THE EFFECTS OF MACROPRUDENTIAL POLICIES ON MORTGAGE LENDING FIRMS

A STUDY ABOUT SWEDISH MORTGAGE LENDING RESTRICTIONS

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Authors: Ibrahim Makdessi Afrem (115808) & Josefin Karlsson (115664)
Supervisor: Søren Ulrik Plesner

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ABSTRACT

In recent years, macroprudential policies in the form of lending restrictions have been implemented in Sweden with the objective of slowing down the increased indebtedness among households. The implemented restrictions are an LTV cap, an amortisation requirement and an extended amortisation requirement, which all apply for new mortgage loans. The restrictions are believed to impact the overall systematic risk, mortgage loan levels and prices in the housing market. The restrictions will therefore indirectly affect mortgage lending firms. The purpose of this study is to examine the mortgage lending restrictions' impact on profit and risk of mortgage lending firms. The impacts are measured by stock price reactions of the announcement of each restriction.

The mortgage lending market in Sweden is dominated by four banks, which are the only firms fulfilling all criterions set for a firm to be relevant for this study. Two of the firms have dual share classes of stock, both stocks of these firms are included in the sample. An event study approach is taken to determine whether the returns of the stocks were abnormal around the announcement of each restrictions. First, a standard event study is conducted where cumulative abnormal returns for each stock is tested for significance and is complemented with a rank test that examines abnormal returns at a portfolio level. Second, event study-based regression models are conducted to determine the size of abnormal returns. The regressions are run on both an equally weighted portfolio of all stocks and on an individual stock basis.

The results of this study indicate a positive investor reaction of the LTV cap, implying that the lending restriction is positive for the profit and risk of mortgage lending firms. On the contrary, negative abnormal returns are found in relation to both amortisation requirements. The results suggest that the amortisation requirements are negative for the profit and risk of mortgage lending firms. Based on the regression models, no conclusions can be made regarding the size of the abnormal returns at a portfolio level. At a stock level, no significant results are found for the LTV cap. For both amortisation requirements, SEB A and Nordea are found to have negative abnormal returns. The finding contradicts the hypothesis that firms with higher mortgage loans-to-total assets ratios will be more affected. The impact of the first amortisation requirement is negative but relatively small for SEB A and Nordea. A final finding in this study is related the dual share class of SEB which shows an unexpected discrepancy in stock return development.

Table of Contents

1. Introduction

In the last two decades, the debt-to-income (DTI) ratio among Swedish households has been constantly increasing and outpaced the corresponding ratio of most European countries (Eurostat, 2019). In 2000, the DTI ratio in Sweden was 96%, however, in 2017 the ratio measured up to almost 163% (Ibid). The sharp increase in indebtedness among households has been a major concern to the Swedish Financial Supervisory Authority (FSA), since the high levels of debt may aggravate a financial downturn.

Macroprudential policies, in the form of lending restrictions and with the objective of slowing down increased household debt, have therefore been implemented in the country (Swedish FSA 2016 & Hull 2017). In 2010, an 85% loan-to-value (LTV) cap was introduced, enforcing borrowers to have a minimum equity stake of 15%. Before this regulation was introduced, mortgage lending firms were autonomous in credit approval processes. The implementation of the LTV cap was only the beginning of the FSA in restricting the mortgage lending market. In 2016, an amortisation requirement was implemented, forcing new mortgage loan borrowers to amortise 2% on loans exceeding 70% in LTV ratio and 1% on loans exceeding 50% LTV. Before the amortisation requirements, most mortgage loans were effectively interest-only mortgages (Hull, 2017). To further ensure a decrease in household debt, an additional amortisation requirement was implemented in 2018. With the extended amortisation requirement, new mortgage loan borrowers are required to amortise an additional 1% if the debt-to-income (DTI) ratio exceeds 450% (Swedish FSA, 2017a). With the new restrictions, households with high mortgage debt levels are believed to lower their indebtedness over time (ibid).

The effectiveness of macroprudential policies in decreasing debt levels is a well-debated topic. Hull (2017) investigates the first proposed Swedish amortisation rate intensification through a quantitative equilibrium model and find it to be ineffective at reducing aggregate debt. Hull finds that amortisation requirements need to be complemented with credit supply requirements as well as DTI restrictions in order to effectively reduce debt. In contrast, multiple studies show that lending restrictions in terms of caps on LTV ratios as well as restrictions of DTI ratios decrease lending. Cerutti, Claessens & Laeven (2015) show that borrower-based policies are effective in

reducing credit growth. Borio and Shim (2007) concludes that policy measures reduce credit growth by between 4-6 percentage points and more recently Kuttner (2016) shows that Debt-service-to-income (DSTI) reduces credit growth with 4-6 percentage points. These findings are in line with a report by Næss-Schmidt, Bjarke Jensen, Heebøll & Sørensen (2017), the authors also estimate that a hard cap of 600% DTI limit on mortgage lending can cause a decline in household debt by 8% in Sweden. The idea that borrowing restrictions decrease debt appears to be an accepted notion in economics, implying that mortgage debt levels in Sweden will decrease in the future. In accordance with this notion, the FSA made the following statement regarding the regulation's impact on mortgage levels following the first amortisation requirement:

> *"In the long term, the amortisation requirement means that outstanding volumes of mortgage loans will become lower than what it would be without the requirement. The amortisation requirement will likely reduce interest income for mortgage lending firms, but at the same time, it will lower risk for the individual mortgage borrowers and the economy as a whole, since borrowers will be less sensitive to disturbances."*
>
> (Swedish FSA, 2016)

1.1 Problem statement

Multiple studies, along with memorandums from the FSA (2016 & 2017a), indicate that the new lending restrictions will result in lower debt levels among households. In addition, with the new restrictions, people that take on new mortgage loans will have to repay their debt at a relatively faster pace than before. Lower levels of debt among households will improve financial stability in the country, however, decreased levels of debt may lead to other implications for certain stakeholders in the mortgage lending business. Lower levels of mortgage loans imply less interest income for mortgage lending firms while, on the other hand, the firms' risk could become reduced. Moreover, predictions made by the FSA suggest that each restriction will in some way affect housing prices in the country (Swedish FSA, 2010b; Swedish FSA, 2016; Swedish FSA, 2017a). With fluctuations in the housing market, mortgage loans become riskier assets for mortgage lending firms. Conclusively, if the regulations lead to lower levels of mortgage loans and

fluctuations in the housing market, the profit and risk of mortgage lending firms will become affected.

Furthermore, a share price is assumed to be forward-looking and risk adjusted (Modigliani & Miller, 1958; Berk & DeMarzo, 2017, p. 309). The share price of a mortgage lending firm should therefore reflect the future expected discounted cash flows of the firm. If the new lending restrictions result in decreased levels of debt, the effects may take several years before they appear in the books of the mortgage lending firms. On the other hand, changes in risk related to fluctuations in the housing market may have a more immediate effect. Regardless of the timing of the effects, the expected change in the firm's profit and risk levels should be reflected in the current valuation of the firm. If the lending restrictions impact firm value and if the market is efficient, a change in share price should occur upon announcing the information.

In a study on credit supply, Gandhi (2011) finds that higher credit growth is correlated with lower expected returns for banks, suggesting that banks in Sweden could expect an increase in share price following lending restrictions. However, Jung & Park (2017) instead investigate the effect of financial regulations in the mortgage lending market in Korea on mortgage lending firms. Evidence from the study indicate that the implementation of lending regulation, similar to the ones in Sweden, had negative impact on the share prices of mortgage lending firms in Korea. Clearly, there are contradictory evidence about how the lending restrictions may impact mortgage lending firms. The FSA has not assessed the economic impact of lending restrictions for the shareholders of mortgage lending firms as it is difficult to do so ex ante. Studying adverse effects on shareholder value of affected firms should be relevant for policy makers when assessing the overall effects of lending restriction policies. For mortgage lending firms and shareholders there is a self-evident interest in understanding how lending restrictions impact firm value. This raises the question if the restrictions in Sweden have impacted the share prices of mortgage lending firms. The objective of this paper is to answer the following research question:

How have the lending restrictions impacted the profits and risk of mortgage lending firms, as reflected by their stock prices?

1.2 Thesis structure

In this chapter, a background over modern Swedish banking history is given followed by a description over the three newly implemented regulations. In chapter 2, a review over literature regarding macroprudential policies, credit supply and bank profit and risk is presented along with investor reaction theories. The intention with the literature review is to enable the empirical findings of this paper to be tied together with previous research. Because this paper takes on a deductive approach, hypotheses are developed based on theories presented in the literature review. Further, chapter 3 describes the data selection process. As concluded in this section, the sample in this study consists of four major mortgage lending firms that all fulfils the requirements set for this study. These firms are publicly listed and account for 75% of the outstanding mortgages of Swedish homes (Swedish Bankers' Association, 2018a). Moreover, the methodology in chapter 4 describes the quantitative approach this paper takes on in detail. Multiple tests are conducted to answer the research question and to ensure the validity of the results. In broad line, the methodology contains of two parts, a standard event study and event study-based regressions. The event studies test for abnormal returns of the four firms over a defined event window per event. This results in three event windows representing the announcement of each of the three different lending restrictions. The extensive methodology allows significance testing of abnormal returns cumulated over the entire event window and for each day in the event window. The results from the test are presented in table and text in chapter 5 together with a discussion of the result of each event. Chapter 6 provides an overall discussion of the results from the three events together. The objective of the discussions in both chapter 5 and 6 is to answer the research question and explain the results with previous literature. A concluding section of the results is presented in chapter 7. Finally, chapter 8 provides a brief outlook over other topics affecting mortgage lending firms that are currently discussed in news and media.

1.3 Delimitations

In order to stay within the scope of this paper, boundaries for the study are set. In this section the delimitations of this paper are described.

Firstly, this paper argues that mortgage loan levels will most likely decrease in the future following the implementation of the restrictions. The argument is based on previous research and statements from the FSA. However, no further research in this paper examines the policies actual effectiveness

in reducing debt. The results are therefore based on what investors believe will be the effect on mortgage loan levels at the announcements of the restrictions. Moreover, other macroeconomic variables, such as interest rates, may affect the expected changes in mortgage loan levels. Changes or expected changes in other macroeconomic variables, that may impact investors assessment of the effect of the restrictions, are not taken into consideration in this study.

Second, the firms offering mortgage lending for Swedish households must fulfil certain criterions to be included in the study as described in section 3.3. One of the criteria imply that the firms included must be publicly listed. As a result, two major mortgage lending firms, SBAB and Länsförsäkringar, are not included in the sample. The two firms respective market share are illustrated in figure 5. By leaving out large market players in the sample, the results are only a proxy for effects on mortgage lending firms overall.

Third, event studies can be conducted in multiple ways. The data in this study is characterised by cross-correlation due to event clustering, limiting the number of tests that are valid for this type of study. The selected tests in this study are robust against cross-correlation. However, the tests included are not the only event study test that have been applied in event studies with data of similar characteristics. Kolari & Pynnönen (2010) suggest that the BMP test by Boehmer, Masumeci & Poulsen (1991) takes cross-correlation into account and performs well. Due to the scope of this paper, such test is not conducted. No examination over the relative strength of the BMP test in relation to the selected tests of this study is done.

1.4 Background

The historical context of financial regulations in Sweden as well as previous crisis and real estate price falls are a key to understand the motivation behind the implementation of lending restrictions. The historical background of banking in Sweden also provides an insight in how investors may value the quality of mortgage loans of banks. Below is a description of the previous regulations in Sweden as well as an overview of the previous banking crisis in the 1990s. This is followed by an overview of the post crisis development in Sweden and the desire of the FSA to prevent vulnerability of the financial system.

1.4.1 Strict banking regulations soften up

In the time before the introduction of the lending restrictions studied in this paper, the Swedish banking regulations were not particularly strict. However, looking back in time, the reality has been different for the banking sector. Following the Brett-Woods gold-pegged system collapse in 1973, Sweden had issues with several currency devaluations (Sveriges Riksbank, 2019). After speculations rose again in 1981, the country had a currency crisis which led to a loan cap for banks and financial companies (ibid). The regulation for the banks was extensive and included cash requirements, liquidity ratios, lending ceilings, interest regulations and bond issuance permits (Englund, 2015). Deregulation started to occur in 1983 when liquidity ratios for banks were removed. In 1985 the interest ceiling and lending ceilings were fully removed, essentially removing most banking regulation in two years' time (ibid). Simultaneously, financial money markets experienced fast growth which increased the banks' access to capital enabling fast expansion of operations with few regulations hindering the process.

1.4.2 Economic boom

The GDP growth averaged 2.9% in Sweden in the years 1984-1989 (World Bank, 2019). However, following the deregulation 1985, the growth rate of lending increased from ~8-10% annually to ~16% annually in the years 1985-1990, significantly faster than GDP growth (Englund, 2015). For the institutions mostly affected by regulations, banks and mortgage institutions, expansion was the highest. Englund (ibid) shows that banks grew with 174% and mortgage institutions with 167% in the years 1985-1990. Petterson (1993, p. 199) and Urwitz (1998) argues that several banks increased risk taking without taking proper measures for it. These risks included increasing market shares by offering loans to new customer segments such as high-risk borrowers (Englund, 2015). In this period, banks with a high lending growth had significantly higher credit loss rate than banks with a lower lending growth rate (Petterson, 1993, p. 199). Right after deregulation took place in 1985 the maximum LTV ratio was kept at 75%, however in 1988, the number had increased to 90%, exposing banks to a much higher sensitivity to real estate prices (Englund, 2015). During the boom years in 1985-1988, debt amongst households increased at approximately 55% annually and corporations had a similar pace (ibid). The removal of lending constraints along with high price expectations of commercial real estate created a bubble in the Swedish economy.

1.4.3 Crisis years

In 1990, a financial crisis hit Sweden that primary affected so-called finance companies and later carried over to banks. Commercial real estate prices started to fall in 1990 leading to credit losses. Credit losses for banks went from an average of 0.4% in the mid-1980s to 3.5% by 1991 and 7.5% in 1992. Solvency issues followed for the banks and government intervention became a reality in 1991 when the state opted to contribute SEK 2bn to the bank Nordbanken. Another bank, Första Sparbanken, received a loan which was guaranteed by the state. A third bank, Gota Bank, became insolvent in 1992 and was acquired by state owned Nordbanken. Shortly after the takeover of Gota Bank all banks received state guarantees. (Englund, 2015)

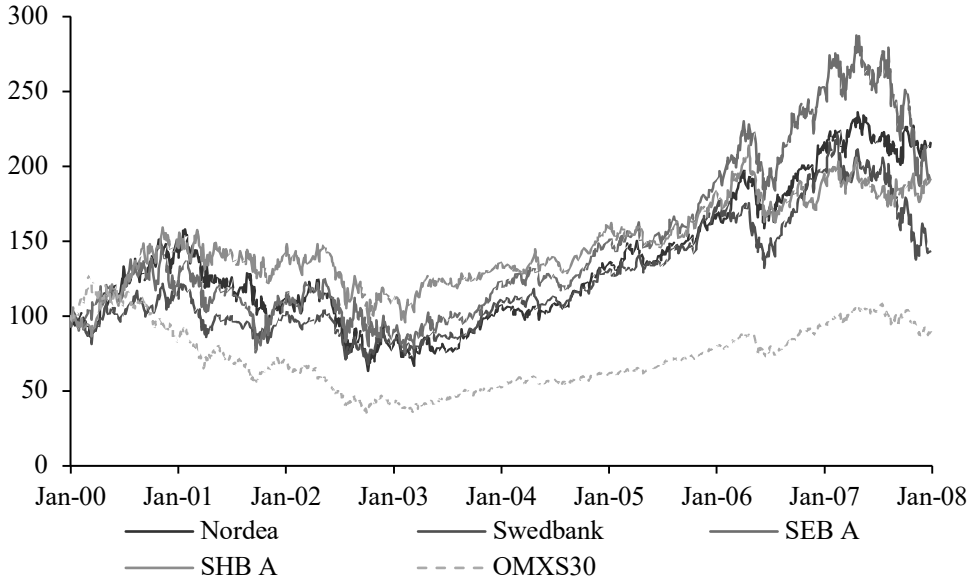
In the aftermath of the crisis, the total number of banks declined from six to four. Nordbanken's acquisition of Gota Bank later became what today is Nordea. The banks Föreningssparbanken and Sparbankernas bank merged into what today is named Swedbank. Althought going through some reorganisations, SEB and Handelsbanken remained the same (Englund, 2015). However, the bank crisis was according to Ingves & Lind (1998) much less severe than what was initially anticipated. The banks become profitable shortly after the crisis, which continued into the 21th century.

1.4.4 Banks flourishing in Sweden

Following the difficult years in the 1990s Swedish banks stocks saw significant upswing the following years after the bank crisis. In 1996 the reported credit losses were at the levels of pre-crisis of about 0.5% (Englund, 2015). Continuous expansion by acquisitions as well as organic growth helped the banks reach success on the stock market as they witnessed their shares outperform the index OMXS30[1] up until 2007. As seen by the graph below the largest Swedish banks significantly outperformed the market during the years leading to the global financial crisis.

[1] The OMXS30 index consist of the 30 most traded stocks on the Stockholm exchange. The Large cap index used in the rest of this study was not constructed until 2008 (Nasdaq, 2018)

Figure 1
Stock price development 2000-2007[2]
The figure contains stock price development from January 1, 2000 to December 31, 2007 of SEB A and Handelsbanken A, Swedbank, and Nordea compared to OMXS30 index = 100 in 2000



Source: Nasdaq Nordic (2019a & 2019b)

The growth in lending during the post crises years in 1995-1999 was strong and averaged 10.6%[3] (Statistics Sweden, 2019). However, in the new millennium, banks increased their lending even more and averaged 12.8% in the years 2000-2007 (ibid). The peak was reached in 2007 when lending grew with 22.6% in one year.

The development was seen not only in Sweden, but across all Western Europe. The lending growth in Western Europe averaged at 14.8% in the years 2004-2007 for commercial banks (Meriläinen, 2016). This can be compared to the average in Sweden of 17.7% in the years 2004-2007 (Statistics Sweden, 2019). The lending was not attributable to a single sector, however mortgages loans continued to increase at a fast pace. The increased household debt outpaced the income growth and GDP growth effectively increasing the household debt-to-income ratio. The FSA did, however, not see any significant risks for the banks in a report in 2006 as stress testing showed

[2] For the stock price development in 2009-2018 see appendix 1
[3] Arithmetic average

resilience against a decline in the real estate market (Swedish FSA, 2006). The FSA also concluded that the real estate market did not pose any threat towards the financial stability in Sweden (ibid).

As the financial crisis hit in in the US in 2008, Europe was affected by the subsequent sovereign debt crisis in 2009. For Sweden, the public debt to GDP ratio was stable at a relatively low 40% of GDP during the crisis years with a maintained budget surplus (Bergman, 2011). The severity of the systemic crisis for the rest of the European countries reminded the Swedish authorities that pre-cautions were necessary for Sweden as well. Shortly after the debt crisis hit Europe, the FSA concluded that the high LTV ratios amongst households were worrisome (Swedish FSA, 2010). Five months later, the FSA announced the LTV cap restriction on mortgage loans. In 2014 the FSA concluded that although the LTV ratios have decreased with a loan cap, the lack of amortisation on debt was problematic (Swedish FSA, 2014). The FSA proposed that banks could require amortisation from customers in 2013 but lacked support (Swedish FSA, 2014b). In late 2014 the FSA announced an implementation of amortisation requirement for all mortgage loans with LTV ratios over 50% (Swedish FSA, 2014a). During this period the Swedish central bank (Sveriges Riksbank) adopted a low interest rate policy to accelerate inflation in Sweden. Early in 2015, the repo rate was negative for the first time (Sveriges Riksbank, 2019). Real estate prices continued to soar following low interest rates, with an increased household lending as a result (Swedish FSA, 2017c). In 2017, the FSA explained that they continue to monitor household debt closely (ibid). The main reason for this was that the FSA expected interest rates to increase, resulting in price drops in real estate prices (ibid). Following this concern, the FSA decided to implement an extension to the amortisation requirement which was announced later in 2017 (Swedish FSA, 2017a).

