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# Overheated or Stable?

-An Analysis Of The Swedish Housing Market

Bachelor's thesis within Economics

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## **Bachelor's Thesis in Economics**

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### **Abstract**

The Swedish housing market has been subject to extensive attention in the media recently, and the existence of a housing bubble has been questioned. The purpose of this thesis is to analyse the Swedish housing market to investigate if there are reasons to believe that the market is overvalued. The current situation in the housing market will be compared to the United States market prior to the crash of 2007. The models that are used in the paper is the house price-to-income, price-to-rent and imputed rent-to-rent. Other fundamental factors such as rent control, household debt, interest rates, and other policies effecting the housing market will be discussed.

The main findings indicate that the Swedish housing market in 2010 is overvalued, however one has to consider that there are limitations to these models such as the extra benefits of owning a house compared to renting.

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# 1 Introduction

The housing market has always been a popular subject and the price development has been closely followed by the media. Lately though, the question of a housing bubble has been a hot topic. The Swedish housing market has since the crash in the 1990s been in a strong upward trend, during which prices has increased by an astonishing 290 percent (Statistics Sweden, 2010). The question that has been debated in the media is whether strong growth in house prices has been driven by fundamentals<sup>1</sup>, or whether it has been due to a bubble in the market (Dagens Nyheter, 2010).

The recent global financial crisis has affected most of the worlds markets, with a decline in house prices. In the United States (US) the housing market crashed in 2007, and prices went down substantially (Wall Street Journal, 2008). During the year 2007 the house prices fell with more than 8% on a national level (MacroMarkets, 2010). One would think that the small Swedish market would follow a similar pattern, but on the contrary the Swedish housing market was not significantly affected by the downturn. The housing prices experienced a moderate decrease of 1% from the last quarter of 2007 to the first quarter of 2008, then the prices started increasing again, reaching higher levels then prior to the crisis (Statistics Sweden, 2008). Sweden is now in a situation with historically low interest rates and with government subsidies affecting the housing market. This situation is similar to the one the US faced before the crisis, with low interest rates and government subsidies aimed at increasing home ownership rates (Holt, 2009). This raises the question as to whether the Swedish housing market is facing a similar fate to what the US market experienced.

The purpose of this thesis is to analyse the Swedish housing market to investigate if there are any signs of the market being in a bubble. This will be done by using the imputed rent model, price-to-income, and price-to-rent ratios. The imputed rent model measures the relation between the cost of owning a house and renting. The other two ratios compare the house price to rent and income, which can give a good indicator on how the market is currently valued. The results will then be compared to the situation prior to the US housing crash. This is as an interesting topic due to the fact that buying a house is a big decision to make, and normally is the biggest form of capital investment a person makes during his or her life. Also, a house is often the only form of substantial wealth the average person has hence, making the economy sensitive to larger reductions in housing prices (Muellbauer, 2007). The lack of studies on the Swedish housing market is another reason why this is an interesting topic for the paper.

This paper examines only the part of the housing market which consists of one- or two-dwelling houses in Sweden, during the time period from 1984 to 2009. The results of the models are based on national data, which means that the models used do not take into account different local factors and there are no adjustments for quality improvements of houses.

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<sup>1</sup> Fundamentals being the underlying factors that affect the supply and demand of housing.

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The topic of valuating housing markets has been studied many times, Case and Shiller (2003) and Hott and Monnin (2008) have in their papers examined different models to evaluate the housing markets in the following countries: US, UK, Netherlands, Japan, and Switzerland. The model used in this paper is the imputed rent model proposed by Himmelberg, Mayer and Sinai (2005), which is an model that examines the cost of owning a house compared to renting a similar dwelling. The Swedish housing market has not been studied to the same extent, but there are some papers that focuses on the Swedish market. There are two studies of particular interest, Jaffee (1994) discusses the Swedish real estate crisis of the early 1990's and a study by Björklund and Söderberg (1999) which focused more on property cycles in Sweden in general.

The first part of the paper, section 2, will go through past work on housing bubbles, and give a background of the Swedish and American housing markets. In section 3 different models regarding the housing market will be discussed. In section 4 of the paper the method used will be explained and the variables will be defined. In section 5 the results will be presented which will be followed with an analysis in section 6. In section 7 the conclusion will be presented.

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## 2 Background

This chapter will go through previous work that has been done on the housing market. To be able to draw a conclusion whether the Swedish housing market is facing a similar crash as the US market experienced in 2007, one has to look at the causes behind the crash in the US and look at the current situation in the Swedish market. For the same reason, the Swedish housing crash in 1991 will also be discussed.

### 2.1 Definition of a bubble on the housing market

There exist many definitions explaining what a bubble is and how it comes about. One of the most used definitions is the one by Stiglitz (1990, p.13).

*"If the reason that the price is high today is only because investors believe that the selling price is high tomorrow-when 'fundamental' factors do not seem to justify such a price-then a bubble exists. At least in the short run, the high price of the asset is merited, because it yields a return (capital gain plus dividend) equal to that on alternative assets."*

What Stiglitz refers to as fundamental factors are the underlying factors that affects the price movements, namely the supply and demand of housing. Factors that affect the supply and demand includes household incomes, construction permits, vacancy rates, number of households etc. (Quigley, 1999).

Another well cited definition of a bubble is the one by Case and Shiller (2003, p.299).

*"...a situation in which excessive public expectations of future price increases cause prices to be temporarily elevated".*

Case and Shiller (2003) explain how homebuyers, under a bubble, can consider housing that normally would be too expensive because the future increase of the house value will make up for the high price, making saving not as necessary since the price increase of the house will save for them. Since prices increase rapidly under a bubble, first time homebuyers try to get into the market as quickly as possible since it is believed that prices will be higher tomorrow. Himmelberg et al (2005) explains speculation as the situation where investors expect that house prices will be higher tomorrow than today. A housing bubble is being driven by homebuyers that are willing to pay a premium because they expect a unrealistic increase in housing prices.

There are different opinions about the existence of bubbles in the housing market, Levin and Wright (1997) agree with the conventional definition of speculation, however the authors argue that speculation in the housing market is unlikely. The reasons being that there are high transaction costs such as conveyance, real-estate agent, and lawyer fees. Additionally there could also be high search costs to find a suitable property, hence it is believed

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that in the short run the expected gains from real-estate speculation will be reduced or, possibly eliminated.

## **2.2 Previous studies**

In the paper by Case and Shiller (2003), the purpose was to look at the US housing market and determine if the market was overheated or in other words, if there was a housing bubble. The authors emphasize that there are many different ways to describe a bubble and among economists the presence of bubbles is sometimes refuted. According to a investigation by Case and Shiller (2003), the term bubble was something rarely used in media before 2002, when the word all of a sudden started to appear more frequently. The authors questioned if media's use of words like "housing bubbles" and "housing boom" could affect the way homeowners and potential homebuyers think about housing prices. It is argued in the paper that the growth in income explains the increase in house prices for most states. Additionally the appreciation in housing values can be explained by the decline in interest rates. To investigate if there was a housing bubble the authors used the two ratios price-to-rent and price-to-income and analysed US state-level data from 1985 to 2002. In addition, they also performed a survey in 2003, asking people who had bought houses in 2002 different questions like if they regarded their house as an investment and how they did perceive the riskiness of purchasing a home. The authors concluded that the general price increase in the US from 1995 was driven by fundamentals and that a nationwide drop in real house prices is not very likely. On the other hand, their analysis showed that there existed speculative bubbles in some of the cities.

Himmelberg et al (2005) argue that the previous studies using the price-to-rent and price-to-income ratios is not suitable methods to assess whether there is a speculative housing bubble or not. These conventional methods of analysing the housing market are not sufficient because they do not take into account the annual cost of ownership. To account for the additional cost of house ownership they are using a formula referred to in the housing literature as the imputed rent. The authors computes the imputed rent by calculating the costs and benefits of owning a house. There are six components which are used in the formula: housing price times the risk free interest rate, property tax times the housing price, tax deductibility of mortgage interest and property taxes, maintenance costs as a fraction of home value, expected capital gains or loss and depreciation rate. In their paper they apply this formula to 25 years of real estate data and then compare the annual cost of ownership to the price of actual rents on the market. The paper concludes that house prices are a very local phenomenon and that when one looks at national-level data it is easy to overlook the economic differences among the cities. The authors argued that there was no proof that the house prices were systematically deviating from the fundamental prices, although the authors still argued that if underlying fundamental factors like the interest rate increase the housing prices could experience a significant fall in value.

Hott and Monnin (2008) used a two step approach in their analysis of the housing markets in the US, UK, Japan, Switzerland, and the Netherlands, with the objective to see if the

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valuation is according to the fundamentals. The first step in their model is the imputed rent where the expected capital gain variable is derived from expected fundamentals. In contrast to previous papers where imputed rent is used, the authors do not consider the possibility of tax deductibility of mortgage payments. The second part of their analysis looks at market equilibrium costs between demand and supply of housing. The authors define the aggregate demand for housing as being dependant on the aggregate income and imputed rent. The supply of housing is determined by the depreciation rate, the initial housing stock and the previous construction of housing. Both models provided very similar results and the conclusion drawn by the authors were that the house prices in the UK, US, and the Netherlands were overvalued at the time of the study.

