LUND UNIVERSITY
School of Economics and Management

The Swedish Housing Market

An Analysis of two Different Policy-Induced Shocks to the Swedish Fundamental House Prices

by

Arvid Lodén

Johan Persson

May 2019

Master's Programme in Economics

Supervisor: Fredrik NG Andersson

Abstract

This paper presents an analysis of two different policy-induced shocks to the Swedish housing market. An abolishment of the interest deduction and a reintroduced property tax. The paper closely follows the methodology presented by Bergman and Sørensen (2016). This is a model that can be used to analyze the behavior of the estimated fundamental house prices and is suitable for various policy simulations. The sample period is between the first quarter of 1986 to last quarter of 2018. The main finding of this paper shows that the estimated fundamental house prices have increased sharply since the mid-1990s. Furthermore, some evidence states that the abolishment of the interest deduction will have a more substantial effect than the reintroduced property tax on the forecasted fundamental house prices.

Keywords: Fundamental house prices, macroprudential policies, interest deduction, property tax

Acknowledgements

We would like to express our gratitude to our supervisor Fredrik NG Andersson for guidance as well as great discussions throughout this paper. We also want to thank Joakim Westerlund for contributing with helpful comments. Lastly we want to thank Ulf Michael Bergman for providing us with some data and useful insights.

Table of Contents

1 Introduction

Understanding the factors behind economic downturns have been researched by many macroeconomists over the years. Studies show that 8/10 of the past financial crises have been correlated with the housing market (Mian & Sufi, 2010). Therefore is it in vast importance to be able to detect if there are any dangerous developments in the housing market. Hanson, Kashyap and Stein (2011) state that many argues that the regulatory framework before the Great Financial Crisis was insufficient. Furthermore, after the crisis, both policymakers and academics have highlighted the need of macroprudential measures to safeguard the financial system as a whole. For example, Borio (2014) claimed that macroprudential measures are essential for the financial stability. However, there is still room for improvements in the macroprudential framework available.

In Sweden, the house prices have increased to historically high levels, and the real prices of dwellings have tripled since the mid-1990s. The Swedish Riksbank points out that rising real wages, lower taxes, and falling interest rates have together increased the households' disposable incomes (Swedish Riksbank, 2018a). Englund (2011) also states that most of the rapid increase of Swedish house prices can be explained by fallen real interest rates and a reduction of Swedish housing taxation. These variables are linked to the so-called user cost of housing, which has fallen in Sweden since the mid-1990s. In a situation where the housing prices are rapidly increasing, policymakers might want to intervene before the development reaches dangerous proportions and becomes a severe macroeconomic risk. Usually, these kinds of policy interventions work via the user cost of housing (Bergman & Sørensen, 2016). Additionally, Davis, Fic and Karim (2011) states that macroprudential policies are more effective rather than monetary policies when countering aggressive developments related to household debt and house prices.

Several macroeconomic prudential measures have been applied so far, such as amortizing requirements and mortgage caps. However, there has been a discussion concerning applying further macroeconomic prudential measures (IMF, 2019).

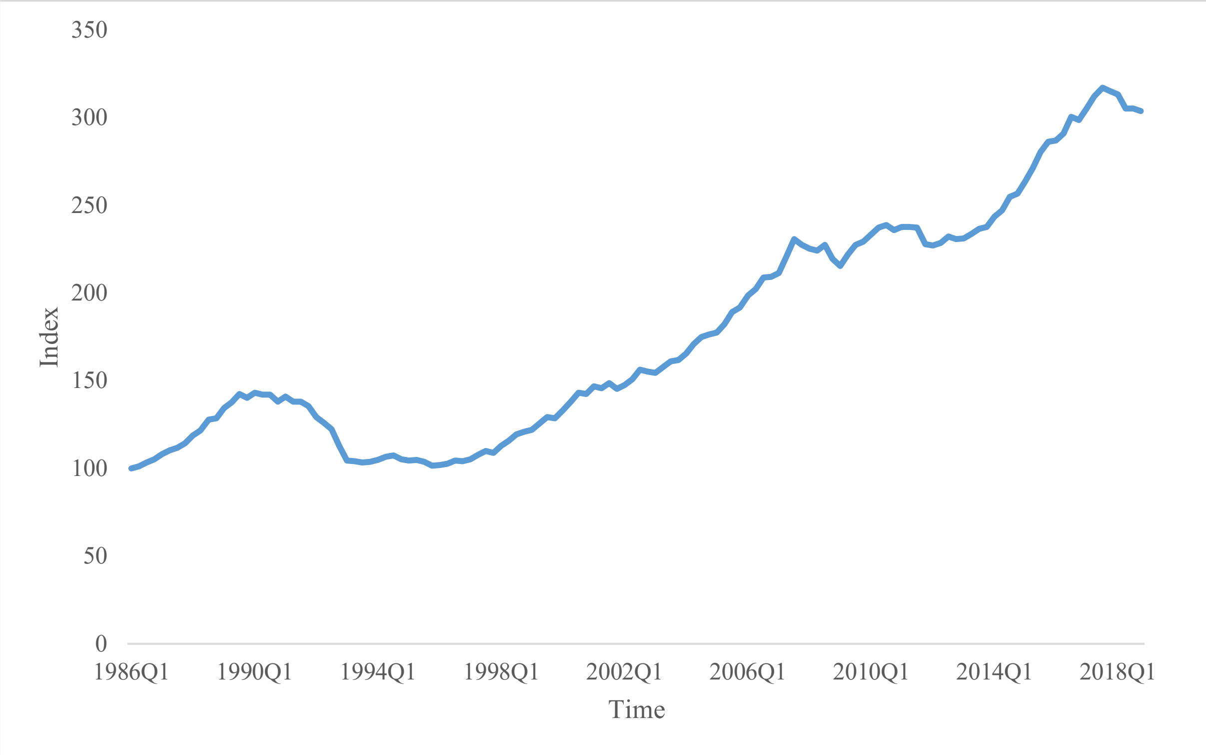
The purpose of this paper is to investigate two possible cases of macroprudential measures concerning the demand side of the Swedish housing market. The first one is a reintroduced property tax in Sweden. The abolishment of the property tax in 2008 has been debated among economists over the years, which makes it interesting to analyze. The other policy intervention that is going to be tested is the removal of the deductibility of mortgage interest payments, which also has been debated recently. To be able to analyze these policy interventions, this paper closely follows the methodology developed by Bergman and Sørensen (2016). The main findings show that the fundamental house prices in Sweden have rapidly increased since the mid-1990s. Additionally, the analysis of the two policy interventions provides some evidence that the removal of the deductibility of mortgage interest payments will have the most significant impact on the fundamental house prices.

The outline of the paper is the following: the second section presents a background of the housing market in Sweden. This part also includes the development of the two policy reforms that are going to be analyzed, the property tax and the deductibility of mortgage interest payments. In the third section, empirical and theoretical approaches concerning the housing market are presented. Furthermore, in this section, the methodology of this paper is presented. In section four, the data collected to this study is presented. The theoretical model is parameterized with data in section five. Furthermore, this section also includes the analysis of the two policy interventions. In part six, the result is discussed, and in the last section, the main findings are summarized, and some suggestions on further studies are presented.

2 Background

2.1 The Swedish housing market from the 1980s

Figure 1. *Real house prices index (1986Q1=100)*



Source: Statistics Sweden (2019)

At the beginning of the 1990s, Sweden suffered a severe financial crisis and house prices fell, which can be observed in figure 1. Moreover, loan default rates increased, and the financial sector was distressed. At the same time, the unemployment rates increased, and the GDP decreased. Furthermore, several property companies went bankrupt, which resulted in a banking crisis in Sweden. One explanatory factor behind the recession was the deregulations on the Swedish credit market that started in the 1980s. Other factors were the increasing indebtedness and the Swedish tax reform that made households more sensitive to changes in interest rates (Swedish Riksbank, 2019; Debelle, 2004).

The deregulation on the Swedish credit market occurred at the same time as other credit markets in Northern Europe were deregulated. This led to increased lending, which had an effect on Swedish house prices (Turner, 1997). The reason behind the tax reform in Sweden was that the old system was inefficient and led to tax evasion (Calmfors, 2014). Two policies within the tax reform was a new property tax, and the interest deduction was changed. The property tax which had been a progressive property tax which was linked to the income taxation was abolished. The new property tax was determined by the assessed value, which was 75 percent of the market value of the property. The market value was determined by the property- and its yard size, quality, and where it was located (Swedish Tax Agency, 2007). The interest deduction was reformed as well. It was first introduced to make it easier for individuals to take on bigger loans and not being afraid to invest in a home and influence more individuals to become householders. It was a percentage of the interest one pays on their loan and was able to deduct from the income tax return. The interest deduction was first restricted to 50 percent in 1985 and was then reduced to 30 percent in the tax reform in 1990 (Swedish Tax Agency, 2015).

Furthermore, the Swedish currency was impacted by several waves of speculations, which led to increases in the marginal rate. In a final attempt to stop the outflow of currency, the marginal rate was raised to a historical 500 percent in September 1992. However, in November of the same year, the policy regime was abolished, and the SEK was allowed to float (Swedish Riksbank, 2019; Debelle, 2004). With a combination of the increasing marginal rate and the tax reform, especially the reduced interest deduction, this lead to increased floating mortgage rates to levels around 24 percent in 1992. Therefore, the change of the interest deduction should be seen as an underlying factor to the burst of the boom (Sandberg, 2005).

Since the 1990s, several changes have been made on the property tax rates and can be observed in Appendix A (Henrekson & Stenkulla, 2015; Swedish Tax Agency, 2007). In 2008 the property cap tax was introduced which replaced the old property tax. The property cap tax is determined by a fixed maximum amount which is bound to an index. In other words, properties which have a low assessed value pays a lower tax in comparison to those with a high assessed value. The property cap tax has changed over the years since it was introduced. Today is it 0.75 percent of the assessed value of the property, but the tax has a maximum amount, which is 8049 Swedish kronor (Englund, 2001; Swedish Tax Agency, 2018). Moreover, the interest deduction has been on the same level since the tax reform in the 1990s (Swedish Tax Agency, 2015).

As stated in the introduction, the Swedish house prices boom started in the mid-1990s, and the length and magnitude have not been seen before in recent history (Swedish Riksbank, 2018a; Englund, 2011). This development with rising house prices can also be observed in figure 1.

Several have pointed out the development of the Swedish housing market as a potential macroeconomic risk, e.g., the Financial Supervisory Authority of Sweden (2018), the Swedish Riksbank (2018a) and the International Monetary Fund (IMF) (2019). The high level of household debt is one factor that the Financial Supervisory Authority of Sweden is concerned about. The high level of the debt-to-income ratio has several explanatory factors, and many are linked to the housing market. One reason is that the share of owner-occupied housing has increased in Sweden. Another factor is that taxes on housing services have declined and that the interest rates have been trending downwards since 1993. The rapid increase in house prices has also fueled the household debt-to-income ratio since the prices have increased more than disposable incomes (Financial Supervisory Authority of Sweden, 2018). The Swedish Riksbank also points out the Swedish household debt as the most severe risk on the financial stability and the rising house prices are pointed out as an explanatory factor on the increasing household debt (Swedish Riksbank, 2018a).

