The housing market and the role of macroprudential policy in Sweden

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Executive summary

This thesis is motivated by the recent development in the Swedish housing market; where house prices have appreciated steadily, coupled with a strong increase in household indebtedness. This trend has worried policymakers, as the housing market historically has had adverse consequences for the real economy and financial stability, both in Sweden as well as in other markets. The financial crisis and the 'lean-clean' debate have made it relevant to question the appropriateness of monetary policy to address housing market imbalances. This has resulted in a more widespread acceptance and application of a set of alternative instruments, so called *macroprudential tools*, to more explicitly target imbalances in specific sectors of the economy and the financial market.

A vast number of international studies have investigated the housing market's transmission mechanism to the real economy, and the empirical support for macroprudential policy has grown gradually stronger over the past decade. However, research in the Swedish context, to examine the empirical performance of the macroprudential measures targeted at house prices and household debt, has been rather limited. Thus, the aim of this thesis is twofold; first, it provides evidence on the housing market's transmission mechanism to the real economy and financial stability, secondly, it tests the empirical impact from the loan-to-value (LTV) limit and the amortisation requirement.

The first part is supported by an analytical framework building upon intertemporal choice theory, agency theory and the Q-theory of residential investment, which guides the collection of evidence from reports and other researchers' findings on the housing market's role in Sweden. The evidence suggests that the growing importance of the housing market, to affect real economic variables and financial stability, largely has been driven by changes in credit market conditions, which has made it easier to extract collateral wealth. This stimulates consumer expenditures, but on the downside also increases the sensitivity of actors in the financial market to the housing cycle. The second part employs a synthetic control method (SCM), to statistically quantify the impact from the credit and housing targeted macroprudential measures taken so far. Furthermore, a Vector Autoregression (VAR) model is used to quantify the impact from monetary policy on house prices. The VAR results are then used to investigate the interaction between monetary and macroprudential policy, by disentangling the policy rate effect from that of the LTV limit. The empirical results suggest that the LTV and the policy rate do mitigate house price growth, while there is no visible effect from the amortisation requirement. The results also indicate that the effect from the intervention fades away over times and that its relative strength varies across regional areas.

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1.0 Introduction

1.1 Motivation and research questions

Research suggests that asset prices have become increasingly important in the transmission mechanism of domestic and global business cycles. In particular, the US subprime mortgage crisis in 2008-2009 accentuated the importance of the housing market. Since then, the housing and the mortgage market have been in the epicentre of the popular debate, resulting in a vast amount of research on the housing market's impact on both economic and financial stability. The role of housing, as a transmitter of shocks to the real economy, has raised some questions with regards to how monetary policymakers and/or other supervisory authorities could be better equipped to tackle housing market imbalances. Already before the global financial crisis (GFC) in 2008-2009, there was an ongoing debate about what role asset prices should play in monetary policy. One set of scholars promoted the '*leaning against the wind*' monetary approach, allowing monetary policy to step in during the expansionary phase of an asset price upturn, to prevent the development of dangerous imbalances (Cecchetti, Genberg, Lipsky, & Wadhwani, 2000).

Nevertheless, when the Swedish central bank, henceforth the Riksbank, did so by raising the policy rate in 2010-2011, it turned out to have devastating consequences for the rest of the economy. In an interview with the Financial Times, the world famous economist Paul Krugman calls the action by the Riksbank "*possibly the most gratuitous policy error of the crisis*" (Financial Times, 2014). Moreover, critiques argued that it failed to address the housing and credit market imbalances (L. E. O. Svensson, 2012). Considering the current dominance of a zero lower bound for interest rates in Sweden, as well as in several other countries, economists have started to experiment with complementary measures to target critical sectors of the economy and financial market. The Swedish policy rate hit zero in Q3 2014, and has since then been lowered further to today's negative of - 0.5 %[1]. The low interest rate climate and the recognition of asset prices' important role in financial markets have motivated the use of macroprudential instruments to improve the financial sector's resilience to housing market cycles (IMF, 2011b). In the Swedish context, macroprudential tools targeted at credit demand, have been employed to a rather limited extent, such as the introduction of loan-to-value, henceforth LTV, limit in 2010 and the amortisation requirement in 2016.

Tough some policy measures have been taken, the Swedish housing market is still an ongoing concern; during spring 2016 Sweden was identified in the Alert Mechanism Report presented by the European Commission, due to macroeconomic imbalances related to the pronounced increase in household credit accompanied with rising house prices. Finansinspektionen's, henceforth FI, latest report on financial stability from April 2017 states that "*FI judges there to be an elevated risk that house prices will fall compared to a*

[1] See appendix 1 for the development of the Swedish policy rate, the "repo rate" over time.

normal state" (p. 3), this calls for further investigation, which highlights the relevance of this thesis. Thus, our research interest is not only motivated by the importance of the housing market for real economic variables, but also driven by the urgency to examine the Swedish housing market due to its critical development over past years.

Since the GFC, the Swedish housing market has deviated a bit from the norm; relative to other Nordic and OECD markets, the Swedish one experienced a rather modest dip in house prices around 2009, and since then they have increased steadily. The particularly troublesome feature in the Swedish market is that the strong positive growth in house prices has been accompanied with increasing household indebtedness. At the same time, the GFC and the Swedish monetary contraction in 2010-2011 resulted in a decline in output and inflation, as well as higher unemployment. Since 2011 the Riksbank has sought to boost the economy by lowering the policy rate. Nevertheless, critiques have argued that this has further fuelled the continuous increase in house prices coupled with mounting household debt. The combination of these two factors, have had adverse consequences in the past (i.e. the Swedish Banking Crisis in the 90s), not only in Sweden, but also across other markets (Jansson & Persson, 2011). Though the rise in house prices partly can be explained by fundamental factors, such as growth in disposable income and population growth, other indicators, such as the price-to-rent ratio[2], suggest that house prices are overvalued, which pose a risk of a future price correction that could have adverse consequences for the real economy and financial stability (The European Commission, 2017).

To create a fundamental understanding for the housing market in the Swedish context, the first part of this thesis, henceforth *Part 1*, will examine both the theoretical and empirical links from the housing market to real economic variables and financial stability. Therefore, the first section sets out to investigate the housing market's transmission mechanism on economic variables and financial stability, guided by the following research question:

i) What is the housing market's transmission mechanism on the real economy and financial stability?

This thesis acknowledges that there already exists a vast number of academic research papers that address the housing market's transmission mechanism,[3] and especially the wealth and collateral effects on consumer spending. Nevertheless, research in the Swedish context is a bit more scares; some have focused on the role of housing wealth on consumption by examining the marginal propensity to consume (Chen, 2006), or the role of collateral effects in the business cycle (Walentin, 2014), as well as the housing market's impact on

[2] House prices to housing rents is a common proxy for over valuation.
[3] See Assenmacher-wesche and Gerlach, (2009), Giuliodori (2005), Goodhart and Hofmann (2008), and Iacoviello and Neri (2010) to mention a few.

residential investments (Berg & Berger, 2005). Rather than replicating their findings, *Part 1* seeks to bridge theory, empirical research, as well as Swedish institutional and structural factors, to generate a holistic picture of the housing market's role in the real economy and the financial market. Moreover, researchers have argued that national structural factors, as well as their change over time, need to be taken into consideration to understand the housing market's role in the real economy (Catte, Girouard, Price, & André, 2004). Thus, *Part 1* is relevant to understand the importance of the housing market under more "normal" economic conditions and not only under severe financial distress, which has been the main focus of the popular debate in the aftermath of the GFC.

Given that earlier research has acknowledged the importance of the housing market and the recent development in the Swedish housing and credit market, the second section empirically investigates the impact of monetary and macroprudential policy during the past decade. Farelius and Billborn (2016) acknowledge that "*macroprudential policy implementation in the Nordic and the Baltic region is a fairly new concept with limited empirical experience*" (p. 144). To the authors' knowledge, only Walentin (2014) has tried to quantify the impact from the LTV limit and no others have tested the impact from the amortisation requirement, through econometric modelling, in the Swedish context. Moreover, since the Riksbank raised the policy rate in the same period as the LTV limit was introduced, there is a risk of confounding effects, which calls for a novel investigation to potential disentangle the effects of monetary and macroprudential policy.

A second rationale for investigating this empirically is to address the discussion centred around what other measures that should be taken, and why increasing regulation does not seem to have had the desired effect (The European Commission, 2017). Nonetheless, critiques have not empirically tested the impact of the prudential measures taken so far, but rather examined the aggregate development of the outcome variables of interest (house prices and credit), to conclude that these policies have had limited impact. To address the housing market with accurate policies in the future, it appears important to empirically assess the impact of both conventional monetary policy and the macroprudential measures taken since the GFC. On that note, the second part of this thesis, henceforth *Part 2*, seeks to answer:

ii) Has monetary policy and other macroprudential tools mitigated house price fluctuations?

More specifically, this thesis will test the impact from the LTV limit and the amortisation requirement. The rationale for testing these specific prudential policy incentives is because they are targeted at credit demand, thus addressing the contemporary worrisome development, as well as the link between the housing and the credit market. It is relevant to do so, considering the solid theoretical and empirical support for

macroprudential measures, which has emerged over the past years[4]. Hence, it appears relevant to ask if these measures have had an impact despite that Swedish house prices and credit continues to increase.

The thesis is divided into the following chronological chapters: The first chapter constitutes the introduction, including the topic delimitation, methodology and the thesis structure. The second chapter presents the analytical framework that supports the final part of that chapter, which outlines the analytical propositions. The third chapter will contain the *Part 1* evidence, which addresses the first research question. The forth chapter contains a brief introduction to the second part and an explanation of the econometric method, followed by the results from the *Part 2* analysis, as well as its limitations. The fifth chapter contains the discussion and perspectives. The final chapter concludes.

1.2 Topic delimitation, methodology and thesis structure

The purpose of this section is to decompose the different aspects of our research to create a fundamental understanding for the choice of methodology that will guide this research process. To select the most appropriate methodological approach, it is valuable to first specify the research topic more precisely. Therefore, the first section defines the topic delimitation. Secondly, the methodological approach and the methods used to answer the two research questions are described. The third section will define the use of theory and its limitations, followed by the final section, which will present the thesis structure.

1.2.1 Topic delimitation

This thesis focuses on about the Swedish housing market and its empirical context. Therefore, it refers to the Swedish context or Swedish variables unless else is stated. Also, when talking about the housing market's transmission mechanism, it will refer to the aspects of the real economy and financial stability as they will be defined in this section. Since the first research question (RQ1) addresses the housing market's transmission mechanism, the empirical investigation will mainly focus on the link between the housing market and the real economy as well as financial stability, and not the opposite[5]. Despite that it focuses on the Swedish housing market, other markets will be included as reference points when relevant. Furthermore, as a prerequisite to employ the econometric method in *Part 2*, the Canadian housing market will serve as the main unit of comparison in that section. Next, we turn to define the scope of the main concepts included in the research questions.

[4] Among others, see Kuttner, Kenneth and Shim (2013), Claessens (2014) and Borio and Shim (2007) to mention a few.
[5] We acknowledge the multidimensional dynamics between several of these variables and institutions, and in particular the important interplay between credit and housing (see Kiyotaki and Moore (1995)). Due to the limited scope of this thesis, *Part 1* is only to a limited extent concerned about these interdependencies.

The housing market, the real economy and financial stability

Since RQ1 addresses three rather broad topics, "*What is the **housing market's** transmission mechanism on the **real economy** and **financial stability**?*", it is useful to specify what these refer to in the study context. First, despite that *the housing market* consists of both residential and commercial property, this paper only focuses on the former. Within residential property, we will consider both owner-occupied and rental housing, as they directly influence the wealth and credit effect, and ultimately also consumption. When the housing market or house prices are mentioned, both apartments and houses are taken into consideration. To account for differences that might occur across geographical areas, municipalities and across demographical factors, the housing market is examined from both a national and regional perspective when relevant.

Considering the *real economy*, the study directs its focus to the economic variables that can be directly linked to the housing market's transmission mechanism; that is private consumption and residential investment.[6] Our point of departure has been the key components of overall economic activity (GDP)[7], and the variables that carries the strongest theoretical link to the housing market have offered a natural limitation. On that note, we recognize the broad meaning of the real economy defined as the part of the economy concerned with producing goods and services (Financial Times Lexicon, 2017), but do only to some extent examine the housing markets consequences for other important economic variables such as employment.

This research acknowledges that there is no clear consensus about how *financial stability* best should be defined and what components to include. Crockett (1996) distinguishes between financial stability related to financial institutions and financial markets, whereas the former refers to the resilience of the actors in the financial market, while the latter can be defined as in Weber (2008) "*a precondition for macroeconomic stability and economic growth reflected by a flow of information between borrowers and lenders, sufficiently stable to overcome the inherent information asymmetries between two parties*" (Weber cited in Vasilescu, 2012, p. 129). The latter conceptualization will be the main point of departure in this paper, nevertheless we acknowledge that stability across financial markets and financial institutions is interlinked through the principal-agent dilemma, thus to obtain a holistic picture of the housing market's role in the financial stability debate, it is necessary to evaluate the resilience of financial institutions directly involved with mortgage lending.

Specifically, we will consider the vulnerability of the actors in the mortgage market, by examining both lenders and borrowers as well at the multidimensional aspect of their relationship. Both mortgage holders'

[6] We acknowledge that the housing market also affect all types of investment, but including for example firm's investment would involve an examination of the commercial property market, which is beyond the scope of this paper.

[7] Per definition GDP can be expressed as: $Y = C + I + NX$, which resembles the Keynesian aggregate demand function ($AD = C + I + G + NX$) but allows for a broader definition of investments.

and mortgage providers' balance sheets will be analysed considering information asymmetries as well as structural and regulatory factors, which potentially amplifies or mitigates the housing market's transmission mechanism on financial stability.

Monetary and macroprudential policy

The second research question (RQ2) seeks to address "*Has **monetary policy** and other **macroprudential tools** mitigated house price fluctuations*". Considering the persistent growth of mortgage debt and house prices this paper limits its focus to mainly study the role of *housing and credit related prudential tools*. Given that the lean-clean debate has been one of the key motivators of this research, the following definition of macroprudential policy appears to be particularly useful: "*macroprudential policies are regulatory instruments mainly imposed on the credit intermediation process to ex-ante prevent the build-up of risks*" (Suh, 2012, p. 1). More specifically, macroprudential tools set out to address potential instabilities in the financial sector, which could be transmitted to the real economy, and the other way around (Rubio, 2016). The latter suggests that the some of the housing market's transmission mechanisms relevant for the real economy will be relevant for financial stability as well. The reader should therefore note that there is a natural theoretical overlap between the collateral channel and the financial stability channel, as both can be understood considering the notion of information asymmetries between borrowers and lenders.

Here credit prudential measures are understood as regulatory tools that can be classified based on what they affect. While some instruments seek to limit the demand for credit, by affecting the terms and conditions of transactions, others seek to restrict the supply of credit (Kuttner & Shim, 2013). RQ1 will consider the importance of both demand and supply side measures in light of their impact on the information asymmetry problem. The empirical focus in RQ2 will be on the credit prudential tools targeted at credit demand, in this case, we evaluate the performance of the LTV limit and the amortisation requirement ex-post.

This thesis acknowledges that the housing market's impact on the real economy and financial stability cannot be viewed in isolation, it depends on what type of structural variables or shocks that drive the house price development. Due to the limited scope of this thesis, most house price changes (appreciations/depreciations) will be taken as given. The only shock directly examined is demand shocks powered by the monetary transmission mechanism (MTM): With regards to RQ1 this mainly refers to 1) the policy rate's impact on monthly mortgage interest payments and house prices, which ultimately affects consumption and 2) the financial stability risks related to the mortgage structure. RQ2 is per definition more directly concerned with the underlying determinants of house prices, including the role of monetary policy shocks and macroprudential regulation. Nevertheless, one should acknowledge that much more can be said about the housing market's important role in the MTM, which is beyond the scope of this thesis.

1.2.2 Main methodological framework

A naturalist approach to philosophy of science

The naturalist school of thought provides some useful insights to create a fundamental understanding for how we will address the research questions. Naturalists perceive the world as an external reality independent of the agents that act within it, or their representations of the world. The naturalistic epistemology suggests that social science should seek to discover general patterns and document these as correlations. It implies that knowledge about the laws of nature is acquired through the identification of associations and the ultimate purpose of science is to uncover regularities. To understand how such knowledge can be acquired one can apply the induction-deduction approach of interference. This mode suggests that deduction, which builds on true and accepted claims, starts with general truths and proceeds through established rules of reasoning towards an explanation of a single event. On the contrary, induction builds on sensory observations; it starts with empirics and generates more general theories at the higher level. It has been argued that science must rely on both deduction and induction (Moses & Knutsen, 2007), which supports the approach taken in this thesis.

Moreover, naturalism focuses on systematic observations from a positive perspective. In this thesis, we mainly take a positive approach, as it enables us to study the housing market's impact on the real economy and financial stability on an empirical fact-based ground. Despite that this paper does not explicitly set out to provide policy recommendations, it does refer to the normative strand of literature when it is deemed relevant to do so[8]. Also, when answering RQ2, the naturalist approach will guide the analysis of how macroprudential and monetary policy potentially have affected the housing market. Nevertheless, the naturalist philosophy of science holds certain limitations: a common critique is that it is not able to reveal general explanations and predictions about reality, as the naturalist ontology clearly states that social scientists should study the world disregarding the independent mind of the actors. On that note, one should acknowledge that a strict and exclusively naturalist perspective will not be able to explain the housing market's transmission mechanism to its fullest.

Choice of method

Naturalists suggest that there are certain research methods that are more suitable to discover and understand the world. These methods can be ranked hierarchically; the experimental approach is the ideal method, but commonly this approach is difficult to apply, and therefore the naturalists consider the statistical method as the second-best option. If the data needed to conduct statistical research is not available, a comparative approach (resembling the experimental) is suggested. Lastly, if the comparative technique is not suitable,

[8] FI, the Riksbank, the European Commission and many more have already published several reports with numerous policy recommendations, when relevant we will refer to some of them.

then the naturalists suggest the case study[9] method (Moses & Knutsen, 2007). To answer RQ2 we will employ the statistical method, i.e. an econometric analysis using both a Synthetic Control Method (SCM) and a Vector Autoregression (VAR) configuration. The econometric method will be explained in detail in *Part 2*, therefore the remainder of this section focuses on how the case study approach will be employed to address the first research question.

Due to the inherent disparity between some of the methods presented above and RQ1[10], the statistical approach and the case study were considered the most suitable options. Given the vast amount of previous research, which has examined the relationship between the housing market and the real economy using statistical methods[11], the case study approach was regarded the most appropriate to yield important insights beyond the ones captured by statistical relationships. In that sense, the case study allows us to investigate important housing specific factors[12], which commonly are omitted from a pure statistical analysis.

This thesis employs a case study method, which can be referred to as a *theory fitting*[13]. Theory fitting implies that the case of interest (the Swedish housing market) will be investigated in light of its relative fit with an analytical framework (Lijphart, 1971; Moses & Knutsen, 2007). In our case the analytical framework will consist of propositions derived from theoretical and empirical concepts of the housing market's transmission mechanism and its proposed impact on private consumption, residential investment and financial stability. The empirical application of the analytical framework will investigate to what extent this case fits with the propositions, and if necessary challenge the concepts' explanatory power if the observed reality presents evidence that might contradict theory. However, this thesis does not seek to confirm the validity of the theories employed, but rather provide prescriptions for how one could describe and discuss a specific phenomenon.

	Research Question 1 (RQ1)	Research Question (RQ2)
RQ	*What is the housing market's transmission mechanism on the real economy and financial stability?*	*Has monetary policy and other macroprudential tools mitigated house price fluctuations?*
Method	Theory fitting case study	Statistical method: synthetic control method and VAR

[9] "*A case study is a test of the proposition, which may turn out to be confirmed or infirmed*" (Lijphart, 1971, p.691).
[10] The size and complexity of the housing market suggests that an experiment or a comparative study (which seeks to mimic the logic of the experiment) is inappropriate in this context.
[11] See among others Case, Quigley, & Shiller (2013), Arestis & González (2014).
[12] See for example Emanuelsson (2015) and Berg & Berger (2005) for comments on those in the Swedish housing context
[13] A method where "*a case is chosen as an empirical venue for applying a particular theory... and seeks to demonstrate how the case fits a general proposition*" (Moses & Knutsen, 2007, p.133).

Empirical Sources	Secondary data: Scientific articles, reports, books and newspapers.	Secondary data: Datastream, Bloomberg and Statistics Sweden.

Table 1: Overview of RQ1, RQ2, the methods and the empirical sources

Use of theory and theoretical delimitations

In line with the naturalist philosophy, the aim is to use economic theories as a map to build the analytical framework (Moses & Knutsen, 2007). On that note, this thesis departs from the New Keynesian school of thoughts, as this theoretical perspective captures both the micro- and macroeconomic aspects of the housing market's role in the business cycle[14]. Moreover, some neoclassical assumptions, such as utility maximisation, rational market actors and well-ordered preferences, will be useful to understand the fundamentals of consumer choice theory. Nevertheless, the topic of this thesis would not have been relevant if the neoclassical theory perfectly held true[15]. Thus, market inefficiencies and, in particular credit market imperfections, are vital components to understand the relevance of the housing market for the real economy. The theoretical foundation to explain the link between the housing and credit market largely rest upon the principal-agent framework and the interplay between various economic actors under information asymmetries (Crockett, 1996). We will draw upon this concept to explain both the housing collateral effect and the housing market's influence on financial stability.

Delimitation to the analytical framework and use of theory

The analytical framework, which will be presented in the upcoming chapter rests upon the main theoretical ideas presented above. With regards to the housing market's *transmission mechanism*, we recognize that depending on what research you refer to, there are various subcategories of transmission channels can stimulate private consumption, residential investment and financial stability. Most literature have agreed on that the wealth, collateral, interest rate and investment effect are among the most important ones (Goodhart & Hofmann, 2008; Kiss & Vadas, 2006). Furthermore, the literature commonly divides the wealth channel into a 'pure' wealth channel and then views the collateral and rent effect as sub-wealth effects to explain consumer spending. For the sake of consistency with previous research this thesis will do so as well. One should be aware that there are other important transmission mechanisms, such as non-tradable employment and the confidence effect, which are beyond the scope of this research.

[14] One should note that this paper does aim at constructing a full DSGE model of the housing market like among others Iacoviello (2005), Monacelli (2008) and Iacoviello & Neri (2010).

[15] The neoclassical perspective denies the notion of mispricing and overvaluation in the housing market, implicitly this means that one does not need to worry about potential house price "corrections".

Furthermore, with regards to the housing market's *transmission mechanism* on financial stability, the analytical framework will focus on some empirically important aspects of the mortgage market. Thus, the analysis will be more pragmatic in a sense that it sets out to assess the vulnerability of the financial system considering relevant analytical concepts, which will be used to form propositions that inherently carry a stronger empirical than theoretical foundation. Here, the analysis draw upon some of the central aspects of agency theory, while acknowledging that there are other ways to create a theoretical understanding for such a broad concept as financial stability.

1.2.3 Thesis structure

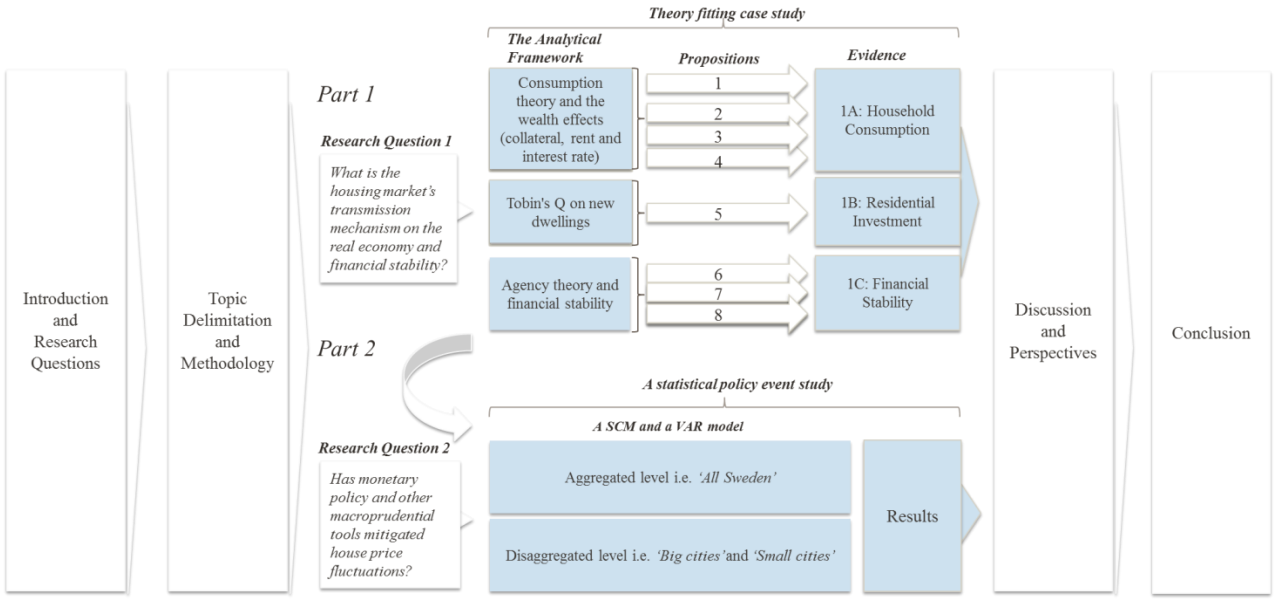

Figure 1: Own illustration of the thesis structure

2.0 The analytical framework

This chapter will present the theory and the concepts that will guide the analysis. The first section introduces the monetary transmission mechanism (MTM), to create a fundamental understanding for the relationship between monetary policy, the housing market and the real economy. The second part is devoted to consumer choice theory, which will be the core pillar to understand the housing wealth effect. Thirdly, residential investment theory and specifically the Q-theory of new dwellings will be explained. Forth, the housing market's transmission mechanism on financial stability will be described considering agency theory and structural factors. Finally, these theories and concepts will be tied together into the analytical propositions, which constitutes the final section of this chapter.

2.1 The monetary transmission mechanism

The monetary transmission mechanism operates in two stages: In the first stage, monetary policy has the power to affect market interest rates, the exchange rate, asset prices, credit supply and expectations though communication and policy rate changes. In the second stage, demand and supply factors react to the first stage (Kiss & Vadas, 2006). The focus of this thesis is the second stage, and more specifically the link between assets, in this case housing, and the real economy, through supply and demand factor. Also, given RQ2, this section will serve as a core pillar to grasp the underlying mechanisms of monetary policy and its impact on mortgage market conditions and house prices, which is essential to understand the multidimensional relationship between monetary policy, the housing market and the real economy. Consequently, this section fills two purposes: 1) To create an understanding for the underlying factors of the housing market's transmission mechanism in case of a monetary shock and 2) set the rules of the game for what monetary and macroprudential policy can do, to potentially limit the housing market's propagating effect.

The broad literature on the MTM can be divided into two views; one neoclassical and one non-neoclassical, whereas the former refers to the classical interest rate and asset channel including consumption, investment and trade decisions, as well as their effect on the real economy. The latter, the non-neoclassical, rests on observed market imperfections, such as government intervention and credit market imperfections. Credit market imperfections lend support for three sub-channels of the MTM: 1) The bank lending channel and 2) the balance sheet channel of the lender and the 3) balance sheet channel of the borrower (Boivin, Kiley, & Mishkin, 2010). The main focus of this thesis will be the two latter.

Given some level of short-run price stickiness, the short-term nominal interest rate affects short-term real rates, even under the assumption of rational expectations. The role of the nominal interest rate to affect real

variables has become became an accepted phenomenon among both the monetarist school and New Keynesian theorists. Yet, the monetarist has argued that other assets[16], apart from the interest rate, gives rise to wealth effects and can be viewed as important alternative channels of the MTM. One of these alternative channels of the MTM, can be understood as the wealth channel of land and housing (Mishkin, 1996). This builds on the life-cycle model of consumption (Ando & Modigliani, 1963), which will be described in greater detail in the consumption section.

Though the link between nominal and real variables has been a well-established phenomenon in the MTM for quite some time, some economists have found it puzzling to understand how rather small monetary changes can have large real effects. Even though the role of other assets has improved the explanatory power of the MTM, another set of scholars have complemented this view by incorporating the role of credit market imperfections. The role of credit in the MTM was accentuated by Bernanke and Gertler (1996) and Bernanke, Gertler and Gilchrist (1999), who labelled the potential worsening impact from credit conditions, resulting in a slowdown of the business cycle, the *financial accelerator*. The financial accelerator can be defined as an *"amplification of real or monetary shocks in the economy due to variations in credit conditions"* (Arestis & González, 2014, p. 146). Since it effects both borrower's and lender's balance sheet, it is a fundamental concept to understand the multidimensional relationship between the housing market and credit conditions.

The role of house prices in the MTM – The interest rate effect

Kiss and Vadas (2006) suggest that the housing market's role in the MTM can be considered through three different mechanisms: the interest rate, the wealth and the collateral effect. These three have an impact on aggregate demand through consumption and investments. Both monetarists and New Keynesian theorists agreed that asset prices tend to fall after a monetary contraction: When the interest rate rises, asset values fall, including that of property, equities and bonds. The role of the policy rate will be analysed considering the direct interest rate effect affecting mortgage rates and house prices; where the former directly have an impact on disposable income and the latter affects wealth and collateral effects.

The interest rate effect on consumption can be viewed as a result of a changes in the short-term policy rate, which has direct implications for consumer spending as it affects household cash flows and the user cost of housing[17] (Kiss & Vadas, 2006). Thus, following an increase in the interest rate, variable mortgage payments rise and this implies that households hypothetically need to substitute a fraction of their income away from consumption to afford greater monthly debt payments, ultimately having a negative effect on aggregate

[16] Here the literature allows for a broad definition of equities, including residential investments, housing and land (Mishkin, 1996).
[17] The user cost of housing has two main components: the capital cost of owning a house and the operating cost of maintaining it.

demand (Finansinspektionen, 2017). Also, as the interest rate directly enters the function defining the user cost of housing, it has a direct impact on house prices. All else equal, given an increase in the interest rate house prices should drop. Thus, the increase in the interest rate does not only affect households' cash flows, it also lowers the value of the housing collateral, which has potential adverse consequences for consumer spending (Kiss & Vadas, 2006). Altogether, this shows how the housing market potentially propagates the MTM.

Thus, the housing market's magnifying role in the MTM can by summarised by its impact on both consumption, investment and financial stability: Higher interest rate means a reduction in wealth from both a decline in property values and equities owned by households. At the same time the cost of capital for firms increase, meaning that investments become relatively more expensive (Mishkin, 1996). When the borrowers net worth fall, it is not only the cost of external finance that increases, also as the borrower's probability of default rises, the bank's balance sheet weakens and its stance to extend credit declines (Basel Committee on Banking Supervision, 2011). Because the MTM inherently operates through several channels it is difficult to disentangle the relative strength of the housing channel. Empirically, the role of the housing market in the MTM has differed across markets and time. Hence, scholars have argued that its relative strength depends on financial market conditions. Boivin et al. (2010) suggest that the role of structural changes in credit markets appear to have played an important role to explain the variation in the relative importance of the MTM's sub-channels over time and across countries. In sum, most scholars suggest that the role of housing in the MTM is greater, the more flexible and market based the financial system is (Kuttner & Mosser, 2002; Rubio, 2009).

It has been argued that the mortgage structure, i.e. fixed and variable loans, as well as length and maturity of mortgages matters for the relative sensitivity of both consumption and the financial system to changes in the interest rate and house prices (Kiss & Vadas, 2006). Apart from the mortgage structure, the average LTV ratio is commonly used as a proxy for the flexibility of the financial system. Furthermore, the possibility of mortgage equity withdrawals (MEWs), the level of mortgage securitisation and share of owner-occupied dwellings are other empirical proxies, which are expected to increase the role of the housing market in the MTM (Assenmacher-wesche & Gerlach, 2008). The analysis addressing the first research question will accentuate the potential role of these factors in the Swedish economy.

2.2 Consumption theory

2.2.1 The link between housing wealth and consumption

The housing wealth effect on consumption stems from Keynesian consumption theory (Keynes, 1936) and intertemporal choice theory (Fisher, 1930). Intertemporal choice theory extents the basic consumption theory to allow for forward-looking expectations. This implies that individuals decide upon their optimal consumption bundle, subject to their intertemporal budget constraint, which represents the total resources available today as well as from future income streams. Income consist of *both* human and non-human capital, such as housing equity, and is assumed to be stable over time (Mankiw, 2013).

Modigliani and Brumberg coined the Life-Cycle Hypothesis, henceforth the LCH, which can be viewed an extension to intertemporal choice theory allowing for variations in income over time. The LCH assumes that at every point in time, the consumer maximises his utility[18] subject to a budget constraint, which is the sum of current and discounted future earnings over his lifetime. If wealth increases in one period, the consumer will allocate the additional wealth to consumption proportionally over time, a phenomenon that has been referred to as consumption smoothing (Ando & Modigliani, 1963). The LCH proposes that all sources of increased wealth should have a positive effect on household spending, including the wealth from homeownership. Moreover, the LCH suggests that two consumption functions exist: a short-term and a long-term function. In the long run, wealth and income is assumed to grow proportionally, resulting in a constant average MPC over time and therefore consumption should also remain constant. However, the short run dynamics are different; if wealth increases, consumption rises due to the short-term increase in total income (Zhu, 2003).

Later Milton Friedman (1957) extended the work on the LCH to account for different types of income. His work resulted in the Permanent Income Hypothesis (PIH), which builds upon intertemporal choice theory, but distinguish between two types of disposable income; 1) permanent income, which is the income the agent expect to obtain over his lifetime and 2) transitory income, which refers to the income that is obtained randomly during the agent's lifetime (Mankiw, 2013; Romer, 2012). Households cannot smooth consumption based on transitory income as it is irregular, and thus current consumption solely depends on permanent income. This implies that households with a higher permanent income level have a proportionally higher propensity to consume (Mankiw, 2013).

[18] The individual's utility function can be expressed as a function of his resources and the rate of return on assets including an age parameter to account for variation across time. Here the individual's utility function is homogenous with respect to consumption over time.

In the housing market, the principles of the PIH implies that the magnitude of the wealth effect depends on whether house price changes are perceived as permanent or temporary, whereas the former have an impact on consumption. Both the LCH and the PIH, henceforth referred to as the LCH-PIH, argues that fluctuations in private consumption can be driven by changes in housing wealth. On that note, subsequent section will explorer the housing wealth effect in greater detail, including collateral and rent wealth effect, as well as their implication for various types of actors: homeowners (assuming liquid markets), credit constraint homeowners, renters and prospective homeowners.

2.2.2 Wealth effects on consumer expenditure

The LCH-PIH suggest that increases in housing wealth should have a positive effect on household spending; both with regards to durable and nondurable goods and services[19]. Nevertheless, other scholars have challenged this view and suggested that the increase in wealth, from a rise in house prices among homeowners (higher consumer spending), should be levelled out by 1) the decline in consumption amongst prospective homeowner, as they need to save more to be able to buy a home, and 2) high transaction costs makes the housing market rather illiquid, which potentially offsets part of the wealth effects. Thus, they argue that the aggregate effect on consumer spending should cancel out, and thus consumption should remain constant. This has been referred to as the zero-sum equilibrium argument of the wealth channel (Giuliodori, 2005).