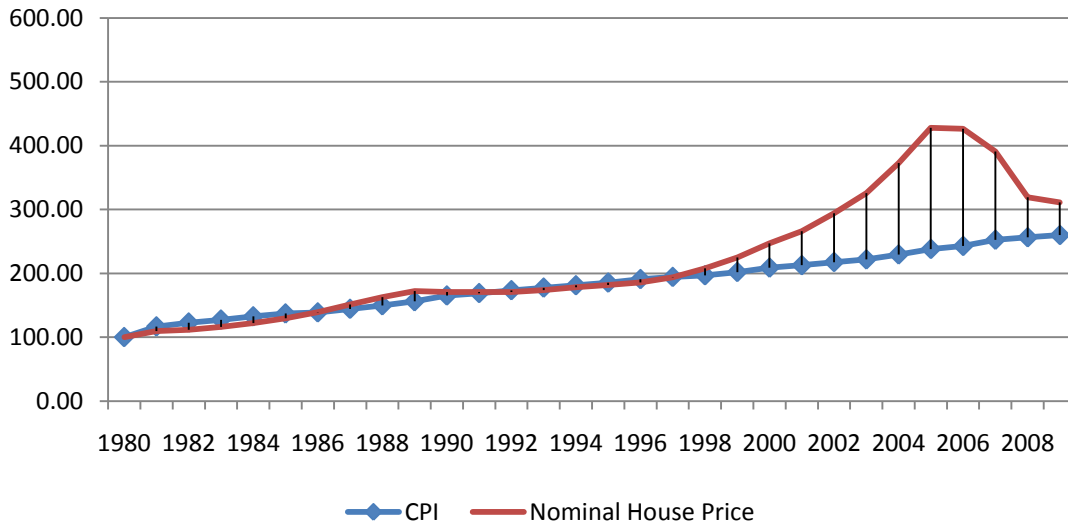
Jaffee (1994) looked at the Swedish housing crisis of the early 1990s, with the aim to explain what the cause behind the crash was and whether the rapid increase in housing prices during the 1980s and early 90s could be justified by economic fundamentals. To analyse the housing market Jaffee (1994) uses a stock/flow model structure which incorporated stock supply and stock demand. When the housing supply and demand are in equilibrium it is referred to as an asset price equilibrium. The author also applies Tobin's q model to test for a speculative bubble, more specifically by looking at the price of assets and comparing it to the price of new constructions. It is concluded in this study that the rapid increase during the 1980s and fall in prices that followed in the beginning of the 1990s could be explained solely by fluctuations in the underlying fundamentals.

The conclusions drawn by Jaffe (1994) has been questioned by other studies of the Swedish housing market. The study by Björklund and Söderberg (1999) raises doubt whether the rapid increase in housing prices could be explained by fluctuations in fundamentals. Using a Gross Income Multiplier (GIM) model they measure the different stages of the property cycle and tracked if there are imbalances between the prices of housing and the fundamentals. If there exists a significant difference the market may be subject to speculation. They argued that their findings suggests that the rapid price increase during 1980s was partly driven by a speculative boom.

Even though the price-to-income and the price-to-rent has been criticized because they do not take into account the annual cost of ownership, they are still indicators for how the current market is valued. Due to this fact we will use these two ratios accompanied with the imputed rent.

## 2.3 The US Housing Market

Figure 2-1 shows the growth in the nominal housing prices compared to the increase in consumer price index (CPI). The CPI will work as a proxy for inflation and one can observe that the CPI increased steadily from 1980 to 2009. Between the years 1980 and 1997, the nominal house price increased at approximately the same pace as the CPI. After this period the nominal house price started to increase rapidly until 2005. From 1997 to 2005 the nominal house prices increased by roughly 121 percent.



**Figure 2-1** Housing Prices and CPI 1980-2009 Data: Cleveland FED, Federal Housing Finance Agency and Macro Markets.

### 2.3.1 Government Policies

The United States government has been keen to increase homeownership and has implemented a number of policies to achieve that goal. The Community Reinvestment Act was changed in 1995 to make banks enlarge their mortgage lending to low-income borrowers (FFIEC, 2010). In 1996 the Department of Housing and Urban Development changed the number of percentage of mortgages to low-income borrowers the two government sponsored institutions Fannie Mae and Freddie Mac must have in their portfolios. In order to meet these new requirements the banks had to relax their mortgage lending standards (Holt, 2009). Another policy with the goal of increasing the homeownership rate was the American Dream Down-payment Assistance Act which was made law in December 2003. This act authorized up to \$200 million annually between 2004 and 2007, to help Americans with down-payments and other costs associated with purchasing a house (US department of Housing, 2010). These grants were only available for first time homebuyers. The act enabled people who could not afford to buy a house to actually buy a house, which increased the demand for houses. From 1995 to 2007 the homeownership rate increased from 64.2% to 67.8% (Bureau of the Census, 2010).

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### **2.3.2 The Federal Reserve**

The Federal Reserve (FED) sets the discount rate (sometimes referred to as the marginal lending rate) which is the rate that the banks pay to borrow money from the Federal Reserve. Determining this rate is a powerful tool to control the economy and since the interest rate that the banks require to lend out money is directly affected by the discount rate, the FED determines the cost of borrowing (Federal Reserve, 2010). A low interest rate would mean a lower cost for the person taking on a mortgage. After the 2001 recession the FED started lowering the interest rate, and did so eleven times from 6.50% down to 1% in 2003. In 2004 FED started to increase the interest rate but it stayed at a low 2% (Federal Reserve Bank Of NY, 2010). Holt (2009) argued that the low interest rate contributed to the housing bubble.

### **2.3.3 Subprime-mortgages**

A subprime mortgage is a loan made to borrowers who are considered as high credit risk, this can be due to bad credit history or relatively large personal debts. These types of loans demand a higher rate of interest due to the higher risk of defaulting (Laderman, 2001). These kind of mortgages normally are adjustable-rate mortgages which gives the borrower a low interest rate the first two years and after that a market rate is used (Nyberg, 2007). Historically most mortgage loans were issued by financial institutions and were held until maturity. This has changed and instead of holding the mortgages banks pack them into securities and sell them off to other institutions and investors. Securitization was originally used on prime borrowers and mortgages with government guarantees. This has changed over the past decade due to increased demand for mortgage securities with higher returns (Rosengren, 2007). Prior to 2005 subprime loans represented around 10% of all mortgage loans, but at the end 2006 subprime loans had increased to represent 20% of all outstanding mortgage loans (Krinzman, 2007).

### **2.3.4 Credit agencies**

Credit agencies such as Standards & Poor's and Moody's rate companies and financial products on how risky they are. Krugman (2010) argues that these credit agencies bear some responsibility in the financial and housing crisis, due to the fact that these agencies gave top credit rating to many of the mortgages that were sold and later defaulted. Holt (2009) writes that investors had the belief that the mortgage securities were safe investments due to the high credit rating they were receiving at the time. Brunnermeier (2009) argues that investors and credit agencies were too optimistic in their recommendations regarding financial products because their statistical models were based on low default rates on mortgages.

## 2.4 The Swedish Housing market

Figure 2-2 shows that the increase in nominal house prices has been far more volatile than the increase in inflation, from 1980 until 1998 the percentage increase in the Swedish housing market was below the increase in inflation, but as of 1999 and onwards housing prices has increased at a faster pace than inflation. Since the crash in the housing market in the early 1990s the Swedish house prices has risen by 290 percent in nominal terms. The Swedish market has been in a very strong upward trend and even the financial crisis of 2008 which affected most housing markets around the world negatively with falling house prices, did not have a significant effect on the Swedish market.

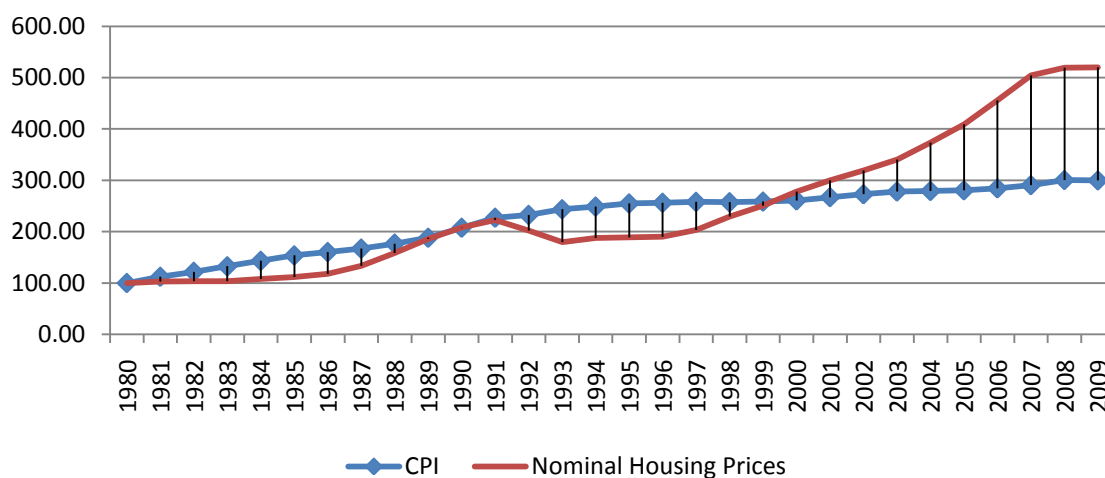


Figure 2-2 Housing prices and CPI 1980-2009 Data: SCB

### 2.4.1 Interest-rate

Himmelberg et al (2005) explain that asset prices like housing are very sensitive to changes in the interest rate that is paid on mortgages, making it an important variable to examine. The interest rate is the cost of borrowing, hence the lower the interest rate the less costly it is to borrow. At the same time holding money is less profitable due to the low saving rates. This creates an incentive to accumulate debt, which is normally used to acquire housing (Stiglitz and Weiss, 1981). From 1994 to 2010 the average interest rate has been 4.899%. In September 2008 the Swedish Central Bank started lowering the interest rate, and did so four times from 4.75% down to 0.25% which is the current rate, and a historically low interest rate (Riksbanken, 2010).

## 2.4.2 Household debt

Borio, Kennedy and Prowse (1994) argued that credit is an important variable to take into account when looking at asset prices, and since debt is normally used to finance purchases of housing it is an important variable to consider when investigating a housing market. The proportion of the housing values that is represented by debt has from year 2000 increased from levels around 25–30% to 35–45%. Housing prices have increased vastly during the same time period, the growth in the proportion of debt has increased at a faster pace (Tillgångar, skulder och Kapitalvinster, 2010).

