The effect of the Swedish mortgage cap on house prices depending on the loan-to-value ratio:

A regional study within Sweden

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Abstract

This research aims to study the effect from the introduction of the Swedish mortgage cap in October 2010 on regional house prices in Sweden depending on the loan-to-value ratio. We study the house prices in regions around the introduction of the mortgage cap through a difference-in-difference analysis. Our theory is that the credit-restrictive mortgage cap has had a more negative price effect in regions with the higher loan-to-value ratios. This we base on basic demand mechanisms and the fact that previous theory suggests that credit-easing standards lead to higher house prices, which is why we believe the opposite is also true. Regionally we look at the greater Stockholm-, Gothenburg- , Malmö-area and the rest of Sweden. Our initial belief is that the big city regions have the highest loan-to-value ratios and thus have experienced a more negative price effect. We find evidence for our theory that a higher loan-to-value ratio has led to a more negative effect from the mortgage cap on the house prices. However, opposite to our expectations, the rest of Sweden has the higher loan-to-value ratio and is the region that has experienced a larger negative house price effect following the introduction of the mortgage cap.

Key words: Mortgage cap, regional house prices, loan-to-value ratio, difference-in-difference

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2. Introduction and previous literature

2.1 Introduction

The European debt crisis has spread like a fire around the Mediterranean Sea, starting with Greece and now most recently the vacation paradise Cyprus was hit by the flames. Southern Europe has been grappling with austerity and sinking into a state of a staggering economic engine as recently described by various media channels[1]. Politicians sit behind closed doors trying to figure out a solution to how companies and more specifically banks are going to get a grip of their massive amounts of debts to be able to stay afloat. This concept also goes for people, whose debt levels have been increasing significantly much due to the easing of credit standards.

However far away Sweden might seem from the trouble, however safe we might feel here in Sweden, the facts tell a different story. The Swedish population's debt-levels have increased a lot, from under 90 percent debt-to-income in 1996 to 170 percent in January 2011, which is depicted by Johansson et al. (2011) in a report on behalf of the central bank of Sweden (Riksbanken)[2]. This is also underlined by Johannes Holmberg at the statistical institute SCB (2012). Even more interesting, or frightening, is that according to the credit authority BKN (2011), the share of housing mortgage loans out of total loans in Sweden has been the fastest growing compared to a lot of other developed economies. The debts relating to house purchases have risen tremendously from 1995 to 2010 (BKN, 2011). Holmberg also describes this (SCB, 2012), and says that in December 2011, housing related loans constituted 80 percent of the debt of the Swedish population, showcasing a massive growth in housing related loans. Figure 1 in the appendix[3] shows a large percentage increase (compared to the previous year) in housing related loans in the 2000s, and a slightly smaller increase in recent years.

This sort of horror scenario makes it extra interesting to isolate a research to the Swedish mortgage loan market since it obviously makes out an important part of the increased debt levels of the Swedish population. Like the politicians who try to put out the fire in the Mediterranean region, the financial supervisory authorities try to prevent people from getting too indebted. An example of an action to stop the soaring debt levels and create economic stability is the introduction of the Swedish mortgage cap. The mortgage cap implies an 85 percent maximum loan-to-value (LTV) ratio, i.e. amount of the purchase price of the house

[1] http://www.bloomberg.com/news/2013-02-17/debt-bubble-born-of-easy-cash-prompts-swedish-rule-review.html, viewed 5 April 2013
[2] Will be referred to as Riksbanken
[3] All figures and tables are shown in the appendix.

that can be financed with loans. The Swedish mortgage cap was introduced by the Swedish financial supervisory authority (FI)[4] in October 2010.

A lot of earlier literature and research circle around how the *easing* of credit standards has effects on debt-levels, consumption and house prices. The introduction of the Swedish mortgage cap can instead be viewed as a new regulation or *restriction* of credit standards, which means that studying it will be an adventure along a road less traveled. The mortgage cap is not really a new law or regulation, but rather a new guideline or recommendation that the banks should follow when issuing new loans. Before the mortgage cap there were no such guidelines. However, there is for example still possible to buy a house and finance it with over 85 percent loan ("blancolån"), but those situations have become less common[5] and the mortgage cap is clearly setting the norm for new loans.

The starting point of our research will be to study whether there are regional differences within Sweden when it comes to debt-levels in the shape of LTV-ratios, and then see if there is a connection with the regional house price developments. For the regions, we have divided Sweden into the greater Stockholm-, Gothenburg- and Malmö-area, and compare it to the rest of Sweden. This we do because Stockholm, Gothenburg and Malmö are the three biggest regions in Sweden. Also, to be able to get more clear differences in the LTV-ratios, we cannot have too many regions which would mean too few house purchases to represent a region, and also mean a more diffuse and hard-to-motivate division of Sweden into regions. We have used SCBs definition of which counties in our data to put in the regions that we compare. Factors looked at on a regional level are LTV-ratio, volume of housing related loans, debt-level in general (debt-to-income), what people have left for non-housing consumption after paying housing related costs and "blancolån". There are many factors to close in on to determine what should be seen as measures of risk. By risk we mean being exposed to loan related problems such as not being able to pay the interest, or personal default.

We have chosen to specifically look at the mortgage cap's effect on house prices in different regions in Sweden with different LTV-ratios. This is because the research has to have a niche, and more importantly, the idea of the mortgage cap is to restrict the loan-to-value ratio. The effect on house prices is interesting for us to study for several reasons.

Firstly, house prices are interesting because the Swedish house prices have risen steadily until sometime in 2011, when a decline occurred (Mäklarstatistik (2013)), suggesting that there might be an effect from the introduction of the mortgage cap in late 2010. This can be

[4] Will be referred to as FI (Finansinspektionen).
[5] http://www.fi.se/Tillsyn/Rapporter/Rapporter/Listan/Den-svenska-bolanemarknaden1/, last viewed 9 May 2013

seen in figure 2, where the monthly price development is shown for small houses[6] and in figure 3, where the monthly price development is shown for co-operative apartments[7]. Even though these two types of houses do not show the exact same price development every year, the long term trend is similar and both the figures show a decline in the previously steadily rising house prices in 2011, after the introduction of the mortgage cap in late 2010. In this research we will focus on the small house prices because as can be seen in figure 2 and 3, the price development is smoother over time while it is more volatile for co-operative apartments suggesting that it might be more difficult to pin-point what affects co-operative apartment prices. Also, there seems to have been a larger and clearer dip following the introduction of the mortgage cap in late 2010 for small house prices compared to co-operative apartment prices. Additionally, the share of co-operative apartments is low outside the big city regions. Finally and most importantly, the biggest and most clear difference in regional LTV-ratios is when you look at small house purchases. Therefore, we think by focusing on small houses we will get better results.We are of course aware of that there might be other factors that have also affected the house price development around the introduction of the mortgage cap, which is why we plan on using relevant control variables in our research. Whatever effect on house prices we find that we related to the mortgage cap in our research, we are aware of that the mortgage cap might be one of several factors contributing to the house price development.

Secondly, the relative house price development has consequences on the households in the different regions depending on the other regional-level factors mentioned above. Therefore the other factors mentioned will also be an important stepping stone to be able to draw potential conclusions about regional risk in Sweden. For instance, if households in some region tend to have a high percentage of "blancolån" or for instance little left to live for after paying their housing related costs, and there has been a more negative house price effect in the period we study following the introduction of the mortgage cap, that region might be considered to have high risk.

This main focus of this research will therefore be to study how the house prices in Sweden have reacted to the introduction of the mortgage cap depending on the LTV-ratio. We study the question whether the mortgage cap has had a different impact on the house prices in the different regions in Sweden with different LTV-ratios. Using regional and micro-level data on house prices and LTV-ratios, we examine the relative price movements of the houses with different LTV-ratios. We compare big city regions to the rest of Sweden and when it comes to

[6] Swedish: Småhus (villor, radhus och kedjehus)
[7] Swedish: Bostadsrätter

LTV-ratios our initial belief was that the LTV-ratio is higher in big city areas like the Stockholm-area compared to more rural parts of Sweden. First of all this is the typical picture that various media channels paint[8], which Magnus Karlsson at FI also indicated[9]. Our initial belief was also strengthened because FI's report on the Swedish housing and mortgage market (2013) indicates that the big city areas have the highest percentage of the volume of loans paid out, and highest average amount in Swedish kronor (SEK) of loan paid out. This is also shown in the data file from FI that we have worked with. The fact that the big city areas have the highest amount of loans in Swedish kronor led us to believe that the LTV-ratio would then also be higher in the big city areas.

However, the results showed us that the reality is actually the other way around. The LTV-ratio, especially for small houses, is higher in the rest of Sweden compared to the Stockholm-, Gothenburg and Malmö-area.

Our hypothesis is that house prices are affected more negatively if the LTV-ratio is higher. This is because as found in previous literature and theory presented in the next section, a higher possibility to take on loans due to for instance easing the credit standards leads to higher prices. We therefore believe the opposite is also true: if the possibility to take on debt is prevented due to a restriction of credit standards, demand for loans and the number of house purchases are held back and prices will be negatively affected. We hypothesize that prices are relatively more negatively affected if the LTV-ratio is higher. The mechanism is basically that if the LTV is higher, the demand for loans in relation to the purchase price is higher. If a cap is introduced on how much loans you can finance your house purchase with, the demand will be held back. This would have a negative impact on the house prices.

We started working on our research right after FI released their third extensive research on the Swedish housing and mortgage market in March 2013. We were able to get a contact at FI early on, which means that our research is based on new and unique micro-level data on LTV-ratios for Swedish households. Therefore this is the first research being done using this data after FI's own report, which further motivated our choice of subject.

Previous research on the effects of the mortgage cap on house prices is scarce. There is some research, for instance by Albertsson and Åsberg (2012), that studies the impact in general of the mortgage cap on Swedish house price growth and tries to compare Sweden to Norway or Denmark where a mortgage cap was not simultaneously introduced. We on the

[8] Hellekant, J., Unik Statistik avslöjar var bolånen är störst. SVD Näringsliv 8 May 2013.
[9] Meeting with Magnus Karlsson at FI, 26 March 2013

other hand compare house prices and LTV-ratios within the Swedish borders which brings certain stability to the research from a macroeconomic perspective, i.e. one might expect that the same macro-factors affect the Swedish housing market. Previous research on the effects of the mortgage cap has compared the Swedish housing market to for instance the Norwegian and Danish housing market, which leaves a substantially higher risk for endogeneity problems, i.e. that the explanatory variables are correlated to the error term where some explanatory factors might be hidden, known as omitted variable bias. The different housing markets risk being exposed to different shocks, isolated to the market of the specific countries. The Danish housing market has for instance experienced a strange development, with sky-rocketing debts[10]. In Denmark 56 percent of the loans are not amortized by the borrowers, and the International Monetary Fund (IMF) has recently encouraged Denmark to take control over these loans and debt levels[11]. Also, as indicated by Finocchiaro et al. (2011), it can be misleading to treat the mortgage and housing markets as homogeneous across nations. Finocchiaro et al. (2011) mean that there are important general differences between nations when it comes to these markets, making an across-the-border comparison very difficult to interpret. Therefore, we think a comparison within Sweden could yield better results.