1.4.5 Summary

Sweden entered the 1980s with strict regulations of the financial institutions, mainly banks. These regulations were gradually removed and beside some capital requirement regulations, most regulations concerning lending were abolished. The removal helped lenders to accelerate growth although a backlash came in 1990. The backlash was mainly driven by overconfidence in the commercial real estate prices together with access to funding with limited risk monitoring. The post-crisis period saw the banking sector flourishing with increased household indebtedness as a

consequence. A continued increase in housing prices along with low interest rates has made the Swedish FSA cautions, especially post sovereign debt crisis in 2009. In order to maintain financial stability and mitigate adverse effects from a potential recession in Sweden, the FSA has implemented several lending restrictions.

Below follows a description over the situation before the new policies were implemented followed by descriptions of each of the three lending restrictions.

1.5 Regulation description and predicted consequences

Pre October 1st 2010:

Before the lending restrictions were implemented, there were no formal LTV caps on mortgage loans and mortgage lending firms were autonomous in credit approval processes. Mortgage loans were split up between 2 tranches of loans, bottom loans and top loans, where the top loan averaged 1 percentage point higher interest rate. The share of loans with an LTV cap exceeding 80% exceeded 10% of the outstanding loans in December 2008 (Swedish FSA, 2009). In brief, the situation was the following:

- Bottom loans account for up to 85% of LTV ratio and is the most senior debt type of loans. After an evaluation and credit check of a borrower, each bank decides on the LTV limit for a bottom loan. Usually the limit is between 70-85%.
- Top loans are less senior than bottom loans and account for all debt above the bottom loans. Top loans usually are limited to 10-15% of the LTV.
- Equity stake in a mortgage account for the residual of the purchase value, which usually require a minimum of 5-15% of the value.
- Amortisation is either voluntary or decided by the mortgage lending firm

Swedish FSA (2009)

October 1st 2010 - May, 31st 2016:
On July 8, 2010, the FSA announced a general advice[4] regarding LTV caps on mortgage for mortgage lending firms. The general advice was implemented on October 1st 2010 and implied the following:

- Loans are capped to 85% LTV, meaning that a home cannot have more than 85% in collateral in loans
- Top loans are in practice removed as they account for the additional debt above the bottom loans. Mortgage lending firms can however enforce a stricter lending policy and require top loan debt for LTV's higher than e.g. 70%
- Equity requirements in loans increase to 15% minimum, however the equity stake can be borrowed through third party lenders as an unsecured debt
- Amortisation is either voluntary or decided by the mortgage lending firm

Swedish FSA (2010b)

The FSA released a memorandum describing the background for announcing the LTV cap and the predicted consequences of implementing LTV cap. The regulation was expected to have a small negative one-off effect on housing prices. Another predicted consequence was an increase in unsecured lending to help finance a house or apartment. The FSA concluded that the higher cost of unsecured loans will lead some households to choose a cheaper accommodation to reduce their debt burden.

Swedish FSA (2010b)

June 1st 2016 - February, 28th 2018:
After proposing an amortisation requirement on November 11, 2014, the first amortisation requirement was implemented in 2016. The amortisation requirement was enforced on all new mortgage loans. Under this restriction, the size of the amortisation depends on the LTV ratio of the loan with the following rules:

[4] A general advice is, in contrast to a law, not binding. With a general advice a firm can instead of directly following the advice, take on other measures that results in the purpose of the advice being reached. Compliance with the general advice is expected by the FSA

- All new loans with an LTV ratio between 50-70% must amortise 1% of the loan per year until the LTV ratio is below 50%
- All new loans with an LTV ratio over 70% must amortise 2% of the loan per year until the LTV ratio is below 70% and after that 1% yearly until the LTV ratio is below 50%

Swedish FSA (2014a)

Following the announcement of the amortisation requirement, the FSA concluded that the LTV cap did not fully mitigate the risks posed by households with high debt. The FSA expected the amortisation requirement to reduce interest income for mortgage lending companies following decreases in lending. The restriction was also expected to lower risks for the individual mortgage borrowers and the national economy due to less sensitivity to economic disturbances. The FSA also concluded that the amortisation requirement is deemed to result in the aggregation demand for housing decline by about 5%. The decreased demand was expected to be reflected in the prices.

Swedish FSA (2016)

Post March 1st 2018:
The extended amortisation requirement was announced on June 22, 2017 and later implemented in 2018. The extended amortisation requirement was a further tightening of the first requirement that was implemented in June 2016 and implied the following:

- All new loans require households to amortise an additional 1% of mortgage loans if their debt-to-income (DTI) ratio exceed 450%
- All new loans with a DTI below 450% are unaffected by the new rules
- The additional amortisation of 1% for borrowers with DTI over 450% is separate from the LTV ratio, meaning that the new amortisation requirement forces borrowers to amortise up to 3% if they have a DTI over 450% and LTV ratio over 70%

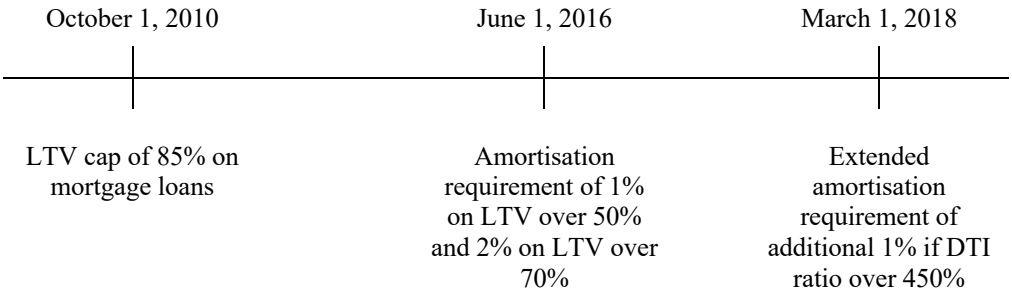
Swedish FSA (2017a)

The FSA stated that households borrowed 9% less and bought homes that were 3% cheaper as a consequence of the first amortisation requirement. In relation to the extended amortisation requirement, the FSA expected an average decrease of 4% in new mortgage loans, which can be

compared with 9% decrease from the previous requirement. The FSA expected households affected by the requirement to lower their debt by an average of 17% following the extended requirement. The FSA concluded that extended requirement affects fewer households than the first amortisation requirement.

FSA (2017a)

A timeline over the implementation of the mortgage loans is presented below:

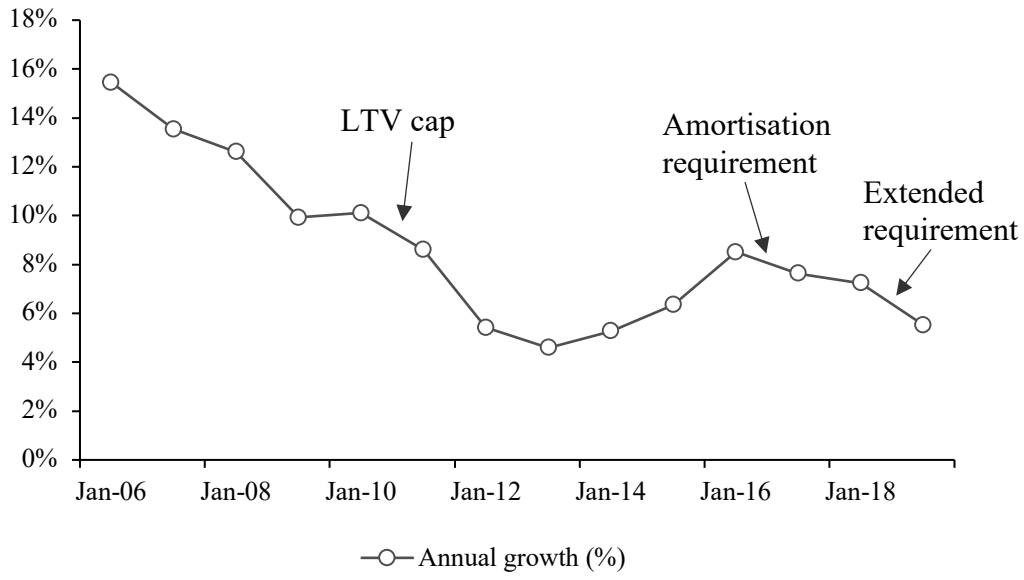


The implementation of lending restrictions raises the question regarding the effectiveness of the regulations. The intended effects are slightly different for the two types of policies. The intention of the LTV cap restriction is to affect the lending growth of household loans, as no more loans with LTV ratios above 85% will be granted. Intuitively, the LTV cap should lower the lending growth for the Swedish market. The assumptions for it to hold true is that the number of new loans and real estate prices are held constant. An LTV cap will, ceteris paribus, lead to lower growth in household loans as no more LTV ratios above 85% are allowed on new loans. The second type of policy is intended to lower the aggregate household debt. By increasing the number of amortising households, debt will decrease over time and aggregate debt should in theory decrease, as new borrowers must amortise with LTV ratios above 50%. Growth in debt should also be affected as an increase in amortisation lowers the share of household income that can be paid on interest expenses. The amortisation requirement will therefore affect household's maximum debt capacity. The effect of amortisation requirement on total debt level is however a long-term effect as amortising only reduces debt over time. However, Hull (2017) investigates the first proposed

Swedish amortisation rate intensification through a quantitative equilibrium model and find it to be ineffective at reducing aggregate debt. On the other hand, multiple of other researches, such as Næss-Schmidt et al. (2017), provide findings pointing at a decreased level of debt following the lending restrictions.

Looking at data on the lending growth over time in Sweden gives inconclusive answers on the effectiveness of the lending restrictions. In figure 2 the mortgage lending growth development is depicted. As can be seen, mortgage lending growth started declining from 16% in 2006 to 10% when the financial crisis hit. After the first lending restriction in October 2010, the mortgage lending decreased furthermore to 5.7% in 2012. Increasing real estate prices drove lending growth in 2014 and 2015. Lending growth seem to have dropped again following the subsequent amortisation requirements in 2016 and 2018, the effect seems however somewhat vague.

Figure 2
Annual growth of Swedish household loans
The figure displays the total Swedish household loans growth over the period 2006 – 2018



Source: Statistics Sweden (2019)

2. Literature review

2.1 Introduction

In this chapter, a summary of relevant literature for this study is presented. The review is divided into three sections. The first section covers literature on macroprudential policies and relevant factors that may be affected by such policy. The purpose of this section is to get a general understanding of how factors that may change following the new restrictions can affect bank profit and risk. The second part summarise theories regarding market reactions. The aim of the second section is to understand how investors may react following announcements as those being studied in this paper. The third section presents the hypotheses in this paper. The hypotheses are formulated based on theories presented in literature review.

From chapter 3 below, the relevant firms for the sample are found which all happens to be banks. Parts of the literature review are related to theories about banks as it seems to be a more commonly used word in academic papers than mortgage lending firms. Since all firms in the sample are banks, the words banks and mortgage lending firms are used interchangeably in this study.

2.1 Macroprudential policies and bank operations

2.1.1 Macroprudential policies

The aim of macroprudential policies is to maintain financial stability in a country by restraining build-ups of financial imbalances and create resilience in the financial system (Kuttner & Shim, 2016). Macroprudential policies therefore serve as a tool to mitigate systematic risk and vulnerability in financial markets. Common policies include restrictions on liquidity and capital levels as well as lending restrictions. With less risk in the financial system, the probability of a financial crisis, or the severity of a potential financial crisis, becomes lower. Altunbas, Manganelli & Marques-Ibanez (2017) conclude that macroprudential policies are effective in adjusting the risk-taking of a bank. The authors find that the effect of new policies on banks risk-taking varies depending on the characteristics of the bank, such as the balance sheet structure. Therefore, the relative size of mortgage loans for the banks in this study may affect banks' risk-taking behaviour differently, following the new policies. Cerutti et al. (2017) find that the usage of macroprudential policies in well-developed economies is generally more effective than in emerging economies. The authors also conclude that borrower-based policies are associated with lower credit growth,

especially in household loans. The findings from Cerutti et al. (2017) suggests that the policies from the FSA could lower household loan growth in Sweden.

The regulations studied in this paper are borrower-based macroprudential policies that are implemented to lower the debt levels among households in the country. The FSA is addressing both lending growth by LTV cap and loan level by increased amortisations. The risk in the financial system should decrease following the implemented policies as suggested by Altunbas et al. (2017). In addition, the lending growth should decrease according to the findings of Cerutti et al. (2017).

2.1.2 Bank profits and risk

In this paper, the effect of regulatory changes on bank profits and risk is examined. Bank profit is inevitably affected by bank risk, therefore both profits and risk levels are discussed. The composition of the balance sheet and level of risk are according to Clark (1986) important in determining a bank's profit. Staikouras & Wood (2011) acknowledge the importance of chosen risk level for a bank's profitability as well. In their study examining the profitability of European banks, the authors' risk-adjust profitability by including loan-to-assets ratio. The measure loan-to-assets is considered to incorporate risk because loans generally have higher risk and greater expected returns than other assets that may appear on a bank's balance sheet, such as government securities. According to the authors, a decrease of bank's assets in form of loans, will affect profitability and risk level of the bank, which is in line with Clark's (1986) conclusion. This suggests that decreases in mortgage loans will affect the composition of the bank's balance sheet, risk level and hence also the profits.

Another debated variable in relation to bank profitability is the loan composition mix which Clark (1986) mention. Miller & Noulas (1997) find evidence that real estate loans have negative effect on bank profitability in America, while construction and land development loans have a strong positive effect on bank profitability. Seeing that the lending restrictions studied in this paper only affect mortgage loans, the loan composition mix of banks may change and thus profitability might be affected.

Seemingly, loans are relatively risky assets compared to the assets of non-lending operations of banks. If the lending restrictions result in decreased loan levels for the bank, the risk of the firms

will become reduced. Additionally, mortgage lending restrictions might lead to changed loan composition mix, if that is the case profitability might be affected for the banks.

2.1.3 Credit supply changes and equity returns

The research over banks' decision to change credit supply and the effects on excess returns is limited. An explanation might be that isolating credit growth as an independent variable on the dependent variable 'excess return' is difficult. The reason is that credit growth is highly dependent on macroeconomic conditions, which also affects asset returns. According to Imran & Nishat (2013) credit growth is generally determined by economic growth, exchange rates and monetary conditions. There are, however, some studies examining the effect of credit growth on stock returns. Gandhi (2011) finds that higher credit growth is correlated with lower expected returns for banks. The author finds a 1% increase in credit growth yields lower excess returns of bank stocks by 3% in the following year. This result suggests that if a lending restriction lower mortgage lending growth, the excess stock returns should increase. Furthermore, Baron & Xiong (2017) compare the relative changes of bank credits. The study examines the subsequent three-year returns after changes in credit growth and find that equity returns are lower following a bank credit expansion. More specifically, the banks in the 10% percentile or lower in credit expansion have significantly higher returns than expected and banks in the 95% percentile of increased credits or higher have significantly lower expected returns. The authors find that a credit expansion increase of one standard deviation result in an expected 11%-point decrease in excess returns the following three years. These studies are however in contrast with the findings of Jung & Park (2017). The authors study the short-term effects from implementation of lending restrictions in South Korea and conclude that the effects on stock prices are negative following new regulation. The authors perform a five-day event study and find that the implementation of DTI lending restrictions and LTV restrictions negatively affects stock prices.

The above presented results measured over a long period of time suggest that credit growth over time is negative for stock prices. Short term effects, on the other hand, seem to be positively affected by credit growth. Given the findings described above, the implication is that Swedish banks' stock prices should benefit from the lending restrictions in the longer term, seeing that they expect lower credit growth. However, short term effects following lower credit growth for Swedish

banks are likely to be negative if the findings from Jung & Park (2017) are applicable for the Swedish market.

2.1.4 Mortgage default risk and housing market

Credit losses is a type of risk that banks are constantly exposed to. The market value of real estate indirectly impacts banks, as homes are collateral for mortgage loans. With fluctuating housing prices, the mortgage loans become riskier assets.

Von Furstenberger (1969) identifies LTV ratios and terms of the loan as leading indicators of mortgage default probability over the life of mortgages. This is further strengthened by Yang, Lin & Cho (2009) who find that the LTV ratio, use status of collateral, and location of collateral, among other factors, are significantly positively related to the default probability of home mortgages. The findings indicate that the regulations in Sweden may lead to less mortgage loan defaults in the future. Furthermore, debt overhang among mortgage loan borrowers may lead to reduced incentives in investing in their property, which creates an agency conflict between loan borrowers and lending firms. Melzer (2017) concludes that mortgage loan borrowers that are in risk of default cut back substantially in their home improvements and in their principal payments.

With increasing indebtedness, the purpose of the new regulations in Sweden is to reduce the debt levels among Swedish households. However, borrowing constraints affects households' optimal choice of leverage. Concerns about LTV restrictions may lead to persistent house price shocks (Chen, Michaux & Roussanov, 2013). With the new lending restrictions, the optimal choices of leverage will likely change, which in the long run may affect the prices in the housing market. According to the literature, volatility in real estate prices may have two contrasting effects on bank stability. From one point of view, an increase in housing prices increases the value of the collateral of mortgages and increases the net worth of borrowers, which reduces the likelihood of credit defaults. On the contrary, if the house prices decrease, the net worth of borrowers decline as well as the value of the collateral, which increases the likelihood of credit defaults. From another point of view increased housing prices may lead to customers taking on larger, and more risky loans. Koetter & Poghosyan (2010) conclude that house price volatility contributes to bank instability in Germany.

Since the regulations in Sweden may impact on the prices in the real estate market, the regulations may indirectly affect the stability of the banks in Sweden as the collateral of mortgage loans become a riskier asset. If predictions of Chen et al. (2013) hold true in Sweden, persistent house price shocks may occur that are negative for the banks' profit and risk. If the findings of Koetter & Poghosyan are applicable in Sweden, the regulations will also contribute to bank instability. These findings suggest that lending restrictions are negative for banks profit and risk.

2.2 Market reactions

2.2.1 Efficient market hypothesis

The definition of an efficient market follows that prices fully reflect available information and that there are no arbitrage opportunities (Berk & DeMarzo, 2017, p. 105). The efficient market hypothesis relies on the assumption that investors are rational. Mandelbrot (1966) proved that future price contracts will have expected price differences of zero given the information known today, implying that the prices follow a random walk. Jensen & Benington (1970) supports the notion of a random walk of stock prices in their studies, as well as Jensen (1969) who uses the term efficient markets. The evidence that given the information today, no conclusions can be made about tomorrow's prices was further developed by Fama, Fisher, Jensen & Roll (1969). Based on efficient markets, Fama (1970) later developed a hypothesis concerning how markets respond to new information. The developed hypothesis divides market efficiency into three levels; weak form of efficiency, semi-strong form of efficiency and strong form of efficiency.

If the market is efficient in weak form, securities are fairly priced and reflect all available information on historical share prices. Therefore, in a market of weak form, no excess returns can be expected in the future based on historical data. In this scenario, the securities' prices follow a random walk because the price movements in the future are determined by other information than historical data. Moreover, in a semi-strong market stock prices adapt to new public information rapidly, implying that an investor cannot obtain excess returns by trading on available information. Introduction of new information in a semi-strong market will lead to a new equilibrium level of the share price. According to Fama (1970), the speed of pricing in new information in a share price is a key factor explaining a semi-strong market. In a semi-strong market, an investor thereby price changes in response to new public information. Lastly, a strong form of efficiency is characterised

by a market that reflects all new information, both public and private. In a market with strong form of efficiency, an investor would not be able to gain excess return based on private information.

The proponents of market efficiency are many and the consensus is that a semi-strong efficiency is the most likely form to be present in capital markets. Researches that study capital markets still use a semi-strong form of market efficiency as a basis for their research. Andrade, Mitchell & Stafford (2001) assume capital markets to be efficient with public information being priced in quickly in stock prices, supporting a semi-strong form of efficiency. Malkiel (2003) suggest that despite the presence of irregularities in efficient markets, the evidence for a semi-strong form of efficiency is overwhelming. Cochrane (2011) brings up the topic on efficiency and concludes that the consensus is that markets are efficient;

"Efficiency basically won, and we moved on"

Looking at the findings presented above, evidence suggests that if semi-efficient markets hold true the banks' stock prices should, according to the efficient market hypothesis, adjust to the expected changes in bank profit and risk when the information about the lending restrictions are announced. If markets are efficient, the possibility of identifying the effect of the announcements on the stock prices becomes facilitated.

