though these suggestions are important, I argue that the regulated renting market and its consequences must be investigated more thoroughly, where other countries such as such as Germany have a more functioning and efficient housing and renting market. Without doing an overview of the whole market, there is a risk that implementing more regulations in each sub-market may impair the efficiency more, even though the intention is good.

# 9 References

Bokföringsnämnden (2007). *Limited companies.* Available (2017-05-09): http://www.bfn.se/sv/english/what-applies-to/limited-companies

Capozza, D. R., Hendershott, P. H., Mack, C., & Mayer, C. J. (2002). *Determinants of real house price dynamics* (No. w9262). National Bureau of Economic Research.

Case, K. E., & Shiller, R. J. (1990). *Forecasting prices and excess returns in the housing market.* Real Estate Economics, 18(3), 253-273.

Case, K. E., & Shiller, R. J. (2003). *Is there a bubble in the housing market?.* Brookings Papers on Economic Activity, 2003(2), 299-342.

Dagens Nyheter (2015). *Risk för ökande boskulder trots krav pä amortering.* Available (2017-05-09): http://www.dn.se/debatt/risk-for-okande-boskulder-trots-krav-pa-amortering-/

Fama, E. F. (1970). *Efficient capital markets: A review of theory and empirical work.* The journal of Finance, 25(2), 383-417.

Friedman, M. (1957). *The permanent income hypothesis. In A theory of the consumption* function (pp. 20-37). Princeton University Press.

Goodhart, C., & Hofmann, B. (2008). *House prices, money, credit, and the macro economy.* Oxford Review of Economic Policy, 24(1), 180-205.

Hansson, M., & Karlsson, M. (2013). *Insatsöjning i bostadsrättsfreningar: Lönsamt för alla?.* Unpublished Thesis from Halmstad University

Keynes, John Maynard. 1935. *The General Theory of Employment, Interest, and Money.* San Diego/New York/London: Harvest/HBJ

Malpezzi, S. (1999). *A simple error correction model of house prices.* Journal of housing economics, 8(1), 27-62.

Mikhed & Zemčk (2009a). *Do house prices reflect fundamentals? Aggregate and panel data evidence.* Journal of Housing Economics, 18(2), 140-149.

Mikhed & Zemčk (2009b). *Testing for bubbles in housing markets: A panel data approach.* The Journal of Real Estate Finance and Economics, 38(4), 366-386.

Olsson, O. (2013). *Essentials of advanced macroeconomic theory (Vol. 17).* Routledge.

Persson, E., & Rosendahl, T. (2012). *Bostadsrättsfreningar, en potentiell skattkammare: Ett Modigliani-Miller exempel på svenska bostadsrättsmarknaden.* Unpublished Thesis from Uppsala University

SCB. *Arbetslösheten tog fart under finanskrisen.* Available (2017-05-08): http://www.scb.se/hitta-statistik/sverige-i-siffror/samhallets-ekonomi/arbetslosheten/

Skatteverket (2007). *Skatteregler för bostadsrättsföreningar och deras medlemmar* (SKV 378 edition 4)

Sveriges Riksbank. *Previous repo rate decisions.* Available (2017-05-08): http://www.riksbank.se/en/Monetary-policy/Forecasts-and-interest-rate-decisions/Previous-repo-rate-decisions/

Turk, R. (2015). *Housing Price and Household Debt Interactions in Sweden.*

Utredningen om stärkt konsumentskydd på bostadsrättsmarknaden (2015). *Stärkt konsumentskydd på bostadsrättsmarknaden (SOU 2017:31).* Stockholm: Justitiedepartementet

Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach.* Nelson Education.

# 10 Appendix

## 10.1 Definition of a private housing cooperative

The definition of a private housing cooperative is *"an economic association whose purpose is to deed cooperative apartments in the cooperative building"* according to the Swedish law of private housing cooperatives (1 §, 1$^{\text{th}}$ chapter, 1991:614). Moreover, *"the apartments can only be deeded to the members of the PHC. Each member pays a fee to the PHC as a down payment when the cooperative apartment is deeded and the PHC also have the right to charge the members a yearly fee for the operating activities"* (14 §, 7$^{\text{th}}$ chapter, 1991:614). The members cannot be held personally liable in case of a bankruptcy occurs, but can loose his or hers down payment. In case of a bankruptcy, the building is sold on the market, and the apartments are turned into rental apartments.

The Swedish setup with cooperative apartments is somewhat similar to condominiums which are more common abroad. The main difference is that a buyer of a condominium owns the apartment, whereas a buyer of a cooperative apartment owns the right to access the apartment. Moreover, a condominium building does not have any debt itself whereas the PHC (in general) does. In Sweden there are approximately 25.000 PHC's with a total number of one million cooperative apartments (SOU 2017:31).

