Do Housing Prices Affect Loan Supply?

Evidence from Sweden During the Post-Crisis Period

HAMPUS ÅKERSTRAND
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by

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Abstract

Financial intermediaries are paramount for modern society. During the last decade, however, our reliance on these institutions have been meticulously debated, especially in the aftermath of the financial crisis. This thesis contributes to this debate with a novel perspective on loan supply changes in light of the recent events in the Swedish real estate market. More specifically, it investigates what influence housing prices have on the supply of commercial and industrial loans. This is done by estimating dynamic panel data models using a quarterly panel containing balance sheet data for 68 Swedish monetary financial institutions, during the post-financial crisis period of 2009-2017. The results indicate that housing prices do not have a significant effect on commercial and industrial loan supply. However, these loans are to a considerable degree dependent on the institutes’ earlier levels of commercial and industrial loans.

JEL Classifications: E50, G21, G30, G31

Keywords: Bank Loans, Housing Prices, Collateral Channel, Crowding Out Effect
# Contents

1 Introduction ......................................................... 1  
1.1 Background .................................................................. 1  
1.2 Research Question .................................................. 4  
1.3 Sustainability ......................................................... 5  

2 Theory ................................................................. 6  
2.1 The Credit Channel .................................................. 6  
2.2 Bank Loan Substitution ............................................. 8  
2.3 Banks’ Role ............................................................. 9  
2.4 Macroeconomic Stability .......................................... 10  
2.5 Policy Intervention .................................................. 10  
2.6 Previous Empirical Findings ......................................... 11  
2.7 Literature Review .................................................... 14  

3 Methodology .......................................................... 16  
3.1 Data ........................................................................... 16  
3.2 Model Specification .................................................. 18  
3.2.1 Multicollinearity ...................................................... 19  
3.2.2 Heteroskedasticity .................................................. 19  
3.3 Dynamic Panel Data Models ............................... 19  
3.3.1 Autocorrelation ...................................................... 20  
3.3.2 Anderson & Hsiao Estimator .................................. 21  
3.3.3 Arellano & Bond Estimator ...................................... 22  
3.3.4 Blundell & Bond Estimator ...................................... 24  

4 Analysis of Results .................................................... 25  

5 Conclusion ........................................................... 31  
5.1 Further Research ..................................................... 34  

A Appendix ............................................................... 43  
A.1 List of Monetary Financial Institutions ........................ 43  
A.2 Descriptive Statistics .................................................. 44  
A.3 Wooldridge Robust Hausman Test ................................. 45
List of Figures

1 Housing mortgage margins ........................................... 2
2 Average annual values of the HOX-index and the ratio of commercial and industrial loans ........................................... 18

List of Tables

1 Variance Inflation Factors ........................................... 25
2 Variance Inflation Factors following Balling (2008) ............... 25
3 Test for heteroskedasticity and autocorrelation .................. 26
4 Test for autocorrelation and overidentifying restrictions ........ 28
5 Estimation results ....................................................... 30
1 Introduction

1.1 Background

The housing prices of Sweden have shown tremendous growth during the post-crisis period. Consequently, the indebtedness of Swedish households has grown at a faster pace than the corresponding levels of income. This development is worrisome as it poses a risk not only for the households but the financial intermediaries as well as the financial stability and the macroeconomic progress of Sweden (Finansinpektionen, 2018). Indeed, concerns regarding the Swedish real estate market have been raised in the past, but housing prices have repeatedly exceeded expectations of reaching a slowdown, up until the fall of 2017 (Cervenka, 2017). Now, as the once red-hot market is cooling down, investor sentiment is shifting, and warning signs are beginning to pile up. Consequently, stakeholders are trying to recoup their losses and instill confidence in the market while rejecting the possibility of any future real estate market crash (Bloomberg LP, 2017). Intuitively, the credibility of a real estate market crash per se is questionable. For instance, competition in the mortgage market shows few signs of abating (Bloomberg LP, 2018). In addition, the average housing price of Sweden increased during 2017 despite the rising market tension. For example, small residential houses even showed an average price growth of 9.4 percent (Svenska Bankföreningen, 2017). Alongside the housing price development of the post-crisis period, profit margins for housing mortgage lending have shown a remarkable growth, which illustrated in Figure 1.
Figure 1: Mortgage lending margins are calculated as an average interest expense for borrowers as a share of lenders’ average financing cost, here shown for a 3 month floating rate (Finansinspektionen, 2017a).

On the other hand, one can argue that the fear of a crash is not unwarranted. During the preceding period of the financial crisis in 2008 (the most-severe financial crisis since the Great Depression) the American real estate market was characterized by a significant surge in prices. Furthermore, asset prices rose by well over 100 percent leading up to the crisis of the 1990s in Sweden (Borio et al., 1994). Similar price patterns have been observed historically, where real estate markets grow substantially only to crash at the onset of a crisis. The fluctuations of asset prices are said to exacerbate business cycles; fueling upswings, magnifying downswings and slowing down recovery (Chakraborty et al., 2016). Ultimately, the magnitude of such price changes can be catastrophic, not only from an economic perspective but for society at large.¹

The Financial Supervisory Authority of Sweden, Finansinspektionen (FI), estimates household debt to be SEK 3 563 billion, approximately representing 81 percent of Sweden’s gross domestic product. Additionally, 82 percent of household debt consists of housing mortgage loans (Finansinspektionen, 2017b). By June 2017, Swedish banks’ outstanding stock

¹Even with regards to matters of life and death. See for instance Karanikolos et al. (2013).
of housing loans to the real sector was SEK 3,824 billion, with an annual growth rate of 7 percent. Remarkably, this growth rate represented a slow down compared to the preceding period (Svenska Bankföreningen, 2017). By December 2016, mortgage institutes were the biggest suppliers of household mortgage loans, followed by banks, with a respective market share of 64 percent and 34 percent. Although, the mortgage institutes are usually related to banks, functioning as their mortgage lending body (Konkurrensverket, 2016). Hence, banks account for (almost) all housing mortgage loans in Sweden. Furthermore, the eight largest mortgage lending institutes in Sweden account for 95 percent of the total lending to households and 91 percent of new loans issued for households which indeed represents a high market concentration (Finansinpektionen, 2018). Historically, mortgage lending institutions financed housing mortgage lending by issuing housing bonds up until 2006, at which new laws were instated making it possible to fund mortgage lending through covered bonds. By the end of 2016, Swedish covered bonds were valued SEK 2,125 billion, and these bonds have stood relatively well compared to other covered bonds in neighboring countries (Konkurrensverket, 2016).

In tandem with expanding mortgage lending, Swedish non-financial corporations have increased their borrowing, mainly by issuing debt securities but also by obtaining intermediated loans. During recent years, however, borrowing through debt securities has become an increasingly big part of the financing for non-financial corporations. In fact, during the second quarter of 2017 non-financial corporations increased borrowing by issuing debt securities by SEK 74 billion, with a total liability in debt securities of SEK 1,024 billion. Simultaneously, non-financial corporations’ intermediated loans increased by SEK 30 billion and amounted to SEK 2,124 billion. Hence, since 2013, non-financial corporations’ liability in debt securities have increased by 47 percent, and the corresponding liability for loans has grown by merely 14 percent. Despite this, intermediated loans remain the most common form of financing for non-financial corporations (Sweden, 2017). Assets such as real estate typically secure these loans, indeed in the aftermath of the financial crisis, when higher collateral requirements were instated, although the share of non-secured loans has increased during recent years. Furthermore, many firms issue securities as a complement to loans financing since loans to non-financial corporations are sensitive to fluctuations in the business cycle (Statistics Sweden, 2013).

The relationship between asset prices and loan supply is multifaceted. For instance, agents can utilize borrowed funds to buy assets, and these leveraged expenditures tend to indirectly generate an upswing in asset prices, which in turn increases agents’ net worth and hence their borrowing capacity (Borio et al., 1994). A self-reinforcing process can easily develop, which makes it hardly surprising that lenders, investors, and stakeholders have flocked to the growing real estate market of Sweden. To this day there are vast
amounts of research investigating asset price busts, presumably due to its devastating consequences and in remembrance of the financial crisis. However, one seldom recognizes the negative consequences of asset price boom phases, where recent research indicates that asset price appreciations may have negative spillovers on the real economy as it makes lenders prefer some type of lending over others. Since financial intermediaries’ capacity to raise funds but also extend and sell loans are limited relative to their capital value and quality, it results in a crowding out effect for investors who do not hold the booming asset. Indeed, banks are more likely to extend mortgage loans following the considerable increase in housing prices and housing loans’ profit margins which, in turn, could affect their supply of other loans negatively. For instance, Chakraborty et al. (2016) show that U.S. banks which are active in strong housing markets increase mortgage lending and decrease commercial and industrial (C&I) lending which leaves firms that borrow from these banks with fewer funds to invest. The fact that these mechanisms are often overlooked in favor of investigating periods characterized by asset busts emphasizes the need for exploring this relationship further, regardless of how the relationship between asset prices and loan supply manifests itself.

1.2 Research Question

To this day, there are vast amounts of literature that highlight the real adverse effects of asset price drops, nonetheless with regards to capital markets and financial intermediation. Despite this, few investigate the periods of asset price appreciations on firms’ access to external funds, presumably in remembrance of the financial crisis. Indeed, this research gap can have dire consequences considering the remarkable appreciation in the Swedish real estate market as well as mortgage lending profits. Hence, the research question of this thesis is:

• What, if any, effect do housing prices have on financial intermediaries’ C&I lending?