Fisher (1933) argues that too high levels of debt will lead to households trying to reduce their debt. This can lead to distress selling to raise capital to be able to decrease their debt levels, hence leading to a decrease in house prices. High levels of household debt in a situation with falling house prices increases the risk of a banking crisis, since the households might struggle with their payments on their debt, and default on their loans, which will lead to losses for the banks.

## 2.4.3 Tax deductibility of home improvements

This is a new policy, which came into place in 2009 in Sweden. This policy gives homeowners the possibility to get tax deductions on renovations on their houses. The owner of the house can get a 50% tax deduction on a maximum 50,000 SEK renovation cost. If there are two persons owning the house, they can apply for a maximum of 100,000 SEK (Regeringskansliet, 2010). This makes it cheaper for homeowners to renovate and give their houses a better standard, hence increasing the value of the house.

## 2.4.4 Construction costs

The cost of constructing a house is an important variable as well. If the cost of building has increased this could explain the much higher housing prices we have today. Hort (1997) found that construction costs has a significant effect of the movements of the real housing prices. Looking at figure 3-2 one can see that housing prices have increased more than the actual cost of building the houses.

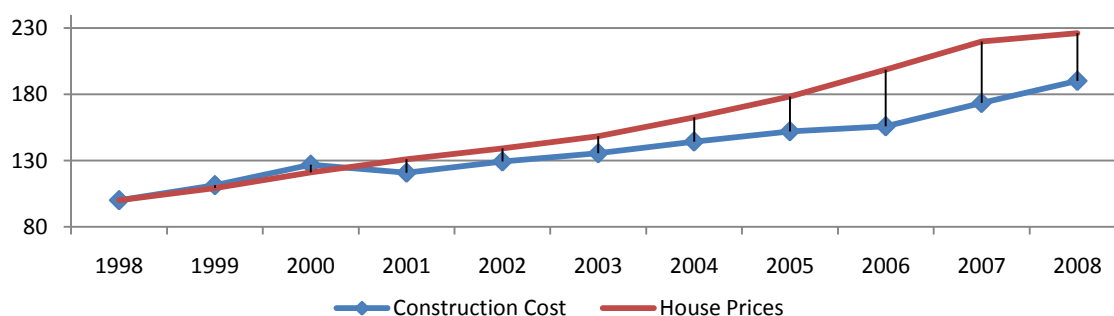


Figure 2-3 Construction cost 1998-2008 Data: SCB

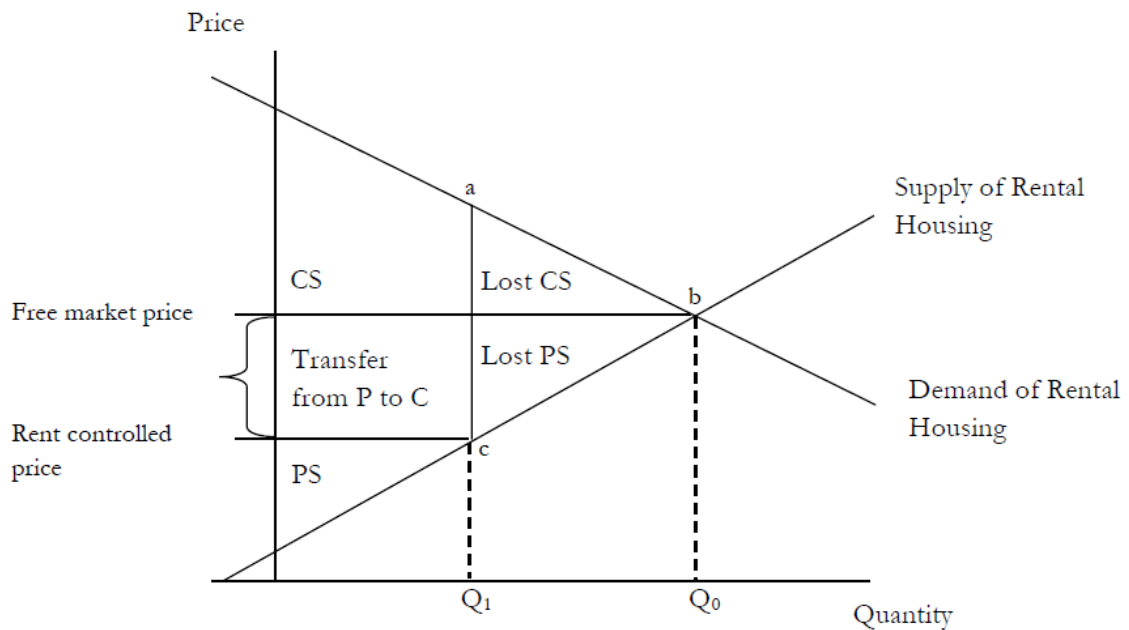
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### 2.4.5 Rent control

Laws or ordinances that restricts how landlords set their rents is commonly referred to as rent controls. The purpose of rent control laws is to control the price that landlords can demand for renting out their properties, these laws can be implemented to work as either a price ceiling or a price floor. A price ceiling refers to the maximum price the landlord is allowed to charge while the price floor regulates the minimum price that can be charged, these prices varies depending on variables like location and size of the dwellings. In Sweden, the rent is determined by negotiations between the owner of the property and a local tenant's association. The law also states that the cost of renting a apartment must be reasonable, which means that the rent cannot be significantly higher than the rent for apartments of equivalent value (Sveriges Domstolar, 2010). These rent control laws became popular during the World War II when rents were frozen in North America and Europe. Today, there is still price ceilings in affect in cities in the US, New York being the most famous example. However, the American housing market is not nearly as regulated as the markets in Scandinavia, where rent controls are imposed an a national level (Arnott, 1995).

The effectiveness of rent control has been questioned widely by economists. Alston, Kearn and Vaughan (1992) performed a survey on a stratified random sample of American economists which consisted of questions about economist's opinions about rent controls. The question that most economists agreed upon was the statement "A ceiling on rents reduces the quantity and quality of housing available." This is hardly any evidence against the possibility that price ceilings can be beneficial but it shows what the general consensus of economists was at that time. The theory behind this statement is that by keeping the prices artificially low the price ceilings will cause excess demand and the supply will not be able to keep up with this increase in demand.

Hirshleifer and Glazer (2005) shows that since the prices of renting are kept lower than the equilibrium levels, investments in building new apartments might be cancelled because it is simply not profitable for the landlords to rent out at the prices regulated by the price controls. The figure 2-3 shows the effects of a price ceiling under the classical assumption that goods will be allocated efficiently if there is a shortage.



**Figure 2-4** Rent control – The classical case

The free market equilibrium is at point *b* but due to the price ceiling the equilibrium is pushed down to *c*, where we have situation with excess demand which leads to shortages of apartments at that price. The lost PS (Producer Surplus) and lost CS (Consumer Surplus) is the deadweight loss due to the price ceiling. Another argument is that the apartments will not be allocated to the people who value them most and hence even though they are prepared to pay a higher amount for renting there will be no apartment available.

## 2.5 The Swedish Housing Crash of 1991

During the period 1985 to 1991 there was a rapid growth in the prices of houses in Sweden. There were many causes for this increase in prices; increasing disposable income, inflation, and government policies played an important role. The government intervention in the credit market is one of the causes that are believed to have had a major impact on the housing market. The regulations in the banking sector loosened up and this made it possible for a vast majority of the population to borrow to pay for a large proportion of their houses (Jaffee, 1994).

This period of rapid growth ended during the aftermath of a major banking crisis which led to financial distress in countries all over the world. In the United States 206 banks failed in 1989, which was the largest bank failure the US had experienced up until 2006 (FDIC, 2005). In Sweden, this banking crisis meant higher vacancy rates and the rate of default loans skyrocketed. The price of houses plummeted together with the production of new housing projects; because of the financial turmoil there was a lack of new investments. As the value of houses fell and the vacancy rates increased, homeowners and real estate investors suffered massive losses. The banks turned to the government and asked them to guar-

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antee people's savings and to help the banks financially so that they would avoid the risk of total collapse. The failing housing market affected the aggregate demand in Sweden and made the recession that the bank crisis started even more severe (Jaffee, 1994).

The gross domestic product which had grown rapidly in previous years turned into a negative growth for a short period of time (Statistics Sweden (SCB), 2007). Following the crash the Swedish economy experienced high unemployment, low growth and soaring interest rates. Prior to the crash, the unemployment rate was as low as 1,5 percent. By 1990 the unemployment rate started to increase and after the financial crisis in 1991, the unemployment rate reached levels around 10 percent (Eurostat, 2010). The question remains, whether the boom in the housing market during the 1980s was supported by "fundamentals" or was it caused by speculation? This question has been debated among scholars and there are several different views on what caused the rapid price increase. Jaffee (1994) argues that the changes in fundamentals alone explained the increase in house prices. Björklund and Söderberg (1999) have another point of view; they raise doubt to Jaffe's conclusion. Using GIM (Gross Income Multiplier) they showed that there are imbalances between the housing prices and fundamentals, which theoretically suggests that the market was affected by a speculation.

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## **3 Discussion of Models for Assessing the Housing Market**

There are many different ways to analyse a housing market, each model has its strengths and weaknesses. There is currently no universal model that is recognized as the most accurate to evaluate deviations in housing prices from their fundamental values. In this section three different models that have been used in previous research will be discussed. These models were chosen because they are the most conventional methods used to analyse the housing market.