2.2.2.1 The wealth effect

House price fluctuations (independent of their cause) can be transmitted to the real economy through their impact on the 'pure' wealth effect, that is, either through a permanent increase in house prices or through capital gains from trading in houses. Following the LCH-PIH, the housing wealth effect can be defined as "*consumers maximising their intertemporal utility under a lifetime resource constraint per which current consumption is proportionate to the total wealth incorporating realised capital gains from housing equity*" (Altissimo et al., 2005, p.4). Mathematically, it can be expressed as:

$$C = mpc_W[A + H(Y)] = mpc_W A + mpc_Y Y \quad (1)$$

Where C denotes current private consumption, A is real non-labour wealth and H is the present value of the expected future labour income (Y) after taxes. The two coefficients mpc_W and mpc_Y are the long-run MPC

[19] In their famous studies Case, Quigley, and Shiller (2005, 2013) found that the relationship between housing wealth and consumption to be positive and statistically significant in the US. However, the empirical support of the wealth effect varies across market and depends on whether the definition of wealth only includes the 'pure' wealth effect or also considers the collateral wealth effect.

out of permanent wealth and disposable income. By taking the first order derivative with respect to consumption, equation 1 can be rewritten as:

$$\frac{\Delta C}{C} = \underbrace{\left[mpc_W \frac{A}{C}\right]}_{\text{Wealth elasticity of consumption}} \frac{\Delta A}{A} + \left[mpc_Y \frac{Y}{C}\right] \frac{\Delta Y}{Y} \qquad (2)$$

Equation (2) shows that wealth elasticity of consumption[20] depends on the relative size of the mpc_W and on the wealth consumption ratio $\frac{A}{C}$. This implies that the wealth elasticity of consumption is constant when the wealth to consumption $\frac{A}{C}$ ratio is equal to one (Altissimo et al., 2005). At an aggregate level, housing wealth effects that arise from gains in owner-occupied equity is a function of the market share value of all residential assets that are owner-occupied within the given market (Iacoviello, 2011). Research suggest that the MPC out of household wealth is positive in most OECD countries[21] and that cross-country differences in MPC out of housing wealth relates to variation across structural factors, such as mortgage market conditions, the tax system and the relative fraction of homeowners to non-owners (Catte et al., 2004).

Baseline framework: Homeowners and no market frictions

By extending rational consumer choice theory (Frank, 2003), one can illustrate the housing wealth effect graphically, to better understand the homeowner's consumption behaviour following a change in housing wealth. The theory assumes that homeowners enter the market with already pre-defined preferences and allocate their income to best serve those preferences, while they take prices as given (Frank, 2003). This allows for imperfect substitution between housing and non-housing goods. The baseline framework, illustrated in chart 1 below, assumes liquid markets as well as no transaction costs, thus an increase in home equity can be transferred to private consumption at no cost. Theoretically, the relative magnitude of the housing wealth effect, considering a permanent house price appreciation, $(+)\,\Delta P_{housing}$, should be proportional to the percentage change in house prices and the change in consumption ($+\Delta C$) should be equal to the mpc_W , multiplied with the total increase in housing wealth ($+\Delta A$), as suggested by equation (1) above.

Chart 1 illustrates that the increase in housing equity cause a shift of the original budget constraint, from B_1 to B_2, where the shift from point A to point B shows that the homeowner obtains greater utility as the optimal consumption bundle lies on a higher indifference curve than before (I_1 to I_2). The shift in the vertical intercept (B_2) illustrates that the homeowner could enjoy a $(+)\,\Delta P_{housing}$ increase in consumption of other

[20] The percentage change in consumption given a 1 % change in financial wealth (Campbell & Viceira, 2002).

[21] Catte, Girouard, Price, and André (2004) measure MPC out of housing wealth to find that the in the average OECD country it is $ 0.35 increase in consumption per $1 increase in housing wealth.

goods (given the assumption of liquid markets allowing for trade and/or refinancing opportunities). The effect on consumption can be summarised by two main points:

1) When the price of housing as a consumption good increases, this suggest that the homeowner will substitute away from consuming housing to consuming other relative cheaper goods. This is the substitution[22] effect, illustrated by the inward shift in the horizontal intercept (B_2).
2) Since the homeowner's wealth has increased, the owner now has stronger purchasing power to consume more other goods, which yields a positive income effect[23] .

Both affects have a positive impact on consumer expenditures, but the substitution effect is assumed to be greater (Frank, 2003; Ludvig & Sløk, 2002).

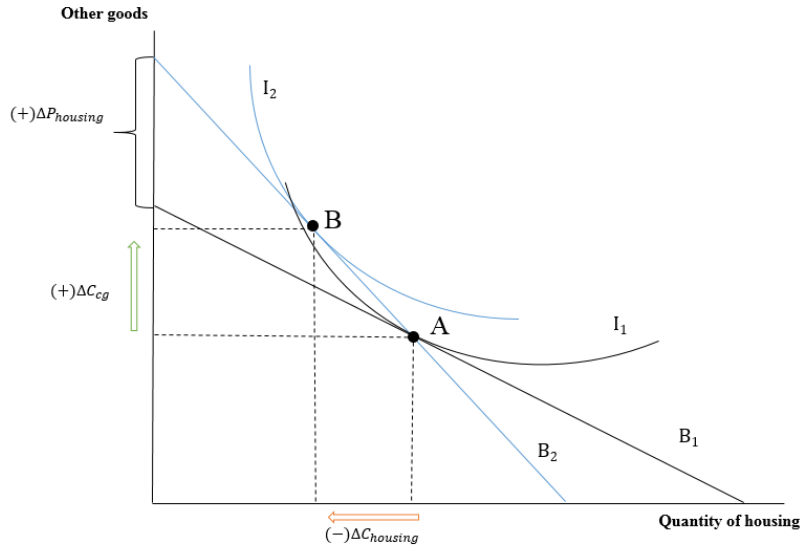

Chart 1: Own illustration of the wealth effects following a permanent house price appreciation for homeowners.

2.2.2.2 The collateral effect

The collateral effect can be understood as the transmission mechanism between housing collateralised wealth and the real economy. Given that homeowners use the house as a security against default (collateral), the housing market affects the homeowner's balance sheet. The collateral wealth channel affects consumption by improving refinancing opportunities by; 1) increasing borrowing possibilities and 2) lowers the cost of external finance (Mishkin et al., 2007). Theoretically, this facilitates additional private consumption

[22] The substitution effect is a consumption decision that results from a change in the relative attractiveness of other goods (in this case attractiveness is defined by price) and the consumer would want to substitute away from an expensive to a less expensive good (Frank, 2003).

[23] The income effect results from a change in real purchasing power i.e. all else equal, when the price of one good increases (here housing) a consumer can afford less of that good (Frank, 2003).

(Giuliodori, 2005; Ludvig & Sløk, 2002). Empirically, several scholars have confirmed this link between collateral wealth and consumer spending[24].

The collateral effect can be understood in light of agency theory: First, external finance is assumed to be more expensive than internal finance, due to agency costs related to information asymmetries between the lender (principal) and the borrower (agent). These information asymmetries arise because the lender cannot costlessly obtain information about the borrower's real default risk. Therefore, the lender is induced to charge an extra fee (a risk premium) to provide external finance to the borrower to compensate for the risk. Secondly, the risk is negatively correlated with the net wealth of the borrower, taking both illiquid assets, such as the housing, and liquid assets, such as cash flow streams, into consideration. In other words, an appreciation of the housing collateral can facilitate greater lending, as the agency costs involved with obtaining external finance, all else equal, should fall (Mishkin et al., 2007).

Furthermore, as home equity increases, the homeowners net worth rises, meaning that the borrower can finance greater consumption by relending, as his existing LTV ratio has declined. This phenomenon is what has been referred to as the mortgage equity withdrawal (MEW)[25]. One should note that the collateral effect cannot be viewed on its own, other factors such as the initial level of home equity, affect the ultimate impact on consumption from a rise in house prices. All else equal, a rise in house prices should have the greatest impact on consumer spending when the initial level of home equity is low, and the rise in equity therefore is relatively more important for consumption (Benito, Jamie, Waldron, & Wood, 2006).

Credit constrained vs. unconstrained homeowners

Given the agency problems involved with lending, the literature suggests that the collateral wealth effect on consumer spending differs depending on the homeowner's fundamental economic constraints. Under the assumption of two types of homeowners, constrained and unconstrained, the responsiveness of consumption among the former group depends on if the increase in housing wealth can be realised i.e. turned into cash[26]. This suggests that an increase in home equity can be viewed as a source of liquidity for this group (Ludvig & Sløk, 2002). On the contrary, the latter group, is assumed to have sufficient other resources that serves as a source of liquidity, and therefore this group is less dependent on housing equity as a source of consumption.

Consequently, the collateral effect should theoretically have a larger positive effect on homeowners with weaker balance sheets. Similarly, this group should face a larger drop in consumption from reduced access to

[24] See among others: Muellbauer and Murphy (1993), Arestis and González (2014) and Mishkin et al., (2007).
[25] Studies suggest that the rise in MEW has contributed to a rise in consumption the decline in the household savings rate observed in in the late 20th and early 21th century in the US. See: Duca, Johnson and Muellbauer (2009), Greenspan and Kennedy (2005, 2008) and Hazius (2005).
[26] Ways to realise capital gains will be presented in the next section.

credit, relative to those with stronger balance sheets. These consumers face liquidity constraints, defied as the inability to turn housing equity into cash, which prevents consumption in the current period to exceed current total income ((Mankiw, 2013). In that sense, the collateral effect is relatively more important to mitigate the information asymmetry problem for the credit constraint consumer[27], since those homeowners are more dependent on the housing collateral as an insurance against their debt. Ceteris paribus, a rise in the housing collateral lowers the borrower's default risk. On the contrary, a fall in the collateral reduces the agent's net wealth, resulting in an increase in the risk premium which makes the agent's cost of external credit higher, which puts a downward pressure on consumption and investments (Mishkin et al., 2007).

Wealth effects for constrained owners in illiquid markets

As just seen, credit market frictions result in that agents with stronger balance sheets can obtain credit with greater ease, meaning that as households net worth increases they can borrow more to finance greater consumption. Consider the baseline framework (p. 20-21), for a constrained homeowner under the assumption of illiquid markets. Here, consumer expenditure, following a permanent house price appreciation, depends on the household's economic constraints and if the increase in home equity can provide a source of liquidity. Under the assumption of illiquid markets (i.e. housing equity cannot easily be converted into cash), these types of owners might find it expensive or even impossible to convert housing equity into cash, because of high transaction costs, or a poorly developed credit system.

Compared to the baseline framework, a constrained homeowner is in this case worse-off from a house price increase as market illiquidity hypothetically hinders him from realising the increase in home equity. The total effect on consumer expenditure can be summarised as:

1) First, an increase in house prices makes housing as a consumption good more expensive compared to other goods, thus the homeowner would want to substitute away from housing to non-housing goods, but as housing equity cannot be used for non-housing consumption, the result will be a negative substitution effect.
2) Additionally, the homeowner's purchasing power declines when the consumption of housing becomes more expensive, therefore the consumption of other types of goods will drop as well, this is the negative income effect.

Relating the baseline framework (perfect liquidity) to the one above, together the two suggests that the aggregate effect on consumer spending, from a potential increase in housing wealth, depends on financial

[27] Iacoviello (2005) and Iacoviello and Neri (2010) find that the role of the housing market becomes more important the greater credit constraints are. The latter also found that the role of the housing collateral in the MTM has grown increasingly important over time.

market conditions that allows constrained households to realise capital gains from trading their homes and/or convert housing equity into new loans. This is consistent with previous research, suggesting that the collateral channel has a relatively stronger impact on consumption in markets where the easiness of relending is greater (Giuliodori, 2005). Consequently, next section will review some ways the constrained homeowner can realise collateral wealth. Studies acknowledging the importance of the collateral effect have theorised that one of its links to consumption arise from the MEW.

In practise, homeowners can take advantage of the rise in home equity in at least six ways, these are summarised in table 2 below (J. Smith, 2005). The two main channels are re-mortgaging (extending the current loan) and trading (sell the home) (Mishkin et al., 2007). The relative importance of the MEW to increase consumption depends on the relative cost of additional housing debt (MEW), to that of unsecured debt. However, MEWs are commonly accompanied with a fee, which might make the total cost difference between the two smaller. Ultimately, the aggregate effect on consumption will be greater if the price difference between secured and unsecured debt is greater (Bridges, Disney, & Gathergood, 2006).

Mortgage equity withdrawal	
Last time sales	After sale, the house is released from the housing market. This could occur place after divorce, emigration, death or if someone sells a second home.
Trading down	Homeowner sells the house and buys one at a cheaper price.
Over mortgaging	Homeowner takes a greater mortgage than needed when buying the home
Re-mortgaging	Homeowner increases outstanding mortgage debt.
Further advances	Draw-down facilities on flexible mortgages or 2nd mortgages.
Equity release schemes	Older homeowners that can take out a mortgage and is not required to make regular capital repayments.

Table 2: Ways to realise housing capital gains (J. Smith, 2005).

2.2.2.3 Wealth effects among renters

The efficient market hypothesis (EMH) assumes that asset prices fully reflect all available information and therefore no arbitrage opportunities should exist. Theoretically, rent prices should be driven by the same underlying market forces that drives house prices and therefore individuals should be indifferent between owing and renting their homes (Glaeser & Gyourko, 2007), since a change in house prices should result in a proportional change in the cost of rental housing. Under the no arbitrage condition, one can hypothesise what the wealth effect should be for renters, following a permanent house price increase. The budget constraint among renters will be even lower than for constrained owners, as renters do not hold any house equity.

Compared to the baseline framework (p.16-17), the total income and substitution effect for renters can be summarised by the following two points:

1) A house price appreciation encourages renters to substitute away from housing consumption to consumption of other goods as they are relatively cheaper, this cause a negative substitution effect.
2) Given no arbitrage, an increase in house prices will be reflected in rent prices, which lowers the purchasing power among renters, this results in a negative income effect.

Considering the baseline application, the rent effect offsets parts of the positive wealth effect among homeowners. The magnitude of the rent effects depends on the size and the function of the rental market; the role of the private rent sector and the corresponding wealth effect, linked to house price fluctuations, is expected to be more moderate, the more regulated the rental market is. This limits the sensitivity of the rental market to house price dynamics and therefore also the hypothetical income and substitution effects on consumption (Maclennan, Muellbauer & Stephens, 1998).

One should note that some renters are prospective homeowners, who save up to invest in a home. Since housing wealth can be a fraction of the household's precautionary savings[28], a rise in house prices means that the need to hold other sources of wealth as precautionary savings decline. These other forms of wealth are thereby freed and can be allocated to consumer spending. Empirical research has shown that the magnitude of the precautionary savings effect depends on the level of future uncertainty about the economic outlook, all else equal, the greater the uncertainty, the greater is the savings effect (Benito et al., 2006). However, the aggregate impact from such effect depends on the relative fraction of owners to non-owners and the level of development in the mortgage market. A more developed mortgage system, ceteris paribus, means that there is greater opportunity to obtain external finance, resulting in a lower savings effect. The positive savings effect for households planning to purchase a home is greater in countries with high down-payment requirements or with a poorly developed mortgage system (Kennedy & Andersen, 1994; J. Muellbauer & Lattimore, 1995).

2.3 Residential investment theory

Most literature has acknowledged the housing market's impact on the real economy through its effect on consumption. A more modest number of papers have focused on how the housing market transmits to the real economy though its impact on residential investment. House price increases (decreases) makes investment in new dwellings more (less) profitable for construction firms, under the assumption that the

[28] Precautionary savings refer to savings related to future uncertainty.

house price increase is not coupled with an increase in cost of inputs to production of new dwellings. This concept has formally been termed Tobin's Q of residential investment or Tobin's Q of new dwellings, after its originator James Tobin who coined the term in 1969 and later suggested that it could be applied equally well in the housing context (Fettig, 1996).

2.3.1 The Q-theory of investment

The Q-theory of investment can be viewed as the equivalent to a static neoclassical investment model with instalment costs. The q shows the relationship between a firm's capital and its replacement value; in other words, the market value of new additional investments to their replacement cost. Hence, q is the market value of a unit of capital (Hayashi, 1982). The basic theory rest on some key assumptions about the economy and its actors; it is costly for firms to adjust their capital stock, there are no uncertainty about future profitability and the discount factor (Romer, 2012). Moreover, q encapsulates all information about the future relevant for the investment decision and therefore firms can base their investment decision solely on q. Average q is, as defined by Romer (2012) "*the ratio total value of the firm to the replacement cost of its total capital stock*" (p. 414), but given diminishing returns the firm should care about marginal q rather than average q, that is the marginal value of a unit of capital to its replacement cost. However, under a special case, where the returns to adjustment costs are constant, average q equals marginal q (Hayashi, 1982). This scenario has proved particularly useful when testing the Q-theory empirically, as it has turned out to be tedious, if not impossible, to find accurate data to estimate marginal q.

2.3.2 The Q-theory of new dwellings

The Q-theory of new dwellings stems from a combination of traditional Q-investment theory and the empirical observations of the positive correlation between house prices and the level of construction. As in the Q-theory, the rate of investment is determined by the marginal value of a unit of capital to its marginal replacement cost. Assuming a homogenous housing market, then when q is above 1, the market value is greater than the replacement cost and the upward pressure on demand makes the investment decision profitable (Berg & Berger, 2005). The Q-theory of residential investments has proved empirically valid by among others Takala and Tuomala (1990), Jud and Winkler (2003), Grimes and Aitken (2006) and Grimes (2007)[29]. In the Swedish context, the Q-theory has been tested by Jaffe (1994) Barot (2006) and Berg and Berger (2005), who all find support for Tobin's Q as a useful predictor of housing investments.

[29] Empirically, house prices' impact on housing investment has been measured by examining variables such as housing starts, building permits, housing expenditures investment and gross investment.

If housing investment decisions are myopic one can model them as any other investment decision. Nevertheless, the durability of housing makes the investment rate relatively lower to that in other capital markets. Households move between existing homes to a much greater extent than they move to newly built dwelling. Thus, the importance of the existing housing stock makes the short run elasticity of housing supply low. In this set-up, the existing housing stock acts as a major determinant of prices of new housing and ultimately investments in new dwellings (Jud & Winkler, 2003). Housing investment adjust slowly, meaning that the marginal revenue from housing investment is lower than the interest rate, if house prices increase from a monetary demand shock for instance. The marginal revenue from housing investments and the interest rate will only be equal when the desired and actual housing stock corresponds. In the Tobin's Q context, the delays in the housing investment process brings a positive correlation between the ratio of marginal revenue from new capital to the rental price of capital to investment, thus q provides an indication of the "market climate" for housing investments. The relationship to the real rental cost of housing can be viewed as a function of the replacement house price adjusted for the interest rate and depreciation. (Takala & Tuomala, 1990).

Altogether, housing investment can be viewed as a function of current prices, expectations about future profits and the interest rate. The Q-theory allows expectations to be part of the neoclassical cost of capital approach to house prices. Nevertheless, the theoretical appeal diminishes when taking the underlying assumption into account, i.e. perfect capital markets, a competitive market environment where firms are price takers, and symmetric taxes across investors. If one only are to address the short-run fluctuations in the housing stock demand shifts are solely captured by the variation in house prices, whereas the price is the exogenous determinant of investments. Due to the important role of the existing housing stock, the price must adjust to make the demand side equate. The price adjustment is not immediate, thus the lags in the price adjustment process will generate the positive response in the investment level. In such set-up, given that the efficient market hypothesis holds, current prices embody all the necessary information for the investment decision to take place and thus the change in the house price index can be viewed as a reasonable proxy for profitable investments (Takala & Tuomala, 1990).

2.4 The housing market and financial stability

2.4.1 Financial (in)stability and its theoretical roots

The main theoretical building blocks of financial stability has emerged from cyclical and monetarist theory. The monetarist approach suggests that financial instability will not arise unless there is an initial alteration of the money supply and in their view, monetary policy is the root cause of financial instability. On the contrary, earlier cyclical theorist claimed that irrationality and disequilibrium behaviour of economic actors

was the reason for financial instability, with little or no microeconomic support for their arguments. In the 1990s the original building blocks of financial (in)stability were complimented by the ideas of credit market frictions, game theory and economies of decision-making (Crockett, 1996).

This section will draw upon the theories behind credit market friction to create a fundamental understanding for the housing market's role in the principal-agent dilemma. Thus, some of the theoretical mechanisms discussed in the consumption section, related to information asymmetries and the borrower's balance sheet are still valid. Nonetheless, the borrower's balance sheet is not enough to fully comprehend financial stability. In addition, one needs to consider the supply side of credit, i.e. the bank's balance sheet and the bank's lending channel. Those two aspects focus on the lender's financial status, which potentially affects the liquidity of the financial system (Iacoviello & Minetti, 2008). Altogether, these three transmitters (borrower's balance sheet, lender's balance sheet and the bank lending channel) have mutually reinforcing effects affecting the functioning of the financial system. Therefore, the first part of this section seeks to provide a more comprehensive view of the role of financial institutions in the information asymmetry problem, and how the lender's balance sheet and its interaction with the borrower is important to understand how the housing market can cause financial instability.

2.4.2 Asymmetric information and the role of banks and financial intermediaries

The collateral channel has illustrated how housing can act as a guarantee in the mortgage contract to mitigate information asymmetries between borrowers and lenders under normal economic circumstances. Nevertheless, under some scenarios these agency issues might become more severe, causing financial instability. Mishkin (1991) defines a financial crisis as *"a disruption to financial markets in which adverse selection and moral hazard problems become much worse, so that financial markets are unable to efficiently channel funds to those who has the most productive investment opportunities*" (p.1). Thus, the housing market does not only have the power to mitigate the agency dilemma, but could also worsen the adverse selection[30] and the moral hazard problem[31], and ceteris paribus, increase the cost of external finance and erode confidence among actors in the financial markets. At its worst, there will be no point where lenders and borrowers are willing to come together, and confidence in the whole financial system falls (Stiglitz & Weiss, 1981). Under more normal circumstances, adverse selection can result in a 'flight to quality', meaning that borrowers with the relatively weaker balance sheet will face problems obtaining external finance first (Bernanke et al., 1999).

[30] Occurs when one part has more information than the other party and there is a risk that, for example, a lender enters a mortgage contract that is worse than expected (Ambrose, Conklin, & Yoshida, 2014, p.3).
[31] "*Refers to the risk that one side to a contract has incentives to engage in activities that might cause harm or loss to the other party*" (Ambrose et al., 2014, p.4).

In the housing context, the collateral value also affects the banks' balance sheet. Since mortgage debt constitutes a great fraction of total lending, house prices play an important role to explain bank's profitability and vulnerability. Thus, a house price correction can pose a direct threat to the bank's balance sheet when the collateral no longer work as a security against the borrower's default risk (Kiss & Vadas, 2006). If credit institutions' solvency is at stake investments become more uncertain, meaning that there is a greater risk that funding will be withdrawn, which could fuel a vicious cycle, where the financial system suffers from liquidity constraints. Ultimately this could cause severe disruption to the financial system and real economic activity, as a reduction in supply of bank lending effects both consumption and investments adversely (Jansson & Persson, 2011).

Furthermore, the bank's balance sheet can be understood as the other side of the borrower's balance sheet, meaning that households liabilities constitute an asset on the lender's balance sheet. Considering the MTM; in times of expansionary monetary policy, lower short-term rates increase the bank's net profit margin. At the same time, lower short-term rates boost asset prices, which also boost the bank's asset and capital ratio. Ceteris paribus, this gives the bank more room to lend to constrained owners, resulting in an increase in aggregate demand**.** On the contrary, a monetary contraction would mean a lower net worth among banks and a lower collateral among borrower's, which increases the information asymmetry problem. As borrower's default risk increases, it also puts the profitability and liquidity of the financial intermediaries at stake. Thus, a house price correction pose a direct threat to the bank's balance sheet when the collateral no longer work as a security against the borrowers' default risk (Kiss & Vadas, 2006).

Moreover, banks' capital levels are commonly indirectly affected by housing market conditions through the balance sheet. The first mechanism is the same as the one previously described; a decline in asset values result in a reduction of the value of the bank's or any other financial intermediary's portfolio of loans, as well as a reduction in credit quality, due to the greater default risk of borrowers. Also, a decline in the bank's asset values commonly coincide with an erosion of capital, which further reduces credit supply. To remain liquid, banks commonly tries to restore their capital to asset ratio by reducing their own asset and one way of doing so is by restricting lending (Kiss & Vadas, 2006). The scarcity of lending commonly hit the most constrained borrowers first, this is the flight to quality argument, which results in a cutback on consumer spending (Boivin et al., 2010)

In addition, the overall resilience of the financial system is affected by the bank's lending channel, which is determined by the level of reservable demand deposits. The bank lending channel can be understood as the effect on the availability of loanable funds in the banking sector. Any change in the money base affects the availability of loanable funds; for example, a monetary contraction results in lower bank reserves. This has a

depressing impact on both firms and households, as both of them are dependent on credit to consume and invest, thus resulting in a fall in aggregate spending (Kuttner & Mosser, 2002). Under such scenario, the user cost of housing services increase, and all else equal demand for housing falls, and ultimately also house prices. In light of the agency problem, the idea is that the greater the quantity of bank reserves and deposits, the greater is the potential to lend to credit constraint consumers, which results in a positive effect on aggregate demand (Boivin et al., 2010).

Research has suggested that the relative sensitivity of the financial system to potential housing market shocks are correlated with institutional and structural factors, which differs across countries (IMF, 2011a). Kiyotaki and Moore (1995) were among the first who sought to explain the dynamic interdependence between housing market and credit market conditions, as well as its propagating mechanisms. Empirical studies have shown that real estate markets tend to exuberate credit cycles: Iacoviello and Minetti (2008) suggest that *"housing is particularly exposes to the credit channel"* (p. 71). The idea is that shocks to households' and firms' net worth have a pro-cyclical effect on their debt capacity, either because the cost differential between internal and external finance moves inversely with the economic cycle, or because the value of the collateralised asset determines the risk premium, or both (Almeida, Campello, & Liu, 2005).

Some consensus has emerged around common features of the mortgage market, both in terms of competition, funding, restrictions on lending and degree of liberalisation, which tends amplify the housing market's impact on the credit channels discussed above. More developed mortgage market does not only increase the correlation between the housing market and consumption, but also makes the housing market's role in the financial system more pronounced. There are numerous of empirical factors that can be used as a proxy for a more developed mortgage system, such as the down-payment rate (LTV), the mortgage repayment rate (amortisation rate) and the mortgage interest rate structure (fixed vs. floating) (Calza, Monacelli, & Stracca, 2006).

2.5 Building the analytical propositions

As stated in the methodology, this thesis will conduct a theory fitting case study, to address the first research question. The previous theoretical sections presented insights and fundamental concepts through which one can analyse the housing market's transmission mechanism on the real economy and financial stability. These analytical concepts have been used to formulate propositions, which will guide the analysis.

2.5.1 Private consumption

The wealth effect

Theory and earlier empirical studies on the consumption channel suggest that the housing wealth effect is ambiguous and that certain structural factors can affect its relative magnitude. To investigate this further, the LCH-PIH facilitates a fundamental understanding for the link between a change in house prices and consumption. More specially, short-term consumption theory helps one grasp how temporarily consumption fluctuation might be the result of changes in housing wealth, while the LCH-PIH suggests that the lifetime consumption decision only should respond to long-term house appreciations, conditional on that the house price appreciation is perceived as permanent opposed to temporary. Moreover, the wealth elasticity of consumption implies that the net worth of wealth depends on the potential asymmetry between homeowners and non-owners: the positive wealth effects among homeowners, could be offset by negative income and substitution effects among renters. Altogether this gives rise to proposition 1:

Proposition 1: *Supported by the existence (nonexistence) of a permanent growth in house prices, a positive (negative) wealth effect lead to higher (lower) consumption. This effect is more pronounced (vague) the higher (lower) the homeowner-to-renter ratio is.*

Collateral and rent wealth effects

Theory of rational consumer choice builds a foundation to study the collateral and rent effect at a micro level. By comparing the basic model assuming no market friction, with an extended version, allowing for information asymmetries and market imperfections, one can analyse how market (il)liquidity hypothetically has an impact on the collateral wealth effect, due to income and substitution effects among constrained owners. Additionally, the no arbitrage condition between house prices and rental prices should theoretically affect the income and substitution effect among renters and prospective homeowners. Overall, this lends support for proposition 2 and 3:

Proposition 2: *A house price appreciation (depreciation) results in negative (positive) income and substitution effects for constrained homeowners. This effect is greater (smaller) if markets are relatively illiquid (liquid).*

Proposition 3: *Considering a house price appreciation (depreciation), the positive (negative) wealth effect on aggregate consumption could be offset by the negative (positive) income and substitution effects among renters and prospective homeowners.*

The interest rate effect

Potential changes in the short-term official policy rate has direct effects on variable mortgage rates and thereby households' monthly cash flows. Hypothetically, one should expect that households adjust consumption to their monthly cash flow streams, which lends support for proposition 4:

Proposition 4: *A larger (smaller) share of variable mortgage contracts results in a greater (lower) sensitivity of households' monthly cash flows to interest rate fluctuations.*

2.5.2 Residential investment

The Q-theory of new dwellings facilitates an understanding for how residential investments respond to house price changes, which ultimately affects the real economy. Through the lenses of the Q-theory, proposition 5 follows:

Proposition 5*: An increase (decrease) in house prices will lead to a rise (fall) in the Q-ratio of residential investments, resulting in more (less) investments in new dwellings.*

2.5.3 Financial stability

Building upon the information asymmetry problem between borrowers and lenders, the final part of the analytical framework will address some aspects identified as important empirical factors, which affect the housing market's transmission mechanism on financial stability. In light of the second part of this thesis, which empirically sets out to test the impact from the LTV, the interest rate and amortisation requirement, proposition 6A, 6B and 6C pursue to create a fundamental understanding for how certain characteristics of the mortgage market and its actors affect financial stability. Thus, the theoretical backbone is complimented by the characteristics of a more developed mortgage market, will guide the assessment of the relative sensitivity of households and banks to house price fluctuations, by addressing the following propositions:

Proposition 6A: *The higher (lower) the average LTV ratio, the greater (lower) is the sensitivity of the borrower's and bank's balance sheet to fluctuation in house values.*

Proposition 6B: *The greater (lower) the ratio of floating to fixed mortgages, the greater (lower) is the sensitivity of the borrower's cash flow streams and the bank's revenue streams to policy rate changes, which increases (decreases) the financial market's sensitivity to the housing cycle.*

Proposition 6C: *Longer (shorter) maturities and low (high) amortisation rates increases (decreases) the financial market's sensitivity to the housing cycle.*

The propositions presented above will guide subsequent chapter, presenting evidence on the housing market's transmission mechanism in Sweden.

3.0 Evidence of the housing market's transmission mechanism in Sweden

This chapter will apply the analytical framework presented in previous chapter to address the first research question: *What is the housing market's transmission mechanism on the real economy and financial stability.* Supported by the conceptual foundation, this chapter is divided into the following three sub-chapters: 1) private consumption, 2) residential investment and 3) financial stability. Each part will be guided by the propositions outlined in the analytical framework to investigate to what extent the case, Sweden, fits the analytical concepts, while considering relevant structural and institutional factors.

3.1 Part 1A: The housing wealth effects and private consumption

3.1.1 The wealth effect

Long-term positive house price growth and a high share of homeowners strengthens the wealth effect

This section studies the house price development in light of proposition 1:

Supported by the existence (nonexistence) of a permanent growth in house prices, a positive (negative) wealth effect lead to higher (lower) consumption. This effect is more pronounced (vague) the higher (lower) the homeowner-to-renter ratio is.

The house price development has followed a positive trend since the mid-1990s, apart from a modest stagnation around the financial crisis in 2008-2009 (Turk, 2015). From 2009 to 2016, the real house price index (HPI) grew by 43 % and in the capital, Stockholm, corresponding number was 59 %. From chart 2 one can see that in the 1980s real house prices followed a typical boom-bust cycle. In the early 1990s they dropped quite drastically, mainly because of the Swedish banking crisis, which fuelled an economic recession during the subsequent years. Among other factors, market uncertainty resulted in a rather extensive decline in demand for housing and mortgages after the crisis, which kept house prices relatively lower until 1996 (Barot & Yang, 1998). During the past two decades, house prices have almost doubled and today's growth rate exceeds the total average across OECD countries (Finansinspektionen, 2017; Riksgälden, 2015), whereas apartments have experienced the greatest price appreciation (The Economist, 2015b).

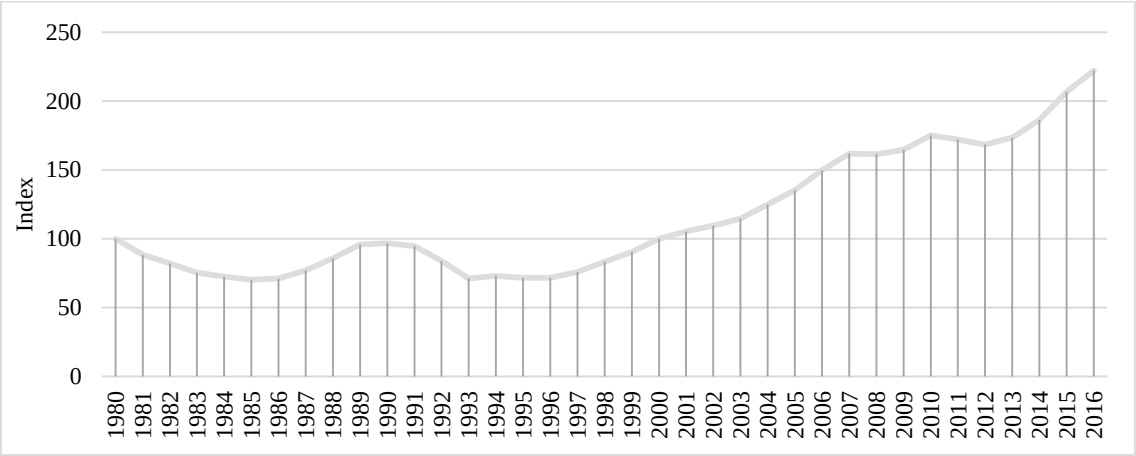

Chart 2 : Development of the Swedish real HPI, 1980-2016 (Base=1980). Source: Datastream and own calculations.

In general, the housing market carries some characteristics which makes it reasonable to expect a rather high degree of predictability of its price development: Transaction costs are commonly higher than in other asset markets and combined with backward looking expectations, this can result in a relatively large serial correlation in house prices over time (Davis, Fic, & Karim, 2011). In other words, house price cycles tend to be relatively longer than the general business cycle (Drehmann, Borio, & Tsatsaronis, 2012) and most studies show that house prices tend to follow a long run positive trend (Agnello & Schuknecht, 2009; Genesove & Mayer, 2001).