Due to the higher level of household debt, the Financial Supervisory Authority of Sweden has introduced several macroprudential policies that aim to reduce the risks on Swedish households and banks. In 2010 a mortgage cap was imposed, and in 2014 the Financial Supervisory Authority of Sweden introduced capital requirements on Swedish banks. In 2016 the Financial Supervisory Authority of Sweden introduced amortization requirements on loans, and in 2018 did they presented an even more stringent amortization requirement. The requirements do, e.g., mean that if an individual with a debt-to-income level higher than 450 percent and a loan-to-value of 70 percent or higher has to amortize 3 percent of the loan yearly. This action has resulted in a slight decrease in the house prices as well in the aggregate household debt (Financial Supervisory Authority of Sweden, 2019).

In 2017 Sweden experienced a fall in the house prices, and the decrease was most extensive in the major cities. This has increased the uncertainty on the Swedish housing market, and there are some indications that housing investments are going to decrease in the short run. The Swedish Riksbank states that the recent price drop reveals faults in the financing model that has been common when housing investors[1] build new houses in Sweden. The major problem, according to the Swedish Riksbank, is that households take a large share of the risk associated with the investments. The reason is that it is common to require that the house should be sold before the production start. This has resulted in a lower risk for the investors and the banks. However, it has increased the risk for households. In the long-run, it is expected that other financing models become more common where the risks are more evenly shared so more houses can be produced (Swedish Riksbank, 2018a).

To be able to observe the risk on the housing market, the Financial Supervisory Authority of Sweden performs stress tests on the Swedish household economy continuously. The stress test investigates how the Swedish households' react to increases in unemployment rates, interest rates, and declines in house prices. In the early of 2019, the Financial Supervisory Authority of Sweden found that a decrease in the house prices in combination with higher interest rates would have a marginal effect on the Swedish households' economy. Only 2.7 percent of the Swedish households would experience a deficit in their monthly budget and obtain a higher debt than assets if the house prices would drop 40 percent, and the interest rates would increase 5 percent. The Financial Supervisory Authority of Sweden stress tests show that the resilience of Swedish households has increased since 2013 and especially after 2015. The Financial Supervisory Authority of Sweden also states that resilience among Swedish households had improved in 2018. However, household consumption is still expected to decrease if their economic situation worsens. Particularly among those households that have a high debt relative to their income or the value of their house. This can affect the economic development negatively depending on the magnitude of the decrease in households' consumption (Financial Supervisory Authority of Sweden, 2019). Furthermore, the Swedish Riksbank states in their financial stability report from 2018 that if the uncertainty on the Swedish housing market or if

[1] A housing investor is a firm that invests in land or existing buildings for housing projects. However, the construction work is outsourced to a construction firm.

the house prices decrease further can result in problems for several households and housing investors which can cause macroeconomic consequences. This chain of events is a potential threat against the financial stability (Swedish Riksbank, 2018a).

2.2 Policy reforms

To preserve the financial stability, several policy interventions have been applied as mentioned before, such as amortization requirements, capital requirements, and mortgage caps. Further policy interventions have been proposed. Potential reforms concerning the interest deduction and the current property cap tax have been widely debated in the Swedish parliament. A vast majority of the Swedish parliament is against an abolishment of the interest deduction, but six out of eight parties are in favor of a gradual decrease. Moreover, there is also a vast majority in the Swedish parliament against changing the current property cap tax (Bratt, 2018).

Several within the non-political Swedish authorities are positive to a gradual decrease of the interest deduction. Both the Swedish Riksbank's governor, Stefan Ingves, and the director general of the Financial Supervisory Authority of Sweden, Erik Thedéen, are in favor of a gradual decrease. Ingves also discusses the importance of being aware of Swedish households' debt ratio and suggests that the gradual decrease of the interest deduction could be a possible solution (Mölne, 2018; Rex, 2018).

Furthermore, both the Swedish Riksbank and the Financial Supervisory Authority of Sweden are also positive for a change in the tax system regarding a reintroduced property tax. They both raise the struggle thought politically to reintroduce a property tax because taxes overall are not popular among the population (Swedish Riksbank, 2018b; Rex, 2018).

Additionally, Ingves has also stated that the problems linked to the Swedish housing market have occurred over many years, and the situation is unsustainable. Moreover, Ingves claims that the system today creates insiders and outsider dilemma on the Swedish housing market. Those individuals that have an owner-occupied house have several benefits and can earn money on their homeownership. In contrast to those individuals that are outside the owner-occupied house market. This has led to skewness in the system. The macroeconomic reforms[2] that has been introduced by the Financial Supervisory Authority of Sweden has helped, yet Ingves claims that more structural reforms are needed (Ingves, 2019).

The First Deputy Governor of the Swedish Riksbank Kerstin af Jochnick also states that the policy reforms that were introduced by the Financial Supervisory Authority of Sweden have made Swedish households more robust. However, af Jochnick claims that more has to be done. Af Jochnick points out that there needs to be reforms in the Swedish construction sector and the tax system. The reforms should aim for a better variation of housing in Sweden, and the deductibility of mortgage interest payments should be reviewed (af Jochnick, 2019).

The IMF has also suggested that Sweden needs several structural reforms to tackle the dysfunctional housing market. Rent controls, construction regulations, and tax policies are areas where there need to be improvements according to the IMF. Furthermore, it is suggested that the property cap tax should be higher, and the mortgage interest deductibility should be phased out to incentivize efficient property allocation (IMF, 2019).

Another organization that points out that structural changes are needed in Sweden to restore access to affordable housing for all is the Organization for Economic Co-operation and Development (OECD). With generous deductibility of mortgage interest with low property taxes (cap tax) has made homeownership more favorable over renting. A way to make it more neutral between homeownership and renting is to phase out the deductibility of mortgage interest. Alternative policy intervention is to increase the property tax (cap tax) and continue with the deductibility of mortgage interest, which can have some distributional advantages, especially for younger households. OECD also points out reforms in the construction sector and

[2] i.e. amortization requirements, loan-to-value ceiling and capital requirements for Swedish banks,

the rental regulations as other potential measures that can have positive effects on the Swedish housing market (OECD, 2019).

The abolishment of the interest deduction and a reintroduced property tax have been widely debated among economists. Hansson (2014) states that the abolishment of the property tax led to a skewness of investments and consumption behavior since it made housing investments more profitable compared to other investments. Furthermore, Hansson (2014) also claims that one advantage with the property tax is that it is an inelastic tax. In contrast to taxes on capital gains that are more elastic and can cause more changes in behavior among individuals, e.g., that investments of capital income are moved abroad if a capital tax increases.

Another economist who is in line with Hansson is Calmfors, which in 2014 argues that the abolishment of the property tax has made investments and consumption on owner-occupied housing more profitable over other investments and consumption. According to Calmfors will a property tax make the tax system more neutral and not encourage housing investments over other investments and vice versa with consumption. Calmfors also suggest that a combination with a reintroduced property tax and a lower capital gain tax rate could increase the movement on the housing market. Both Hansson (2014) and Calmfors (2014) brings up the legitimacy problems that were associated with the old property tax. One explanatory factor behind the legitimacy problems was that the tax caused some liquidity problems for some households. Calmfors (2015) also argue that an abolishment of the interest deduction could be a solution to the problem with rising house prices. However, Calmfors (2015) believes that the property tax is a preferred solution to the problem. That something is needed to be done to deal with the problem associated with the Swedish housing market has been clarified in this section. The effects of the two different policy interventions will be examined in the next sections of the paper.

3 Models concerning the housing market

3.1 Empirical and theoretical approaches

There is a rich literature on the housing market where both empirical and theoretical approaches have been used. One empirical paper by Agnello and Schuknecht (2011) investigates the real estate price boom and busts in industrial countries. The paper uses a methodology that initially was presented by Harding and Pagan (2002), i.e., to look at first differences on de-trending annual logged real house prices series and detect troughs and peaks. Others have also investigated the autocorrelation in the first difference of house prices, e.g., Glaeser and Gyourko (2007) and Englund and Ioannides (1997). Both of these papers found that there is a positive autocorrelation in the first difference of house prices, which indicates that house prices are predictable in the short-run to some degree. Furthermore, Allen and Rogoff (2011) state that the positive autocorrelation can cause persistence in housing bubbles. However, the paper also concludes that more research is needed to detect the factors behind the autocorrelation.

When investigating the housing market from a more theoretical approach, it is common to look at the fundamental house prices and the user cost of housing. Turk (2015) examines the interaction between household debt and housing prices in Sweden using a three-equation model. Furthermore, Turk (2015) concludes that housing prices and household debt are estimated above their long-run equilibrium levels. The paper also states that a gradual phasing out of mortgage interest deductibility is going to have a significant effect on housing prices and household debt. Englund (2011) concludes that decreasing user costs in Sweden has driven down the rent-to-price ratio and also that rental apartment rents have lagged behind the value of owner-occupied housing services. Claussen (2013) investigates Swedish house prices with a one equation error correction model. The findings are that fundamental factors can explain most of the rapid increase in Swedish house prices and that Swedish house prices were at the fundamental level in 2011. As much as 95 percent of the increase in the fundamental house price since 1996 can be explained by rising real disposable income, household real financial wealth and the fall in the real mortgage rate.

Hott and Monnin (2008) present a model for estimating fundamental house prices, which is based on the methodology developed by Campbell and Shiller (1988). The paper by Hott and Monnin (2008) find some evidence that house prices for the UK, Switzerland, Japan, Netherlands, and the USA deviate for long periods from their fundamental values. Furthermore, Hott and Monnin (2008) state that in the long run, there is some evidence that actual house prices tend to return to their fundamental price level. Bergman and Sørensen (2016) present a fundamental house price model, which is similar to the methodology used by Hott and Monnin (2008). The model can be used to analyze possible simulations of policy-induced shocks to the housing market. Bergman and Sørensen (2016) investigate the Danish housing market with quarterly data from 1974 to 2015 and the Swedish housing market with quarterly data from 1986 to 2015. Evidence presented shows that the actual prices converge on fundamental prices. Furthermore, Bergman and Sørensen (2016) simulate the removal of the deductibility of mortgage interest payments in Sweden. The simulation shows the development of the fundamental house prices, and it is expected to be 6 percent lower in 2018 compared to 2015.

3.2 The fundamental house price model by Bergman and Sørensen

The purpose of this paper is to analyze two different policy-induced shocks. At first, the removal of the deductibility of mortgage interest payments is analyzed. Moreover, the second policy-induced shock is a reintroduced property tax. Since this paper aims to investigate what effect policy interventions have on fundamental house prices, a theoretical model is used that we parameterize with real data. A methodology suitable to this is the one presented in Bergman and Sørensen (2016). The section below describes the model from Bergman and Sørensen (2016), where the full derivation can be found.