### **3.1 Price-to-income Ratios**

Case and Shiller (2003) looked at the US housing market on both a local and a national level, and by using a ratio analysis and a questionnaire tried to determine if prices were deviating from the fundamental values. They argued that rapid price increases or decreases does not necessarily indicate that there is a housing bubble, one has to compare increases in housing prices to underlying fundamentals like income and rental costs. The first ratio used is the price-to-income ratio which measures the relation between the housing prices and the income levels. The home prices that Case and Shiller (2003) used were constructed from a repeat-sales price index they had developed for previous studies they made in 1987 and 1989. In some cases where the Case-Shiller index was not possible to use they used data available from the Office of Federal Housing Enterprise Oversight (OFHEO). These house prices were compared to the personal income per capita which were collected from the Bureau of Economic Analysis. The price-to-income approach has been used by other studies such as Poterba (1991), Lamont and Stein (1999) and Himmelberg et al (2005). However, Himmelberg et al (2005) argued that this ratio alone cannot be used to evaluate if there exists a housing bubble or not since it does not take into account the actual costs of owning a house.

### **3.2 Price-to-rent Ratios**

Case and Shiller (2003) also mention the price-to-rent ratio which measures the relation between house prices and the rental costs on a similar house. The price-to-rent ratio is not widely used but studies like Ayuso and Restoy (2006) compare house prices to rents with their equilibrium asset pricing approach. Himmelberg et al (2005) also uses the price-to-rent ratio partly but they consider it too incomplete because the house prices used do not take into account the annual cost of house ownership. Due to this fact they use a concept referred to in real estate jargon as the imputed rent.

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### 3.3 Imputed Rent

Imputed rent is a formula that consists of six different components which corresponds to both costs and offsetting benefits of owning a house. The six components consists of: the housing price times the risk-free interest rate, the property tax rate times the house price, the tax deductibility of mortgage interest and property taxes, maintenance cost as a fraction of home value, expected capital gain or loss, and finally the additional risk premium to compensate for the additional risk of owning a house compared to renting. The annual cost of ownership is calculated by Himmelberg et al (2005) with the following formula:

**Annual Cost of Ownership (ACO):**

$$ACO_t = P_t r_t^{rf} + P_t \omega_t - P_t \tau_t (r_t^m + \omega_t) + P_t \delta_t - P_t g_{t+1} + P_t \gamma_t$$

$P_t$  = House price,  $r_t^{rf}$  = Risk free rate,  $\omega_t$  = Property tax,  $r_t^m$  = Mortgage rate,  $\tau_t$  = Marginal tax rate,  $\delta_t$  = Depreciation rate,  $g_{t+1}$  = Appreciation rate,  $\gamma_t$  = Risk premium.

This formula has also been used in previous studies like Hendershott and Slemrod (1983) and Poterba (1984). When the user cost or imputed rent of owning a house has been computed, Himmelberg et al (2005) then compare it to the rents of similar housing to evaluate if the housing market seems to be in equilibrium or not. If the ratio is significantly higher than one it is an indicator of a overvalued housing market since it implies that the cost of owning a house is more expensive than renting a similar dwelling.

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## 4 Method

### 4.1 Price-to-income

The price-to-income ratio is derived by dividing house prices by disposable income, which shows how house prices have developed against income. A high ratio would mean that house prices have increased more than income and hence a bigger part of the households disposable income is allocated to owning a house.

$$PI = P_t / D_t$$

Where PI = Price-to-disposable income,  $P_t$  = House price,  $D_t$  = Disposable income.

### 4.2 Price-to-rent

The price-to-rent ratio shows how house prices have developed against rents, derived by dividing house price by rent. A high ratio is due to a faster increase in house prices compared to the increase in rents, hence a high ratio means that it is more costly to buy a house than renting one.

$$PR = P_t / R_t$$

Where PR = Price-to-rent,  $P_t$  = House price,  $R_t$  = Rent.

### 4.3 Imputed Rent

The main method that will be used to analyse the Swedish housing market is the formula imputed rent. This formula represents the annual cost of owning a house and the results from the calculations can then be compared to the prices of renting a similar dwelling.

$$(1.1) IR_1 = P_t r_t^{rf} + P_t \omega_t - P_t \tau_t (r_t^m + \omega_t) + P_t \delta_t - P_t g_{t+1} + P_t \gamma_t$$

$$(1.2) IR_2 = P_t r_t^{rf} + TV_t \omega_t - P_t \tau_t r_t^m + P_t \delta_t - P_t g_{t+1} + P_t \gamma_t$$

$$(1.3) IR_3 = P_t r_t^{rf} + (1/3)TV_t \omega_t - P_t \tau_t r_t^m + P_t \delta_t - P_t g_{t+1} + P_t \gamma_t$$

$P_t$  = House price,  $r_t^{rf}$  = Risk free rate,  $\omega_t$  = Property tax,  $r_t^m$  = Mortgage rate,  $\tau_t$  = Marginal tax rate,  $\delta_t$  = Depreciation rate,  $g_{t+1}$  = Appreciation rate,  $\gamma_t$  = Risk premium,  $TV$  = Taxable value.

Formula (1.1) represents the imputed rent formula that Poterba (1984) and Himmelberg et al (2005) used for the US housing market. Since the tax laws in Sweden are different from the US laws the imputed rent formula has been modified to suit the Swedish housing market. There are two differences between the formula used for the US market and the one modified for Sweden's market. In Sweden the property tax is not paid on the full value of the house and the property tax payments are not deductible like in the case of the US. Dur-

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ing the period 1991 to 2009 property tax was paid on the total assessed value of a house. However, it is important to note that as the property tax changed in 2008, the tax decreased from 1% of the assessed value to 0.75% and there was also a maximum tax that could be paid as property tax. In 2008 this maximum tax was 6000 SEK and in 2009 it was 6362 SEK (The Swedish Tax Authorities 2010), this is taken into account when using the calculations in formula (1.2). Formula (1.3) is to be applied for the period 1984-1991 when the property tax was only paid on one third of the assessed value.

## 4.4 Data sources

In this section the data used in the analysis is described.

### **Risk-free rate: ( $r_t^{rf}$ )**

The first component of the imputed rent formula consists of the house prices times the risk-free rate, the risk free rate is the minimum return that an investor should be willing to accept for an investment. However, this is only theoretical since in practice there is no such thing as a risk free rate. In economics there are several different rates that are used as risk free rates but the norm in economics and finance is to use short government treasury bill as the risk free rate, usually the t-bills that has a maturity of 3 to 12 months. However, for this formula the risk free rate that will be used is the 10 year government t-bills, this data was gathered from Riksbanken (The Swedish central bank). The reason for choosing t-bills with such a long time to maturity is that interest rates fluctuates so much in the short-run and this make the imputed rent formula very volatile. Himmelberg et al (2005) also used the 10 year government t-bill rate, the authors argued that in a low real interest rate environment a decrease in real rates will bring about a large potential increase in house prices.

### **Property tax ( $TV_t\omega_t$ and $(1/3)TV_t\omega_t$ )**

The second component in the formula represent the yearly cost of the property tax, calculated as the property tax times the assessed value of the house. Between 1984 and 1991 the tax was paid on one third of the assessed value and between 1991-2008 the tax has been paid on 75% of the value. The average assessed value of one or two-dwelling houses has been gathered from SCB. The property tax rates have in general been 1% for this type of housing until 2008 when the tax rate changed to 0.75% on the assessed value and this is the rate that will be used for the years 2008 and 2009. (Swedish Tax Authorities 2010).

### **Mortgage Rate and Marginal tax rate ( $P_t\tau_t r_t^m$ )**

The third component represents the tax deductibility of the interest payments on the mortgage. The marginal tax rate is the additional tax paid on each extra SEK earned. The mortgage rate that will be used is the 2 year fixed rate except for the period 1984-1988, when the 5 year mortgage rates were used because there was no data available for the 2 years fixed rate. The rates used are the ones offered from Swedbank Hypotek, which is one of the leading credit institutions in Sweden.

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### **Depreciation rate ( $P_t\delta_t$ )**

The fourth component represents the cost of wear and tear, commonly referred to as depreciation. Finding an appropriate depreciation rate that will be accurate for the average one or two-dwelling houses in Sweden is not an easy task, the best proxy available is arguably an approximation made by Englund (1999). This approximation is based on a econometric analysis on the Swedish housing market, covering a 12 year period between 1983 and 1993 by looking at eight metropolitan regions in Sweden. The mean value of depreciation in this region was found to be 2.5 percent. A study on the US housing market made by McCarthy and Peach (2004) also used a depreciation rate of 2.5 percent in their calculations. However, this depreciation rate can be a bit misguided since there are many factors affecting the depreciation rate of houses, for example location and how old the houses are. Still, this depreciation rate will have to suffice as a proxy since it is not feasible to analyse all the houses in Sweden at a unique level.

### **Appreciation rate ( $P_tg_{t+1}$ )**

The fifth component represents the average long run appreciation of the house value. Poterba (1992) argues that the average appreciation rate should equal to the long run expected inflation rate, which is assumed to be 2 percent. Himmelberg et al (2005) approach is a bit different as the authors argue that the appreciation rate should be equal to the long run expected inflation rate plus real expected appreciation rate. However, this expected appreciation is based on the average appreciation rate from the sample and since the Swedish housing market has been extremely volatile during the period of interest, trying to estimate an accurate appreciation rate is not feasible.

### **Risk premium ( $P_t\gamma_t$ )**

The sixth component consists of a risk premium required to compensate for the additional risk for owning a house compared to renting a similar dwelling. There are not too many studies that aims at explaining the additional risk premium needed to make it worth buying a house instead of renting, however Flavin and Yamashita (2002) estimates that a risk premium of 2% is required to offset the risks, this is the same risk premium used by Himmelberg et al (2005).

### **House prices ( $P_t$ )**

The house prices used in this formula refers to the prices of one- or two-dwelling houses in Sweden. The numbers for the house prices and the assessed values of housing is referring to the average purchase prices for sold houses, the data required has been gathered from Swedish Statistics (SCB).

### 4.4.1 Income

The income that is used in the formula represents the average yearly disposable income of a family, which is defined as a married cohabiting couple with two children (Statistics Sweden).