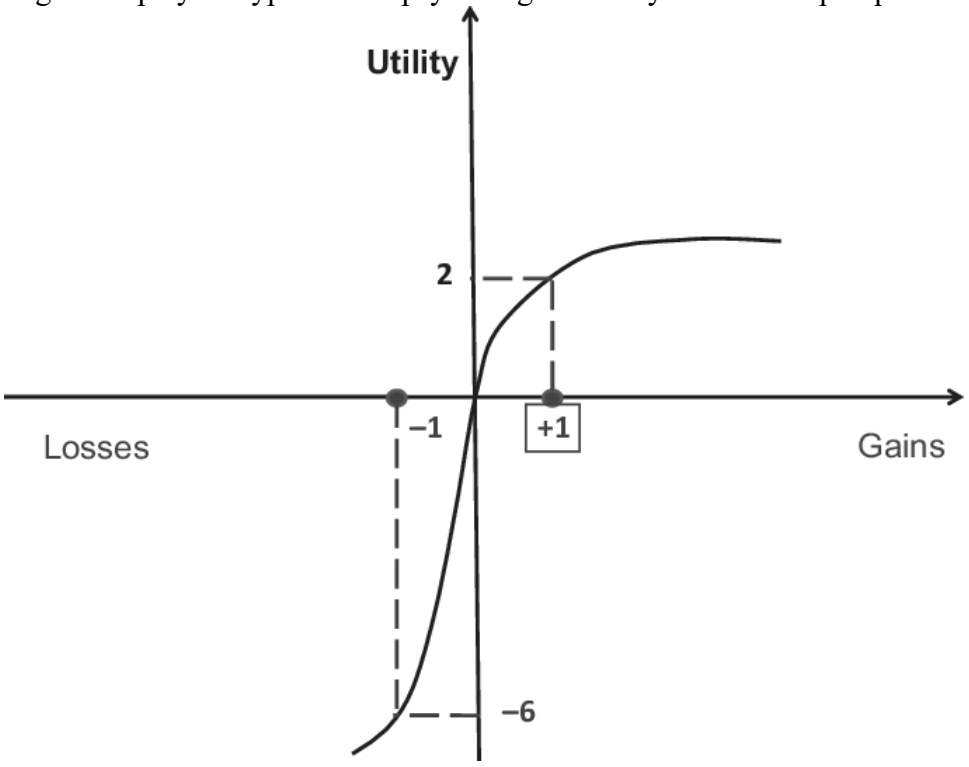
2.2.2 Behavioural economics

Despite broad support, market efficiency still has its opponents and critics. Grossman & Stiglitz (1980) explains that an underlying assumption in market efficiency is that public information is accessible to all investors, which implies that obtaining information is free. The authors argue that the free information assumption is incorrect and thus all information cannot be reflected in prices. Foster, Olsen & Shevlin (1984) argue that semi-strong efficiency does not hold by showing post-announcement drifts in stock prices. If markets in fact are efficient, these drifts should not be present.

Supporters for efficient markets claim that a rational investor will act in a rational manner when assessing stock prices (Fama, 1970 & Merton 1973). However, several studies argue for situations where investors are not necessarily rational. The collective description of theories opposing rationality and efficient markets is behavioural economics theories. Kahneman & Tversky (1979)

developed the prospect theory stating that risk preferences change depending on whether investors expect loss or gain. The idea behind the theory is that if an investor expects gain, the investor becomes more risk avert. On the contrary, if an investor expects loss, the investor become prone on taking on more risk. The prospect theory shows, in contrast to the efficient market hypothesis, that investors are not homogenous and rational. This implies that investors do not have expected utility decision making process. The prospect theory hypothetical utility function is depicted in figure 3. The prospect theory contradicts the efficient market hypothesis because markets cannot be efficient if individual investors value information differently depending on an expected gain or loss. For the situation with the new lending restrictions for mortgage loans, an investor's assessment of new policy would change depending on expected gains or losses from the investor's perspective.

Figure 3
Prospect theory
The figure displays a hypothetical psychological utility function in prospect theory

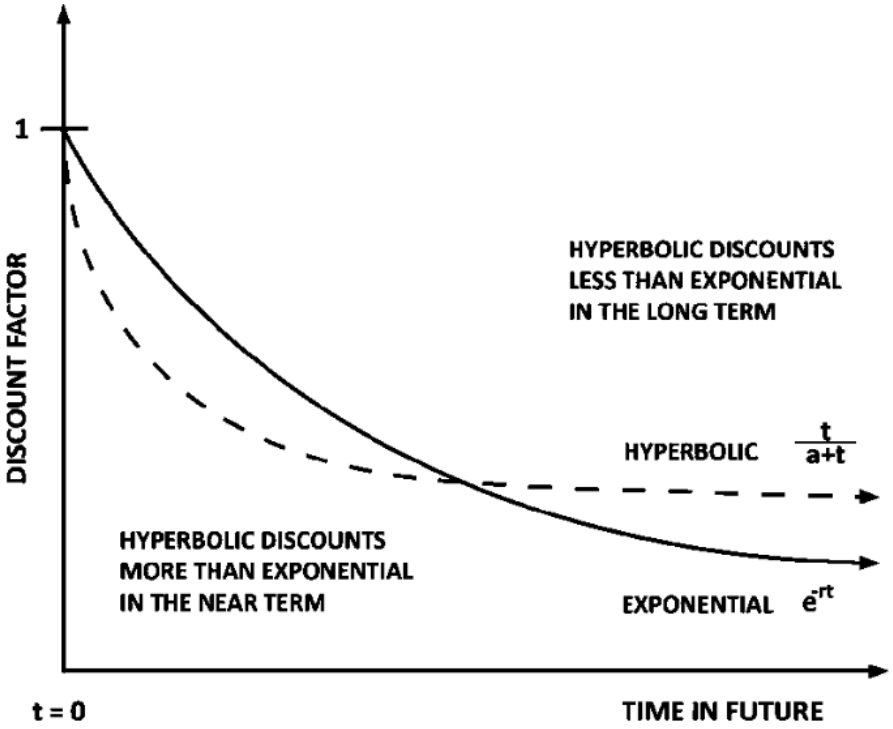


Source: Osimani (2013)

Another model that falls into the category of behavioural economics is hyperbolic discounting. The model suggests that investors do not discount profits as they are expected according to the

efficient market hypothesis. Strotz (1955) concluded that linear discounting was inappropriate for an investor. Thaler (1981) further suggests that the required marginal payoff for rewards diminishes over time and the discount rate decreases with increased size of the reward. Laibson (1997) explains hyperbolic discounting to have a relatively high discount rate over short horizons and relatively low discount rate over long horizons. The effect described by Laibson can be seen in figure 4. Hyperbolic discounting assumes that an investor's discount factor flattens out over time. Events taking place in distant future are not discounted as heavily as with exponential discounting. The effect from the regulations in Sweden will most likely take multiple years before they affect the profit of the banks. According to hyperbolic discounting, changes in the stock prices would be smaller than with exponential discounting due to the expected long-time horizon before an effect on loan levels affect the banks.

Figure 4
Exponential and hyperbolic discounting
The figure displays the utility functions in constant discounting and hyperbolic discounting



Source: Seager et al. (2017)

The theories in behavioural economics generally contradicts the idea of efficient markets. Intuitively, markets that are efficient should not be affected by behavioural economics theories

such as the once described above. The prospect theory explains how expected losses and gains affect how investors value payoffs. If prospect theory holds true, it implies risk seeking investors in bad times and risk avert investors in good times. Applying prospect theory in this paper mean that effects from lending restrictions could be valued differently depending on the performance of the stock markets. Moreover, hyperbolic discounting proposes that events in the distant future are not heavily discounted. The expected effect of decreased revenues from lower lending will likely not be immediate. With hyperbolic discounting, these effects occurring in the far future will not be discounted as heavily as with exponential discounting. Hyperbolic discounting therefore supports that the stock prices will change following the announcements.

2.2.3 Heuristics

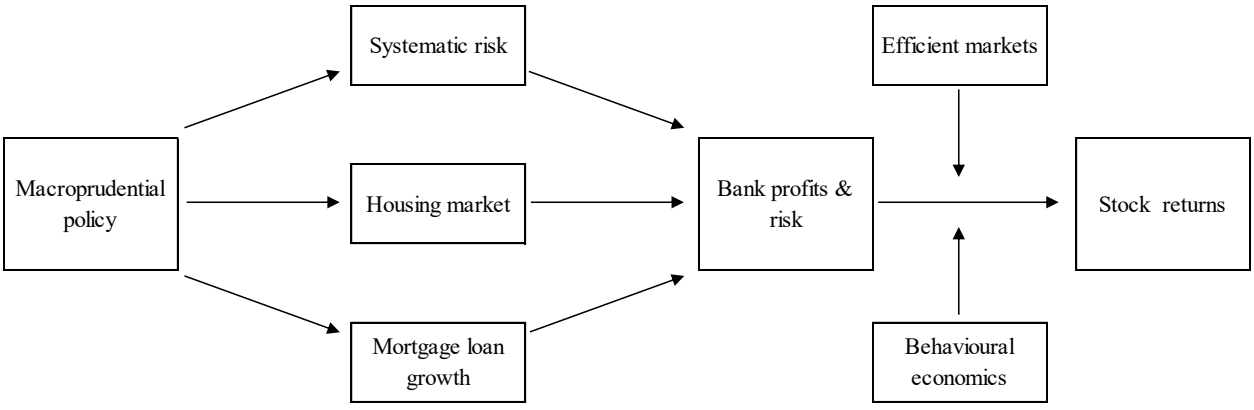
Decisions are often based on beliefs about the likelihood of a certain outcome of an event. Heuristics principles help people to assess what the probability of a certain outcome is, making decisions processes less complex. However, sometimes these principles lead to systematic errors in the decision making (Tversky & Kahneman, 1974). In finance, heuristic principles can explain why investors act in a certain way. Commonly analysed heuristic principles in finance contexts are representativeness heuristics and conservatism bias. Tversky & Kahneman (1974) describes representativeness heuristics as when decisions are made based on stereotypes. One type of bias that may evolve by representative heuristics is when investors contextualises a firm in a way that is easy to understand, when assessing the risk of the firm (Khan, Naz, Qureshi & Ghafoor 2017). In this way, investors view stereotypes as an alternative to required research for the investment. As a consequence, investors may ignore other factors that affects the value of the firm. Representativeness heuristics could explain how investors assess the lending restrictions effects on bank profits and risk by, for example, comparing with the effects of similar implementations in other countries, or with previous policy implementation in Swedish banking history. Moreover, conservatism bias is another type of heuristic implying that investors gradually update their beliefs about an asset's payoff when new information is realised. In comparison, a rational investor would update their beliefs immediately with new information. For example, with a signal of good news, a conservative investor would have a smaller expected return of the asset than what a rational trader would (Luo, 2014, p. 6). The opposite relationship applies in signals of bad news.

If the banks' investors are characterised by conservatism, the full expected effect of the new regulations will not, in opposition with the efficient market hypothesis, be directly incorporated in the stock price.

2.3 Hypothesis formulation

In conclusion, the stock market movements following the announcements of the mortgage lending restrictions are determined by two factors, first how profits and risk of the mortgage lending firms are expected to become affected, and second, how investors react upon the expected effect. By implementing mortgage lending restriction, the systematic risk of financial markets become affected. Assuming that the restrictions result in lower levels of mortgage debt, the implication for mortgage lending firms involve lower profits from interest income and lower risk. The lending restrictions may also impact the housing market in both positive and negative ways. Since the housing market is connected to the mortgage lending firms, fluctuations in the market may affect the value of the firms. Theories regarding investors' reaction have conflicting implications. While some theories suggest that investors will price the expected change directly and equally between different investors, other theories suggest otherwise. Below is a graphical explanation of the relationships between different theories:

Figure 5
Theoretical framework
The figure displays the relationships between relevant theories described



Source: Authors drawing

The hypothesis of this paper is that there will be an effect on profit and risk of the mortgage lending firms followed the announcements. However, it is unclear if the change in profit and risk together will imply a negative or positive change. Therefore, the null hypotheses are formulated such that two-sided test can be conducted. Assuming that the macroprudential policies result in lower levels of mortgage debt, the restrictions may affect various mortgage lending firms differently. Firms offering mortgage loans generally have other operations that would be unaffected by mortgage lending restrictions. The restrictions should therefore reasonably affect the firms that are relatively more concentrated in the mortgage lending business more than firms with operations consisting of relatively less mortgage lending.

The conclusions above lead to the following hypotheses in this paper:

Event 1 – Announcement of LTV cap

H_{0a} : The announcement of the LTV cap has no effect on the stock prices of the mortgage lending firms

H_{1a} : The announcement of the LTV cap has an effect on the stock prices of the mortgage lending firms

H_{2a}: The announcement of the LTV cap has larger effect on the stock prices of the mortgage lending firms with relatively more mortgage loans

Event 2 – Announcement of amortisation requirement

H_{0b}: The announcement of the amortisation requirement has no effect on the stock prices of the mortgage lending firms

H_{1b}: The announcement of the amortisation requirement has an effect on the stock prices of the mortgage lending firms

H_{2b}: The announcement of the amortisation requirement has larger effect on the stock prices of the mortgage lending firms with relatively more mortgage loans

Event 3 – Announcement of extended amortisation requirement

$H_{0c:}$ The announcement of the extended amortisation requirement has no effect on the stock prices of the mortgage lending firms

$H_{1c:}$ The announcement of the extended amortisation requirement has an effect on the stock prices of the mortgage lending firms

$H_{2c:}$ The announcement of the extended amortisation requirement has larger effect on the stock prices of the mortgage lending firms with relatively more mortgage loans

As described by the FSA, the amortisation requirement and the extended amortisation requirement are expected to have the similar effects on mortgage loans with less borrowing and price declines in real estate prices. However, the FSA is expecting the extended amortisation requirement to affect fewer households than the first amortisation requirement. Seeing that the two amortisation requirements are structured in the same way, the two different events can be compared against each other. The suggestion that the extended amortisation requirement affects fewer household implies that if there is an effect on the stock prices of banks, the extended amortisation requirement should have a lower effect than the first amortisation requirement. An additional hypothesis is added to compare the first and extended amortisation requirements below:

$H_{3a:}$ The announcement of the extended amortisation requirement has a smaller effect on the stock prices of the mortgage lending firms than the first amortisation requirement

3. Data

3.1 Introduction

Data selection is steered by the research question and hypotheses of the thesis. This paper focuses on explaining the effect of mortgage lending restrictions on mortgage lending firms' stock prices in Sweden. Data selection entails collection of policies on mortgage lending, mortgage loan levels, stock returns and market returns. Data on policy changes and policy announcements is collected from the FSA which regulates mortgage lending restrictions. The relevant data on mortgage loans and mortgage lending firms is gathered from Statistics Sweden and the Swedish Bankers' Association. Firm specific data covering valuation multiples and balance sheet items is collected

from S&P Capital IQ[5]. Stock data and index return data is collected from Nasdaq Nordic that operate the Stockholm Stock Exchange. Details of data collection and selection process is described below.

3.2 Data sources

Decisions regarding restrictions in mortgage lending are taken by the FSA, therefore the relevant information on policies is collected from policy documents published by the FSA. Relevant dates of the first announcements of lending restrictions are also retrieved from the FSA as they serve the basis for when the information is first communicated to the public. Collecting the data on announcements is done by processing press releases on the FSA website and controlling if any statements have been made in media by the FSA. The dates are of relevance as they serve as starting points for examining changes in profit and risk and stock prices. Mortgage loans data is reported to the Swedish governmental agency Statistics Sweden by each entity offering mortgage loans. Reports on the aggregated loans in Sweden as well as mortgage loan level for each firm is then presented in annual reports by the Swedish Bankers' Association. Firm mortgage loan levels are of interest as they present descriptive figures on the significance of the size of mortgage loans. Stock data on closing prices and number of trades in this study is collected from Nasdaq Nordic, the platform that operates the Nordic stock exchanges. Firm specific data on market capitalisation, total assets, market-to-book ratio and income line items explain the characteristics of each firm and are retrieved from the S&P Capital IQ database. From Nasdaq Nordic's webpage, the daily closing prices are retrieved for each of the firms in the study as well as for the market return index. The closing prices for the index is gross total returns, meaning the closing prices are adjusted for dividends and stock splits. On the other hand, the closing prices for the stocks are adjusted for stock splits but not adjusted for cash dividends. The stock returns are manually adjusted to account for cash dividends and are explained in further detail in the methodology section 4.2.3.

3.3 Selection criteria

The list containing banks and other lending institutions active in Sweden is collected from the Swedish Bankers' Association. The list is processed with the criterions set up to decide on what firms to include in the sample for the study.

[5] Standard & Poor's Capital IQ is abbreviated S&P Capital IQ

The selection process follows the criteria set up beforehand:

1) Firm must offer not only lending to the public in Sweden but specifically mortgage lending

2) Mortgage lending firms must be publicly listed on the stock exchange

3) Mortgage lending in Sweden must be offered during the entire period of interest

4) Mortgage lending in Sweden must be a substantial part of the firm's operations

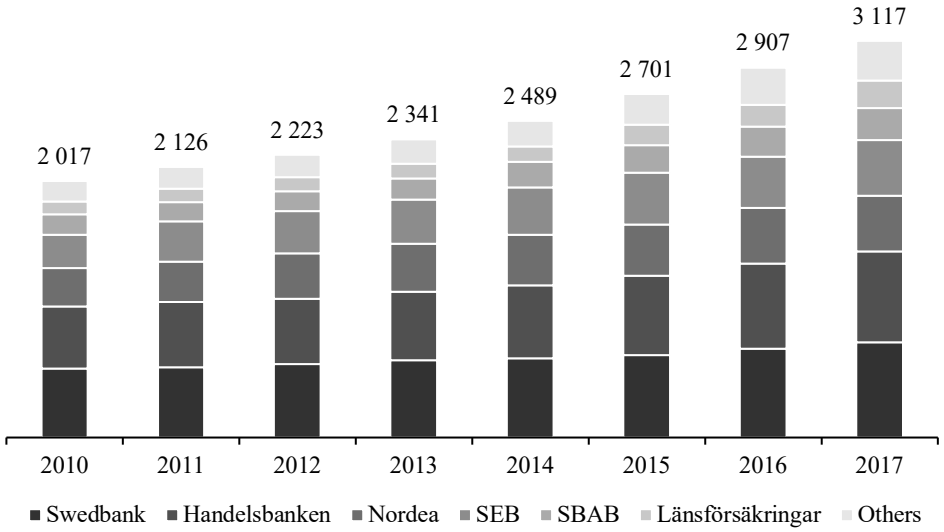
5) Securities in the sample need to be frequently traded in the estimation window, trades must occur at least 90% of the days in the estimation period

In appendix 2, a full list of all Swedish bank operational firms and foreign banks with branches in Sweden is included. The list contains the criterions fulfilled for each firm.

In relation to the first criteria, there are 70 firms active in bank operations in Sweden as of December 2017[6] (Swedish Bankers' Association, 2018b). However, all these firms are not operating in mortgage lending. Firms that are not operating in mortgage lending in Sweden are not of interest for this study and therefore excluded. Figure 6 depicts the mortgage lending in Sweden during the time of interest.