By investigating this relationship, this thesis contributes to the field in loan supply and financial intermediation. Previous studies emphasize the importance of financial intermediaries’, meaning that these institutes have a paramount role in the modern-day economy. Following a reduction in loan supply, the consequences for firms in need of capital could be dreadful. Indeed, if financial intermediaries favor housing mortgage lending at the expense of C&I loans it could affect output, employment, tax income, innovation and much more. On the other hand, a positive relationship between housing prices and C&I loans could indicate that Swedish firms have significant exposure to the real estate market and that the housing price appreciation of the post-crisis period increases their asset value which in turn increases their collateral and results in a higher ability to take on debt. This exposure, however, would be alarming considering the recent stagnation of the Swedish
real estate market. Ultimately, this thesis provides a novel approach to previous work on loan-supply theory, and its results are valuable for policymakers, business owners and stakeholders in the real estate market.

1.3 Sustainability

Sustainability has played a significant role in shaping the financial intermediaries of today. This development consists of two key components; the pursuit of sustainability in business operations, but also the integration of sustainability into the intermediaries’ core businesses. While the former efforts are welcome, they are hardly unique for financial intermediaries. Rather, sustainable business operations are common in many sectors. More importantly, it is the latter component of the sustainable development that is of certain interest, and that is applicable in light of this thesis’ research question. By integrating sustainability into their core business, financial intermediaries can alter their loan supply to provide more sustainable enterprises with easier access to capital, support environmentally or socially responsible projects, innovative technologies, and so on. This development, however, could be influenced by changes in loan supply. Consequently, by determining how C&I lending is affected by housing prices, these findings are surely applicable from a sustainability perspective (International Institute for Sustainable Development, 2013).

The outline of the thesis is the following; Section 2 presents relevant theory coupled with a review of previous empirical findings, followed by the methodology in Section 3. The results are shown and analyzed in Section 4 and lastly, a discussion and a conclusion are given in Section 5.
2 Theory

Monetary policy is partially transmitted through changes in the loan supply. Alongside the primary interest rate effect, the so-called credit channel operates as an amplification mechanism following monetary policy changes (Bernanke and Gertler, 1995). This channel serves as a natural starting point for this thesis’ theoretical framework since it predicts that fluctuations in loan supply will influence the real economy. Furthermore, the credit channel framework highlights the fundamental importance of external financing and financial intermediaries. As an extension to this, one could argue that the consequences of loan supply changes are independent of their cause, i.e., monetary policy or some other cause.

2.1 The Credit Channel

Borrowers face a higher cost when externally raising capital compared to utilizing internally available funds assuming that they are not fully collateralized. This cost difference, or rather the external financing premium, is due to frictions related to imperfect information between the agents.\footnote{Banks’ role as screening agents to overcome these informational frictions is particularly highlighted in earlier research (Mishkin, 1996). In fact, according to Boot (2000), the raison d’être of banks is mitigating informational asymmetries. For instance, the lender-borrower relationship is characterized by adverse selection problems which arise since borrowers in need of funds may be those who are least likely to repay their debt. Banks consequently screen their clients and incur agency costs on borrowers. Furthermore, since the ability to repay loans may be dependent on the success of the financed projects, borrowers could be incentivized to claim its failure. Hence, banks monitor and incur additional cost on borrowers to receive repayment on their loans by overcoming these informational frictions (Bernanke and Gertler, 1995).}

Monetary policy aims to affect the size of the external finance premium, thus altering the price and availability of loans. For instance, contractionary monetary policy strives to increase the size of the premium and therefore, partially through the credit channel reduce the supply of loans and impose a higher opportunity cost for externally available capital. This effect is in turn transmitted through two conduits; the balance sheet- and bank lending channel (Bernanke and Gertler, 1995).

The balance sheet channel assumes that the size of the external finance premium is inversely related to borrowers’ net worth, and therefore higher net worth agents are considered safer borrowers and can borrow at a lower cost, all else equal (Bernanke et al., 1994).

\footnote{These information asymmetries are central to the literature on financial intermediation; see for instance Diamond (1984) and Bhattacharya and Thakor (1993).}
Contractionary monetary policy will reduce firms’ investments through, e.g., increased inter-


terest payments and decreased collateral value. The demand reduction following policy change will reduce firms’ revenue, while their short-run fixed costs do not adjust as quickly which in turn diminishes gross cash flow. Ultimately, economic agents experience reduced cash flow, decreased net worth, a drop in loans and a declining in demand (Bernanke and Gertler, 1995).

The bank lending channel is similar to the balance sheet channel, albeit more directly affecting financial intermediaries ability to extend loans. For instance, contractionary monetary policy will drain banks’ reservable deposits as the alternative cost of holding money increases. Since banks cannot easily replace loanable funds, at least not without incurring costs, reserve requirements will force them to decrease their lending (Westerrlund, 2003). Banks are essential screening agents and fundamental suppliers of loans since they specialize in overcoming credit market frictions (Mishkin, 1996). Firms that rely on bank loans may either be temporarily shut off from external funds or will suffer additional search costs to find a different supplier of loans, increasing firms’ external finance premium. With limited access to loans, firms will decrease their investments which in turn affects the aggregate output of the economy (Bernanke and Gertler, 1995).

The credit channel mechanism emphasizes the distinct role of financial intermediaries. However, previous studies that investigate the bank lending channel have provided inconclusive results (which is shown in Section 2.7). Ultimately, to which degree the bank lending channel is apparent hinges upon the fact that investments are subject to the supply of bank loans and that monetary policy can affect the supply of bank loan (Kashyap and Stein, 1995). Given that there are many possibilities for substitution between bank-and non-bank financing, the credit channel should be less apparent. Indeed, the twenty-first century is characterized by a great deal of financial innovation, regulatory effects, behavioral determinants and other things that could alter this loan dependency, since the increased competitive pressure in lending provides options for substitution (Mateut, 2005). Nonetheless, C&I loans remain the most popular source of external funding and changes in loan supply may be the result of mechanisms beyond the credit channel, while the resulting influence on firm activity should be somewhat similar.

For instance, borrowers face higher agency costs due to changed market sentiment during recessions which result in loan supply reductions. In turn, this causes an incremental decline in production that exacerbates economic fluctuations. Hence, changes in lending conditions amplify and propagate the effects of initial real or monetary shocks, a mechanism known as financial accelerators. Financial accelerator-theory predicts that borrowers

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3There is a reduction in firms’ net discounted value of assets, which serves as collateral.
with more limited access to loans and lower net-worth reduce spending and production earlier and more sharply during recessions compared to borrowers with greater access to credit markets, as a result of the flight to quality among credit suppliers (Bernanke et al., 1994).

Importantly, literature dating back as far as Fisher (1933) argue that asset markets price busts affect the overall, real economy. The decline in asset markets will affect firms’ assets adversely, which in turn hurts firms’ creditworthiness thus reducing its debt capacity through the so-called collateral channel. Indeed, this phenomenon could be triggered by housing price fluctuations, since real estate assets permeate the whole economy.

2.2 Bank Loan Substitution

The amplification mechanism of the credit channel should be stronger if firms are more dependent on intermediated loans, relative to other sources of funding (Miles et al., 2012). Theoretically, if firms easily could access external capital markets or switch from one source of capital to another, then its performance should be more unresponsive to, e.g., adverse bank loan supply changes following contractionary monetary policy. For instance, Mateut (2005) presents a model in which firms have access to three sources of external funding; capital markets, banks loans, and trade credits. The model’s results indicate that an interest rate increases produce a flight to quality effect on all credit markets and that market- and bank lending decrease while trade credit increases. Hence, trade credit soothes the impact of contractionary monetary policy and the subsequent shifts in loan supply. These results go beyond monetary policy changes, and should be applicable for other sources of funding than trade credit, serving as a substitute to bank loans.

According to Boot (2000), a proliferation of transaction-oriented banking and increased availability of direct funding in the financial markets have started to challenge banks’ distinct role as suppliers of capital. This development implies that more possibilities for substitution are becoming available as competition increases in the lending market. Despite this, Diamond (1991) and Hoshi et al. (1993) emphasize, that bank lending typically serves as a complement to market funding, rather than a substitute. Banks’ screening of borrowers serves as a certification of quality for future suppliers of funds, implying an ex-post bank lending improvement of firms’ statue in capital markets (Hoshi et al., 1993). In turn, some borrowers strive towards a sound banking relationship before accessing capital markets (Diamond, 1991). Furthermore, Caglayan and Xu (2016) argue that stock market volatility increases the dispersion of bank loans, as other sources of finance become less desirable. If the stock market volatility indicates overall unrest in the financial markets, then the supply of bank loans would probably decrease. Ultimately, bank loans remain a
vital source of capital.

Holmstrom and Tirole (1997) emphasize that adverse selection- and moral hazard frictions can limit even profitable and growing firms’ ability to externally raise capital or to substitute between different sources of capital. An adverse shift in bank loans supply does not imply that firms are shut off from credit, especially not in economies with advanced capital markets. If anything, firms would more likely experience search costs associated with finding financiers and establish a new borrower-lender relationship. Due to this, reduced supply of bank loans, relative to other sources of external funds, is likely to increase the external finance premium and to some extent impede real activity for firms despite the fact that other capital sources are available (Mishkin, 1996).

2.3 Banks’ Role

There are vast amounts of literature that emphasize banks’ role as a financial intermediary due to their superior ability in overcoming informational frictions. All else equal, the supply of external capital should be limited for informationally opaque firms due to these frictions. Furthermore, monitoring and imperfect financial contracting will raise the external finance premium, consequently lowering these firms’ desired level of leverage and constrain capital supply (Chava and Purnanandam, 2011). Boot (2000) argue that the raison d’être of banks is their role in mitigating these informational asymmetries, especially with so-called relationship banking. Certainly, non-bank intermediaries can engage in relationship lending, and this type of service is not restricted to bank loans (Carey et al., 1998). Nonetheless, Degryse and Van Cayseele (2000) argue that the scope economies of banks’ lending provide a great competitive advantage. Ultimately, banks’ proprietary information about their customers, the flexibility in relationship banking and more informative credit contracting decisions increase the possibilities to provide external funds to informationally opaque firms (Boot, 2000). In turn, these firms are likely to be highly reliant on bank loans due to their inability to access the, e.g., public capital markets on attractive terms (or at all). Any change in the supply of bank loans should, therefore, have a serious impact on these disadvantaged borrowers (Baum et al., 2009). In the same sense, borrowers with higher collateral should theoretically obtain funds more easily during periods of credit rationing since collateral serves as a mitigating device for moral hazard problems, and one advantage of bank loan contracts is that they can easily accommodate collateral requirements (Boot, 2000). The importance of collateral is aligned with the balance sheet channel’s mechanisms, where changes in borrowers’ net

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worth affect their access to external funds. All in all, banks are unique in their borrower-lender relationship. Any change in their supply of loans should, therefore, have an impact on the aggregate economy.