Table 1: Notations
$\boldsymbol{P}$ = real price of a unit of owner-occupied housing,
$\boldsymbol{R^H}$= imputed rent on a unit of owner-occupied housing,
$\boldsymbol{R}$ = real rent on a unit of rental housing,
$\boldsymbol{Y}$ = aggregate real disposable household income,
$\boldsymbol{H}$ = aggregate real housing stock,
$\boldsymbol{i}$ = nominal mortgage interest rate,
$\boldsymbol{\pi}$ = expected rate of consumer price inflation,
$\boldsymbol{\tau^i}$ = interest deduction rate,
$\boldsymbol{\tau}$ = effective property tax rate,
$\boldsymbol{\eta}$ = user cost premium for risk and credit constraints (constant),
$\boldsymbol{\delta}$ = rate of depreciation of the real housing stock (constant),
$\boldsymbol{E_t[X_{t+i}]}$ = expectation held at time t regarding the value of variable X at time t + i
$\boldsymbol{\varepsilon_Y}$ = long-run income elasticity of housing demand
$\boldsymbol{\varepsilon_R}$ = long-run price elasticity of housing demand

3.2.1 The theoretical model

The imputed rent on a unit of owner-occupied housing is the marginal rate of substitution between housing service and all other goods. In other words, it is the amount the consumer is willing to pay for the housing service. The user cost in Bergman and Sørensens model includes the nominal mortgage interest rate, the interest deduction rate, the expected consumer price inflation rate, the effective property tax rate, the depreciation rate of real housing stock and the user cost premium for risk and credit constraints. The user cost can be observed in equation (1).

$$\gamma_t = i_t(1-\tau^i) - \pi_t + \tau_t + \delta + \eta \tag{1}$$

Assuming that agents are rational, the fundamental house price is the discounted expected future imputed rents, which is defined in equation (2). One can see that the period-by-period discount rate is equal to the user cost.

$$P_t = E_t\left[\sum_{i=0}^{\infty} \frac{R_{t+i}^{H}}{\prod_{j=0}^{i}(1+\gamma_{t+j})}\right] \qquad \textbf{(2)}$$

Bergman and Sørensen (2016) present two approaches to estimating the expected future imputed rents, which is the same approach that is presented in Hott and Monnin (2008). First, a rent model is presented which assumes that the imputed rent is a fraction of the cost of rental housing. This paper is going to focus on the second model presented, which is called the supply-and-demand model (SD). In this model, it is assumed that the imputed rents are adjusting after the supply and demand for housing services. In a housing market equilibrium, the demand is equal to the supply, which is defined as the aggregate housing stock. This yields the following expression for the imputed rents.

$$R_t^H = B^{1/\varepsilon_R} Y_t^{\varepsilon_Y/\varepsilon_R} H_t^{-1/\varepsilon_R} \qquad \textbf{(3)}$$

Where B is a constant, ε_Y and ε_R are elasticities, Y is the disposable income, and H is the aggregate housing stock. Equation (2) and (3) can be used when calculating the fundamental house price. Bergman and Sørensen (2016) introduce the variable price-to-imputed-rent ratio to make the fundamental house price model more appropriate for estimation purposes.

$$X_t = \frac{P_t}{R_t^H} \qquad \textbf{(4)}$$

Using this ratio, it is possible to rewrite the definition for fundamental house prices in terms of the price-to-imputed-rent ratio instead. By using natural logarithms and the first-order Taylor approximation, the following equation is calculated.

$$x_t \approx ln(1+exp(\bar{m})) + \left(\frac{exp(\bar{m})}{1+exp(\bar{m})}\right)(x_{t+1}^{e} + \Delta r_{t+1}^{He} - \bar{m}) - \gamma_t \qquad \textbf{(5)}$$

$$\bar{m} = \bar{x}^{e} + \Delta\bar{r}^{He}$$

The lowercase letters are the logged value, and the superscripted *e* is a notation for the expected value. Furthermore, the following expression is defined.

$$\phi = \frac{exp(\bar{m})}{1+exp(\bar{m})} \tag{6}$$

Using this expression, it is possible to rewrite equation (5) in the following way.

$$x_t = \kappa + \phi(x_{t+1}^{e} + \Delta r_{t+1}^{He}) - \gamma_t \tag{7}$$

$$\kappa = -\phi\, ln(\phi) - (1-\phi)\, ln(1-\phi) \tag{8}$$

If it is assumed that agents are forward-looking, it is possible to derive equation (9) using forward iteration.

$$x_t = c + \sum_{j=1}^{\infty} \phi^j E_t[\Delta r_{t+j} - \gamma_{t+j}] - \gamma_t \tag{9}$$

$$c = \frac{\kappa}{1-\phi}$$

By taking natural logarithms of equation (3) and then calculate the first differences, the following expression is defined.

$$\Delta r_{t+j}^{H} = \left(\frac{\varepsilon_Y}{\varepsilon_R}\right) \Delta y_{t+j} - \left(\frac{1}{\varepsilon_R}\right) \Delta h_{t+j} \tag{10}$$

By substitute equation (10) into equation (9) the linear version of the Supply-and-Demand model is obtained.

$$x_t = c + \sum_{j=1}^{\infty} \phi^j E_t\left[\left(\frac{\varepsilon_Y}{\varepsilon_R}\right) \Delta y_{t+j} - \left(\frac{1}{\varepsilon_R}\right) \Delta h_{t+j} - \gamma_{t+j}\right] - \gamma_t \tag{11}$$

3.2.2 The model for estimation purposes

To be able to use the formula presented in equation (11) in analysis, one must know how agents' expectations are formed. Bergman and Sørensen (2016) follow Hott and Monnin (2008) and several others when the authors are modeling agents' expectations. The assumption is that agents form their expectations with a vector autoregressive (VAR) model. The variables used in the VAR model developed by Bergman and Sørenssen are those that determine the fundamental house price according to their theoretical model presented above. Those variables are the following, the first difference of logged real rent on a unit of rental housing, the first difference of the logged disposable income, the user cost of owner-occupied housing and the first difference of the logged aggregate housing stock. Following Bergman and Sørenssen (2016), this paper also includes the first difference of the logged actual house prices since it is reasonable to assume that agents include the actual prices in their forecasts. Furthermore, the real rents are included in the VAR model even though the theoretical Supply-and-Demand model is not directly affected by the real rents. The motivation Bergman and Sørensen (2016) has is that the explanatory variables in the SD model is expected to interact with the real rents and should, therefore, be included in the VAR forecasting model. The matrix form of the VAR forecasting model is presented in equation (12) and (13) below.

$$b_t = \Phi_0 + \Phi_1 b_{t-1} + \Phi_2 b_{t-2} + \cdots + \Phi_n b_{t-n} + \varepsilon_t \tag{12}$$

$$b_t = \begin{vmatrix} \Delta p_t^a \\ \Delta r_t \\ \gamma_t \\ \Delta y_t \\ \Delta h_t \end{vmatrix} \tag{13}$$

Φ_0 is a 5 x 1 column vector of constants and where Φ_j is the 5 x 5 matrix of coefficients on the lagged endogenous variables with lag length j. The VAR(n) model presented above can be transformed into a VAR(1) model in the following way. At first, the column vector z_t is defined in equation (14).

$$z_t \equiv \begin{bmatrix} b_t - \mu \\ b_{t-1} - \mu \\ . \\ . \\ b_{t-n+1} - \mu \end{bmatrix} \qquad \mu = (I_5 - \Phi_1 - \cdots - \Phi_n)^{-1}\Phi_0 \tag{14}$$

With this definition on z_t it is possible to rewrite the VAR(n) model presented in equation (13) into the equation below.

$$z_t = Az_{t-1} + \xi_t \quad \textbf{(15)}$$

$$A \equiv \begin{bmatrix} \Phi_1 & \Phi_2 & . & \Phi_{n-1} & \Phi_n \\ I_5 & 0 & . & 0 & 0 \\ 0 & I_5 & . & 0 & 0 \\ . & . & . & . & . \\ 0 & 0 & . & I_5 & 0 \end{bmatrix}$$

$$\xi_t \equiv \begin{bmatrix} \varepsilon_t \\ 0 \\ . \\ . \\ . \\ 0 \end{bmatrix}$$

The reason why the VAR(n) model is transformed into a VAR(1) model is to be able to estimate the expected future values of the variables in the VAR(n) model. To calculate these future expected values, the equation presented below is used.

$$E_t[z_{t+i}] = A^i z_t \quad \textbf{(16)}$$

The Supply-and-Demand model (11) can now be written in the following general form.

$$x_t = \sum_{j=1}^{\infty} \phi^j g_1 A^i z_t + g_2 z_t \rightarrow x_t = [g_2 + \phi g_1 A(I - \phi A)^{-1}] z_t \quad \textbf{(17)}$$

$$g_1 = [0\ 0 - 1\ \left(\frac{\varepsilon_Y}{\varepsilon_R}\right)\ 0 \dots 0]\ g_2 = [0\ 0 - 1\ 0\ 0\ 0 \dots 0] \quad \textbf{(18)}$$

$$\phi = \frac{exp(\bar{x}^e + \triangle\bar{r}^H)}{1 + exp(\bar{x}^e + \triangle\bar{r}^H)} \quad \textbf{(19)}$$

By using equation (17-19), it is possible to obtain an estimate for the fundamental price-to-imputed-rent ratio. In equation (19), the $\bar{x}^e$ is the expected mean value of x_t that is not observed. Bergman and Sørensen (2016) assume that the actual house prices have the same mean as the fundamental house prices. With this assumption, it is possible to estimate the expected mean of x_t in the following way.

$$\bar{x}^e = \bar{p}^a - \bar{r}^H \quad \textbf{(20)}$$

$\bar{r}^H$ is the mean of the level of imputed rent that is not directly obtained. Therefore is the mean estimated in the following way in equation 21. Where $\bar{p}^a$ is the mean value of logged actual house prices, and $i(1-\tau^i)-\pi$ is also a mean value over the sample period.

$$\bar{r}^H = \bar{p}^a + log[i(1-\tau^i)-\pi] \quad \textbf{(21)}$$

Furthermore, it is possible to back out the estimate of the fundamental house price from equation (3) and (4).

$$\hat{p} = x_t + \left(\frac{\varepsilon_Y}{\varepsilon_R}\right) y_t - \left(\frac{1}{\varepsilon_R}\right) h_t + \beta_0 \quad \textbf{(22)}$$

The β_0 is a constant that captures the conversion factor which is needed to transform the data into comparable units. It also captures the constant part in equation (3). Bergman and Sørensen (2016) estimate the β_0, so the sum of the squared deviations of the log of the actual house prices from the estimated log of the fundamental house prices is minimized.

$$\beta_0 = \left(\frac{1}{T}\right) \sum_{t=1}^{T} \left(P_t^a - x_t - \left(\frac{\varepsilon_Y}{\varepsilon_R}\right) y_t + \left(\frac{1}{\varepsilon_R}\right) h_t\right) = \bar{p}_t^a - \bar{x}_t - \left(\frac{\varepsilon_Y}{\varepsilon_R}\right) \bar{y}_t + \left(\frac{1}{\varepsilon_R}\right) \bar{h}_t \quad \textbf{(23)}$$

Following Berman and Sørensen (2016), the expression above is inserted in equation (20) to get the following expression for the estimated fundamental house price.

$$\hat{p} = \bar{p}_t^a + (x_t - \bar{x}_t) + \left(\frac{\varepsilon_Y}{\varepsilon_R}\right)(y_t - \bar{y}_t) - \left(\frac{1}{\varepsilon_R}\right)(h_t - \bar{h}_t) \quad \textbf{(24)}$$

Bergman and Sørensen (2016) present two different cases for the fundamental house prices. One baseline case where both the long run elasticities ε_Y and ε_R are equal to 1. The other case is a robustness check where ε_R is equal to 0.5 and ε_Y is equal to 1.