## 10.2 Figures

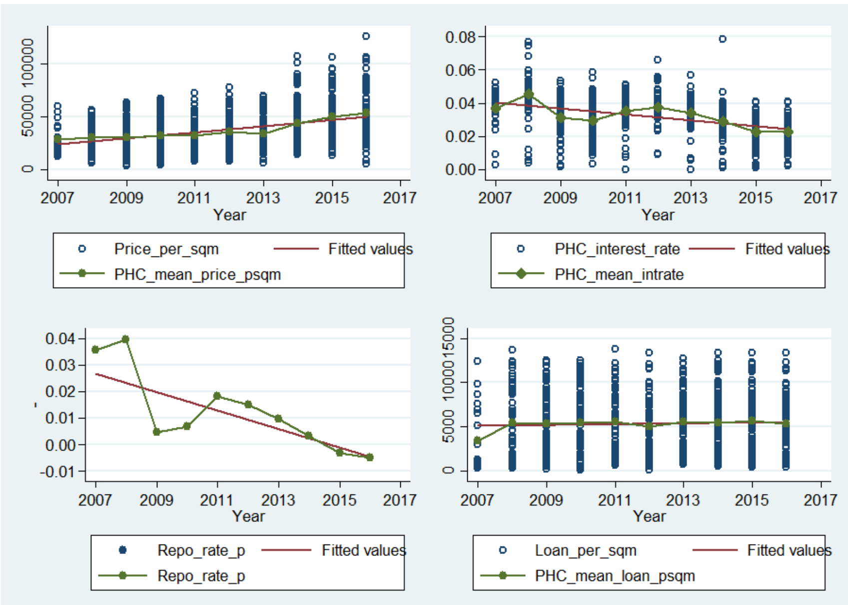


Figure 1: Descriptive figure for Yearly trends

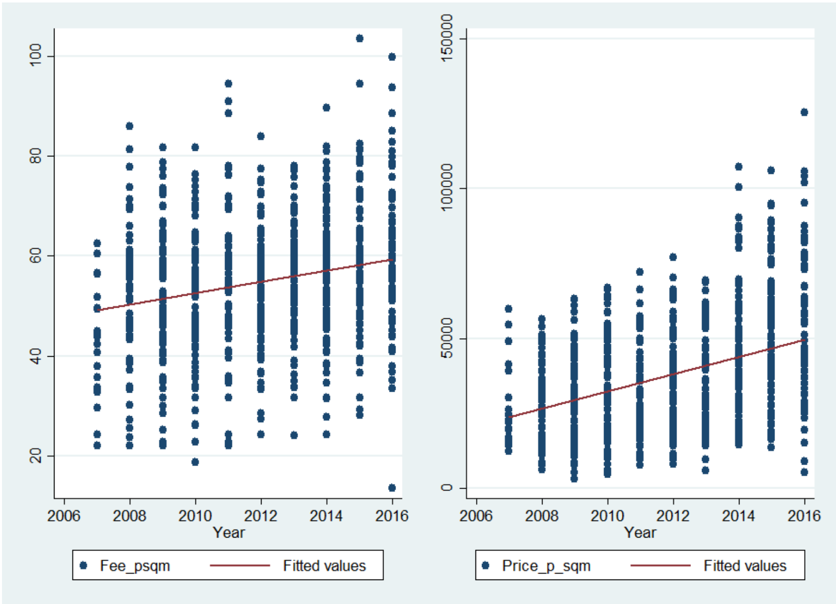


Figure 2: Mean *fee per square meter* and *price per square meter* for each year

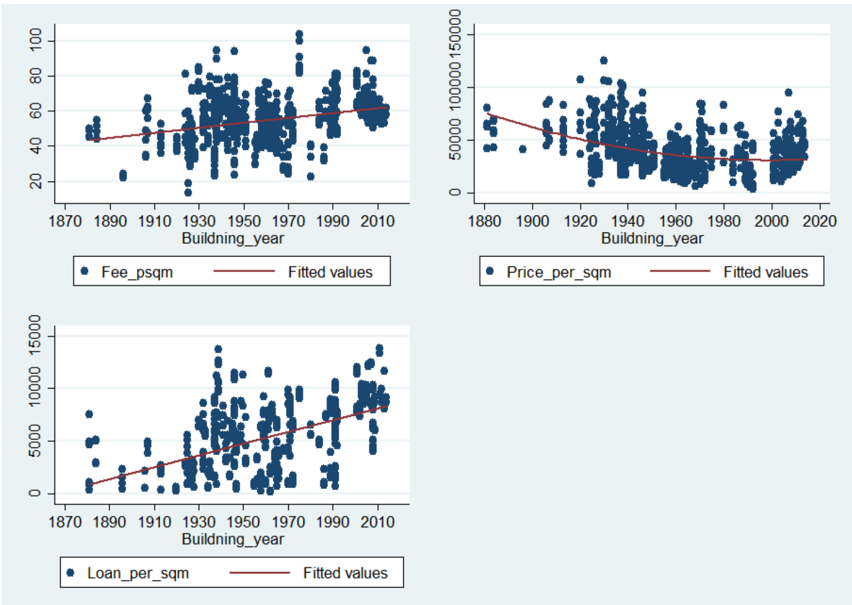


Figure 3: Year of the building

## 10.3 Tables

| | GDP_Growth | Unemployment | Inflation | Repo_rate | Construction_index | Gothenburg | Stockholm | Malmo |
|---|---|---|---|---|---|---|---|---|
| mean | 1.670481 | 7.696879 | .8540962 | .9274382 | 30205.17 | .0611183 | .816645 | .0598179 |
| sd | 3.124612 | .6938087 | 1.158646 | 1.223603 | 3382.236 | .2397032 | .3872091 | .2373036 |
| max | 6 | 8.6 | 3.4 | 3.96 | 36754 | 1 | 1 | 1 |
| min | -5.2 | 6.1 | -.3 | -.5 | 25084 | 0 | 0 | 0 |

Table 2: Descriptive statistics macro variables

| | Price_per_sqm | Loan_per_sqm | PHC_intrate | Sqm_object | Rooms | Gross_income |
|---|---|---|---|---|---|---|
| mean | 38128.88 | 5386.407 | 3.14636 | 59.60598 | 2.205462 | 40440.21 |
| sd | 19913.3 | 3394.341 | 1.146765 | 22.30878 | .9420287 | 18791.03 |
| max | 125500 | 13818.67 | 7.842007 | 154 | 6 | 140000 |
| min | 3153.153 | 131.6872 | 0 | 20 | 1 | 14700 |

Table 3: Descriptive statistics micro variables

| | (1)<br>Pooled OLS |
|---|---|
| Before 1900 | 0 |
| | (.) |
| 1900-1919 | -0.0772 |
| | (-1.07) |
| 1920-1929 | -0.217** |
| | (-2.99) |
| 1930-1939 | -0.203*** |
| | (-3.31) |
| 1940-1949 | -0.339*** |
| | (-5.62) |
| 1950-1959 | -0.557*** |
| | (-8.99) |
| 1960-1969 | -0.626*** |
| | (-8.96) |
| 1970-1979 | -0.437*** |
| | (-5.74) |