2.4 Macroeconomic Stability

At the onset of a recession, the increased risk in lending results in a credit-rationing by financial intermediaries. Ferri et al. (2014) argue that supply of bank loans tends to decline following monetary and financial shocks, making it difficult for bank-dependent borrowers to access external finance. Caglayan and Xu (2016) mean that inflation volatility makes bank managers behave more conservatively in issuing new loans, resulting in sub-optimal capital allocation. In the same sense, according to Baum et al. (2009), macroeconomic stability will favor more efficient allocation of loans.

The real estate market is a unique factor for economies’ well-being. According to the model by Aoki and Nikolov (2015), housing boom-bust cycles lead to larger output fluctuations compared to equivalent equity cycles. They argue that weak supervision will make banks invest extensively in the booming asset which in turn makes their profits sensitive to asset price fluctuations. Indeed, banks have significant exposure to the real estate market and have enjoyed low and even negative interest rates during the post-crisis period. According to Stein (1997), corporate headquarters must decide how to allocate resources among competing projects. Banks, like any other firms, allocate resources accordingly and if housing mortgage lending proves more profitable following housing price appreciations, then some trade-off between other types of loans could be apparent. This might result in a crowding out effect, aligned with the results of Chakraborty et al. (2016), who show that U.S. banks are more likely to do housing mortgage lending if the bank is active in booming real estate markets. Due to capital requirements and constraints, these banks decrease their C&I lending to increase their mortgage lending. In turn, this effect is more significant for constrained banks because these banks are smaller, more levered, and less active in securitization markets.

2.5 Policy Intervention

Whether policy should react to asset price bubbles is a controversial issue. While some argue that intervention would be pragmatic and legitimate, asset price bubbles have proven difficult to identify in real time. When policies are incorrectly implemented, or current market conditions hold great uncertainty regarding policy, it may be more harmful than helpful to the economy. For instance, Chi and Li (2017) argue that policy uncertainty increases the credit risk for commercial banks, and results in a crowding out effect on bank lending. The uncertainty and inefficient capital allocation the policy aims to counter are
therefore fueled. However, there are prevalent risks that a crisis in one market leads
to changed investor sentiment and changed perception of risk in other markets, without
any real linkages between respective markets in the first place and regardless of policy
effectiveness (Hasman, 2013). Financial crises have shed light on the fact that the finan-
cial system and especially financial intermediaries can not only amplify and transfer one
sector’s problem to another but also be the primary driver of a crisis. Since financial
intermediaries permeate the whole economy, they pose as a more prominent influence, as
well as risk. Policy needs to account for not only asset price fluctuations but to which
degree financial intermediaries are exposed to the asset.

2.6 Previous Empirical Findings

There are vast amounts of literature on the effects of loan supply contractions.⁶ On the
other hand, research on the underlying influences that cause these fluctuations per se,
aside from monetary policy, can be considered much more modest. If anything, previous
research in loan supply is more inclined to observe periods of economic turmoil. This
thesis aims to fill this gap by investigating the post-crisis period of Sweden, which is
characterized by significant housing price appreciations. Importantly, Westerlund (2003)
shows that small, illiquid and undercapitalized Swedish banks’ supply of loans is signif-
ically affected by monetary policy, ultimately supporting the bank lending channel’s
presence as well as the dependence on bank lending for firms’ investments. Ultimately, a
well-functioning bank sector is fundamental for economic growth through efficient capital
allocation (Levine, 2005).

Adverse effects on bank loan supply force borrowers to substitute to other sources of
external capital. This will certainly have an impact on informationally opaque and bank-
dependent borrowers who face higher informational frictions.⁷ Gertler and Gilchrist (1994)
investigate how contractionary monetary policy affects the inventories and short-term debt
of large and small manufacturing firms. Larger firms, who are more likely to have access
to commercial paper markets and other sources of short-term credit, typically respond to
an unanticipated decline in cash flows by increasing their short-term borrowing and are
therefore more able to maintain their level of operations when facing an economic slow-
down, at least initially. In contrast, small, informationally opaque firms who in most cases
have more limited access to short-term credit respond to a loan supply shift by decumulat-
ing their inventories. Hence, smaller firms are not able to increase short-term borrowing
to the same extent as their larger counterparts and are in this case more affected by the
change in loan supply. Leary (2009) explores the relevance of capital market frictions

⁶For instance Faulkender and Petersen (2005), Sufi (2007), Leary (2009), Lemmon and Roberts (2010),
Chava and Purnanandam (2011), and more.
⁷See for instance Bernanke et al. (1994) and Miles et al. (2012).
for firms’ capital structure decisions during the initiation of the market for certificates of deposit in 1961, and the credit crunch of 1966. Following an expansion (contraction) in bank loan supply, leverage ratios of bank-dependent borrowers significantly increase (decrease) relative to firms with bond market access. Having access to bond markets could reduce the impact of loan supply changes and if some firms cannot quickly shift different sources of capital, adverse capital shocks prove more severe.

Chava and Purnanandam (2011) show that adverse capital shocks to U.S. banks affect their borrowers’ performance negatively, using the Russian crisis of Fall 1998 as an exogenous shock to the banking system. In addition, they find that bank-dependent firms lost disproportionately higher market value and suffered larger declines in capital investments and profitability following the financial crisis as compared to firms with access to the public-debt market. According to Lemmon and Roberts (2010), however, large firms with access to public debt markets are also susceptible to capital supply fluctuations, as bank debt substitution was limited following exogenous economic shocks in the U.S. during 1989. James (1987) and also Lummer and McConnell (1989) show that bank loan agreements have a positive announcement effect on stock prices, indicating that banks provide a distinct added value through their services and their capital function as a complement to other sources of capital.

James and Smith (2000) show that banks play a unique role in providing relationship lending to corporations, not only for small firms that lack public debt markets access but for larger firms as well. Relationship lending provides access to capital when firms have an immediate need for funding but interest rates in public debt markets are prohibitively high, or if firms are undervalued by the market. Petersen and Rajan (1994) and Berger and Udell (1995) show that the duration of the bank-borrower relationship positively affects the availability of credit and makes interest rates and collateral requirements fall.

Adelino et al. (2015) emphasize the importance of the collateral channel for smaller firms since small business establishments and self-employment increase in areas with substantial housing price appreciations. Since the same effect is not apparent for larger firms, they conclude that real estate serve as an important collateral for smaller firms. Simultaneously, Gan (2007) shows that firms with higher collateral losses following adverse economic shocks, are less likely to sustain their banking relationships and tend to obtain less bank loans. Hence, firms with e.g. high exposure in real estate, can borrow less and consequently invest less following housing price busts. Cvijanović (2014) shows that listed firms in the U.S. significantly alter their capital structure in response to collateral value appreciation. Loutskina and Strahan (2015) find that banks move mortgage capital from low into high appreciating real estate markets which suggest that banks play an active
role in the housing price booms. Furthermore, real estate exposed banks decreased their lending following asset price busts, causing further deterioration in firms’ access to capital and possibility to invest.

Certainly, firms are inherently different and should desire different capital structures. Although, Faulkender and Petersen (2005) investigate the link between firms’ sources of external capital, private versus public debt markets, and their leverage ratios. Even when controlling for firm characteristics, they show that firms with access to public debt markets have higher leverage, indicating that the supply of external funds determine firms’ capital structure, at least to a significant extent.

Asset price boom and bust patterns have historically led to the real economic volatility in many advanced economies. In addition, disruptions in banks’ balance sheets caused by asset price fluctuation have resulted in financial distress for many economies, nonetheless in Sweden (Borio et al., 1994). Broner et al. (2014) show, when studying the euro-zone recession in the aftermath of the financial crisis, that crowding out effects and inefficient capital allocation occurred. More specifically, there was a reallocation of capital from the private sector to the public sector, which reduced investments and deepened the recession even further. Sovereign debt offers a higher expected return to domestic investors than to foreign investors during economic turmoil. Hence, domestic debt purchases displaced productive investments, resulting in incremental reductions in growth and welfare. Simultaneously with sovereign spreads increasing, so did the borrowing cost for the private sector, resulting in a crowding out effect.

Crowding out effects resulting from capital allocation are also explored by Chakraborty et al. (2016). According to them, booming housing prices lead to substitution in lending, towards the booming real estate market. In addition, they discuss endogeneity issues that housing price variables impose. Housing price appreciation usually coincide with economic growth, implying a positive relation between housing prices and firms’ investment opportunities. Hence, basic regression models underestimate the reduction in lending and investment due to a positive real estate price shock that is unrelated to firms’ demand for capital. Consequently, they use land unavailability and the national 30-year fixed mortgage interest rate combined as an interaction term and as an instrument. The crowding out effect in loan supply manifests when housing prices have a negative marginal effect on banks’ C&I lending, all else equal.

On the other hand, Chaney et al. (2012) document that U.S. firms that own real estate benefited from the increase in real estate prices through the collateral channel. This implies that housing prices have a positive marginal effect on loan supply. Hence, given that
firms hold real estate assets, the crowding out effect could be countered by the collateral channel. In turn, this effect resembles the balance sheet channel, as appreciations in housing prices increase borrowers’ net worth, thus loan supply. However, the risk of high real estate exposure among firms can certainly be devastating. For instance, Japanese property prices collapsed in the 90s leading to Japan suffering a banking crisis as well as a “lost decade” of low economic growth. In addition, Bluedorn et al. (2016) show that equity, as well as housing price drops, have substantial marginal effects on the likelihood of a new recession. Lastly, Farmer (2012) argues that the housing price bust in the U.S. triggered the stock market crash of 2008, and the subsequent global recession.