[6] Appendix 2

Figure 6
Mortgage loans in Sweden per bank
The figure contains mortgage loans in Sweden per bank between 2010-2017. The category others include Danske Bank, Skandiabanken and Ålandsbanken among others



Source: Swedish Bankers' Association (2018a)

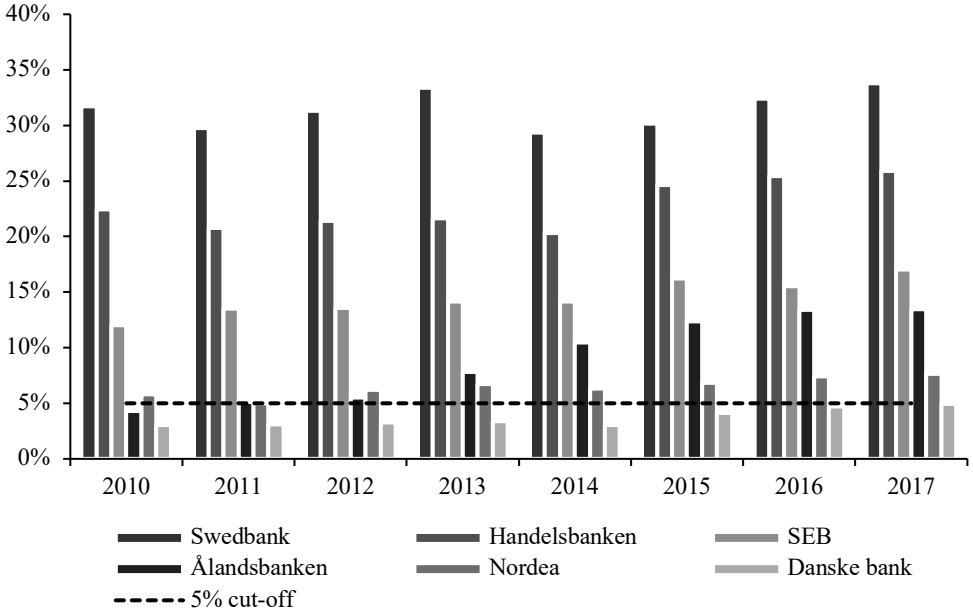
For the second criteria, the paper focuses on examining the effect of mortgage lending on profit and risk of banks and is doing so by examining stock prices of mortgage lending firms. The exact methodology of the event study is described below in chapter 4. If a firm is not publicly listed on a stock exchange the effect on stock prices are difficult to assess. Although private firm valuations can change following a regulatory change, the possibility to measure such changes are very limited. This is because information on private company transaction is limited. Therefore, all non-public mortgage lending firms are excluded in the study. In the case of Nordea, the firm is listed in three different countries, Sweden, Denmark and Finland (Nordea, 2019, p. 38). As this paper focuses on the Swedish market regulation and Stockholm being Nordea's main market, only the Swedish stock will be included in the sample.

In regards of the third criteria, firms must also have continued practices in mortgage lending after the announced regulation. The criteria essentially mean that firms need to have mortgage lending practice during the entire period of interest, 2009-2017. As explained in the theoretical discussion, changes in stock prices are an effect of changes in the future cash flows. If a firm announce that it will discontinue its mortgage lending practice, the regulation will not have an impact on that firm

and hence said firm is not of interest for this study. For example, the Norwegian bank DNB previously had mortgage lending in Sweden but discontinued its practice and sold the assets to SEB in March 2011 (DNB, 2014; SEB, 2011). The publicly listed bank Collector Bank went public in 2015, however mortgage loans were not introduced in the bank until 2017 (Collector, 2018). As these two banks have not offered mortgage lending during the entire period, DNB and Collector Bank are not included in the study.

Looking at criteria number four, this paper focuses on the profit and risk effect on mortgage lending firms following the implementation of lending restrictions. For a policy change to be measurable in a stock reaction, this paper is assuming that lending must be a substantial part of a firm's operations. As described in the hypothesis section the paper tests the hypothesis of firms with higher mortgage loan ratio to have larger effect on stock prices. Hence, firms with both high and low exposure towards mortgage lending in Sweden are of interest to measure said hypothesis. However, if Swedish mortgage loans is an insignificant part of the firm's operations, the results are likely distorted by noise. For example, ICA Bank, which is part of ICA Group, is a Swedish retailer offering food and health products. As the entire ICA Bank operations accounts for less than 1% of the listed ICA Group revenues in 2017 and total ICA Bank lending is less than 4% of the balance sheet (ICA Group, 2018, p. 43), it is seen as a non-substantial part of the operations and hence ICA Group is removed from the sample. As it lacks clear guidance in finance literature on how to decide on what is a substantial business segment in bank industry, this study sets a minimum Swedish mortgage loans-to-total assets to be included in the sample. For a firm to be deemed having substantial mortgage lending practice in Sweden, mortgage loans must account for a minimum of 5% of the total assets of a firm. The limit of 5% is somewhat arbitrary, nevertheless it serves as an important cut-off to include only relevant firms. In figure 7, the exposure to Swedish mortgage loans can be seen. As can be seen, Danske bank is below the 5% threshold during the entire period and only reaches 4.9% in and is therefore not be included in the sample as their mortgage operations in Sweden account for a minor part of the operations.

Figure 7
Swedish mortgage loans-to-total assets
The figure contains the ratios of Swedish mortgage loans to total assets per firm during the period of 2010 – 2017.

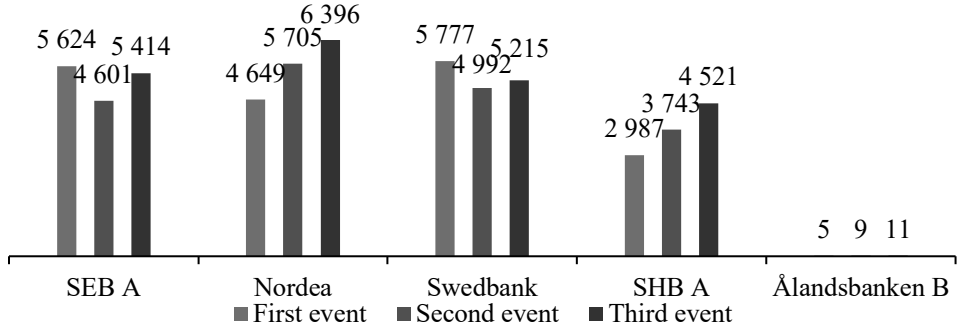


Source: Swedish Bankers' Association (2018a) & S&P Capital IQ (2019)

The fifth criteria are in place to address problems with thinly traded securities. Thin trading occurs when securities are traded infrequently with several daily returns of zero and is usually a concern of smaller firms. When having several zero-return days due to infrequent trading, the covariance with the market return decreases. Although securities that are thinly traded are not necessarily less-risky than frequently traded securities, the thin trading leads to low beta values and inaccurately display low expected returns for a thinly traded security. Inaccurate low expected returns then provide high abnormal returns when trading occurs and therefore might lead to false conclusions on abnormal returns. The problem is also called nonsynchronous trading as defined by Scholes & Williams (1977). There are ways to adjust for thinly traded securities in models that account for the nonsynchronous trading. Cowan & Sergeant (1996) however found that previous corrections for nonsynchronous trading provides no significant benefit for addressing problems caused by thin trading. As there is lack of consensus on the best way to cope with thinly traded securities and suggested models to cope with thinly traded securities are complex and outside the scope of this study, this paper removes securities that are thinly traded. Removing firms suffering from thin

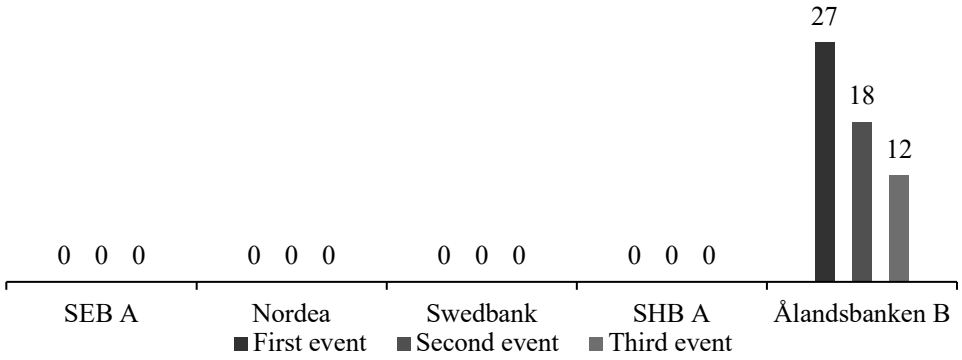
trading is a viable solution as seen by Rose, Sørheim & Lerkerød (2017). Figure 7 displays the number of daily average trades for the firms of interest, Ålandsbanken B is seemingly traded infrequently. This can also be concluded by the fact that Ålandsbanken has over 10% non-trading days in the first event which can be seen in figure 8. The securities SEB A, Nordea, Swedbank, Handelsbanken A has no trading days with zero trading in the estimation periods. Therefore, Ålandsbanken is removed from the sample of firms.

Figure 7
Average number of trades per day and number of zero trades days
The figure displays the average number of trades per day for the firms on each event



Source: Nasdaq Nordic (2019b)

Figure 8
Average number of trades per day and number of zero trades days
The figure displays the number of days with zero trading



Source: Nasdaq Nordic (2019b)

In order to increase the number of securities and the number of observations, this paper include both stocks with and without voting rights. The system with two share classes on the same market is called a dual-share class system and gives higher voting rights for one of the share classes but allows the same dividend rights. Prevalence of price discrepancies are common in dual share class stocks (Schultz & Shive, 2010; Smith & Amoako-Adu, 1995). Share price premiums are found for higher voting power and for higher trading volumes (Smith & Amoako-Adu, 1995). SEB and Handelsbanken have a dual-share class system with two stocks listed on the Stockholm exchange. SEB therefore has a SEB A where one share equals one vote and SEB C where one share equals 1/10 of a vote (SEB, 2018, p. 29). Handelsbanken has SHB A where one share equals one vote and SHB B where one share equals 1/10 of a vote (Handelsbanken, 2018, p. 42). Although the lower voting right stocks SEB C and SHB B display lower trading volumes than their higher voting right counterparty, both shares have been traded frequently[7] and none of the shares have any nonsynchronous trading problems as both have zero days of none trading. Dual share classes have different

The final sample in this study consist of four public Swedish mortgage lending institutions, namely SEB, Nordea, Swedbank and Svenska Handelsbanken (SHB). Together, these banks accounts for 75% of the outstanding mortgage loans in the country. All of the firms are listed on Stockholm Stock Exchange. To increase the number of observations stocks of both voting type classes are included in the study. In result, the data consist of six different stocks since both SEB and SHB have dual share classes.

3.4 Descriptive statistics

In table 1 below key firm characteristics are presented. Nordea is the largest firm of all firms in terms of revenue, total assets and market capitalisation. The three others are very similar to each other in terms of size of revenues, total assets and market capitalisation. The fact that Nordea is the biggest one of the banks is not surprising as the market presence in the Danish and the Finnish markets are substantial part of the operations (Nordea, 2019). The three other banks have a much clearer concentration on the Swedish market (Handelsbanken, 2018; SEB, 2018; Swedbank, 2019).

[7] Appendix 3 contain data on trading frequencies for all stocks

Table 1
Key financial items for Fiscal Year 2017
The table displays key financial items for each sample firms in Fiscal Year 2017

Item	*SEB*	*Handelsbanken*	*Nordea*	*Swedbank*
Total revenue (SEKbn)	45.4	40.0	94.6	40.9
Net interest income (SEKbn)	20.0	30.4	48.9	24.6
Net interest income-to-revenue (%)	44.0%	75.9%	51.7%	60.1%
Total assets (SEKbn)	2,556.5	2,767.0	6,448.7	2,212.6
Mortgage loans in Sweden (SEKbn)	442.7	717.0	430.2	748.2
Market capitalisation (SEKbn)	207.4	226.1	396.5	231.3
Return on Equity (%)	11.6%	11.6%	9.3%	14.7%
Price-to-book value (x)	1.4x	1.4x	0.9x	1.2x
Common Equity Tier 1 (%)	19.4%	22.7%	19.5%	24.6%

Source: S&P Capital IQ (2019) for all data except; Swedish Bankers' Association (2019a) on Mortgage loans in Sweden and Swedish FSA (2018) for data on Common Equity Tier 1 ratio

Looking at the net interest income, it is clear that there are some differences between the firms. SHB has the second highest interest income of SEK 30.4bn, however the net interest income-to-revenue ratio is 75.9%. This shows that much of SHB's operations is in lending rather than commission fees. On the other side of the spectrum is SEB with only 44.0% in net interest income-to-revenue ratio, showing that commission fees account for more than half of their operations. Commission fees involve, issuance of securities, card fees, life insurance commissions, advisory services and other (SEB, 2018). Swedbank is also prone to mainly operate in lending with a net interest income-to-revenue ratio of 60.1% and Nordea has half of its revenues from the lending operations.

Table 1 also presents the size of the mortgage lending operations in Sweden for each bank. Swedbank is dominant in mortgage lending in Sweden, closely followed by SHB. Swedbank has approximately 73% more mortgage loans outstanding than Nordea in Sweden, even though the size of Swedbank is less than half of Nordea in terms of total assets. This shows that Swedbank has a much higher exposure towards Swedish mortgage loans than Nordea. Nordea and SEB has a similar size of mortgage loans in Sweden, however SEB has a much higher exposure towards mortgage loans in Sweden due to their relative smaller size. This is also shown in figure 7 in mortgage loans-to-total assets.

The valuation and return metrics of the banks displays that Swedbank had significantly higher Return on Equity than the other banks. Looking at SEB and SHB, the return metrics show identical returns on equity. Nordea's performance is lower than the other banks. A glance at the price-to-book value metric shows that Nordea is lower than the other banks in this metric as well.

As for the common equity tier 1[8] it is visible that all banks are well capitalised. There are differences in capitalisation requirements between the banks, however these are a reflection of the different demands on the bank from the FSA. Each bank has an individual capital requirement depending on the businesses it operates in (Swedish FSA, 2018).

The descriptive statistics reveal that the four banks of interest are similar in firm characteristics. To see the relatedness between the stocks, a correlation matrix is presented in table 2. As can be seen, all stocks have positive correlation for the period 2009-2017. The inter-firm correlations are also high implying that the bank sector in Sweden is fairly homogenous in terms of stock price movements. The two dual share class firms, SEB A & C and SHB A & B have the highest correlations.

Table 2
Stock correlations 2009 – 2017
The table displays the stock return correlation matrix for the studied firms

	SEB A	***SEB C***	***NDEA***	***SWED***	***SHB A***	***SHB B***
SEB A	1					
SEB C	0.89	1				
NDEA	0.73	0.69	1			
SWED	0.77	0.72	0.67	1		
SHB A	0.73	0.66	0.74	0.68	1	
SHB B	0.69	0.64	0.70	0.66	0.92	1

Source: Nasdaq Nordic (2019b) on stock data

[8] Common equity tier 1 includes common stock, common stock surplus, retained earnings and some perpetual preferred stock. (Estrella, Park & Peristiani, 2000)

4. Methodology

4.1 Introduction

In this paper, the hypotheses will be tested with a quantitative method in the form of an event study. Bhagat & Romano (2002) states that the most successful econometric approach in policy analysis is an event study, therefore the method is considered appropriate in analysing the effect of mortgage lending restrictions. Furthermore, an advantage of a quantitative method compared to a qualitative method is that it is generally easier to draw generalisations based on the results.

The methodology chapter in this paper is divided into three sections. The first part consists of a comprehensive description over the standard event study approach. The second part consists of a detailed description over event study-based regression models. The purpose of including the second part is because the models complement the standard event study in its limitations. Finally, in the third section, a brief discussion over general issues with the event study methodology and sample size is presented.

4.2 Standard event study

Event studies are extensively used in financial economics and the number of published studies amounts to several hundreds of studies (Kothari & Warner, 2007). The purpose of an event study is to measure the value effect of a specific event on a company by estimating abnormal returns at the event dates. The method is therefore useful when stock price adjustments occur immediately after the event. A non-exhaustive list of events includes stock-splits, CEO changes, debt issuance, earnings announcements and announcements of macroeconomic variables (MacKinlay, 1997). In this paper, the event study examines the effects of the lending restrictions on bank profit and risk. The approach follows a five-step procedure in line with suggestions from Campbell, Lo & MacKinlay (1997):

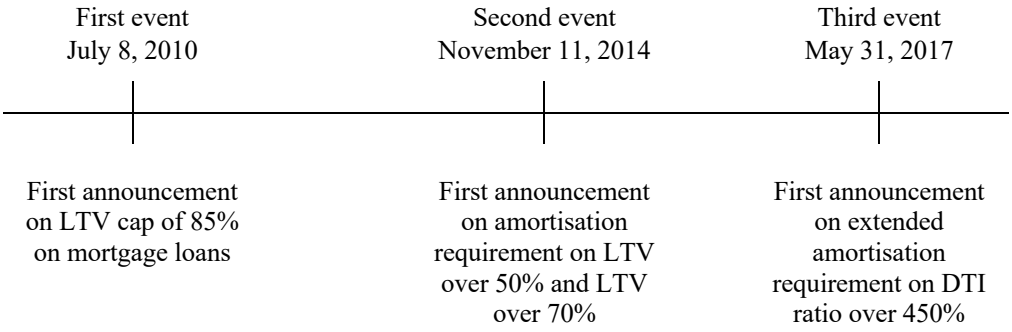
1. Determine dates
2. Estimate normal returns
3. Calculate abnormal returns
4. Accumulate abnormal returns
5. Statistically test abnormal returns

4.2.1. Determine dates

Event window

The first step in this event study is to identify dates of interest and define a period around the defined dates over which the variables of interest will be examined (MacKinlay, 1997). The period that is examined represent the event window of the study. Previously conducted event studies have event windows of different length for various reasons. Apart from the actual event day, event windows usually include the day after to incorporate the information effects that occurred when the market is closed (Campbell et al. 1997). Moreover, factors such as information leakage are commonly used as motivation for including days before the actual event day in the event window. According to the efficient market hypothesis, movements in the stock prices should be observed as soon as the information about an event is available for the investor. The theory thereby supports an event window of shorter length. However, other economic theories, such as conservatism bias, support an event window of further length. The drawback with using a short event window is that it may fail to capture the full effect of the event. However, with a long event window, the results can become biased (Jung & Park, 2017). In order to capture the entire effect of the event while mitigating the risk of biased results from long event windows, the length is set to 4 days per event. The event windows thereby include the day before each announcement, the day of the actual announcement, and the following two trading days after the announcement.

In this study, the events of interest are when the mortgage lending restriction was announced to the public, rather than when the restrictions were implemented. The motivation for this is based on the efficient market hypothesis stating that an investor price expected changes in cash flows when new information is realised. Given the efficient market hypothesis, the effects of the mortgage lending restrictions on bank profit and risk should be reflected immediately in the stock prices when information about the restrictions are first known to investors. Conclusively, the following dates have been identified as events of interest and are described in section 1.5:



Source: Swedish FSA, 2010b; Swedish FSA, 2014a; Swedish FSA 2017b

With identified announcement dates of the lending restrictions, the event windows are defined. With event windows of 4 days, the event window consists of the following days:

Table 3
Event dates
The table displays the dates of the days in each event window

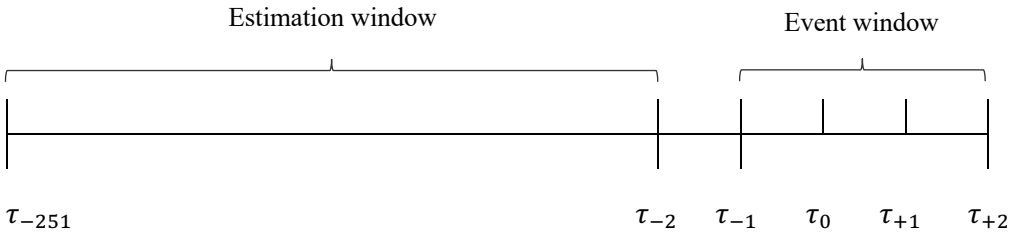
	Event dates		
Observation	*First event*	*Second event*	*Third event*
τ_{-1}	July 7, 2010	November 10, 2014	May 30, 2017
τ_{0}	July 8, 2010	November 11, 2014	May 31, 2017
τ_{+1}	July 9, 2010	November 12, 2014	June 1, 2017
τ_{+2}	July 12, 2010	November 13, 2014	June 2, 2017

There are multiple factors affecting the share price of a stock. For an event study to examine abnormal returns that are strictly related to an event of interest, it is important to control for the possibility of other stock-influencing events occurring simultaneously. Other events and news on a firm that have impacted the stock prices in the event window may lead to incorrect conclusions to be drawn about the impact of the event of interest. To mitigate the risk of obtaining biased results for such reason, a screening over news for each sample firm in each event window is done. All press releases from the sample firms and all news articles mentioning the sample firms in the event window are presented in appendix 4. From this screening, only one article is identified to potentially have affected the stock price of a sample firm. SEB announced the divestment of a smaller division in Germany at July 12, 2010 (SEB 2010), which represents τ_{+2} in the event

window of the first event. The sale could possibly have distort the abnormal returns for τ_{+2} for SEB. Any abnormal returns for day τ_{+2} are therefore possibly biased for SEB A and SEB C.