In light of proposition 1, a permanent house price appreciation should theoretically yield a higher lifetime consumption among homeowners. The positive and persistent trend in Swedish house prices lends support for the housing wealth effect. However, this evidence is not enough to determine the magnitude of the observed increase in home equity on aggregate consumption, since the positive wealth effect on consumption among homeowners, could hypothetically be levelled out by the negative income and substitution effects among renters. Therefore, one would expect a stronger aggregate wealth effect if owning a house is a relatively more common than renting one. The total homeownership rate reached 70.6 % in 2016, where only a small fraction (7.2 %) were homeowners without mortgages or housing loans, while the share of renters at that time was 29,4 % (see chart 3). Thus, the higher share of homeowners compared to renters lends theoretical support for a higher aggregate wealth effect, which supports the latter part of proposition 1. This is consistent with earlier research in the Swedish market, suggesting that MPC out of housing wealth is positive in both the long and the short run [32].

[32]Chen (2006) examines the housing wealth's impact on aggregate household consumption in Sweden (1980-2004), and find that there is a statistically significant relationship between aggregate consumption, disposable income and housing wealth. Almost all

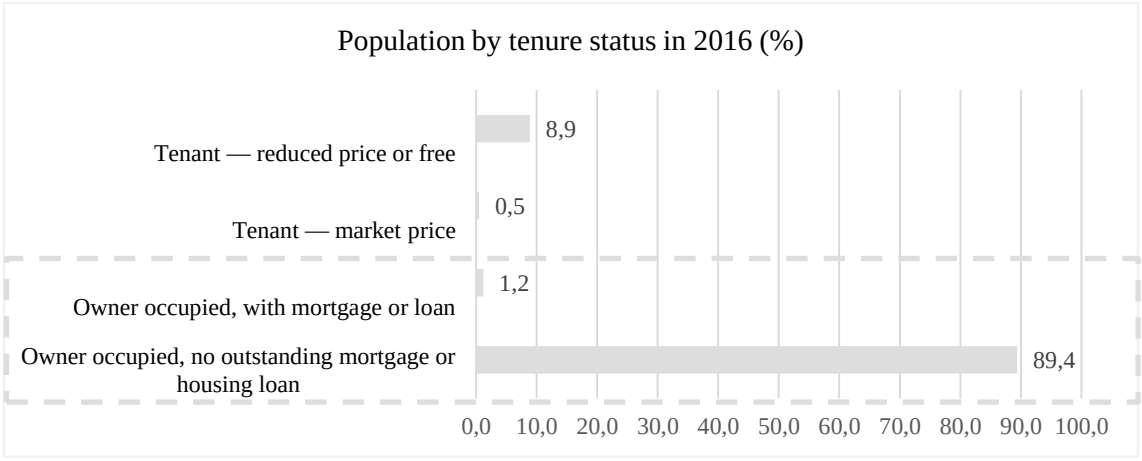

Chart 3: Distribution of population by tenure status (%) (Statistics Sweden, 2017b).

The relatively large fraction of homeowners can partly be explained by alterations in the tax system, including real estate taxes. The tax system underwent a major reform in the early 1990s to address the, at that time, tax non-neutrality[33]. Nevertheless, since then the property tax system has undergone gradual changes, resulting in new biases, which arguably increases the demand for housing and housing debt. Some of the main changes have occurred during the 2000s: First, both the property inheritance tax and the property wealth tax were abandon. Then, in 2008 the property tax (at that time 1 % for houses and 0.4 % for apartments) was replaced with an annual property charge of 0.75 % of the rateable value, or max 7412 SEK. Corresponding charge is 0.3 % for apartments, at a maximum of 1268 SEK[34] (Englund, 2016; Skatteverket, 2017).

In addition, the cap which limits the maximum property charge payment means that around 50 % of households pay a property fee independent of the actual value of their home. Secondly, mortgage interest payments are tax deductible, which creates an incentive to hold mortgage debt relative to other type of debt and lowers the after-tax user cost of housing (Englund, 2016). Overall, the property tax system supports homeownership[35], which hypothetically strengthens the wealth effect and thereby lends support for proposition 1. However, what must not be forgotten is that the aggregate wealth effect largely rest on the assumption that people do not have any borrowing constraints and can trade houses as any other asset, to realise capital gains from a potential price appreciation, which ultimately results in a higher level of consumer spending. Next section will study this a bit closer in the Swedish context.

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movements in consumption are permanent and the MPC out of housing wealth is estimated to be 0.056. Johnsson and Kaplan (1999) find that the long run MPC of net housing stock is 0.04 when using data from 1970-1998 in Sweden.

[33] The principles of tax neutrality suggests that "*decisions should be made on their economic merits and not for tax reasons*" (Furman, 2008, p.1)

[34] See Appendix 3 for a an overview of Swedish property taxes.

[35] Traditionally, it has been in the best interest of policymakers to incentivise homeownership as it supports the welfare state (Holmqvist & Turner, 2013)

Transaction costs creates a disincentive to trade

As revealed in previous chapter, there are numerous ways to realise housing wealth, for example by trading or re-mortgaging. Considering the trading possibilities, the property tax system has been critiqued for creating lock-in effects, which creates a disincentive for homeowners to trade their homes and thereby offsets part of the potential wealth effect on consumer spending. Prior to 1991 capital gains were taxed at 50 % or more; today the tax rate is flat at 22 % and tax payments can be deferred (Skatteverket, 2017). Though, the overall capital gains tax has fallen, the property capital gains tax is constant at 22 % independent of the relative length of the tenure, which can be compared to other Nordic countries, where the capital gains tax on real estate drops to 0 % after a couple of year (Bergendahl, Hjeds Löfmark, & Lind, 2015). Both the capital gains tax and interest levied on deferred capital gains could create greater disincentives to move (Fiscal Policy council).

Moreover, housing differs from other financial assets such as stocks, in a sense the average homeowner does not solely view his home as an investment good, but rather an important source of wellbeing (Benito et al., 2006; S. J. Smith & Beverley, 2010). Furthermore, trades in the housing market involves relatively higher transaction costs than in other asset market (Englund, 2011), which offers a natural explanation to the low turnover (Davis et al., 2011). Altogether, taxes, transaction costs and housing role as source of wellbeing, suggest that the aggregate wealth effect from house trading on private consumption, will be lower than what the baseline theoretical framework suggested.

3.1.2 The collateral wealth effect

A liberalised credit market reinforces the collateral channel

While the section above investigated the effects from long-lasting positive growth in house prices, coupled with structural factors that promote homeownership, this section will go beyond the 'pure' wealth effect to consider the collateral wealth effect. Proposition 2 will guide the following two sections:

A house price appreciation (depreciation) results in negative (positive) income and substitution effects for constrained homeowners. This effect is greater (smaller) if markets are relatively illiquid (liquid).

Alike most developed markets, the Swedish credit market has undergone structural changes and has become more liberalised since the mid-1980s. Among others, the increase in competition among Mortgage Financial

Institutions (MFI[36]), has made the average mortgage loan cheaper. Before the deregulation banks were bound to issue long term mortgages with fixed interest rates. However, today banks have a much greater freedom to govern their terms of mortgage lending, which has resulted in more innovative mortgage products and a greater fraction of variable mortgages. Moreover, the mortgage holder is free to choose between different types of interest rates, ranging from a 3-months variable rate to a fixed rate, which is determined for five years or more [37] (Turk, 2015). All else equal, this suggests that today's credit market environment has made it easier for the constrained homeowner to utilise the housing collateral to obtain better terms and lower cost of external finance, which theoretically promotes greater consumer spending.

Agency theory suggest that the housing market's role in the principal-agent relationship should be relatively strong, given that most homeowners take on mortgage debt to finance their homes in the first place (see chart 4 below). Chart 3 suggests that 64 % of the total population are homeowners with loans or mortgages, while only 7 % of the total population own a house without any loans or mortgages. Relative to other countries, a greater fraction of homeowners depend on housing credit to afford their home (Statistics Sweden, 2017b), which suggests that credit constraints are prevalent. The high dependence on mortgages suggests that the information asymmetry between borrowers and lenders is more sensitive to the housing cycle.

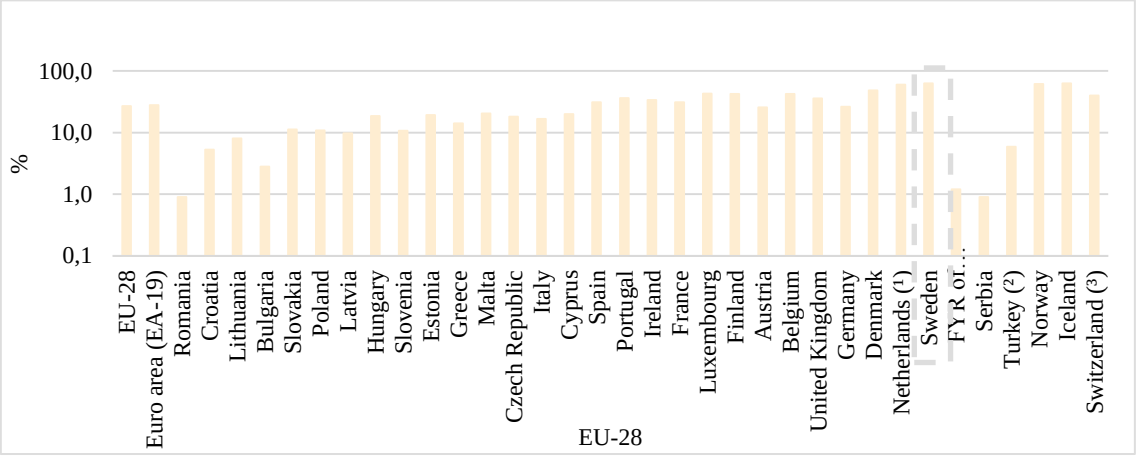


Chart 4: Share of total population with mortgage or other loan (%), EU-28 (Statistics Sweden, 2017b).

Today property is both private homeowners' largest asset and mortgage debt their largest liability (Turk, 2015). Recent numbers show that the total number of mortgages is at a historically high level. In January 2017, 82 % of financial institutions' lending to households constituted mortgage lending, while 5 % was consumption loans backed by property and the remaining 13 % was backed by other securities than housing. Additionally, during the past two decades the volume of mortgages have grown almost twice as fast as the

[36] Banks, mortgage institutions, financial companies, municipals and corporate financed institutions, monetary securities companies and monetary investment funds (money market funds) (Riksbank, 2017b).
[37] The implications of the mortgage structure will be further analysed in the interest rate and financial stability section.

nominal GDP (Andersson & Jonung, 2016). This suggests that the magnitude of the collateral effect has grown stronger supported by the volume of mortgage debt. As expected, chart 5 shows that housing backed lending has a lower external financing cost.

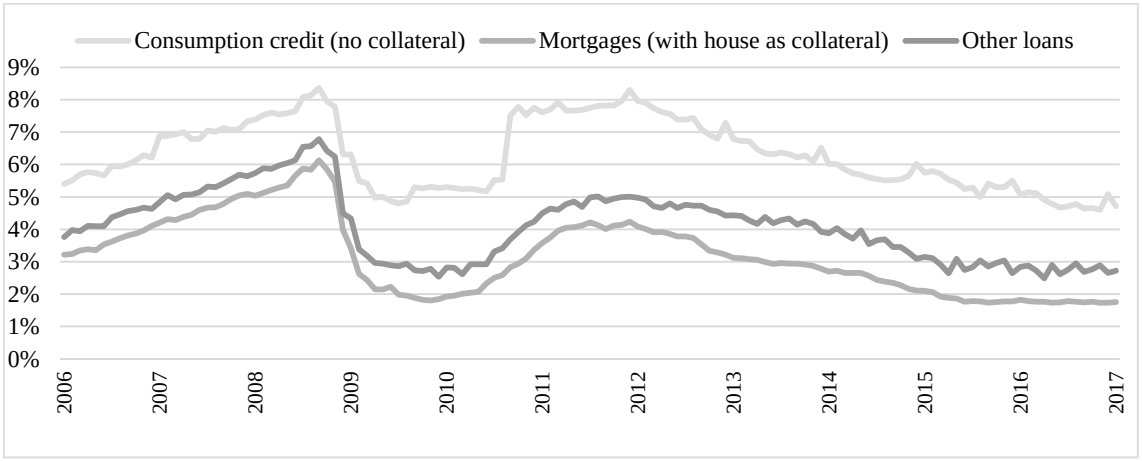


Chart 5: Development of MFI's average borrowing per purpose (%) (Statistics Sweden, 2017a).

The high dependence on housing debt and the lower cost of mortgage debt should not in itself result in greater consumer spending, unless the credit constrained borrower can exploit the housing collateral to refinance new debt. The latter suggests that the relative importance of the collateral effect on consumption in any given market largely depends on the degree of credit market liberalisation. Supported by previous research[38], one would expect that greater credit market deregulation has resulted in a greater opportunity for mortgage equity withdrawal (MEW). In the Swedish context, the credit market liberalisation process has been coupled with technical advances, which ultimately made credit conditions more flexible and generous for both lenders and borrowers[39] (Burgert, D´Souza, & Vermeulen, 2016).

Furthermore, homeowners can extract secondary mortgages, which gives them an opportunity to take on additional debt using the house as a collateral and this is a form of MEW. Before 1985, refinancing through secondary mortgages using housing as collateral,, was only possible through commercial banks, while today other mortgage institutions and ordinary banks are permitted to do so (Turner, 1997). The relative allocation of the loan between the first and the second mortgage differs depending on the individual bank's requirements. Apart from the relative size of the housing collateral, these two types of mortgages are associated with different risks, whereas the secondary mortgage inherently is considered riskier, which yields a higher cost (Finansinspektionen, 2016; Turk, 2015). Theoretically, the opportunity to extract secondary mortgages lends support for market liquidity, which thereby indicates that the substitution and income effect

[38] See Greenspan and Kennedy (2008).
[39] Walentin and Sellin (2010) suggest that this relationship holds true in the Swedish context, arguing that at least 20 % of homeowners are credit constrained. Through a DSGE calibration they show that the housing market has a strong impact on other macroeconomic variables.

should be positive among constrained homeowners following a rise in house prices, opposite to in the illiquid market discussed in previous chapter.

In light of proposition 2, this section indicates that the collateral effect has grown more important due to: 1) the relatively large fraction of homeowners with debt secured by housing and 2) credit market liberalisation has increased liquidity and the flexibility of both lenders and borrowers, suggesting that credit constrained borrowers will find it easier to take advantage of housing wealth to increase consumer spending. Nevertheless, the evolution of the mortgage market has also increased the sensitivity of both borrowers and lenders to the housing cycle, this will be investigated in greater detail in the financial stability section.

The LTV limit and the amortisation requirement weakens the collateral channel

Despite that the credit market is substantially more liberalised today than 20 years ago, the GFC and the US subprime mortgage crisis, has resulted in that several developed markets have started to impose regulation in the mortgage sector to limit the potentially dangerous growth in lending. The LTV limit, also called the mortgage cap, introduced in 2010 and the amortisation requirement in 2016 are examples of such regulation. The LTV limit puts an upper limit to the maximum level of housing credit that can be obtained from the first and second mortgage, which implies that the two loans are not allowed to surpass the 85 % limit. Consequently, the household must finance the remaining part with its own capital or backed by a collateral secured by another asset (Riksbank, 2014). The amortisation requirement entails that the mortgage holder must amortise 2 % of the loan up until the top loan is paid off, and then 1 % per annum until the outstanding amount is repaid. Both the LTV and he amortisation requirement only applies to new loans, while the latter only restricts the maturity of loans with an LTV above 50 % (Hull, 2015).

The introduction of the LTV limit and the amortisation requirement has somewhat tightened credit conditions, which suggest that it is slightly more difficult for credit constrained homeowners to extract equity from secondary mortgages. Furthermore, the amortisation requirement force mortgage holders to prioritise repayment of their debt to a greater extent than before, which theoretically should result in a negative substitution effect, meaning a decline in consumption to repay debt. Hypothetically, this offsets parts of the total positive collateral wealth effect on consumer spending. Nevertheless, the collective effect from the macroprudential measures taken so far is only expected to affect the aggregate collateral effect modestly, since the mortgage cap still is above the average Swedish households' LTV (67%) (Finansinspektionen, 2015b) and the amortisation requirement only applies to new mortgages (Finansinspektionen, 2015a). Moreover, the introduction of the LTV limit has resulted in that banks have started to provide unsecured loans instead. These unsecured loans, so called Blanco loans, do not require any collateral.

Considering proposition 2, most empirical evidence, such as the growth in MEWs and the strong dependence on mortgage debts, lends support for a strong collateral wealth effect. In line with previous research, one would expect that some of the latest macroprudential rules might offset part of the aggregate effect on consumption for the most constrained owners[40].

3.1.3 The rent wealth effect

Countervailing forces largely offsets the rent wealth effect

While previous sections have studied the relative magnitude of the wealth effect from the homeowner's perspective, this section will consider the housing market's impact on renters' consumer spending. More specifically, it sets out to investigate proposition 3:

Considering a house price appreciation (depreciation), the positive (negative) wealth effect on aggregate consumption could be offset by the negative (positive) income and substitution effects among renters and prospective homeowners.

If house prices appreciate, rent prices should by the no arbitrage condition increase proportionally. This results in a negative income effect, due to a fall in purchasing power, as well as negative substitution effect, as housing consumption becomes relatively more expensive to other consumption. The relative proportion of homeowners (70 %) to renters (30 %) suggests that the aggregate importance of the rent effect should be rather small. Secondly, if one examines the distribution of renters a bit more carefully, the proportion of renters to owners varies across the bigger metropolitan areas, i.e. Stockholm, Gothenburg and Malmo, and the smaller cities. While it is hard to draw any absolute conclusions, the urban areas seem to be more affected by the hypothetical rent effect. Moreover, the fraction of people accommodating rental housing is to the greater degree the younger and the older generation; more than half of the Swedish citizens between 25-34 and nearly 50 % of the population above 85 rent their homes. Thus, from a demographical perspective, the younger and the elderly generations would be the ones worse off considering the negative income and substitution effect, given a house price appreciation.

[40] This is consistent with Walentin (2014) findings in the Swedish market, where an increase in the LTV from 85% to 95% cause a 26 % increase in aggregate consumption.

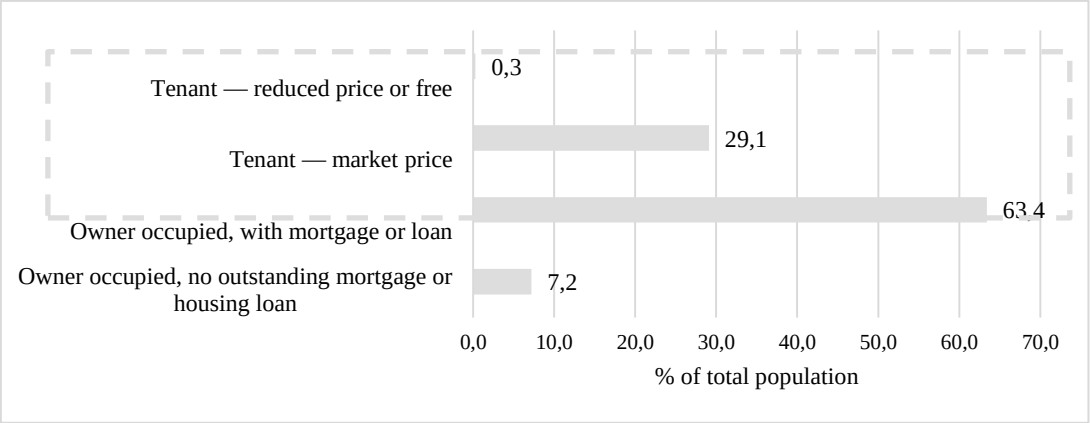


Chart 6: Distribution of population by tenure status 2015, (%) (Statistics Sweden, 2017b).

Nevertheless, the income and substitution argument presented above only holds true under the assumption of an efficient rental market, meaning that rental price levels respond proportionally to house price changes and no arbitrage opportunities exist. Empirical data shows that the rental price level is well below equilibrium due to rent controls, which impose an upper limit on rental prices. This creates a disincentive for construction firms to build new rental apartments despite high demand (Hüfner & Lundsgaard, 2007; Lind, 2003). To address this problem, presumption rents have been introduced, meaning that landlords are allowed to charge higher rents for newly built dwellings, while keeping the rents on existing buildings low (SABO, 2013). From a theoretical point of view, rent controls may have an offsetting effect on the negative income and substitution effects, that otherwise would have prevailed given the long-lasting observed house price appreciation.

Another well-recognised distortion, being a result of the rent controls is that it creates an incentive for tenants and renters to re-sublet their apartments on the black market. One could argue that the black market resembles an efficient rental market, as the rental level tracks the house price development in the owner-occupied market more closely. Considering the rent effect, this has a diminishing effect on consumption if it means renters must spend a greater fraction of potential consumption on their relatively high "black market rent". Though it is difficult to quantify the number of unauthorised leases the Swedish National Board of Housing and the Swedish Property Federation estimate that they have increased, leading to substantial market distortions in terms of mobility and housing shortage (Eklund, 2014). Evidently it is difficult to gain a fair idea of the actual magnitude of the rent effects in terms of its overall impact on consumer spending.

Another factor worth considering is the savings effect across the group of renters that are prospective homeowners, meaning that they are currently saving for the down-payment to buy a home. Considering a house price increase, one would expect that this group substitute a relatively larger fraction of their current consumption to savings, at least if they expect the positive price trend to last. However, considering today's

low interest rate climate, the spread between the lending and deposit rate has dropped from 2,6 % to 2 % (IMF, 2016), and the general drop in savings rate over the past years has created a disincentive for the average households to deposit their money in a savings account at any given level of risk aversion. Moreover, if the prospective homeowner expects that interest rate, will remain low, he also expects a lower user cost of future housing which might offset parts of the negative substitution effect from higher savings on consumer spending among prospective homeowners.

Overall, two contrarious structural factors make it difficult to evaluate the overall strength of the rent effect; rent controls mitigate the negative income and substitution effects, while the black market reinforces them. Moreover, the general house price increase should theoretically result in a negative substitution effect across prospective homeowners. Nevertheless, this might be partly offset by the low interest rate environment and relatively low down-payments[41]. Altogether, these structural factors largely offset the hypothesised negative income and substitution effects among savers and renters, thus the aggregate impact on consumer spending is expected to be rather small.

3.1.4 The interest rate effect

The low interest rate climate and interest tax deductibility support a positive interest rate effect

Previous sections considered the housing market's impact on wealth, collateral and rent effects, as well as their implication for consumer spending. This section turns to the interest rate effect, which both has a direct impact on house prices and mortgage interest payments. This section will focus on the latter and be guided by proposition 4:

A larger (smaller) share of variable mortgage contracts results in a greater (lower) sensitivity of households' monthly cash flows to interest rate fluctuations.

Previous two sections suggested that several structural factors have resulted in that a relatively large fraction of Swedes hold debt secured by housing and that the ratio of floating to fixed mortgages has increased. Ceteris paribus, this suggests that the average household's sensitivity to mortgage interest rate changes has increased. If interest rates remain low the dominance of variable mortgages should have a positive impact on consumer spending[42], as the monthly mortgage interest payments are relatively lower to those of a fixed contract.

[41] Chiuri and Jappelli (2003) suggest that the down-payment in Sweden is relatively low to many other European countries.
[42] One should be aware that this applies to all variable loans, but due to the limitations of this thesis, the focus here is solely on the effect through mortgages.

As a result of expansionary monetary policy, the mortgage interest rates for the various types of mortgage loans available to households have followed a decreasing trend from mid-2011 (Riksbank, 2017a). Without considering the agent's level of risk aversion, one would expect that the lower variable mortgage rate increases the incentive for households to take on variable rather than fixed mortgage debt. Given the relative increase in the volume of variable mortgages (illustrated in chart 7 below), the interest rate has grown more important, making consumption more sensitive to mortgage interest rate changes.

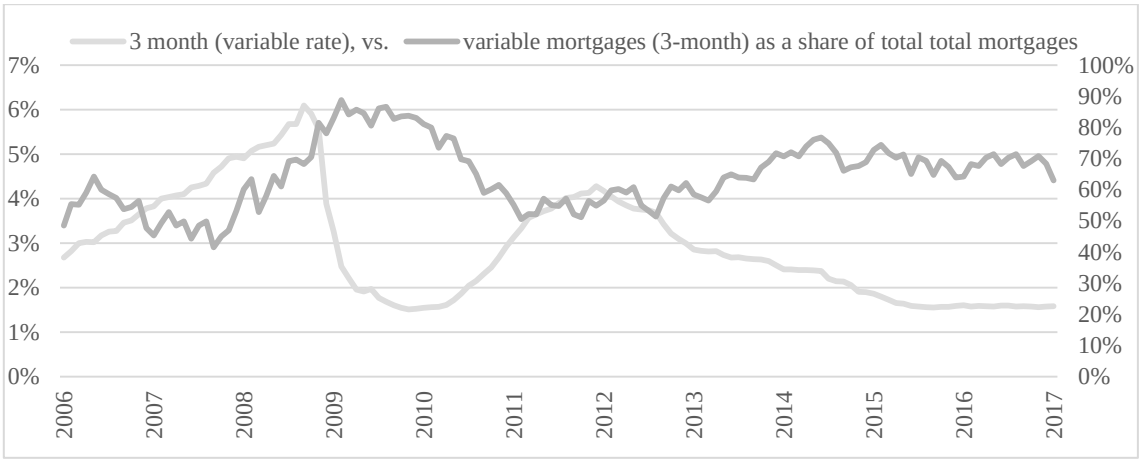


Chart 7: The development of the 3-month variable mortgage rate (left Y-axis) and its share of total mortgages (right Y-axis), 2007-2017 (Statistics, Sweden).

As expected, the development shows that the ratio of variable to fixed loans is sensitive to the mortgage rate (i.e. looking at the fall in the floating rate in 2009/2010 and the increase in the relative share of variable lending during the same period). The ratio of variable to total mortgages has been rather constant at around 60 % - 70 % (dark grey line) for the past five years, and so has the 3-month mortgage rate (light grey line). One can see that when the floating rate decreases, the demand for variable lending increases given the inverse relationship between the two. This is not unexpected, given that empirical evidence has shown that customers typical choose the one with the lowest cost (Burgert et al., 2016; The Swedish Banker's Association, 2016).

Furthermore, mortgage interest payments are tax deductible[43], meaning that homeowners have the right to get 30 % of their monthly mortgage interest payment in return. This monthly reimbursement, means that the average household can increase consumer spending. The higher the monthly mortgage interest payment is, the large the absolute value of the tax reimbursement. Considering the greater fraction of variable mortgage contracts, the average tax reimbursement from mortgage interest has fallen over time. Nevertheless, interest

[43] In fact, interest rate deductibility applies to all household loans, but since mortgage debt constitute the larger fraction of household debt it becomes more relevant to examine its impact in the housing context.

deductibility reduces the after-tax user cost of housing, as the effective mortgage rate paid declines and has combined with the low real interest rate, resulted in a negative after tax interest on mortgages (Englund, 2016). On the one hand, the welfare argument is that the tax interest relief promotes homeownership, which theoretically lends support for greater consumer expenditures. On the other hand, this it puts an upward pressure on the long-run house price level and household credit demand, which is worrisome for economic and financial stability.

Considering proposition 4, the combination of predominately variable mortgages, coupled with historically low interest rates, should have a positive impact on consumer spending. Nevertheless, this has increased households' sensitivity to interest rate variation, suggesting that future levels of consumer spending are more uncertain compared to under a predominately fixed mortgage regime. This is consistent with Walentin and Sellin's (2010) findings in the Swedish market, suggesting that the dominance of variable mortgage contracts propagates the role of housing in the MTM. Overall, the relatively greater proportion of variable mortgage contracts have strengthened the interest rate effect on the real economy. Moreover, the negative after tax interest on mortgages does not only create an incentive to take on housing debt, but also suggest that the tax reimbursement can be allocated to additional consumption.

3.2 Part 1B: The housing market and residential investments

While previous sections focused on the housing market's transmission mechanism on private consumption, this sub-chapter will focus on the housing markets impact on the real economy through residential investment. More precisely, it sets out to assess the incentives for construction firms to build new homes, by examining Tobin's Q of new dwelling. Theoretically, a positive Q-ratio should create an incentive for construction firms to build more homes, which lends support for proposition 5:

An increase (decrease) in house prices will lead to a rise (fall) in the Q-ratio of residential investments, resulting in more (less) investments in new dwellings.

A positive Q-ratio supports residential investments

The positive house price development observed during the past two decades should theoretically contribute to a positive development in the Q-ratio. Given constant costs ultimately cause an increase in residential investments. Data on the Q-ratio, generated by the Institute for Housing and Urban research (IBF) across Sweden, is only available up until 2010[44]. Nevertheless, it is reasonable to expect that the development of the

[44] IBF has been contacted to obtain updated estimates of the Q-ratio of residential investment, but these are no longer calculated.

Q-ratio has been relatively similar up until today, or even greater, given the development of house prices and construction costs displayed in chart 8 below.

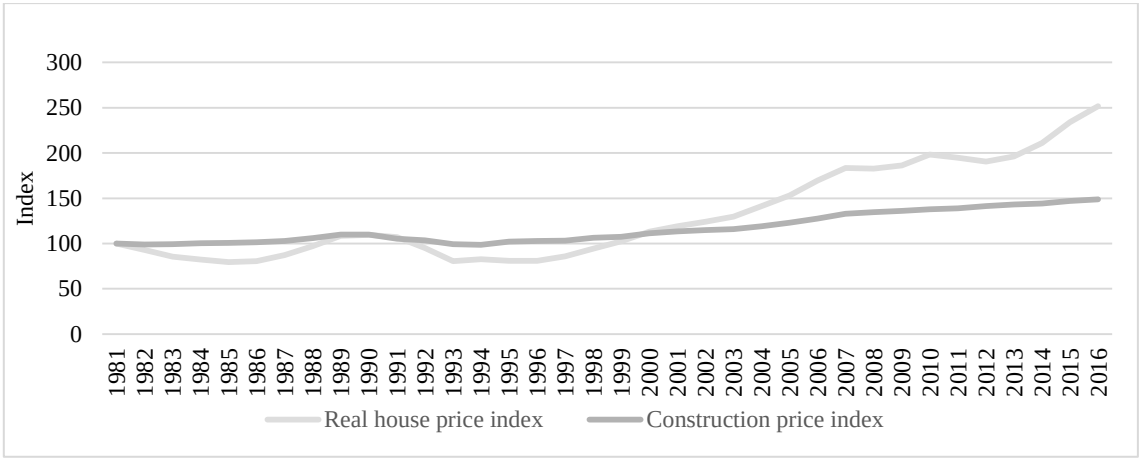


Chart 8: The development of the Swedish HPI and the Construction price index 1981-2016 (Base= 1981) (SCB, 2017).

Furthermore, the literature suggests that the construction sector in Sweden has become more liberal since the 1990s, and important deregulation during the past three years has resulted in greater competition (Konkurrensverket, 2015), which theoretically should put a downward pressure on construction costs and therefore have a positive impact on the Q-ratio. However, no such direct effects can be observed from the graphical representation of the development in the construction cost index over the past years. On the contrary, construction costs have followed a modestly increasing trend since the late 90s, however growing at a lower rate than the HPI.

Theoretically, an average positive Q-ratio suggests that there is sufficient incentive for construction firms to undertake residential investments, which lends support for proposition 5. Nevertheless, residential investment has empirically turned out to be rather sluggish during the past decade, as seen from chart 9 below. Therefore, some demographical and structural factors might provide evidence for offsetting mechanisms and variation in the overall importance of Q[45], these will be discussed next.

[45] Grimes and Aitken (2006) suggest that there are regional differences in the importance of Q in a study across New Zealand. Due to variation in regulation on house prices across regions responsiveness in supply to price changes varies, suggesting that supply elasticities are regional.

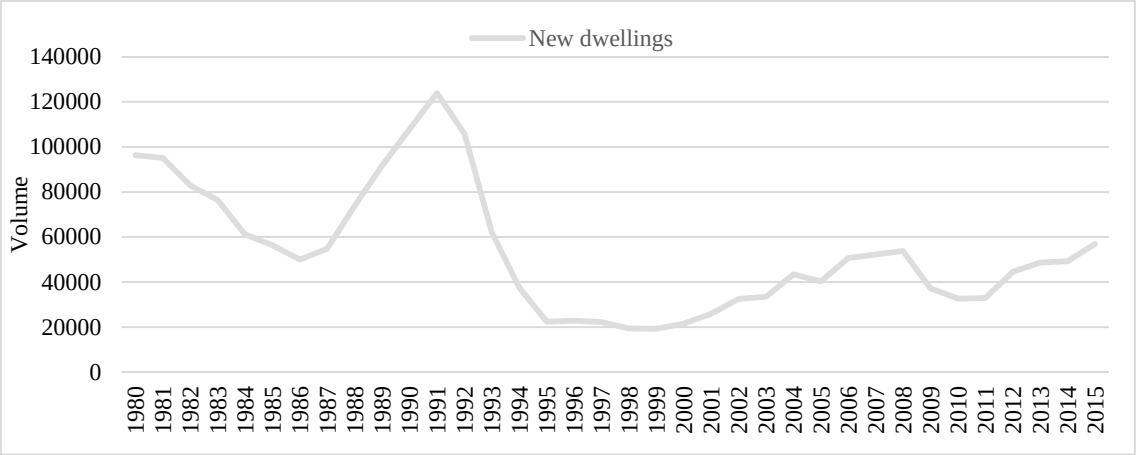


Chart 9: Change in construction volume of new dwellings, 1980-2015 (Statistics Sweden, 2017b).

Regional differences in the Q-ratio indicates why aggregate residential investment does not pick up

The IBF estimates did also examine the differences in the Q-ratio across all 290 Swedish municipalities, to find that the Q-ratio only was positive in 32 % of all municipalities. Though, this number has increased over time (Emanuelsson, 2015), the disaggregated variation in the Q-ratio offers a potential explanation to why aggregate residential investment is more sluggish then first expected.

MUNICIPALITY	Tobin's Q 2010	MUNICIPALITY	Tobin's Q 2010
Sundbyberg	2.79	Nacka	2.12
Solna	2.74	Båstad	1.92
Danderyd	2.50	Tanum	1.88
Lidingö	2.45	Vellinge	1.81
Sotenäs	2.21	Öckerö	1.81
Stockholm	2.14	Malmö	1.80

Table 3: Municipalities with the highest Q-ratios in Sweden, 2010 (Emanuelsson, 2015).

Given the average Q-ratios in table 3, it should theoretically be more desirable for construction firms to build new homes in metropolitan areas. Nevertheless, chart 10 illustrates that the annual percentage change of new residential construction is lower in these areas relative to the less densely populated ones. The graphical representation indicates that there appears to be other important structural factors, which must not be forgotten to explain the relatively low ratio of new construction in larger cities (Netzell, 2015).