Furthermore, the American housing bubble in 2006-2007, by many described as the triggering factor to the recent financial crisis, has contributed vastly to extensive research on the impact of easing credit standards on housing prices, consumer debt etc. Interesting is that the literature and research done on the influence of making credit standards more restrictive is more limited. Therefore, a study on this, certainly restrictive, credit initiative introduced by FI would contribute to a less adventured area of research which is an important advantage that motivated us to do this study.

When it comes to our results, we have performed difference-in-difference regressions with several specifications and all regressions yield results that show the expected coefficient in the diff-in-diff estimator, i.e. showing a relative negative effect from the mortgage cap in the rest of Sweden compared to the large city regions. This diff-in-diff effect is displayed in graph 1. The effect of the diff-in-diff estimator for the mortgage cap and the mortgage cap variable combined gives us a net negative effect for the rest of the country in most of the regressions. This in comparison to the larger cities, where the recommendation of a mortgage cap does not seem to have had any negative price effect, and where the regions instead seem to have

[10] http://www.svd.se/naringsliv/branscher/bank-och-fastighet/nordea-under-press-i-danmark_7470570.svd, viewed 2013-03-23.
[11] http://www.di.se/artiklar/2013/4/3/imf-stoppa-amorteringsfria-lan/, viewed 2013-04-04.

experienced an ambiguous and often insignificant effect in prices after the introduction of the mortgage cap despite the fact that the number of loans above 85 percent LTV-ratio ("blancolån") have dropped.

Regarding our different regression specifications, the individual house purchase observation regressions, as well as the mean house price regressions show similar results, using the same explanatory variables. In nearly all cases, the additional control variables get the expected coefficient directions, which additionally cement the results. As it is a dual diff-in-diff, due to the potentially high impact of the change of property taxation, the estimators for the property tax and the diff-in-diff estimator for the property tax take the expected signs.

We argue that a probable reason for our findings is based on basic demand factors. The demand-side is closely connected to the introduction of the mortgage cap. The rest of Sweden with the higher LTV-ratio suggests a high demand of loan in relation to the purchase price of the house. A cap on the LTV-ratio therefore holds back the demand for loans and a subsequent house purchase to a larger extent in the rest of Sweden, leading to a relatively more negative house price effect. Also, the rest of Sweden has more people who are over the 85 percent mortgage cap limit, i.e. have taken "blancolån". This results in a higher number of people not being able to finance their house purchases after the recommendation has been implemented. This is because if a potential house buyer belongs to the group who would previously buy a house with more than 85 percent LTV, that possibility might have disappeared.

Whereas the results are highly statistically significant, it is not necessarily exogenous, even though theory would support these ideas. Regardless, it is probable that the price effect has been different in the rest of Sweden compared to the large city regions. Furthermore, the results are based on the assumption that the LTV-ratios have been different in the regions over a period of time, which is at least partly supported over the last few years.

2.2 Previous literature

In the 2013 report on the Swedish housing and mortgage market, FI presents that two thirds of the Swedish population live in small houses or co-operative apartments. Housing mortgage loans and other housing related loans constitute as much as 85 percent of the total lending to the Swedish population. Therefore, one can believe that a structural change on the Swedish mortgage market would influence the households' way of living when it comes to housing as well as other consumption, which motivates our research.

FI describes how the debt-levels of the Swedish households increased in line with the house prices between 1995 until 2007, and a research by Peter Englund on behalf of Riksbanken shows a 144 percent increase in real Swedish house prices between 1995 and 2010. Also, the LTV-ratio in Sweden rose between 2000 and 2009. A too high LTV-ratio creates a serious vulnerability because if the price of the home would decrease and the loan-takers, or house owners, simultaneously have to sell the house, they end up with a high debt that will not be covered by the money they get from selling the house. This mechanism is further underlined by Duca et al. (2010). To prevent a deteriorating mortgage market, like the one leading to a massive house bubble in the United States in 2006-2007, FI decided to introduce a credit restriction, the Swedish mortgage cap on 1 October 2010, regulating that new housing mortgage loans are not allowed to exceed 85 percent of the market value of the house: a maximum LTV-ratio of 85 percent. Restricting the possibility to take on debt is supposed a margin of safety for the household, making them better prepared for sudden drops in prices of their houses (FI, 2013). The importance of this safety is also underlined by Abraham and Hendershott in their 1996 description of the dynamics of house price models.

The effect of the mortgage cap on the LTV-ratio is clear according to FI (2013), the trend of steadily rising LTV-ratios in Sweden has been stopped which can be seen in figure 4, and a big amount of new loans has a LTV-ratio of exactly 85 percent.

Furthermore, Englund's extensive research presents what factors that can explain the development of house prices. The research depicts for instance the real prices in different regions in Sweden (Englund, 2011). As can be seen in figure 5 which shows real price index for small houses (originally from SCB), the big city prices in real terms are in 2010 two and a half times the 1980 price levels. The real prices in the more rural, less populated areas have barely increased at all. Englund explains this difference with the population growth and the importance of the price of land in relation to the house price, which both are higher in the big city areas.

As stated earlier, we believe that there is a high likelihood that the same macro-factors

affect the entire Swedish housing market. However, the trend shown in Englund's paper somewhat depicts that there might be interesting differences in the Swedish housing market on a regional level which further motivates our research. This is also confirmed by Mäklarstatistik (2013), where differences in the price developments in the regions that they present research on are emphasized. The big regions Stockholm, Gothenburg and Malmö are compared and the price developments are not the same. Also, Mäklarstatistik (2013) describes that within the bigger regions they compare, there are differences in the price development.

Englund depicts how credit restrictions can give fluctuations in the house prices, in the short run, moving the prices away from the fundamental long run trend. We think that the mortgage cap might have this effect, because if looking at the Swedish house prices they have increased a lot in general over the last 20 years. However, after the mortgage cap was introduced the Swedish house prices in general seem to have fallen somewhat in early 2011 after the mortgage cap was introduced in late 2010, to now be back again on an increasing path again (Mäklarstatistik (2013)).

Englund continues with that there are only a few econometric house pricing models that take a change in the access to loans into account. However, Duca et al. (2010) use a measure of the average LTV-ratio for first time home buyers as a variable in the regression equation. Their findings are that if the LTV-ratio increases, i.e. people pay a higher fraction of the house purchase using a loan, then the house price increases. They find that an increase in the LTV-ratio on 10 percent leads to a price increase on houses of between 8 and 11 percent. Therefore, one might believe that the opposite could also be true: that if the LTV-ratio decreases following a restriction such as a mortgage cap, then the house price would decrease.

Duca et al. (2010) base their paper mainly on the American market, and take a standpoint in the latest housing bubble. Mortgage innovations lead to a weakening of credit standards contributing to the build-up and bursting of the American housing bubble. Again, this is an analysis of how the easing of credit standard affects housing prices. Our research will take the opposite direction – studying the effect of a credit restriction. However, Duca et al. (2010) do state that if the U.S., like other countries such as England and Denmark, would have restricted the LTV-levels by removing the tax deductibility of mortgage interest, the house price boom could have maybe been prevented, i.e. they imply that a credit restriction could lead to a decrease in house prices.

Even though most literature on the housing and mortgage market is studying what happens when credit standards are eased, there are a few good papers on the opposite situation, i.e. when credit standards are restricted. One example is our previous finance teacher Ulf von

Lilienfeld-Toal who in collaboration with Dilip Mookherjee (2011) has done a research on a reform in the United States that had a restrictive effect on credit standards. They found that this reform actually had a preventing effect on the house price increases in the United States, which is in line with our belief that the mortgage cap has affected house prices negatively. Also, Benito (2006) shows in a research on the UK housing market, evidence that households having high leverage (expressed in loan-to-value-ratio) will raise the sensitivity of house prices to a credit change such as a down-payment constraint or some other shock. This is also in line with our hypothesis that the regions with the higher LTV-ratios are more negatively affected by a credit constraint in the shape of the Swedish mortgage cap.

Duca et al. (2010) further describe how models on house pricing are not complete, meaning that the models often omit variables where credit standards have an effect on asset prices. Basic U.S. house price models that did not control for shifts in credit standards broke down during the U.S. house bubble (Duca et al., 2009c). Von Peter (2009) also underlines how interactions of asset prices, loan losses, and defaults can lead to crises. In the U.S. market, financial innovations increased the liquidity of housing wealth, by reducing the need of collateral constraints – a kind of opposite mortgage cap. This fueled a sharp house price rise in the early 2000s. However, they mean that this effect is not necessarily what would happen in other countries: it is important to recognize how financial innovations can affect house prices and how the impact differs across countries. Ahearn et al. (2005) and Girouard et al. (2006) describe that there are significant cross country differences in house price trends and effects from credit standard changes. This motivates our decision to look on the effects within Sweden, and not compare Sweden to other countries, to avoid endogeneity problems.

Regarding LTV-ratios, Duca et al. (2010) depict how subprime mortgages, loans with very high LTV, took over the U.S. market in 2000-2006. The average LTV was as high as 94percent in 2006 (Credit Suisse, 2007). Subprime lending simply means lending to people who would not normally qualify for a house loan due to trouble maintaining the repayment schedule. However, the idea is that the asset (the house) that people borrow money for to buy is expected to increase in value so that people can take on new loans to pay back the old loans. The subprime loans are characterized by high interest rates and low collateral (high LTV-ratio).

The rise in the LTV-levels is related to easing of credit standards fueled by new financial products (DiMartino and Duca, 2007). Furthermore, Duca et al. (2010) underline the relationship between credit standards and demand for houses, in turn related to the house price development. This relates to the basic theoretical demand mechanisms being an important

reason for our theory. As stated earlier there is a lack of models that adjust for credit access and changes in credit standards. However, for instance Meen (2001) or Muellbauer and Murphy (2008) actually present a house price model adjusting for credit availability. They use a certain variable to adjust for mortgage credit standards: the variable is negatively related to mortgage credit standards for first-time home buyers reflecting for instance caps on the LTV-ratio, which is what the Swedish mortgage cap is an example of. They explicitly state that easier credit standards raise the demand and raise the house prices, but the implication is that more restrictive standards should lower the house prices. This is what we examine, and our initial belief is that the prices are relatively more negatively affected if the LTV-ratio is higher to start with. As further described in our methodology part, we will therefore group the households based on regional LTV-ratios, where the introduction of the mortgage cap should have a larger effect on the group where the LTV-ratio is higher.