The housing price appreciations of Sweden during the post-crisis period impose various risks. Overall, the importance of capital market functionality, nonetheless bank loan supply and the real estate market, emphasizes the need to further investigate the relationship between housing prices and banks’ C&I lending.

2.7 Literature Review

This section provides the reader with an illustrative overview of previous research whose findings relate to this thesis’ research question.
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Area</th>
<th>Period</th>
<th>Method</th>
<th>Main Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Favero et al. (1999)</td>
<td>France, Germany, Italy and Spain</td>
<td>1992</td>
<td>Case study</td>
<td>Reject the bank lending channel but acknowledge different reactions to fluctuations in external capital supply.</td>
</tr>
<tr>
<td>Gan (2007)</td>
<td>Japan</td>
<td>1994-1998</td>
<td>Least absolute distance regression</td>
<td>Firms with greater collateral losses are less likely to sustain their banking relationships and tend to obtain a smaller loans.</td>
</tr>
<tr>
<td>Lemmon and Roberts (2010)</td>
<td>United States</td>
<td>1986-1993</td>
<td>Difference in difference-approach</td>
<td>Large firms with access to public debt markets are susceptible to fluctuations in the supply of bank capital.</td>
</tr>
<tr>
<td>Chava and Purnanandam (2011)</td>
<td>United States</td>
<td>1998</td>
<td>Multiple regression model</td>
<td>Following a credit crunch, bank-dependent firms suffered larger losses compared to firms with access to the public debt market.</td>
</tr>
<tr>
<td>Chaney et al. (2012)</td>
<td>United States</td>
<td>1993-2007</td>
<td>Multiple regression model</td>
<td>Housing prices have a significant and positive marginal effect on aggregate investment through the collateral channel.</td>
</tr>
<tr>
<td>Chakraborty et al. (2016)</td>
<td>United States</td>
<td>1988-2006</td>
<td>Dynamic panel data model</td>
<td>Banks that are active in strong real estate markets increase mortgage lending and decrease commercial lending. Firms that borrow from these banks have significantly lower investment.</td>
</tr>
</tbody>
</table>
3 Methodology

3.1 Data

Housing loans in Sweden are to no small extent given by specific bank-owned mortgage institutes, but also by the banks themselves. Three of the top four biggest Swedish banks own Sweden’s three most prominent mortgage institutes; Swedbank (Swedbank Hypotek), Svenska Handelsbanken (Stadshypotek) and Nordea (Nordea Hypotek). Other banks supply mortgage loans directly, for instance, Skandinaviska Enskilda Banken AB, Skandiabanken and so on. SBAB, a significant supplier of housing mortgage loans, reorganized from being a mortgage institute to a bank in 2010. Furthermore, a substantial share of bank lending is derived from local, smaller institutes, so-called savings banks (Svenska Bankföreningen, 2017). The savings banks are commonly publicly traded banks with Swedbank as a partner (Svenska Bankföreningen, 2016). For simplicity’s sake, all these kinds of institutes are in this thesis interchangeably referred to as monetary financial institutions (MFIs).

Panel data enables observation of multiple occurrences over multiple time periods for the same individuals. A panel is constructed containing quarterly observations for 68 different MFIs, ranging from the first quarter of 2009 to the third quarter of 2017. The range of the observation period is mainly due to data availability but also because of the extraordinary nature of the preceding periods, i.e. the financial crisis. There are plenty of previous studies observing the relationship between asset price busts and financial intermediation, especially in light of the financial crisis. This thesis serves as an extension to these fundamental studies by studying the post-crisis period, not to mention the Swedish economy, during asset price appreciations.

The dataset contains MFIs’ financial report data that is gathered from a database provided by FI, and while this database is not available to the public, it can be replicated using the MFIs’ financial reports. The included MFIs are active in C&I- as well as mortgage lending. The database also contains foreign MFIs’ branches in Sweden, and while these branches may certainly be active in these two lending markets, it is hard to ensure data quality and availability for these institutes. Furthermore, one could expect that these branches will be significantly affected by exogenous economic shocks in their home country, at least to a larger extent than Swedish MFIs. Lastly, Chakraborty et al. (2016) argue that foreign banks’ branches account for a relatively small fraction of C&I loans due to financial frictions and transfer costs that limit how much capital foreign parent companies supply across borders. In this case, Danske Bank is the most prominent foreign lender, with an overall average market share of 6.1 percent in 2017 (Bloomberg LP, 2018). Hence, the foreign branches are excluded from this thesis’ dataset. In addition,
the dataset contains all savings banks with exception to three institutes (Hälsinglands Sparbank, Sparbanken Alingsäs AB, and Swedbank Sjuhärad AB). These institutes have inadequate data quality and are therefore removed from the dataset. A list of the included MFIs is given in the Appendix, Section A.1. The dataset also contains housing price- and macro variables corresponding to the ones used in Chakraborty et al. (2016).

In the applied model, each MFI’s ratio of loans to non-financial corporations divided by total assets (C&I loans) serves as the dependent variable. Note that loans to real estate companies are included in the C&I loans variable and that these companies are likely to benefit from housing price appreciations. However, these real estate companies access external financing mainly through bond markets and should therefore not distort the results significantly (Svenska Dagbladet, 2017a). In the model, control variables at the MFI level are applied, namely net income (NI), total equity (TE) and interest expenses (IE), all divided by total assets. The MFI’s size (SZ) is also included, which corresponds to total assets minus total loans. Furthermore, this thesis uses a housing price-index produced by Valueguard in conjunction with KTH Royal Institut of Technology, the Nasdaq OMX Valueguard-KTH Housing Index (HOX-index) as a proxy for the national housing price. The index uses data from Swedish Mäklarstatistik AB, which compiles data from the real estate agents in Sweden and is a transaction-based price index for single-family houses and house cooperative apartments in Sweden. The HOX-index utilizes a statistical model that aims to overcome seasonality in the sales of different types of households (Valueguard, 2018).

The applied model also controls for macro conditions using the unemployment rate (UR) and the Swedish Central Bank’s repo rate (RR). The UR is defined as the number of unemployed people as a percentage of the labor force, which in turn consists of the unemployed plus those in paid or self-employment. Also, the unemployed people have taken active steps to find work in the last four weeks. This data is gathered from OECD (2018). The RR is the interest rate at which banks can deposit or borrow money for seven days with the Swedish Central Bank (Riksbanken). Lately, the RR has shown historically low levels, which is considered to be one of the reasons for the appreciating housing prices as well as the high-profit margins and the extensive lending of Swedish banks (Svenska Dagbladet, 2017b). Indeed, the outstanding amount of loans should be closely related to interest rate levels, as it serves as the most fundamental tool in monetary policy (Bernanke and Gertler, 1995). Data on the RR is gathered from Sveriges Riksbank (2018).

All in all, descriptive statistics for the variables mentioned in this section are given in the Appendix, Section A.2. All values are given in SEK, if not presented as a ratio or an index, and are adjusted for inflation using the consumer price index (CPI), with the second
quarter of 2015 as the base year, i.e., 2015Q2 = 1 (Statistiska centralbyråns, 2018). The data contains no missing observations. In order to provide the reader with an illustration of the variables of certain interest (C&I loans and the HOX-index) their annual averages are presented below in Figure 2.

![Figure 2: Average annual values of the HOX-index (circle marker) and C&I loans (square marker). Data from FI.](image)

### 3.2 Model Specification

An econometric methodology enables hypothesis testing using regression analysis to investigate if, and in that case, how MFIs’ C&I loans are affected by housing prices. All model estimations use C&I loans as the dependent variable. Hence, Equation 1 below represents the initial model specification:

\[
C&I_{it} = \alpha_i + \beta_1 \text{HousingPrice}_t + \beta_2 \text{MFIVars}_{it} + \beta_3 \text{MacroVars}_t + u_{it} \tag{1}
\]

Where \(i = 1, \ldots, N; t = 1, \ldots, T\). The dependent variable, \(C&I_{it}\), represents the C&I loans’ share of the total assets for MFI \(i\) at time \(t\) and \(\text{Housingprices}_t\) represents the national, average, Swedish housing price at time \(t\). Note that this variable lacks between variation and only differs with respect to time. The same applies for \(\text{MacroVars}_t\), serving as a control for overall macro conditions in Sweden. \(\text{MFIVars}_{it}\) represents the MFI specific...
control variables. In order to make reliable inferences about causal relationships between variables, the applied model needs to account for several possible complications that are usually apparent when utilizing economic data.

3.2.1 Multicollinearity

Multiple regression models commonly contain explanatory variables that can linearly predict other explanatory variables in the model, with a substantial degree of accuracy. Sometimes, with such accuracy that the variables are said to be collinear (Hill et al., 2008). Panel data is usually more informative, provides more variability and less collinearity among the variables in comparison with other forms of data, e.g., time-series (Baltagi, 2005). Nonetheless, even though theory might indicate a variable’s importance, collinear variables do not provide enough information to estimate variable-separate effects. Estimations containing explanatory variables that suffer from multicollinearity will change erratically in response to small changes in the data structure or model specification. Hence, multicollinearity is tested for by calculating the variance inflation factor (VIF). The rule of thumb is that a VIF value above ten should be of concern (Chatterjee and Hadi, 2015).\(^8\) There are various methods for dealing with multicollinearity when apparent. For instance, Balling (2008) suggests calculating ratios of highly correlated variables to avoid excluding these from the model while eliminating the collinearity issues.\(^9\)

3.2.2 Heteroskedasticity

Heteroskedasticity refers to when the variance in the regression error term is not constant, homoskedastic, which is a common problem when utilizing economic data and regression analysis. If the data is not homoskedastic, multiple regression estimated standard errors become inferior to other estimations. Furthermore, confidence intervals and hypothesis tests that use these standard errors may yield misleading results (Hill et al., 2008). Hence, the occurrence of heteroskedasticity is tested for using the Breusch-Pagan test, and estimations are corrected for heteroskedasticity if apparent by using robust standard errors (Cameron and Trivedi, 2010).