Estimation window

The next step in an event study is to determine a period of dates that the stock returns in the event window will be compared against. This period is referred to as the estimation window. The purpose of the estimation window is to get a proxy of 'normal' returns of the security, and therefore, the estimation window is typically much longer than the event window. An estimation window usually consists of a period prior the event that is representable for normal returns for the security. Typically, this period does not include the event itself (MacKinlay, 1997). By excluding the event days in the estimation window, the parameters of the normal returns will not be affected by the event (ibid). According to Campbell et al. (1997) an estimation window is typically the period prior to the event consisting of approximately 120 days. On the other hand, Bartholdy, Olson & Peare (2007) suggest that a standard estimation window is 200-250 days, representing approximately one year in trading days. To get an appropriate estimation of normal returns, the estimation windows in this study is set to be 250 days, which correspond to approximately one year in trading days.



With an estimation window that is approximately a year long, all events affecting stock prices that occur on a regular yearly basis are captured in the model, such as earnings announcements. The related estimation dates are presented in the table 4 below:

Table 4
Estimation windows
The table displays the beginning and end dates of each estimation window

	Estimation window		
Observation	*First event*	*Second event*	*Third event*
τ_{-2}	July 6, 2010	November 7, 2014	May 29, 2017
.	.	.	.
.	.	.	.
.	.	.	.
τ_{-250}	July 9, 2009	November 7, 2013	June 2, 2016

There are multiple factors affecting the share price of a stock. For the estimation windows to truly represent normal returns, factors affecting the stock price that do not occur on a regular basis need to be controlled for. Non-recurring events that have impacted the stock prices in the estimation window may lead to biased estimates of what the 'normal' returns should be. A research over the periods of the estimation windows has identified two events that have had significant impacts on the stock prices of the sample firms. These events are the EU accepting budget support to countries that suffered badly from the Great Financial Crisis, and the decision of Great Britain to leave the EU. However, since these macroeconomic events are not stock-specific or industry-specific, they affect the market returns as well for the same dates. Adjusting normal returns for these events is therefore considered redundant. Moreover, firms, and banks in particular, have historically been subject to scandals such as money laundering and tax evasion, that have affected their stock price. However, no firm specific event as such has been identified over the estimation windows. Conclusively, the model estimating normal returns, presented below in section 4.2.2, do not need to be adjusted for non-recurring events.

4.2.2. Estimate normal returns

Multiple of different models have been developed to obtain estimates of a firm's normal returns. The capital asset pricing model (CAPM) is a widely used approach to calculate the expected returns of a firm. Expected returns can be considered as a proxy of normal returns. However, according to MacKinlay (1997), proven deviations from the normal returns derived by CAPM have made researchers chose other methods for estimating normal returns in event study contexts.

MacKinlay (1997) presents two common models for calculating normal returns in event studies. The first model, the constant mean model, assumes that an asset's average return is constant over

time. The second model, named the market model, instead assumes that a stable linear relationship lies between the market and the asset's return. In a research over event study methodologies, Brown & Warner (1980) conclude that the use of market model performs well in predicting normal returns. In a later study, Brown & Warner (1985) show that the market model performs better than the constant mean model. Both MacKinlay (1997) and Brown & Warner (1985) are in favour of using the market model since it excludes the return related to the variation in the market return. MacKinley (1997) discusses extended versions of the single-factor market model and concludes little gain from using a multifactor model. One of the reasons is that the variance reduction in abnormal returns is small by using a multifactor model. Furthermore, Cable & Holland (2010) compare models of estimating normal returns and conclude a preference for regression-based market models and CAPM models, where the market model is dominating the CAPM.

When using the market model to calculate abnormal returns, the variance of the abnormal returns will be reduced compared to constant mean model (MacKinlay, 1997). Smaller variance increases the ability to discover the effects of the event (ibid). This is desirable as it is the purpose of the study whether the event has led to effects on returns and stock prices.

Based on the findings from previous studies, the market model is selected to estimate normal returns. The market model is illustrated with the following formula (MacKinlay, 1997):

$$\mathbf{R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}} \qquad \textbf{(1)}$$

$$\boldsymbol{E(\varepsilon_{i,t}) = 0} \qquad \boldsymbol{var(\varepsilon_{i,t}) = \sigma^2_{\varepsilon_\tau}}$$

$\mathbf{R_{i,t}}$ = Normal return for security *i* in time period *t*

$\boldsymbol{\alpha_i}$ = Idiosyncratic return parameter for security *i*

$\boldsymbol{\beta_i}$ = Systematic risk for security *i*

$\mathbf{R_{m,t}}$ = Return on the market portfolio in time period *t*

$\boldsymbol{\varepsilon_{i,t}}$ = Predicted error term

Since the data applied in the market model follow a temporal ordering, the data is a time series. The market model uses the method of ordinary least squares (OLS) to obtain estimates of the parameters in the model. For the OLS estimates to be unbiased and consistent, certain assumptions need to be fulfilled (Wooldridge, 2013:349-53). The assumptions follow:

1. Linearity in parameters
2. No perfect collinearity
3. Zero conditional mean
4. Homoscedasticity
5. No autocorrelation

MacKinlay (1997) argues that the market model tends to be robust from violations of the assumptions. In this study, the first three assumptions are assumed to hold. The first assumption holds because the market model in equation 1 has, per definition, a linear specification. The second assumption implies that no explanatory variable can be constant nor a linear combination of another explanatory variable (Wooldridge, 2013:350). Since the market model only contains one explanatory variable, market returns, the model cannot suffer from perfect collinearity. The second assumption thereby holds. The third assumption implies that the error term at time *t* is uncorrelated with the explanatory variable at all points of time (Wooldridge, 2013:352). A typical situation where the zero conditional mean assumption is violated is when the model suffers from omitted variable bias, meaning the model lacks a variable with explanatory power. However, the wide use of the market model in previous research indicates that the model is not miss-specified. The fourth assumption, homoscedasticity, implies that the variance of the error term is constant over time (Wooldridge, 2013:352). If the assumption is violated, the errors are said to be heteroskedastic, which result in biased standard errors of the parameters. One way to deal with heteroscedasticity is to apply robust standard errors in the regression. However, plots over the residuals indicate no clear sign of heteroskedasticity[9]. In addition, the standard errors of the estimates in the market are not of particular interest, therefore no adjustments are made. Finally, the fifth assumption of no autocorrelation implies that the errors of two different time periods are uncorrelated (Wooldridge, 2013:353). In order to ensure that the errors are uncorrelated, a Durbin-Watson test is conducted,

[9] Appendix 5

testing for positive first-order autocorrelation in the residuals. The Durbin-Watson test generates Durbin-Watson statistics (DW) with the following formula:

$$\boldsymbol{DW = \frac{\sum_{t=2}^{N}(\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{N}\hat{u}_t^2}} \qquad \textbf{(2)}$$

The null hypothesis in the test implies no autocorrelation in the errors. Implications with DW-statistics include problems with obtaining the null distribution of the statistics, therefore two critical values are needed, which are denoted d_L for lower and limit d_U for upper limit. (Wooldridge, 2013:419)

The DW statistics is interpreted in the following way:

If $DW < d_L$ – reject the null hypothesis of no autocorrelation

If $DW > d_U$ – do not reject the null hypothesis of no autocorrelation

If $d_L \leq DW \leq d_U$ – no conclusions can be made from the test

Table 5
Durbin-Watson d-statistic table 1% significance level
The table contains table over Durbin-Watson rejection limits for d_L and d_U where *k* represents number of regressors and *n* the number of observations

	k* = 1		**k* = 2**	
n	*dL*	*dU*	*dL*	*dU*
100	1.522	1.562	1.502	1.582
150	1.611	1.637	1.598	1.651
200	1.664	1.684	1.653	1.693
250	1.700	1.716	1.692	1.724

Source: Stanford University (2018)

Table 6
Durbin-Watson d-statistic results for sample
The table contains Durbin-Watson d-statistic test results for the sample of the six stocks

	Durbin watson d-statistic		
Security	*First event*	*Second event*	*Third event*
SEB A	2.02	2.23	1.91
SEB C	1.97	2.16	2.00
NDEA	2.14	2.15	1.81
SWED	1.84	2.09	1.95
SHB A	2.27	2.18	1.83
SHB B	2.38	2.18	2.18
Portfolio	2.05	2.08	1.78

The test results show that the time series data is not serially correlated as all values are larger than the d_U limit of 1.716, which is the critical value for the 1% significance level. The conclusion is therefore that the fifth assumption holds true.

The validity of an event study is dependent on accurate calculations of normal returns and abnormal returns. The relationship between a security's returns and market returns in the market model is therefore in part described by the adjusted R-squared value. Since the market model is a single factor model, the adjusted R-square will be identical to the R-square. Roll (1988) explain that higher R-squared value is desirable in models predicting asset pricing. In the market model, a high R-square implies that the market returns have high predictive power on stock returns, while a low R-square means that market returns do not explain security returns very well. A low R-square would implicate that individual security returns are not related to the market returns and must be described by other variables. Although the R-square can be a somewhat blunt metric for interpreting efficiency in a model, in the example of the single factor market model, it provides very clear guidance on how good a specific market index can explain the returns for individual securities. The R-squared from the market model regressions on each security for each event have all considerably high R-squared[10], implying that the market index returns have high predictive power of each of the security in this study.

[10] Appendix 6

4.2.3 Calculate abnormal returns

Security returns

The index used for calculating the market returns, are reported in closing prices. In order to be consistent with the calculations for the variables in the market model, the returns for the securities are also calculated with closing prices. However, because the closing prices are not adjusted for dividends, the closing prices prior to the period's dividend ex-date is adjusted for dividends with a dividend multiplier. The following formula is applied on the closing prices prior to the dividend ex-date:

$$\boldsymbol{P^*_{i,t} = \left(1 - \left(\frac{Div_i}{P_{i,div-1}}\right)\right) * P_{i,t}} \quad \textbf{(3)}$$

$\boldsymbol{P^*_{i,t}}$ = The dividend-adjusted closing price for security *i* in period t

$\boldsymbol{Div_i}$ = The dividend for security *i* during the period

$\boldsymbol{P_{i,div-1}}$ = The closing price for security *i* the day before the dividend ex-date

$\boldsymbol{P_{i,t}}$ = Closing price for dividend *i* in period *t*

At the dividend ex-date, investors adjust the security price with respect to the dividend. The prices at the ex-date and the period after are therefore not adjusted for dividends. The closing prices at the ex-date and after thereby follow:

$$\boldsymbol{P^*_{i,t} = P_{i,t}} \quad \textbf{(4)}$$

The return for security *i* in period *t* follow:

$$\boldsymbol{R_{i,t} = \frac{P^*_{i,t}}{P^*_{i,t-1}} - 1} \quad \textbf{(5)}$$

Furthermore, the correlation matrix for the six stocks is calculated after adjusting prices. For each event correlations are calculated which gives an opportunity to analyse the intra-firm relationships for dual share stocks and inter-firm relationships between the different stocks during each event.

Market returns

Event studies rely on the ability of differing normal returns from abnormal returns of a particular security. In the market model, market returns should reflect normal returns, therefore the selection of security that measures market returns has a critical role for the validity of the event study. Previous research in finance include firm size as an explanatory variable for the returns of the firm. Banz (1980) concludes that common stock of small firms has higher risk adjusted returns than that of larger firms. The effect of market value on stock returns is, in other words, called the size effect. The stocks of the mortgage lending firms in this study are all listed on the large cap list and actively traded in the market (Nasdaq Nordic, 2019b). The Nasdaq Stockholm Large Cap index is therefore considered as an appropriate estimate of market returns. By using the Large Cap index, higher returns of smaller market capitalised firms will not distort the estimation of normal and abnormal returns. Generally in finance studies, the approximation of market returns is the S&P 500 index. The Nasdaq Stockholm Large Cap index is the most similar index to the S&P 500 but for the Swedish market. Conclusively, the Nasdaq Stockholm Large Cap index[11], denoted Index in equation 6, is in this study used as approximation for market returns.

$$R_{m,t} = \frac{Index_t}{Index_{t-1}} - 1 \qquad (6)$$

Abnormal returns

The market model estimates normal returns of a firm. The abnormal returns are the difference between estimated normal return and actual return. The abnormal returns are, in other words, the residuals from the market model.

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i R_{m,t}) \qquad (7)$$

$AR_{i,t}$ = The abnormal return for security *i* in time period *t*

$R_{i,t}$ = The actual return for security *i* in time period *t*

$(\alpha_i + \beta_i R_{m,t})$ = The expected return for security *i* in time period *t*

Intuitively, the variance of the abnormal returns is the residual variance of the market model.

[11] The Stockholm Large cap index consist of the largest stocks at Nasdaq Stockholm with market caps above EUR 1bn (Nasdaq, 2018)

4.2.4 Accumulate abnormal returns

In order to draw conclusions about the overall inference of the event, the abnormal returns must be aggregated (Campbell et al., 1997). Normally, the aggregation is done both across time and across securities (ibid). In the classical standard event study methodology, the abnormal returns are aggregated across time to get Cumulative abnormal returns (CAR) and across firms to get Average cumulative abnormal returns[12] (ACAR). To examine the overall effect of one event day, the abnormal returns are aggregated on firm level to get Average abnormal returns[13] (AAR). However, in this study the abnormal returns are only aggregated across time at a stock-specific level to get CAR. The motivation behind this is further described in section 4.2.5.

$$\boldsymbol{CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau}} \quad \textbf{(8)}$$

The variance of CAR is estimated with the following equation:

$$\boldsymbol{Var(CAR_i) = \sigma_i^2(\tau_1, \tau_2) = (\tau_2 - \tau_1 + 1)\sigma_{\varepsilon_i}^2} \quad \textbf{(9)}$$

$\boldsymbol{\tau_1}$ = Day 1 in the event window

$\boldsymbol{\tau_2}$ = Day 2 in the event window

The estimation of the CAR variance in equation 9 relies on the assumption that there are no sampling errors in the estimators, $\boldsymbol{\alpha_i}$ and $\boldsymbol{\beta_i}$. If sampling errors are present the variance of CAR would increase, and an additional variance term would need to be included. MacKinlay (1997) explains that sampling errors are common in all event windows, however the sampling errors diminish with increased estimation window size. MacKinlay (1997) suggest that equation 9 can therefore be used when the length of the estimation window is large. With an estimation window of 250 days, the sample is considered large enough to not contain any sampling errors.

[12] Appendix 7
[13] Appendix 7

4.2.5 Statistically test abnormal returns

Parametric tests

As previously mentioned, aggregations of abnormal returns are commonly done across two dimensions, across time and across securities. However, when conducting parametric tests of the aggregated variables, certain properties of the data need to be fulfilled for the inference of the test to be valid. Criticism of an event study with parametric testing concerns the validity of hypothesis testing if the estimated variance is understated (Binder, 1998; Brown & Warner 1980). Such issues may arise when the event windows of different securities overlap. This situation is in event study context referred to as event clustering (MacKinlay, 1997). With event clustering, the covariance between the abnormal returns of different securities will likely be different from zero, implying cross-correlation across securities. As a result, the variance of the abnormal returns becomes biased downwards, affecting the inferences of the test statistics in the parametric tests. Cross-correlation therefore often result in inflated t-statistics and a significantly increased risk of falsely rejecting the null hypothesis. Kolari & Pynnönen (2010) conclude that even when the cross correlation between securities is relatively low, the event clustering issue is serious in over rejecting the null-hypothesis. Since the events examined in this paper are public announcements of macroprudential policies, the event windows per policy occur at same time period for all securities in the sample. Parametric tests of abnormal returns that are aggregated across securities would therefore most likely generate biased results with inflated t-statistics. The commonly used measures ACAR and AAR are therefore not applicable in this event study. However, since CAR is only an aggregation across time, but not across securities, the issue of event clustering is irrelevant. In conclusion, in this study, parametric test is only conducted on abnormal returns that have been accumulated across time, but not across securities, namely CAR. The test statistics of CAR is given by:

$$t_{CAR} = \frac{CAR_i(\tau_1, \tau_2)}{\sqrt{\sigma_i^2(\tau_1, \tau_2)}} \quad \textbf{(10)}$$

With test statistics that, in absolute value, is larger than the critical value of a t-distribution, the null hypothesis presented in section 2.3 will be rejected.

In the section 4.2.1, the event window is set to four days. Since the cumulative abnormal return is cumulated gradually, different lengths of the event window can easily be tested for. CAR is therefore tested for significance at multiple event windows of different lengths. By testing the CAR of different event window lengths, the chances of discovering effects increases. In result, the CAR will be tested for in four different event windows covering the following periods: τ_{-1} - τ_{+2}, τ_{-1} - τ_{+1}, τ_{-1} - τ_{0} and τ_{0} - τ_{+1}.

Non-parametric tests

The drawback with using parametric tests in event studies is that they require specific assumptions to be made about the distribution of the abnormal returns (MacKinlay, 1997). In contrast, non-parametric tests do not rely on such stringent assumptions. Typical non-parametric tests applied in event studies are a sign test or a rank test. Corrado & Zivney (1992) suggest that the sign test is more powerful than a t-test and that the rank test is, in turn, preferable over the sign test in event studies. Power is defined as the probability of making a Type II error[14]. The authors further explain that non-parametric tests are robust against cross correlation from event clustering. With a non-parametric test, it is therefore possible to test the overall effect of the event on all securities in one test. Kolari & Pynnönen (2010) performs a study over event study methodologies when cross-sectional correlation is present and examines four different types of tests. Kolari & Pynnönen (2010) show that when using the market model to calculate abnormal returns, the rank test has the most power of all tests. The benefit is that this rank test will not over-reject the null-hypothesis but still be able to detect abnormal behaviour. Given this background, a rank test is applied in this study. The test is conducted following the procedure explained by Corrado (1989).

A rank test is conducted by assigning a rank to the abnormal returns in the event window and estimation window for each stock. The observation with the lowest return is assigned the lowest rank. The test statistics follow:

[14] Type II errors occur when a test fails to reject a false null hypothesis. (Wooldridge, 2013:779)

$$t_{rank} = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} (U_{i0} - 1/2)/S(U) \quad (11)$$

where:

$$U_{it} = K_{it}/(1 + M) \quad (12)$$

K_{it} = rank for security *i* at time *t*

N = number of securities

M= number of observations for security *i*

The standard deviation is given by:

$$S(U) = \sqrt{\frac{1}{M} \sum_{t=1}^{M} \left(\frac{1}{\sqrt{N}} \sum_{i=1}^{N} (U_{it} - 1/2) \right)^2} \quad (13)$$

Critical values for t_{rank} is obtained from a t-distribution table. With rank test statistics exceeding the critical value, the null hypothesis in section 2.3 will be rejected.

4.3 Event study-based regressions

Previous sections in the methodology are based on a standard event study approach. Since there are multiple of implications for this type of event study to be valid, researchers have further developed methodologies used in event studies. Instead of determining abnormal returns by the residuals from a market model, another method includes binary variables of the event days of interest in a regression on stock returns. In this way, the abnormal returns become parameterised (Binder, 1998). The estimates of the regression model are, similarly to the market model, obtained by OLS estimates on time series data.

This approach is, in contrast to the standard event study methodology, completely robust against clustering problems (MacKinlay, 1997). Multivariate regression models are therefore commonly applied in event studies where the event days overlap across securities. For example, Jung & Park

(2017) examines the effect of mortgage lending restrictions on mortgage lending firms in Korea by applying the previous described method.

The drawback with the regression model approach is that it has little power compared to other tests (MacKinlay, 1997). As augmented in section 5.4, a rank test has strong power in detecting effects. On the other hand, if a regression model does detect an effect, the model also provides estimates of the size of the effect. Regression models are therefore included in the study to complement the CAR and the rank test with the size of the effects, in case effects are detected. Previous studies using this approach conduct regressions on an equally weighted portfolio of all securities in the sample, as well as firm specific regressions (Binder, 1998). Both methods will be applied in this study.