However, as depicted by Duca et al. (2010) there has been very little testing on the models including variables for credit standards. That alone motivates our research. Two exceptions are Duca et al. (2009c) and Cameron et al. (2006), but both these look at the effect from easing the credit standards. This further motivates our choice of subject, to focus on a credit restriction.

3. Data

3.1 House price data

To begin with, we received from our former finance teacher Timotheos Mavropoulos a data file with times series data on house purchase prices in Sweden from 2005 until 2012. The file consists of about 80 percent of all house purchase prices on small houses. The file contains around 300000 observations and except for regional prices on houses, the house purchase price data file contains extensive information and numbers on the characteristics of each house purchased, for instance the size of the house (living area), lot size in square meters and number of rooms. These factors or characteristics variables are important not to neglect as they might affect the price of the house and the LTV-ratio, also indicated by for instance Magnus Karlsson at FI[12]. The house purchase prices and the variables showing the characteristics of the houses purchased are originally from the Swedish real estate agency[13] and from Valueguard, and the division into regions is based on the real estate register of the Swedish land surveying office[14].

We made some adjustments for noise in the price data file. Therefore we adjusted the house purchase price data for missing values and negative values. Due to missing observations for control variables we also dropped the price observations from before 2006. We also ran several types of regression specifications, i.e. using house prices on many levels as our dependent variable to be able to see if we get similar results. When running the regressions we chose as stated to use a sample of individual prices. Additionally, we converted the house purchase observations to monthly mean values and ran the same regressions, as well as running regressions again using SCB's price index. Similar results in all regression specifications should indicate a certain robustness of the results.

[12] Meeting with Magnus Karlsson at FI, 26 March 2013
[13] Swedish: Mäklarsamfundet
[14] Swedish: Lantmäteriet

3.2 Data on new loans

The data file from FI was used in their latest report on the Swedish housing and mortgage market (FI, 2013). As this data is not publically available, and FI are not as concerned about the house price impact we believe that our research can provide some additional insight.

The data file from FI contains a sample of a big amount of new loans paid out on a household level, i.e. on a micro-level. The sample consists of all new housing related loans that have been issued between August 28th to September 4th 2012, and September 26th to October 3rd 2012, i.e. both for co-operative apartments and small houses, but also for other types of housing such as holiday housing. The definition from FI's report of the new loans is loans issued "strictly to new borrowers", but that also includes current borrowers who have increased the LTV on the house loan by more than 50 percent compared to their previous loan (FI, 2013). The sample originally consisted of 27000 loans, but observations that had not increased the LTV by more than 50 percent were cleared away to decrease the risk to include so-called additional loans that have really been used to finance some additional purchase such as a car, boat or renovations (FI, 2013). It maybe would have been most interesting just to look at the first-time-buyers of homes since they are arguably the ones most affected by the mortgage cap when trying to find a house since they for instance cannot use profits on an earlier sold house to finance the 15 percent cash collateral needed on the loan for a new house to get below the maximum 85 percent LTV. It has not been possible to make out the first-time-buyers in the sample and therefore new loans to first-time-buyers are basically included in the sample along with all new loans under the definition from FI.

In total, the cleared sample consists of a little above 18000 observations, of which almost 10000 are small house observations. All observations have additional micro-level information on first of all the for us very interesting LTV-ratio which is calculated as the relation between total housing related debt of the household to the market value of the house. To be able to take into account the size of the individual house loans and adjust for the size of the mortgage market, we used a volume weighted LTV-ratio in our analysis.

Furthermore, the total volume of housing related loans is described in the data. Additionally the regional general debt-level, calculated as total debt of the household to total income of the household is provided. Interesting from a housing perspective might also be what people have left for non-housing consumption after paying housing related costs, which we also look at on a regional level. The regional share of house purchases financed with more than 85 percent loan (amount of "blancolån") is also included in our analysis. There are more variables in the data, which we chose not to look further into as their relevance was questionable for our

research. The data is divided on a regional basis, in this case into Swedish counties. We aggregate the counties into larger regions: the larger Stockholm-, Gothenburg- and Malmö-area, and the rest of Sweden, and show findings for these regions.

Since we are looking at the impact on house prices using time series data on the prices, but do not have access to LTV-ratios from before the time that the mortgage cap was introduced, we had to make the assumption that the regions with high (low) LTV-ratios today also had high (low) LTV-ratios before the mortgage cap was introduced. This we consulted FI on and they thought that it was a reasonable assumption to consider the LTV-ratios to be in a similar relation to each other regionally in the data for 2012 as for the whole time series we look at. If looking at figure 4, we also see that the LTV-ratio for new loans has had a smoothly increasing trend in previous years prior to the introduction of the mortgage cap, suggesting in line with our assumption that there have not been any major swings in the LTV-ratios between different regions in Sweden.

Furthermore, as stated earlier in this section the FI data file contains loans for both small houses and co-operative apartments, meaning that we separate these types of houses and focus on small houses. The difference in the LTV-ratios is as earlier stated most distinctive when looking at small houses.

Eventual sample bias could be an issue, both from the variation in the houses bought in different periods, as well as the selection. To handle these problems we both test extra control variables in the individual observation regression, to see if the results are still robust. In the variation of house purchases between different periods of the year we assume that it follows a similar pattern each year. The comparison to the price index regression could be seen as an additional robustness test.

4. Methodology

We look at the relative house price development between house purchases with high LTV-ratios and houses with low LTV-ratios. The difference in house prices before and after the mortgage cap was introduced in October 2010 will be studied, which naturally leads us towards using the difference-in-difference (diff-in-diff) methodology. The diff-in-diff methodology was first used by O. Ashenfelter and D. Card in 1985 where they looked at the effect on earnings from having a trainee program versus not having a trainee program. The so-called treatment group was the one where the trainee program was used because that is where they expected the biggest effect, while the so-called control group was the group without a trainee program. Then the relative earnings development was compared, i.e. they looked at the difference between earnings before the trainee program and compared that to the difference between earnings after the trainee program was introduced. As described by von Lilienfeld-Toal (2012)[15], the diff-in-diff methodology can be used to assess the effectiveness of a certain policy with little risk for endogeneity problems if used carefully.

The general set-up is the following diff-in-diff regression:

$$y = \beta_0 + \delta_0 d2 + \beta_1 dT + \delta_1 d2 \cdot dT + otherfactors$$

You then let *T* be the treatment group and *C* denote the control group. The dummy variable *dT* equals 1 if the observation belongs to the treatment group, the dummy variable *d2* is a time dummy: *d2* equals 1 if time is after the policy change. The diff-in-diff estimator of the general diff-in-diff regression equation, δ_1 is given as:

$$\hat{\delta}_1 = \underbrace{(\bar{y}_{2,T} - \bar{y}_{2,C})}_{\text{Difference second period}} - \underbrace{(\bar{y}_{1,T} - \bar{y}_{1,C})}_{\text{Difference first period}}$$
$$= \underbrace{(\bar{y}_{2,T} - \bar{y}_{1,T})}_{\text{Increase for T}} - \underbrace{(\bar{y}_{2,C} - \bar{y}_{1,C})}_{\text{Increase for C}}$$

[15] Lecture notes course 642:Fundamentals in Corporate Finance, Ulf von Lilienfeld-Toal, fall 2012

The specification of our diff-in-diff regression equation is as follows:

$$Price_{i,t} = \beta_0 + \delta_1 Cap + \delta_2 Rest\_SWE + \delta_3 CapRest\_SWE + \beta_1 prop\_tax + \delta_4 prop\_taxRest\_SWE + \beta_2 unemployment_{i,t} + \beta_3 interest_t + \beta_4 GDP_t + \beta_5 population\_growth_{i,t} + timedummies + \varepsilon_{i,t}$$

The specification of our diff-in-diff estimators can be found in the following steps:

Treatment before mortgage cap: $Price_{i,t} = \beta_0 + \delta_2 + \beta_1 + other\ control\ coefficients$

Treatment after mortgage cap:
$Price_{i,t} = \beta_0 + \delta_1 + \delta_2 + \delta_3 + \beta_1 + \delta_4 + other\ control\ coefficients$

Control before mortgage cap: $Price_{i,t} = \beta_0 + \beta_1 + other\ control\ coefficients$

Control after the mortgage cap: $Price_{i,t} = \beta_0 + \delta_1 + \beta_1 + other\ control\ coefficients$

Diff-in-diff estimator = (Treatment after – Treatment before) – (Control after – Control before) = $(\delta_1 + \delta_3 + \delta_4) - (\delta_1) = \delta_3 + \delta_4$

Our dependent variable ($Price_{i,t}$) in the diff-in-diff regression will be the house price in observation *i* at time *t*, and we show several regressions looking at both the fixed purchase price for the individual observations and house prices on an mean level as the dependent variable. We also provide a regression on an index level for robustness. If we look at individual house purchase prices, we have also tested to adjust the regressions for factors that are related to the houses themselves. These are factors such as the area of the house and housing lot area.

The variable *Cap* depicts the policy change of our diff-in-diff regression, which equals 1 if after the introduction of the mortgage cap on 1 October 2010. Treatment group variable *Rest_SWE* equals 1 if the observations belong to the treatment group. Our treatment group will be the regions with houses with higher LTV-ratio because that is where we expect the biggest impact on the house prices from the change (the introduction of mortgage cap). This we expect because as found in previous literature, a higher possibility to take on loans due to for instance easing the credit standards leads to higher house prices. We therefore believe the

opposite is also true as previously mentioned: if the possibility to take on debt is prevented due to a restriction of credit standards, prices will be negatively affected. This mechanism was for instance found by von Lilienfeld-Toal and Mookherjee (2011). We therefore also believe prices are relatively more negatively affected if the LTV-ratio is high, than if the LTV-ratio was low in the first place. The control group will consequently be the regions with houses with lower LTV-ratio. The rest of Sweden has a higher LTV-ratio than the big city regions. This trend is clear when it comes to small houses, shown in figure 6.1. In figure 6.2 we see the LTV-ratios for co-operative apartments where the Malmö-area is an exception. Since we focus on small houses, the rest of Sweden will be our treatment group which will be compared with control group Stockholm, Gothenburg or Malmö.

The variable *CapRest_SWE* is our most important interaction variable depicting if the observations are both after the mortgage cap was introduced and in the treatment group. Through the diff-in-diff estimator, coefficient δ_3, we then compare the price difference after the change with the initial price difference before the change, and look if the difference changed. Since we expect there to be a relatively more negative effect from the mortgage cap on the treatment group, we believe the diff-in-diff estimator will be negative.