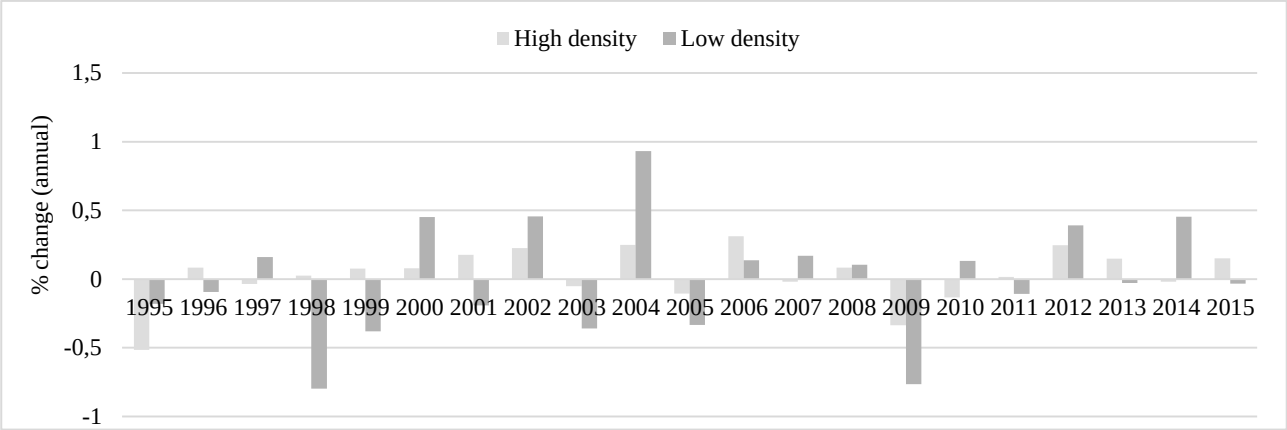


Chart 10: Annual change in new construction. High density vs. low density regions (%), 1995-2015 (Statistics Sweden, 2017c).

Scarcity of land puts a natural constraint to residential investments

As seen, construction appears to be most scarce in the urban regions where housing demand is greater. It has been particularly low in the regions around Stockholm, Gothenburg and Malmo, which is reflected in a lower number of completed new dwellings. Studies have shown that land constraints in more populated areas cause a fundamental increase in house prices, which is difficult to address through policy or regulation (Bergendahl et al., 2015). The scarcity of land put an upward pressure on land prices; if one allows land prices to enter the Q-ratio, higher land prices should theoretically put a downward pressure on the Q-ratio[46]. Nevertheless, most reports indicate that house prices has increased relatively more than land prices, suggesting that the Q-ratio should remain positive (Emanuelsson, 2015).

The disaggregate house price development up until today indicates that the incentives to undertake residential investment in the more densely populated areas should be greater than in other parts of Sweden. This can be seen by examining the development in HPI across five Swedish regions (see chart 11), where Stockholm, Skåne and Västra Götaland are the more densely populated ones and Västerbotten and Norrbotten are some of the least densely populated areas.

[46] Grimes (2007) suggest that including land prices in the Q-ratio improves its explanatory power.

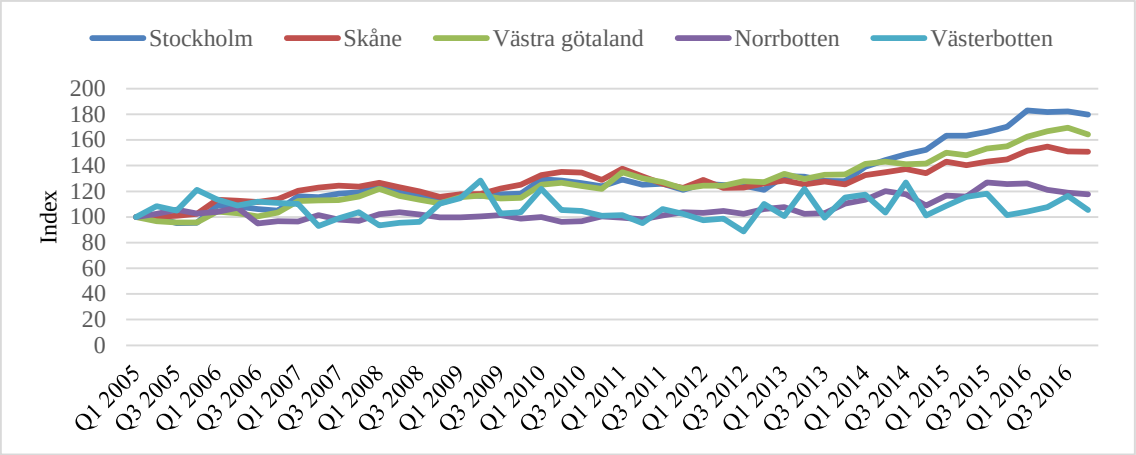


Chart 11: Real HPI per county, Q1 2005-Q3 2016, Base=Q1 2005 (Statistics Sweden, 2017d).

Nevertheless, chart 12 shows that residential investment has not been substantially different across more 'attractive' regions. This could partly be explained by the scarcity of land in urban areas, creating a real rigidity to the adjustment of the housing stock in those regions. Consequently, residential investment is potentially hindered by structural factors, which offset parts of the effect on the real economy from the greater Q-ratio in those regions.

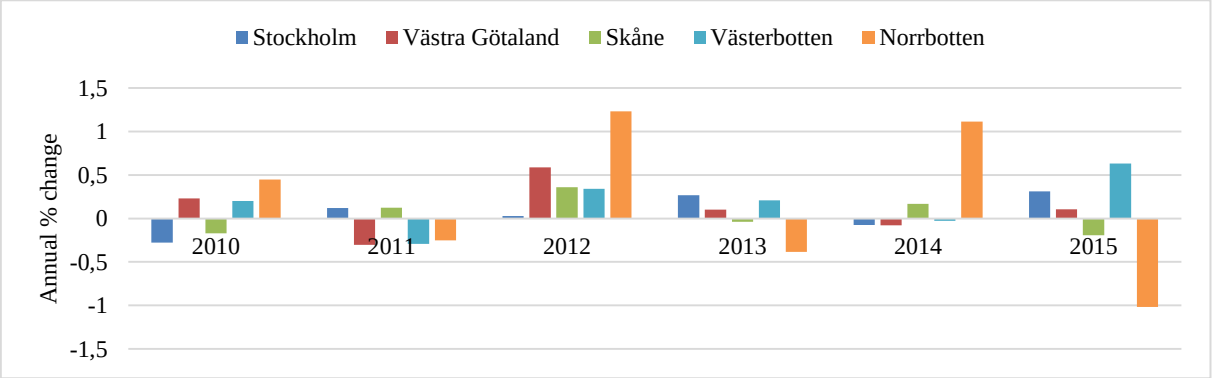


Chart 12: Annual change in new dwellings per county (%), 2010-2015 (Statistics Sweden, 2017c).

Nonetheless, a qualitative survey of the perceived housing shortage across municipalities showed that roughly 67 % experiences a scarcity in housing supply, which indicates that other factors than the regional differences in land availability also play a role to explain the perceived housing shortage (Eklund, 2014). The variation across regions suggests that it would be fruitful to examine the role of regulation and the market actors in the construction sector in greater detail to potentially provide a richer explanation to why investment in new dwelling has not evolved as the Q-theory predicts. Therefore, the next three sections will explain some important structural factors.

Offsetting factors

Due to the municipalities planning and zoning monopoly, the construction sector is potentially best understood from a regional perspective. Through the monopoly, the municipalities have the right to restrict the distribution of land, despite a perceived housing shortage. This has potential adverse consequences for the speed of the construction process since, the individual municipality might have an incentive to smooth its income streams by promoting a slow and even construction process. In other instances, they might consider it necessary to hinder new construction projects, due to its adverse impact on existing homes or green areas (Bergendahl et al., 2015).

The total construction procedure accounting for planning, zoning, final approval and development is rather lengthy and involves several regulatory steps, which thereby increases the risks and costs for the construction firms involved (Lind, 2003). Moreover, the costs of building new dwellings are relatively high compared to average European country, but relatively similar to most neighbouring Nordic countries. This can be explained by environmental and planning regulation, for instance, construction firms must comply with noise, pollution and handicap requirements (Emanuelsson, 2015). In some instances, the total construction process is even longer than the suggested standards, because the municipalities rarely impose any sanctions on the construction firms if the development process is delayed beyond the five-year development threshold. Legally, the planned construction should take place within five years after the permission to develop the land has been granted, but since there are no consequences of not doing so the construction firms sometimes have an incentive to wait (Konkurrensverket, 2015). In all, this contributes to a sluggish construction process even in municipalities where the Q-ratio theoretically should be above 1.

Moreover, the municipalities also have the power to grant construction firms the right to build new homes on the land they assigned. This process varies across municipalities; in some instances, the municipality simply grant the construction allowance to a single building company and thereby restricts free market competition. In other instance the municipality compares different building offers and construction plans. Other times they sell or auction the land, allowing for competition between the construction companies. To directly assign the right to one construction company saves the municipalities some costs involved with the auction or comparison process and gives the individual construction firms incentives to generate more innovative and technical advanced bids in the first place. Nevertheless, it comes at the cost of greater entry barriers for new actors and the role of relationship-building between the construction companies and the local authorities might play a deceive role in the process, ultimately putting a downward pressure on competition (Konkurrensverket, 2015).

The differences across counties implies that some firms potentially face a higher construction cost due to the additional effort to build a good relationship with the local municipality. Tough, the cost of relationship-building can be viewed as a sunk cost, it might, together with the risk involved with the long planning time, force some smaller player off the market. This challenges the applicability of the Q-theory in the first place. First, the uncertainty of both future revenue streams and the future discount rate, which might arise due to increases in the policy rate, pose a threat to the underlying assumption of the Q-theory. Thus, one can argue that the Q-ratio does not encapsulate all necessary information for the firm to undertake the investment decision. Also, since marginal q or average q does not take sunk costs into account, they might not be adequate indicators to explain residential investment.

In the Swedish Competition Authority's report from 2015, several municipalities report that some of the land, which has been allocated to new dwellings, remains unbuilt. One potential explanation could be the conflict of interest between manufactures and the municipalities; whereas the local authorities might want to increase the proportion of population in the less densely populated areas, while construction firms want to secure their future income streams and avoid building on land where the expected profitability is lower due to greater uncertainty about future demand (Konkurrensverket, 2015).

Despite that the housing construction sector historically has been characterized by a relatively low number of large market actors, the current level of competition should not be viewed as exceptionally low (Bergendahl et al., 2015; Konkurrensverket, 2015). This suggests that the overall number of market actors should not be the main explanation to the observed sluggish construction. Nevertheless, a closer examination reveals that the actual number of market players involved in the individual building process is lower than what the total statistics indicates. This is because municipalities commonly have a disincentive to involve several players in a construction project.

Even though the municipalities have the ultimate responsibility for the planning procedure, it is not uncommon that the larger construction firms contribute to this process, as it requires both a lot of time and resources. This potentially skews competition as the construction firm that has been most involved with the planning process has a greater chance of obtaining the right to build upon the land. Secondly, the municipalities tend to dispense the right to larger construction projects to the firm with the most technical advanced solutions, resulting in that the more established market actors frequently are the ones with sufficient resources to live up to these requirements (Konkurrensverket, 2015). Once one constructor has been granted the sole right to a land area, there is little or no incentive to rush the construction process as the construction firm, alike the municipality, might have an incentive to smooth income (Bergendahl et al., 2015).

Due to various structural factors, the net effect from residential investment on the real economy from a hypothetical positive Q-ratio is expected to be moderately positive. The empirical evidence suggest that these structural factors are mainly a result of regional differences in land availability and regulation. The scarcity of land in urban areas, the lengthy total construction process and the interplay between the actors involved offer a potential explanation to the short-run sluggishness in supply. Theoretically, this puts an upward pressure on house prices to equate supply and demand. As seen from the consumption section, higher asset prices have a positive impact on consumption, through the wealth and collateral effect. Hence, the residential investment effect on the aggregate economy might be due to the consumption channel. Also, it must not be forgotten that the expected residential investment effect on is expected to be rather modest, given that new housing is a small fraction of existing housing stock (Takala & Tuomala, 1990).

Moreover, the sluggishness in supply has potential adverse consequences for the labour market due to poor housing market mobility. This cause longer average recruitment times and potentially delays planned investments (Eklund, 2014). Finally, one should note that empirical applications of the Q-approach, in the housing market, has been critiqued for its reliance on some questionable assumptions, i.e. information efficient housing markets and that the average q equals marginal q. Thus its empirical relevance appears questionable despite that (Berg & Berger, 2005) argue that these assumptions hold reasonable well in the Swedish context.

3.3 Part 1C: The Swedish housing market's impact on financial stability

While previous two sections examined the housing market's impact on private consumption and residential investment, this third and final sub-chapter will examine the links between the Swedish housing market and financial stability. The relative importance of housing in the business cycle largely depends on the vulnerability of the financial system, which is affected by both borrowers and lenders. Given the shared risk between mortgage holders and mortgage providers, i.e. mortgage loans are banks' assets and borrowers' liabilities, information asymmetries provide the fundamental understanding for how the housing market potentially can cause disruptions to the financial system in the first place.

This section investigates the mortgage market characteristics that have proved more important to potentially propagate the theoretical link between the housing market and financial stability i.e. the loan-to-value ratio, the mortgage structure and the maturity of mortgage. Given the vital role of financial stability to assure macroeconomic soundness, the relative importance of these factors will be considered in light of structural and institutional features that might alter the housing market's transmission mechanism on financial stability. On that note, the first three sections will be guided by proposition 6A, 6B and 6C, outlined in the analytical

framework. The final two sections will study some structural and institutional factors that affects the overall resilience of the financial system to housing market fluctuations.

A high average LTV increases borrowers' and lenders' sensitivity to house price changes

The higher the LTV, the greater is the risk that the borrower can find it difficult to repay its debt, given a house price correction. In other words, any decline in the home value becomes relativly larger when the intial value of the housing collateral is lower. Thus, the LTV is a useful indicator of the level of vulnerability of households to a change in house prices. Furthermore, the high LTV-ratio suggest that there is a relative low level of risk sharing between mortgage holders and mortgage issuers, as banks bear a comparably greater fraction of the total risks. On that note, subsequent section will be guided by proposition 6A:

The higher (lower) the average LTV ratio, the greater (lower) is the sensitivity of the borrower's and bank's balance sheet to fluctuation in house values.

The average LTV in Sweden has been rather stable (around 65 %) during the past five years (Finansinspektionen, 2017), this correponds to the graphical reprensentation in chart 13 below. As one can see, the annually average LTV ratio increased between 2011 to 2015, to then experience a modest dip between 2014 and 2016. Moreover, if one looks at the relative distribution of different groups of LTV's in chart 14 below, the greatest proportion of lenders are on the 'high-debt' end. Altogether, the relatively stable and high average LTV level makes borrowers' more sensitive to house price fluctuations.

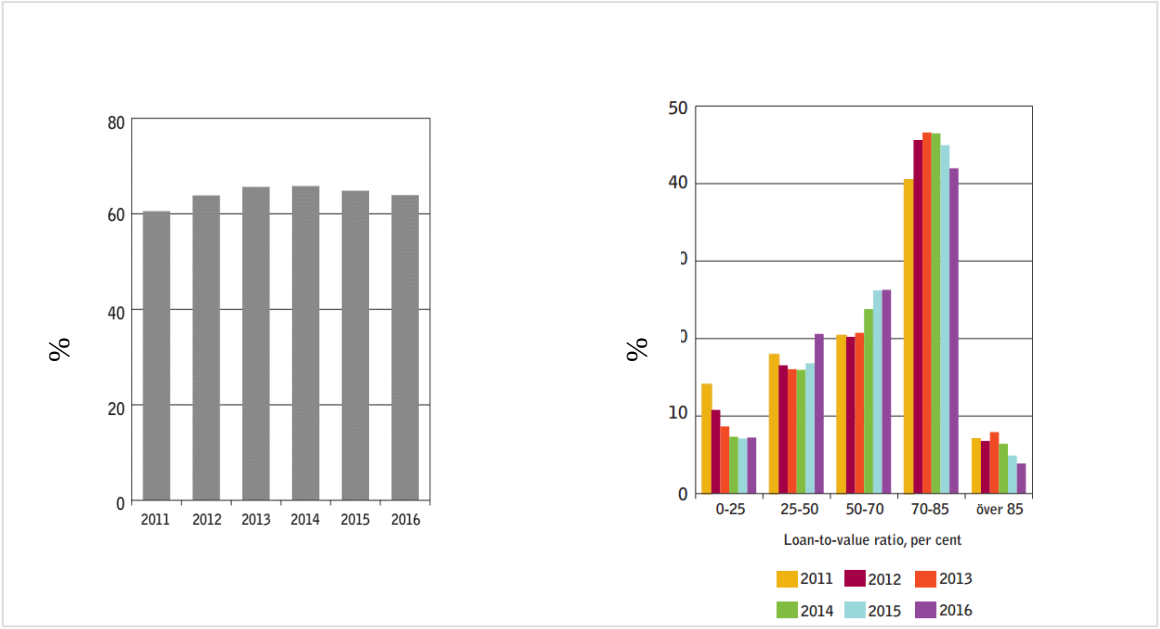


Chart 13 (left): National Average LTV (%), 2011-2016 (Finansinspektionen, 2017).

Chart 14 (Right): Distribution (from 0-25% to above 85 %) of the LTV , 2011-2016 (Finansinspektionen, 2017).

Under such scenario, the loan remains constant, but the reduction in the housing value cause a fall in the asset side of the borrower's balance sheet, which increases the LTV-ratio. If households end up in a situation where the size of their debt is larger than the size of their assets, there is a risk that these borrowers find it hard to pay interest and amortisation, thus they could potentially default on their mortgages (Hull, 2015). This risk is inherently greater among households with higher LTVs. However, if homeowners unexpectedly lose confidence in the housing market a sudden house price correction could result in a dramatic fall in the price level, resulting in a scenario where information asymmetries substantially lowers credit supply and ultimately also economic activity (Crockett, 1996). Theoretically, a more 'normal' drop in house prices suggest that the more heavily indebted borrowers would have to lower consumption, due to an increase in external financing costs and/or worse terms of lending.

In light of proposition 6A, the theoretical importance of both the borrower's balance sheet and lender's balance sheet grows stronger in a 'high LTV environment'. Given the presence of the financial accelerator, households become more sensitive to monetary demand shocks, which can be summarised as *"the impact of shocks to household income on house prices is amplified by the higher marginal opportunity to borrow associated with a high loan-to-value ratio"* (Almeida et al., 2005, p. 2). Considering the agency problem, one would expect that a higher LTV worsens the moral hazard problem, i.e. it should theoretically result in risker behaviour among households with higher LTVs. Following a drop in house prices, the potential default risk among borrowers put banks' liquid at risk. The decline in constrained borrowers' credit standing could hinder new lending. A consequence is that these households might be removed from the pool of potential homebuyers, which thereby puts a downward pressure on house prices, which lowers the collateral value and thereby worsening both the bank's and the borrower's balance sheet (Abrahams & Zhang, 2009; IMF, 2011a).

Variable mortgages increase the sensitivity of the financial system

The relative ratio of variable to fixed mortgages makes borrowers' more sensitive to future changes in the policy rate and thus increases the uncertainty about future repayment abilities (Abrahams & Zhang, 2009). Research suggests that the relative dominance of variable mortgages in any given market will affect both the interest rate channel and the balance sheet channel; a mortgage regime dominated by floating loan will inherently be more sensitive to exogenous interest rate shocks, resulting in greater effects on aggregate demand (Rubio, 2009, 2016). The hypothesised increase in uncertainty about the borrower's future repayment ability suggest that the information asymmetry problem becomes relatively more sensitive to the housing market:

The greater (lower) the ratio of floating to fixed mortgages, the greater (lower) is the sensitivity of the borrower's cash flow streams and the bank's revenue streams to policy rate changes, which increases (decreases) the financial market's sensitivity to the housing cycle.

Due to the liberalisation of financial markets, mortgage contracts with variable rates have increased by approximately 60 % over the past 20 years, while loans with a fixed mortgage rate has dropped from around 20 % to 3 % during the same period (Holmberg, Janzén, Oscarius, Van Santen, & Spector, 2015). The section on the interest rate effect revealed that the majority of Swedish households hold variable mortgages and cross-country studies suggest that the level of variable mortgages in Sweden is relatively greater to a number of comparable markets (Giuliodori, 2005). Variable rate loans affect household finances more quickly that fixed ones; thus, households have less time to adjust to credit market conditions, compared to if the mortgage rate would be fixed (Jansson & Persson, 2011). As the mortgage holders' monthly payments grow relatively more sensitive to fluctuations in the mortgage rate, it also makes banks' future revenue streams more uncertain (Holmberg et al., 2015; OECD, 2017b).

Theoretically, increasing uncertainty about the future quality of the borrower should worsen the information asymmetries between borrowers and lenders. The aggregate impact is related to two effects; first, a greater ratio of floating mortgages result in a greater cash flow effect related to the monthly mortgage interest payments. The second effect relates to the relative value of the collateral; a mortgage holder will experience a greater fall in the value of their collateral, as their overall demand for housing is reduced, which theoretically occurs due to the interest rate effect. Altogether, these two effects are mutually reinforcing, which further increases the information asymmetry problem and, ceteris paribus, increases the cost of external finance. Considering proposition 6B, this suggests that relative sensitivity of the financial system to housing market cycles has increased since the 1990s.

Long maturities increase the sensitivity of the financial system

Similar to the increase in uncertainty from a pre-dominantly variable mortgage structure, longer maturities and a low amortisation rate should theoretically increase the uncertainty about borrower's repayment capabilities (Riksbank, 2011). All else equal, longer maturities imply that borrower's future repayment abilities are more insecure given that the general economic conditions are increasingly difficult to predict. This also increases the uncertainty among financial intermediaries with regards to their future profitability and liquidity, which supports proposition 6C:

Longer (shorter) maturities and low (high) amortisation rates increases (decreases) the financial market's sensitivity to the housing cycle.

At first glance, the amortisation rate of Swedish mortgages appears worrisome as most contracts have been characterised by very long maturities of around 50 years and slow repayment rates (The European Commission, 2017). Following the implementation of the amortisation requirement in June 2016, new loans needs to be repaid within 30 years. Before 2016 Sweden had, in contrast to several other OECD countries, a voluntary amortisation system, which resulted in that mortgage loans not always were fully repaid. At that time, mortgage holders only needed to amortise up until they had reached the LTV limit, then only the monthly interest payment was binding. The main objective of the amortisation rule was *"to reduce demand for housing and subsequently housing indebtedness"* (Hull, 2015, p. 3). In other words, it is another mean to achieve the same goal as intended by introducing the LTV limit; to reduce housing related credit demand.

In their latest report from 2017, FI notes that the pay-back rate of mortgages has improved and from 2015 to 2016, the average monthly pay-back amount increased by 48 %, which could be due to the announcement of the amortisation requirement[47]. In light of proposition 6C, the long maturities make actors in the financial market more vulnerable to general economic conditions. These could be related to the housing market, but does not necessarily have to be so. However, the structure of mortgage contracts, i.e. long maturities, suggest that the housing market indeed makes the information asymmetry problem more sensitive to business cycles.

Nevertheless, neither the LTV, the variable mortgages, nor the amortisation requirement, should be viewed in isolation; the relative sensitive of households also depend on how large their loans are in comparison to their income levels, as this has an impact on their repayment abilities under various economic conditions. Therefore, it is worth looking at the development of the debt-to-income (DTI) ratio. If this ratio has fallen, borrowers' repayment abilities will be relatively stronger, which hypothetically could offset parts of the information asymmetry problem as the quality of the average borrower improves. However, chart 15 (below) shows that this is not the case as the total debt-to-income ratio for households with new mortgages has increased since 2011, suggesting that even though income has increased the debt level has increased even more rapidly.

[47] The EMH suggests that rational agents should react to information and adjust behavior accordingly.

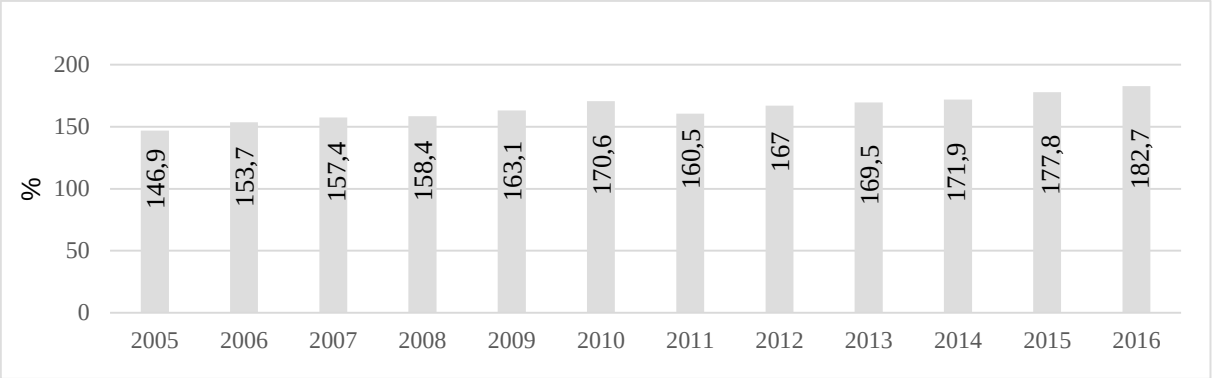


Chart 15: Household debt of net disposable income %, 2005-2016 (OECD, 2017a).

All else equal, this implies that homeowners with higher DTI are more vulnerable to income changes than those with a lower ratio (Finansinspektionen, 2015b), i.e. the mathematical logic is the same as for households with high LTVs. If one considers household consumption, a larger DTI results in that parts of income that could have been allocated to consumption for example, is spent on repaying debt (Finansinspektionen, 2016).

Altogether, the relative high average LTV level, the growth in floating rate mortgages and the relatively long amortisation periods, lends support for proposition 6A, 6B and 6C. These factors make the information asymmetries between borrowers and lenders relatively more dependent on the conditions in the housing market and thus increases the sensitivity of financial markets to the housing cycle. However, what must not be forgotten is that these prudential measures only apply to new mortgages, which suggests that it will take time before these limits the aggregate sensitivity of the financial market to the housing cycle. So far the analysis of financial stability has largely focused on structural factors that affect credit demand and mortgage market conditions, which directly affects borrowers and indirectly have an impact on mortgage providers. Nevertheless, to only examine three mortgage market characteristics would not be sufficient to fully assess the real vulnerability of the Swedish financial market to the housing cycle. To provide a holistic view, the next section turns to more implicitly examine the role of lenders and their sensitivity to housing market conditions.

Maturity mismatches create structural liquidity risks for banks

This section will illuminate some of the structural features of borrowers' mortgage contracts and indebtedness that make banks' liquidity more sensitive to the housing market. It will examine some factors affecting the interdependence between Monetary Financial Institutions (MFI) and the housing market that could pose a threat to the financial system and the real economy, as a reduction in supply of bank lending effects both consumption and investments adversely. First, since mortgage loans make up a relatively large share of MFI's asset side of the balance sheets, and given that most MFI's in Sweden are banks (Riksbank,

2014), this suggest that banks are strongly dependent on the conditions in the mortgage market. Compared to other sources of debt, mortgages secured by housing is by far the most common form of household lending across banks (82 % in 2016) and between 2013 and 2016 this ratio grew by 21 % (The Swedish Banker's Association, 2016).

Banks typically issue mortgages through so called covered bonds[48], these corresponds to approximately 70 % of mortgage lenders total mortgage funding. Currently there is a mismatch between the maturity of households' mortgages and the covered bonds. The leading Swedish banks have a much larger maturity mismatch (see table 4 below) than most European banks' average (Riksbank, 2016). The main reason for the mismatch, is that household's mortgages have a much longer maturity (Riksbank, 2016), compared to the substantially shorter average payback time for covered bonds of about three years. If households face financial distress and have difficulties to pay back their loans, these maturities could potentially result in a liquidity shortage among banks. One could argue that banks would be more resilient against the borrower's sensitivity to the housing market if they increased their relative fraction of other assets. Furthermore, the risks involved with a house price correction are magnified by the strong interlinkage between Swedish MFI's and foreign banks, especially in the Nordics. That means that asset price fluctuations do only have consequences for the Swedish financial system but, could also cause spillover effects across neighbouring countries (IMF, 2016; Sandström, Forsman, Stenkula, & Johanna, 2013).

	Average maturity-assets (year)	**Average maturity-liabilities (years)**	**Maturity mismatch (years)**
Nordea	10.3	3.4	6.9
SEB	10.1	3.1	7.0
Handelsbanken	14.8	3.7	11.1
Swedbank	15.5	3.7	11.7
Average European Banks	11.1	4.2	6.9

Table 4: Maturity mismatch the four largest mortgage provides in Sweden (Riksbank, 2016).
Note: *Average maturity for assets, liabilities and the difference between the two (maturity mismatch).*

Regulation improves the resilience of the financial system

Before banks fund mortgage loans, they are obliged to perform a credit assessment to determine if the household's income is sufficient to afford its monthly interest and amortisation payments (Riksbank, 2014). Moreover, banks have the right to take compulsory action, meaning the right to sell the property, if the borrower defaults (Englund, 2011; Riksbank, 2014). Also, the Debt Restructuring Act do not allow Swedish

[48] A common funding financing instrument for banks, where bonds are sold by investors to banks. The investors have the priority right to the collateral that is linked to the bond if the bank goes bankrupt (Sandström et al., 2013).

borrowers to go bankrupt to 'get rid' of their debt. This suggests that banks should be more confident that homeowners will repay their loans. Finally, the macroprudential initiatives taken so far have not only targeted credit demand, some of the rules have focused on credit suppliers' resilience by introducing risk weights on mortgages, counter-cyclical capital buffers, systemic risk buffers and stricter capital requirements for large banks (IMF, 2011a). See Appendix 2 for an exhaustive list of the macroprudential tools implemented in Sweden up until this date.

Altogether all of these factors should somewhat mitigate the bank's liquidity risks involved with mortgage lending and thus increase the trust in the financial system, which limits the risk of an escalation of the information asymmetry problem and a severe confidence given a drop in house prices. Nevertheless, the mismatch between the maturity of covered bonds and household's mortgages suggests that the bank's balance sheet potentially becomes more sensitive to the housing market. This lends further support for the important link between banks and borrower's balance sheet - together these two are mutually reinforcing, which potentially worsening the financial stability risks and the adverse consequences for the real economy given fluctuations in house prices.

3.4 Part conclusion

The evidence revealed that the housing market's transmission mechanism on private consumption mainly is expected to be driven by the collateral wealth effect[49]. Most empirical proof suggest that the collateral wealth effect mainly has grown in importance as a result of market liberalisation, which made it easier for credit constraint homeowners to extract housing equity through secondary mortgages. Moreover, the 'pure' wealth effect is expected to be moderately positive; it is supported by the persistent upward trend in house prices since the mid-1990s, coupled with the high rate of homeownership. Some inherent structural and institutional factors create lock-in effects, which makes it reasonable to expect that the aggregate wealth effect from housing trade on consumption, will be rather small. Evidence suggests that the anticipated negative rent effect is partly offset by the regulatory measures, which limits the overall rental market efficiency. Furthermore, the increase in variable mortgages combined with the low interest rate environment over the last years lends support for a positive interest rate effect on consumption.

Despite that earlier research have shown that the Q-ratio is a valid predictor of new dwellings, the empirical data shows no particular increase in construction activity. Instead the evidences suggest that a number of

[49] This is consistent with previous research arguing that collateral effect on consumption is more pronounced than that of aggregate wealth (Mishkin et al., 2007).

structural and institutional factors, such as regulation and land availability, most likely offset the theoretical effect from a positive Q-ratio. Overall, the empirical evidence suggests that the rather low level of residential investments will have a modest impact on the real economy and that residential investment is best understood at a regional level. The low level of residential investment in new dwellings pose some real challenges to the labour market and long-term economic growth, this will be one of the topics in the discussion chapter. Considering this thesis application of the Q-ratio, one should be careful to say too much about its relative strength, as the secondary data only spans up until 2010.

The evidence of the housing market's impact on financial stability has showed that it indeed poses a risk to the financial system given that most households use their homes to secure their debt. While mortgage market deregulation has had a positive impact on the collateral effect, similar mechanism has also increased the financial stability risk given the increase in variable mortgages and more innovative credit products, such as Blanco loans. Moreover, the housing market creates a strong interdependence between borrowers and lenders, which could amplify the information asymmetry problem and pose a risk to the confidence in the financial system, following a house price depreciation. Some of the regulatory measures taken to increase the resilience of banks and lower the demand for household credit has somewhat improved the financial systems ability to handle housing market fluctuations. Nevertheless, given the economic outlook and that a potential interest rate change might occur within the next year (Finansinspektionen, 2017), the proportion of variable mortgages does pose a threat to households' liquidity, which both effects consumer spending, but also their repayment capabilities and ultimately banks.

As stated in the methodology, the aim of this chapter has been to provide the reader with some novel insights on the Swedish housing market's role to affect some important economic variables, such as consumption and investments, as well as financial stability. The theory fitting case method has provided some useful insights to explain the housing market's transmission mechanism on real economy and financial stability. Howver, despite that the analytical framework has sought to bridge theoretical support with empirical findings, the statistical relationship between some of the proposed effects and the quantitative magnitude of the various structural factors have not been examined. Thus, one should acknowledge that the evidence put forward are subject to some underlying criticism related to its validity and the proposed relationships should at best be interpreted as correlations. Thus, this thesis cannot say anything about the causality of these relationship, other than draw support from previous research.

4.0 The efficiency of monetary and macroprudential policies in Sweden – A policy event study

The financial crisis in 2008-2009 has shed light on the question whether financial stability should be a complementary goal of conventional monetary policy. Economists have not fully agreed on whether financial stability is a compatible objective for the central bank alongside monetary policy, and some have suggested that macroprudential policy might be more appropriate to target financial stability. Woodford (2012) suggests that it is justifiable to use monetary policy to ensure financial stability when macroprudential policy cannot achieve that goal on its own. Furthermore, the former vice governor of the Riksbank, Leo Svensson (2012), suggests that macroprudential tools are more appropriate to target financial instability than the policy rate[50]. Thus, one of the main advantages of macroprudential policy is that it can be targeted at specific sectors of the economy (L. E. O. Svensson, 2012), while monetary policy, when used to address asset prices, might have unintended consequences for other sectors (Suh, 2012).

Previous research has showed that the role of both monetary and macroprudential policy to address financial stability is ambiguous and depends on the market specific context. In light of the current negative interest rate, the room for monetary policy to address financial stability is arguably limited. The evidence from 2010-2011, when the Riksbank tightened monetary policy to address house prices and curb credit growth, had severe consequences for the real economy. Svensson (2016) suggests that Sweden is a case in point, as this type of *'leaning against the wind'* policy came at a cost of disinflation and a high unemployment. He argues that this type of monetary policy has done nothing but increased the financial stability risks, as the average Swedish household's debt burden today is greater than if inflation would have been at its target level.

The consequences for the real economy in 2010-2011 suggests that Swedish policymakers need to address the housing and mortgage market with complementary tools, rather than solely relying on conventional monetary policy. Also, research indicates that the housing market's role to affect macroeconomic variables and financial stability is particularly strong when driven by a monetary shock (Bjørnland & Henning, 2010; Walentin, 2014). Moreover, in light of *Part 1*, evidence show that monetary policy has the power to alter house prices and thereby the balance sheet of both households and banks, which ultimately affects both the real economy and financial stability. Considering the scarcity of empirical research[51] on the effect from the LTV and the amortisation requirement in the Swedish context, the remainder of this thesis sets out to answer the following:

[50] This rest upon the Tinberg principle, which suggests that policymakers need one independent tool per policy objective (Carrillo, Mendoza, Nuguer, & Roldán-Peña, 2017).
[51] See Walentin (2014) for a DSGE calibration incorporating the LTV in the Swedish context.

Has monetary policy and other macroprudential tools mitigated house price fluctuations?