In order to measure the overall effect of each restriction, equally weighted portfolios of all sample stocks are constructed for the returns in the estimation and event window. With an equally weighted portfolio of returns, the estimates of the binary variables represent the average abnormal returns across stocks (Binder, 1998). Binary variables are assigned to each event day in the event window, in result, the regressions model have the following set up:

$$\boldsymbol{R_{pt} = \alpha_p + \beta_p R_{mt} + \sum_{a=1}^{A} \gamma_{pa} D_{at} + u_{pt}} \qquad \textbf{(14)}$$

$\boldsymbol{R_{pt}}$ = Returns from an equally weighted portfolio at time t

$\boldsymbol{R_{mt}}$ = Market returns at time t, measured by the large cap index

$\boldsymbol{A}$ = Number of days in the event window

$\boldsymbol{D_{at}}$ = Binary variable for day a in the event window that takes on the value 1 if the return is from day a and 0 otherwise

The firm specific regressions are applied to examine the effect per firm of each of the events. In contrast to the cumulative abnormal returns from section 4.2.5, the result shows the effects per day and specifies exactly which day in the event window abnormal returns are significant or not. Moreover, apart from testing for the effect of the events on the stock price of mortgage lending firms, this paper has an additional hypothesis that an effect from the events will be larger for the

firms with relatively more mortgage lending. With stock-specific regressions, conclusions regarding this hypothesis can be made by comparing the coefficients of the binary variables across firms. The firm specific regressions have the following set up for security *i*:

$$\boldsymbol{R_{it} = \alpha_N + \beta_i R_{mt} + \sum_{a=1}^{A} \gamma_{ia} D_{at} + u_{it}} \quad \textbf{(15)}$$

T-statistics of the binary variables in the regression models determine whether there are significant effects or not.

As described in the market model presentation, a regression model of a time series needs to satisfy several OLS assumptions for the estimators to be unbiased and consistent. Since inference of the regression model parameters will be based on t-statistics, biased estimates or standard errors may result in wrong conclusion to be made. The OLS assumptions are presented in section 4.2.2. Similarly to the market model, the design of the event study-based regression models are linear in parameters per definition, satisfying the first OLS-assumption. For regression models including binary variables, particular attention needs to be taken to ensure that the assumption of no perfect collinearity is fulfilled. Binary variables represent a category each and take on the value 1 if the category is true for the observation in question. One binary variable for a category needs to be left out of the model to represent the case where all of the other binary variables take on the value 0. This category is called the base group. The effect of the base group is captured by the intercept of the regression model. In cases where regression models are over parametrised with binary variables for each category and no base group exists, the binary variables together with the intercept exhibit a perfect liner relationship, violating the assumption of no perfect collinearity. In econometrics, the problem is referred to as the dummy variable trap (Wooldridge, 2013:236). The event study-based regression models are run on the observations of the estimation window and the event window. Each binary variable in the model represents one day in the event window. For the observations in the estimation window, all binary variables take on the value 0. Hence, the observations of the estimation window represent the base group. In conclusion, the assumption of no perfect collinearity is not violated. Moreover, the assumption of zero conditional mean would be violated if the model lacks an explanatory variable. Considering that the regression model set-

up follows that of previous research, the model is assumed to not omit a crucial explanatory variable. For this reason, the assumption of zero conditional mean is assumed to hold.

The final two assumptions consider homoscedasticity and no autocorrelation. The assumptions can be fulfilled by applying heteroscedasticity and autocorrelated consistent (HAC) standard errors to the model. A general perception in econometrics is that the application of robust standard errors is harmless even in cases where the errors already are homoscedastic and are not autocorrelated (Fomby & Murfin, 2005). However, in the particular case of event study-based regression models, this general view may not be true. Fomby & Murfin (2005) argues that HAC standard errors applied in event study models with binary variables may lead to spuriously identified significant events. Furthermore, Ford, Jackson & Skinner (2010) prove that HAC standard errors in regression-based event studies render misleading results. For this reason, the regression models are run with default standard errors.

4.3 Comments on methodology issues

4.3.1 Event study pitfalls

Binder (1998) identifies statistical issues that may cause problems with the inference of an event study. First, a common issue in an event study is event clustering, which is discussed in section 4.2.5. Because this study is highly characterised by event clustering, the entire selection of models in the methodology is based on which test are robust against event clustering. A second issue with the statistics of events studies is when the abnormal returns are not independent across time. In this study, this issue is controlled for with a Durbin-Watson test for autocorrelation. Thirdly, another debated issue in event studies that may cause problems with the inference of the tests is event-induced variance, implying that the variance increases in event window compared to the estimation window (Binder, 1998). With event-induced variance, the errors become heteroskedastic. However, the rank test is robust against event-induced volatility (Corrado & Zivney, 1992). The regression models could be carried out with heteroskedastic-consistent standard errors. As discussed in section 4.3, heteroskedastic-consistent standard errors in event study regression models may result in biased results and are therefore not applied in this study.

4.3.2 Event studies based on few firms

At a first glance, a study containing four firms might be perceived as problematic. Elementary statistical knowledge proposes the use of large samples and observation when performing statistical analysis as inference can be problematic when there are few observations. However, several studies use event studies on single events or on single firms, which are not invalid by default (Bhagat & Romano, 2002). Problems with small samples are, on the other hand, related to the statistical power of the test. First, detecting abnormal returns is more difficult with only one firm due to a generally higher variability in abnormal returns of a single firm compared to in a portfolio of several firms. Second, other information might distort the returns of a single firm in the event period, however, this effect diminishes with increased number of firms. MacKinlay (1997) support the fact that statistical power increases with the number of firms by showing that a 2% abnormal return is detected 69% of the times with a sample of 6 securities but 99% with a sample of 20 firms.

As the Swedish mortgage lending market is dominated by few very large players, the sample simply does not consist of more firms that can be included. However, as discussed by Bhagat & Romano (2002), the fact that this paper uses few securities is in no way disqualifying the use of an event study but merely, present a challenge to find significant results. If it de facto are abnormal returns during the events, this study might be unable to detect it due to the few numbers of securities. On the other hand, this study is not likely to over-reject the null hypothesis as the significance level will be maintained. This means that conclusions drawn from the results of this study are still reliable in terms of rejecting the null hypothesis.

5. Results

5.1 Introduction

In this section, the results from the tests described in the methodology chapter are presented in tables and text. Three different tests are conducted on each event. The tests include CAR, rank test and event study-based regressions. The regression models are applied on both an equally weighted portfolio of all stocks and on each stock separately. The term β in the regression models refers to the coefficient of the market return index and is used interchangeably with the term coefficient.

The results from the regression models are interpreted as if all other factors were held constant. The results are presented per event in a chronological order.

5.2. Event 1

Event 1 represent the introduction of an 85% LTV cap on mortgage loans which was announced in 2010. Below follows a presentation of the test results from this event.

5.2.1 Cumulative abnormal returns event 1

Table 7
Cumulative abnormal returns event 1
The table contains cumulative abnormal returns with t-statistics per firm

Event window	*No. Days*	***SEB A***		***SEB C***		***Nordea***		***Swedbank***		***SHB A***		***SHB B***	
		CAR	*t-stat*	*CAR*	*t-stat*	*CAR*	*t-stat*	*CAR*	*t-stat*	*CAR*	*t-stat*	*CAR*	*t-stat*
$\tau_{-1} - \tau_{+2}$	4	4.13%	1.39	-0.01%	0.00	0.65%	0.28	3.13%	0.80	0.09%	0.04	-0.01%	-0.01
$\tau_{-1} - \tau_{+1}$	3	3.32%	1.29	0.92%	0.34	0.36%	0.18	1.53%	0.45	-0.02%	-0.01	0.27%	0.15
$\tau_{-1} - \tau_{0}$	2	3.43%	1.63	2.05%	0.94	-0.69%	-0.42	1.91%	0.69	0.28%	0.19	0.39%	0.26
$\tau_{0} - \tau_{+1}$	2	1.01%	0.48	-0.07%	-0.03	-0.31%	-0.19	0.01%	0.00	-1.46%	-0.99	-1.29%	-0.85

, **, * represent significance levels of 10%, 5% and 1%*

SEB A

The CAR is positive in all event windows, implying that the 85% LTV cap will be positive for the profit and risk of SEB. However, the t-statistics in all event windows indicate that the results are not statistically different from zero. With insignificant results, no conclusion about the event's effect on the stock price of SEB A can be drawn. Furthermore, the divestment of the German asset that SEB announced on τ_{+2} does not show any significant results.

SEB C

The CAR for SEB C do not consistently move in the same direction as the CAR of SEB A. For SEB C, the CAR for the four-day event window and two-day event window, starting from τ_0, is small and negative. With these windows, the result imply that the announcement of the LTV cap is negative for the profit and risk of the firm. On the contrary, the other two event windows indicate a positive effect. However, as the results for all event windows are insignificant, no conclusions can be drawn. Furthermore, the divestment of the German asset that SEB announced on τ_{+2} does not show any significant results.

Nordea
The event windows lasting for three and four days have positive CAR, implying that the 85% LTV is positive for the profit and risk of the firm. On the other hand, the event windows lasting for two days have negative CAR. When the event window is shorter, and therefore more concentrated around the date of the actual announcement, the results imply a negative effect on the firm. However, the t-statistics shows that all results for Nordea are insignificant, and thus no conclusions can be made.

Swedbank
With positive CAR, the result for Swedbank implies that the LTV cap will have a positive effect on the profit and risk of the firm. However, similar to previous presented results, the t-statistics show that the results are insignificant, and no conclusions can therefore be drawn.

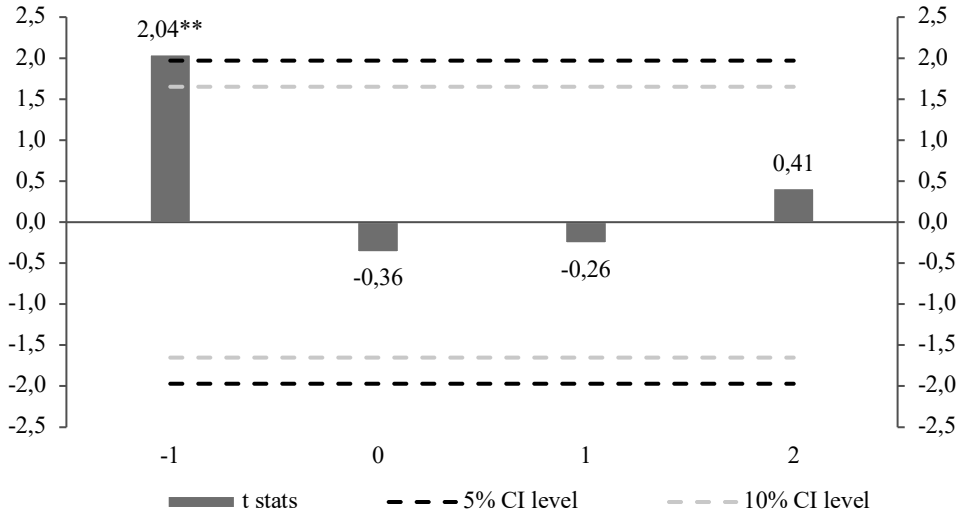
SHB A
The CAR for SHB A is positive for the event windows of four days and two days, starting from day τ_{-1}. The results imply that the 85% LTV cap is positive for the profit and risk of the firm. However, the results for SHB A are conflicting as the other two event windows have negative CAR. Because the CAR has been both positive and negative around the announcement of the restriction, the CAR for the event window of three, and four days, is small. Common for all event windows is that the results are insignificant and therefore no conclusions can be drawn.

SHB B
The CAR for SHB B do not consistently move in the same direction as SHB A. While the event window of three days has negative CAR for SHB A, it is positive for SHB B. Similar to SHB A, the CAR in the four-day event window for SHB B is small. Moreover, the event windows covering less than four days have positive CAR, implying that the 85% LTV cap will positively affect the profit and risk of SHB. Similar, to the results of SHB A and the rest of the firms, the results are insignificant and thus no conclusions can be made.

5.2.2 Rank test event 1

The second test is a rank test with t-statistics for each day in the event window, based on a portfolio of all stocks in the sample.

Figure 9
Rank test event 1
The figure contains t-statistics generated by the rank test based on a portfolio of all firms



**, ** represent significance levels of 10%, and 5%*

Given the results from the rank test, value of the first day in the event window, τ_{-1}, is significant at a 5% level of confidence with t-statistic of 2.04. The result implies that the abnormal return for the portfolio was statistically different from zero on the day before the policy announcement. Although the rank test does not illustrate an estimation of size of the abnormal returns, the test shows the direction. In this case, the significant effect is positive. The interpretation of the significant results is that profit and risk of the mortgage lending firms are positively affected by the LTV cap. Furthermore, in the days τ_0 and the result from the rank test indicates negative abnormal returns with t-statistics of -0.36 and -0.26. The t-statistics are close to zero and insignificant, therefore the test gives no evidence of abnormal returns for these days. Similarly, to the results of day τ_{-1}, day τ_{+2} has positive t-statistic indicating positive abnormal returns. However, as illustrated by figure 9, the t-statistic is not large enough for statistical significance and therefore no conclusion can be made regarding the returns of this day.

5.2.3 Portfolio regression event 1

The third test is a regression of market returns on stock returns with binary variables for each day in the event window.

In the first regression, stock returns are the returns from an equally weighted portfolio of the stocks in the sample. The results are presented below:

Table 8
Portfolio regression event 1
The table contains output from the regression on the portfolio

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	-6.3E-06	0.0005	-0.0114	0.9909
Large cap index	1.2766	0.0410	31.1741***	0.0000
τ_{-1}	-0.0019	0.0087	-0.2194	0.8266
τ_{0}	-0.0018	0.0087	-0.2024	0.8398
τ_{+1}	0.0026	0.0087	0.3012	0.7635
τ_{+2}	0.0041	0.0087	0.4702	0.6386
Adj. R-squared	0.7961			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The coefficient Large cap index is highly significant with a p-value of approximately zero. The interpretation is that the market returns are highly significant in explaining the portfolio returns. According to the model, a 1% change in the large cap index will result in a 1.28% change in the stock portfolio. This suggests that the portfolio $\boldsymbol{\beta_{Portfolio}}$ is higher than the $\boldsymbol{\beta_{Market}}$[15] which implies that the risk in the portfolio is higher than in the market. All the binary variables have high p-values and are therefore not significant. The p-values are 0.83, 0.84, 0.76 and 0.64 for the periods $\tau_{-1}, \tau_0, \tau_{+1}$, and τ_{+2}. The model therefore predicts that the event has had no significant impact on the stock returns.

[15] $\boldsymbol{\beta_{Market}}$ is defined as 1 by default

5.2.4 Stock-specific regressions event 1

Table 9
SEB A regression event 1
The table contains output from the regression on SEB A

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	-4.9E-04	0.0009	-0.5127	0.6086
Large cap index	1.5254	0.0708	21.5416***	0.0000
τ_{-1}	0.0112	0.0150	0.7446	0.4572
τ_{0}	-0.0013	0.0150	-0.0867	0.9310
τ_{+1}	0.0081	0.0150	0.5379	0.5911
τ_{+2}	0.0054	0.0151	0.3546	0.7232
Adj. R-squared	0.6496			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The market returns are highly significant in explaining the returns of SEB A. The coefficient on the large cap index implies that a 1% increase in the index, the SEB A stock will increase with 1.53%, implying that the risk in SEB A is higher than in the market. The regression shows no significant effect in the event window. This implies that the LTV cap does not have an impact on profit and risk of SEB A. Finally, the divestment of the German asset that SEB announced on τ_{+2} does not show any significant results.

Table 10
SEB C regression event 1
The table contains output from the regression on SEB C

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	1.3E-04	0.0010	0.1311	0.8958
Large cap index	1.0873	0.0734	14.8060***	0.0000
τ_{-1}	0.0105	0.0155	0.6785	0.4981
τ_{0}	-0.0114	0.0156	-0.7313	0.4653
τ_{+1}	-0.0094	0.0155	-0.6055	0.5454
τ_{+2}	0.0017	0.0157	0.1087	0.9135
Adj. R-squared	0.4626			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The results imply that with a 1% change in the index return, the return of SEB C changes with 1.09%. $\beta_{SEB\ C}$ is close to the β_{Market} meaning that the risk in SEB C is approximately the same as the market. The result is counter-intuitive compared to SEB A, as the $\beta_{SEB\ C}$ is significantly lower than the $\beta_{SEB\ A}$, even though the securities are issued by the same company and have the same underlying assets. The result is evidence that the securities are traded and valued separately. This is confirmed by looking at the correlation matrix[16] for the event, which shows a lower correlation of 0.81 compared to the period 2009-2017 of 0.88. Given the result, the impact of the index on the stock returns suggests a higher risk for SEB A than for SEB C. The coefficients of all binary variables are insignificant. The results do not support the hypothesis that the LTV cap have an impact on profit and risk of SEB C. Finally, the divestment of the German asset that SEB announced on τ_{+2} does not show any significant results.

Table 11
Nordea regression event 1
The table contains output from the regression on Nordea

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	-7.6E-04	0.0007	-1.0450	0.2970
Large cap index	1.3349	0.0547	24.4165***	0.0000
τ_{-1}	-0.0136	0.0116	-1.1729	0.2419
τ_{0}	0.0104	0.0116	0.9008	0.3686
τ_{+1}	0.0029	0.0116	0.2473	0.8049
τ_{+2}	0.0000	0.0117	0.0025	0.9980
Adj. R-squared	0.7063			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The model predicts that 1% increase in the index returns result in a 1.33% increase in returns for Nordea, suggesting that Nordea has a higher risk than the market. Similarly to previous presented results, the coefficients of the binary variables are insignificant. The output suggests that the LTV cap does not have an impact on profit and risk of Nordea.

[16] Appendix 8

Table 12
Swedbank regression event 1
The table contains output from the regression on Swedbank

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	1.0E-03	0.0012	0.8324	0.4060
Large cap index	1.5942	0.0923	17.2738***	0.0000
τ_{-1}	0.0039	0.0195	0.1972	0.8438
τ_{0}	-0.0039	0.0196	-0.2005	0.8413
τ_{+1}	0.0160	0.0195	0.8189	0.4137
τ_{+2}	-0.0034	0.0197	-0.1745	0.8616
Adj. R-squared	0.5409			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

A 1% increase in index returns, will according to the model output, result in a 1.59% increase in returns of Swedbank. The $\beta_{Swedbank}$ is the highest in the sample for the event with LTV cap. The coefficients of the binary variables are all insignificant. These results suggest that the LTV cap does not have an impact on the profit and risk of Swedbank.

Table 13
SHB A regression event 1
The table contains output from the regression on SHB A

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	2.3E-05	0.0007	0.0350	0.9721
Large cap index	1.0664	0.0494	21.5966***	0.0000
τ_{-1}	-0.0116	0.0104	-1.1120	0.2672
τ_{0}	-0.0031	0.0105	-0.2935	0.7694
τ_{+1}	0.0011	0.0104	0.1034	0.9177
τ_{+2}	0.0107	0.0105	1.0151	0.3110
Adj. R-squared	0.6542			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The coefficient for the Large cap index implies that with a 1% increase in the index return, the stock return of SHB A will increase with 1.07%, suggesting a market risk is close to the market. All binary variables are insignificant. Thus, the LTV cap cannot be concluded to have an effect on profit and risk of SHB A.

Table 14
SHB B regression event 1
The table contains output from the regression on SHB B

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	3.3E-05	0.0007	0.0484	0.9614
Large cap index	1.0518	0.0509	20.6675***	0.0000
τ_{-1}	-0.0118	0.0108	-1.0928	0.2755
τ_{0}	-0.0013	0.0108	-0.1207	0.9040
τ_{+1}	-0.0029	0.0108	-0.2714	0.7863
τ_{+2}	0.0103	0.0109	0.9489	0.3436
Adj. R-squared	0.6339			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The results imply that a 1% increase in the index return will result in a 1.05% increase in the returns of SHB B. The difference between the coefficients on the large cap index in the regression for SHB B compared to in the regression for SHB A is small, suggesting the same level of risk in both securities as well as the market. This result is also confirmed by looking at the correlation matrix[17] which shows a very high correlation of 0.96 between the stocks. Similar to above presented results, the binary variables are insignificant and therefore the LTV cap cannot be concluded to have an effect on the profit and risk of SHB B.