We are well aware of that the mortgage cap is one of many factors that might have influenced the house price development during the recent years. So we have to try to as well as possible isolate the effect from the mortgage cap. Therefore we have to use other variables in the diff-in-diff regression equation to adjust for other factors and avoid endogeneity problems.

When it comes to these other variables, so-called control variables, for instance Vitner and Iqbal (2009) suggest that the job growth rate is a factor that contributes to house bubbles and especially the increase of subprime loans past due rate, i.e. debts not paid when due or even in the process of foreclosure. If the job growth was high as in 2002 to 2005, the past due rate on subprime loans would fall as the economy recovered and house prices increased. Therefore, we included the variable $unemployment_{i,t}$ for region *i* at time *t*, as a replacement apt for our regression specification.

Furthermore, an even more important variable according to Duca et al. (2010) is the interest rates, which fell in the early 2000s boosting the subprime lending and house price increase. It is argued by Leamer (2007) and Taylor (2007) how cuts in the U.S. short-term real interest rates to zero in 2003-2004 by the Federal Reserve fueled the subprime bubble. It is also explicitly described how when the interest rates rose in 2006, the house prices started to fall which made the bubble burst. Therefore, we also include in the regression equation a variable

that adjusts for the interest rate levels through the variable $interest_t$.The interest rate we use is the mortgage interest rate on new loans for house purchases from 2006 until today retrieved from Riksbanken, aggregated for entire Sweden at time *t*. The importance of the interest rate was recently described in the Swedish newspaper Dagens Industri, where the author Henrik Mitelman depicts his view on how low interest rates fuel the increase in house prices[16].

Leamer (2007) also states that "housing is the business cycle", i.e. it is described that you might want to adjust for the general business cycle when looking at house prices because house prices simply tend to follow the business cycle. Also, Holmberg (SCB, 2012) describes that the house price development has followed the general consumer prices quite well in the 1980s and 1990s, even though the house prices have been increasing a lot more than consumer prices in the 2000s. Therefore we include the Swedish GDP development at time *t* as a control variable through the variable GDP_t. However, since we have individual house purchase price observations and not a growth measure as our dependent variable, we use a GDP-index normalized to the first quarter of 2005.

As described earlier, the population growth which is higher in the big city areas, can have an impact on the house price development and explain regional differences (Englund, 2011), which is also emphasized by Holmberg (SCB, 2012). Therefore we include a control variable for the regional population growth through the variable $population\_growth_{i,t}$, adjusting for the population growth in region *i* at time *t* in the regression equation. The specification of this variable is not perfect for our regressions, but alternatives are hard to come by.

Furthermore, we have to take into account the fact that other big events related to the housing market might have taken place during the years we study, which possibly have impacted the housing prices. One event connected to the housing market during the years we study is the change in the taxation of real estate in Sweden, introduced on January 1st 2008. Before the change of the real estate taxation, this tax was a state tax proportional to the taxation value[17] of the house. This tax was then replaced by a community charge, a sort of fee that is proportional to the taxation value of the house up to a rather low limit and fixed in SEK above the limit. Recently there was a statement from the European Union commission that the current Swedish real estate taxation, which by many is concerned a relief compared to the earlier real estate taxation, combined with low interest rates could fuel an increase in Swedish household debt and house prices[18]. We adjust for the event when the real estate taxation was

[16] Mitelman H., Dagens Industri, last viewed April 9 2013
[17] Taxation value: the taxable part of the market value of the house
[18] http://www.svd.se/naringsliv/branscher/bank-och-fastighet/eu-kommissionen-sverige-har-makroekonomiska-obalanser_8074826.svd, last viewed April 12 2013

changed on January 1st 2008 in our regression equation through the variable $prop\_tax$, which equals 1 if after the change in real estate taxation. Because of this we will get a second interaction variable through the variable $prop\_taxRest\_SWE$ which shows if the observations are both after the change in real estate taxation and in the treatment group.

Additionally, we have adjusted for time-fixed effects through our time-dummy variables, which takes care of general time effects from year to year, common to all regions. We adjust for regional fixed effects taking into account possible region-specific factors affecting the house prices there. Last in the regression equation is the error-term $\varepsilon_{i,t}$, which is idiosyncratic, i.e. includes observation specific risk over time. Finally, we also use robust regressions to adjust for heteroskedasticity, i.e. adjust for the risk that the variance of the error-term is non-constant over time.

5. Results

5.1 Regional findings and differences

Using the data file from FI to reach a volume weighted LTV-ratio we first calculated the average housing related debt of the observations for the different regions: the Stockholm-area, Gothenburg-area, Malmö-area and the rest of Sweden. This is shown in figure 7, where we see that for small houses the big city areas have higher house related debts compared to the rest of Sweden, which is in line with our expectations. We see in figure 8 the total debt in relation to income, i.e. not only debt related to housing. The result is similar to the result for housing related debt and both these results are in line with media descriptions and our own expectations that it is the big city regions that have the highest debt-levels.

Continuing on how we reached the volume weighted LTV-ratio, we divided the individual house loan by the average housing related debt for the region of the house loan, and then multiplied with the original LTV to reach the volume weighted LTV. The average volume weighted LTV-ratio for all house purchases in our sample from FI, for all regions, is 0.71. This includes small houses, co-operative apartments and other house purchases such as holiday houses. This means that on average 71 percent of the house purchase is financed with debt. Figure 6.1 shows the average volume weighted LTV for the regions for small houses, where it is actually found that the rest of Sweden has a higher LTV-ratio compared to especially the Stockholm-area and the Gothenburg-area, but also to the Malmö-area. This is the opposite of what we had expected. However, if looking at the total sample and the report from FI (2013) the Malmö-area shows the highest LTV-ratio while the Stockholm-area and Gothenburg-area still shows a lower LTV-compared to the rest of Sweden. If looking at the LTV-ratios for co-operative apartments (figure 6.2), which are higher in general, we see why the volume weighted LTV-ratio for the total sample, which FI presents, is higher for the Malmö-area.

Moving on with the characteristics for the regions and looking at house purchases made with more than 85 percent debt (“blancolån”), we see in figure 9 that the rest of Sweden has the significantly highest percentage of “blancolån” compared to especially the Stockholm-area. This means that if looking at the percentage of “blancolån” we would have made a similar regional division as we do when looking at regional LTV-ratios. The difference when it comes to these types of loans is also clearer than it is for LTV-ratios. This “blancolån”-percentage is calculated as the regional amount of “blancolån” divided by the total amount of loans for the region. This to capture the share of house purchases in each region financed with

more than 85 percent loans. When it comes to what people who have purchased small houses during the period have left in SEK per month for non-housing consumption after paying housing related costs, the rest of Sweden has the lowest amount while especially the Stockholm-area has the highest amount left per month. This is shown in figure 10.

5.2 Empirical results

Table 1 shows summary statistics for the individual house price data set, and table 2 shows summary statistics for the mean data set. Table 3 with panels A, B and C are for the regressions showing the results for the individual house price, mean and price index data set respectively.

5.2.1 Descriptive statistics

The descriptive statistics show the average prices, and the values for the control variables for the whole data set, and as well for the pre mortgage cap period and post mortgage cap period. In table 1 we see the real mean values for the prices from the individual house price observations, showing an average price of 2.04 million SEK for the whole data set, where the big city regions have an average price of 3.20 million SEK and the rest of the country 1.43 million SEK. On average the prices rose from 1.97 million to 2.21 million SEK from the pre mortgage cap to the post mortgage cap period. Comparing the two different groups, the big city regions saw the mean price rising 411 480 SEK (a 13.35 percent increase), whereas the increase was only 135 231 SEK (9.71percent) in the rest of the country.

Looking at the control variables, we see the same mortgage interest rates taken on a monthly basis and indexed GDP taken on yearly basis, as they have been retrieved on a national level. The regional unemployment and population growth are on a regional basis though: the bigger city regions separately between the three of them, and the rest of the country being another region. The population growth (yearly data) has a much lower mean value in all time periods in the rest of the country, and the same is true of the regional unemployment (quarterly data), i.e. it is lower in the rest of the country compared to the aggregate of the big city regions.

The mean data statistics in table 2 are not as interesting to look at for mean values, as they would be aggregated twice and not weighted properly (one observation for each of the four regions per month). However, it shows that this works for lowering the variation between the periods. It must be taken into account that the prices in the set for the whole of Sweden and the bigger cities encompass many regions, which would make the minimum and maximum values larger than what might seem intuitive, but it is still true that there is quite a lot of seasonal variation.

5.2.2 Regression results

The first regressions are run on the individual observations as our data set, shown in table 3, panel A. Regressions vary from naive ones on the left hand side, to more complicated ones on the right hand side. In all specifications the regressions show similar results, with the diff-in-diff coefficients showing results with the same sign: negative, which we expected. However the other explanatory variables vary a little more. The additional explained value shows that even a regression on an individual basis can partly be explained by macro factors, with the explained variation, R^2 varying from 0.32 to 0.34 without house characteristics added, and 0.49 with them added in regression (7). On top of this, most regressions show statistically significant results, with the diff-in-diff estimators being of highly significant statistical value. The regional fixed effects yield results with far lower R^2.

The same expected coefficients are given in the results in the mean value regressions (table 3, panel B), but with slightly different values. Results are still statistically significant, especially for the difference-in-difference estimator being significant at a 1 percent level in all cases. The explained variation, R^2, is a lot higher in the mean regressions, mostly due to taking away a lot of the variation coming from individual house characteristics, and the other factors affecting individual house purchases. Without regional fixed effects, the R^2 ranges from 0.8 in the most naive regression, to 0.94 with the control variables, and from 0.60 to 0.71 with regional fixed effects.

Even at the simplest level, with only the mortgage cap variable *Cap* together with the diff-in-diff estimator the results are showing mostly expected results. The cap shows a large positive effect for the bigger city regions, whereas the diff-in-diff estimator for the other parts of the country is negative, but still resulting to a net positive effect on prices in the rest of the country. The fact that the effect is positive in all parts of the country can be attributed to the generally higher price level after the introduction of the mortgage cap due to the time trend, and the mortgage cap variable being endogenous and taking up that effect at the simplest-level regression. This regression result can be seen in both panel A and B of table 3, as regression (1).

The addition of the property tax variable (and the diff-in-diff estimator for it) and time fixed effects on a yearly basis, in regression (3) of both panel A and B of table 3, add some explanatory power, and adjusts the coefficient of the mortgage cap. It also adds some inconsistency between the individual observation and the mean regressions: a large difference is shown in the values of the mortgage cap variable and the property tax variable (but not in the diff-in-diff estimator). In the case of the mean regression the mortgage cap effect for the

bigger city regions is statistically insignificant, which would be more in line with our expectations of the effect. However, this still yields a total net negative price effect for the rest of the country. The property tax variable shows that the prices rose all over the country, which is along the lines with our expectations: the net present value of the house rises when there are less negative cash flows in the future, which should result in a higher price.