In light of earlier research, an econometric approach is considered most appropriate to quantify the impact of the LTV and policy rate change, as well as the amortisation requirement. The following propositions[52] will guide the analysis:

Proposition 1.A: *The LTV limit introduced in 2010 has mitigated house price growth in the subsequent periods after the policy change.*

Proposition 1.B: *The gradual policy rate increase from Q3 2010 to Q3 2011 has mitigated house price growth in the periods after the interest rate change*[53].

Proposition 2: *The announcement of the amortisation requirement in 2015 has mitigated house price growth in the subsequent periods after the policy announcement.*

Subsequent section describes the empirical method, the sample and the data, followed by the results section. The results will follow the ordering of the propositions; thus, it starts off with the LTV/interest rate effect, to then examine the amortisation requirement. The last results section seeks to disentangle the effect from the LTV and the interest rate. Finally, some limitations to the econometric method will be discussed.

4.1 The econometric method

To account for the trend in house price growth we employ a Synthetic Control Method (SCM) to test the effects of both the LTV limit and the amortisation requirement. First, we test these polices on both an aggregate and disaggregate level, by first examining the effect on the whole sample, to then divide the sample into two groups; one consisting of regions that are less densely populated, henceforth *Small Cities*, and one group containing the regions with the three largest cities (Stockholm, Gothenburg and Malmo), henceforth *Big Cities*. The rationale for dividing the sample into two sub-groups is because the empirical evidence from *Part 1* showed that different regions have experienced different development in house price growth.

[52] As the synthetic control method, does not involve any formal statistical significance test it is deemed most appropriate to label these propositions, as we will not be able to confirm or reject them by any formal test statistic.

[53] Several studies have proved that changes in the policy rate dampens house prices see Iacoviello (2005), Iacoviello and Neri (2010), Giuliodori (2005) and Goodhart and Hofmann (2008). Some have directly addressed the role of interest rates on Swedish house prices. Assenmacher-wesche and Gerlach (2008) finds a positive and statistically significant effect from a monetary policy shock on Swedish house prices. Likewise, Bjørnland & Henning, 2010 investigate the role of housing in the MTM to find that it has increased over time in Sweden. (Moreover, they find that house prices fall by approximately 1-2 % immediately after a contractionary monetary policy shock.)

Secondly, supported by previous literature on monetary policy we employ the Vector Autoregression (VAR) model (Sims, 1980), to detect the effect from the policy rate shock. Moreover, previous research in the Swedish context has shown that the interest rate does not only determine house prices, house prices also have an impact interest rates (Bjørnland & Henning, 2010). The VAR approach is appropriate to account for the simultaneity problem, as it allows all variables to be endogenous and multidimension (Lütkepohl, 2005). In our case the VAR[54] serves a slightly different purpose, namely to disentangle the effects from the LTV and the interest rate change. Thus, first we estimate the orthogonal impulse response functions, henceforth only called IRF, to approximate the effect of monetary changes on house prices[55]. Secondly, we use the IRF to anticipate the response in the house price index (HPI) to the policy rate changes in the post-treatment period, to then to compare that development with the treated and synthetic sample.

4.1.1 The synthetic control method (SCM)

To test hypotheses the propositions this thesis employs the synthetic control method, henceforth SCM, developed by Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010). The SCM is a form for counterfactual analysis; whereas it seeks to address questions, such as: *"what would have happened if the change did not take place in the first place"*. In this case, we ask "*what would have been the development in the real HPI if the LTV and amortisation requirement were not implemented?*".

The synthetic control method addresses some of the common problems with counterfactual policy analysis, such as omitted variable bias, endogeneity issues, causality problems and measurement errors (Campos, Coricelli, & Moretti, 2014). Also, another main advantage of SCM, is that it solves the ambiguity problem of a traditional case study, where the researcher picks the control unit(s) manually. Contrary, SCM uses a data-driven selection procedure to pick control units, which lowers the risk of the researcher's selection bias. The purpose of the synthetic control group, also called the artificial control group or donor pool, is to match the treated unit in the pre-treatment period, with the control group, for a given set of predictors of the outcome variable. In this case the synthetic counterfactual is used to illustrate the development of the HPI if the LTV and amortisation requirement would not have come into power. The relatively low number of cross-sectional observations made the SCM appear the most appropriate choice, as more traditional regression methods require larger samples to increase the robustness of the findings (Abadie, Diamond, & Hainmueller, 2015).

[54] We acknowledge that most other studies using the VAR in the housing context look at numerous multidimensional effects (see Assenmacher-wesche and Gerlach (2008), Bjørnland and Henning (2010), and Giuliodori, 2005).
[55] To be consistent with earlier findings all IRFs are OIRFs.

Constructing a synthetic counterfactual

The synthetic control unit can be understood as the weighted average of available control units that approximates the most relevant characteristics of the treated unit prior to the treatment or intervention. Technically speaking, SCM solves for the optimal combination of control units that minimises the distance between the synthetic unit and the treated unit, through a data-driven procedure to pick the individual weights so that the mean square prediction error (MSPE) is minimised over the chosen pre-intervention period (Abadie et al., 2010; Abadie, Diamond, & Hainmueller, 2011; Abadie et al., 2015; Abadie & Gardeazabal, 2003). Here, J denotes the number of control units, in this case the 11 Canadian regions, and W is a nonnegative weight vector (w1, …. w) ′, representing the (J x 1) control units and sums to one. Every single W can be viewed as an artificial version of Sweden, including a subset of control units ($w_z..w_j$) chosen to resemble Sweden in the pre-treatment period. X_1 is a (K x 1) vector of pre-LTV (pre-amortisation requirement) values of the house price index. X_0 denotes a (K x J) matrix, which consists of the values of all the predictor variables, but in this case for the J potential control units. Finally, V is a vector representing the relative importance of the various predictors included.

W* is derived to minimise the distance between the pre-treatment characteristics of the treated group, i.e. Sweden, and its synthetic version, i.e. regional control units in Canada. Formally, W* minimises $(X_1 - X_0W)'V(X_1 - X_0W)$ subject to $w_j \geq 0$ (j = 1, 2, ... , J) and $w_1 + \ldots + w_j = 1$. W* depends on V and since the predictors to some degree are subjectively selected there is an inherent element of selection bias in W*. The choice of predictors is based on the theoretical drivers of house prices, constrained by data availability issues. In this case, we face a trade-off between disaggregated data availability and including as many relevant predictors of the outcome variable as possible. Therefore, the first dataset contains regional house prices and national predictors, while the second dataset only contains regional data.

The outcome variables can be defined as Y_0 and Y_1, whereas as Y_1 represents the actual outcome for the treated unit, in this case the observed development in Sweden at time *t*, and Y_1 refers to the synthetic outcome at time *t*, in other words the outcome if Sweden would not have been exposed to the LTV limit (amortisation requirement). Y_1 represents a vector of real HPI for Sweden over T time periods (T x 1) and Y_0 denotes a (T x J) matrix which consists the values for the HPI for the control units, J, over the same time period. The synthetic HPI in Sweden can therefore be estimated as $Y^*_1 = Y_0W^*$, where the W* will be constructed by the weights chosen by the data-driven procedure available through the software package called 'Synth'[56].

[56] The package 'Synth' was developed by (Abadie et al., 2010). To run the SCM one needs to employ statistical software were the Synth package is readily available for installation. Here we use STATA and R-Studio.

4.1.2 Estimating the Vector Autoregression (VAR) model

The VAR makes it possible to estimate the response function of a variable without deriving a complete structural model of the economy and has been one of the standard macroeconomic tools to estimate casual relationships between several variables of interest such (Vargas-silva, 2007). We estimate the linear VAR[57], which should be preferred when the number of observations are limited. The approach follows Giuliodori (2005) and (Assenmacher-wesche & Gerlach, 2009), minimising the number of endogenous variables the government might be concerned about (output and inflation) and one policy instrument, in this case the policy rate. All variables are in logarithms apart from the policy.

The VAR takes the following form: x_t denotes the vector of *n* jointly endogenous time series variables (nx1), which can be modelled as a function of C, which denotes a vector of *n* constants, *p* prior values of the x_t vector, a vector of random disturbances, ϵ_t, i.e. that is the vector of structural shocks. The VAR specified below captures the multifaceted interdependencies between the x_t and $\epsilon_{i,t}$, without depending on unrealistically strong assumptions (Sims, 1980). Thus, the economy is represented by a linear, stochastic dynamic system taking the following structural form:

$$B_0 x_t = C + B_1 x_{t-1} + \cdots + B_p x_{t-p} + \epsilon_t \qquad (3)$$

Equation (3) shows that every endogenous time series, $x_{i,t}$, is a function of both its own lagged values and the lagged values of all the other endogenous time series. Here B_i, i=0, …, n, are (nxn) matrix of coefficients, and the random disturbances ϵ_t are by definition uncorrelated. Because all the endogenous variables depend on the lagged values of all the *n* time series, defined by a the vector y_t, the individual endogenous variable, $y_{i,t}$, is a function of both its own random disturbances, $\epsilon_{i,t}$, and all other elements of ϵ_t. Given that B_0 is mutually orthogonal (invertible), and provided that the residuals are white noise, the VAR can be rewritten in its reduced form by multiplying both sides with the inverse of B_0 (B_0^{-1}):

$$x_t = A_1 x_{t-1} + \cdots + A_p x_{t-p} + u_t \qquad (4)$$

This implies that $A_1 = B_0^{-1} B_i$, for I = 1, …, n, the relationship between the innovations, denoted by u_t, and the structural shock ϵ_t is given by:

$$\epsilon_t = B_0 u_t \qquad (5)$$

[57]Maclennan et al., (1998) argues that house price responses to interest rate changes cannot be captured by the linear VAR. Contrary, (Giuliodori, 2005) suggest that the linear specification has been successfully employed to estimate the effect from a monetary policy shocks on house prices in the Nordics and the UK.

Ordinary least squares (OLS) can be used to estimate the correlation matrix Σ , however, to detect the orthogonal shocks ϵ_t and to calculate the IRF coefficient defining the effect of the structural innovations to the variables in the dynamic system, one needs to determine the (n^2) squared elements of B_0 (Becketti, 2013). Following Sims (1980) and Giuliodori (2005) this paper impose restrictions on the contemporaneous effects of the endogenous variables by using the Cholesky decomposition of the variance-covariance matrix, and thereby assume that B_0 is lower triangular.

Before one estimates the VAR some statistical properties of the time series should be analysed. First, the appropriate number of lags must be determined. Previous studies within this field have shown that longer lag lengths does not change the results significantly, but rather means giving up degrees of freedom and thus results in lower statistical significance of the IRF (Giuliodori, 2005). Following Bjørnland and Henning (2010) and Giuliodori (2005) we employ the Schwarz's Bayesian Information Criterion (SBIC)[58]. See Appendix 4 for an overview of the lag length for each variable, and the whole model.

Secondly, all variables need to be covariance stationary to estimate the VAR. Therefore, we perform the Augmented Dickey Fuller (ADF) test statistics testing for a unit root, including the lag length suggested by the information criteria for each individual variable respectively. Here, the null hypothesis is that the variables have a unit root, thus are nonstationary. As suggested by Assenmacher-wesche and Gerlach (2008) the ADF is performed with an intercept and a trend for all variables apart from the policy rate, which only includes the intercept. The ADF results are presented in table 5 below.

	ADF	**Lags (SBIC)**	**Significance level**
GDP (growth)	-3.294	2	10 %
HPI (growth)	-1.6	8	None stationary
Policy rate	-2.016	3	None stationary
Inflation	-3.603	5	5 %
	ADF	**Lags (SBIC)**	**Significance level**
Δ GDP (growth)	-6.433	2	1 %
Δ HPI (growth)	-3.572	8	1%
Δ Policy rate	-4.830	3	1%
Δ Inflation	-5.327	5	1 %

Table 5: Augmented Dickey Fuller – Unit root test statistics

[58] The results are also cross-checked against Hannan and Quinn's information criterion (HQIC). Lütkepohl (2005) argue that the SBIC and HQIC are more appropriate than the Akaike information criteria, which commonly suggest too many lags. Though we have estimated the appropriate number of lags ex ante we include a formal significance test of the lags ex post to make sure that we have estimated the model correctly. The results indicate that the model could been specified with two lags; when doing do the results are only marginally different.

The results show that we can only reject the null hypothesis for GDP and Inflation, as they are stationary at the 5 % and 1% significance level respectively, while the ADF results for the HPI and the policy rate show that we fail to reject the null hypothesis of nonstationary. All variables are stationary after taking the first difference, using the lag length suggested by the SBIC. The nonstationary suggests that it is inappropriate to run the VAR in levels. Nevertheless, estimating the model in first differences could result in misspecification and over differentiation problems (Giuliodori, 2005).

To address both problems we follow the approach by Sims, Stock and Watson (1990) arguing that it is still possible to run the model in levels if the variables are cointegrated. Therefore, we test for cointegration among the variables to determine if we can run the model in levels. Here H_0 = no cointegration, H_A = cointegration. The Trace statistics and the Max Eigenvalue statistics are greater than the 5% critical value, thus we can reject the null hypothesis of no cointegration (see appendix 5). These results are consistent with both (Giuliodori, 2005) and (Assenmacher-wesche & Gerlach, 2008). Thus, the analysis of the time series suggest that the model can be specified in levels.

4.2 The synthetic sample

With regards to all comparative case studies, the selection of comparison units is critical to avoid biased results and to facilitate accurate conclusions. Ideally, one should strive to construct a synthetic control study that resembles the treated unit with respect to the included pre-intervention characteristics (Abadie et al., 2015). As a prerequisite to enable comparison, the first selection criterial, was to find a country with similar house price development to that of Sweden during the pre-treatment and post-treatment period, which had not introduced a LTV limit, an amortisation requirement, nor had an interest rate shock at the same time.[59] The second selection criterial was to find a country with a similar development in most predictor variables, to enable an accurate construction of the synthetic Sweden.

By examining the growth in house prices since the financial crisis across several OECD countries, it appeared that two countries have experienced a rather similar development to that of Sweden, namely, Norway and Canada (Hull, 2015). Norway was disregarded as they introduced a mortgage cap around the same time as Sweden. Hence, Canada was considered the most appropriate control group control unit fulfilling the selection criteria (see Appendix 6 for a comparison of Swedish and Canadian variables). To run the SCM more than one control unit, also called 'donor', is a prerequisite. Therefore, the main Canadian

[59] Canada has introduced some similar prudential measures such as an LTV limit on newly extended mortgages in 2014 (Krznar & Morsink, 2014). This was well after the Swedish measures were taken and should therefore not be considered a concern.

regions were selected as the donor pool[60]. Ideally, one would have strived to find a larger sample of comparable countries, but since no other country fully satisfied the two selection criteria in the first place, it restricted us to only employ regional data.

SCM Data

We use quarterly regional data for the period Q1 2005 - Q3 2016 and Q1 2005 - Q4 2015. For the sake of consistency with earlier studies on house prices and macroprudential policy, quarterly data is used as far as possible. However, the SCM allows for a combination of different data intervals within the same panel dataset, as various programming options permits the predictors to vary in frequency, without having any direct implications for the results. Thus, annual data has been employed for some of the disaggregated predictors, due to data availability constraints. To obtain accurate estimates both a sizeable pre- and post-intervention period is required (Abadie et al., 2011). The choice of sample period is benchmarked against previous synthetic control studies[61].

All variables are seasonally adjusted and deflated by the national consumer price index (CPI), to enable a comparison in real terms. To perform an analysis of all policy changes we create three datasets; the two first are related to the SCM and the third is for the sake of the VAR analysis. The first dataset contains data points up until Q3 2016, but only covers disaggregated house price data, while all other predictors are national. The second dataset is restricted to only include predictors that can be found at a disaggregated level and only contains data up until Q4 2015, due to lack of Swedish disaggregated predictors after then. We run the SCM on two datasets to increase the validity of our findings. Both SCM datasets are constructed in long panel format, with regions as the cross-sectional variable and quarters (Q1 2005 – Q3 2016) as the time series variable. The VAR dataset includes quarterly time series data from Q2 1990 to Q2 2010 with Swedish national data on CPI, real GDP, real HPI and the Swedish policy rate[62]. A detailed description of the variables and data sources is to be found in Appendix 7.

The first dataset

The first dataset is a balanced panel of quarterly observations from 2005 to 2017, including a more exhaustive list of relevant predictors, which either by nature is restricted to national data (such as the policy rate and CPI) or only are to be found at a national level using secondary data sources. All predictors are either converted to growth rates by taking the natural logarithm, or presented as percentage fractions. The

[60] To avoid interpolation biases, a smaller more restricted sample with similar characteristics to those of the treated unit should be preferred over a larger less comparable sample. By limiting the sample size one also avoids the risk of overfitting, a phenomenon which arise when the treated unit is artificially matched by the idiosyncratic variations in the sample of donor units (unaffected) (Abadie et al., 2015).

[61] See Abadie et al., (2010, 2015) and Abadie and Gardeazabal (2003).

[62] Guidorio (2005) uses the 3-month money market rate, due to this thesis research focus we use the policy rate.

first set of synthetic results are solely derived from the disaggregated HPI across 11 Canadian cities and 20 Swedish regions in the pre-treatment period, as well as the pre-treatment growth in the house price index. The short-run predictability in house prices allows us to include its previous values as predictors, as this would have corresponded to lagged values of house prices in a regular panel regression (see among others Kuttner, Kenneth and Shim (2013). However, following the standard SCM approach lagged values are not included. The selection of cities and regions are based on data availability in terms of HPI; whereas the Canadian regional HPI is collected from Datastream (original source Teranet), the Swedish national HPI is collected from Datastream (original source Statistics Sweden) and the regional HPI from Statistics Sweden.

The 11 Canadian cities with readily available house price data are Quebec, Toronto, Hamilton, Victoria, Vancouver, Edmonton, Winnipeg, Ottawa, Halifax, Calgary and Montreal, thus these are the control units. The treated units are the following 20 Swedish regions: Stockholm, Uppsala, Södermanland, Östergötland, Jönköping, Kronoborg, Kalmar, Blekinge, Skåne, Halland, Västra Götaland, Värmland, Örebro, Västmanland, Dalarna, Gävleborg, Västra Norrland, Jämtland, Västerbotten and Norrbotten.

As suggested by Emanuelsson (2015) it is fruitful to examine the house price development at a disaggregated level to account for variation in structural factors[63]. Thus, we run the first 'Synth' setting the whole country (Sweden) as the treated unit and then split the treated sample into two based on population density[64]. The more densely populated regions are selected based on including a city with more than 500 000 inhabitants, thus, Stockholm, Västra Götaland and Skåne represents *Big Cities*, as they include Malmo, Gothenburg and Stockholm. The other 17 regions constitute *Small Cities*. The *Big Cities* and *Small Cities* are constructed as a weighted average of the included regions' individual HPI times their relative population.

The second dataset

The second set of predictors are all to be found at disaggregated level. Thus, some of them are weaker determinants of house price growth, but appropriate proxies to match the treated region with the donor pool. Some of these variables are only available on an annual basis, which results in an unbalanced panel dataset across six Canadian regions: Quebec, Ontario, British Columbia, Alberta, Manitoba and Nova Scotia. As the regional predictors, do not match the cities included in the Canadian HPI perfectly, the most populated cities in each region are selected[65] to match the outcome variable, HPI, with the predictors. These are represented by Montreal (Quebec), Toronto (Ontario), Vancouver (British Columbia), Calgary (Alberta), Winnipeg (Manitoba) and Halifax (Novia Scotia).

[63] Such as variation the in-construction activity, population density and HPI development discussed in greater detail in *Part 1*.
[64] Moreover, SCM only allows us to run the study with one treated unit at time.
[65] Here we include the largest cities, as any regional population weighted HPI would have derived a greater fraction from the most populated areas. Henceforth, these are considered most representative.

Again, all predictors are represented as growth rates or as percentage fractions (policy rate and employment rate). The following variables are included: regional wage (as a proxy for income), regional GDP, fraction of people employed in manufacturing and agriculture added together, as well as fraction of people employed in construction. None of the Swedish disaggregated variables are available as growth rates or fractions, thus they are collected as values and then manually transformed into growth rates or percentage fractions. As before, the treated group (Sweden) is divided into two sub-samples, whereas both the predictors and the outcome variable are constructed based on the population weighted average of *Big Cities* and *Small Cities*. Since the disaggregated dataset includes a shorter time span than the first dataset, it only facilitates analysis of the LTV limit and not the amortisation requirement.

The third dataset – the VAR data

The VAR dataset constitutes national Swedish data on consumer price index (CPI), real GDP, the real house price index and the policy rate (R). Previous studies have sought to study the MTM, using a sample period of 20 years of quarterly data[66]. Thus, using those studies as a benchmark, the pre-period effect from a change in the interest rate is estimated from Q2 1990 to Q2 2010. All the variables are collected from Datastream. The HPI has been deflated by the national CPI and GDP was readily available in real terms. The relevant variables have been seasonally adjusted. The CPI, HPI and GDP have been transformed to growth rates taking the natural logarithm following the approach in (Giuliodori, 2005).

4.3 Results

The presentation of the results follows the ordering of the three datasets presented in previous section. Thus, it starts off by investigating the development of Swedish house prices, given no policy change in Q4 2010 (policy rate and LTV), to then examine the announcement of the amortisation requirement in Q4 2015. Secondly, the investigation of the LTV/policy rate effect will be conducted using the extended set of regional predictors. The final section examines how the effect form the interest rate and the LTV could be disentangled by first reporting the pre-period IRF (VAR results), followed by the incorporation of the estimated interest rate effect in the baseline SCM specification.

4.3.1 Results – HPI data

This section presents the results from the empirical application of the SCM for *All Sweden*, *Big cities* and *Small cities.* The graphical representations in this section illustrates the estimated development in the Swedish HPI if there would have been no policy change in October 2010. In other, words it addresses the

[66] See Giuliodori (2005), Assenmacher-wesche and Gerlach (2008) and Bjørnland and Henning (2010).

question "*what would have been the development in the Swedish HPI without the LTV limit (85%) and no policy rate change?*".

4.3.1.1 All Sweden – LTV and policy rate increase

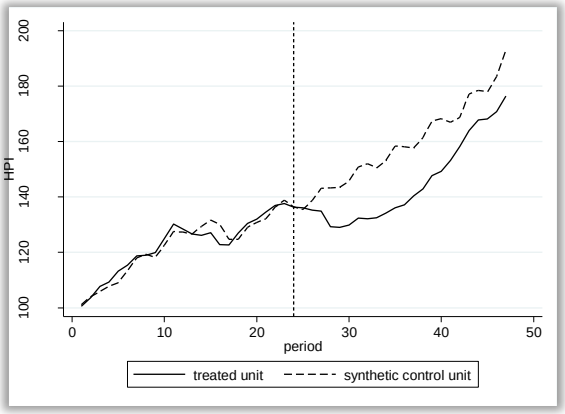
The synthetic *All Sweden* is constructed based on the weights presented in Table 8. As one can see, W* derives approximately 70 % from the house price development in Hamilton, around 12 % from Calgary and 18 % from Montreal to construct the synthetic counterpart, while all other regions are left out. The weights are derived based on the pre-treatment similarity in the house price index, including both the log and level development.

City	**Synthetic control weight**
Montreal	18 %
Hamilton	69.8 %
Calgary	12.2 %
All Others	0 %

Table 6: The Synthetic Sweden (W)*

Note: All Others represents Quebec, Toronto, Victoria, Vancouver, Edmonton, Winnipeg, Ottawa, and Halifax

The results from the baseline synthetic specification for the treated *All Sweden* (actual HPI) and the synthetic Sweden (no treatment) are plotted as the linear combination of the weights from Hamilton, Calgary and Montreal, in chart 16 below. The dotted horizontal line represents the synthetic Sweden, while the solid black line shows actual Sweden. The Y- axis represents the real HPI and the X-axis the periods running from Q1 2005 (period 1) to Q3 in 2016 (period 47). The dotted vertical line marks the time period for the policy change (LTV). The left-hand side of the line represent the pre-implementation development in the HPI and the right-hand side the post implementation evolution of the HPI.



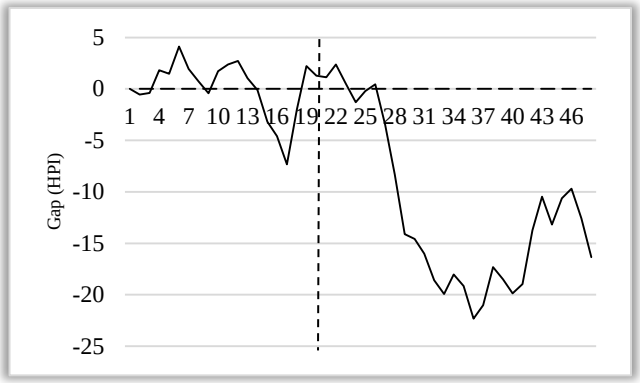


Chart 16 (left): HPI treated (Sweden) vs. Synthetic (RMSPE: 2.54).
Chart 17 (right): Plotted gap (treated-synthetic version) for Sweden vs. Synthetic version.

The results above suggest that the LTV and the interest rate has mitigated the growth in house prices. The development in the synthetic HPI is on average 9.8 % higher in the post-treatment period relative to actual (treated) Sweden, this is graphically represented in the gap plot (chart 17 above). Not unexpected the HPI starts to fall slightly before the LTV came into power, which could be a result of the increase in the policy rate (the Riksbank started to increase the policy rate in Q3 2010, from 0.25 % to 0.75 %). It could also be related to anticipation of the macroprudential regulation, as the LTV had been on the FI's research agenda since 2009[67] (Finansinspektionen, 2010). Interestingly, the effect appears to die out overtime, suggesting that neither of the effects (policy rate or LTV) are long lasting, which corresponds to the previous literature on the policy rate's effect on house prices. Nevertheless, one would expected that the LTV should have a more permanent effect, unless it is counter-cyclical, which is not the case in Sweden. In fact, given that the LTV applies to new loans and to extensions of existing mortgages (MEWs), the effect should hypothetically become stronger over time as the proportion of "post LTV" mortgages (new mortgages) increases. Nevertheless, as the mortgage cap still is relatively high, it should only apply to a relatively small fraction of total borrowers (Aranki, Friberg, & Sjödin, 2010). Therefore one would expect that part of the rather strong effect seen graphically most likely is due to other factors, such as the policy rate increase.

The graphical representation also shows that the gap between the treated and synthetic Swedish HPI is greatest approximately four quarters after the policy intervention. This is contrary to expected given that the Riksbank started to lower the policy rate again in Q4 2011. Intuitively and in line with the MTM, one would expect the fall in the policy rate to put an upward pressure on house prices around that time (period 28-30). This is the opposite to what the graphical representation shows and cannot be explained by any other drastic change in any of the variables presented in Appendix 6. Nevertheless, one should acknowledge that the

[67] Due to forward-looking expectations, one would have liked to test the reaction by the announcement of the LTV limit and not implementation date. However, the announcement date is not documented in public sources.

Canadian and Swedish HPI (Appendix 6) differed slightly during that period as well. Thus, we cannot say too much about what caused the "dip" based on a preliminary analysis of the variables included, this requires a more thorough analysis of various quantitative and qualitative parameter beyond the scope of this thesis.
The RMSPE assessing the fit of the model is 2.54 % and can be thought of as the lack of fit between the treated unit and its synthetic counterpart during the pre-intervention period (Abadie et al., 2015). To evaluate the relative accuracy of the model it can be compared to the standard deviation of pre-period HPI, which has an annualised standard deviation of 58,74 %[68]. The RMSPE obtained from the synthetic estimation, is well below the standard deviation of the outcome variable, which suggest that the model has a reasonable fit.

4.3.1.2 Big Cities and Small Cities – LTV and policy rate increase

Next we run the same specification of the SCM on the two sub-samples of Sweden: *Big Cities* and *Small Cities*, to test if the post treatment effect differs across the two sub-samples. One could expect that the effect from the LTV is relatively greater in areas with more credit constrained households, assuming that these are the ones that traditionally have taken the mortgage loans above 85 %. The hypothesis is that the effect from the LTV is greater and more permanent across *Small Cities* as the average income level is lower there (Almqvist, 2016). Here income is used as an imperfect proxy for more credit constraints, suggesting that a further increase in debt restrictions is expected to hit those regions harder.

Table 8 and Table 9 below show how the optimal weights (W*) for the synthetic *Big Cities* and the synthetic *Small Cities* are derived to minimise the RMSPE in the validation period.

City	**Synthetic control weights**
Toronto	6.9 %
Hamilton	53.9 %
Victoria	20.9 %
Edmonton	2.8 %
Ottawa	8.5 %
Calgary	7.0 %
All Others	0.0 %

Table 7: The Synthetic Big Cities (W)*
Note: All Others represents Quebec, Vancouver, Winnipeg, Halifax and Montreal.

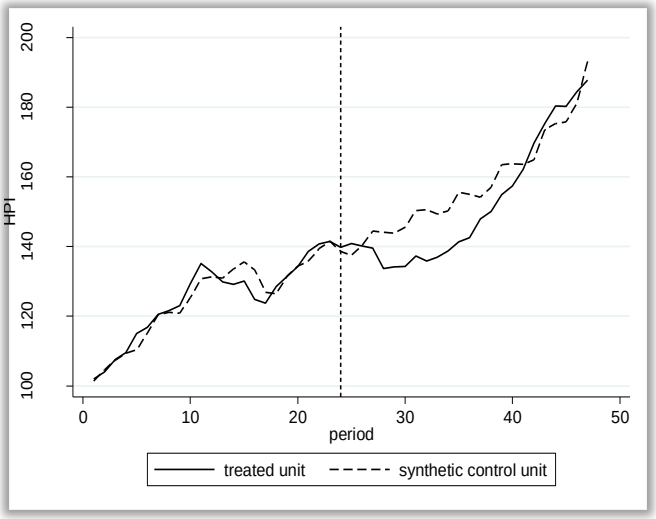
[68] The quarterly standard deviation is annualised by multiplying it with the square root of four.

City	Synthetic control weights
Hamilton	70.7 %
Victoria	3.4 %
Calgary	9.5 %
Montreal	16.5.0%
All Others	0.0 %

Table 8: The Synthetic Small Cities (W)*

Note: All Others represents Quebec, Toronto, Vancouver, Edmonton, Winnipeg, Halifax and Ottawa

The results of the SCM from *Big Cities* and *Small Cities* are presented in the charts 18 and 19 below and the graphical format is identical to the *All Sweden,* thus the interpretation of the axes and lines are the same as when only *All Sweden* was considered.



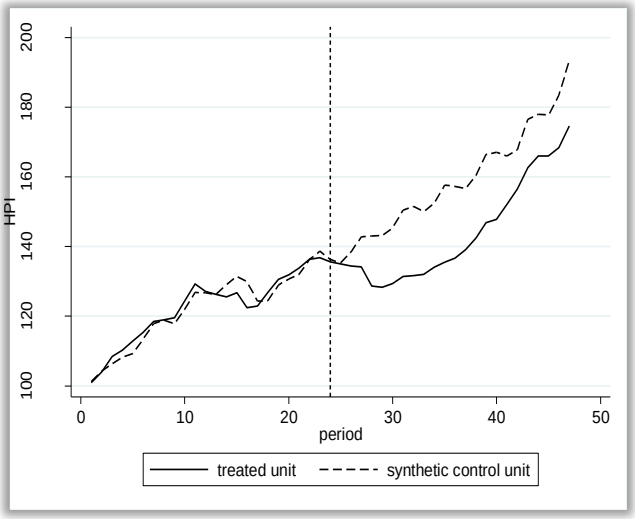
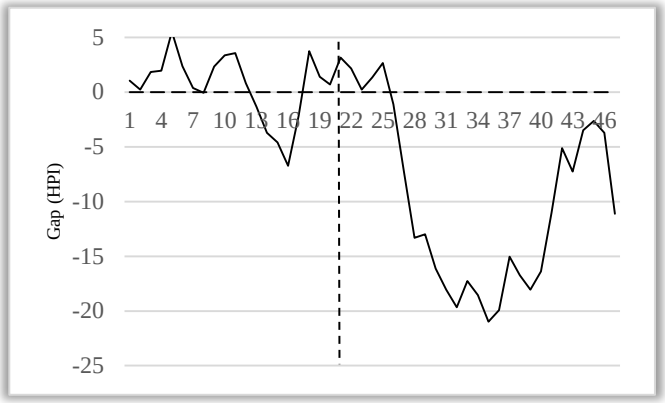


Chart 18 (left): HPI treated Big Cities vs. Synthetic (RMSPE: 3.05)

Chart 19 (right): HPI treated Small Cities vs. Synthetic (RMSPE: 2.54)



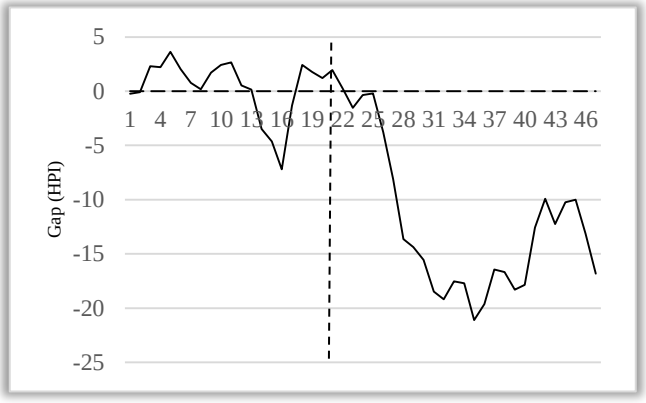


Chart 20 (left): Plotted gap (treated-synthetic version) for Big Cities vs. Synthetic version.
Chart 21 (right): Plotted gap (treated-synthetic version) for Small Cities vs. Synthetic version.

The results indicate two main things: that the effect is more modest across *Big Cities* and fades away more rapidly. Looking at chart 18, *Big Cities*, one can see that treated unit eventually surpasses its synthetic version, this is reflected in the average lower difference between the treated and synthetic unit in the post-treatment period (7.7 %), which is graphically illustrated in the gap plot (chart 20) above. The RMSPE increases considering *Big Cities*, while the RMSPE across *Small Cities* is almost identical to *All Sweden* [69]. Chart 19 and 21, representing *Small Cities* is only marginally different from chart 16 and 17 (*All Sweden*). This does not come as a surprise given that '*Small Cities*' constitutes 17 out of the 20 regions included in linear population weighted version of *All Sweden.*

4.3.1.3 Policy announcement: The amortisation requirement

This sections presents the SCM results investigating the potential impact from the announcement of the amortisation requirement in Q4 2015. Considering forward-looking expectations, the public should adjust behaviour to information about future changes of lending conditions. Moreover, earlier applications of the SCM[70], suggest that the post intervention period is too short to yield any fruitful results, hence the announcement quarter is considered the most appropriate treatment period. Also, given some degree of rationality, the market actors should react to information with direct implication for their debt burden. Using the same samples (*All Sweden, Big Cities, Small Cities*) we run the SCM using an identical set-up to the one presented in previous section, but with another treatment period. The graphical representations in this section illustrates the estimated development in the Swedish HPI if there would have been no policy announcement

[69] Std. Dev annualised (HPI pre-period) 58,71 (*Big Cities*) 58,73 (*Small Cities*).
[70] See Adabie, Diamond and Hainmueller (2015), Abadie and Diamond (2010) etc.

in Q4 2015. In other, words it addresses the question "*what would have been the development in the Swedish HPI without the amortisation requirement*?"