5.2.5 Analysis event 1

The results from the different tests on the announcement of the LTV cap are somewhat conflicting. The CAR is insignificant for all banks in all days of the event window. The test thereby indicates that the event had no impact on the mortgage lending firms. On the contrary, the results from the rank test show a significant and positive effect on the first day in the event window, τ_{-1}. The results from the rank test thereby indicates that the stock returns of mortgage lending firms were abnormal the day before the announcement of the restrictions. The positive sign of the test result implies that the profit and risk of the mortgage lending firms are positively affected by the LTV cap on mortgage loans.

[17] Appendix 8

If the announcement of the LTV cap did in fact affect the stock price, the absences of evidence in CAR could simply be explained by the relative power of the test. Since CAR cannot be aggregated across securities, the chance of detecting an effect is smaller. Another reason for why no significance is shown could be that investors gradually price in the change in the stock. This goes in line with the economic theory of conservatism bias among investors, which in this case would mean that investors price in the expected changes of the LTV cap over a period longer than what the event window covers. However, a slow incorporation of the change in the stock price as a result of conservatism bias does not go in line with the result from the rank test.

By looking solely at the rank test the null hypothesis of the first event, $H_{0a,}$ can be rejected at a 5% level of confidence, as day τ_{-1} has a significant result. The result implies that H_{1a} is true. According to Kolari & Pynnönen (2010), the rank test is the most powerful test in detecting abnormal returns, when normal returns are based on the market model. Therefore, significant results at 5% levels should not be overlooked. A comprehensive research over firm-and industry-specific news has not identified any event occurring in day τ_{-1} that may have impacted the stock price. The likelihood of the significant result being related to something else is therefore low, as the research over news point at the significant abnormal return being related to the LTV cap.

Going further, the positive sign of the significant rank test result indicate that investors consider the LTV cap as being positive for the profit and risk of the banks. Looking back in history, in the years following the bank deregulation in the mid 80's LTV ratios increased from 75% to around 90%. The crisis following the deregulation may be a reminder for investors about the risk of having too high LTV ratios. Applying representativeness heuristics on the situation, investors would contextualise the LTV cap in a way that is easy for them to understand. An example could be making parallels to what happened in the country when LTV ratios were too high. As described in section 1.4.3, when commercial real estate prices fell, the high LTV ratios led to increased credit losses. Investors today may therefore value the decreased risk that comes with LTV caps higher than the potential decrease in interest income. Furthermore, in previous research LTV ratios have been identified as a leading indicator of the probability of mortgage default (Von Furstenberger, 1969). This finding could be another explanation for why investors value the lending restriction positively.

In long term, the LTV cap may result in lower levels of mortgage loans. Both Gandhi (2011) and Baron & Xiong (2017) find that credit expansions are negatively related to asset returns. Since the LTV cap may lead to the opposite situation regarding credit levels, the result of positive asset returns aligns with the findings of previous mentioned authors.

Event study-based regression models are conducted to complement previous method with magnitudes of possible changes in stock returns. However, the results from all regressions imply no effect, as none of the coefficients of the binary variables at neither portfolio nor stock-level are significantly different from zero. The reason why the results do not align with the result from the rank test can be explained by the relative power of the regression models, as the regression models are not particularly strong in detecting effects. With insignificant results from the portfolio regression, the size of the significant change from the rank test cannot be concluded. In addition, with no significant results from neither the CAR nor the firm specific regression, no conclusions regarding the hypothesis H_{2a} can be made.

The rank test is the only test with evidence for an investor reaction in the event window. Although arguments are given for why the rank test is solid evidence, there is always a risk of falsely rejecting the null hypothesis in statistical tests. If the rank test for some reason falsely rejects $H_{0a,}$ the indication is that investors did not react on the announcement of the lending restriction, which is supported by all of the other test. A false rejection would imply that investors in reality did not react to the announcement of an LTV cap. If investors did not react to the LTV cap. If this is true, one explanation could be that investors did not know how to assess how the restriction would impact profit and risk of the banks. The LTV cap was the first implemented mortgage loan restriction in multiple years. The restriction of the LTV cap is formulated as a "general advice", implying that mortgage lending firms are given flexibility in determining how they will reach the goal of 85% LTV. The formulation of the rule could possibly be perceived as diffuse among investors. As a result, a general advice may complicate investors' assessment of the restriction's impact on bank profit and risk, as it is unclear exactly in what way each firm will reach the goal, and thereby unclear how profit and risk will become affected.

In summary, while the CAR shows no evidence of investor reaction, the rank test rejects the null hypothesis H_{0a} and implies that banks are positively affected by the LTV cap. The regression

results align with the CAR, that no investor reaction occurred by the announcement of the LTV cap. In result, no conclusions regarding H_{2a} can be made.

5.3 Event 2

Event 2 represent the announcement of the amortisation requirement on mortgage loans, in 2014. Below follows a presentation of the test results from this event.

5.3.1 Cumulative abnormal returns event 2

Table 15
Cumulative abnormal returns event 2
The table contains cumulative abnormal returns with t-statistics per firm

Event window	No. Days	SEB A		SEB C		Nordea		Swedbank		SHB A		SHB B	
		CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
$\tau_{-1} - \tau_{+2}$	4	-1.75%	-1.23	-1.97%	-1.20	-2.04%	-1.43	-2.15%	-1.53	-0.49%	-0.39	-0.49%	-0.38
$\tau_{-1} - \tau_{+1}$	3	-2.49%	-2.03**	-1.62%	-1.14	-1.58%	-1.28	-1.65%	-1.36	-1.30%	-1.20	-1.30%	-1.15
$\tau_{-1} - \tau_{0}$	2	-2.28%	-2.28**	-1.84%	-1.59	0.01%	0.01	-1.46%	-1.47	-0.93%	-1.06	-0.93%	-1.01
$\tau_{0} - \tau_{+1}$	2	-1.29%	-1.29	-0.70%	-0.60	-1.83%	-1.81*	-1.16%	-1.17	-1.08%	-1.22	-1.08%	-1.17

, **, * represent significance levels of 10%, 5% and 1%*

SEB A

The CAR for SEB A is negative in all event windows, implying that the amortisation requirement will have a negative impact on the profit and risk of the banks. With a three-day event window, the t-statistic is -2.03, and therefore the CAR is significantly different from zero at a 5% level of confidence. In this window, the CAR is -2.49%. In addition, the two-day event window starting from a day τ_{-1} has a t-statistic of -2.28 and is also significant at a 5% level of confidence. In this window the CAR is -2.28%. The other two event windows have insignificant results. Put together, the results imply that the abnormal returns occurred in the days τ_{-1} and τ_0. With significant results there is statistical evidence supporting a negative impact of the amortisation requirement on the profit and risk of SEB.

SEB C
Similar to the results of SEB A, the CAR is consistently negative, indicating that the amortisation requirement has a negative impact on the firm's profit and risk. However, in contrast to the results for SEB A, none of the results for SEB C are significant. No conclusions can therefore be drawn based on the result from the CAR of SEB C.

Nordea
The CAR for Nordea is negative in all event windows apart from the two-day event window starting from day τ_{-1}, where the return is close to zero. The negative results in the other windows imply that the amortisation requirement is negative for the profit and risk of Nordea. The t-statistic for the two-day event window starting from day τ_0 is -1.81 and therefore significant at a 10% level of confidence. The CAR in this window is -1.83%. The significant result imply that the market reacted negatively on the day of the announcement and the day before. Furthermore, the other event windows insignificant results.

Swedbank
The CAR for Swedbank is negative in all event windows. The negative movements in the stock price implies that the amortisation requirement has negative impact on the profit and risk of Swedbank. However, since the results are not statistically significant, no conclusions can be drawn.

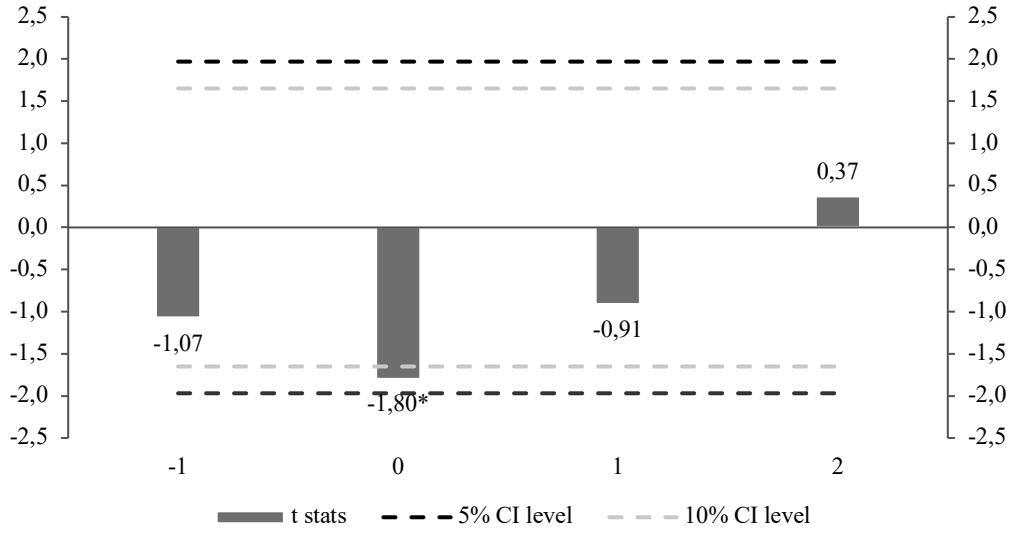
SHB A
The CAR for SHB A is negative in all event windows, indicating that the amortisation requirement is negative for the profit and risk of SHB. The results are not statistically significant, and therefore, no conclusions can be made regarding the negative CAR.

SHB B
Similar to the results of SHB A and almost all of the other firms, the CAR is negative for all different event windows. The results therefore indicate a negative impact of the amortisation requirement on the profit and risk of SHB. However, in line with the results for SHB A, the results are insignificant for all different lengths of the event windows, and thus no conclusions can be made.

5.3.2 Rank test event 2

The second test on event 2 is the rank test. The test generates t-statistics for each day in the event window for the returns of a portfolio of all stocks.

Figure 10
Rank test event 2
The figure contains t-statistics generated by the rank test based on a portfolio of all firms



**, ** represent significance levels of 10%, and 5%*

The rank test generates t-statistic of -1.07 in day τ_{-1} of the event window. The negative sign of the coefficient indicates that the profit and risk of the mortgage lending firms will be negatively affected by the amortisation requirement. However, as the result is insignificant, no conclusion about the return of this day can be made. The result for day τ_0 generates t-statistic of -1.80, which is significant at a 10% level of confidence. The result indicates that the return was lower than usual on the day of the announcement of the amortisation requirement. The implication of the significant result is therefore that the profit and risk of the mortgage lending firms are negatively affected by the amortisation requirement. Furthermore, the t-statistic of day τ_{+1} implies, in line with previous result, that the returns were lower than normal. On the contrary, the t-statistic of day τ_{+2} is positive, implying higher returns than normal. However, since none of the two last-mentioned days have significant statistics, no conclusions about abnormal returns can be made for day τ_{+1} and τ_{+2}.

5.3.3 Portfolio regression event 2

Table 16
Portfolio regression event 2
The table contains output from the regression on the portfolio

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	2.4E-04	0.0003	0.7717	0.4410
Large cap index	1.0476	0.0386	27.1389***	0.0000
τ_{-1}	-0.0042	0.0050	-0.8467	0.3980
τ_{0}	-0.0079	0.0050	-1.5787	0.1157
τ_{+1}	-0.0040	0.0050	-0.7909	0.4298
τ_{+2}	0.0016	0.0050	0.3233	0.7467
Adj. R-squared	0.7464			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The coefficient on the large cap index is significant with a p-value approximately 0. The interpretation is that the market returns are highly significant in explaining the returns of the equally weighted portfolio of stocks. The results indicate that with a 1% move in the index, the portfolio return move with 1.05%, suggesting that the portfolio risk is similar to the market risk. The coefficients of the binary variables are insignificant. The coefficient of the binary variable for day τ_0 with t-statistic of -1.58 and a p-value of 0.12 suggests that the amortisation requirement has a lowering effect on returns. However, as the coefficient is still insignificant the relationship is still not proven. The coefficient for this day implies that the return was 0.79% lower than usual. The almost significant variable is notable because it concerns the same day in the event window as the one that is significant in the rank test.

5.3.4 Stock-specific regressions results event 2

Table 17
SEB A regression event 2
The table contains output from the regression on SEB A

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	2.6E-04	0.0004	0.5735	0.5668
Large cap index	1.1095	0.0547	20.2678***	0.0000
τ_{-1}	-0.0120	0.0071	-1.6857*	0.0931
τ_{0}	-0.0109	0.0071	-1.5343	0.1262
τ_{+1}	-0.0020	0.0071	-0.2877	0.7738
τ_{+2}	0.0074	0.0071	1.0464	0.2964
Adj. R-squared	0.6220			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The result implies that a 1% move in the index result in a 1.11% move in the returns for SEB A. The binary variable for the day τ_{-1} is significant at a 10% level of confidence with a p-value of 0.09. The result imply that the return was 1.20% lower than normal. This is evidence that the returns on SEB A were lower than normal due to the amortisation requirement. Furthermore, the coefficient on day τ_0 has a p-value of 0.13 which is close to being significant on a 10% level. The coefficient for this day implies that the returns were 1.1% lower in the day. The result for day τ_0 resembles the results from the portfolio regression and represent the day with significant results in the rank test. SEB has the second lowest mortgage loans-to-total assets ratio as can be seen in figure 7. SEB is more affected by the amortisation requirement than Swedbank and SHB that have higher mortgage lending to total asset ratios.

Table 18
SEB C regression event 2
The table contains output from the regression on SEB C

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	4.2E-04	0.0005	0.8110	0.4181
Large cap index	1.0388	0.0635	16.3599***	0.0000
τ_{-1}	-0.0092	0.0082	-1.1182	0.2646
τ_{0}	-0.0092	0.0082	-1.1229	0.2626
τ_{+1}	0.0023	0.0082	0.2763	0.7825
τ_{+2}	-0.0035	0.0082	-0.4263	0.6703
Adj. R-squared	0.5113			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The result indicates that with a 1% move in the index, the stock will move 1.04%. All of the binary variables are insignificant. The effect measured in SEB A cannot be found in SEB C, therefore there lacks evidence on the amortisation requirement affecting returns of SEB C. One explanation for the lower t-statistics in SEB C compared to in SEB A is that SEB C has higher standard errors, which is a consequence of the lower predictive power of the model.

Table 19
Nordea regression event 2
The table contains output from the regression on Nordea

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	-7.4E-05	0.0005	-0.1639	0.8699
Large cap index	1.2188	0.0552	22.0883***	0.0000
τ_{-1}	0.0025	0.0071	0.3502	0.7265
τ_{0}	-0.0024	0.0071	-0.3351	0.7379
τ_{+1}	-0.0159	0.0072	-2.2148**	0.0277
τ_{+2}	-0.0046	0.0072	-0.6448	0.5197
Adj. R-squared	0.6643			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The result indicates that a 1% change in the index will result in a 1.22% change in the stock return, which implies that Nordea has higher risk than the market. The coefficient for day τ_{+1} has a p-value of 0.03 and is therefore significant at a 5% level of confidence. The results imply that on day

τ_{+1}, the stock return was –1.59% lower than normal. This implies that the amortisation requirement had a small, negative impact on the firm. Nordea has the lowest Swedish mortgage loans-to-total assets ratio as can be seen in figure 7. Nordea seems to be the firm that is affected the most by the amortisation requirement.

Table 20
Swedbank regression event 2
The table contains output from the regression on Swedbank

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	1.7E-04	0.0004	0.3878	0.6985
Large cap index	1.0119	0.0544	18.5920***	0.0000
τ_{-1}	-0.0049	0.0071	-0.6998	0.4847
τ_{0}	-0.0096	0.0071	-1.3671	0.1728
τ_{+1}	-0.0020	0.0071	-0.2778	0.7814
τ_{+2}	-0.0050	0.0071	-0.7063	0.4807
Adj. R-squared	0.5766			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The results indicate that with a 1% increase in the index return, the return for Swedbank will increase with 1.01%, indicating that the risk in Swedbank has decreased compared to the first event. None of the binary variables are significant and thus no effect of the amortisation requirement can be concluded.

Table 21
SHB A regression event 2
The table contains output from the regression on SHB A

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	3.3E-04	0.0004	0.8407	0.4013
Large cap index	0.9596	0.0483	19.8707***	0.0000
τ_{-1}	-0.0022	0.0063	-0.3516	0.7254
τ_{0}	-0.0071	0.0063	-1.1399	0.2554
τ_{+1}	-0.0036	0.0063	-0.5801	0.5624
τ_{+2}	0.0081	0.0063	1.2850	0.2000
Adj. R-squared	0.6132			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The $\beta_{SHB\ A}$ has decreased compared to the first event and the results imply that with a 1% increase in the index, the stock return will increase with 0.96%. The binary variables are insignificant and therefore no evidence is found for the amortisation requirement to have an impact on SHB A.

Table 22
SHB B regression event 2
The table contains output from the regression on SHB B

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	3.5E-04	0.0004	0.8557	0.3930
Large cap index	0.9472	0.0505	18.769***	0.0000
τ_{-1}	0.0004	0.0065	0.0577	0.9540
τ_{0}	-0.0081	0.0065	-1.2370	0.2172
τ_{+1}	-0.0026	0.0066	-0.3891	0.6975
τ_{+2}	0.0073	0.0065	1.1223	0.2628
Adj. R-squared	0.5852			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The results imply that a 1% increase in the index, the return for SHB B will increase with 0.95%. The results are similar to that of SHB A, which means both SHB securities have lower risk than the market. The coefficients for SHB B are very close to SHB A which is not surprising as the returns are highly correlated between the two stocks. This is expected as the underlying assets are identical for SHB A and SHB B. In addition, just like for SHB A, the binary variables for SHB B are insignificant. Therefore, none of the SHB securities show any evidence of being affected by the amortisation requirement.

5.3.5 Analysis event 2

In summary, some of the results shows evidence of abnormal returns in the event window. SEB A and Nordea are the only stocks with CAR that are significantly different from zero. For SEB A, the event windows of three days and two days, starting from day τ_{-1}, are both significant at a 5% level with cumulated abnormal returns of -2.49% respective -2.28%. The two-day event window covering the period from τ_0 - τ_1 has insignificant result, intuitively, the above presented significant abnormal returns must have been occurring in the days τ_{-1}- τ_0. Moreover, for Nordea, the CAR of -1.83% during the period τ_0 - τ_{+1} is significant at a 10% level of confidence. The significant results for the CAR imply, in line with the efficient market hypothesis, that the information

regarding the amortisation requirement has been incorporated in the stock price relatively quickly. By solely looking at the CAR, H_{0b} can be rejected as proof for H_{1b} is given by some stocks.

The remaining stocks have negative CAR, but which are insignificant. Seeing that SEB and Nordea both have significantly lower mortgage loans-to-total asset ratios than Swedbank and SHB, the results from the CAR are particularly interesting. The two firms showing evidence of being significantly affected by the amortisation requirement are the two banks with the lowest share of Swedish mortgage loans-to-total assets ratios[18]. This result therefore contradicts H_{2b}, the hypothesis of regulation having more effect on mortgage firms with relatively more mortgage loans.

At a 10% level of confidence, the rank test has significant result in day τ_0 implying negative abnormal returns. The result supports the notion of efficient markets as τ_0 is the only day with significance. If markets are efficient and there is no information leakage, the effect should be shown in day τ_0. The rank test includes all stocks of the sample, the result therefore indicates that the bank industry itself was affected by the announcement of an amortisation requirement. The negative sign of the rank test indicates that investors value the amortisation requirement as negative for the banks. The results from the rank test supports a rejection of the null hypothesis $H_{0b,}$ indicating that H_{1b} is true.

Since no other stock-specific nor industry-specific event has been identified over the event widow, the amortisation requirement seems to be the sole event affecting the bank sector during the event days. This supports the claim that the abnormal returns are related to the announcement of the amortisation requirement.