When adding the control variables regional unemployment, the mortgage interest rate, GDP-growth and population growth, we get even more statistically significant results and more of the variation in prices is explained. This can be seen in regression (4) in both panel A and B of table 3. The mortgage cap coefficient and the treatment diff-in-diff estimator are still of the same signs as previously, but with a much larger effect, especially in the case of the diff-in-diff of the rest of the country. The mean regression has an R^2 of 0.95, and shows a large negative net effect of the mortgage cap in the rest of the country, indicating both actual lower prices in that area and that there is a large treatment effect, which could be considered economically significant as well. The control variables are all of the expected signs, and with high statistical significance. The regional unemployment variable is negative, which signifies a lower aggregate demand during periods of higher unemployment. The mortgage rate variable coefficient is negative as well, which could theoretically be explained with a lower NPV of the house investment, due to higher negative cash flows in the future to pay the higher interests. However this is a bit problematic due to the correlation between "good" times and higher interest rates. The indexed GDP variable partly solves that problem by explaining the positive price effects in "good" times, i.e. people get more money when the economy grows. The population growth variable coefficient is positive as well, and is the result of more people needing somewhere to live, which translates into higher prices. It might be surprising that the macro variables have significant results even in the case of the individual observation regression, which most likely due to a general price trend existing that is correlated with these control variables.

Graph 1 displays the diff-in-diff regression (4) in panel B of table 3 (mean values): the constant and the mortgage cap variable as the bigger city region line, and adding the rest of Sweden and the diff-in-diff estimator gives us the line for the rest of Sweden. The treatment effect as seen in graph 1 is quite clear. However this does not take into account the other control variables and should not be seen as the true mean prices, but rather as the effect of the mortgage cap solely.

The regional fixed effects regressions, regressions (5) and (6) in both panel A and B of table 3, still yield good results for the diff-in-diff estimator, but are somewhat problematic and

give us a lower R^2, and less significant control variable results. This is likely related to our regional set-up, with the rest of the country being a single region even though it can range from the smallest communities to some relatively big cities. While it is still a good sign that the mortgage cap in the rest of the country gives us a negative net effect, it is probably not a very good estimate of the actual effect.

When adding house characteristic variables, regression (7) in panel A, e.g. area and housing lot area, we get quite a bit of explanatory value in the individual level regression with the individual observations. The effect of the diff-in-diff estimator for the mortgage cap and the mortgage cap variable combined gives us a net negative effect for the rest of Sweden, with the diff-in-diff estimator showing economic significance, due to its large negative value. However, the characteristic variables are problematic, and the exogeneity is doubtful. Considering that the housing lot area coefficient sign is negative, that variable probably describes the effect of where the house is located more than anything else, i.e. the further away from a city a house is, the more probable it is that it has a larger lot area. In the case of living area, the coefficient is highly significant, but it still does not tell us very much about the actual price of a square meter, which could possibly be partly fixed by adding interaction variables for the area combined with the region that the house is in. The problem of getting a highly significant positive mortgage cap effect might be related to these issues.

In panel C of table 3 we see a simple regression of SCB's price index, with time fixed effects, as well as the mortgage cap variable and the diff-in-diff estimator, yielding results which are in line with the rest of our regressions.

5.3 Discussion of results

The most important topics for discussion of the regression results are statistical significance (or lack of significance), exogeneity and economic significance. The fact that several different regression specifications, with highly significant values, show a treatment effect should be taken as a sign that it is probable that the effect of the mortgage cap differs between the larger city regions and the rest of Sweden, even to the point of being economically significant. Whether it is due to the fact that the average LTV-ratio is higher in the rest of the country, or to the fact that there were more people taking "blancolån", or some other reason, is still to be discussed as that has not been explored in our research. However, theory supports the idea that an introduction of a credit-restrictive mortgage cap would have a larger effect in areas with either high LTV-ratio or high share of "blancolån" due to basic demand mechanisms.

The significance of what the control variables explained is also an important factor, which varied far more in the different regression specifications. While the control variables were not necessarily perfectly chosen, they seem to be explaining quite a bit of the variation in prices, at least at an aggregate level, either directly or indirectly.

A problem with the mean level regression, or any regression not including the house characteristics, is that there is variation between the houses sold in the different periods. In general it follows a similar growth to actual price indices, while having a larger monthly variation. Different types of houses might be bought at different times during the year, which would result in a smaller part of the prices being explained by our explanatory variables, but during a long time period these variations will most likely to a large extent cancel out and not cause unusable regression results.

The room for improvements might mostly lie in a better regression specification, especially when it comes to the regions. This is a result of using easily available data, which results in large samples, but not perfect data. As shown in the report by FI (2013), there are relatively big cities in Sweden such as Uppsala, which are not counted as one of the three biggest city-regions. These cities might have more in common with the big city regions, despite being part of the rest of the country in our regression specification. One of the main reasons for our choice of regression specification is the fact that it is problematic to find data on certain explanatory variables for these other large cities, e.g. unemployment would have to be based on statistically insignificant data.

Another problem is the time horizons for the explanatory variables. The mean regressions are run on a monthly basis, whereas many explanatory variables are not on a monthly basis. The unemployment variable is on a quarterly basis, the GDP growth variable is on a yearly

basis, while the lending interest rate is on a monthly basis. Connected to this problem is the possible use of additional, or better, control variables. Our choice of control variables has empirical support, but is still far from perfect.

Another problem that has not been addressed is the one of serial correlation. The prices in the mean regression, and even to a degree in the individual observation regression, are correlated with past prices. In difference-in-difference regressions this might cause particular problems, as the standard deviation of the treatment effect might be understated, as well as the standard deviations of some of the control variables. Therefore it cannot be said with certainty that all effects with t-values close to 2 are statistically significant. This is described by Bertrand et al. (2004). However, as the treatment effect had a t-value far over 2 and being highly significant in nearly all our regressions, as well as tests with lagged variables not showing a big impact on the other variables, this is not as worrisome. While we still believe that these effects are significant, the significance might be overstated and the results might not always be as significant as shown in the regression results.

Regardless of this, there seems to be an economically and statistically significant effect of the mortgage cap that differs between the big city regions and the rest of the country on the prices of small houses.

6. Conclusion

Our results show evidence for our theory that a higher LTV-ratio has led to a relatively more negative house price reaction following the introduction of the mortgage cap. However, the reality seems to be the opposite of our initial belief of the big city regions having higher debt-levels, which is often the picture painted by media. However, the media picture only holds true when it comes to the loan volume in SEK. We find that the rest of Sweden has the higher LTV-ratio compared to the big city-areas in Sweden and is the region that has experienced the relatively more negative house price reaction.

Since it is the LTV-ratio that is restricted to 85 percent following the introduction of the mortgage cap, we have used the LTV-ratio as a starting point to determine how we run our regressions. It can be misleading just to look at debt levels in SEK, because if the purchase price of the house is higher, the debt level (in SEK) will naturally be higher. Even though not perfect, the LTV-ratio captures both loan value (L) and purchase price (V) of the house.

We believe that our findings of a larger negative effect in the rest of Sweden can be partly explained by basic demand mechanics. If a cap is introduced on how much loans you can finance your house purchase with, the demand for loans and a subsequent house purchase will be held back, this to a larger extent in the rest of Sweden compared to the big city-regions due to different LTV-ratios. This has a negative effect on the house prices, which would otherwise be fueled by demand factors. Also, the rest of Sweden has more people who are over the 85 percent mortgage cap limit, i.e. have taken "blancolån". This results in a higher number of people not being able to finance their house purchases after the recommendation has been implemented. This is because the possibility to buy a house with more than 85 percent LTV might have disappeared for a potential buyer who would have done so previously before the introduction of the mortgage cap.

The idea of the mortgage cap is good because restricting the possibility to take on debt in relation to the house purchase value creates a margin of safety for the household, making them better prepared for sudden drops in prices of their houses. However, our research shows that there might have been some spill-over effects from the introduction of the mortgage cap, for instance a negative house price reaction in the rest of Sweden compared to the big city regions, which was not a goal in itself of the introduction of the mortgage cap.

Even though our results are solid, there might be other factors that play a part in the price development that we showcase. We have pointed out that basic demand is a factor to why the prices have reacted relatively more negatively if the LTV-ratio or the share of house

purchases being financed with more than 85 percent loans is higher. The demand side is therefore closely connected to the introduction of the mortgage cap. However, the supply of houses might be a factor not specifically connected to the introduction of the mortgage cap, which we suggest further research to dig deeper in. Examples of supply side factors could be slower turnover of the houses driven by the supply side, as well as the possibility to rent out the house instead of selling it in the big city regions, causing the prices to not drop as much.

Also, the supply of banks or more specifically the ability to get a bank loan in big cities versus the rest of Sweden might be a factor. It is reasonable to believe that there is a higher availability of loans, or a higher supply of banks in the big cities. The lower possibility to get a loan at the local bank in the rest of Sweden might lead to that the demand for a loan to buy a new house is not satisfied, and prices are not able to increase as much compared to the big city areas. Furthermore, the liquidity of houses in the different regions could be an influence. That is if houses can be sold fast or not in the market to a fair price. It is most likely the case that the rest of Sweden has less liquid houses. If you have trouble selling your house and maybe have to do a "fire sale" of the house, the cost of selling the house would be higher, implying a lower price, due to problems finding a buyer in the rest of Sweden. It is surprising that the LTV is higher in the rest of Sweden, being the less liquid region and having a higher risk for varying house values.

For further research it might be worth looking into the effect on price development of the mortgage cap, instead of only the difference in price effects between the regions. This could possibly require more comprehensive data, and some additional time as only two and a half years have gone since the introduction of the mortgage cap. In the case of regulations, other factors than restricting the LTV-ratio might be worthy of considering to hinder risky house purchases. An example would be restrictions on debt-to-income, which could possibly be more effective in the big city regions.

We can finally conclude that regardless of what factors other than the introduction of the mortgage cap might have influenced the house prices, our research shows significant evidence that the mortgage cap had an influence too. We think our research creates some important discussion about not only debt related risk and what measures to look at, but also what other effects, such as a negative house price effect, a credit restriction might have.

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8. Appendix

8.1 Figures

Figure 1: Percentage change in housing related loans compared to previous year. The top line shows co-operative apartments, the bottom line small houses and the middle line total housing related loans.