3.3 Dynamic Panel Data Models

Dynamic panel data models play an increasingly important role in corporate finance research (Flannery and Hankins, 2013). Panel data provides a better understanding of variables’ dynamics of adjustment, and one can expect that MFIs’ commercial lending is persistent between period, which suggests that lagged values of the variables may be

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\(^{8}\)While VIF thresholds have been criticized, the author of this thesis lacks other more appropriate measures. See for instance O’Brien (2007) for further discussions on this topic.

\(^{9}\)For further reading, Baayen et al. (2006) operate with ratios for their experimental items.
relevant to explain current loan realizations. For instance, due to the development of close lender-borrower relationships, a so-called lock-in effect occurs that makes it costly for the borrower to change the supplier of loans (Ehrmann et al., 2001). Also, institutes may be more or less specialized towards C&I lending, and business decisions regarding certain types of lending can go beyond a quarterly time horizon.

The dynamic relationships can be estimated by including lagged values of the dependent variable in the regressions equation. Accordingly, Equation 2 utilizes a dynamic specification:

\[ C_{it} = \alpha_i + \delta_1 C_{it-1} + \beta_1 HousingPrice_{it} + \beta_2 MFIVars_{it} + \beta_3 MacroVars_{it} + u_{it} \]  

Where \( C_{it-1} \) represents the outstanding share of C&I loans for MFI i at the previous period, t-1. Indeed, the model can contain more lags in order to account for different seasonal effects on the dependent variable. While this model may capture a more rich data structure than Equation 1, the dynamic regression model is characterized by different sources of persistence over time which might cause estimation bias. In fact, dynamic panel data models provide different reasons for over time period correlation in the dependent variable; directly through the dependent variable’s preceding periods (a so-called true state dependence); directly through observable regressors (observed heterogeneity); and indirectly through time-invariant individual effects (unobserved heterogeneity) (Cameron and Trivedi, 2010). The estimation bias could be due to either autocorrelation since the lagged dependent variable is included among the explanatory variables or unobserved individual heterogeneity (Baltagi, 2005).

### 3.3.1 Autocorrelation

Autocorrelation implies that the regression error term is related over different time periods. When present, autocorrelation can reduce the size of coefficients’ standard errors which in turn will give the model a misleadingly higher explanatory power (Hill et al., 2008). There are several ways to detect and solve for autocorrelation. For instance, when estimating a pooled ordinary least squares (OLS) model, the Wooldridge test can detect autocorrelation while cluster robust options solve for it (Cameron and Trivedi, 2010).

For illustrative purposes, assume that the following arbitrary relationship exists between MFIs’ C&I lending and housing prices:

\[ C_{it} = \delta_1 C_{it-1} + \beta_1 HousingPrice_{it} + \beta_2 X_{it} + u_{it} \]  

Whereas the error term, \( u_{it} \), is the relevant variable for the matter at hand. Assume that
the error term is composed of the following components $u_{it} = \mu_i + v_{it}$. Note that $\mu_i$ is a time-invariant component and also assume that $\mu_i \sim IID(0, \sigma^2_\mu)$ and $u_{it} \sim IID(0, \sigma^2_u)$. In this case, the lagged dependent variable will be correlated with the contemporary error term’s time-invariant components, i.e. $E(C&I_{it-1}, \mu_i) \neq 0$ and exogeneity assumptions will consequently be violated since $E(C&I_{it-1}, u_{it}) \neq 0$. This endogeneity renders estimators to be biased as well as inconsistent, even though $v_{it}$ may not be autocorrelated (Baltagi, 2005). Empirically, when investigating certain firm-level characteristics, such as payout policy, capital structure, investment decisions or possibly lending behavior, it arguably requires the use of firm fixed effects to control for this issue (Flannery and Hankins, 2013).

There are typically two common assumptions made about the earlier mentioned unobserved heterogeneity, mainly the fixed effects (FE) assumption and the random effects (RE) assumption. While being a more efficient estimation, the RE model holds given strict assumptions that individual effects are uncorrelated with the explanatory variables, contrary to the FE assumptions which allow for correlation between individual effects and explanatory variables. Typically, the Hausman test is applied to decide which model is appropriate, although, a severe shortcoming of the standard Hausman test is that it requires the RE estimator to be efficient (Cameron and Trivedi, 2010). Given the more likely scenario that the RE model is not adequately efficient, Wooldridge (2002) proposes a robust version of the Hausman test. Hence, to control for individual heterogeneity and possible endogeneity issues, the Hausman test, followed by the appropriate model estimation are presented in Section 4.

The FE model requires strict exogeneity among its regressors with respect to the idiosyncratic error term, but in a dynamic model, this assumption is likely to be violated since FE model utilizes mean-difference transformation. Mean difference transformation may correct the time-invariant individual heterogeneity, but the correlation between the transformed, lagged dependent variable and the transformed error will violate the strict exogeneity assumption, i.e. $E((C&I_{it-1} - \bar{C}&\bar{I}_i), (u_{it} - \bar{u}_i)) \neq 0$ (Nickell, 1981). When the strict exogeneity assumption of the FE model is violated, the estimation becomes inconsistent (Flannery and Hankins, 2013). This predicament of the FE model has been highlighted by Anderson and Hsiao (1981), who propose a particular model specification as a remedy to avoid the bias associated with the FE model.

### 3.3.2 Anderson & Hsiao Estimator

The Anderson and Hsiao (1981) (AH) estimator utilizes first difference-within transformation to rid the model from individual heterogeneity, $\mu_i$. The AH estimator utilizes the second lag of the dependent variable, $C&I_{it-2}$, as an instrument for the first-differenced
lag, i.e., $\Delta C&I_{it-1}$ (where $\Delta$ indicates the first difference), to avoid correlation with the differenced idiosyncratic error term. This instrument will be valid given that it is not correlated with $\Delta v_{it}$, which in turn requires that $v_{it}$ is not autocorrelated (Cameron and Trivedi, 2010).

The instrument that Anderson and Hsiao (1981) propose yields consistent although not necessarily efficient parameter estimates since it does not utilize all the available moment conditions. Furthermore, the AH estimator does not take into account the differentiated structure of the residual disturbances (Baltagi, 2005). Arellano (1989) argues that this inefficiency could yield inflated variances for a given parameter value interval. Consequently, Arellano and Bond (1991) propose a generalized method of moments (GMM) procedure that has efficiency gains over the AH estimator while utilizing the first difference-within transformation.

### 3.3.3 Arellano & Bond Estimator

Arellano and Bond (1991) argue that additional instruments to the ones proposed by Anderson and Hsiao (1981) can be obtained by utilizing the orthogonality conditions that exist between lagged values of the dependent variable and the disturbances, $v_{it}$. This technique results in the Arellano & Bond (AB) estimator where differenced lags of the dependent variable are instrumented, using deeper lags of the dependent variable. When estimating the AH model, adding deeper lags of the dependent variable will reduce the number of available observations. For instance, if observations are available at $T$ periods, then the first-difference transformation will leave $T-1$ usable lags. If the model uses $K$ lags of the dependent variable as instruments, only $T-K-1$ observations can be used in the regression model meaning that adding more lags provides more instruments, but reduces the sample size for the AH model. The AB estimator, however, circumvents this trade-off problem (Roodman, 2006).

For illustrative purposes, assume that C&I loans follow an arbitrary, strictly autoregressive relation, in accordance with Equation 4 below:

$$C&I_{it} = \delta C&I_{it-1} + u_{it}$$  \hspace{1cm} (4)

Where, again, $u_{it} = \mu_i + v_{it}$, $\mu_i \sim IID(0, \sigma^2_\mu)$ and $v_{it} \sim IID(0, \sigma^2_v)$. Similar to Anderson and Hsiao (1981), to rid the model from individual heterogeneity first difference-within transformation is utilized, resulting in Equation 5 below:

$$\Delta C&I_{it} = \delta(C&I_{it-1} - C&I_{it-2}) + (v_{it} - v_{it-1})$$  \hspace{1cm} (5)
The first available observation becomes $t = 3$, due to the first-difference transformation. $C & I_1$ is possibly a strong, valid instrument for $(C & I_3 - C & I_2)$ but remains uncorrelated with $(v_{t3} - v_{t2})$, given that $v_{it}$ is not autocorrelated. At $t = 4$, the number of presumably valid instruments increases due to the fact that $C & I_1$ remains a valid instrument in addition to $C & I_2$. Ultimately, the number of valid instruments for this first-differenced model is $T - 2$. Furthermore, the instrument estimators can be obtained in two ways. Moment conditions combined with premultiplying with the differenced equation, and performing generalized least squared (GLS) estimation yields the Arellano and Bond (1991) preliminary one-step estimator.\(^\text{10}\) Although, because the model is overidentified, more efficient estimation is possible using the optimal generalized method of moments (GMM) parameter based on Hansen (1982), also known as the two-step estimator. This estimator requires no preexisting knowledge regarding the initial conditions or distribution of $v_{it}$ and $\mu_i$ and is utilized as differenced residuals obtained from the preliminary consistent estimator replaces $\Delta v_{it}$ (Roodman, 2006). The two-step estimation is asymptotically more efficient and consistent in the presence of heteroskedasticity, but its standard errors tend to be severely downward biased. Windmeijer (2005) suggest a correction term to the two-step covariance matrix that provides more accurate estimations in finite samples when all the moment conditions are linear, without the downward bias (Roodman, 2006).