### 4.4.2 Rental cost of housing

When the imputed rent is calculated, the annual cost of ownership is then compared to renting similar dwellings. The yearly rental cost of a comparable home used is the price to rent a three room and kitchen apartment. This data was gathered by looking through statistical yearbooks of Sweden available at SCB's webpage.

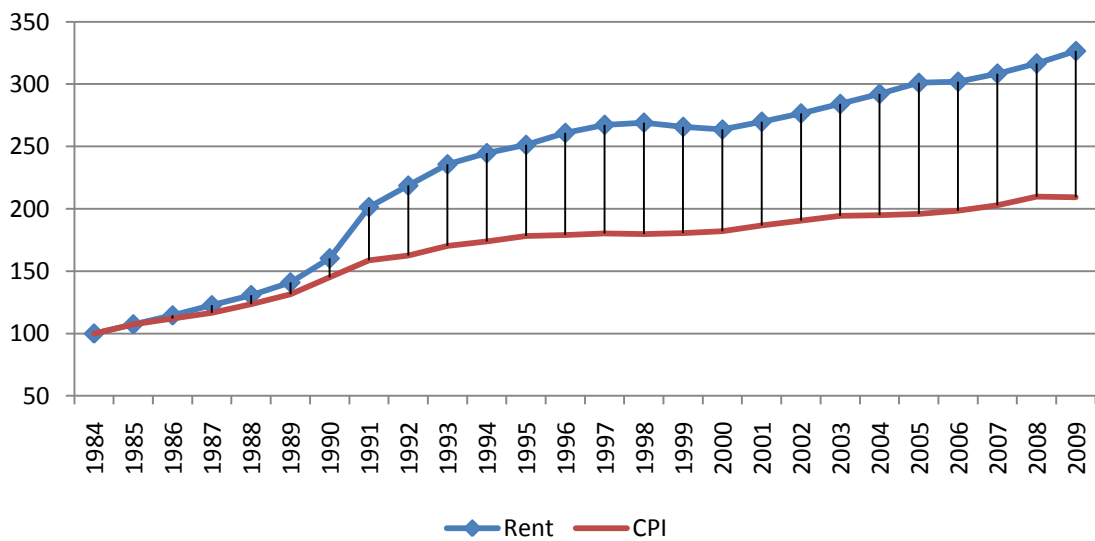


Figure 4-1 Rents between 1984-2009 Data: SCB

When the imputed rents were calculated, the annual cost of ownership was then compared to the cost of renting similar dwellings. The yearly rental cost of a comparable home used is the price to rent a three room apartment. Figure 4-1 shows how the rental costs have changed during the last 25 years, the index starting at 100 in 1984. From looking at figure 4-1, one can see that the prices of renting apartments have increased quite steadily over the years, an exception is the steep increase between 1990 and 1992. It is important to note that the line representing rent prices are stated in nominal terms, hence the cost of renting is assumed to increase as CPI increases, not necessarily to the same extent considering there are many other factors involved like the possibility of excess supply in the rent markets.

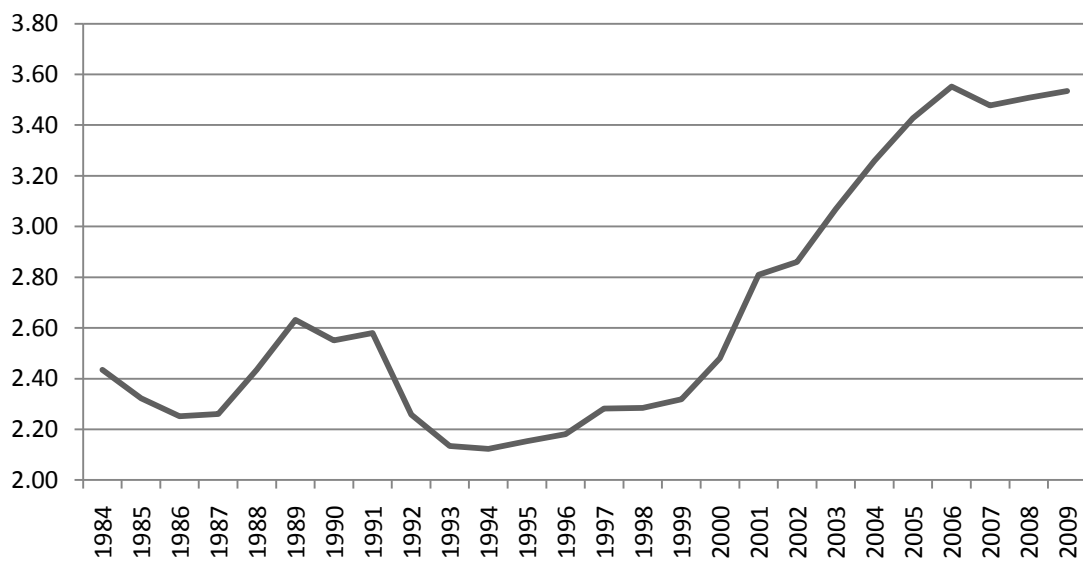
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## 5 Empirical Results

In this section of the paper, the results from our models will be presented and discussed.

### 5.1.1 Price-to-Income

The ratio for the years 1984 – 2009 are depicted in figure 4-1 below. From 1984 to 1992, there were first a period of rapid increase in the ratio, which could be explained by the deregulations of the markets in Sweden at that time. There was also a period of a sharp decline, which would be the aftermath of the 1990s crisis, when house prices fell sharply.



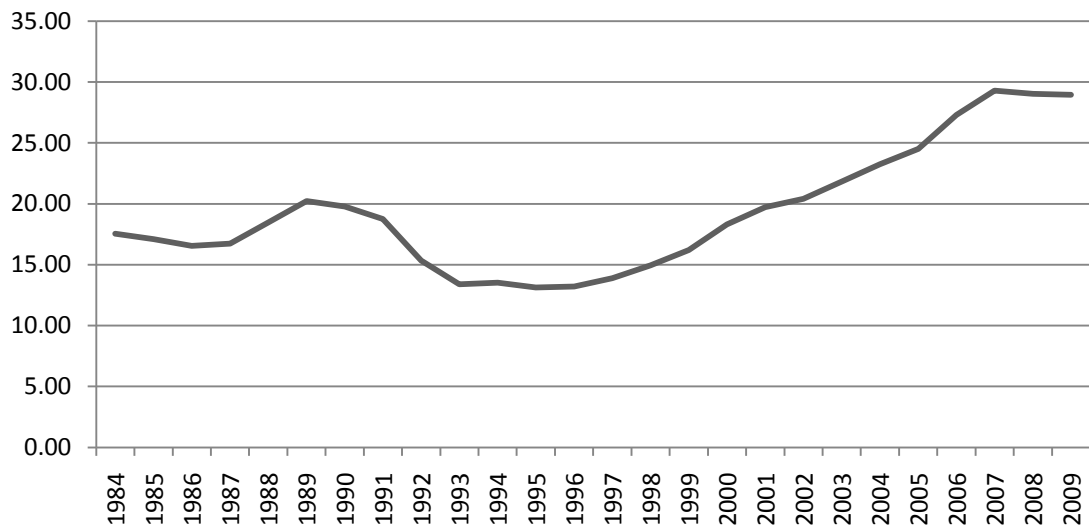
**Figure 5-1** Price-to-Disposable income Ratio 1984-2009 Data: SCB

As seen in figure 4-1, after 1994 the price-to-income ratio has increased vastly, and at the end of 2009 was at record levels. This means that house prices have increased at a faster pace than disposable income, and this could point towards an overvalued housing market.

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## 5.1.2 Price-to-Rent

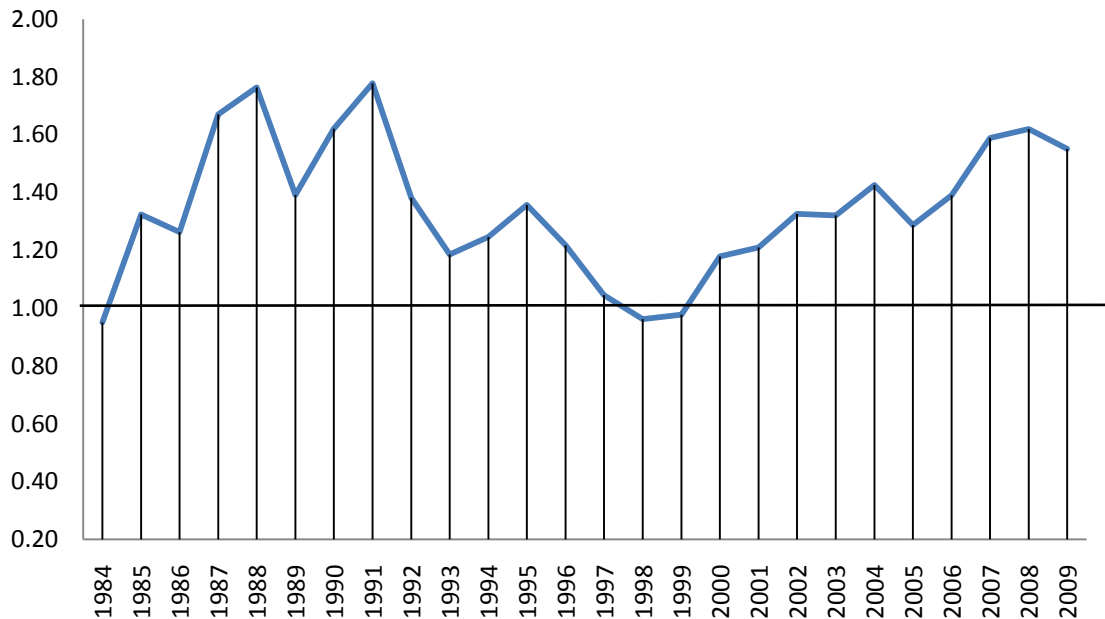
As depicted in figure 4-1, the ratio increased until 1989 when it started decreasing due to the current housing crisis in Sweden at the time. The price-to-rent ratio continued to fall until 1995 when it started increasing, the ratio continued to increase until 2007 when the financial crisis hit Sweden and the ratio decreased. The decline of the ratio was not very significant and the price-to-rent ratio in 2009 is still near the all time high levels.