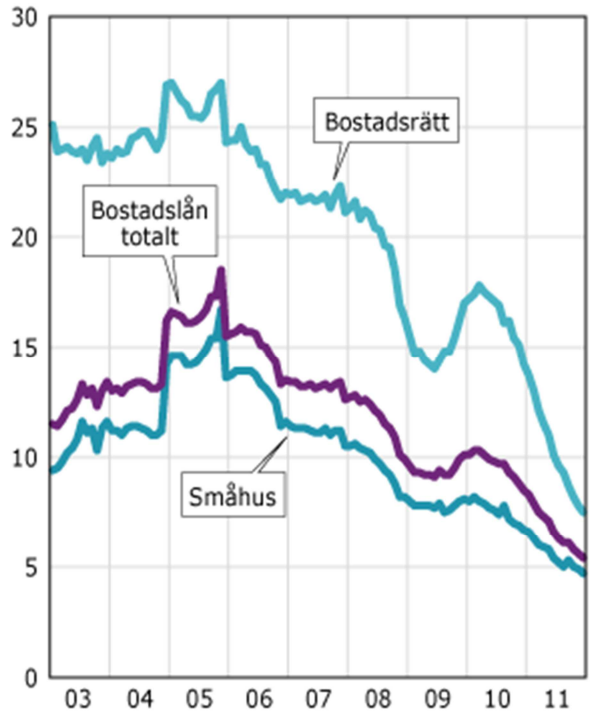


Figure 2: Monthly Swedish house price development (K/T: Purchase price divided by taxation value) for small houses.

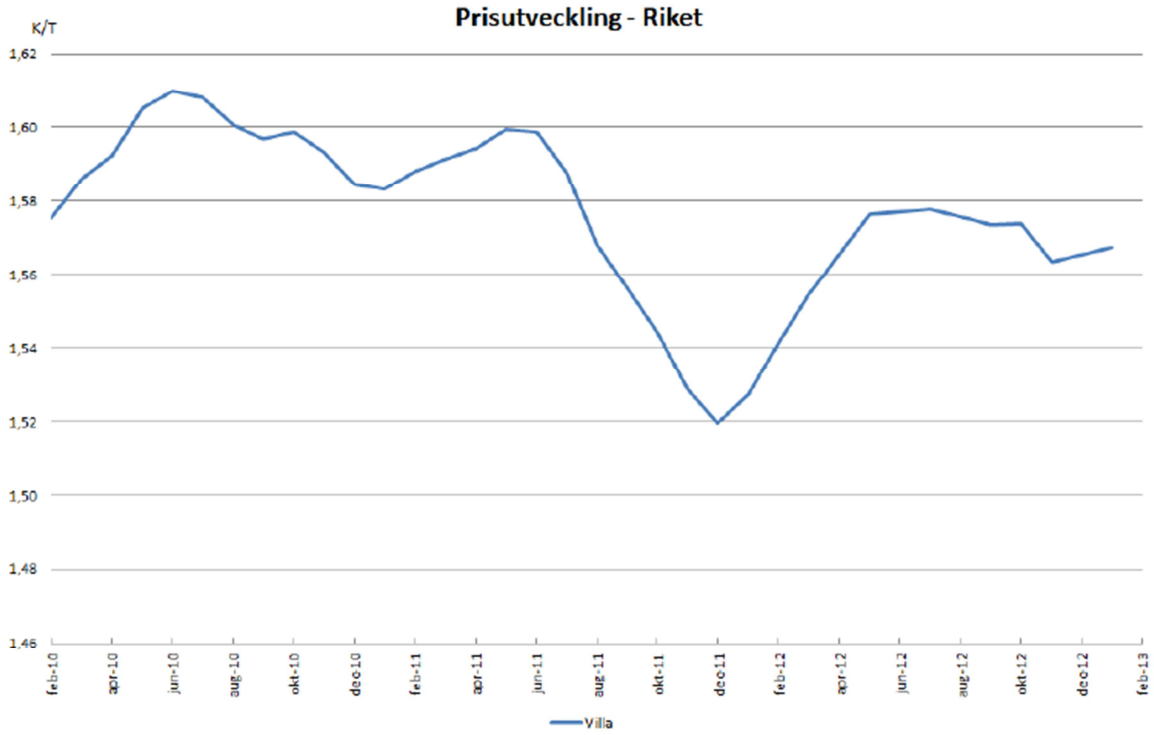


Figure 3: Monthly Swedish house price development (price per square meter) for co-operative apartments.

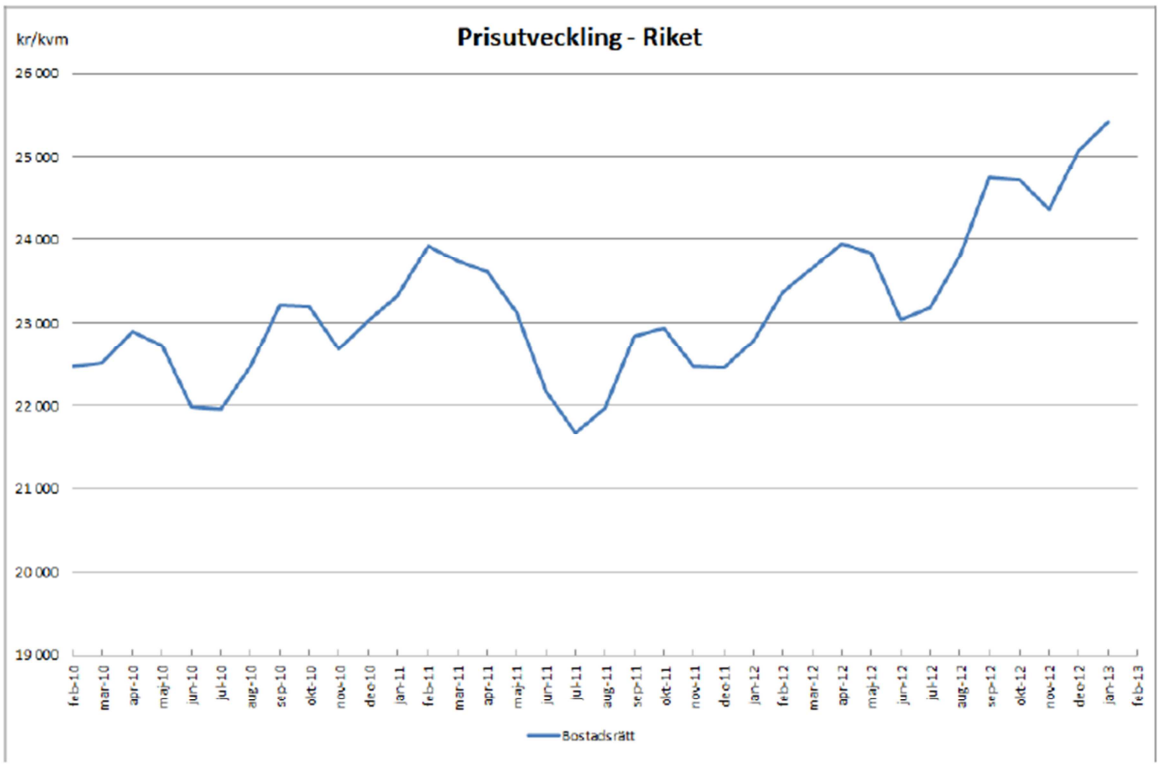


Figure 4: The LTV-ratio for new loans

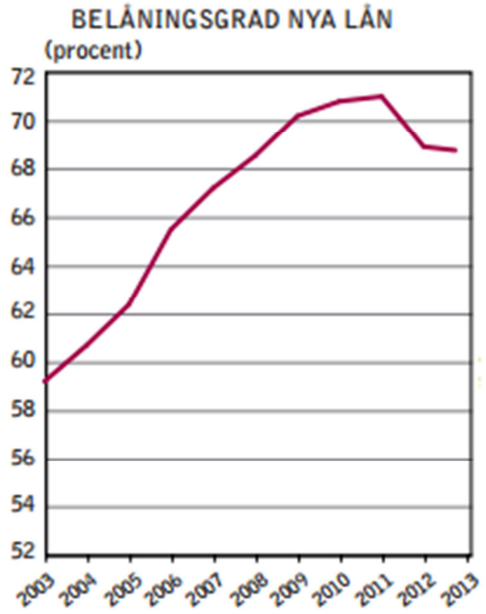
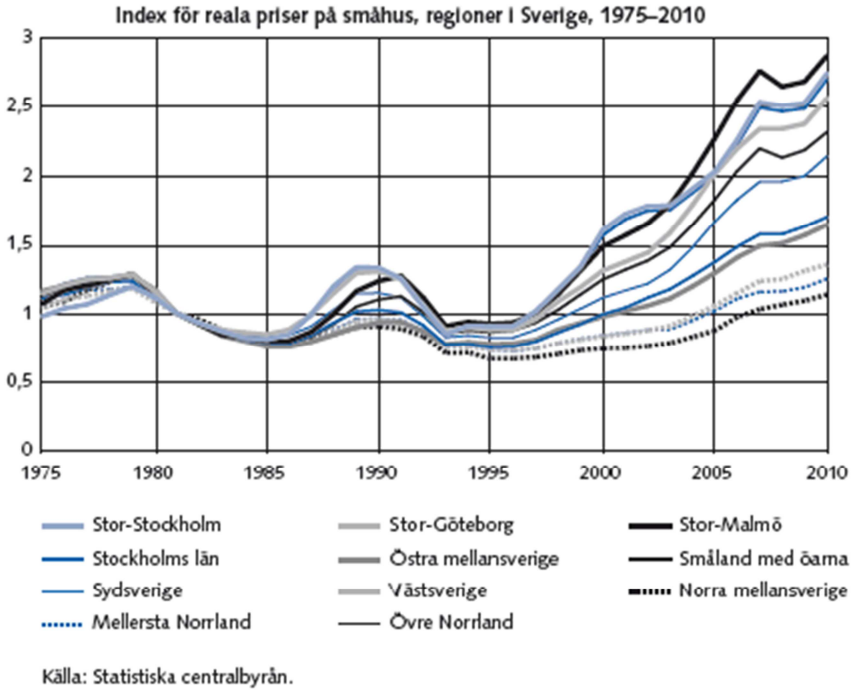


Figure 5: Real price development (index) for small houses in different regions in Sweden



Källa: Statistiska centralbyrån.