| 1980-1989 | -0.374*** |
| | (-4.82) |
| 1990-1999 | -0.960*** |
| | (-9.91) |
| 2000-2009 | -0.391*** |
| | (-5.74) |
| 2010-2016 | -0.246** |
| | (-3.25) |
| Numer of observations | 766 |
| R-squared | 0.714 |
| adjusted R-squared | 0.704 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Year of the building

| | (1) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Loan_per_sqm | PHC_intrate | Sqm_object | Rooms | Fee_psqm | Gross_income | Borrowers |
| Loan per square meter | 1 | | | | | | |
| PHC interest rate | 0.00879 | 1 | | | | | |
| Object square meter | 0.0651 | 0.0801 | 1 | | | | |
| Number of rooms | 0.108 | 0.106 | 0.881 | 1 | | | |
| Fee per square meter | 0.494 | 0.0188 | -0.135 | -0.0284 | 1 | | |
| Gross hosehold income | 0.0387 | -0.0309 | 0.396 | 0.393 | -0.119 | 1 | |
| Borrowers | 0.000937 | 0.0531 | 0.466 | 0.457 | -0.113 | 0.715 | 1 |

Table 5: Correlation matrix micro variables

| | (1) | | | | |
|---|---|---|---|---|---|
| | GDP_Growth | Unemployment | Inflation | Repo_rate | L_construct |
| GDP Growth | 1 | | | | |
| Unemploument | -0.0451 | 1 | | | |
| Inflation | 0.165 | -0.509 | 1 | | |
| Repo rate | -0.233 | -0.422 | 0.771 | 1 | |
| Construction index (log) | 0.405 | 0.0543 | -0.535 | -0.533 | 1 |

Table 6: Correlation matrix macro variables

```
Test:  Ho:  difference in coefficients not systematic

                chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                        =      138.36
              Prob>chi2 =      0.0000
              (V_b-V_B is not positive definite)
```

Table 7: Hausman test