**Figure 5-2** Price-to-Rent Ratio 1984-2009 Data: SCB

### 5.1.3 Imputed rent-to actual rent

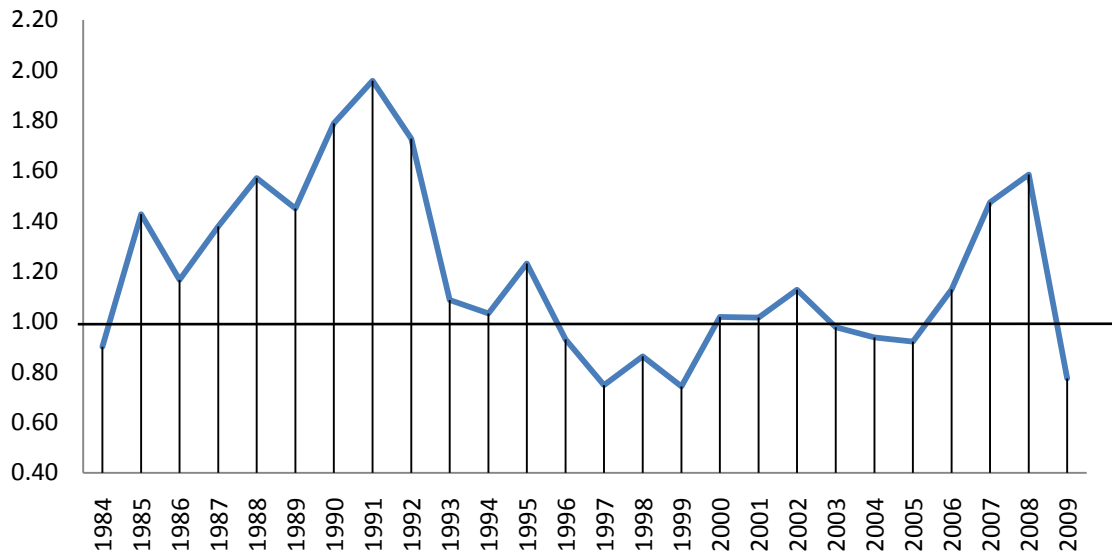
This imputed rent-to-actual-rent ratio is depicted in figure 5-3 as a time series, from 1984 till 2009. The theory behind this model is that equilibrium between rental market and ownership exists when the ratio is equal to 1. If the ratio is considerably above 1 the ownership cost is higher than the rental cost which Himmelberg et al (2005) concludes would be an indication of an overvalued housing market, although the authors at the same time state that small deviations from 1 will always occur and are not significant signs of an overvalued market.



**Figure 5-3** Imputed rent-to-Actual rent 10 year Data: SCB

After the deregulations in the markets in 1984, the ratio increased vastly and peaked in 1991. The financial distress in the early 1990s led to a crash in the housing market, this can be seen in Figure 5-3 quite clearly with the ratio falling from 1,80 down to 1,30 in one year. The only time in our time series data except for the year 1984 that the ratio was below 1, was the years 1998 and 1999. The ratio then increases quite steadily for many years until 2009 where one can see a small dip, although still being on quite high levels, and quite close to the same levels that we saw in 1991.

In Figure 5-4 one can observe how different the result becomes when calculating the imputed rent-to-actual rent when using the 12 month risk-free interest rate.



**Figure 5-4** Imputed rent-to-Actual rent 12M Data: SCB

Both figures follows a similar pattern during the first half of the sample measured, the imputed rent ratio is significantly higher before the 1992 crash than during the rest of the sample. However, after that there are staggering differences between the two figures, one can observe that while there is only two periods where the ratio is below 1 in figure 5-3, there are three periods where the house market is assumed to be undervalued according to the figure 5-4. The most significant change is that by looking at figure 5-3 one can draw the conclusion that the housing market might be overvalued while 5-4 suggests that the housing market is undervalued.

#### 5.1.4 Testing for Stationarity Augmented Dickey-Fuller Test

Since the imputed rent model assumes that there exists an equilibrium between the housing prices and the rental cost, the ratio should through time return to 1 which is the equilibrium level between the two. To test if there exists a tendency for the imputed rent-to-actual rent ratio to move towards 1, the augmented Dickey-fuller test has been used. The test is commonly used to test for unit roots. A unit root means that there is a tendency for changes in a system to continue forever. If the total of unit roots are less than 1, the system will eventually converge to the equilibrium level. The null hypothesis is that there is an autoregressive integrated moving average process and it is tested against the alternative hypothesis that there is stationary alternative (Cheung, Lai, 1995).

The formula for the Augmented Dickey Fuller Test without a constant and trend is:

$$\Delta y_t = \delta y_{t-1} + u_t$$

$H_0$ : Ratio has a unit root  $H_1$ : Ratio does not have a unit root

Exogenous: None

Lag Length: 0 (Automatic based on SIC, MAXLAG=5)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	0.236564	0.7467
Test critical values: 1% level	-2.660720	
5% level	-1.955020	
10% level	-1.609070	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RATIO)

Method: Least Squares

Date: 05/17/10 Time: 08:33

Sample (adjusted): 2 26

Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RATIO(-1)	0.007002	0.029597	0.236564	0.8150
R-squared	-0.015587	Mean dependent var		0.025980
Adjusted R-squared	-0.015587	S.D. dependent var		0.197878
S.E. of regression	0.199414	Akaike info criterion		-0.347689
Sum squared resid	0.954383	Schwarz criterion		-0.298934
Log likelihood	5.346110	Durbin-Watson stat		1.984548

**Table 5-1** Augmented Dickey-Fuller Test - Imputed rent-to-actual rent

The t-statistic from the test is 0.236564, hence the null hypothesis is accepted at all of the different critical value levels. This means that the ratio variable has a unit root and thus, the process is non-stationary. Since it is a non-stationary process, the imputed rent-to-actual rent ratio does not seem to move towards the equilibrium level over time. This means that people seem willing to pay more for owning a house compared to renting a similar dwelling. Since the process is non-stationary and the model assumes that the ratio should return to equilibrium, we performed a similar test on the variable rent and the imputed rent. The results from the tests was that both variables was non-stationary. This confirms that the imputed rent does not tend to move towards the equilibrium level. These tests are shown in the Appendix, Figure 1-4.

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## 6 Discussion of Results

This section will analyse the results retrieved from the ratios and models used. These results will then be discussed and compared to the situations in the US before the crash to see if our hypothesis that the Swedish market is overvalued and might be facing a similar fate to what the US market experienced, can be accepted.

The price-to-rent ratio was the first ratio calculated and examined. The findings were quite clear. Since 1996 there has been an apparent upward trend, and the current price-to-rent level is close to the all time high level in 2007. This shows that renting has become increasingly more affordable compared to ownership which could be an indication of a possible overvalued housing market. Looking at the results from the ratio, we can clearly see how the ratio during and after the housing crash of 1992 fell significantly, this suggests that the house prices were overvalued when the ratio was at a level of 20. The current ratio is 29 which is significantly higher than the one in before the last crash.

The second ratio used was the price-to-income ratio which had similar results to the price-to-rent ratio. One can immediately see, that after the housing crash of 1992 the ratio fell significantly which indicates that when the ratio was 2.6 the housing market was overvalued. After the crash the ratio stayed at low levels for several years compared to the levels of the 1980s. The ratio did not stay at these low levels for long, from 1995 and onwards the ratio increased rapidly and currently the ratio is at significantly higher levels than before the last housing crash. The results of this ratio analysis is similar to the results of the price-to-rent ratio and also suggests that the housing market is overvalued.

Although these two models suggest that there is a possibility that the market is overvalued, there are certain limitations that have to be taken into consideration. Most importantly, neither of these ratios take into account the annual cost of ownership.

The cornerstones of this study are the findings from the imputed rent formula. These findings give the reader a good overview how the annual cost of ownership has increased over time compared to the cost of renting a similar dwelling. One can see from the calculations depicted in the figure 5-3 that the annual cost of ownership has been higher than the rental cost for the most part of the time period examined except for the period between 1997 to 1999 where the imputed to rent ratio actually was below 1, which indicated that the rental cost was less than the cost of ownership. The movements during the aftermath of the housing crash of 1992 follows a similar pattern to the results that were observed from the previous ratios. The current imputed-to-rent ratio is 1,55, this value is significantly higher than the equilibrium level between imputed rent and actual rent, which is 1. Contrary to the price-to-income and price-to-rent ratios observed, the 2009 value of the imputed rent ratio is not higher than the ratio observed before the crash of 1992. This finding is interesting because even if the ratio is at a high level the prices may not be at a sufficiently high level to support the argument that the housing market in Sweden is going to experience a new housing crash.

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If there is a significant difference between the cost of home ownership and renting similar dwellings, people will tend to move to the cheapest alternative until the difference in prices has disappeared and the situation reaches an equilibrium. To see if our imputed rent-to-actual rent is moving towards equilibrium the augmented Dickey-Fuller test was implemented to test if the process was stationary in the times series. The results from the test did not support the hypothesis that the data is moving towards equilibrium over time. We cannot draw any liable conclusions due to a small sample used. Since there was only 25 years of data available the sample only consists of 25 observations which is regarded as a quite small sample. According to Sanso and Montanes (2001) the power of Dickey-Fuller test decreases as the sample size becomes smaller.