3.2.3 Policy simulation procedure

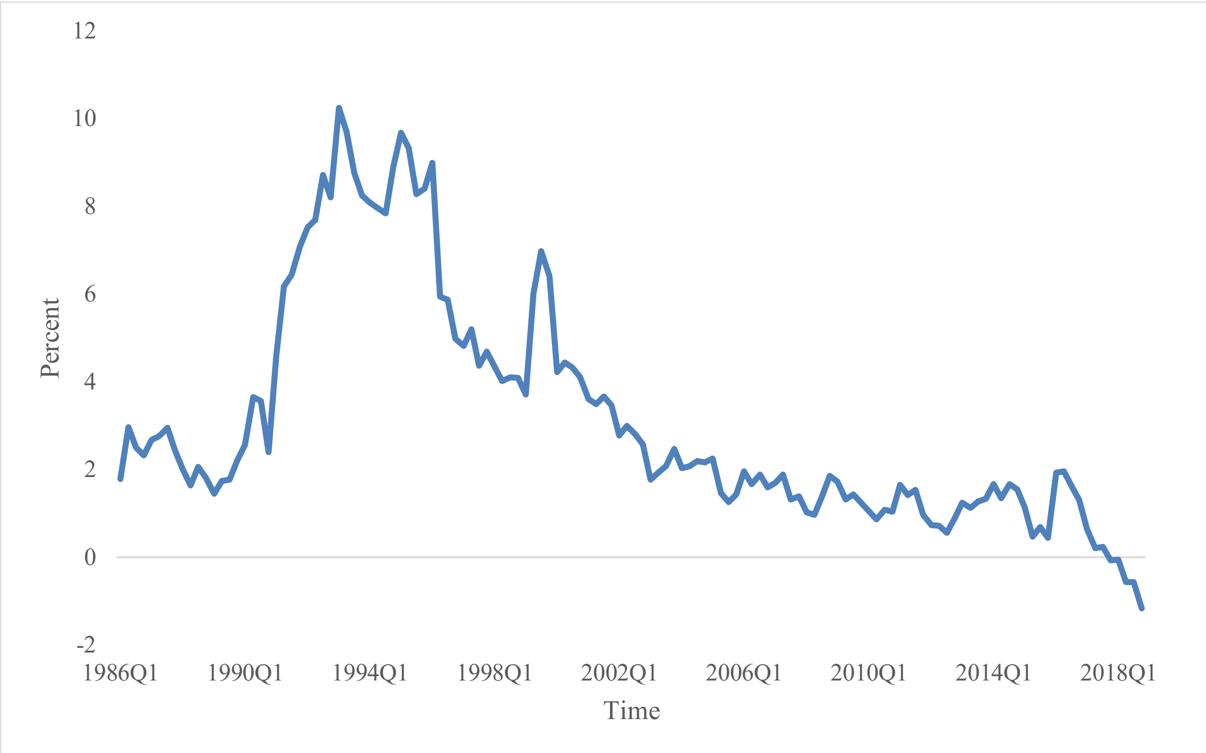
Bergman and Sørensen (2016) also present a procedure to simulate policy-induced shocks to the housing market. It is stated that policy interventions on the housing market usually work via changes in the user cost. The simulated policy reform is assumed to be unanticipated before it is implemented, so there are no announcements effects. However, the policy reform is assumed to be built into all future user cost forecasts from the implementation date. Due to the structural break that the policy intervention causes to the user cost, it is not possible to forecast future values on the user cost with the VAR(1) model (equation 15). The user cost is therefore forecasted exogenously and is then fed into the VAR(1) model to help forecast the other variables.

4 Data

We collect data from several sources to calibrate the model. The time period is between 1986 and 2018, and the reason 1986 is a good year to start from is because this is the first year after the deregulation on the borrowing market and the new system on borrowing was introduced which allowed for heavier borrowing for individuals.

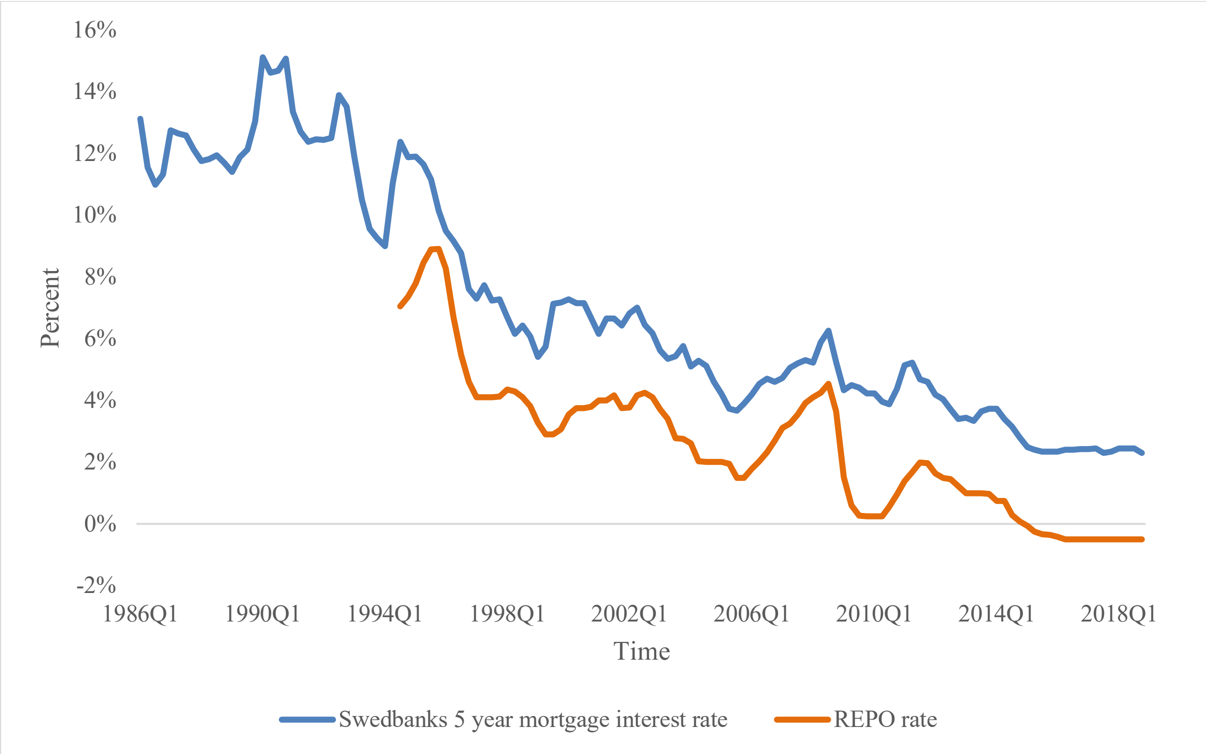
The actual house prices that were used are the house price index from Statistics Sweden (SCB) that is deflated by the consumer price index with a fixed interest rate (CPIF) and then recalculated with the base year 1986Q1. The house price index includes prices on one- and two-dwelling buildings and not tenant-owned flats. The data concerning the tenant-owned apartment is only available from the early 2000s and is therefore not included in this paper. The user cost is calculated under the assumptions that $\delta + \eta = 0$. Furthermore, the nominal interest rate i_t is Swedbank's 5-year mortgage interest rate. The interest deduction rate τ^i and the effective property tax rate τ between 1986-2015 were collected from Bergman and Sørensen. The interest deduction rate has been the same from 2015 to 2018, and the effective property tax from 2015 was calculated with the average municipality property cap tax and the average assessed value on dwellings downloaded from Statistics Sweden. The expected inflation was gathered from the National Institute of Economic Research of Sweden. The real rent proxy that is used in this paper is the same as Bergman and Sørensen (2016) used which is the CPI component of rents for housing which is downloaded from Statistics Sweden (COICOP04). The disposable income and the housing stock was collected from Statistics Sweden. The housing stock data had some minor problems because SCB only published data from 1990 and forward because of a new method of estimating the housing stock. This paper uses data from 1986 and therefore was the housing stock between 1986-1989 calculated with the approach from Sørensen and Whitta-Jacobsen (2010) which is inspired by the theory of the housing market that is presented in Poterba (1984) (see Appendix B). Since the house price data concerns one and two dwelling buildings, the housing stock also excludes tenant-owned apartments. Figure 2 illustrates the user cost of owner-occupied housing and the changes over the period 1986-2018. One can observe that the user cost has structurally declined since the 1990s in Sweden and are currently on lower levels than before the banking crisis in Sweden in the 1990s. In order to calculate the exogenous forecast of the user cost, the expected future values of the interest rate and the inflation are needed. These variables were collected from the Swedish Riksbank monetary policy report from December 2018. The historical data on the REPO-rate between 1994Q3 to 2018Q4 was also collected from the Swedish Riksbank. The historical data on the REPO-rate was used to calculate an average spread between the policy rate and the Swedbank's 5-year mortgage interest rate, which was then used in the forecast. The development of the two rates can be observed in figure 3.

Figure 2. *User cost of owner-occupied housing*



Source: Own calculations

Figure 3. *Swedish interest rates*



Source: the Swedish Riksbank (2019) and Swedbank (2019)

5 The fundamental house price analysis

In section 3, we presented the methodology that the following fundamental house price analysis will be based on. The first step is to diagnose the VAR model (equation 12), which is then used to calculate the Swedish fundamental house prices. The two policy interventions are then simulated to determinate what the effects these causes on the fundamental house prices.

5.1 The VAR-model

To determine the lag length of the VAR model (equation 12), the Bayesian information criterion with maximum 12 lags was used and indicated that the model should have three lags (see Appendix C: 1). However, the autocorrelation in the residuals was also tested with the Lagrange multiplier (LM) test for VAR-models, which was presented by Johansen (1995). The result indicates that the null hypothesis of no autocorrelation could not be rejected on the fifth lag (see Appendix C: 2). This motivates that there should be five lags in the VAR model.