Figure 6.1: Regional volume weighted LTV-ratios for small houses

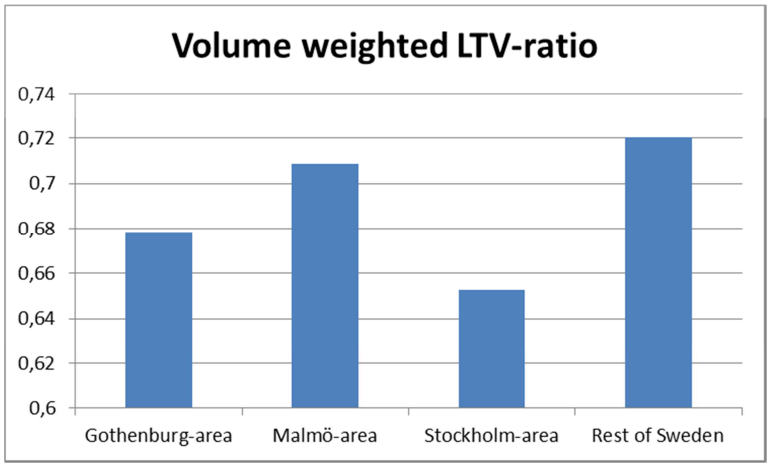


Figure 6.2: Regional volume weighted LTV-ratios for co-operative apartments

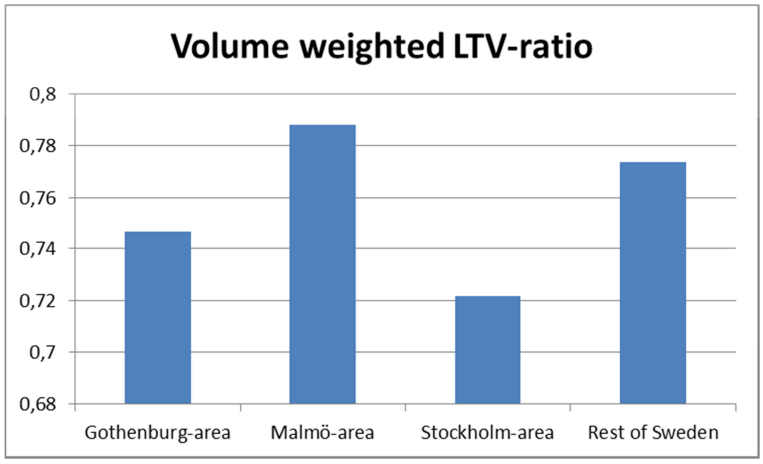


Figure 7: Regional debt (in SEK) related to housing for small houses

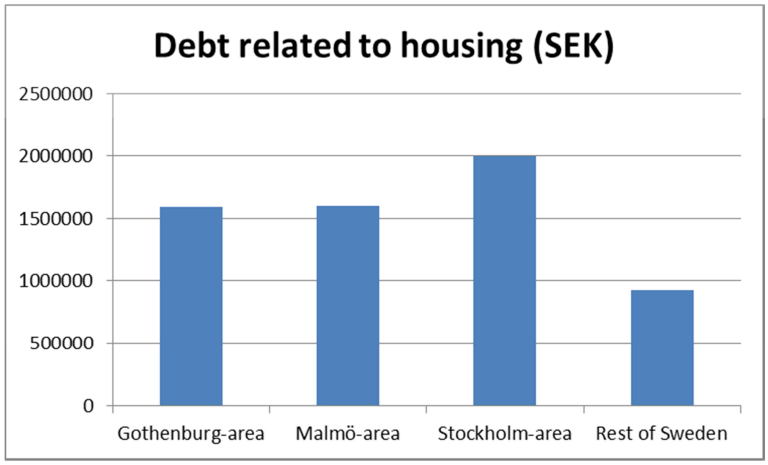


Figure 8: Regional average total debt-to-income for small houses

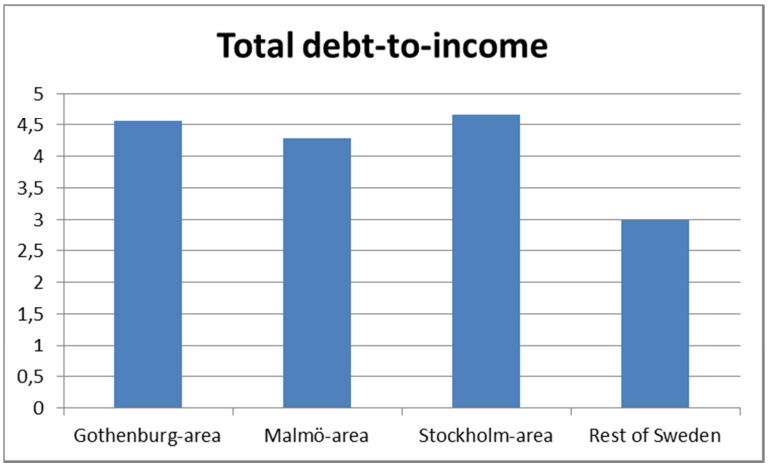


Figure 9: Regional percentage of “blancolån” for small houses

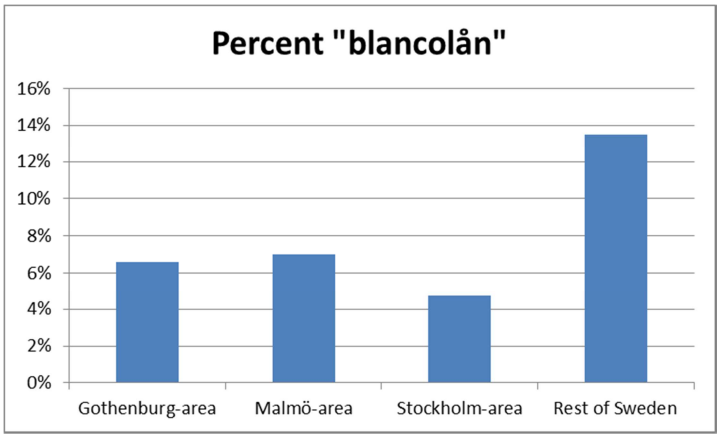
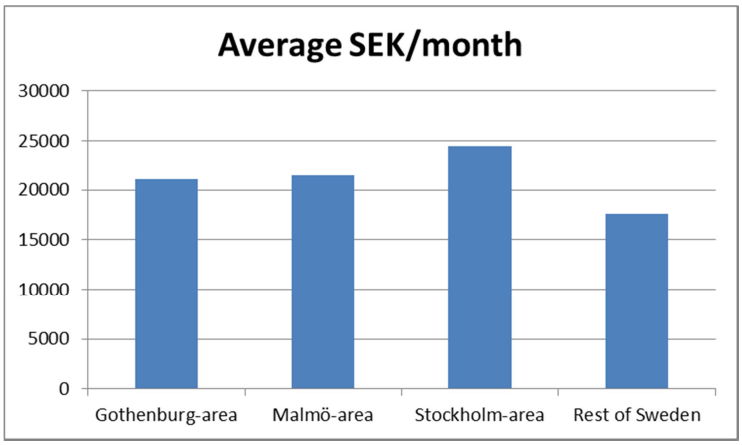
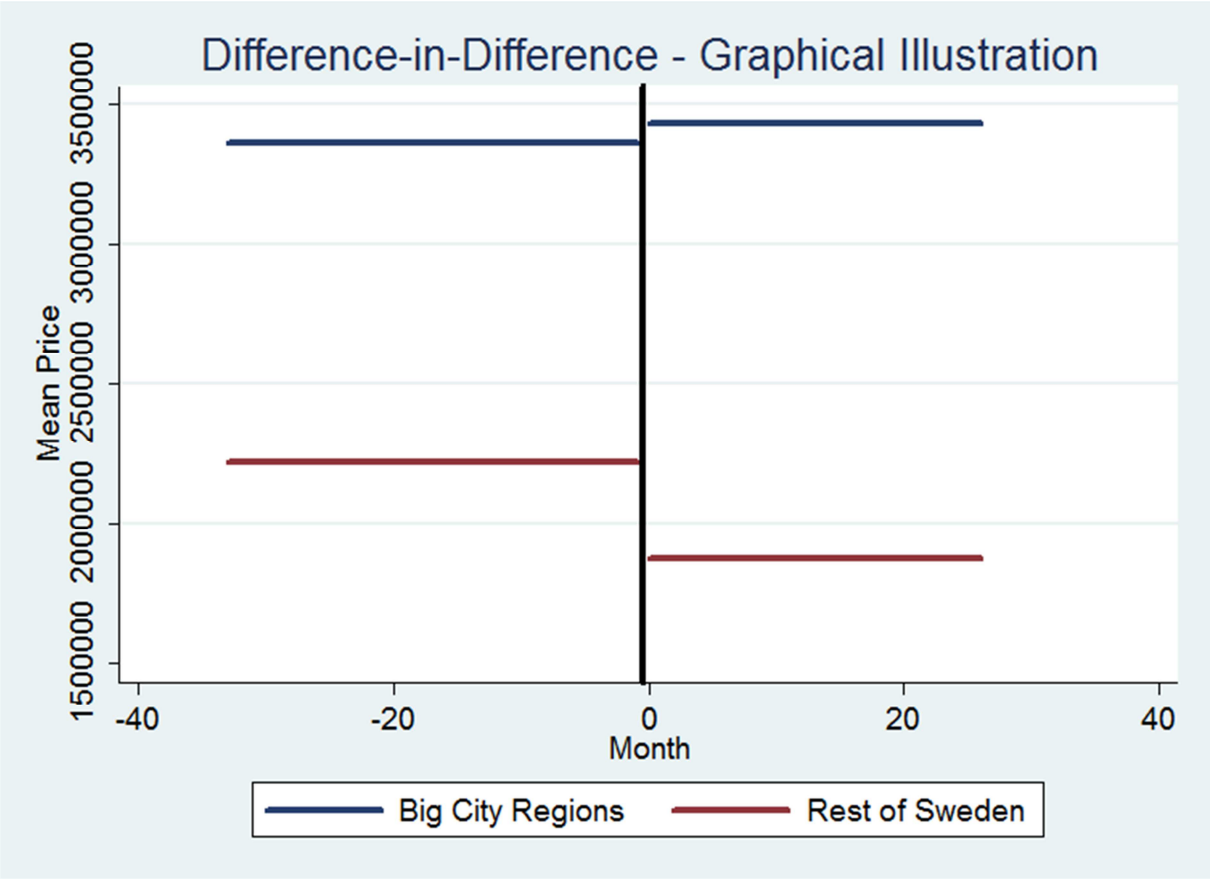


Figure 10: Regional amount (SEK) left to live for after paying housing related costs for small house buyers



8.2 Tables and graphs

Graph 1



This graph displays a graphical illustration of the difference-in-difference regression (4) from Table 3, Panel B, with the event date, the mortgage cap introduction, being month 0. The Big City Regions is composed of the constant, as well as the Cap starting from the event date, while the Rest of Sweden is composed by the constant and Rest_Swe, as well as the Cap and the difference-in-difference estimator, CapRest_Swe, from the event date. This does not represent the true mean price values, as the effects of the control variables are not included, but should only be taken as an indicator of the effect of the mortgage cap.