All in all, the AB estimator relaxes the strict exogeneity assumption, allowing fixed individual effects and autocorrelation as well as heteroskedasticity within individuals (Roodman, 2006). Predetermined or weakly exogenous regressors are instrumented by their lags and contemporaneously endogenous regressors instrumented, using deeper lags (Cameron and Trivedi, 2010). This technique is certainly useful given the endogeneity issues in housing prices discussed by Chakraborty et al. (2016) and in lack of a similar instrument variable to the one they use. Arellano and Bond (1991) suggest post-estimation testing for second-order autocorrelation as well as performing the Sargan’s test for over-identifying restrictions validity.\(^\text{11}\)

Despite this, the AB estimator has been documented to have poor finite sample properties, causing bias and imprecision when the variables are highly persistent, or if the variance of the individual effect is large relative to the variance of the error term (Blundell and Bond, 1998). In this case, the lags will be weakly correlated with the following first differences. Hence, the AB estimator’s instruments will be weak which in turn can inflict inflated variance-inefficiency or estimate bias, especially when working with shorter panels (Hill et al., 2008). Blundell and Bond (1998) revisit the importance of exploiting the

\(^{10}\)For further reading, this calculation is based on Holtz-Eakin (1988).

\(^{11}\)Note that the Sargan’s test can only be estimated if the model specification is without any robustness-options since the test assumes that errors are naturally IID.
initial condition in generating efficient estimators, thus proposing an alternative to the AB estimator.

### 3.3.4 Blundell & Bond Estimator

The AB estimator is based on the assumption \( E(C\&I_{st}, \Delta u_{it}) = 0 \) when \( s \leq t - 2 \) so that deeper lags can be used as instruments for the first-differenced estimation. Given the possibility that past levels convey little information about future changes, Blundell and Bond (1998) show that the lagged-level instruments of the AB estimator become weak as the dependent variable moves closer to a random walk. To obtain a more precise estimator with better finite-sample properties and more moment conditions than the AB estimator, they propose a system GMM estimator that uses additional moment conditions in which lagged differences are instruments for the level equation in addition to the moment conditions of lagged levels used as instruments for the differenced equation. The Blundell and Bond (1998) (BB) estimator has in the existing literature on firm liability structures been proven superior to the AB model, considering the typically high persistence of the dependent variable (Catão et al., 2017). Hence, in addition to the AB estimator conditions the BB estimator proposes the additional condition \( E(\Delta C\&I_{it-1}, u_{it}) = 0 \). This results in greater efficiency and more available, stronger instruments. Additionally, the two-step robust estimation proposed by Windmeijer (2005) is generally more efficient than the one-step estimator, especially when estimating the BB model (Roodman, n.d.). Similar additional moment conditions can be added for endogenous and predetermined variables, whose first differences can be utilized as instruments (Cameron and Trivedi, 2010). Aside from this, the initial assumptions of no high order autocorrelation and overidentifying restrictions still apply when estimating the BB estimator (Baltagi, 2005).

Lastly, dynamic panel data models enable estimation of coefficients and standard errors for long-run effects, using the procedure proposed by Papke and Wooldridge (2005). This alternative method for long-run effects in a dynamic panel data model is a nonlinear function of the coefficients of the explanatory variables and the lagged dependent variable (Baum et al., 2017). More specifically, the long rung effects are calculated as the sum of the coefficients of the lags of a specific variable, divided by one minus the sum of the coefficients on the lagged dependent variable. This methodology has been used in corporate finance research such as Ehrmann et al. (2001) and may provide additional insights to understand the relationship between housing prices and C&I lending.

\(^{12}\)The model is estimated using the 'xtdpdys' syntax in Stata 13.0.
4 Analysis of Results

In light of the methodology in Section 3, this section presents its tests and results. Note that all model estimation results are available in Table 5 but this section provides the reader with the analysis of the results. Furthermore, the notations "L" indicates the lag and "D" indicates the difference of the following variable. Table 1 below presents a VIF estimation for all available regressors.\(^{13}\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOX</td>
<td>19.78</td>
<td>0.050544</td>
</tr>
<tr>
<td>UR</td>
<td>8.00</td>
<td>0.125011</td>
</tr>
<tr>
<td>RR</td>
<td>7.67</td>
<td>0.130350</td>
</tr>
<tr>
<td>IE</td>
<td>1.51</td>
<td>0.660214</td>
</tr>
<tr>
<td>TE</td>
<td>1.43</td>
<td>0.696935</td>
</tr>
<tr>
<td>NI</td>
<td>1.41</td>
<td>0.707887</td>
</tr>
<tr>
<td>SZ</td>
<td>1.16</td>
<td>0.858731</td>
</tr>
<tr>
<td><strong>Mean VIF</strong></td>
<td><strong>5.85</strong></td>
<td></td>
</tr>
</tbody>
</table>

Apparently, the VIF for the HOX-index exceeds the rule of thumb factor of 10, and the macro variables’ VIFs are close to the threshold. Balling (2008) suggests calculating the ratio between the collinear variables in order to rid the model of multicollinearity. This technique can provide more reliable estimates without compromising the explanatory power of the model. Although, this technique can make the interpretation of the variables’ marginal effects counter-intuitive. Hence, in order to keep interpretation of results simple, the HOX-index is kept in its original form while the variable IE is divided by the corresponding TE (IT) and in the same way RR is divided by UR (RU). The resulting VIF estimation is presented in Table 2 below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>RU</td>
<td>3.19</td>
<td>0.313107</td>
</tr>
<tr>
<td>HOX</td>
<td>3.18</td>
<td>0.314548</td>
</tr>
<tr>
<td>NI</td>
<td>1.33</td>
<td>0.751766</td>
</tr>
<tr>
<td>IT</td>
<td>1.30</td>
<td>0.766513</td>
</tr>
<tr>
<td>SZ</td>
<td>1.06</td>
<td>0.946655</td>
</tr>
<tr>
<td><strong>Mean VIF</strong></td>
<td><strong>2.01</strong></td>
<td></td>
</tr>
</tbody>
</table>

\(^{13}\)Tables 1 and 2 are post-estimation tests for a cluster robust pooled model in accordance with Equation 1.
None of the explanatory variables show a VIF that exceeds the rule of thumb factor of 10. The transformed variables are theoretically essential, but are merely included in the model for control rather than interpretation. Hence, since the interpretation of the transformed variables’ marginal effects is redundant, the remedy for multicollinearity suggested by Balling (2008) is certainly applicable. Simultaneously, this specification will lead to more reliable estimations compared to one that suffers from multicollinearity. According to Roodman (2006), dynamic panel data estimations are inherently sensitive and estimating such a model with high levels of multicollinearity will most likely worsen the already sensitive results. Consequently, the transformed explanatory variables, shown in Table 2 are used exclusively henceforth.

The Breusch-Pagan test for heteroskedasticity and the Wooldridge test for autocorrelation is presented below in Table 3.

<table>
<thead>
<tr>
<th>Table 3: Results from the Breusch-Pagan and Wooldrige tests.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breusch-Pagan test for heteroskedasticity</td>
</tr>
<tr>
<td>H0: Constant variance</td>
</tr>
<tr>
<td>chi2(5) = 63.53</td>
</tr>
<tr>
<td>Prob &gt;chi2 = 0.0000</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Wooldridge test for autocorrelation in panel data</td>
</tr>
<tr>
<td>H0: No first-order autocorrelation</td>
</tr>
<tr>
<td>F(1, 67) = 11.760</td>
</tr>
<tr>
<td>Prob &gt;F = 0.0010</td>
</tr>
</tbody>
</table>

The null hypothesis of both tests is rejected at all significance levels, indicating heteroskedasticity as well as first-order autocorrelation. For the initial, pooled OLS model, error clustering specification allows for intragroup correlation among errors while relaxing the usual requirement of observation independence. Hence, the error clustering affects the standard errors and variance-covariance matrix of estimators but not the size of estimated coefficients (Baltagi, 2005). The estimation results from a simple pooled OLS model, as well as a similar, cluster robust specification, are presented in Table 5. Note that the pooled OLS regression model is probably not the most appropriate in this case. Nonetheless, this model can provide an initial indication of possible causal relationships.

Not surprisingly, the pooled OLS model’s result indicates an underestimation of the standard errors, most likely due to the issues apparent in the earlier presented tests. All the following model estimations will have to account for this. Nonetheless, the HOX-index
shows a significant, negative marginal effect on the ratio of bank C&I loans of -0.0005179, indicating that housing prices have a negative marginal effect on MFIs’ ratio of C&I loans. However, the pooled OLS model does not account for plausible unobserved individual heterogeneity. Consequently, the Wooldridge (2002) robust Hausman test is estimated, and its results are presented in the Appendix, Section A.3. The test’s null hypothesis is rejected at all significance levels, indicating a systematic difference between estimations due to endogeneity. Since the RE model does not facilitate endogeneity, the FE model is preferred in this case (Cameron and Trivedi, 2010). The FE model’s estimation results are presented in Table 5.14 Note that the standard errors are clustered in accordance with earlier discussed diagnostic tests.

Apparently, the HOX-index has a significant, negative marginal effect on MFIs’ ratio of C&I loans, by a value of -0.000663. Furthermore, the standard errors for the FE model are smaller than for the pooled OLS model. All variables except IT remain significant in the FE model, although the variable SZ becomes insignificant at the 1 percent significance level. While the estimated FE model accounts for unobserved individual heterogeneity, it does not explore the possible dynamic nature of MFIs’ loan supply. Simultaneously, including lagged values of the dependent variable in the FE model will most likely result in endogeneity issues. Hence, the AH-, AB-, and BB models proposed by Anderson and Hsiao (1981), Arellano and Bond (1991) and Blundell and Bond (1998) respectively can possibly capture this dynamic while accounting for individual heterogeneity and autocorrelation, and are presented in Table 5. Firstly, the interpretation of the AH estimator is given below.