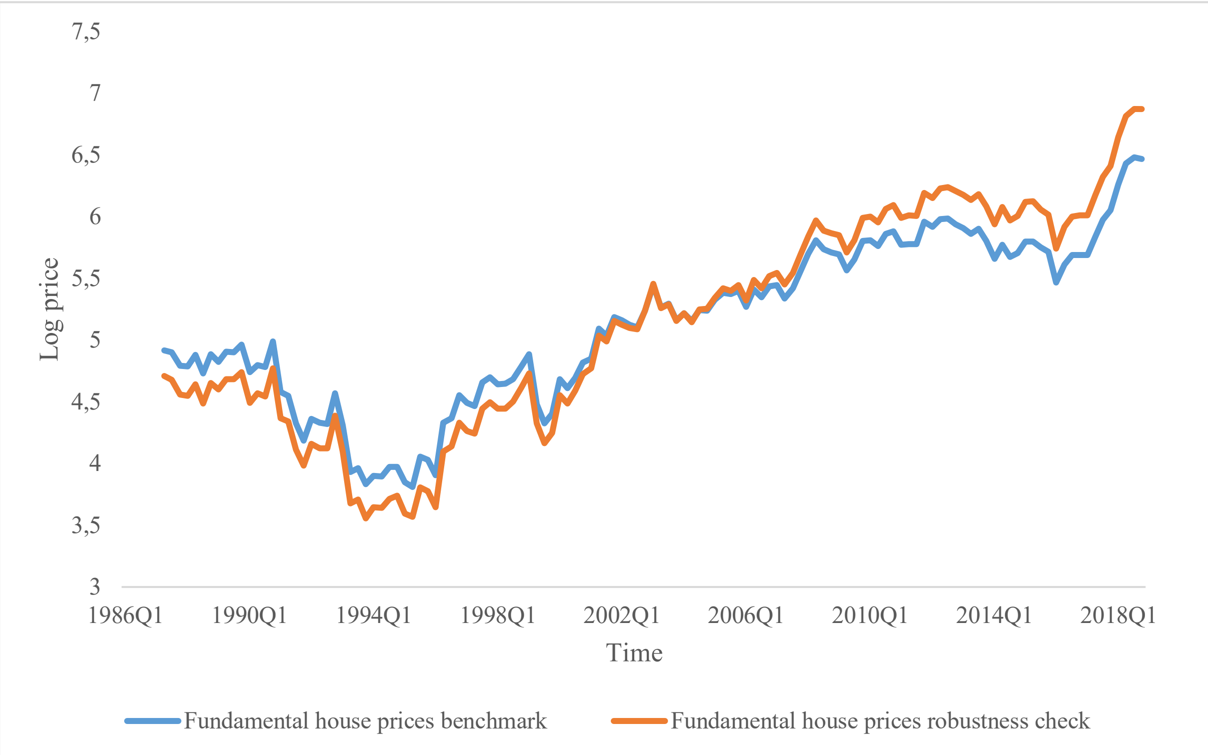
To check if the residuals in the VAR model are normally distributed, the Jarque-Bera test was used (see Appendix C: 3). The test indicates that there is no normal distribution when looking at the variables altogether, but the log of actual house price and the log of disposable income have normally distributed residuals themselves, while the other three do not when looking at each variable separately.

Furthermore, the existence of heteroscedasticity in the residuals was also examined. If heteroscedasticity in the residuals exist, then there will be volatility clustering in the time series. When testing if it exists, the Engle's Lagrange multiplier (LM) test for the presence of Autoregressive Conditional Heteroscedasticity (ARCH) was used. The test implies that there exist no ARCH effects on Δp_t^a,Δr_t, and γ_t, while Δy_t and Δh_t had indications of ARCH effects (see Appendix C: 4).

Bergman and Sørensen (2016) assume that their theoretical model is stable, which motivates test for unit roots and cointegration in the VAR model. To test for cointegration, the Johansen multiple trace test was used, and the result indicates that there are two cointegrated vectors. When excluding the user-cost variable and only test for the four other variables, then the Johansen-test does not indicate there exist any cointegration vectors (see Appendix C: 5). This result was expected since the Augmented Dickey-Fuller test was used on each of the variables, and the null hypothesis could be rejected on all variables besides the user cost (see Appendix C: 6). The reason why the test pointed out a potential unit root in the user cost case is likely because there has been a structural break in the constant and not an exploding covariance matrix. Moreover, the downward sloping user cost can be linked to the structural falling nominal interest rate during and reductions of the housing taxation the sample period. The falling nominal 5-year mortgage lending rate can be observed in figure 3. Since the nominal interest rate has a lower bound, it is reasonable to assume that the user cost will return to higher levels in the future and can, therefore, be treated as a stationary time series.

5.2 Fundamental house prices in Sweden

Figure 4. *Fundamental house prices in Sweden*



Source: Own calculations

Having diagnosed the lag length in the VAR(n) model (equation 12) to five lags, the model was estimated (see Appendix D). Then the model was transformed into the VAR(1) according to the procedure presented in section three (equations 14 and 15). By using equations (16-21), the fundamental price-to-imputed-rent ratio was estimated with the Supply-and-Demand approach. Following Bergman and Sørensen (2016) two different measurements on the elasticity ε_R to be able to check the robustness. By then using the equations (22-24), two different estimates of the fundamental house prices were calculated. In figure 4, these estimates are presented where the blue line is the benchmark case with $\varepsilon_Y$and $\varepsilon_R$are equal to 1. The orange line is the robustness check where ε_R is equal to 0.5 and $\varepsilon_Y$is equal to 1. It can be stated that the fundamental house prices have in both cases structurally increased since the mid-1990s.

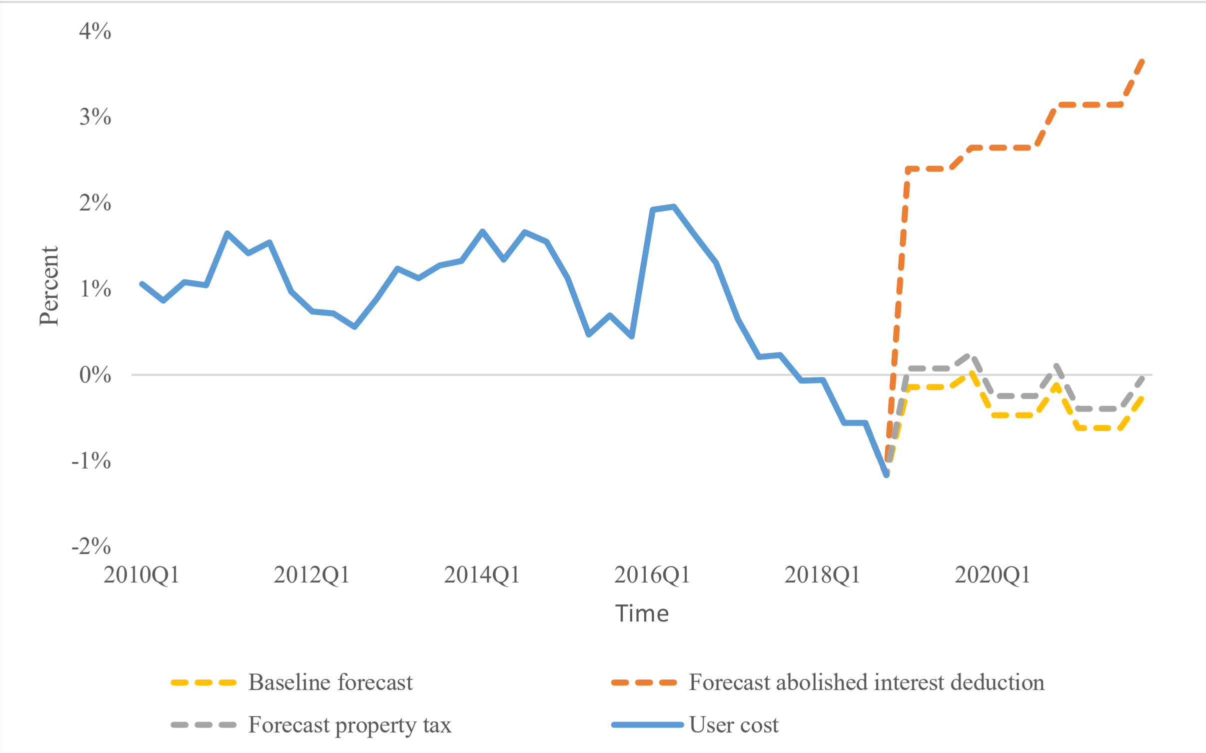
Furthermore, one can observe that since 2015, Sweden has experienced a sharper increase in the fundamental house prices. One possible explanation of the rapid increase might be the fact that Sweden experienced an expansive monetary policy during this period, and the REPO-rate was set below 0 percent in 2015.

5.3 Policy interventions

The current situation on the housing market in Sweden has made it clear that something is needed to be done by policymakers to slow down the development of house prices in Sweden. Since it is assumed by several studies that fundamentals determine the actual house prices in the long run (Hott & Monnin, 2008; Claussen, 2013; Bergman & Sørensen, 2016). This section is going to investigate two policy reforms that aim to decrease the fundamental house prices. The first policy intervention that is investigated is a reintroduced property tax in Sweden, and the second is the removal of the deductibility of mortgage interest payments. To be able to determinate the effects this forecast covers a three-year period from 2018Q4 to 2021Q4. Both of the policy interventions work throughout the user cost of housing (equation 1), which makes Bergman and Sørensen (2016) policy simulation procedure suitable. The first step in the policy simulation procedure was to estimate a baseline exogenous forecast on the user cost. The interest variable i_t is the Swedbank's 5-year mortgage interest rate which does not have any expected future time path. The solution to this problem, which is in line with Bergman and Sørensen (2016) is to use the Swedish Riksbank's forecast of the repo rate. The average spread between the two different interest rates was 2.74 percent over the period 1994Q3 to 2018Q4, and one can observe the development in figure 3. The average spread was then added to the forecast on the repo rate to make the forecast on the user cost more accurate.

In the baseline forecast, the effective property tax rate is expected to remain at the same level as in 2018Q4 during the forecast. The deductibility of mortgage interest payments is also at the same level as in 2018Q4 in the baseline forecast. The expected future inflation rate is also collected from the Swedish Riksbank, and the parameters $\delta + \eta$ is still assumed to be zero. The reintroduced property tax is simulated by doubling the effective property tax rate while the other variables are the same as in the baseline forecast. The removal of the deductibility of mortgage interest payments is simulated by increasing the user cost by $i_t * \tau_t^i$ in every period, so the user cost is defined as the following instead $\gamma_t = i_t - \pi_t + \tau + \delta + \eta$.