All Sweden - The amortisation requirement

Table 10 below shows that the synthetic *All Sweden* (W*) is constructed by the linear weighted combination of solely Hamilton (75.8 %) and Victoria (24.2 %), while the other regions are left out.

City	Synthetic control weight
Hamilton	75.8 %
Victoria	24.2%
All Others	0.0%

Table 9: Regression weights using 'Sweden' as the treated unit.

Note: *All Others represents Quebec, Toronto, Vancouver, Edmonton, Winnipeg, Ottawa, Halifax, Calgary and Montreal.*

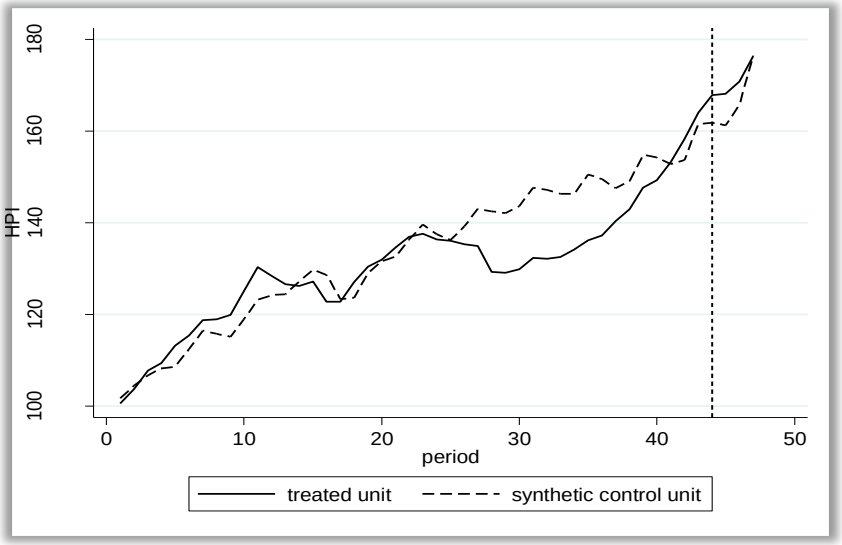


Chart 22: HPI treated (All Sweden) vs. Synthetic Sweden (RMSPE 7.17).

The graphical representation (chart 22) above shows no effect from the announcement of the amortisation requirement. This is not too surprising, given that the The European Commission (2017) claims that the amortisation requirement have had no visible impact yet. This is also consistent with Farelius and Billborn (2016) who claim, that the effect of the macroprudential measures taken so far is quantify to measure, given the rather short post treatment period.

Moreover, one can see that the treated *All Sweden* resembles the representation in chart 16, thus, this example provides a natural placebo test, as assigning the treatment to another time period or to one of the control units should (given that there is a treatment effect) yield no effect (Abadie et al., 2015). The RMSPE is substantially higher, meaning that the fit of the model is much worse compared to in the first policy test. As this could be a result of that we include the full sample period to obtain the pre-treatment period fit, we re-run the 'Synth' only including data from the end of 2011. These results produce no different results, and generates a substantial decline in the model fit, suggesting that the potential impact is not measurable, at least not using the SCM approach. For the sake of consistency, we also test the effect from the amortisation requirement on the two other samples *Big Cities* and *Small Cities*[71]. The results are marginally different from *All Sweden* and overall the results from all sample tests suggest that the potential effect from the amortisation requirement is not visible yet.

4.3.2 Results – Including more predictors

Subsequent section presents the results from investigating the impact from the LTV and interest rate change in 2010 expanding the sub-set of regional predictors. By doing so one should expect the synthetic Sweden to be more accurately matched with its real counterpart.

4.3.2.1 All Sweden – LTV and policy rate

Table 11 reports the means for the predictors for the *All Sweden*, the synthetic version of Sweden and for the six Canadian regions (the donor pool). Since the data for all included predictors are available at a regional level, the components of W* are derived based on the similarity across all predictor variables and all the control units.

	All Sweden	**Synthetic Sweden**	**Donor pool**
Wage Growth	2.50 %	0.60 %	0.62 %
Population Growth	0.70 %	0.40 %	0.41 %
GDP Growth	3.70 %	1.70 %	1.98 %
Agri. & Manu. sector empl.	13.70 %	12.40 %	11.84 %
Construction sector empl.	4.70 %	4.46 %	4.87 %
Employment[72]	58.70 %	61.70 %	65.50 %
HPI Growth	1.30 %	1.40 %	1.30 %

Table 10: Pre-period means (Q1 2005 - Q3 2010).

Note: Pre-period estimates derived from 'Synth'.

[71] See Appendix 8 for a detailed overview of those results.
[72] Whole population above 15 years old.

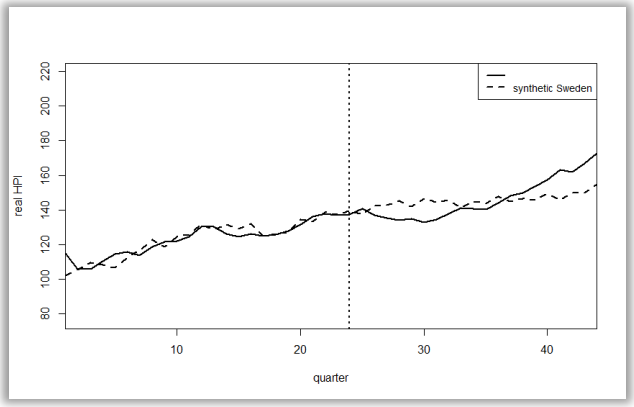
The pre-period similarity across most means depicted in table F, looking at the *All Sweden* and the donor pool, suggests that there is a satisfactory good fit between for the 'synth' to produce an artificial counterpart, which reflects the treated unit. Nevertheless, the fit between the Swedish mean and the donor pool mean across wage growth and GDP growth could have been better. This is most likely due to the rather larger swings in the Swedish GDP in the pre-period (2005-2010), comparable to that of the Canadian (World Bank, 2017). A detailed overview of the weights derived from each variable is to be found in Appendix 9.

City	**Synthetic Control Weight**
Montreal	57.5 %
Vancouver	39.20 %
Winnipeg	3.3 %
All Others	0.0%

Table 11: Synthetic weights – All Sweden.

Note: All Others represents Toronto, Halifax and Calgary.

The results for the disaggregated SCM is presented in chart 23 and the corresponding gap plot illustrates the difference between the treated and the synthetic control group (chart 24). The graphical representation is formatted as in previous section, thus the axes and the dashed/solid lines (the real Sweden) can be interpreted as before.



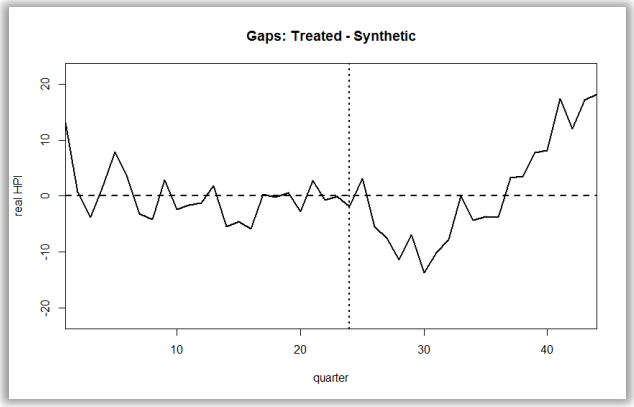


Chart 23 (left): Synthetic vs. Treated Sweden (RMSPE 2.32)

Chart 24 (right): Plotted gap (treated-synthetic version)

The results show a similar development to that examining the synthetic version derived solely the regional differences across HPI growth and pre-period HPI values. This indicates that including more predictors does

only change the RMSPE and the results marginally. Nevertheless, the graphical representation suggests a slightly more modest reaction, which fades away earlier than when only fitting the SCM based on the disaggregated HPI. The actual Sweden (treated) surpasses its synthetic counterpart, around Q4 2013 (period 36), while the results in chart 16 *All Sweden*, suggest that this does not occur.

4.3.2.2 Big Cities and Small Cities – LTV and policy rate increase

For the sake of consistency, we run the same specification of the SCM on the two sub-samples *Big Cities* and *Small Cities*. The results do, as expected, resemble the ones in previous sections.

Big Cities

	Big Cities	**Synthetic Sweden**	**Donor pool**
Wage Growth	2.90 %	0.40 %	0.62 %
Population Growth	1.10 %	0.40 %	0.41 %
GDP Growth	4.00 %	1.60 %	1.98 %
Agri. & Manu. sector	10.80 %	15.30 %	12.00 %
Construction sector	3.70 %	4.50 %	4.87 %
Employment	58.70 %	61.80 %	65.50 %
HPI Growth	1.30 %	1.30 %	1.30 %

Table 12: Pre-period means Big cities, (Q1 2005 – Q3 2010).

Note: Pre-period estimates derived from 'Synth'.

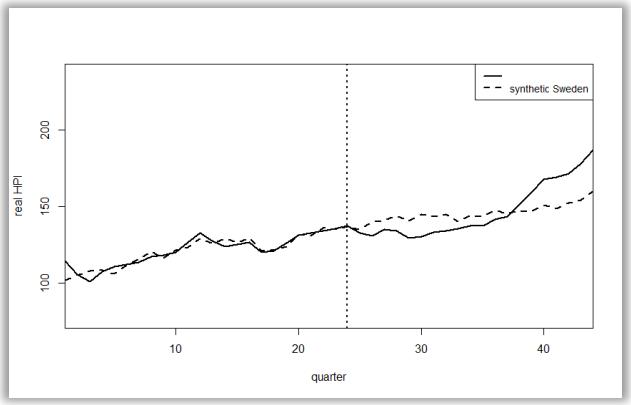
The pre-period similarity across the means, examining *Big Cities* and the donor pool resembles the patterns across the means displayed, from *All Sweden* in Table 11. The main difference is that less Swedes are employed in the agriculture and manufacturing sector, which is not too striking given that we now examine the more urbanised regions.

City	**Synthetic weight**
Toronto	20.60 %
Montreal	37.80 %
Vancouver	41.60 %
All Others	0.00 %

Table 13: Synthetic – Big Cities.

Note: All Others represents Halifax, Winnipeg and Calgary.

As seen in Table 14, 'Synth' derives the total synthetic *Big Cities* from the three relatively larger cities in Canada, i.e. comparing the population in Toronto, Montreal and Vancouver to that of Halifax, Winnipeg and Calgary. This should not come as a surprise given that one would expect the pre-period development in the predictors across the three largest regions in Sweden to resemble the three largest in Canada to a greater extent.



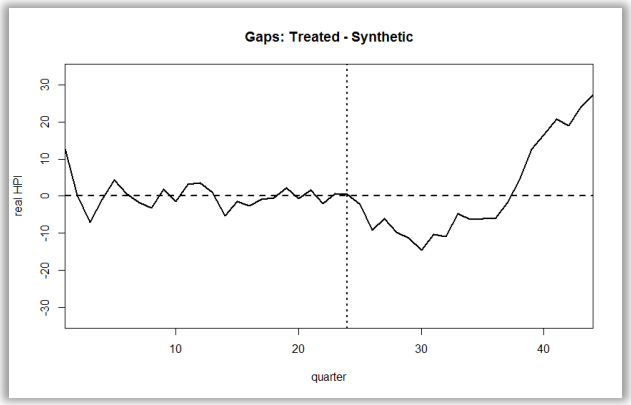


Chart 25 (left): Synthetic vs. treated Sweden (RMSPE 1.95).
Chart 26 (right): Plotted gap (treated-synthetic Big Cities version).

The chart of the treated and the synthetic *Big Cities* shows a similar development to *All Sweden*, apart from that the increase in HPI takes off a bit more rapidly around Q4 2013/ Q1 2014. The gap plot shows a slightly more modest difference between the treated and synthetic *Big Cities*, thus the findings corresponds well to previous 'Synth' only examining *Big Cities*. The RMSPE is slightly lower than before, suggesting that the more comprehensive list of regional predictors has improved the fit of the model.

Small Cities

	Small Cities	**Synthetic Sweden**	**Donor pool**
Wage Growth	2.10%	0.70%	0.62%
Population Growth	0.30%	0.40%	0.41%
GDP Growth	3.40%	2.00%	1.98%
Agri. & Manu. sector	16.80 %	10.90 %	12.0 %
Construction sector	5.80%	5.00%	4.87%
Employment	58.70%	63.30%	65.50%
HPI growth	1.30%	1.30%	1.30%

Table 14: Pre-treatment means (Q1 2005-Q3 2010).
Note: Pre-period estimates derived from 'Synth'.

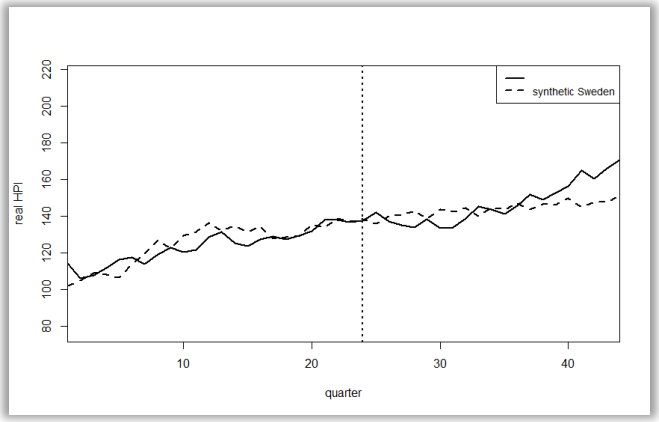
The pre-treatment means illustrate a similar pattern as when we only considered *Big Cities*, apart from that the average fraction of people employed in the agriculture and manufacturing sector now is the opposite to before. It does not come as a surprise given that more people are expected to work in these sectors in less densely populated regions.

City	Synthetic weight
Montreal	56.60 %
Vancouver	21.70 %
Calgary	21.70 %
All others	0.00 %

Table 15: Synthetic weights – Small Cities.

Note: All Others represents Toronto, Winnipeg and Halifax.

The weights to construct the synthetic *Small Cities.* differs as expected given that other control units are supposed to match smaller cities in Sweden better than when we considered only the larger cities. Both the graphical results and the RMSPE show that the fit is substantially lower than in the two previous cases. Thus, it makes poor sense to interpret these results further given the reduced fit.



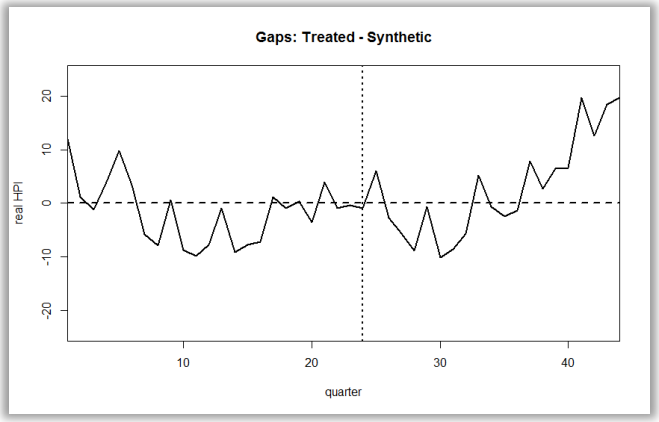


Chart 27 (left): Synthetic vs. Treated Sweden (RMSPE 4.53)

Chart 28 (right): Plotted gap (treated-synthetic version).

4.4 Robustness test

One of the main challenges with comparative case studies is to determine whether the effect is the result of the intervention (treatment) or whether it is driven by other unobservable factors. Depending on the

econometric method there are various ways to go about this, whereas a *Placebo Test* is the most common one in a synthetic control context[73] (Abadie & Gardeazabal, 2003).

Placebo test

A placebo test is exactly what it sounds like; it means that one should assign the treatment to the control units and to other time periods to make sure that they do not react to the intervention. Naturally, it is most important to assign the treatment to the regions that carries greatest weights in the construction of the synthetic counterpart (Abadie & Gardeazabal, 2003). The results presented with regards to the amortisation requirement constituted a natural placebo test as seen; changing the treatment period from Q4 2010 to Q4 2015 did not alter the findings. To further increase the robustness of our findings, we run the placebo test on all control units for all three sub-sets of Sweden; *All Sweden, Big Cities and Small Cities*. Chart 29, 30 and 31 show the gap plot.

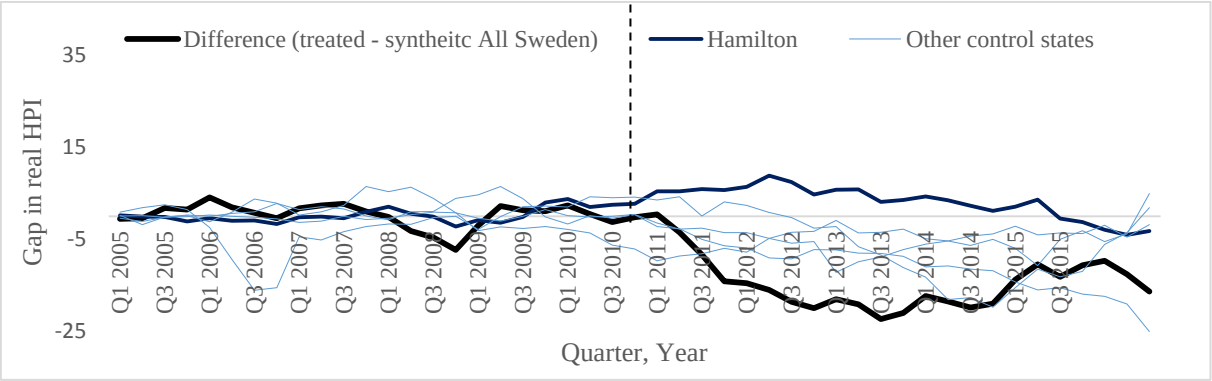


Chart 29: Results from the placebo test – All Sweden

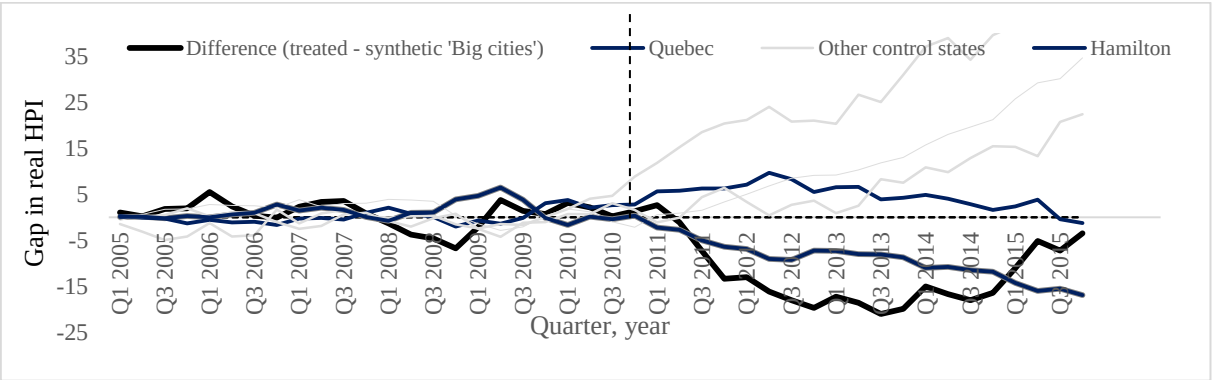


Chart 30: Results from the placebo test - Big Cities

[73] We acknowledge that the placebo test does not provide any measure of statistical significance and this is one of the main critique towards the SCM.

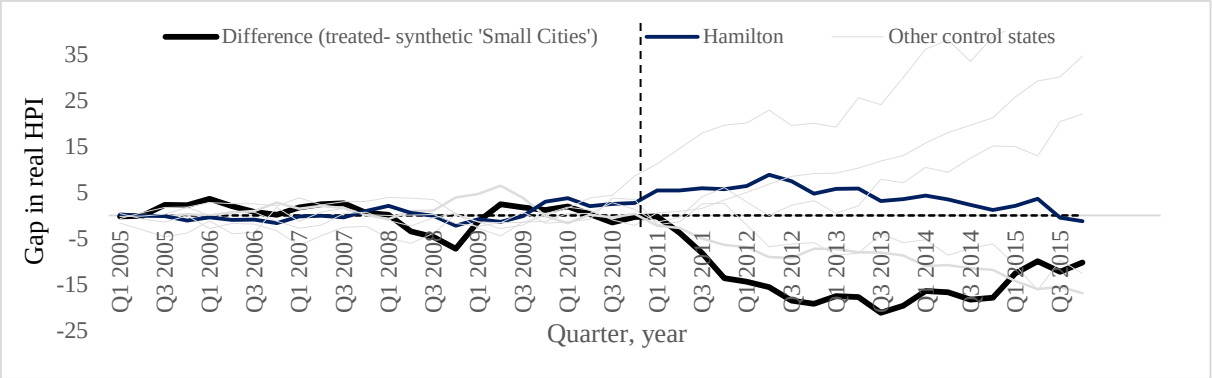


Chart 31: Results from the placebo test - Small Cities

The solid black line shows the effect on the treated unit, and the blue solid lines show the outcome from the placebo tests. All three sets of robustness test suggest that the findings are valid, as the control units do not react to the treatment. The second dataset, containing disaggregated data across all the predictors, show similar placebo results, these can be found in Appendix 10.

4.5 Disentangling effects – Policy rate versus LTV

As the LTV came into power during a quarter (Q4 2010) when the Riksbank also raised the policy rate, one cannot disentangle the effect from the LTV to that of the policy rate by solely examining the results from the synthetic estimation. This could be addressed by artificially removing the interest rate, period by period, during the post-treatment years. Hypothetically, one would expect that, by removing the policy rate from the total effect, the results from the LTV would be more modest. Graphically, this suggests that the gap between the treated version of *All Sweden* and the synthetic Sweden should be smaller if only the impact from the LTV was considered.

4.5.1 Impulse response functions

First, we specify the VAR as in Giuliodori (2005), whereas the recursive ordering is consistent with earlier literature on the MTM. Hence, the variables are placed in the following order: logarithm of CPI, logarithm of GDP, logarithm of HPI and the policy rate. This implies that the policy rate is assumed to react directly to shocks in the other variables, while the other three react to interest rate changes after one quarter has passed. We run the VAR with three lags, as suggested by the SCIB criteria[74] (see Appendix 4). In this case, we first determine the response of the interest rate to a shock to its own value (Chart 32), to then estimate the response of house price growth to a shock in the interest rate (Chart 33) during the period before the LTV was introduced. The impulse response functions, IRFs, are presented in the charts below.

[74] We also run the VAR using two and four lags as well and obtain almost the same results.

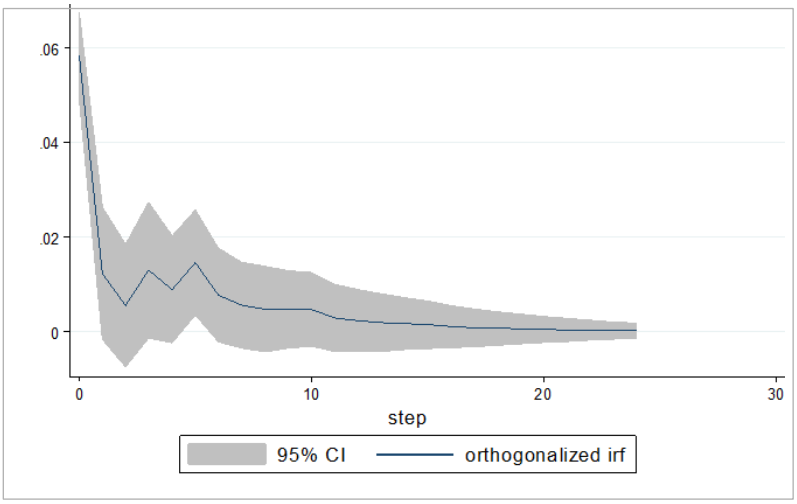


Chart 32: Impulse response function – Response: Policy rate, Impulse: Policy rate

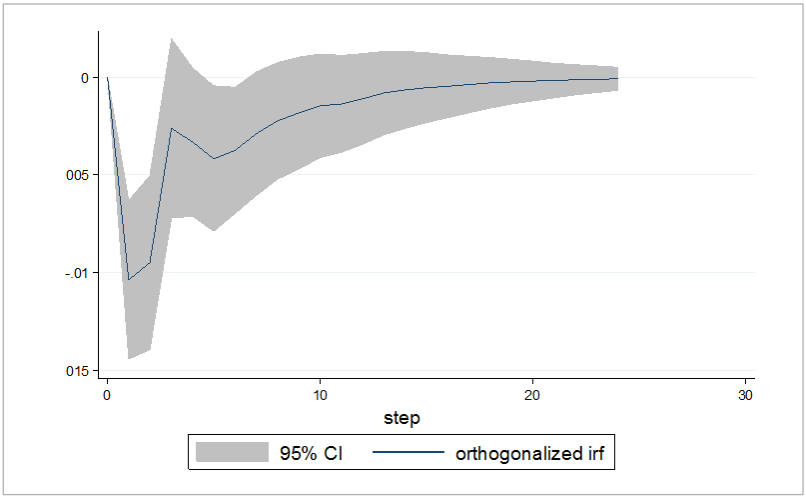


Chart 33: Impulse response function – Response: House prices, Impulse Policy rate

The results show that the response of the policy rate to itself, as well as the house price growth to a policy rate shock, displays a nearly identical pattern to the findings in Giuliodori (2005), which is expected considering that the sample period overlaps with his[75]. The policy rate's reaction to a shock in its own value is illustrated by the drop of 4.58 % in Chart 32. House prices react by a falling by 40 % in the first period after the shocks. The house price response is immediate, but almost fades away after two quarters. The results from the FEVD suggests that around 30 % of the variation in house prices can be explained by the

[75] Giuliodori (2005) use data from 1979:3-1998:4, while our sample spans from 1991:1 – 2010:2

interest rate. The bootstrapped confidence interval suggests that both the impulse response function and the variance decomposition is statistically significant at the 95 % level [76].

The results are consistent with the findings by Bjørnland and Henning (2010) suggesting that house prices do react immediately to interest rate changes, but the effects are not long lasting. The immediate response from a change in the interest rate also confirms the findings of Assenmacher-wesche and Gerlach (2008), nevertheless, the effect we find is more immediate and fades away more rapidly relative to the more gradual effect they find. Critiques have argued that the ordering of the variables chosen affect the interpretation of the relationships between them (Becketti, 2013)). To increase the robustness of our findings, we therefore rerun the VAR specification, changing the ordering of the variable and obtain similar results.

4.5.2 Estimating the response in the HPI from Q4 2010

The IRF can be defined as "*coefficients tracing the effects of the structural innovations on the variables of the system*" (Giuliodori, 2005, p. 528). Thus, the response of the variable of interest (HPI) to a shock in the policy rate, can be estimated using the IRF results, to then trace the effect of the policy rate in the post treatment period assuming similar reaction to the pre-treatment period. By doing do, we seek to separate the policy rate effect from that of the LTV.

We use the IRF (Appendix 11) to multiply their cumulative effect over time with the synthetic Swedish HPI from the pre-treatment period (Q3 2010) and onwards until the end of the sample period. We adjust the IRF to the observed change in the policy rate, to then add the adjusted IRFs together throughout all post-treatment periods up until Q3 2016. In each period, we artificially remove the interest rate by multiplying the synthetic pre-period HPI (HPI_t) by the adjusted response to the policy rate[77], which occurs from in t+1. Since the policy rate changes at least once a year throughout the rest of the sample period, all effects are taken into consideration. For instance, this means that the adjustment of the synthetic HPI_{t+2} accounts for 1) the cumulative IRF from the policy rate change in period t (in this case response in period one and two) and 2) the IRF from the policy rate change in period t+1 (first period's response). We repeat estimating the effect in a similar fashion, adding the impulse responses from all the policy rate changes together. Thus, HPI_{t+j} is adjusted for the cumulative IRF from period t to period j (end of sample period) (see Appendix 12).

[76] All OIRF and FEVD results, including the bootstrapped confidence interval and the Std. Error is reported in Appendix 11.
[77] The adjusted interest rate refers to that we consider the actual change in the policy rate and adjust the IRF correspondingly.

The result shows the synthetic Sweden, excluding the interest rate is displayed in chart 34 (Q4 2010 - Q3 2016).

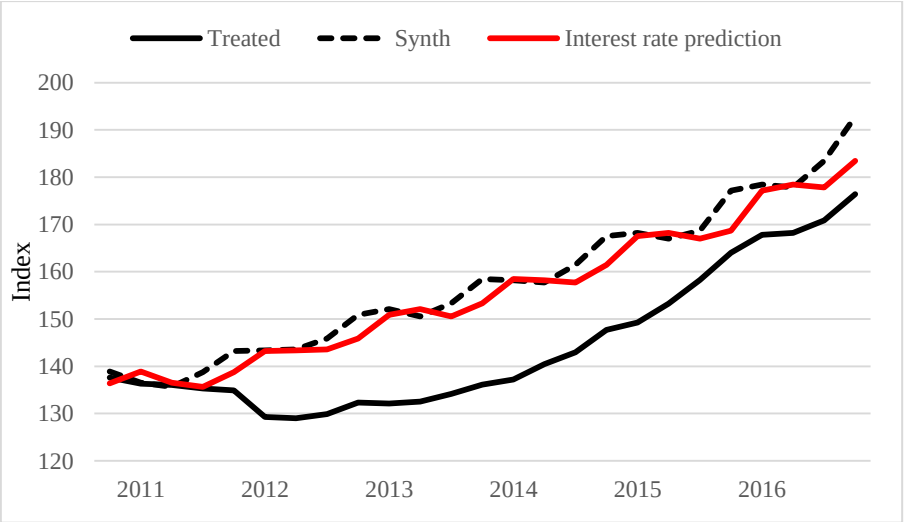


Chart 34: Policy rate effect, Q4 2010- Q3 2016.

The graphical representation shows the results from the response in the house price index to the ongoing changes in the policy rate, using the ex-ante IRFs to estimate the ex post movement in the synthetic HPI. Thus, the graph plots the path of the HPI (black solid line) alongside the synthetic (dotted black line) and synthetic version excluding the policy rate (red solid line) of *All Sweden*, from the baseline SCM specification. The only difference from the initial SCM specification is that we are now only interested in the post-treatment development and therefore the pre-treatment period is left out (i.e. graph starts in Q4 2010). The results suggest that the overall effect from the policy rate is rather modest, as the solid red line in chart 34, moves almost in tandem with the initial synthetic Sweden. Overall, this suggest that the impact from the policy rate on the synthetic Swedish HPI is relatively small to the considerable large overall movement in house prices. This confirms Bjørnland and Henning's (2010) findings suggesting that the impact from the policy rate on house prices is rather small compared to the overall volatility in house prices.

One should acknowledge that these results combines two econometric approaches to pragmatically address an empirical event, which has not been investigated before. On their own, both sets of results (SCM and VAR) suggest that the policy change in 2010 have had an impact on the post-treatment period HPI. Despite that the VAR results obtained are consistent with earlier studies, the policy rate on its own fail to explain the rather large difference between the synthetic and the real Sweden. Nevertheless, it is difficult to confirm the validity of these findings, as to the authors' knowledge no other researchers have combined these two approaches. Thus, it is worth questioning if the combination of these two econometric methods is appropriate to disentangle the effects. The results in this section suggests that, when disentangling the effects, almost the full impact should be due to the LTV. This appears unreasonable given that it only 1) applied to new loans

and 2) still was above the average LTV when implemented, suggesting that only a small fraction of mortgage holders were effected.

4.6 Part conclusion – All results

In light of the propositions presented in the introduction to *Part 2*, the first set of results lends support for proposition 1A and 1B. This suggests that the introduction of the mortgage cap and the policy rate change in Q4 2010 have mitigated house price growth in the subsequent periods. Furthermore, the increase in number of predictors did not alter the results substantially, though it, as expected, resulted in a modest improvement of the pre-period fit (disregarding *Small Cities*). The results were quite uniform across the overall sample and the two sub-samples, apart from a more modest impact across *Big Cities*, which also diminished more rapidly over time to eventually die out completely. This suggest that the policy change might have had some unintended consequences; suggesting that it has had the greatest impact where it is less needed, considering that policymakers today are most concerned about the relatively greater increase in the HPI across urban areas[78].

We fail to obtain empirical support for proposition 2. The results from the SCM, investigating the amortisation requirement, suggest that it has not had any measurable impact yet. This suggests that it might be too early to quantify its effect in a meaningful way, thus this could be a fruitful avenue for future research. The results trying to disentangle the effect from policy rate and the LTV (proposition 1A and 1B) are quite puzzling. The VAR specification suggest a positive and significant response in house prices from a monetary shock. Nevertheless, when the effect from shocks to the policy rate are applied to the synthetic Sweden the results suggest that the LTV should be the main driver of the gap between the treated and synthetic version of Sweden. One would expect an effect, but a slightly more modest one given that the LTV only applies to new loans. In any case, the results suggest that the Riksbank's attempt to address the housing market by raising the policy rate gradually during one year, failed to curb house price growth.

4.7 Limitations to the statistical method

In this section, we have estimated the impact on house prices from credit related prudential regulation. As these policy changes are directly targeted at limiting household debt, the results could potentially have been complemented by estimating the effect more directly, by examining their impact on credit growth as well. However, in this case the regional data requirement limited us from including credit growth as an outcome variable in the analysis.

[78] The unintended consequences of both macroprudential and monetary policy will be discussed further in the discussion and perspective chapter.

Moreover, house prices are a function of several fundamental and non-fundamental factors: As with most statistical studies this pose a risk of omitted variable bias and thereby the validity of the results. In this case, the disaggregated restriction made the data limitations even more severe. Therefore, one of the main critique to the results is that some of the disaggregated Canadian predictors do not perfectly resemble Sweden in the pre-treatment period (see wage growth and GDP growth for instance). Thus, the V vector, which indicates how the synthetic Sweden is constructed, reveals that the weights used to construct W* mainly are drawn from the employment rate and the pre-treatment period house price growth (see Appendix 9). However, the national economic characteristics, presented in Appendix 6, shows that the most common theoretical drivers of HPI in Sweden and Canada are similar enough to preclude that the results are not driven by cross-country variations in the common predictors of house prices.

The synthetic control method has emerged to address some of the flaws associated with other comparable counterfactual methods, and one of its main advantages is that the data-driven selection process eliminates parts of the selection bias. However, in our case, the first step in the sample selection process was manual. Thus, to some extent the choice of Canada was subject to the 'researcher's selection bias'. We also acknowledge that SCM has been critiqued for its limitation to formally reject or accept a hypothesis test, as the gap between the treated unit and its synthetic counterfactual cannot be rejected/accepted by a standard t-test (Campos et al., 2014). Thus, from a pure statistical perspective, the SCM leaves something to be desired, nevertheless it overcomes some of the drawbacks of other methods and was therefore considered most appropriate in this case.

Also, the results from the SCM shows an unexpectedly large effect approximately one year after the treatment. This suggests that the general economic slowdown at that time or some other factor(s), not included in the econometric analysis have had an impact on house prices. Given the evidence in *Part 1*, emphasising a number of institutional and structural factors important for the housing market's transmission mechanism, the results could have been affected by other factors apart from the more obvious ones tested here. The multidimensional relationship between the housing market and several of these other factors, which have been excluded from the econometric analysis, such as confidence levels, construction costs and land could play a role to explain the observed house price development as well. This is again related to the omitted variable bias, which is a problem with many econometric specifications, also the VAR, as these rarely succeed to incorporate all useful predictors and commonly some of these are difficult to find empirical proxies for. Due to the limited scope of this paper, we do not investigate all other important factors[79] further, but rather suggest that it could be a rewarding avenue for future research.