One explanation for the fact that the ratio has been above the equilibrium level for most of the time period examined, could be due to the extra benefits that comes with owning a house which the model does not take into account. The comparison made is between one- or two-dwelling houses and a three room and kitchen apartment and there are several differences to take into consideration. Some of the benefits are the possibility to renovate and change the appearance of the house which is normally not allowed when renting. Other factors like having an garage and a garden are things that people might regard as reasons to pay the additional cost of owning a house compared to renting. There are several other difficulties when one tries to compare the imputed rent to the actual rents, there is no easy way to account for the quality differences between apartments and houses. It is also important to take into account that there may be considerable differences in the sizes between houses and three room apartments. Another important issue with the rental cost is that there are policies implemented to control the rents, which can lead to artificially low prices of rent (Hirshleifer et al, 2005).

Looking at the situation in the US prior to the housing crash, one could see many policies implemented to increase homeownership, and making it easier for the general public to acquire mortgages. At the same time as these policies were implemented, the Federal Reserve had kept a very low interest rate for quite a long time. In Sweden, there have also been new polices implemented that favours homeowners, such as “Rotavdraget” which allows homeowners to make tax deductions on renovation costs. However, the effects of these policies has not had the same impact as the policies that the US government have implemented. The interest rate is currently on historically low levels in Sweden, which is similar to the US before the crash, although this is not a strong enough factor to justify that Sweden is facing a similar fate.

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## 7 Conclusion

We have discussed different methods of examining if there are reasons to believe that the Swedish housing market is likely to face a similar crash like the US market experienced in 2007. Three different models were used to evaluate the market, namely: the price-to-rent, price-to-income, and the imputed rent ratio. All of the models indicated that the housing market is currently overvalued, however the conclusions that can be drawn from the first two models are quite inconclusive due to limitations of the models. The biggest problem is that neither of the models takes into account the annual cost of ownership, this dilemma was solved by adding the imputed rent model which includes the cost of ownership. Himmelberg et al (2005) and Poterba (1984) also use this approach due to the limitations of the first two models. It is also important to note that increasing house prices over time does not necessarily mean that the housing market is overvalued, there are underlying fundamental factors that have to be taken into account. These factors include interest rate, household debt, taxes, construction costs and supply of housing. We can conclude that the increase in construction cost cannot explain the increase in housing prices since the growth in prices increased significantly more than the cost of construction. However, increasing household debts means that the people have to take on higher mortgages to afford housing, which may also indicate that the housing market is overvalued.

We applied 25 years of data to the imputed rent model and then compared it to the rent of similar dwellings, due to the limited amount of observations one cannot draw definite conclusions about the state of the housing market. The results from the imputed rent model indicate that the housing market is currently overvalued. However, when the 12 month risk-free rate was used instead of the 10year rate, one could observe a vast difference in the ratio. Due to the fact that housing is normally considered a long-term investment, it is more appropriate to use the 10 year risk-free to avoid the short term fluctuations that the 12 month risk-free rate experiences. Himmelberg et al (2005) also uses the 10-year risk-free rates in their calculations. We performed a Augmented Dickey Fuller test to see if the process of the time series was stationary, meaning that the ratio would return to the equilibrium level. The result was that the ratio was non-stationary, however there were too few observations to draw a definite conclusion. Although, the fact that the ratio was above 1 for most of the observed time period could be explained by the extra benefits that comes with home ownership that the model does not take into account.

The current situation in Sweden has some similarities to the situation in the US before the crisis, mostly the low interest rate environment and a rapid increase in housing prices during the last couple of years. Although Sweden has implemented policies that favours homeownership, like the tax deductibility of home ownership and subsidies for building new housing complex, the policies that the American government implemented had bigger impacts on the housing market than the Swedish ones.

The result by the models used, indicates that the Swedish housing market is currently overvalued, still due to the numerous limitations mentioned we cannot definitely conclude that the housing market is neither overvalued nor is facing a similar crash as the US housing

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market experienced in 2007. However, the interest rate cannot stay at these low levels forever and as interest rates increases this will likely lead to a fall in house prices in the future.

## **7.1 Suggestion for further studies**

For further studies it could be interesting to adjust for the quality improvements of households over time, since this could explain some part of the increase in house prices. Hwang and Quigley (2004) brings this issue to attention and discusses the fact that there are significant investments made in renovations and repairs of housing.

Another ratio that could be interesting to look at is the house price-to-credit ratio, Black, de Meza and Jeffrey (1996) focuses more on the relation between house prices and credit and this could also be interesting to do for the Swedish housing market.

An interesting issue to look further into could be the problems when comparing the imputed rent to actual rent, considering there are several differences between houses and apartments. If data is available, comparing the rental costs of apartments to the annual cost of ownership for a flat might be more suitable because a flat does not include a garden, a backyard and other differences that exists between a house and a rental apartment.

## List of references

- Ayuso, JA & Restoy, FR., 2006. House prices and rents: An equilibrium asset pricing approach. *Journal of Empirical Finance*, 13. pp.371-388
- Björklund, KB & Söderberg, BS, 1999. Property Cycles, Speculative Bubbles and the Gross Income Multiplier. *Journal of Real Estate Research*, 18(1). pp.151-174.
- Black, JB., de Meza, DDM & Jeffreys, DJ., 1996. The Supply of Collateral and the Enterprise Economy. *The Economic Journal*, 106(434). pp.60-75.
- Borio, CEVB, Kennedy, NK & Prowse, SDP. 1994. Exploring aggregate asset price fluctuations across countries: measurement, determinants and monetary policy implications. *BIS Economic Papers*, 40, April. pp.9-96.
- Brunnermeier, MKB., 2009. Deciphering the Liquidity and Credit Crunch 2007-2008. *Journal of Economic Perspectives*, 23(1). pp.77-100.
- Case, KC and Shiller, RS., 2003. Is There a Bubble in the Housing Market? *Brookings Papers on Economic Activity*, Vol. 2003(2), pp.564-578.
- Cheung, YWC & Lai, KSL., 1995 Lag Order and Critical Values of the Augmented Dickey-Fuller test, *Journal of Business & Economic Statistics* 13(3). pp.277-280
- Englund, P., 1999. The Swedish Banking Crisis: Roots and Consequences. *Oxford Review of Economic policy*, 15(3), pp.80-97.
- Fisher, IF., 1933. The Debt-Deflation Theory of Great Depressions. *Econometrica*, 1(4), pp.337-357.
- Hendershott, PHH & Slemrod, JS., 1982. Taxes and the user cost of capital for owner-occupied housing. *National Bureau Of Economic Research*, 929. pp.1-24.
- Himmelberg, CH, Mayer, CM, & Sinai, TS., 2005. Assessing High House Prices: Bubbles, Fundamentals and Misperceptions. *The Journal of Economic Perspectives*, 19(4), pp.67-92.
- Hirshleifer, J. Hirshleifer, D. & Glazer, A., 2005. Price theory and applications: decisions, markets, and information. 7th ed. New York: Cambridge University Press.
- Hort, KH., 1997. On price formation and quantity adjustment in Swedish housing markets, *Economic Studies*, Vol. 34, Uppsala University, Sweden. pp.51- 56.
- Hott, C.H & Monnin, PM., 2008. Fundamental Real Estate Prices: An Empirical Estimation with International Data. *J Real Estate Financial Economics*, No. 36, pp.427-450.
- Holt, JH., 2009. A Summary of the Primary Causes of the Housing Bubble and the Resulting Credit Crisis: A Non-Technical Paper. *The Journal of Business Inquiry*, 8(1), pp.120-129.
- Jaffe, Dwight DMJ., 1994. The Swedish Real Estate Crisis, *SNS report*, Stockholm, October

- Krinsman, AK., 2007. Subprime Mortgage Meltdown: How did it Happen and How will it End? *The Journal of Structured Finance*, 13(2), pp.1-9.
- Lamont, OL & Stain, JS.,1999. Leverage and house-price dynamics in U.S. cities. *RAND Journal of Economics*, 30(2). pp.498-514.
- Levin, EJJ & Wright, REW., 1997. Speculation in the Housing Market? *Urban Studies*, 34(9). pp.1419-1437.
- Montañés, AM & Sansó, AS., 2001.The Dickey-Fuller Test Family and Changes in the Seasonal Pattern. *Annales D'Économie et de Statistique*, 61. pp.73-90.
- Muellbauer, JM., 2007. Housing and Personal Wealth in a Global Context. *World Institute For Development Economics Research* 2007(27). pp.1-20.
- Poterba, JMP., 1984. Tax Subsidies to Owner-Occupied Housing: An Asset-Market Approach. *The Quarterly Journal of Economics*, 99(4). pp.729-752.
- Poterba, JMP., 1991. House Price Dynamics: The Role of Tax Policy and Demography. *Brookings Paper of Economic Activity*, 1991(2). pp.143-203.
- Poterba, JMP., 1992. Taxation and Housing: Old Questions, New Answers. *The American Economic Review*, 82(2). pp.237-242.
- Stiglitz, JS & Weiss, AS., 1981. Credit Rationing in Markets with Imperfect Information. *The American Economic Review*, 71(3). pp.393-410.
- Quigley, JMQ., 1999. Real estate prices and Economic Cycles. *International Real Estate Review*, 2(1). pp.1-20.

## **E-Sources**

- Arends, BA. 2008. Home Buyers, Start Your Engines. *Wall Street Journal*. [Online] (Updated 15 May 2008) Available at:  
<http://online.wsj.com/article/SB121077112664291771.html?KEYWORDS=housing+bubble+2007> [Accessed 18 March 2010].
- Bernanke, BB. 2007. Subprime mortgage lending and mitigating foreclosures Initiative. [Online] (Updated 20 September 2007) Available at:  
<http://www.federalreserve.gov/newsevents/testimony/bernanke20070920a.htm> [Accessed 19 March 2010].
- Bureau of the Census, 2010. Homeownership Rates for the US and Regions: 1965 to Present, Table 14. [Online] (Updated 5 July 2010) Available at:  
<http://www.census.gov/hhes/www/housing/hvs/historic/index.html> [Accessed 31 August 2010].

Cleveland FED, 2010. U.S. Inflation. [Online] (Updated 10 August 2010) Available at: <http://www.clevelandfed.org/Research/data/US-Inflation/chartsdata/> [Accessed 3 October 2010].