Figure 6. *Forecast user cost*



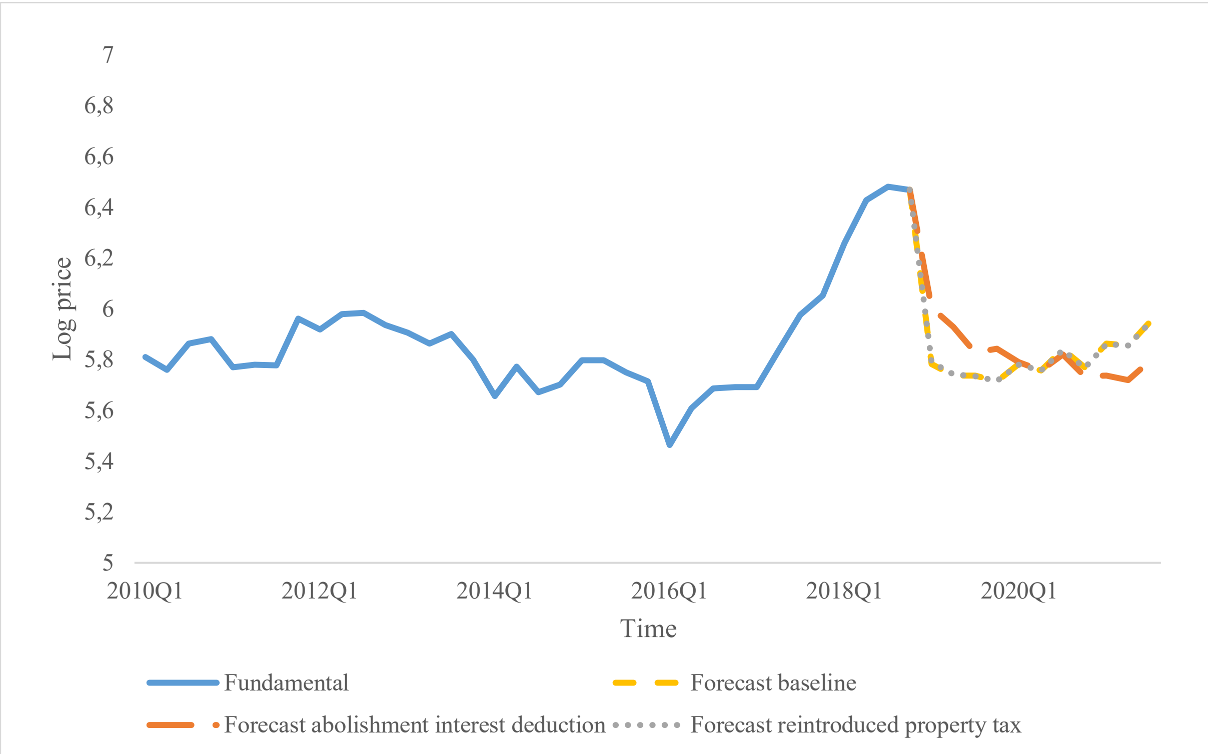
Source: Own calculations

In figure 6 the result is presented, which displays three different cases. First, when not applying any policy changes to the user cost (Baseline forecast). One may observe that the forecast of the baseline is higher than the earlier levels. This may depend on the interest rate, which is predicted to increase in the future.

The other two lines present what occurs when applying the two different policy changes. The orange line presents the result when removing the interest deduction, and the gray line shows the result when introducing the old property tax again. According to this forecast does this indicates that to be able to get back the user cost on higher levels is the best way to remove the interest deduction rather than introducing a property tax. The reintroduced property tax does not show to have a significant effect on the user cost in comparison to the abolishment of the interest deduction.

After the three different exogenous forecasts were done on the user cost, the other variables i.e. $\Delta p_t^a, \Delta r_t, \Delta y_t$, and $\Delta y_t$was forecasted dynamically with the VAR model. This resulted in three different forecasted time series on the variable *z*. By following equation (16) to (22), three different forecasted fundamental price series were calculated. Since the robustness check showed a similar result on the fundamental house prices over the sample period, the following simulation will assume that ε_Y and ε_R are equal to 1.

Figure 7. *Forecast fundamental house prices*



Source: Own calculations

Figure 7 presents the development of the fundamental house prices when introducing the two different policy changes and the baseline case. One can observe that the simulation of a reintroduced property tax follows the baseline simulation closely, which can be explained that the expected increase on the user cost after a reintroduced property tax is small. The policy simulation of the abolishment of the interest deduction has a more substantial expected impact on the fundamental house prices. It can also be stated that the abolishment of the interest deduction creates a smoother drop and afterward slowly and steady decreases. By the fourth quarter of 2021, the fundamental house prices are expected to be 9 percent lower if the property tax has been introduced. In comparison to the abolishment of the interest deduction where the fundamental house prices are expected to be 11 percent lower in the fourth quarter of 2021.

6 Discussion

The main findings of this paper are that the abolishment of the interest deduction had a more significant effect on the forecasts concerning the user cost and the fundamental house prices in comparison to the reintroduced property tax. Both of the policy intervention generates the desired effect, yet the abolishment of the interest deduction had a greater effect. However, one must be humble with the result since it is based on a theoretical model that makes several assumptions. Moreover, some of the parameters in the model are not directly obtained and therefore, several estimations have been made. However, one thing the authors of the model did was using an estimation of the housing stock and not the real housing stock, which is done in this paper as an improvement.

Nevertheless, there have been several others that have analyzed the abolishment of the interest deduction with various models which points in the same direction as the result of this paper. Furthermore, the expected result of this paper was that the reintroduced property tax would have shown a more substantial effect on the fundamental house prices, but this was not the case. A lot of previous studies from well-known economists and different authorities argue that the property tax should be reformed and reintroduced. It could be that the model may have some flaws when forecasting a change in the property tax and therefore, not show the expected result. With this in consideration, both of the analyzed policy interventions could be two alternatives to dampen the macroeconomic risk on the Swedish housing market.

With this result and the fact the Swedish REPO rate tends to continue to be on a low level this may indicate that the abolishment of the interest deduction can be a solution to suppress the aggressive development in the housing prices. It may be observed, according to the result, when removing the interest deduction would bring back the fundamental house prices to the similar levels that Sweden experienced before the REPO-rate became negative.

The abolishment may be a suitable policy intervention for two reasons. First, the removal has a smoother effect on housing prices when the interest rates are low, in comparison when they are on a higher level where the housing prices might experience a greater fall. Thus, the higher the interest rate is, the more are individuals able to deduct from their income tax return and vice versa. Second, the fact that the Swedish interest rates tends to be low for a couple of more years, some intervention might be needed to be able to prevent further aggressive increases in housing prices.

One can argue which of the two different policies is most morally justified to implement. An abolishment of the interest deduction may lead to those young individuals who are planning to become household owners for the first time may experience a struggle to do so without the interest deduction. At the same time, this paper has presented some indications that this policy intervention has a great impact on the user cost, which leads to lower expected future house prices. This can result in a lower macroeconomic risk in the housing market, which should be desirable.

The reintroduced property tax did show some effect and should be in consideration of possible reform. However, a reintroduced property tax also comes with its strengths and weaknesses. As Hansson (2014) and Calmfors (2014) stated, there is a risk that the property tax can cause some liquidity problems for some individuals. A property tax may force people to move when they owned a house for their entire working life and when they retire may not be able to afford to pay the tax if their house has raised in value. Therefore should a reintroduced property tax be reformed and become a more fair tax which not force individuals to move when they, for example, retire. However, this can also be seen as an advantage because it can result in higher mobility on the housing market and more efficient use of the existing housing stock. Moreover, another argument is that a property tax is less likely to suffer from tax evasion compared to other taxes since it is inelastic. The inelastic characteristics of the property tax might also result in more stable tax incomes.

The property tax may also generate some distributional advantages, which was stated in OECD's report from 2019. The current property cap tax has a price ceiling at 8049 SEK, and the fee is 0.75 percent of the assessed value. This implicates that all homes which have an assessed value approximate 1 100 000 SEK or higher have the same fee.

A reintroduced- and reformed property tax could be a removal of the existing price ceiling or an increased one which would mean that homeowners of a house that is worth more would pay a higher tax compared to those with a low-valued house. Just as Calmfors (2014) and Hansson

(2014) stated, in the background section, may the property tax makes the tax system more neutral and not encourage housing investments over other investments such as consumption and other assets investments. By introducing a property tax may then dampen the prices on the housing market because there may exist better investments.

Both of these policy interventions can also suppress the advantages of homeownership over renting, which has been brought up by, for instance, OECD. These structural reforms can also prevent further complications with outsiders and insiders on the Swedish housing market. Moreover, as Sandberg (2005) stated, the change of the interest deduction was an underlying factor of the burst of the boom in the early 1990s. Therefore, the two proposals should be handled with great care. Implementing these will have an impact on the user cost of housing, and if the business cycle changes into a recession at the same time as the implementation, this may end up destabilizing the economy. For this reason, it is essential if implementing these policy interventions that it happens in a plausible time period.

Finally, the two policy intervention needs to conquer the same problem. That is, how to get Swedish parliament to come to an agreement that one of these or a combination of the two policy changes may be a good instrument to control the further development of the Swedish housing prices. As mentioned in the background are a vast majority of the Swedish parliament against the property tax proposal, and none of the parties are in favor of a direct abolishment of the interest deduction but rather a gradual decrease of it. This may be understandable because both of these interventions will most likely cause the average householder in Sweden to have greater expenses, and households may experience a price fall of their home. These consequences may cause legitimacy problems and make it challenging for parties to argue why these policy interventions are needed and therefore will be needing a vast majority of the parties in the Swedish parliament to come to an agreement that they are needed. However, it is clear that some macroprudential measures are needed to prevent further rises in the fundamental house prices, which is one of the most significant macroeconomic risk in Sweden.

7 Conclusion and further studies

The purpose of this paper was to investigate two possible cases of macroprudential measures concerning the demand side of the Swedish housing market. An abolishment of the interest deduction and a reintroduced property tax. The methodology of this paper was a theoretical fundamental house price model that was parameterized with real data. These kinds of models are based on several assumptions and may contain flaws. Therefore, the result of this paper should be observed with caution.

The policy intervention which showed the largest effect on the future fundamental house prices were the abolishment of the interest deduction where the fundamental house price is expected to fall by 11 percent till the fourth quarter of 2021. The reintroduced property tax showed to have a 9 percent decrease in the fundamental house prices till the fourth quarter of 2021. Both of the two policy interventions come with strengths and weaknesses, which are examined in the discussion.

This paper has contributed with information for policymakers on which effects these two policy interventions could have on the fundamental house prices. Further studies could be done on the topic. One thing that would be interesting to investigate is how consumption would react when households' user cost increases. Just as house prices is an important macroeconomic variable is consumption it as well and needs to be observed with caution to be able to prevent the business cycle from shifting and turning into a recession. Furthermore, it would also be interesting to discuss whether a reintroduced property tax should be on a state level or a municipality level. In particular, to analyze the legitimacy of the tax and see which alternative can increase the mobility the most on the housing market. Another interesting question to further studies is to analyze the amortization requirements and loan-to-value ceiling together with the policy interventions discussed in this paper. Moreover, one can also analyze what effects a reintroduced property tax and the removal of the deductibility of mortgage interest payments have on housing investments.