[79] This does not only include the relevant institutional and structural factors discussed in part one, but also involves behavioural aspects such as irrational exuberance and other market imperfections.

5.0 Discussion and perspectives

The purpose of this chapter is to discuss some of the critical aspects of the main empirical findings discovered in this thesis. The general theme of the discussion will be centred around some of the negative externalities, which both the housing market and housing related policymaking might contribute to, such as unintended consequences of policy choices resulting in regulatory arbitrage and demographical disparities. Subsequent section begins with a discussion of the spillover effects from the housing market to other parts of the real economy. Secondly, it will discuss the interplay between monetary and macroprudential policy, as well as their role to address potential housing market imbalances in light the statistical findings from the second part of this thesis. Thirdly, it will discuss aspects of the property tax system, which goes beyond what has been analysed so far, but is of contemporary importance. The final section highlight avenues for future research.

5.1 The housing market's spillover effects

At a regional level, the stronger growth in house prices across metropolitan areas suggests that the collateral and wealth effect for existing homeowners in those regions should be relatively more pronounced, holding all other variables constant. These regional disparities can have long run consequences for social equality, labour market conditions and economic growth. Thus, the deviation in the house price development across regions pose a risk of increasing polarisation between various social groups. For instance, the surge in number of asylum seekers in 2016 has resulted in clusters of immigrants around the suburbs of the three largest cities (Stockholm, Gothenburg and Malmo). Furthermore, students across Swedish universities report an urgent lack of accommodation; in 2016 the average queue length to obtain student accommodation was nine years (Bostadsförmedlingen, 2016). Finally, start-ups and smaller firms report that they find it difficult to attract skilled labour from both other Swedish regions as well as from abroad, because of the surge in home prices and long ques for rental accommodation.

For all of these groups, newcomers, students and prospective labour, current housing market rigidities create an 'insider-outsider' effect, which pose an additional burden on the already exhausted integration system, makes it increasingly difficult for universities and workplaces to attract international students and a talented labour force. This has already had real consequences resulting in that well-recognised firms start to move their headquarters abroad or to less attractive regional locations (Financial Times, 2016). Altogether, this suggests that the current state of the housing market pose real challenges to the long-term sustainability of the welfare state, due to of its direct implications for social equality, employment and economic growth (Wall, 2017; The European Comission, 2017). One of the key ideas behind the welfare state is that it pursues to make housing less dependent on income. From that point of view, some of the macroprudential measures

might contradict the fundamental notion of the welfare state, as it arguable restricts the external credit opportunities for the more vulnerable groups in society. However, potential offsetting factors such as housing allowances and subsidiaries limit the potential adverse social consequences from the macroprudential policies implemented so far (Holmqvist & Turner, 2013).

Moreover, Boverket reports that more than 700 000 new dwellings need to be built around the larger metropolitan areas within the next ten years to address the current housing shortage (Svenska Dagbladet, 2017). This is approximately fifteen times as many as the number of completed new dwellings in 2016 (Statistics Sweden, 2017c). In light of the residential investment section, the desirable increase in construction might be easier said than done, as the construction of new dwellings is limited by the supply of land in urban areas. This is also one of the reasons why some researchers claim that the observed increase in house prices is not dangerous[80], but rather suggest that it is the direct outcome of a shift in fundamental factors such as income and urbanisation. From that point of view, the empirical application of policies targeted at credit demand cannot address the housing market own, structural supply factors are of equal importance. Among others, these could be infrastructure connecting inner cities to suburbs more effectively, shorter developing time across regions and less 'income smoothing' among construction firms and municipalities, to speed up the total lead time (Bergendahl et al., 2015).

Nevertheless, the fundamental value approach to housing market imbalances, largely rest on the neoclassical assumptions of rationality and perfect capital markets. In light of the financial stability section, the role of credit market imperfections is one of the most important factors to understand the magnitude of the housing market as a propagator of business cycles. The fundamental value approach overlooks the central role of future expectation and irrational behaviour of market actors; factors that arguably are of equal importance for housing valuation and potential price corrections. Moreover, the (Riksbank, 2011 p.17-18) acknowledges that the "*natural explanations for the high Swedish housing prices does not necessarily mean that these will develop smoothly in the period ahead*". This suggests two things: First of all, whether there is a gap or not between the fundamental and the market value, might not alleviate the housing market's potential impact on either the real economy or financial stability. Secondly, it does not limit the potential adverse consequences for both social equality, labour market conditions and economic growth from a dramatic house price correction.

[80] Several papers has sought to address the gap between fundamental house values and market values with opposing results, some of these suggest that house prices do not deviate from their fundamental value, see for example Claussen (2013).

5.2 Macroeconomic and macroprudential policy - Unintended consequences of policy changes

The results from the synthetic control method outlined in section Y, suggest that regional differences might limit the overall usefulness of regulation. In particular, its overall impact is more modest in the more populated regions, where it arguably is most needed. Secondly, previous research suggests that macroprudential regulation, like most regulation, could cause regulatory arbitrage. Finally, regulation might have adverse consequences for the prosperity and long term health of the real economy, by decreasing investment and consumption opportunities.

5.2.1 Unintended consequences 1 - Regional differences

The regional differences, presented in the *Part 2*, analysis, give rise to a new question: Will future macroprudential regulation 'hit the critical target', i.e. metropolitan areas, given that all measures taken so far have been imposed at a national level? It has been argued that one of the main advantages of macroprudential policy over conventional monetary policy, to 'lean' against housing imbalances in the first place, is that it can be directly targeted at specific sectors of the economy (L. E. O. Svensson, 2014). Due to their regulatory nature, prudential policy could potentially be targeted better to address the observed regional differences. Evidence has shown that the impact from the LTV hits the most credit constrained homeowners first. It is reasonable to expect that the more credit constrained groups largely consist of young generation or immigrants, which thereby pose a risk to the social equality issues earlier discussed and limits these groups' ability to smooth consumption over time. Thus, as with monetary policy, these macroprudential measures need to be adjusted cautiously to not risk creating other imbalances.

Overall, this indicates that the desired impact from the LTV and other macroprudential tools could be better accomplished if they were adjusted per regional or demographical target groups. Nevertheless, to impose different levels of macroprudential regulation might result in a loss of regulatory transparency, which could decrease the efficiency of the regulatory system[81] and makes it increasingly complex to monitor compliance. Moreover, regional variation in prudential standards could potentially create an incentive for homeowners and prospective homeowners to circumvent regulation. This leads us to the next section, discussing the potential consequences from regulatory arbitrage.

5.2.2 Unintended consequence 2 - Regulatory arbitrage

Regulating specific sectors of the economy might have unintended consequences for financial instability risks when a greater fraction of lenders starts to reallocate debt from housing to other sources of credit that

[81] This is similar to the argument against the municipalities' planning and zoning monopoly discussed in *Part 1*.

are unsecured. In this context, *regulatory arbitrage* refers to that mortgage holders reallocate their lending to credit products and services, in parts of the financial market where the regulation does not apply (Suh, 2012). This risk is hypothetically greater in more liberalised credit markets, where it is easier to substitute between credit products (Suh, 2012). Paradoxically, the regulation aimed at mitigating borrowers' sensitivity to housing market conditions might in this case make them more vulnerable to financial market conditions in the first place. Critiques have argued that macroprudential regulation fuels the development of a shadow banking system, meaning the growth of non-bank forms of financial intermediation, which are not administered under formal banking regulation (Tucker, 2010). In the Swedish context, one example of an unsecured credit product, which could be interpreted as regulatory arbitrage, is the rise of the so called Blanco loans, which inherently increases the borrower's default risk. This suggests that more regulation in one end of the market, might fuel more innovation, to potentially circumvent the regulatory system, in another.

Furthermore, the effectiveness of the mortgage cap is potentially limited by other forms of regulatory arbitrage, such as offshore lending or manipulation of housing values. Thus, from a critical point of view macroprudential policy might address potential financial imbalances that can be directly related to housing debt, at a cost of increasing the overall risk of the financial system. Nevertheless, it is inherently difficult to measure the direct magnitude of regulatory arbitrage and therefore an almost impossible task to assess if the positive effect from regulation dominates its potential negative consequences.

5.2.3 Unintended consequences 3 - Economic growth

Finally, and probably most important, is the adverse consequences from increasing regulation on the overall economic activity. It must not be forgotten that the deregulation and liberalisation of the mortgage market in the mid-1980s arose for a reason; largely to stimulate economic growth and productivity. At that time, the heavily regulated financial system appeared to limit the overall market efficiency, which ultimately proved to have adverse consequences for economic activity (Mester, 2016). Nevertheless, the lax regulation of financial markets has in general been questioned in the aftermath of the financial crisis. This has resulted in that many countries have started to tightening capital requirements and credit market regulation. Among others, increasing attention has been paid to macroprudential regulation, targeted at housing credit demand. Despite that most research from both IMF and BIS[82] takes a positive stance towards macroprudential policy, the downside of these types of policies is that they tend to increase the cost and/or the possibilities to obtain external finance, which per se discourage consumer spending and investments.

[82] See among others Borio and Shim (2007), Bruno, Shim and Shin (2015) and Claessens (2014).

This suggests that increased regulation will at best limit the financial market's vulnerability, but it comes at a potential cost of an overall decline in economic activity, which could have adverse consequences for the real economy and possibly also social equality. Thus, it is worth questioning if the macroprudential regulatory wave will bring about a situation where developed mortgage markets no longer will be associated with an 'ease of obtaining external finance'. Ironically, that per se might challenge the notion of financial stability as the *smooth functioning of the financial system,* which policymakers desperately try to accomplish.

Moreover, the development of Swedish monetary policy after 2011 shows that its conventional goals of inflation and output stability, and the more recently founded objectives of financial stability, are not always easily addressed at the same time. The credit market development illustrates that it, at least in the short run, appears to be difficult to stimulate economic growth with conventional monetary policy, without incentivising additional risk-taking. Under such scenario macroprudential policy is well suited to step in to address the latter, without hindering the former. Nonetheless, risk-taking is a fundamental driver of innovation and therefore also long-term production, which suggest that there is an upper limit to the level of macroprudential regulation, which should be confined by its overall implication for entrepreneurial activity. On that note, the next section will discuss the regulatory dilemma of trying to combine the multidimensional goals of stable inflation, economic growth and financial stability, in light of the supervisory power.

5.3 The supervisory power – Interaction between monetary and macroprudential policy

Before the outbreak of the financial crisis proponents of 'lean' policymaking claimed that asset prices only should play a role in monetary policy insofar as they affect inflation expectations. This view has been shared by many scholars[83], who agreed that central banks only should respond to the information about asset prices rather than asset prices themselves. Such view would allow a central bank to use the interest rate as the main policy instrument to lean against asset price imbalances, even if it would drive the real inflation rate away from the target during a temporary period (Bernanke & Gertler, 1999, 2001). On the contrary, opponents have suggested that the inherent difficulty in detecting asset price bubbles ex ante, makes it utterly problematic to stop them from evolving in the first place, and attempts to do so come at a risk of doing more harm than good (Greenspan, 1999).

Given the combined results from *Part 2,* suggesting that the 'lean against the wind' policy in 2010-2011 did not manage to prick the positive trend in house prices, as the effect from the interest rate alone fails to explain the development in the HPI. Nevertheless, this does not mean that central banks should be indifferent about house prices, as their impact on financial stability has the power to affect economic activity (Mester,

[83] See among others Kent et al. (1997) and Vickers (1999)

2016), whereas the latter is an explicit concern for the Riksbank[84]. This indicates that the conduct of monetary and financial stability policy should be carried out taking the conduct of the other into account, which is not necessarily affected by the supervisory power and whether it is separated or not (L. E. O. Svensson, 2014). However, it suggests that if the supervisory power is separated, as it is in Sweden, there will be a greater need for interaction between the FI and the Riksbank, to assure that the immediate financial stability concerns and the long term economic objectives are compatible. Today, the supervisory authority lies with FI, together with the Financial Stability Council the two of them are responsible for the conduct of macroprudential policy. The latter consists of representatives from the Riksbank, the government, the National Debt Office and FI, which suggest that a common forum for coordination between the different institutional bodies and their policy agenda has been created.

The interaction between financial stability and macroeconomic variables suggests that a systematic response of policymakers to asset prices could be a way of addressing one, without compromising the other. By responding systematically, policymakers could both limit the confidence risks and the information asymmetries, which could arise due to financial instability. Such approach would also address the time-consistency problem, meaning the risk of imposing both monetary and macroprudential policy with a too narrow focus on short-term problems, at the expense of long-term economic growth (Mester, 2016). However, since FI does not have a mandate to enforce macroprudential rules, this results in a general regulatory sluggishness. The implementation of the amortisation requirement is a case in point; it was on the agenda for more than one and a half year before the rule finally came into power. This shows that the division of responsibilities might have negative consequences for the optimal timing of policy making. The increase in the policy rate in 2010, which coincided with the introduction of the LTV limit, appears to be another example of questionable policy coordination in the past.

Given that the effect from the LTV seems to fade away over time, it appears relevant to ask under what conditions macroprudential policy may have a more long lasting impact in the future. This suggests that macroprudential tools might be more powerful if they are dynamically adjusted according to the business cycle, which is consistent with earlier findings, proposing that countercyclical adjustments of credit targeted measurements yields a higher potential impact (Goodhart & Hofmann, 2008). Nevertheless, every adjustment pose a risk involved with the general publics' reaction, i.e. how they alter their expectations (IMF, 2011b), and thereby adjust consumer spending and investments accordingly. As with conventional monetary policy, this suggests that it is difficult to determine the optimal calibration of regulatory instruments ex ante, which calls for cautious adjustments. Tough, a countercyclical LTV might be better

[84] The Riksbank main objective is low and stable inflation and limiting the output gap. In times of crisis it also acts as the lender of last resort.

suited to address the 'fade away' effect observed, one must not forget that the LTV is a rather new and untested instrument. Thus, if it is difficult to single out its impact on house prices and credit today, it is arguably even more challenging to assess its potential impact stimulating credit and housing demand during a potential market downturn.

Furthermore, the results from *Part 2* pointed at a relative large overall policy effect, despite that the effect from the interest rate alone appears to be small on an aggregate level. Therefore, it should be vital to address the coordination issue to potential increase the mutual effectiveness of monetary and macroprudential policy in the future. Even more so, in light of the latest report from FI (April, 2017), suggesting that a number of regulatory measures are on the agenda, as well as expectations about a future increase in the policy rate. Both the evidence of sluggish regulation and the coordination issue makes it worth questioning the effectiveness of the current institutional setup to systematically address financial stability concerns going forward.

Some scholars have taken the systematic idea of financial stability one step further and started to play with the idea of a macroprudential Taylor-type rule, suggesting that central banks could hypothetically address financial stability at the same time as they maintain focus on conventional goals (Rubio & Carrasco-Gallego, 2014). Due to the Swedish institutional setup, the nearby future of monetary policy might not involve an active incorporation of financial stability indicators in the Riksbank's decision-making models. Instead, most attention has been directed towards that FI still lacks the mandate to enforce new prudential regulation, without first obtaining the government's and the parliament's consent. The long and tedious process has resulted in a new proposal presented for the parliament, which advices that the FI should obtain sole mandate to enforce new macroprudential regulation on its own (Ministry of Finance, 2017). Nevertheless, it is worth questioning if a mandate on its own will address the need for more systematic conduct of macroprudential policy.

The role of housing taxation and the impact from potential tax changes

Throughout this paper, taxes have been analysed in light of the current property tax regime. Nevertheless, today's tax regime has been critiqued for increasing the incentives for homeowners to take on mortgage debt (mortgage interest tax deductibility) and the capital gains tax has been critiqued for worsening housing market mobility. Given current tax distortions, institutional reports as well as the popular media have questioned why the property tax system has not yet undergone a fundamental change (The European Comission, 2017; The Economist, 2015). Thus, it is worth discussing some of the implications of potentially changing the property tax system for both house prices, consumption and household debt.

If one considers the impact from eliminating or lowering the tax deductibility on mortgage interest payments or increasing the property charge, the effect on house prices can be understood by examining its impact on the user cost of housing. Such change implies that the user cost of housing will rise and, ceteris paribus, house prices should fall in proportion to the increase in the user cost, to offset the total effect from a tax change. These two hypothetical tax changes also have an adverse impact on their disposable. Furthermore, the theoretical fall in house prices would have a negative impact on the wealth effect. Given the findings from *Part 1*, both effects will have a depressing impact on consumer spending.

Additionally, a change in the tax reform could potentially involve changing the capital gains tax from real estate trade. One option to address the discussed mobility issues, could be to allow the capital gains tax to vary, being a decreasing function of the length of homeownership. Under such scenario, the net effect on consumer spending for the individual household will depend on the overall holding period - the longer holding period, the lower capital gains tax from trading, which increases the housing wealth effect and potentially also mobility. A change in the general level of capital gains taxes on real estate, independent on the length of the homeownership, will have different effects on consumer spending, depending on the household's stage in the lifecycle.

If in its early stage of homeownership, the effect is expected to be small, as the future holding period is relatively longer. If the household is in the later stage of the lifecycle, for instance when the pension is approaching, the wealth effect from a theoretical change in the capital gains tax will be greater, considering that a potential trade to realise housing wealth increases. For a third type of households, those that plan to upgrade the size or quality of their dwelling within the not too distant future, the housing wealth effect will depend on the relative importance of the tax's impact on capital gains versus the tax's impact on house prices. In other words, a decline in the capital gains tax will have a positive effect on the housing wealth effects from trade. Nevertheless, the new home will have increased in value from the fall in the tax rate, meaning that the net effect on consumer spending should be rather marginal. Overall, this suggest that the net effect on aggregate consumption, from a hypothetical change in the property capital gains tax, depends on the relative fraction of different household types.

One would also expect that the magnitude of a potential tax reform on aggregate consumer spending is correlated with the relative distribution of homeowners and renter, whereas owner-occupied households are most affected by all the potential tax reforms outlined above. The large fraction of homeowners in Sweden makes the hypothetical effect on aggregate demand greater. Moreover, it has been argued that the potential direct effect on household debt will be small, because the only way for households to reduce debt drastically

in the short run, is by selling assets, and a change in the tax reform does not, for most households at least, create an incentive to sell assets to repay debt. (Swedish Fiscal Policy Council, 2016).

Previous paragraphs suggest that the overall effect from a potential change of residential taxes, like all other macroprudential regulation, should not solely be considered in light of its potential impact on debt and house prices, but also economic activity. In the long run, a reduction in interest tax deductibility suggests that debt financing becomes less attractive, which therefore should, at least to some extent, address the problem of growing household debt. Moreover, since credit accessibility is a fundamental driver of house prices, such tax change should theoretically put a downward pressure on the price level. Henceforth, a hypothetical tax reform could lower household debt and housing demand, and is difficult to circumvent by regulatory arbitrage, at least within the national borders. Despite that there appears to be advantages for changing the tax system, doing so is an even more extensive process than imposing a macroprudential rule targeted at one sector of the financial system. As mentioned, the tax incentives for homeownership has arisen for political reasons to support the welfare state. This suggests that tax changes are possibly an even more sensitive political topic than other forms of macroprudential regulation, posing a constraint to what changes one should expect in the nearby future.

Moreover, the principles of tax neutrality implies that a fundamental alteration of taxes in one end of the system requires changes across the whole tax system. Thus, any potential future alteration of real estate taxes needs to be seen in light of the broader capital taxation system. For example, considering an alteration of the interest tax deductibility, the tax neutrality principle states that the deductibility of mortgage interest payment must correspond to tax deduction similar to those for income and capital (Englund, 2016). From that perspective, it is highly unlikely to expect that any dramatic changes to the property tax reform is around the corner.

Finally, opposite to the real debt burden, which is greater in today's deflationary climate, a potential alteration of the tax reform in the current low interest rate environment will depress the real income level more modestly. However, the real decline in income will be greater if interest rates increase. This suggests that one should not expect a fundamental change of the tax system as long as the economy is trapped in the current state of zero-bound interest rates (Swedish Fiscal Policy Council, 2016). The fact that the FI already communicated that they expect a rise in the policy rate by the early 2018, makes it reasonable to expect that fiscal policymakers must be careful, if they at all pursue to investigate this further, to not put the overall consumer confidence at stake.

5.4 Avenues for future research

Despite the rather vast amount of previous research on the housing market's role in the real economy, as well as in financial markets, the evidence put forward in this thesis has revealed some interesting aspects, which could be fruitful to investigate further in the market specific context. Thus, this section will discuss some avenues for future research, considering the more general limitations to the insights provided in this thesis and how they could be addressed in future studies. First, the results from the first part focused with few exceptions on the housing market's transmission mechanism on the real economy and financial stability. Nevertheless, the findings pointed at some important structural factors related to both the credit market, the rental system and construction sector, which appears to create market distortions and thereby affects house prices in the first place. In the same vein, the results from *Part 2,* suggest that it could be rewarding to study some of the institutional and structural factors, taking a more 'top-down' approach, to better address the root cause of the current housing market development.

In particular, the results from the SCM suggest that the effect was greatest in the real HPI occurred approximately one year after the policy changes. Either this could be due to inherit features in the data, or be seen as a long delay in the response to the policy shock, or as an indication of other important explanatory factors, which have been omitted from the analysis. In either case, it could be fruitful to investigate this event further, as it is arguably difficult to address the housing and credit market conditions more accurately in the future, unless one understand its underlying dynamics over the past. Specifically, the data limitations restricted our study to mainly be concerned with demand related measures such as past house prices, the policy rate, employment and GDP to mention a few. This calls for a more thorough study of the role and relative importance of supply side measures. Such investigation appears even more important as supply and demand shocks to the housing sector should not be targeted by the same instruments[85]. In other words, the supply side needs to be addressed by other tools than those targeted at credit demand, and as of today both academia and policymakers have only addressed these to a limited extent in the Swedish context.

Furthermore, some of the unintended consequences of macroprudential regulation appears to be relevant to investigate further, as these have implication for the efficiency of each individual policy, but also for the overall interaction between monetary and macroprudential policy to promote financial stability, without sacrificing economic growth. The latter has obtained some attention during the past years[86], but this is relatively modest in comparison to the large amount of reports focusing on the advantages of macroprudential policy. In the Swedish context, it could be rewarding to dedicate research efforts to investigate the demographic variations of policy effects, in order to target macroprudential policy more

[85] See Kannan, Rabanal and Scott (2012).
[86] See Tucker (2016).

effectively in the future. Especially if it puts social equality and productivity at stake. Nevertheless, potential regional or 'across groups' adjustment of regulation is easier said than done, the municipalities planning and zoning monopoly provides a case in point, where the lack of transparency and regional variation arguably could be a cause of the passiveness of national incentives for more construction.

Moreover, this thesis has not directly addressed the role of expectations in greater detail. The expectation aspects of monetary policy are rather well accepted, i.e. the long-term interest rate is the weighted average of the current and expected future short term rate. Nevertheless, the role of expectations in macroprudential policymaking is much less explored. As suggested by Mester, (2016) this topic deserves more attention in light of the critical timing of policy-making and delicate communication of policy choices to affect households expectations in a balanced way. Thus, the role of expectations has important implications for households' consumption, investments and risk-taking behaviour, which ultimately has an impact on both the real economy and financial stability. However, measuring the relative impact from the role of expectations in macroprudential policy, has been beyond the scope of this paper, yet an interesting avenue for future researcher.

6.0 Conclusion

The aim of this thesis has been twofold; the first part sought to provide evidence on the housing market's transmission mechanism on the real economy and financial stability in the Swedish context. The second part has tested the empirical role of monetary and other macroprudential tools, to mitigate house price fluctuations. The first part has investigated the housing market's transmission mechanism through an analytical framework, supported by theoretical concepts and empirical evidence. The findings from *Part 1* lends support for a housing wealth effect on consumption, mainly driven by the important role of the housing collateral, to lower the cost of external finance and to create refinancing opportunities. This has been particular important for the credit constrained homeowner. The evidence suggests that the growing importance of the collateral wealth effect mainly has been the outcome of credit market deregulation since the 1980s, which has increased the opportunities to extract secondary mortgages and obtain variable mortgage contracts. Despite recent regulation, the Swedish mortgage market is still very liberal, which makes the collateral effect one of the more crucial transmitters between the housing market and consumption. Moreover, the persistent positive trend in house prices, coupled with a high rate of homeownership suggests that the increase in housing wealth should have a positive impact on consumption.

Nevertheless, the findings suggest that some structural and institutional factors may offset part of the positive wealth effect. For instance, the taxation system creates lock-in effects, which limits both mobility and trade. Furthermore, the evidence outlined suggests that the housing market does not appear to be a strong driver of residential investment; thus, its impact on GDP is expected to be rather modest. However, the sluggishness in the housing supply sector could be related to institutional factors, such as the municipalities planning and zoning monopoly, which potentially limits firms' ability to respond to housing demand. As discussed, this has potential adverse consequences for labour market conditions and thereby, long run productivity and economic growth. Thus, the evidence implies that some of the structural features related to the housing shortage appears to be of equal importance to address the housing market accurately in the future.

Furthermore, credit market deregulation has not only had a positive impact on credit availability among constrained consumers, it has also increased the sensitivity of the financial system to the housing cycle. The growth in variable mortgages, relative high LTV levels and the average long amortisation periods, make borrowers more sensitive to housing market fluctuations, in particular if they are driven by monetary policy shocks, given its direct impact on both house prices and variable mortgage payments. Moreover, mortgage loans are one of the most important assets on several banks' balance sheets, suggesting that there is a high interdependence between borrowers and lenders, which potentially could have adverse consequences for the confidence in the financial system given a house price drop. Also, the maturity mismatch and high LTV level suggest that banks still bear a relative high risk burden related to mortgage lending. Despite that increasing

macroprudential regulation has somewhat strengthen the resilience of the financial system, the results from *Part 2* suggest that there is more to be done.

The findings from *Part 1* suggest that several of the wealth effects, which fuels the housing market's transmission mechanism to the real economy and financial stability, are amplified or partly offset by institutional and structural factors, which might change in the future. In particular, recent macroprudential measures taken to address housing related credit growth, indicate that the strength of the collateral wealth effect might be more moderate in the future. In that sense, the concluding remarks are to be understood in light of the current state of these factors.

The results from *Part 2* show that the policy change in 2010 dampened the positive trend in house prices, and this effect does not appear to be strongly driven by the policy rate. In line with previous findings, the VAR results suggest that policy rate do affect house price. However, the combined effect from the SCM and the VAR, disentangling the policy rate effect to that of the LTV, suggests that the interest rate alone has only had a moderate impact on the house price development. The empirical results suggest that the LTV have had an effect, but other factors, such as the difference between the Swedish and Canadian HPI in that period, might have contributed to the unexpected increase in the gap between Sweden and its synthetic counterpart, approximately one year after the policy changes. Moreover, the results from the amortisation requirement show that it has had no effect so far, which could be due to the rather limited post-treatment time period, thus it could be fruitful to try to investigate its effect again in the future.

The results reveal two other patterns worth noticing; 1) the effect from the intervention appears to fade away over time and 2) the intervention might have unintended consequences, given that the impact appears to be stronger and more persistent in the regions where the housing market development is less worrisome. Thus, the measures taken have not been effective enough to punctuate the strong positive growth in house prices, rather it suggests that they succeeded to alleviate it temporarily. This implies that macroprudential policy might be more efficient if adjusted dynamically. Also, the empirical evidence indicates that policymakers should take into consideration the unintended consequences of regulatory choices, such as the increase in unsecured credit. Furthermore, the current conduct and interaction between monetary and macroprudential policy suggest that coordination issues might limit their overall efficiency. In general, one of the main arguments against 'leaning against the wind' policies is that it has proved difficult for central banks to detect dangerous housing market imbalances ex ante. In the same vein, it is worth questioning if it is much easier to adjust macroprudential policy ex ante to address housing market imbalances. This suggests that the 'lean-clean' debate is still a relevant avenue for future research in the Swedish context, now also including the role of macroprudential policies.

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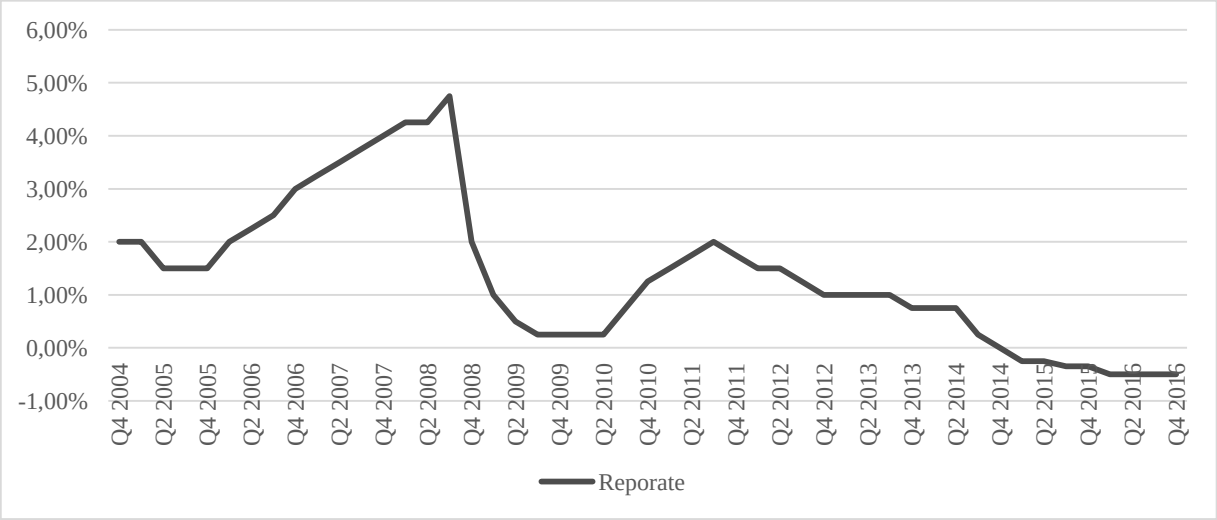
Appendices

Appendix 1

The Swedish policy rate (repo rate) Q4 2004-Q4 2016



Appendix 2

Macroprudential and their implementation date in Sweden

Macro prudential supply side measure (since 2010)	Implementation
Maximum LTV ratio 85 %	October 2010
Risk-weight floor for mortgages 15 percent	May 2013
LCR regulation, including in euro, U.S. dollar, and total	January 2014
Pillar II capital add-on 2 percent for the four largest banks	September 2014
Risk-weight floor for mortgages, 25 %	September 2014
Systemic risk buffer 3 percent for four largest banks	January 2015
Counter-cyclical capital buffer activated at 1 percent	September 2015
Amortisation requirement	June 2016
Counter-cyclical capital buffer raised at 1,5 percent	June 2016
Counter-cyclical capital buffer raised at 2,0 percent	March 2017

Appendix 3

The property taxation system in Sweden

Type of tax	**Target group: Owner-Occupied housing**
Real estate tax - "Property charge"	0.75 % of assessed value or maximum 7,412.00 SEK corresponding to a taxation value of 988 000 for houses. 0.3 % for apartments and maximum 1268.00 SEK
Imputed tax (Schablonintäkt)	1,67 % of 30% of the deferred amount resulting in an effective tax of 0.5 %
Loan Interest Deductibility	Loan interest is tax deductible at 30 %, meaning that 30 % of interest payments can be recovered
Capital gain tax	Only 22/30 of capital gains/losses are taxed. Capital gain taxes can be deferred
Wealth tax	No longer applies, before 2007 1.5 % - 3 % of assessed value

Appendix 4

Lag selection critera – Individual variables

	Inflation		HPI		GDP		Policy rate	
Lag	**HQIC**	**SBIC**	**HQIC**	**SBIC**	**HQIC**	**SBIC**	**HQIC**	**SBIC**
0								
1								
2					-6.50*	-6.46*		
3							-7.77*	-7.71* |
4								
5		-7.44*						
6	-7.56*							
7								
8			-5.40*	-5.22*				
9								
10								
11								
12								

Lag Selection Criteria - All Model

Lag	HQIC[87]	SBIC[88]
0	-24 .30	-24.22
1	-27.08	-26.69
2	-27.56*	-26.85**
3	-27.31	-26.30
4	-27.28	-25.96
5	-27.26	-25.62
6	-27.12	-25.16
7	-27.00	-24.74
8	-26.95	-24.38
9	-27.07	-24.18
10	-26.97	-23.76
11	-27.24	-23.73
12	-26.98	-23.15

[87] Hannan and Quinn information criterion.
[88] The Schwarz Bayesian Information Criterion.

Appendix 5

Johansen cointegration test (nr. of obs= 77)

No. of Cointegration relations (Null hypothesis)	**Eigenvalue**	**Trace Statistics**	**5 % critical value**
None	.	92.9453	54.64
At most 1	0.42085	50.8882	34.55
At most 2	0.27380	26.2531	18.17
At most 3	0.18630	10.3785	3.74
At most 4	0.12610	.	.

Appendix 6

Real HPI (Canada and Sweden) and the pre-period means

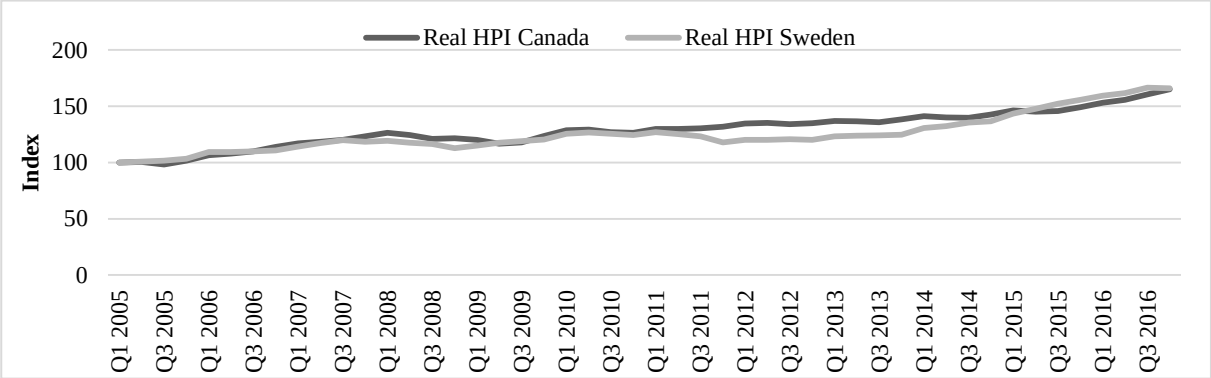


Chart: Real HPI Sweden & Canada (Index) Q1 (2005=100). Source: Bloomberg and own calculations

	Sweden	**Average Canada**
GDP growth rate	1.32 %	0.87 %
Income growth rate	0.85 %	0.75 %
Credit growth rate	1.49 %	1.79 %
Employment rate	58.80 %	62.58 %
National policy rate	2.14 %	2.55 %
Foreign policy rate	2.52 %	2.71 %
Inflation (CPI growth rate)	0.34 %	0.43 %
Population growth	0.24 %	0.34 %
Construction growth	0.62 %	0.58 %
Wealth growth	1.86 %	1.20 %
HPI pre-period (growth)	1.30 %	1.44 %

Table: Pre-treatment (LTV) house price predictor means (Q1 2005-Q3 2010)

Note: The second column reports a population weighted average for the 11 Canadian cities in the donor pool.