Eurostat, 2010. Unemployment data. [Online] (Updated 11 October 2010) Available at: [http://epp.eurostat.ec.europa.eu/portal/page/portal/product\\_details/dataset?p\\_product\\_code=UNE\\_RT\\_M](http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/dataset?p_product_code=UNE_RT_M) [Accessed 12 October 2010].

Federal Deposit Insurance Corporation. 2010. Managing the Crisis: The FDIC and RTC Experience. [Online] (Updated 1 May 2005) Available at: <http://www.fdic.gov/bank/historical/managing/Chron/1990/index.html> [Accessed 20 March 2010].

Federal Financial Institutions Examination Council. 2010. The Community Reinvestment Act (CRA). [Online] (Updated 1 June 2010) Available at: <http://www.ffiec.gov/cra/> [Accessed 25 March 2010].

Federal Housing Finance Agency, 2010. House Price Index. [Online] (Updated 25 August 2010) Available at: <http://www.fhfa.gov/default.aspx?Page=14> [Accessed 3 October 2010].

Federal Reserve, 2010. The Discount Rate. [Online] (Updated 20 July 2010) Available at: <http://www.federalreserve.gov/monetarypolicy/discountrate.htm> [Accessed 31 August 2010].

Federal Reserve Bank of New York, 2008. Historical Changes of the Target Federal Funds and Discount Rates. [Online] (Updated 19 February 2010) Available at: <http://www.newyorkfed.org/markets/statistics/dlyrates/fedrate.html> [Accessed 25 March 2010].

Krugman, PK., 2010. Berating the raters. [Online] (Updated 25 April 2010) Available at: <http://www.nytimes.com/2010/04/26/opinion/26krugman.html> [Accessed 28 May 2010]

Laderman, EL., 2001. FRBSF Economic Letter Subprime Mortgage Lending and the Capital Markets. [Online] (Updated 20 September 2007) Available at: <http://www.frbsf.org/publications/economics/letter/2001/el2001-38.html> [Accessed 19 March 2010].

Löfberg, KL., (2010). Bostadsbubbla på gång igen. *Dagens Nyheter*. [Online] (Updated 26 February 2010) Available at: <http://www.dn.se/bostad/kjell-lofberg-bostadsbubbla-pa-gang-igen-1.1052039> [Accessed 13 March 2010].

Macro Markets, 2010. U.S. Housing. [Online] (Updated 25 August 2010) Available at: [http://www.macromarkets.com/csi\\_housing/index.asp](http://www.macromarkets.com/csi_housing/index.asp) [Accessed 3 October 2010].

Nyberg, LN., 2007. Speech by the Vice president of the Swedish Central Bank. The Development on the real estate market. [Online] (Updated 20 September 2007) Available at: <http://www.riksbank.se/templates/Page.aspx?id=24892> [Accessed 19 March 2010].

Regeringskansliet, 2009. Husavdrag för ROT-arbeten & hushållsnära tjänster. [Online] (Updated 20 May 2009) Available at: <http://www.sweden.gov.se/sb/d/11257> [Accessed 22 March 2010]

Riksbanken, 2010. Svensk Statsskuldväxel 12-månaders löptid. [Online] (Updated 4 June 2010) Available at: <http://www.riksbank.se/templates/stat.aspx?id=16739> [Accessed 26 March 2010]

Sveriges Domstolar, 2010. Hyresrätt som hyrs ut som bostad. [Online] (Updated 25 Augusty 2010) Available at: [http://www.domstol.se/templates/DV\\_InfoPage\\_\\_\\_\\_\\_1010.aspx](http://www.domstol.se/templates/DV_InfoPage_____1010.aspx) [Accessed 3 Sept 2010].

Swedbank Hypotek, 2010. Historiska räntor. [Online] (Updated 4 June 2010) Available at: <http://hypotek.swedbank.se/rantor/historiska-rantor/> [Accessed 24 March 2010].

US department of housing and urban development, 2010. *American Dream Down-payment Initiative*. [Online] (Updated 4 May 2010) Available at: <http://www.hud.gov/offices/cpd/affordablehousing/programs/home/addi/> [Accessed 18 March 2010].

## **Statistics Sweden**

Statistics Sweden, 2010. Tillgångar, skulder och kapitalvinster – Balansräkningens roll underskattas i statistik och analys. [Online] Available at: [http://www.scb.se/statistik/\\_publikationer/NR9999\\_2010A01\\_BR\\_NRFT1001.pdf](http://www.scb.se/statistik/_publikationer/NR9999_2010A01_BR_NRFT1001.pdf) [Accessed 25 April 2010].

Statistics Sweden, 2008. Fastighetsprisstatistik för 1:a kvartalet 2008. [Online] Available at: [http://www.scb.se/statistik/BO/BO0501/2008K01/BO0501\\_2008K01\\_SM\\_BO40SM0802.pdf](http://www.scb.se/statistik/BO/BO0501/2008K01/BO0501_2008K01_SM_BO40SM0802.pdf) [Accessed 13 October 2010].

Statistics Sweden, 2007. Sveriges ekonomi: Statistiskt perspektiv (Publication 3). [Online] Available at: [http://www.scb.se/Grupp/Teman/Sveriges\\_Ekonomi/\\_Dokument/Sverigesekonomikv107.pdf](http://www.scb.se/Grupp/Teman/Sveriges_Ekonomi/_Dokument/Sverigesekonomikv107.pdf) [Accessed 25 March 2010].

Statistical Yearbooks of Sweden. (1984-2009), Volumes 70-95. Stockholm, Norstedts Tryckeri AB.

## Appendix 1 Dickey-Fuller Tests

Null Hypothesis: IMPUTEDRENT has a unit root  
 Exogenous: None  
 Lag Length: 0 (Automatic based on SIC, MAXLAG=5)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	1.570134	0.9677
Test critical values:		
1% level	-2.660720	
5% level	-1.955020	
10% level	-1.609070	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(IMPUTEDRENT)  
 Method: Least Squares  
 Date: 05/31/10 Time: 09:46  
 Sample (adjusted): 2 26  
 Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IMPUTEDRENT(-1)	0.040175	0.025587	1.570134	0.1295
R-squared	-0.076185	Mean dependent var		3281.459
Adjusted R-squared	-0.076185	S.D. dependent var		7750.355
S.E. of regression	8040.166	Akaike info criterion		20.86147
Sum squared resid	1.55E+09	Schwarz criterion		20.91022
Log likelihood	-259.7683	Durbin-Watson stat		1.942238

**Figure 1** Dickey-Fuller test – Imputed Rent

Null Hypothesis: IMPUTEDRENT has a unit root  
 Exogenous: Constant, Linear Trend  
 Lag Length: 0 (Automatic based on SIC, MAXLAG=5)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.379874	0.3800
Test critical values:		
1% level	-4.374307	
5% level	-3.603202	
10% level	-3.238054	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(IMPUTEDRENT)  
 Method: Least Squares  
 Date: 05/31/10 Time: 09:46  
 Sample (adjusted): 2 26  
 Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IMPUTEDRENT(-1)	-0.384555	0.161587	-2.379874	0.0264
C	14180.84	5253.979	2.699066	0.0131
@TREND(1)	921.8404	453.0063	2.034939	0.0541
R-squared	0.206219	Mean dependent var		3281.459
Adjusted R-squared	0.134057	S.D. dependent var		7750.355
S.E. of regression	7212.174	Akaike info criterion		20.71710
Sum squared resid	1.14E+09	Schwarz criterion		20.86336
Log likelihood	-255.9637	F-statistic		2.857727
Durbin-Watson stat	1.730588	Prob(F-statistic)		0.078833

**Figure 2** Dickey-Fuller test – Imputed Rent with Trend and Intercept

Null Hypothesis: RENT has a unit root  
 Exogenous: None  
 Lag Length: 1 (Automatic based on SIC, MAXLAG=5)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	1.141418	0.9294
Test critical values:		
1% level	-2.664853	
5% level	-1.955681	
10% level	-1.608793	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(RENT)  
 Method: Least Squares  
 Date: 05/31/10 Time: 09:50  
 Sample (adjusted): 3 26  
 Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RENT(-1)	0.009489	0.008313	1.141418	0.2660
D(RENT(-1))	0.687644	0.163382	4.208805	0.0004
R-squared	0.275628	Mean dependent var		1799.874
Adjusted R-squared	0.242702	S.D. dependent var		1697.198

S.E. of regression	1476.950	Akaike info criterion	17.51300
Sum squared resid	47990419	Schwarz criterion	17.61117
Log likelihood	-208.1560	Durbin-Watson stat	2.051401

**Figure 3** Dickey-Fuller test – Rent

Null Hypothesis: RENT has a unit root  
 Exogenous: Constant, Linear Trend  
 Lag Length: 1 (Automatic based on SIC, MAXLAG=5)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.913378	0.6165
Test critical values:		
1% level	-4.394309	
5% level	-3.612199	
10% level	-3.243079	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation  
 Dependent Variable: D(RENT)  
 Method: Least Squares  
 Date: 05/31/10 Time: 09:50  
 Sample (adjusted): 3 26  
 Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RENT(-1)	-0.124612	0.065127	-1.913378	0.0701
D(RENT(-1))	0.583652	0.179424	3.252925	0.0040
C	4017.111	1546.664	2.597275	0.0172
@TREND(1)	183.8757	126.0001	1.459329	0.1600
R-squared	0.460821	Mean dependent var		1799.874
Adjusted R-squared	0.379944	S.D. dependent var		1697.198
S.E. of regression	1336.435	Akaike info criterion		17.38441
Sum squared resid	35721177	Schwarz criterion		17.58075
Log likelihood	-204.6129	F-statistic		5.697813
Durbin-Watson stat	2.181609	Prob(F-statistic)		0.005481

**Figure 4** Dickey-Fuller test – Rent with Trend and Intercept