References

Af Jochnick, K. (2019) *Öppet forum: En bostadsmarknad i balans – vilka åtgärder krävs?,* Stockholm: Swedish Riksbank, [video online], Available at: https://www.riksbank.se/sv/press-och-publicerat/riksbanken-play/2019/oppet-forum-en-bostadsmarknad-i-balans--vilka-atgarder-kravs/. [Accessed 11 May 2019]

Agnello, L. and Schuknecht, L. (2011). Booms and busts in housing markets: Determinants and implications. *Journal of Housing Economics*, vol. 20, no 3, pp. 171-190, Available Online: https://www.sciencedirect.com/science/article/pii/S1051137711000155 [Accessed 23 May 2019]

Allen, F. and Rogoff, K. (2011) Tillgångspriser, finansiell stabilitet och penningpolitik, in *Riksbankens utredning om risker på den svenska bostadsmarknaden,* pp. 189-217. Available Online: http://archive.riksbank.se/Upload/Rapporter/2011/RUTH/RUTH.pdf?fbclid=IwAR2oZaBupgNiYTSBCB2lqfmG8ZEAYsiilhv-TwoHGprh18dlgTw0GwMzrPo [Accessed 22 May 2019]

Bergman, U. and Sørensen, P. (2016). The Interaction of Actual and Fundamental House Prices: A General Model with an Application to Denmark and Sweden, working paper, no. 2016-04, Economic Policy Research Unit (EPRU), University of Copenhagen, Available Online: https://www.econstor.eu/bitstream/10419/175496/1/WP-2016-04.pdf. [Accessed 7 Feb 2019]

Borio. C (2014). Macroprudential frameworks: (too) great expectations? [pdf] Available at: https://www.bis.org/speeches/sp140813.pdf [Accessed 23 May 2019]

Bratt, F. (2018). Sex av åtta partier vill trappa ned ränteavdraget, *Expressen,* 19 June, Available Online: https://www.expressen.se/dinapengar/sex-av-atta-partier-vill-trappa-ned-ranteavdraget/ [Accessed 14 April 2019]

Campbell, J. and Shiller, R. (1988). The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors. *Review of Financial Studies*, vol. 1, no 3, pp. 195-228, Available Online:
https://academic.oup.com/rfs/article/1/3/195/1580239. [Accessed 1 April 2019]

Calmfors, L. (2014). Skattereform kräver tryck i välfärdsfrågan, in M, Bergstrand (eds), *En skattereform för 2000-talet.* Visby: PMJ, pp. 39-52. Available Online:
http://perseus.iies.su.se/~calmf/Skattereform_calmfors.pdf [Accessed 10 April 2019]

Calmfors, L. (2015). *Ränteavdrag*. Interview with Claes Aronsson and Mats Eriksson for *Sveriges Radio,* 30 October. Available at:
https://sverigesradio.se/sida/artikel.aspx?programid=1637&artikel=6291169 [Accessed 5 May 2019]

Claussen, C. (2013). Are Swedish houses overpriced?. *International Journal of Housing Markets and Analysis*, vol 6, no 2, pp. 180-196, Available Online:
https://www.emeraldinsight.com/doi/pdfplus/10.1108/IJHMA-12-2011-0056 [Accessed 6 April 2019]

David, P. Fic, T & Karim, D. (2011) Dynamiken på bostadsmarknaden och systemriskförebyggande verktyg, in *Riksbankens utredning om risker på den svenska bostadsmarknaden,* pp. 219-298. Available Online:
http://archive.riksbank.se/Upload/Rapporter/2011/RUTH/RUTH.pdf?fbclid=IwAR2oZaBupgNiYTSBCB2lqfmG8ZEAYsiilhv-TwoHGprh18dlgTw0GwMzrPo [Accessed 22 May 2019]

Debelle, G. (2004). Macroeconomic implications of rising household debt, working paper, no 153, Bank for International Settlements. Available Online:
https://www.bis.org/publ/work153.pdf [Accessed 17 may 2019]

Englund, P. (2001). Fastighetsskattens roll i skattesystemet, in *Sveriges Riksbank, Penning och Valutapolitik,* no. 2, pp 79-96. Available Online:
http://archive.riksbank.se/pagefolders/5314/pv012.pdf [Accessed 15 April 2019]

Englund, P. (2011). Svenska huspriser i ett internationellt perspektiv, in *Riksbankens utredning om risker på den svenska bostadsmarknaden,* pp. 23-96. Available Online: http://archive.riksbank.se/Upload/Rapporter/2011/RUTH/RUTH.pdf?fbclid=IwAR2oZaBupgNiYTSBCB2lqfmG8ZEAYsiilhv-TwoHGprh18dlgTw0GwMzrPo [Accessed 7 April 2019]

Englund, P. and Ioannides, Y. (1997). House Price Dynamics: An International Empirical Perspective. *Journal of Housing Economics*, vol. 6, no. 2, pp. 119-136, Available Online: https://www.sciencedirect.com/science/article/pii/S1051137797902102 [Accessed 23 May]

Financial Supervisory Authority of Sweden (2018). FI:s användning av makrotillsynsverktyg, no 6. [pdf], Available at: https://www.fi.se/contentassets/12b54f07845e42168c5c3b05f36211a3/fi-anvanding-makrotillsynsverktyg.pdf [Accessed 17 April 2019]

Financial Supervisory Authority of Sweden (2019). Den svenska bolånemarknaden, no. 3 [pdf], Available at: https://www.fi.se/contentassets/2035e995c0064717ac47665a6117b1ea/bolan_2019.pdf [Accessed 18 April 2019]

Glaeser, E. and Gyourko, J. (2007). Housing Dynamics, working paper, no. 2137, Harvard Institute of Economic Research (HIER), Harvard University. Available Online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=986604 [Accessed 23 May 2019]

Hansson, Åsa (2014), Dags för en ny skattereform. *Ekonomisk Debatt,* vol 42, no 4, pp. 42-53. Available Online: https://www.nationalekonomi.se/sites/default/files/NEFfiler/42-4-ah.pdf [Accessed 10 April 2019]

Hanson, S., Kashyap, A. and Stein, J. (2011). A Macroprudential Approach to Financial Regulation. *American Economic Association* vol. 25, no. 1, pp. 3-28. Available Online: https://www.jstor.org/stable/pdf/23049436.pdf?refreqid=excelsior%3A9d379fffc9796d6054cb010e301578af [Accessed 24 May 2019]

Harding, D. and Pagan, A. (2002). Dissecting the cycle: a methodological investigation. *Journal of Monetary Economics*, vol. 49, no.2, pp. 365-281. Available Online: https://www.sciencedirect.com/science/article/pii/S0304393201001088 [Accessed 23 May 2019]

Henrekson, M. and Stenkula, M. (2015). Swedish Taxation Developments since 1862. 1st ed. New York: Palgrave Macmillan US, pp.308-310.

Hott, C. and Monnin, P. (2008). Fundamental Real Estate Prices: An Empirical Estimation with International Data. *The Journal of Real Estate Finance and Economics*, vol 36, pp. 427-450. Available Online:
https://link.springer.com/content/pdf/10.1007%2Fs11146-007-9097-8.pdf [Accessed 2 April 2019]

Ingves, S. (2019). Ingves: Det krävs strukturella reformer på bostadsmarknaden. Available Online:
https://www.riksbank.se/sv/press-och-publicerat/tal-och-presentationer/2019/ingves-det-kravs-strukturella-reformer-pa-bostadsmarknaden/ [Accessed 14 May 2019].

International Monetary Fund (IMF) (2019). Sweden: 2019 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for Sweden. *IMF Country Report* No. 19/88. [pdf] Available at:
https://www.imf.org/en/Publications/CR/Issues/2019/03/26/Sweden-2019-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-46709 [Accessed 17 May 2019]

Johansen, S. (1995). Likelihood-based inference in cointegrated vector autoregressive models. *Econometric Theory,* vol. 14, no. 4, pp. 517-524. Available Online:
https://www.jstor.org/stable/pdf/3533216.pdf?refreqid=excelsior%3Afde0303ad8d2ea2bb5fb6b680999a579 [Accessed 11 May 2019]

Mian, A. and Sufi, A. (2010). Household Leverage and the Recession of 2007–09. *IMF Economic Review,* vol. 58, no. 1, pp. 74-117. Available Online:
https://link.springer.com/content/pdf/10.1057%2Fimfer.2010.2.pdf [Accessed 23 Feb 2019]

Mölne, V. (2018). Ingves: Lagstifta om bundna bolån. *Dagens Industri*, 24 May, Available Online:
https://www.di.se/nyheter/ingves-lagstifta-om-bundna-bolan/ [Accessed 14 may 2019]

Organisation for Economic Co-operation and Development (OECD) (2019). Economic Surveys Sweden. [pdf] Available at:
http://www.oecd.org/economy/sweden-economic-snapshot/ [Accessed 17 May 2019]

Poterba, J. (1984). Tax Subsidies to Owner-Occupied Housing: An Asset-Market Approach. *The Quarterly Journal of Economics*, vol. 99, no. 4, pp.729-752. Available Online:
https://www.jstor.org/stable/pdf/1883123.pdf [Accessed 9 May 2019]

Rex, M. (2018). FI-chefen varnar för skenande kostnader med nuvarande ränteavdrag. *Dagens Industri* 24 Nov,. Available Online: https://www.di.se/nyheter/fi-chefen-varnar-for-skenande-kostnader-med-nuvarande-ranteavdrag/ [Accessed 14 May 2019].

Sandberg, N. (2005). Konsten att skapa en finanskris, in Nils-Eric Sandberg (eds), Vad kan vi lära av kraschen? Bank- och Fastighetskrisen 1990-1993, Stockholm, SNS press, pp.11-31

Swedish Tax Agency (2007). Skatter i Sverige Skattestatistisk årsbok 2007 [pdf] Available at:
https://skatteverket.se/download/18.6efe6285127ab4f1d2580006908/1359707451725/15210.pdf [Accessed 3 April 2019]

Swedish Tax Agency (2015). Skatter i Sverige Skattestatistisk årsbok 2015 [pdf] Available at:
https://skatteverket.se/download/18.3810a01c150939e893f1bc72/1452521278721/skatter-i-sverige-skattestatistisk-arsbok-skv152-utgava18.pdf [Accessed 3 April 2019]

Swedish Tax Agency (2018). Kommunal fastighetsavgift kalenderåren 2008 -2019. [pdf] Available at:
https://skatteverket.se/download/18.309a41aa1672ad0c837ccd1/1548770730516/Kommunal+fastighetsavgift+kalender%C3%A5ren+2008-2019_Version+1.0.pdf. [Accessed 4 April 2019]

Swedish Riksbank (2018a). Finansiell stabilitet. 2018:2 [pdf] Available at: https://www.riksbank.se/globalassets/media/rapporter/fsr/svenska/2018/181121/finansiell-stabilitetsrapport-2018_2 [31 March 2019]

Swedish Riksbank (2018b). Årsredovisning för Sveriges riksbank 2017. 2018:2. [pdf] Available at: https://www.riksbank.se/globalassets/media/rapporter/arsredovisning/bilagor/framstallning-till-riksdagen-201718rb1-arsredovisning-for-sveriges-riksbank-for-rakenskapsaret-2017. [Accessed 5 April]

Swedish Riksbank (2019). Räntan 500 % - Kronan flyter. Available Online: https://www.riksbank.se/sv/om-riksbanken/historia/1900-1999/rantan-500----kronan-flyter/ [Accessed 17 May 2019]

Sørensen, P. and Whitta-Jacobsen, H. (2010). Introducing advanced macroeconomics. London, Boston: McGraw-Hill, p.406-414.