The AH estimator does not specify cluster robust errors due to the crucial assumption of no autocorrelation in the error term (Cameron and Trivedi, 2010). Also, including deeper lags of the dependent variable as regressors can rid the model of seasonal influences. However, deeper lags are insignificant in all dynamic model estimations and are therefore omitted from the dynamic specifications. The model results indicate that the first-differenced HOX-index has a significant, albeit positive marginal effect on the first-differenced C&I Loan ratio of 0.0008467. Furthermore, the first-differenced lag of the dependent variable shows a strong, significant marginal effect of 0.6699401, thus indicating a dynamic nature in banks’ C&I lending. Note that the second lag of the dependent variable is used as an instrument for this variable under the assumption of no correlation between the instrument and the contemporaneous error term. All explanatory variables remain significant, except the RU ratio which becomes insignificant at the one percent level. This estimation, however, might be inferior to the AB estimator from an efficiency

14The Wooldridge (2002) robust Hausman test lacks a formal syntax in Stata 13.0. Hence, the test’s code is presented in the appendix.
perspective. Furthermore, it does not take into account the possible endogeneity of housing prices in accordance with the discussion by Chakraborty et al. (2016).

Due to their efficiency gains over the AH estimator, as well as facilitation of possibly endogenous regressors, the AB- and BB models are estimated. Their results are presented in Table 5. In addition, the long-run effects of the HOX-index in the AB and BB models respectively are estimated, using the methodology proposed by Papke and Wooldridge (2005). The lagged difference of the dependent variable in both the AB and BB estimation shows significant, strong marginal effects by 0.8750854 and 0.9451034 respectively. Furthermore, while there is no material difference in the estimated AB- and BB models’ standard errors, the high persistence of the dependent variable is in favor of the BB model. Both models indicate a dynamic relationship in MFIs’ C&I lending. The BB model, however, has been documented as superior to the AB model for shorter panels, which is moderately applicable in this case Blundell and Bond (1998). The estimated marginal effect for the differenced HOX-index is negative for the AB model with a value of -0.0000371, albeit positive for the BB model, with a value of 7.69e-06. The HOX-index’s marginal effects are, however, insignificant in both models at all levels, in short- and long-run. The variables NI and SZ are the only explanatory variables that show significant marginal effects for the AB and BB models. These results will be further discussed in Section 5.

The post-estimation diagnostic tests, recommended by Arellano and Bond (1991), are presented below in Table 4.

<table>
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<tr>
<th>H0: No autocorrelation</th>
<th>AB</th>
<th>BB</th>
</tr>
</thead>
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<tr>
<td>Order</td>
<td>z</td>
<td>z</td>
</tr>
<tr>
<td>1</td>
<td>-2.0548</td>
<td>0.0399</td>
</tr>
<tr>
<td>2</td>
<td>1.2901</td>
<td>0.1970</td>
</tr>
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Applying the tabulated critical values, the null hypothesis of no autocorrelation in the first-differenced errors is not violated. Furthermore, overidentifying restrictions are valid.

Apparently, for both models, the crucial assumption of no autocorrelation in the first-differenced errors is not violated. Rejecting the null hypothesis of no autocorrelation in the first-differenced errors at order zero does not imply error in the model specification since the first-differenced errors are autocorrelated if the errors are independent and identically distributed. However, rejecting the null hypothesis of no autocorrelation in the first-differenced errors at an order greater than one implies model misspecification (Cameron and Trivedi, 2010).

---

15 Rejecting the null hypothesis of no autocorrelation in the first-differenced errors at order zero does not imply error in the model specification since the first-differenced errors are autocorrelated if the errors are independent and identically distributed. However, rejecting the null hypothesis of no autocorrelation in the first-differenced errors at an order greater than one implies model misspecification (Cameron and Trivedi, 2010).
Although, Roodman (2006) argues that for AB and BB models, instrument proliferation can overfit endogenous variables and fail to erase their endogenous components. Typically, this is apparent if the Sargan test shows a test value close to 1. Hence, in order to ensure that estimations are rid of endogenous components, the instrument count is limited for the lagged dependent variable as well as the HOX-index. For instance, the original, unrestricted BB model has an instrument count of 664, whereas the limited, applied model has 168 instruments by restricting the lag count of the dependent variable and the endogenous HOX-index variable to 2. Additionally, this also prevents the model from expunging observations.
Table 5: Model estimation results using the ratio of C&I loans in various forms as the dependent variable; I and II use the ratio of C&I loans, III use mean difference transformation. IV, V and VI use first difference-within transformation.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
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<td>Pooled OLS</td>
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<td>Pooled OLS</td>
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<tr>
<td>L. C&amp;I Loans</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.6699401***</td>
<td>.8750854***</td>
<td>.9451034***</td>
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<tr>
<td></td>
<td>(.0000941)</td>
<td>(.0001132)</td>
<td>(.0001158)</td>
<td>(.1649281)</td>
<td>(.1192135)</td>
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<td>HOX</td>
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<td>-.0005179***</td>
<td>-.000663***</td>
<td>.0008467***</td>
<td>-.000371</td>
<td>7.69e-06</td>
</tr>
<tr>
<td></td>
<td>(.6717147)</td>
<td>(.2405822)</td>
<td>(.5020398)</td>
<td>(.1412346)</td>
<td>(.224472)</td>
<td>(.3770054)</td>
</tr>
<tr>
<td>NI</td>
<td>11.19606***</td>
<td>11.19606***</td>
<td>1.590798***</td>
<td>.4776046***</td>
<td>.810324***</td>
<td>1.050617***</td>
</tr>
<tr>
<td></td>
<td>(.113e-14)</td>
<td>(.1054204)</td>
<td>(.0248256)</td>
<td>(.0064974)</td>
<td>(.0120207)</td>
<td>(.0143793)</td>
</tr>
<tr>
<td>IT</td>
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<td>.2165858***</td>
<td>.0387081</td>
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<td>(.0184256)</td>
<td>(.0184256)</td>
<td>(.0120207)</td>
<td>(.0143793)</td>
</tr>
<tr>
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<td>-.0608272***</td>
<td>-.0743868***</td>
<td>.0355233**</td>
<td>-.0113407</td>
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<td>(.0184256)</td>
<td>(.0184256)</td>
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<tr>
<td>Constant</td>
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<td>.2365258***</td>
<td>.3258066***</td>
<td>-.0028652***</td>
<td>.027587</td>
<td>.0023059</td>
</tr>
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<td></td>
<td>(.0193819)</td>
<td>(.0347753)</td>
<td>(.0219933)</td>
<td>(.0004421)</td>
<td>(.0415949)</td>
<td>(.0166691)</td>
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<td>2380</td>
<td>2244</td>
<td>2244</td>
<td>2312</td>
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<td>0.2416</td>
<td>0.1163</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Note</td>
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<td>Non-adjusted $R^2$</td>
<td>Overall $R^2$</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Long-run effects</td>
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<td>-</td>
<td>-</td>
<td>error correction term</td>
<td>error correction term</td>
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</tbody>
</table>

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01
5 Conclusion

The allocation of scarce resources to their most efficient use is a challenge for all societies. According to the credit channel framework, adverse changes in loan supply will alter this allocation, resulting in lower investments and ultimately reduced aggregate output. Furthermore, the balance sheet channel argues that the external finance premium is inversely related to borrowers’ net worth (Bernanke and Gertler, 1995). Consequently, non-financial corporations enjoy greater access to external capital given that they own real estate in tandem with housing price appreciations. In addition, bank loan contracts can easily adopt collateral requirements. When firms own real estate, it can be used as collateral, which mitigates moral hazard problems and reduces informational frictions (Stiglitz and Weiss, 1981). Due to this, Chaney et al. (2012) argue that firms benefit from real estate appreciation through the collateral channel. All in all, this indicates that the relationship between housing prices and loan supply could manifest with the HOX-index having a positive marginal effect on the share of C&I lending. If this relationship is apparent, then non-financial corporations’ exposure to the real estate market could be worrisome given the recent uncertainty in Swedish housing prices and their relationship to C&I loan supply. Indeed, a significant share of the intermediated loans to the real sector is backed by collateral such as real estate, which indicates a high real estate exposure among non-financial corporations (Konkurrensverket, 2016). Gan (2007) shows that firms with higher collateral losses following adverse economic shocks, are less likely to sustain their banking relationships and tend to obtain smaller loans. In case of a real estate market bust, a self-reinforcing mechanism in accordance with financial accelerator theory could erupt, exacerbating the economic downturn (Bernanke et al., 1994).

The bank lending channel, however, is assumed to directly alter the supply of intermediated credit in the economy, thus exacerbating the fluctuations in output following monetary policy changes (Bernanke and Gertler, 1995). Figure 2 shows how the share of C&I loans among the MFIs has decreased during the post-crisis period and, meanwhile, housing prices have grown substantially. According to Loutskina and Strahan (2015), banks have historically flocked to profitable mortgage markets. In addition, MFIs have to, like any other firm, compare and choose profitable business opportunities over others (Stein, 1995). Indeed, mortgage lending has, according to Figure 1, enjoyed great profit margins and consequently increased substantially. Given that MFIs are limited in their ability to extend new loans or sell preexisting ones, housing price booms can result in a loan supply crowding out effect. For instance, U.S. banks that were active in strong housing markets increased their mortgage lending at the expense of their C&I lending and, in turn, firms in need of external funds significantly lowered their investments (Chakraborty et al., 2016). Since banks specialize in overcoming credit market frictions, informationally opaque firms
suffer from the adverse changes in loan supply (Baum et al., 2009). Similar to the bank lending channel mechanism, this could reduce firms’ investments and consequently their output. This relationship between housing prices and loan supply could manifest with the HOX-index having a negative marginal effect on the share of C&I lending.