Table 1: Statistics for individual house purchase observations

	All				Pre Cap				Post Cap			
Sweden	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Price	2 037 088	1 499 450	3 390	37 500 000	1 966 179	1 416 916	8 000	37 500 000	2 207 804	1 669 319	3 390	26 500 000
Regional Unemployment Rate	7,51	1,52	4,70	13,00	7,29	1,54	4,70	12,20	8,04	1,34	6,00	13,00
Mortgage Interest Rate	5,04	1,06	3,10	7,14	4,86	1,21	3,10	7,14	5,47	0,22	5,04	5,81
Indexed GDP	124,03	8,94	107,31	141,01	119,48	5,97	107,31	129,03	134,96	4,18	128,07	141,01
Population Growth	0,73	0,57	0,24	1,91	0,75	0,57	0,33	1,91	0,69	0,57	0,24	1,81
Observations	244 453				172 714				71 739			
Big City Regions	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Price	3 204 737	1 654 870	3 390	37 500 000	3 082 364	1 550 495	25 000	37 500 000	3 493 844	1 846 659	3 390	26 500 000
Regional Unemployment Rate	7,79	1,96	4,70	13,00	7,43	1,84	4,70	12,20	8,63	2,00	6,00	13,00
Mortgage Interest Rate	5,02	1,05	3,10	7,14	4,83	1,20	3,10	7,14	5,46	0,22	5,04	5,81
Index GDP	124,14	8,97	107,31	141,01	119,54	5,98	107,31	129,03	135,02	4,19	128,07	141,01
Population Growth	1,47	0,32	0,89	1,91	1,50	0,31	0,89	1,91	1,41	0,35	0,96	1,81
Observations	83 370				58 576				24 794			
Rest of the Country	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Price	1 432 761	961 132	8 000	26 000 000	1 393 350	914 723	8 000	26 000 000	1 528 581	1 059 479	8 500	21 600 000
Regional Unemployment Rate	7,37	1,20	5,30	9,60	7,23	1,35	5,30	9,60	7,73	0,59	6,80	8,40
Mortgage Interest Rate	5,05	1,06	3,10	7,14	4,88	1,21	3,10	7,14	5,47	0,22	5,04	5,81
Index GDP	123,97	8,93	107,31	141,01	119,46	5,96	107,31	129,03	134,93	4,17	128,07	141,01
Population Growth	0,34	0,05	0,24	0,40	0,36	0,03	0,33	0,40	0,30	0,06	0,24	0,36
Observations	161 083				114 138				46 945			

This table presents summary statistics for the data set on individual house purchase observations from year 2006 to 2012. With all observations on the left hand side, the pre-mortgage cap data in the middle and post-mortgage cap on the right hand side, and the regions going from top to bottom. Data presented are mean values, standard deviation, minimum values and maximum values, as well as number of house purchases.

Table 2: Statistics for mean value observations

	All				Pre Cap				Post Cap			
Sweden	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Price	2 648 069	807 154	1 150 292	4 210 618	2 545 160	756 946	1 150 292	4 011 370	2 865 321	868 323	1 399 226	4 210 618
Regional Unemployment Rate	8,14	1,92	4,70	13,00	7,79	1,82	4,70	12,20	8,86	1,94	6,00	13,00
Mortgage Interest Rate	5,05	1,05	3,10	7,14	4,85	1,21	3,10	7,14	5,47	0,23	5,04	5,81
Indexed GDP	124,19	9,22	107,31	141,01	119,10	5,9716	107,31	129,03	134,92	4,38	128,07	141,01
Population Growth	1,15	0,55	0,24	1,91	1,20	0,56	0,33	1,91	1,05	0,52	0,24	1,81
Observations	336				228				108			
Big City Regions	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Price	3 054 188	450 370	2 169 526	4 210 618	2 931 327	401 547	2 169 526	4 011 370	3 313 564	439 742	2 683 852	4 210 618
Regional Unemployment Rate	8,38	2,05	4,70	13,00	7,98	1,91	4,70	12,20	9,24	2,08	6,00	13,00
Mortgage Interest Rate	5,05	1,05	3,10	7,14	4,85	1,21	3,10	7,14	5,47	0,23	5,04	5,81
Index GDP	124,19	9,22	107,31	141,01	119,10	5,98	107,31	129,03	134,92	4,38	128,07	141,01
Population Growth	1,42	0,33	0,89	1,91	1,48	0,31	0,89	1,91	1,29	0,34	0,96	1,81
Observations	252				171				81			
Rest of the Country	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Price	1 429 710	114 496	1 150 292	1 631 080	1 386 661	107 860	1 150 292	1 581 975	1 520 592	64 428	1 399 226	1 631 080
Regional Unemployment Rate	7,39	1,18	5,30	9,60	7,24	1,35	5,30	9,60	7,71	0,58	6,80	8,40
Mortgage Interest Rate	5,05	1,05	3,10	7,14	4,85	1,22	3,10	7,14	5,47	0,23	5,04	5,81
Index GDP	124,19	9,26	107,31	141,01	119,10	6,01	107,31	129,03	134,92	4,44	128,07	141,01
Population Growth	0,34	0,05	0,24	0,40	0,36	0,03	0,33	0,40	0,31	0,06	0,24	0,36
Observations	84				57				27			

This table presents summary statistics for the data set on mean house purchase observations from the three big city regions and the rest of the country from year 2006 to 2012. With all observations on the left hand side, the pre-mortgage cap data in the middle and post-mortgage cap on the right hand side, and the regions going from top to bottom. Data presented are mean values, standard deviation, minimum values and maximum values, as well as number of observations. Each month for each of the four regions are considered an observation

Table 3: Regression results

Panel A: Individual house price observations

	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price	(7) price
Rest_SWE	-1689014***	-1749910***	-1747028***	-1020879***			-1006420***
	(0)	(0)	(0)	(0)			(0)
Cap	411480.4***	286457***	161669.3***	199705.3***	187453.9**	122838.2	195297.4***
	(8.4e-208)	(1.07e-83)	(6.42e-14)	(1.06e-15)	(.0018807)	(.2170054)	(1.97e-19)
CapRest_SWE	-276248.7***	-215353.2***	-218254.4***	-379848.3***	-240563.2**	-252185**	-364393.2***
	(5.02e-81)	(3.29e-41)	(2.21e-42)	(4.7e-124)	(.0013159)	(.0011134)	(8.6e-153)
Prop_tax		-284435.9***	-96045.56***	-152578.8***	-153042.2*	-77989.65	-166481.9***
		(9.5e-112)	(2.08e-11)	(5.53e-15)	(.0175313)	(.4012042)	(5.43e-23)
Prop_taxRest_SWE		136514.8***	131497.2***	-23074.52	113316.9	98573.84	-23945.33*
		(2.95e-23)	(7.21e-22)	(.0927319)	(.0511338)	(.0908097)	(.0426507)
Unemployment				-94972.23***	13793.1	9524.628	-105117.8***
				(9.1e-271)	(.6620673)	(.718749)	(0)
Interest				-91314.91***	-19801.05	-7998.225	-96488.81***
				(3.75e-33)	(.5802307)	(.7766727)	(1.50e-47)
GDP				8162.153***	12295.7	7139.734**	6761.643***
				(3.43e-46)	(.0527543)	(.0071556)	(1.79e-41)
Population_growth				589298.5***	270764.7	321182.9*	511998.2***
				(5.5e-230)	(.1663804)	(.0499689)	(2.4e-247)
Living area							15069.87***
							(0)
Lot area							-3.915736*
							(.0239745)
Constant	3082364***	3207387***	3117086***	2382474***	326573.9	867417	809219.6***
	(0)	(0)	(0)	(2.9e-132)	(.6169158)	(.0706828)	(1.65e-21)
R2	.3203237	.3235637	.3262628	.3415863	.0184985	.0205839	.4938209
N	244453	244453	244453	244453	244453	244453	244453
Time FE	No	No	Yearly	Yearly	No	Yearly	Yearly
FE	No	No	No	No	Regional	Regional	No

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

P-value in parentheses.

These tables present the OLS regressions run with different specifications using individual observations in Panel A and mean value observations in Panel B. For each explanatory variable the coefficient on price is presented, as well as the P-value in parenthesis. For every regression the R^2, number of observations, inclusion of time fixed effects and regional fixed effects are presented at the bottom. Panel C presents an additional regression on an index from SCB.

Panel B: Mean values

	(1) price	(2) price	(3) price	(4) price	(5) price	(6) price
(mean) Rest_SWE	-1544666***	-1593419***	-1593419***	-1141769***		
	(9.0e-145)	(5.9e-120)	(1.3e-121)	(2.81e-54)		
(mean) Cap	382237.1***	269615.8***	40885.76	69156.91	209232*	17852.18
	(1.45e-10)	(.0000302)	(.7298809)	(.4266594)	(.032955)	(.8587794)
(mean) CapRest_SWE	-248305.6***	-199552.2**	-199552.2**	-416738.8***	-261873.5**	-279797.4**
	(.0000544)	(.0027988)	(.0027166)	(2.78e-16)	(.0015998)	(.001685)
(mean) Prop_tax		-267475.6***	-351859.5*	-527263.6***	-110911.6*	-542939.9*
		(4.96e-06)	(.0115962)	(2.75e-07)	(.0157689)	(.0193248)
(mean) Prop_taxRest_SWE		115789.4	115789.4*	-20648.02	73028.08	58638.86
		(.059411)	(.0497781)	(.6641736)	(.2345626)	(.2983901)
(mean) Unemployment				-127033.9***	-18358.24	-13160.57
				(6.19e-59)	(.6631738)	(.605515)
(mean) Interest				-100980.2**	-72866.07	-40510.59
				(.0023207)	(.1377307)	(.0952451)
(mean) GDP				7914.596***	14910.49*	7756.566*
				(.0008508)	(.0269289)	(.0263037)
(mean) Population_growth				433269.5***	218456.4	335793.1*
				(1.82e-21)	(.1766626)	(.0120499)
Constant	2931327***	3043948***	3264021***	3361527***	1042293	1847697*
	(5.0e-243)	(8.3e-209)	(6.03e-79)	(1.07e-19)	(.3223439)	(.021437)
R2	.8000474	.8151763	.8356885	.9470742	.5962165	.7042046
N	336	336	336	336	336	336
Time FE	No	No	Yearly	Yearly	No	Yearly
FE	No	No	No	No	Regional	Regional

* p<0.05, ** p<0.01,
*** p<0.001.
P-value in parentheses.

Panel C: Price indices

	(1)
	price index
(mean) Rest_SWE	-177.5614***
	(2.87e-46)
(mean) Cap	13.5078
	(.5133514)
(mean) CapRest_SWE	-20.03119*
	(.0309807)
Constant	728.6404***
	(3.88e-58)
r2	.8849457
N	112
Time FE	Yearly
FE	No

* p<0.05, ** p<0.01, *** p<0.001
P-value in parentheses.