	Sweden	Average Canada
GDP growth rate	0.39 %	0.03 %
Income growth rate	0.83 %	0.67 %
Credit growth rate	0.71 %	0.88 %
Employment rate	58.96 %	62.11 %
National policy rate	2.25 %	1.81 %
Foreign policy rate	1.63 %	1.56 %
Inflation (CPI growth rate)	0.26 %	0.43 %
Population growth	0.20 %	0.32 %
Construction growth	0.47 %	0.34 %
Wealth growth	1.69 %	1.24 %

Table: Pre-period means up until Q 2015 (Amortisation requirement)

Note: The second column reports a population weighted average for the 11 Canadian cities in the donor pool.

Appendix 7

Variables Overview (SCM and VAR)

Sweden (SCM)

Variable	Data Source	S.A.	Deflated/Real	Manual Calculations
Dependent:				
HPI Sweden	Datastream	Yes	Yes	No
HPI "Big Cities"	Statistics Sweden	Yes	Yes	Yes, linearly weighted by population
HPI "Small Cities"	Statistics Sweden	Yes	Yes	Yes, linearly weighted by population
Independent:				
Wage growth	Statistics Sweden	Yes	Yes	Yes, logged to obtain growth rate
Population growth	Statistics Sweden	Yes	N/A	Yes, logged to obtain growth rate
GDP Growth	Statistics Sweden	Yes	Yes	Yes, logged to obtain growth rate
Fraction of pop. employed in Agriculture	Statistics Sweden	Yes	N/A	Yes, percentage fraction calculated manually
Fraction of pop. employed in Manufacturing	Statistics Sweden	Yes	N/A	Yes, percentage fraction calculated manually
Fraction of pop. employed in Construction	Statistics Sweden	Yes	N/A	Yes, percentage fraction calculated manually
Employment rate	Statistics Sweden	Yes	N/A	Yes, percentage fraction calculated manually
Pre-period growth in HPI	Statistics Sweden	Yes	Yes	Yes, logged to obtain growth rate

Canada (SCM)

Variable	Data Source	S.A.	Deflated/Real	Manual Calculations
Dependent:				
Regional HPI Canada	Datastream	Yes	Yes	No
Independent:				
Wage growth	Datastream	Yes	Yes	Yes, natural logarithm to obtain growth rate
Population growth	Bloomberg	Yes	N/A	No
GDP Growth	Datastream	Yes	Yes	Yes, natural logarithm to obtain growth rate
Fraction of pop. employed in Agriculture	Datastream	Yes	N/A	Yes, percentage fraction calculated manually
Fraction of pop. employed in Manufacturing	Datastream	Yes	N/A	Yes, percentage fraction calculated manually
Fraction of pop. employed in Construction	Datastream	Yes	N/A	Yes, percentage fraction calculated manually
Employment rate	Bloomberg	Yes	N/A	No
Pre-period growth in HPI	Datastream	Yes	Yes	Yes, natural logarithm to obtain growth rate

Sweden (VAR)

Variable	Data Source	S.A.	Deflated/Real	Manual Calculations
CPI	Datastream	Yes	Nominal	Yes, natural logarithm to obtain inflation rate
HPI	Datastream	Yes	Yes	Yes, converted to real and logged
GDP	Datastream	Yes	Yes	Yes, natural logarithm to obtain growth rate
3-month short term interest rate	Datastream	-	-	NO

Appendix 8

Amortisation requirement (*Big Cities* and *Small Cities*)

City	Regression weight
Hamilton	66.7 %
Victoria	33.3 %
All Others	0.0 %

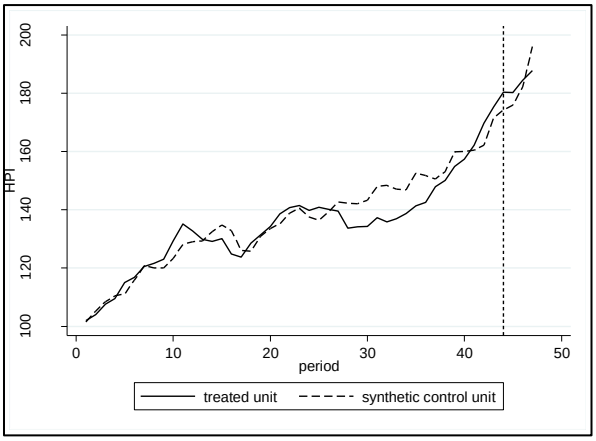
Table: Synthetic weights - Big Cities as the treated unit

Note: All Others represents Quebec, Toronto, Montreal, Vancouver, Edmonton, Calgary, Halifax, Winnipeg and Ottawa

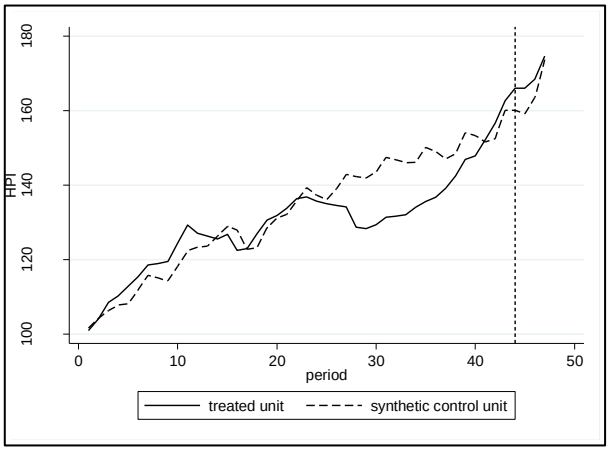
City	Regression weight
Hamilton	32.8 %
Victoria	20.0 %
Ottawa	77.2 %
All Others	0.0 %

Table: Synthetic weights using 'Small Cities' as the treated unit

Note: All Others represents Quebec, Toronto, Montreal, Vancouver, Edmonton, Calgary, Halifax and Winnipeg



HPI treated Big Cities vs. Synthetic (RMSPE 5.46)



HPI treated Small Cities vs. Synthetic (RMSPE 7.42)

Appendix 9

Predictor weights (W)

Solution weights (Q1 2005 - Q3 2010) - Small

	v.Weights (Small)	**v.Weights (Big)**	**v.Weights (All)**
Wage Growth	29.0 %	10.2 %	15.9 %
Population Growth	17.6 %	0.3 %	3.5 %
GDP Growth	10.5 %	7.0 %	8.0 %
Agri. & Manu. sector	9.8 %	15 %	3.1 %
Construction sector	4.1 %	26.2 %	18.2 %
Employment	25 %	26.6 %	48.4 %
HPI growth	5.9 %	14.7 %	2.8 %

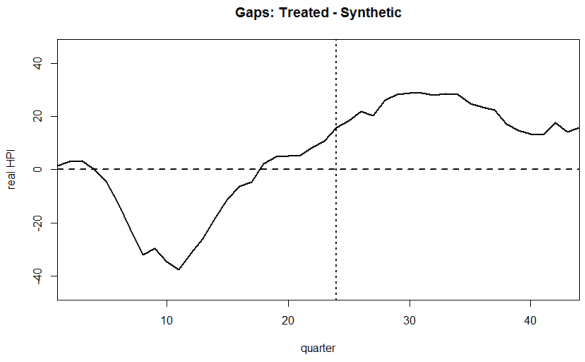
Note: Pre-period estimates derived from 'Synth'

Appendix 10

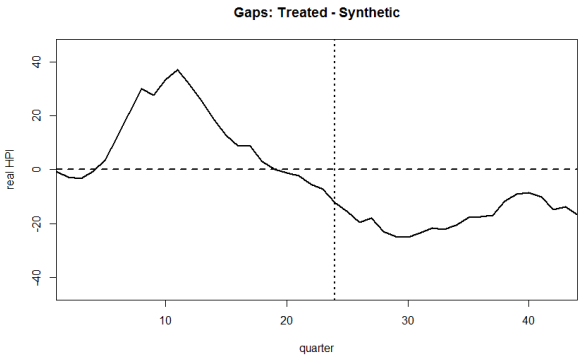
Placebo test

All Sweden

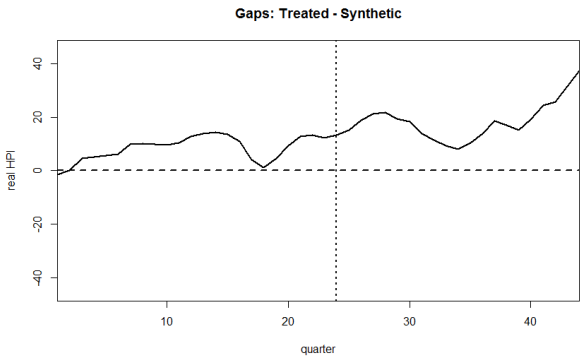
Synthetic: Winnipeg (6)



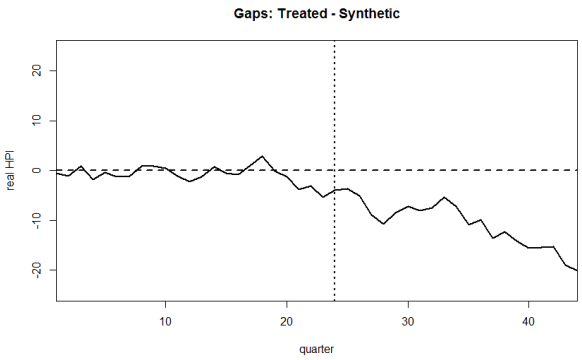
Synthetic: Calgary (5)



Synthetic: Vancouver (4)

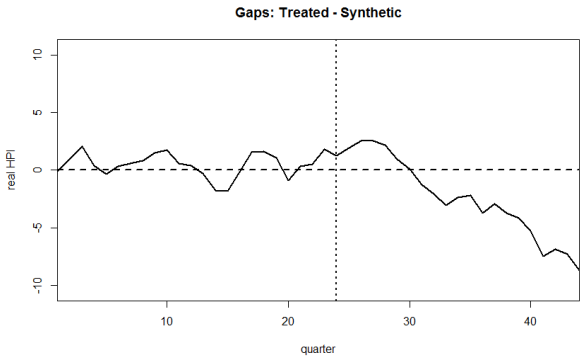


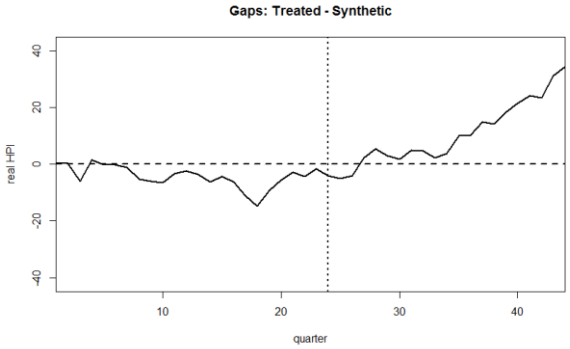
Synthetic: Halifax (3)



Synthetic Montreal (2)

Synthetic: Toronto (1)

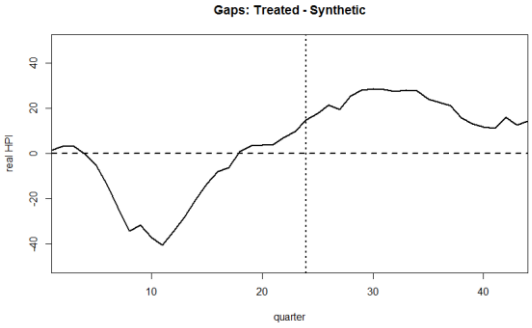


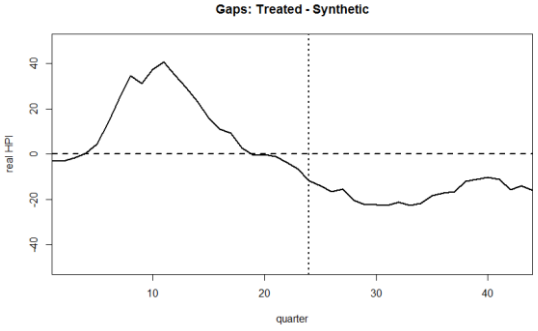


Big cities

Synthetic: Winnipeg (6)

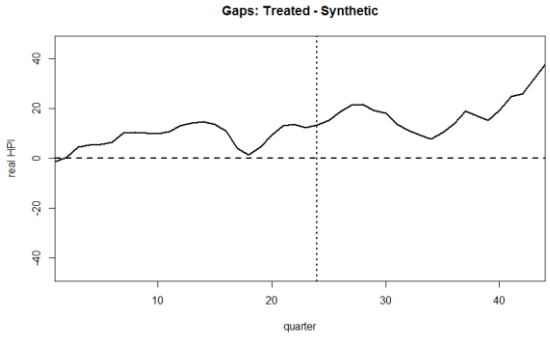
Synthetic: Calgary (5)

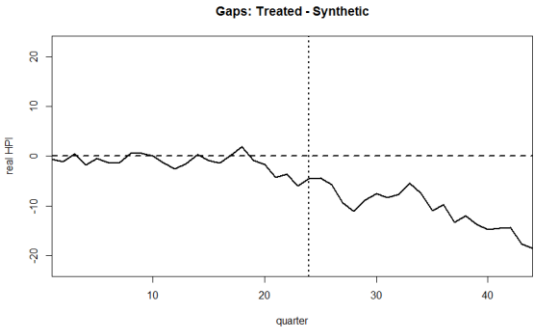




Synthetic: Vancouver (4)

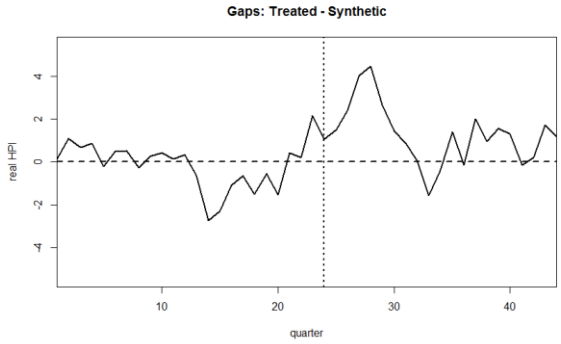
Synthetic: Halifax (3)

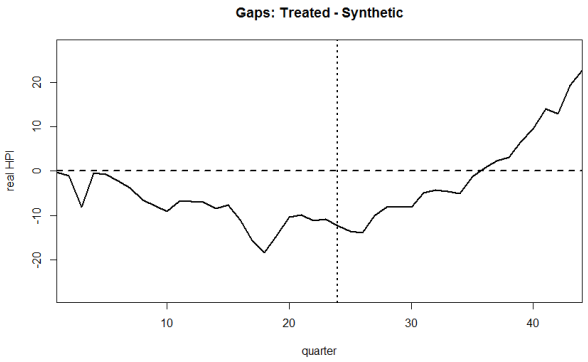




Synthetic: Montreal (2)

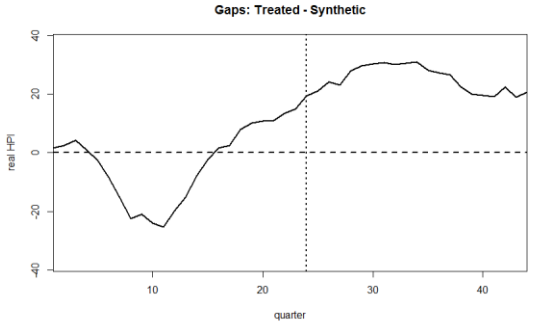
Synthetic: Tornonto (1)



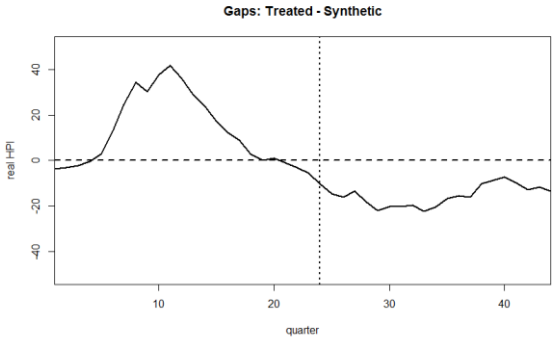


Small cities

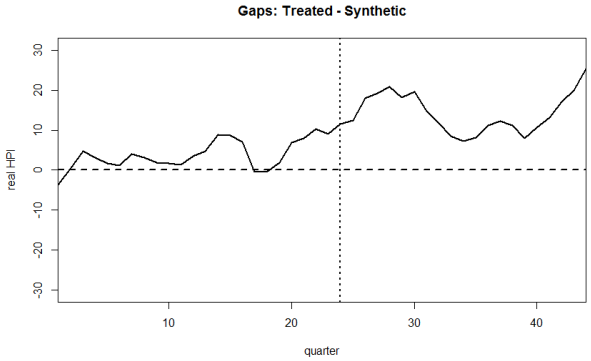
Synthetic: Winnipeg (6)



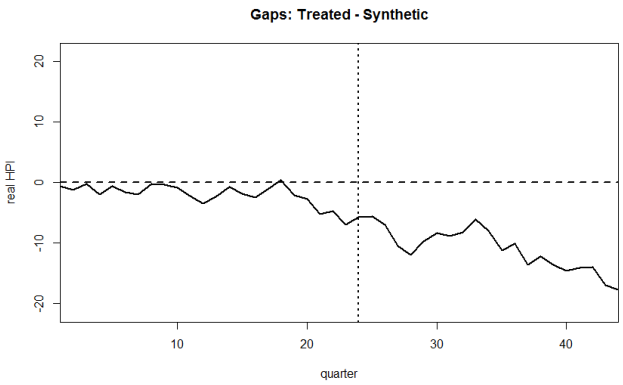
Synthetic: Calgary (5)



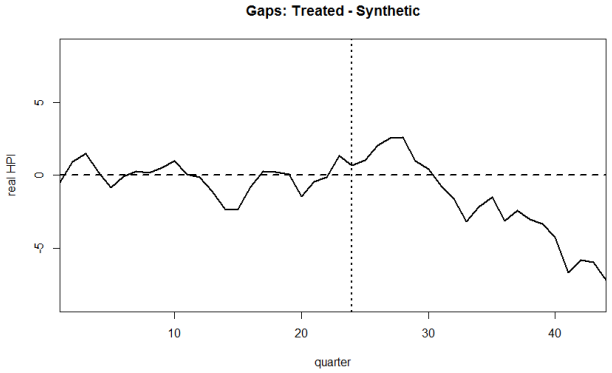
Synthetic: Vancouver (4)



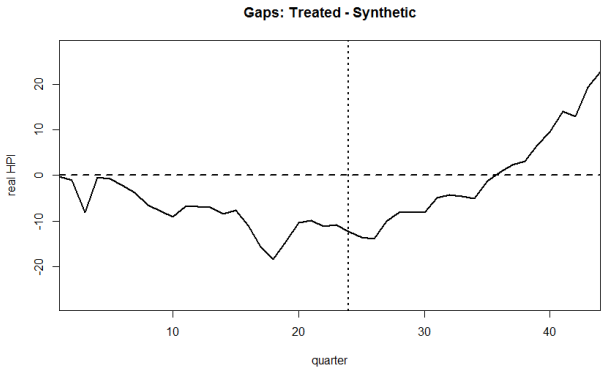
Synthetic: Halifax (3)



Synthetic: Montreal (2)



Synthetic: Toronto (1)



Appendix 11

The impulse response function (oirf) and the forecast error variance decomposition (fevd)

step	(1) oirf	(1) Lower	(1) Upper	(1) S.E.	(1) fevd	(1) Lower	(1) Upper	(1) S.E.
0	0	0	0	0	0	0	0	0
1	-.010373	-.014443	-.006302	.002077	0	0	0	0
2	-.009501	-.013958	-.005045	.002274	.276484	.106278	.44669	.086841
3	-.002626	-.007223	.001972	.002346	.393966	.212975	.574957	.092344
4	-.003326	-.00713	.000478	.001941	.401409	.215317	.587501	.094947
5	-.004171	-.00789	-.000451	.001898	.382051	.206952	.55715	.089338
6	-.003753	-.006993	-.000514	.001653	.395259	.217832	.572686	.090526
7	-.00289	-.006053	.000273	.001614	.403928	.223285	.584571	.092166
8	-.002235	-.005219	.000749	.001523	.410395	.225143	.595647	.094518
9	-.001836	-.004696	.001025	.00146	.410421	.224067	.596774	.09508
10	-.001463	-.00411	.001184	.001351	.410709	.222857	.598561	.095845
11	-.001363	-.003845	.001118	.001266	.410561	.221435	.599687	.096494
12	-.001104	-.003423	.001216	.001184	.411126	.220562	.601691	.097228
13	-.000817	-.002961	.001327	.001094	.411269	.219879	.602659	.09765
14	-.000643	-.00261	.001324	.001004	.411139	.219227	.60305	.097916
15	-.000543	-.002329	.001244	.000911	.410947	.218745	.60315	.098064
16	-.000464	-.002079	.001151	.000824	.410874	.218402	.603347	.098202
17	-.000369	-.001818	.00108	.000739	.410842	.218196	.603487	.09829
18	-.000289	-.001579	.001	.000658	.410818	.218057	.603579	.098349
19	-.000233	-.001379	.000912	.000584	.410782	.217971	.603593	.098375
20	-.000195	-.001204	.000814	.000515	.41076	.217913	.603606	.098393
21	-.000164	-.00105	.000721	.000452	.410747	.217877	.603616	.098405
22	-.000134	-.000907	.00064	.000395	.410742	.217854	.60363	.098414
23	-.000108	-.000782	.000566	.000344	.410738	.217841	.603636	.098419
24	-.000089	-.000673	.000496	.000298	.410735	.217832	.603638	.098422

Impulse: Policy Rate, Response: HPI

step	(1) oirf	(1) Lower	(1) Upper	(1) S.E.	(1) fevd	(1) Lower	(1) Upper	(1) S.E.
0	.058178	.049049	.067307	.004658	0	0	0	0
1	.012378	-.001643	.026399	.007154	.929081	.819264	1.0389	.05603
2	.005554	-.007396	.018505	.006608	.900859	.770456	1.03126	.066534
3	.013042	-.001283	.027368	.007309	.727585	.547602	.907567	.091829
4	.00898	-.002307	.020267	.005759	.706041	.52393	.888153	.092916
5	.014665	.003553	.025777	.005669	.702843	.517535	.888152	.094547
6	.007786	-.002098	.01767	.005043	.706552	.523094	.890009	.093602
7	.005663	-.00342	.014747	.004635	.706291	.520424	.892159	.094832
8	.004787	-.004232	.013807	.004602	.695436	.5007	.890173	.099357
9	.004767	-.003396	.012931	.004165	.692956	.494838	.891075	.101083
10	.00476	-.003057	.012577	.003988	.691046	.490316	.891777	.102415
11	.002961	-.004073	.009995	.003589	.690797	.489106	.892488	.102905
12	.00238	-.004201	.00896	.003358	.689724	.486556	.892892	.103659
13	.001953	-.004125	.00803	.003101	.688577	.48397	.893185	.104394
14	.001782	-.003731	.007294	.002812	.687949	.482479	.89342	.104834
15	.001529	-.003471	.006529	.002551	.687595	.481584	.893606	.10511
16	.001122	-.003325	.005568	.002269	.6874	.481091	.893709	.105262
17	.000899	-.003089	.004886	.002035	.687208	.480628	.893788	.1054
18	.000735	-.002805	.004275	.001806	.687054	.480271	.893836	.105503
19	.000648	-.002474	.003769	.001593	.686964	.480053	.893874	.105568
20	.000537	-.002208	.003283	.001401	.686909	.479922	.893895	.105607
21	.000421	-.001975	.002818	.001223	.686876	.479842	.893909	.105631
22	.000343	-.001749	.002435	.001067	.686849	.479779	.893918	.105649
23	.000285	-.001531	.002101	.000927	.68683	.479736	.893924	.105662
24	.000244	-.00133	.001818	.000803	.686818	.479708	.893928	.10567

Impulse: Policy Rate, Response Policy Rate

Appendix 12

Estimating the response in HPI from Q4 2010

	Policy Rate	Change in Policy rate	Adjusted of own response	OIRF	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
2010 Q1															
2010 Q2	0,25%														
2010 Q3	0,75%	0,50%	0,023%		-1,04%	-0,0002%									
2010 Q4	1,25%	0,50%	0,023%		-0,01%	0,0000%	-0,0002%								
2011 Q1	1,50%	0,25%	0,011%		-0,26%	-0,0001%	0,0000%	-1,1879E-06							
2011 Q2	1,75%	0,25%	0,011%		-0,26%	-0,0001%	-0,0001%	-1,0879E-08	-1,1879E-06						
2011 Q3	2,00%	0,25%	0,011%		-0,33%	-0,0001%	-0,0001%	-3,0068E-07	-1,0879E-08	-2,7204E-10					
2011 Q4	1,75%	-0,25%	-0,011%		-0,42%	-0,0001%	-0,0001%	-3,0068E-07	-3,0068E-07	-2,4912E-12	1,1879E-06				
2012 Q1	1,50%	-0,25%	-0,011%		-0,38%	-0,0001%	-0,0001%	-3,8083E-07	-3,0068E-07	-6,8855E-11	1,0879E-08	1,1879E-06			
2012 Q2	1,50%	0,00%	0,000%		-0,29%	-0,0001%	-0,0001%	-4,7758E-07	-3,8083E-07	-6,8855E-11	3,0068E-07	1,0879E-08	0,000%		
2012 Q3	1,25%	-0,25%	-0,011%		-0,22%	-0,0001%	-0,0001%	-4,2972E-07	-4,7758E-07	-8,7209E-11	3,0068E-07	3,0068E-07	0	1,1879E-06	
2012 Q4	1,00%	-0,25%	-0,011%		-0,18%	0,0000%	-0,0001%	-3,3091E-07	-4,2972E-07	-1,0937E-10	3,8083E-07	3,0068E-07	0	1,0879E-08	1,1879E-06
2013 Q1	1,00%	0,00%	0,000%		-0,15%	0,0000%	0,0000%	-2,5591E-07	-3,3091E-07	-9,8406E-11	4,7758E-07	3,8083E-07	0	3,0068E-07	1,0879E-08
2013 Q2	1,00%	0,00%	0,000%		-0,11%	0,0000%	0,0000%	-2,1022E-07	-2,5591E-07	-7,5777E-11	4,2972E-07	4,7758E-07	0	3,0068E-07	3,0068E-07
2013 Q3	1,00%	0,00%	0,000%		-0,08%	0,0000%	0,0000%	-1,6751E-07	-2,1022E-07	-5,8603E-11	3,3091E-07	4,2972E-07	0	3,8083E-07	3,0068E-07
2013 Q4	0,75%	-0,25%	-0,011%		-0,06%	0,0000%	0,0000%	-1,2641E-07	-1,6751E-07	-4,8141E-11	2,5591E-07	3,3091E-07	0	4,7758E-07	3,8083E-07
2014 Q1	0,75%	0,00%	0,000%		-0,04%	0,0000%	0,0000%	-9,3547E-08	-1,2641E-07	-3,8361E-11	2,1022E-07	2,5591E-07	0	4,2972E-07	4,7758E-07
2014 Q2	0,75%	0,00%	0,000%		-0,03%	0,0000%	0,0000%	-7,3624E-08	-9,3547E-08	-2,8947E-11	1,6751E-07	2,1022E-07	0	3,3091E-07	4,2972E-07
2014 Q3	0,25%	-0,50%	-0,023%		-0,02%	0,0000%	0,0000%	-4,2251E-08	-7,3624E-08	-2,1422E-11	1,2641E-07	1,6751E-07	0	2,5591E-07	3,3091E-07
2014 Q4	0,00%	-0,25%	-0,011%		-0,02%	0,0000%	0,0000%	-3,3091E-08	-4,2251E-08	-1,686E-11	9,3547E-08	1,2641E-07	0	2,1022E-07	2,5591E-07
2015 Q1	-0,25%	-0,25%	-0,011%		-0,02%	0,0000%	0,0000%	-2,6679E-08	-3,3091E-08	-9,6754E-12	7,3624E-08	9,3547E-08	0	1,6751E-07	2,1022E-07
2015 Q2	-0,25%	0,00%	0,000%		-0,01%	0,0000%	0,0000%	-2,2328E-08	-2,6679E-08	-7,5777E-12	4,2251E-08	7,3624E-08	0	1,2641E-07	1,6751E-07
2015 Q3	-0,35%	-0,10%	-0,005%		-0,01%	0,0000%	0,0000%	-1,8778E-08	-2,2328E-08	-6,1094E-12	3,3091E-08	4,2251E-08	0	9,3547E-08	1,2641E-07
2015 Q4	-0,35%	0,00%	0,000%				0,0000%	-1,2366E-08	-1,8778E-08	-5,113E-12	2,6679E-08	3,3091E-08	0	7,3624E-08	9,3547E-08
2016 Q1	-0,50%	-0,15%	-0,007%					-1,0191E-08	-1,2366E-08	-4,3002E-12	2,2328E-08	2,6679E-08	0	4,2251E-08	7,3624E-08
2016 Q2	-0,50%	0,00%	0,000%						-1,0191E-08	-2,8318E-12	1,8778E-08	2,2328E-08	0	3,3091E-08	4,2251E-08
2016 Q3	-0,50%	0,00%	0,000%							-2,3336E-12	1,2366E-08	1,8778E-08	0	2,6679E-08	3,3091E-08
											1,0191E-08	1,2366E-08	0	2,2328E-08	2,6679E-08
												1,0191E-08	0	1,8778E-08	2,2328E-08
													0	1,2366E-08	1,8778E-08
														1,0191E-08	1,2366E-08
															1,0191E-08

12th	13th	14th	15th	16th	17th	18th	19th	20th	21st	22nd	23rd	24th	Accumulated cha	1+accumulated cha	Year	Quarter	Synthetic H	Lagged Reaction
													-0,0002%	99,9998%	2010	Q3	138,92043	
													-0,0002%	99,9998%	2010	Q4	136,51549	138,9200939
													-0,0002%	0,999998189	2011	Q1	135,63464	136,5151627
													-0,0002%	0,9999982	2011	Q2	138,78933	135,6343944
													-0,0002%	0,999998325	2011	Q3	143,22633	138,7891402
													-0,0001%	0,99999887	2011	Q4	143,38836	143,2260301
													0,0000%	0,999999562	2012	Q1	143,60687	143,3881979
													-0,0002%	0,999997932	2012	Q2	145,87646	143,6068071
													0,0000%	1,00000022	2012	Q3	150,91981	145,8761583
													0,0000%	1,000000187	2012	Q4	152,07494	150,9198432
													0,0000%	0,999999828	2013	Q1	150,57826	152,0749685
													0,0000%	1,000000455	2013	Q2	153,30357	150,578234
	0												0,0001%	1,000000624	2013	Q3	158,46559	153,3036397
	0	0											0,0002%	1,000002005	2013	Q4	158,19743	158,4656889
	0	0	1,188E-06										0,0001%	1,000000933	2014	Q1	157,7491	158,1977472
	0	0	1,088E-08	0									0,0001%	1,000001121	2014	Q2	161,47746	157,7492471
	0	0	3,007E-07	0	0								0,0003%	1,000003322	2014	Q3	167,52747	161,477641
	0	0	3,007E-07	0	0	2,376E-06							0,0002%	1,000002103	2014	Q4	168,24161	167,5280265
	0	0	3,808E-07	0	0	2,176E-08	1,188E-06						0,0003%	1,000002681	2015	Q1	166,98213	168,2419639
	0	0	4,776E-07	0	0	6,014E-07	1,088E-08	1,188E-06					0,0002%	1,000001641	2015	Q2	168,72194	166,9825776
	0	0	4,297E-07	0	0	6,014E-07	3,007E-07	1,088E-08	0				0,0002%	1,000002378	2015	Q3	177,16782	168,7222169
	0	0	3,309E-07	0	0	7,617E-07	3,007E-07	3,007E-07	0	4,752E-07			0,0002%	1,000002072	2015	Q4	178,45804	177,1682413
	0	0	2,559E-07	0	0	9,552E-07	3,808E-07	3,007E-07	0	4,351E-09	0		0,0002%	1,000002191	2016	Q1	177,86876	178,4584038
	0	0	2,102E-07	0	0	8,594E-07	4,776E-07	3,808E-07	0	1,203E-07	0	0	0,0002%	1,000001963	2016	Q2	183,46767	177,8631496
	0	0	1,675E-07	0	0	6,618E-07	4,297E-07	4,776E-07	0	1,203E-07	0	0	0	0,0002%	1,000001642	2016	Q3	192,77516	183,4680302
	0	0	1,264E-07	0	0	5,118E-07	3,309E-07	4,297E-07	0	1,523E-07	0	0	0	0,0002%	1,000001363				192,7754766
	0	0	9,355E-08	0	0	4,204E-07	2,559E-07	3,309E-07	0	1,91E-07	0	0	0	0,0001%	1,000001098				
	0	0	7,362E-08	0	0	3,35E-07	2,102E-07	2,559E-07	0	1,719E-07	0	0	0	0,0001%	1,000000836				
	0	0	4,225E-08	0	0	2,528E-07	1,675E-07	2,102E-07	0	1,324E-07	0	0	0	0,0001%	1,000000639				
	0	0	3,309E-08	0	0	1,871E-07	1,264E-07	1,675E-07	0	1,024E-07	0	0	0	0,0000%	1,000000488				
	0	0	2,668E-08	0	0	1,472E-07	9,355E-08	1,264E-07	0	8,409E-08	0	0	0	0,0000%	1,000000341				
	0	0	2,233E-08	0	0	8,45E-08	7,362E-08	9,355E-08	0	6,701E-08	0	0	0	0,0000%	1,000000251				
	0	0	1,878E-08	0	0	6,618E-08	4,225E-08	7,362E-08	0	5,056E-08	0	0	0	0,0000%	1,000000178				
		0	1,237E-08	0	0	5,336E-08	3,309E-08	4,225E-08	0	3,742E-08	0	0	0	0,0000%	1,000000144				
			1,019E-08	0	0	4,466E-08	2,668E-08	3,309E-08	0	2,945E-08	0	0	0	0,0000%	1,000000103				
				0	0	3,756E-08	2,233E-08	2,668E-08	0	1,69E-08	0	0	0	0,0000%	1,000000079				
					0	2,473E-08	1,878E-08	2,233E-08	0	1,324E-08	0	0	0	0,0000%	1,000000062				
						2,038E-08	1,237E-08	1,878E-08	0	1,067E-08	0	0	0	0,0000%	1,000000031				
							1,019E-08	1,237E-08	0	8,931E-09	0	0	0	0,0000%	1,000000018				
								1,019E-08	0	7,511E-09	0	0	0	0,0000%	1,000000005				
									0	4,946E-09	0	0	0	0,0000%	1,000000004				
										4,076E-09	0	0	0	0,0000%	1				
											0	0	0	0,0000%	1				
												0	0	0,0000%	1				

Appendix 13

List of abbreviations

GFC = Global Financial Crisis

LTV = Loan to Value

MTM = Monetary Transmission Mechanism

HPI = House Price Index

CPI = Consumer Price Index

IMF = International Monetary Fund

BIS = Bank of International Settlement

MEW = Mortgage Equity Withdrawal

FI = Finansinspektionen

DTI = Debt to Income

SCM = Synthetic Control Method

VAR = Vector Autoregression