Turk, R. (2015). Housing Price and Household Debt Interactions in Sweden. working paper, no. 15/276, International Monetary Fund. Available Online: https://www.imf.org/external/pubs/ft/wp/2015/wp15276.pdf [Accessed 6 April 2019]

Turner, B. (1997). Housing Cooperatives in Sweden: The Effects of Financial Deregulation. *Journal of Real Estate Finance and Economics,* vol. 15, no. 2, pp.193-217. Available Online: https://link.springer.com/content/pdf/10.1023%2FA%3A1007781600434.pdf [Accessed Online 27 May 2019]

Appendix A

Year	*Owner-occupied housing*	*Apartment Buildings*
1991-1993	1.50	2.50
1994-1995	1.50	1.50
1996-1997	1.70	1.70
1998	1.50	1.50
1999	1.50	1.30
2000	1.50	1.20
2001-2005	1.00	0.50
2006	1.00	0.50
2007	1.00	0.40

Source: (Henrekson & Stenkulla, 2015; Swedish Tax Agency, 2007)

Appendix B

This section presents the formulas used to calculate the housing stock between 1986Q1 to 1989Q4.

$$H_{t+1} = H_t(1 - \delta_t) + I_t^H \qquad \textbf{(B1)}$$

Equation B1 describes the housing stock identity where t is the depreciation rate of the housing stock in time period t and I_t^H is the housing investments in the same time period. In the calculations in this paper, the number of new houses was used as a proxy for the investments, and the data was collected from Statistics Sweden. Furthermore, an average of the depreciation rate between the years 1990-2018 was used in the estimation. To get the sample average, equation B1 was rewritten in the following way.

$$\frac{H_{t+1} - I_t}{H_t} = (1 - \delta_t) \qquad \textbf{(B2)}$$

Then was the sample average computed according to equation B3 and then was the housing stock from 1986 to 1989 estimated according to equation B4.

$$\frac{1}{T}\sum_{t=1}^{T}(1 - \delta_t) = \overline{(1 - \delta_t)} \qquad \textbf{(B3)}$$

$$\frac{H_{t+1} - I_t}{\overline{(1-\delta_t)}} = H_t \qquad \textbf{(B4)}$$

Appendix C

C: 1

Selection-order criteria								
Sample: 1989q2 - 2018q4							Number of obs=119	
lag	**LL**	**LR**	**df**	**p**	**FPE**	**AIC**	**HQIC**	**SBIC**
0	1617,02		25	0	1,20E-18	-27,093	-27,045	-26,976
1	1900,54	567,05	25	0	1,50E-20	-31,438	-31,153	30,7371
2	1938,5	75,909	25	0	1,20E-20	-31,655	-31,134	-30,371
3	2125,3	373,61	25	0	8,20E-22	-34,375	-33,616	32,5065*
4	2165,6	80,591	25	0	6,4e-22*	-34,632	-33,6362*	32,1797
5	2191,21	51,214	25	0,002	6,40E-22	-34,642	-33,409	31,6061
6	2205,54	28,663	25	0,278	7,90E-22	-34,463	-32,993	30,8429
7	2232,64	54,197	25	0,001	7,90E-22	-34,498	-32,791	30,2944
8	2257,3	49,337	25	0,003	8,30E-22	-34,493	-32,548	29,7049
9	2285,15	55,684	25	0	8,50E-22	-34,54	-32,359	29,1689
10	2304,01	37,734	25	0,049	1,00E-21	-34,437	-32,019	28,4819
11	2340,67	73,317	25	0	9,40E-22	-34,633	-31,978	-28,094
12	2372,71	64,078*	25	0	9,50E-22	-34,7514*	-31,859	27,6285
Endogenous: $\Delta p_t^a \; \Delta r_t \; \gamma_t \; \Delta y_t \; \Delta h_t$								
Exogenous: constant								

C: 2

LM Autocorrelation test			
lag	chi2	df	Prob>chi2
1	63.1193	25	0.00004
2	64.5880	25	0.00002
3	37.6625	25	0.04989
4	83.1203	25	0.00000
5	23.8694	25	0.52693
6	18.5342	25	0.81889

C: 3

Jargue-Bera test			
Equations	chi2	df	Prob>chi2
Δp_t^a	0.674	2	0.71388
Δr_t	126.760	2	0.00000
γ_t	155.820	2	0.00000
Δy_t	1.661	2	0.43588
Δh_t	1529.856	2	0.00000
ALL	1814.771	10	0.00001

C: 4

ARCH-LM				
Equations	Lags(p)	chi2	df	Prob>chi2
Δp_t^a	1	1.544	1	0.2141
Δr_t	1	0.225	1	0.6352
γ_t	1	0.005	1	0.9414
Δy_t	1	8.017	1	0.0046
Δh_t	1	9.882	1	0.0017

C: 5

Johansen test without user cost					Number of obs = 126 Lags = 5
maximum rank	**parms**	**LL**	**eignevalue**	**trace statistic**	**5% critical value**
0	105	2274.6519	.	91.1572	68.52
1	114	2295.0221	0.27627	50.4166	47.21
2	121	2306.2497	0.16324	27.9615*	29.68
3	126	2314.8668	0.12784	10.7273	15.41
4	129	2319.9993	0.07824	0.4623	3.76
5	130	2320.2304	0.00366		

Johansen test without user cost					Number of obs = 126 Lags = 5
maximum rank	**parms**	**LL**	**eigenvalue**	**trace statistic**	**5% critical value**
0	68	1789.1563	.	78.1329	47.21
1	75	1806.1991	0.23702	44.0474	29.68
2	80	1816.5051	0.15091	23.4352	15.41
3	83	1824.0763	0.11324	8.2929	3.76
4	84	1828.2227	0.06370		

C: 6

Dickey-Fuller test for unit root for first difference of logged actual house prices				
No. of obs: 130		*Interpolated Dickey-Fuller*		
	Test Statistic	1% critical value	5% critical value	10% critical value
Z(t)	-7.042	-3.5	-2.888	-2.578
MacKinnon approximate p-value for Z(t) = 0.0000				

Dickey-Fuller test for unit root for first difference of logged actual rent				
No. of obs: 130		*Interpolated Dickey-Fuller*		
	Test Statistic	1% critical value	5% critical value	10% critical value
Z(t)	-7.663	-3.5	-2.888	-2.578
MacKinnon approximate p-value for Z(t) = 0.0000				

Dickey-Fuller test for unit root for user cost				
No. of obs: 131		*Interpolated Dickey-Fuller*		
	Test Statistic	1% critical value	5% critical value	10% critical value
Z(t)	-1.014	-3.5	-2.888	-2.578
MacKinnon approximate p-value for Z(t) = 0.7483				

Dickey-Fuller test for unit root for first difference of logged disposable income				
No. of obs: 130		*Interpolated Dickey-Fuller*		
	Test Statistic	1% critical value	5% critical value	10% critical value
Z(t)	-19.042	-3.5	-2.888	-2.578
MacKinnon approximate p-value for Z(t) = 0.0000				

Dickey-Fuller test for unit root for first difference of logged housing stock				
No. of obs: 130		*Interpolated Dickey-Fuller*		
	Test Statistic	1% critical value	5% critical value	10% critical value
Z(t)	-4.468	-3.5	-2.888	-2.578
MacKinnon approximate p-value for Z(t) = 0.0002				

Appendix D

VAR(5) Model					
VARIABLES	(1) Δp_t^a	(2) Δr_t	(3) γ_t	(4) Δy_t	(5) Δh_t
L.Δp_t^a	0.354***	-0.120*	-0.0382	0.114	0.00293
	(0.0888)	(0.0727)	(0.0371)	(0.122)	(0.00317)
L2.Δp_t^a	0.0984	0.0702	-0.0385	-0.0588	0.00283
	(0.0926)	(0.0758)	(0.0386)	(0.127)	(0.00330)
L3.Δp_t^a	0.0949	0.00436	0.0724*	0.153	0.000522
	(0.0937)	(0.0767)	(0.0391)	(0.129)	(0.00334)
L4.Δp_t^a	0.259***	0.187**	-0.0678*	0.325**	0.00193
	(0.0947)	(0.0775)	(0.0395)	(0.130)	(0.00338)
L5.Δp_t^a	-0.0692	-0.119	0.0371	-0.0481	0.00163
	(0.0929)	(0.0761)	(0.0388)	(0.128)	(0.00332)
L.Δr_t	-0.305***	0.491***	0.0195	-0.0681	-0.00192
	(0.108)	(0.0888)	(0.0453)	(0.149)	(0.00387)
L2.Δr_t	0.0250	-0.175*	0.0105	0.0317	-9.02e-05
	(0.113)	(0.0925)	(0.0472)	(0.155)	(0.00403)
L3.Δr_t	-0.147	0.110	-0.0553	0.202	0.000968
	(0.112)	(0.0915)	(0.0466)	(0.154)	(0.00399)
L4.Δr_t	-0.0521	0.348***	0.105**	-0.0665	0.00289
	(0.109)	(0.0892)	(0.0455)	(0.150)	(0.00389)
L5.Δr_t	0.187*	-0.210**	-0.00705	0.0680	0.00351
	(0.101)	(0.0825)	(0.0421)	(0.139)	(0.00360)
L.γ_t	-0.262	-0.405**	0.989***	0.162	-0.00643
	(0.223)	(0.183)	(0.0931)	(0.307)	(0.00796)
L2.γ_t	-0.0363	0.390	-0.110	0.387	0.00101
	(0.314)	(0.257)	(0.131)	(0.432)	(0.0112)
L3.γ_t	0.614**	0.132	0.0879	-0.833**	0.00627
	(0.306)	(0.250)	(0.128)	(0.421)	(0.0109)
L4.γ_t	-0.526*	-0.311	0.0110	0.477	-0.0100
	(0.310)	(0.254)	(0.129)	(0.426)	(0.0111)
L5.γ_t	0.126	0.319*	0.0275	-0.381	0.00488
	(0.230)	(0.188)	(0.0959)	(0.316)	(0.00820)
L.Δy_t	-0.138**	0.0521	0.0792***	-0.727***	-0.00421*
	(0.0635)	(0.0520)	(0.0265)	(0.0873)	(0.00227)
L2.Δy_t	-0.214***	0.0674	0.0409	-0.598***	-0.00260
	(0.0758)	(0.0621)	(0.0316)	(0.104)	(0.00271)
L3.Δy_t	-0.194**	0.0799	0.0404	-0.592***	-0.00230
	(0.0771)	(0.0631)	(0.0322)	(0.106)	(0.00275)
L4.Δy_t	-0.179**	0.0517	0.0323	0.400***	-0.00233
	(0.0781)	(0.0639)	(0.0326)	(0.107)	(0.00279)
L5.Δy_t	-0.00479	-0.000878	-0.0328	0.107	0.00185
	(0.0674)	(0.0552)	(0.0281)	(0.0927)	(0.00241)
L.Δh_t	-2.594	3.346*	2.075**	4.185	0.657***
	(2.324)	(1.903)	(0.970)	(3.197)	(0.0830)

L2.Δh_t	4.200*	0.829	-1.376	-6.941**	0.216**
	(2.460)	(2.014)	(1.027)	(3.383)	(0.0878)
L3.Δh_t	-4.430*	-1.666	0.652	-1.602	0.0185
	(2.554)	(2.092)	(1.066)	(3.514)	(0.0912)
L4.Δh_t	4.516*	1.630	-1.411	2.257	-0.578***
	(2.489)	(2.038)	(1.039)	(3.424)	(0.0889)
L5.Δh_t	-1.875	2.434	1.251	-2.237	0.392***
	(2.299)	(1.882)	(0.960)	(3.163)	(0.0821)
Constant	0.0111**	-0.00969**	-0.00298	0.0189***	0.000374**
	(0.00526)	(0.00430)	(0.00219)	(0.00723)	(0.000188)
Observations	126	126	126	126	126