The relevance of these results depends on the degree to which firms rely on MFIs as suppliers of external capital. According to Boot (2000), the proliferation of transaction-oriented banking and the direct funding available in the financial markets has challenged the role of banks as lenders. Furthermore, while C&I lending has somewhat increased during the post-crisis period, issuance of debt securities has grown substantially. Despite this, Diamond (1991) and Hoshi et al. (1993) emphasize that bank lending often serves as a complement to market funding. Indeed, banks’ screening and monitoring ex-post lending mitigate information asymmetries for other lenders, serving as a certificate of quality (Hoshi et al., 1993). Some borrowers, therefore, strive towards a sound banking relationship before accessing capital markets (Diamond, 1991). Consequently, changes in loan supply will affect firms that solely depend on MFIs, but also firms with access to other external financings who will suffer additional search costs to find a different supplier of loans, hence increasing their external finance premium (Bernanke and Gertler, 1995). Ultimately, C&I loans remain the most prominent source of external financing to this day.

Overall, the applied estimations have proven that the relationship between C&I loans and the HOX-index is ambiguous, with regards to influence as well as significance. The model estimations are preceded with tests for multicollinearity, heteroskedasticity, and autocorrelation. Furthermore, the Wooldridge (2002) robust Hausman test indicates the presence of individual heterogeneity, rendering the RE model as well as OLS estimations invalid. For a dynamic model specification, however, the FE model accounts for the data’s panel structure but ignores the correlation between the lagged dependent variable and the error term, resulting in inconsistent estimations. By utilizing dynamic panel data models, the relationship between C&I lending and housing prices is investigated while controlling for autocorrelation and endogeneity (Flannery and Hankins, 2013). Overall, the preceding periods’ first difference of the share of C&I loans have a strong influence on the current first differenced share of these types of loans. MFIs utilize their relationship lending to overcome informational frictions, which advocates for a positive relationship between past and current levels of lending to a particular individual, as the duration of a bank relationship should be inversely related to information asymmetries between the two agents. For instance, Petersen and Rajan (1994) and Berger and Udell (1995) argue that the duration of the bank-borrower relationship positively affects the availability of credit while interest rates and collateral requirements fall. Also, one might argue that MFIs specialize in different types of lending, which makes their current C&I lending dependent on
past business decisions. Furthermore, the dynamic models facilitate endogeneity issues in housing prices, discussed by Chakraborty et al. (2016). According to the post-estimation tests, suggested by Arellano and Bond (1991), the crucial assumption of no higher order autocorrelation as well as overidentifying restrictions are valid.

The AH estimator shows that the HOX-index has a significant yet positive marginal effect on C&I loans. However, this estimator is asymptotically inefficient as its asymptotic variance is higher than the AB estimator's, which uses a similar set of instruments but GMM estimation instead of instrumental variable estimation. Also, the AH estimator does not account for possible endogeneity in the HOX-index. Hence, the AB and BB estimators provide more efficient estimations while accounting for possible endogeneity issues, resulting in a marginal effect of -0.0000371 and 7.69e-06 respectively. Although, both the AB- and BB model render the HOX-index non-significant at all levels. Ultimately, due to the persistence of the dependent variable, the BB system GMM estimator proves more precise and has better finite-sample properties and more moment conditions. Hence, the BB estimator is, in this case, the most reliable estimate, especially since overidentifying restrictions are valid and higher order autocorrelation is not apparent. The ambiguity in marginal effects and significance of the HOX-index could be because the static models omit the previous levels of C&I lending, and that model specifications, static as well as dynamic, need to control for endogeneity when utilizing housing prices as a regressor.

The results indicate that housing prices do not have a significant effect on MFIs' share of C&I loans. Despite this, the author of this thesis argues that the lack of significant results might be due to counteracting effects between the variables. More specifically, while housing price appreciations may reduce the supply of C&I loans, firms can take on more debt since their net-worth increases, resulting in housing prices having a negligible effect on loan supply. Policy intervention on asset price fluctuations has in some cases proven more harmful than helpful, consequently increasing credit risk rather than mitigating it. The fact that housing prices do not significantly affect the supply of C&I loans provides policymakers with a certain freedom to counter the unsustainable development of the housing market, nonetheless the severe indebtedness of households. Furthermore, in tandem with the inadequate competition in the housing mortgage lending market, MFIs' extensive housing mortgage lending makes them sensitive to housing price fluctuations, which calls for more regulatory action (Aoki and Nikolov, 2015). Non-financial corporations, and our society at large, generally benefit from macroeconomic stability which ensures efficient capital allocation. A well functioning bank sector with adequate exposure to and profits from the real estate market can provide that.
5.1 Further Research

This thesis aims to investigate housing prices’ influence on MFIs’ C&I lending. More specifically, it estimates this relationship by applying various regression models, using MFIs’ ratio of loans to non-financial corporations over total assets as the dependent variable and the HOX-index as a proxy for the national average housing price. In contrast to earlier work on asset price fluctuations and changes in loan supply, this thesis provides a novel academic approach by observing the post-crisis period, which is characterized by a substantial asset price appreciation. Certainly, a global event of such magnitude as the financial crisis will have an impact on how firms and MFIs behave. The fact that this thesis’ results differ from the ones presented by Chakraborty et al. (2016), who study the period before the financial crisis, calls for further research to compare influences in loan supply before and after the crisis. In addition, the development of the Swedish real estate market is a highly topical issue that requires a more in-depth knowledge with regards to its causes as well as its consequences.

Studies that strive to establish a relationship between adverse shocks to financial intermediaries and borrowers performance face a fundamental identification challenge when trying to separate the effect of firm-specific demand-side shocks from the supply-side shocks. For instance, if it is the borrowers’ weak performance that causes the deterioration in MFIs’ lending, then research faces an uphill task in establishing the causation in the other direction. Additionally, if common economic shocks affect the performance of both the real economy and the banking sector, then the task of separating the effect of firm-specific factors from MFI-specific shocks becomes even more difficult (Caglayan and Xu, 2016). C&I loans are subject to demand-based changes, although these go beyond the scope of this thesis, due to its focus on supply-based changes. The share of C&I loans among the selected MFIs have decreased but not because of housing price appreciations’ influence on loan supply. In order to determine the cause of the change in C&I lending, a demand-based approach might be appropriate.

Indeed, non-financial corporations’ dependency on C&I lending is influenced by, among other things, financial innovations, regulatory effects and behavioral determinants that characterize modern credit markets. The increased competitive pressure in lending provides more substitution options for firms in need of capital. For instance, in tandem with the decreased C&I lending ratios, firms have to a larger extent issued debt securities. The increased reliance on this kind of financing emphasizes the need for further research in external capital supply. In the same sense, there has been an upswing of new lenders, typically supplying unsecured loans to households and non-financial corporations. These institutes might to some extent explain the decline in C&I lending among the more con-
ventional MFIs that are included in this thesis. All in all, C&I lending remains the most prominent source of external funds. The fact that this type of funds has decreased during the post-crisis periods urges the need for further research.
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38

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## A Appendix

### A.1 List of Monetary Financial Institutions

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<th>Institution</th>
<th>Institution</th>
</tr>
</thead>
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<td>Nordea Bank AB</td>
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<td>Dalslands Sparbank</td>
</tr>
<tr>
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43
## A.2 Descriptive Statistics

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<th>Max</th>
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<td>.00002</td>
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<td>.0927165</td>
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<td>.4286083</td>
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<td>.033193</td>
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<td>.3970217</td>
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<td>174.3063</td>
<td>33.46472</td>
<td>239.7</td>
<td>N = 2380</td>
<td>A transaction-based price index for single-family houses and house cooperative apartments in Sweden</td>
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<td>174.3063</td>
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<td></td>
<td>within</td>
<td>33.46472</td>
<td>33.46472</td>
<td>239.7</td>
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<td>.0022117</td>
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<td>.0098798</td>
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<td>.0000726</td>
<td>.0291846</td>
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<td>overall</td>
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<td>.0024975</td>
<td>-.0203161</td>
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<td>Bank’s interest expenses divided by total assets</td>
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<td>TE</td>
<td>overall</td>
<td>.1380806</td>
<td>.0637651</td>
<td>.0247189</td>
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<td>Bank’s total equity divided by total assets</td>
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<td>4.01e+10</td>
<td>1.60e+11</td>
<td>1175366</td>
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<td>Bank’s total assets minus total outstanding loans</td>
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<td>1.47e+11</td>
<td>3397012</td>
<td>7.42e+11</td>
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<td>6.54e+10</td>
<td>1.86e+11</td>
<td>1.77e+12</td>
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<td>UR</td>
<td>overall</td>
<td>7.760571</td>
<td>.610622</td>
<td>6.65</td>
<td>N = 2380</td>
<td>Number of unemployed people as a percentage of the labor force (unemployed who actively search for employment plus those in paid or self-employment).</td>
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<td>7.760571</td>
<td>7.760571</td>
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<td>RR</td>
<td>overall</td>
<td>.5403657</td>
<td>.7967184</td>
<td>.5</td>
<td>N = 2380</td>
<td>The repo rate is the interest rate at which banks can deposit or borrow money for a period of 7 days with Riksbanken.</td>
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A.3 Wooldridge Robust Hausman Test

```
quietly xtreg cl $xvar, re
. scalar theta = e(theta)
. global yandxforhausman cl hox ni sz it ru
. sort id

. foreach x of varlist $yandxforhausman {
2. by id: egen mean'x' = mean('x')
3. generate md'x' = 'x' - mean'x'
4. generate red'x' = 'x' - theta*mean'x'
5. }
quietly regress redcl redhox redni ///
redsz reedit redru mdhox mdni mdsz mdit mdru

test mdhox mdni mdsz mdit mdru

(1) mdhox = 0
(2) mdni = 0
(3) mdsz = 0
(4) mdit = 0
(4) mdru = 0
Constraint 1 dropped
Constraint 3 dropped
Constraint 5 dropped

F(2, 2371) = 11.68
Prob >F = 0.0000
```