The regression on the equally weighted portfolio does not generate any significant result for the binary variables. However, the coefficient for day τ_0 is close to being significant with a p-value of 0.12 and implies a small, negative change in returns. The day τ_0 is shown by the standard event study to contain negative abnormal returns. Since the regression model suffers from low power, a

[18] Figure 7

p-value of 0.12 is interesting as support for abnormal returns is given from other tests. However, no conclusions regarding the size of the coefficient will be drawn based on an insignificant result.

Similarly, the coefficient for day τ_0 in the regression on SEB A is almost significant with a p-value of 0.12. In this regression, the coefficient also implies a small, negative change in the returns. The coefficient for day τ_{-1} in the regression for SEB A is significant and imply a small negative change in returns, more precisely, -1.2%. The firm specific regression thereby complements the standard event study with a magnitude of the change in SEB A in day τ_{-1}. Interestingly, the SEB C does not show any evidence of being affected by the amortisation requirement, even though the underlying assets are identical with SEB A. Moreover, in the stock-specific regression for Nordea, the coefficient on day τ_{+1} is highly significant indicating a small negative change in returns of -1.59%. The two most affected stocks are representing the firms with the lowest total mortgage lending to asset ratios, indicating that lower exposure to Swedish mortgage loans have a higher impact on the stock. The reason why the significant results shows a small change does not necessarily mean that the restriction will have little effect on the banks. However, as the expected changes related to decreased levels of debt are in the far future, the effects must be heavily discounted. Hyperbolic discounting suggest that the discount factor flattens out over time. The reason why investors actually do seem to react on the event, despite expected changes being far ahead, could therefore be explained by hyperbolic discounting.

With the standard event study, the H_{0b} is rejected at a 10% level with proof from both parametric and non-parametric test of the standard event study, implying H_{1b} is true. However, with the evidence, the hypothesis H_{2b} cannot be rejected as the results suggest the opposite relationship. Looking at the results from the regression, multiple evidence indicates negative abnormal returns in the event window. The evidence from the regressions indicates that the amortisation requirement did have an impact on abnormal returns. From the event study-based regression models, clues are given that the size of the abnormal returns are quite small.

While the findings from the LTV cap announcement partly indicate a positive reaction among investors, the significant results from the test on the announcement of the amortisation requirement shows the opposite. Given that the amortisation requirement will in long term lead to lower levels of mortgage debt, investors seem to value the decrease in risk less than the forgone interest income.

The FSA predicted that the lending growth would decline following the amortisation requirement (Swedish FSA, 2015). Comparisons of the result with literature finds support for short-term negative reactions upon lending regulation resulting in stagnated credit growth. According to Jung & Park (2017), the implementation of regulation on DTI and LTV in Korea led to a negative reaction, which also is found in this study. Lower interest income due to declined credit growth as well as lower collaterals in mortgage loans upon house price declines explained the negative results in Korea. The Korean results resembles the situation in Sweden as the FSA also predicted that one effect of the amortisation requirement would be lower prices in the housing market (Swedish FSA, 2015). An explanation for the negative abnormal returns could therefore be related to investors' predictions of the regulation's effects on the housing market. With the amortisation requirement, liquidity constrained individuals will not be able to take on as large mortgages as without the restriction. An intuitive impact on the housing market is therefore that the prices will decrease. Koetter & Poghosyan (2010) describes two contrasting effects of fluctuations in the housing market on bank risk. Applying the effects in this scenario, decreased housing prices implies that the net worth of current home owners decrease as well as the value of the collateral for the banks, increasing the likelihood of credit defaults. On the other hand, with individuals taking on lower mortgage loans following the amortisation requirement, the new loans will be less risky. With result in hand, investors seem to be more concerned about the first-mentioned effect of decreased house prices. One explanation for this may be that the effect of less risky loans following the amortisation requirement only applies on new loans. In contrast, the increased risk of credit defaults applies mainly on the current outstanding loans. Investors may therefore consider the increased risk of credit defaults of current outstanding loans to have more impact on the profit and risk of the banks, as they make up for a much larger share of the loans. Put together, fear of a house price decline may serve as an explanation for the negative reactions, as such decline will affect the quality of the banks' assets negatively.

5.4 Event 3

Event 3 represent the announcement of the extended amortisation requirement on mortgage loans in 2017. Below follows a presentation of the test results from this event.

5.4.1 Cumulative abnormal returns event 3

Table 23
Cumulative abnormal returns event 3
The table contains cumulative abnormal returns with t-statistics per firm

Event window	No. Days	SEB A		SEB C		Nordea		Swedbank		SHB A		SHB B	
		CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
$\tau_{-1} - \tau_{+2}$	4	-2.30%	-1.67*	-2.29%	-1.43	-3.59%	-1.86*	-0.20%	-0.14	-2.38%	-1.50	-2.54%	-1.47
$\tau_{-1} - \tau_{+1}$	3	-1.73%	-1.44	-1.25%	-0.91	-2.28%	-1.36	0.47%	0.39	-1.53%	-1.12	-1.82%	-1.21
$\tau_{-1} - \tau_{0}$	2	-1.10%	-1.13	-0.40%	-0.36	-1.83%	-1.34	1.44%	1.46	-0.60%	-0.54	-1.28%	-1.05
$\tau_{0} - \tau_{+1}$	2	-1.14%	-1.16	-0.91%	-0.80	-1.85%	-1.36	-1.29%	-1.30	-0.99%	-0.88	-0.94%	-0.76

, **, * represent significance levels of 10%, 5% and 1%*

SEB A

The CAR for SEB A is negative in all event windows, implying that the extended amortisation requirement has a negative impact on the profit and risk of SEB. With a four-day event window, the t-statistic is -1.67, therefore, the CAR of -2.30% is significant at a 10% level of confidence. On the contrary, the results of the other event windows are insignificant. However, with one significant result, there is statistical evidence that the returns of SEB A were lower than normal around the announcement of the extended amortisation requirement.

SEB C

In line with SEB A, the CAR for SEB C is negative in all event windows. The negative abnormal returns imply that the extended amortisation requirement will be harmful for the profit and risk of SEB. In contrast to the result of SEB A, the four-day event window does not have significant results. Furthermore, none of the other event windows have significant results. As a result, no conclusions can be made based on CAR of SEB C.

Nordea

The CAR of Nordea is negative in all event windows, indicating that the extended amortisation requirement is negative for the profit and risk of the firm. The CAR for Nordea in an event window of four days has t-statistics of -1.86. Similarly to SEB A, the result in this window is significant at

a 10% level of confidence. For Nordea, the CAR measures to -3.59%, implying that the firm exhibited negative abnormal returns around the days of the announcement. Furthermore, the other event windows of shorter length have all insignificant results.

Swedbank

The CAR for Swedbank is negative in the four-day event window and in the two-day event window with start in day τ_0. On the contrary, in the other event widows, the CAR is positive. With none of the results being statistically significant, no evidence is found on abnormal returns. For Swedbank, it seems to be no impact of the extended amortisation requirement.

SHB A

The CAR of SHB A is negative in all event windows, indicating that the extended amortisation requirement is negative for the profit and risk of SHB. However, since none of the results are statistically significant, no conclusions can be made.

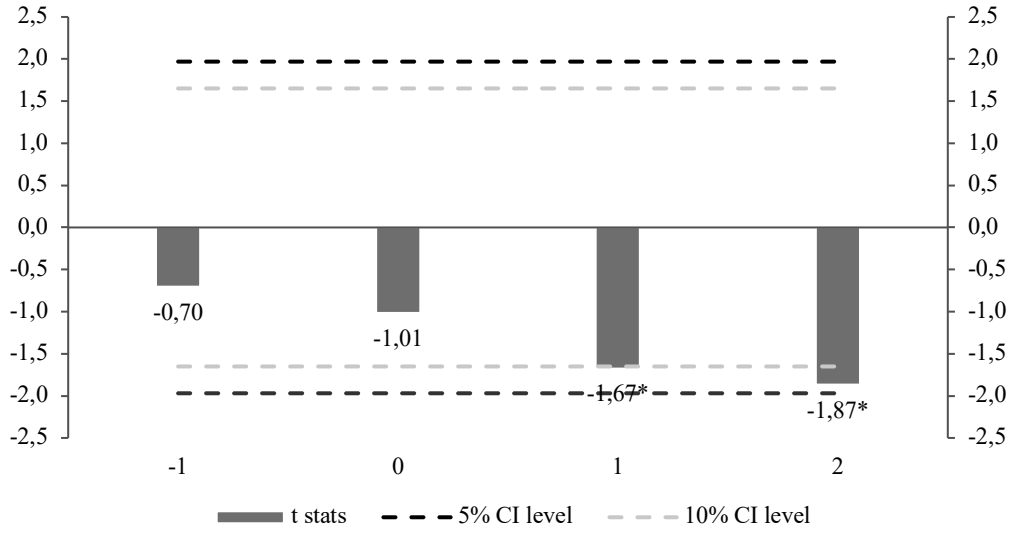
SHB B

The CAR for SHB B is, similarly to SHB A, negative in all event windows. In result, the implication is that the extended amortisation requirement is negative for the profit and risk of SHB. However, since none of the results are statistically significant, no solid evidence of such an impact is given from the test.

5.4.2 Rank test event 3

The second test on event 3 is the rank test. The test generates t-statistics for each day in the event window for the returns of a portfolio of all stocks.

Figure 11
Rank test event 3
The figure contains t-statistics generated by the rank test based on a portfolio of all firms



**, ** represent significance levels of 10%, and 5%*

The t-statistics from the rank test is consistently negative, indicating that the returns were lower than normal in the event window, which is illustrated in figure 11. The test generates t-statistic of -0.70 for day τ_{-1}, which is not significant. Further, on day τ_0, the t-statistic is -1.01 and therefore also insignificant. In result, no conclusions regarding abnormal returns during the days τ_{-1} and τ_0 can be made. Moreover, in day τ_{+1}, the result has t-statistic of -1.67, which is significant at a 10% level. In addition, day τ_{+2} has t-statistic of -1.87 which is also significant at a 10% level. According to the results, the mortgage lending firms exhibited negative abnormal returns during day τ_{+1} and day τ_{+2}. The result thereby imply that the extended amortisation requirement has negative impact on the profit and risk of mortgage lending firms.

5.4.3 Portfolio regression event 3

Table 24
Portfolio regression event 3
The table contains output from the regression on the portfolio

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	1.5E-04	0.0004	0.4212	0.6740
Large cap index	1.0727	0.0378	28.3421***	0.0000
τ_{-1}	-0.0017	0.0056	-0.3091	0.7575
τ_{0}	-0.0046	0.0056	-0.8219	0.4119
τ_{+1}	-0.0073	0.0056	-1.3077	0.1922
τ_{+2}	-0.0086	0.0056	-1.5430	0.1241
Adj. R-squared	0.7600			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The output from the portfolio regression shows a significant coefficient for the large cap index with a p-value of approximately zero. This shows that the market returns are highly significant in explaining the returns of the equally weighted portfolio of stocks. The result implies that a 1% change in the index will lead to a 1.07% change in the portfolio return, almost identical to the **β** in the regression for event 2. The binary variables for day τ_{-1}, τ_0, and τ_{+1} have high, insignificant p-values of 0.76, 0.41 and 0.19. The coefficient of day τ_{+2} of -0.8% suggests that the extended amortisation requirement has a negative impact on the profit and risk of the banks. The p-value of 0.12 is almost significant. This is notable because the day generated a significant result in the rank test.

5.4.4 Stock-specific regression event 3

Table 25
SEB A regression event 3
The table contains output from the regression on SEB A

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	3.5E-04	0.0004	0.7993	0.4249
Large cap index	1.1923	0.0471	25.3111***	0.0000
τ_{-1}	-0.0059	0.0069	-0.8498	0.3962
τ_{0}	-0.0051	0.0069	-0.7432	0.4581
τ_{+1}	-0.0062	0.0069	-0.8993	0.3694
τ_{+2}	-0.0058	0.0069	-0.8306	0.4070
Adj. R-squared	0.7157			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The results imply that with a 1% change in the index, the return of the stock will change with 1.19% which is a small increase in implied risk. A surprising fact is that SEB A has a higher returns correlation[19] with Nordea and Swedbank than with SEB C in this period. This suggests that the returns of SEB A are less related to the returns of SEB C than to the returns of other firms. Moreover, the binary variables are insignificant. Unlike the first amortisation requirement, the results give no evidence of the extended amortisation requirement to affect SEB A.

Table 26
SEB C regression event 3
The table contains output from the regression on SEB C

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	5.2E-04	0.0005	1.0211	0.3082
Large cap index	0.8971	0.0544	16.4811***	0.0000
τ_{-1}	-0.0035	0.0080	-0.4359	0.6633
τ_{0}	-0.0006	0.0080	-0.0692	0.9449
τ_{+1}	-0.0085	0.0080	-1.0629	0.2889
τ_{+2}	-0.0103	0.0080	-1.2912	0.1978
Adj. R-squared	0.5146			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

[19] Appendix 8

The result implies that with a 1% move in the index, the stock return will move with 0.90%, implying that SEB C has lower risk than the market. SEB C has lower **β** and implied risk than SEB A in all three events. The coefficients of the binary variables are all insignificant. The result gives no evidence that the extended amortisation requirement has an effect on SEB C.

Table 27
Nordea regression event 3
The table contains output from the regression on Nordea

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	7.2E-04	0.0006	1.1712	0.2426
Large cap index	1.1407	0.0658	17.3427***	0.0000
τ_{-1}	-0.0043	0.0097	-0.4409	0.6597
τ_{0}	-0.0140	0.0097	-1.4505	0.1482
τ_{+1}	-0.0045	0.0097	-0.4652	0.6422
τ_{+2}	-0.0131	0.0097	-1.3504	0.1781
Adj. R-squared	0.5418			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The results imply that with a 1% change in the index, the returns of Nordea will change with 1.14%. Through all three events Nordea returns are explained by the market returns and consistently shows higher **β** than the market. Further, the binary variables are insignificant. In this third event, unlike the second event, no evidence is found that Nordea is affected by the announced policy.

Table 28
Swedbank regression event 3
The table contains output from the regression on Swedbank

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	-2.2E-04	0.0004	-0.5023	0.6159
Large cap index	1.1027	0.0478	23.0799***	0.0000
τ_{-1}	0.0176	0.0070	2.5034**	0.0129
τ_{0}	-0.0031	0.0070	-0.4484	0.6542
τ_{+1}	-0.0097	0.0070	-1.3843	0.1675
τ_{+2}	-0.0067	0.0070	-0.9530	0.3415
Adj. R-squared	0.6809			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The result implies that a 1% change in the index will result in a 1.10% change in the stock return of Swedbank. The market returns effect on Swedbank is therefore still valid, although different across the three events. The binary variable for day τ_{-1} is significant at a 5% level of confidence with a p-value of 0.01. The coefficient is positive, implying that day τ_{-1} the return increased with additionally 1.76% than on other days. Therefore, the result indicates that the event had a positive impact on the stock return. The evidence indicates that extended amortisation requirement affected Swedbank differently than the other stocks. Swedbank is the only stock that reacted positively by the policy change. Swedbank has the highest mortgage loans-to-total assets ratio as can be seen in figure 7. The result shows that Swedbank is affected most by the extended amortisation requirement, more than the rest of the banks that have lower mortgage loans-to-total assets ratios.

Table 29
SHB A regression event 3
The table contains output from the regression on SHB A

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	-2.5E-04	0.0005	-0.4997	0.6178
Large cap index	1.1943	0.0541	22.0825***	0.0000
τ_{-1}	-0.0054	0.0080	-0.6826	0.4955
τ_{0}	-0.0006	0.0080	-0.0769	0.9388
τ_{+1}	-0.0093	0.0080	-1.1700	0.2431
τ_{+2}	-0.0084	0.0080	-1.0623	0.2891
Adj. R-squared	0.6566			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The result implies that with a 1% change in the index return, the stock will change with 1.19%. The increased **β** shows that risk in SHB A is higher than in the previous two events. The binary variables are insignificant and no effect from the policy announcement can be found for SHB A.

Table 30
SHB B regression event 3
The table contains output from the regression on SHB B

Variable	*Coefficient*	*SE*	*t-stat*	*p-value*
Intercept	-2.2E-04	0.0005	-0.4002	0.6894
Large cap index	0.9091	0.0590	15.4200***	0.0000
τ_{-1}	-0.0088	0.0087	-1.0201	0.3087
τ_{0}	-0.0040	0.0087	-0.4559	0.6488
τ_{+1}	-0.0054	0.0087	-0.6231	0.5338
τ_{+2}	-0.0072	0.0087	-0.8342	0.4049
Adj. R-squared	0.4803			
No. Of observations	254			

, **, * represent significance levels of 10%, 5% and 1%*

The results imply that with a 1% change in the index, the stock will change with 0.91%. The change in the stock of SHB B, followed by a change in the index, is lower compared to that of SHB A and implied risk in SHB B is lower than in SHB A. This is further evidenced by a lower correlation[20] between SHB A and SHB B in this event compared to previous events. Similarly to the result of SHB A, all the binary variables are insignificant. None of the SHB stocks show any evidence on being affected by the extended amortisation requirement.

5.4.5 Analysis event 3

In summary, some of the test results for event 3 point in the same direction. With a four-day event window, the CAR is significantly different from zero for SEB A and Nordea. The CAR for both firms is negative of -2.30% respective -3.59%. The results support a rejection of H_{0c}.

In accordance with the results from the CAR of the first amortisation requirement, SEB A and Nordea are the only stocks with significant results. As described in the foregoing event result, these two stocks belong to the firms with the lowest mortgage loans-to-total assets ratio[21]. Again, the findings contradict the prediction that firms with relatively more mortgage loans would be affected more. The results from the CAR do not support H_{2c}.

[20] Appendix 8
[21] Figure 7

A rejection of H_{0c} is also supported with the results from the rank test implying that the returns were significantly and negatively different from zero in day τ_{+1} and τ_{+2} of the event window. The abovementioned findings from the rank test are significant on a 10% level of confidence, but not on a 5% level. The findings are assumed to be related to the announcement of the extended amortisation requirement, as no other stock-specific or industry-specific event has been identified over the event window.

The regression on the returns of an equally weighted portfolio of the sample firms have insignificant binary variables. However, the coefficient of the binary variable for day τ_{+2} is closest to being significant on a 10% level with a p-value of 0.12. The coefficient implies a small change in the returns and similar to the other results, the change in return is negative. Since the regression model is known for being weak in detecting effects, the result is still interesting as day τ_{+2} has significant result in the rank test. However, with an insignificant result, no conclusions can be made regarding the magnitude of the effect. In addition, with insignificant results from the portfolio regressions of both the first amortisation requirement and the extended amortisation requirement, no support regarding H_{3c} can be found.

The results so far suggest that investors reacted more slowly than what they did with the introduction of the first amortisation requirement. Opposing the efficient market hypothesis, the market reaction did not occur immediately after the news were announced. One theory explaining slow investor reactions is conservatism bias, implying that investors gradually updated their beliefs about news of the extended amortisation requirement in the two days following the announcement.

Similar to the findings from the standard event study of the first amortisation requirement, the test results indicate negative abnormal returns. This aligns with the findings of Jung & Park (2017), who proved negative returns of mortgage lending firms following lending restriction announcement in Korea. Parallels of the conclusions found by Jung & Park (2017) can be made with the findings of this event, as both studies concern restrictions related to the DTI of borrowers.

Moreover, this event is an extension of a previously implemented regulation. The FSA concluded that the extended amortisation requirement was expected to have similar but smaller effects on mortgage loans compared to the first amortisation requirement, as described in section 1.5. The

result support the notion of similar effects for two reasons. First, because the CAR is significant for the same firms in the two different events, and second, because the results for the two event both point at negative reactions. Another view of an extension of an already existing regulation is that investors could use the implementation of the first amortisation requirement as a benchmark when evaluating the effects of the extended amortisation requirement. Following the implementation of the first amortisation requirement, it is possible that investors and other stakeholders of mortgage lending firms gradually learnt what the regulation would mean for the profit and risk of the firm. By the announcement of the extended amortisation requirement, lessons learnt from the first amortisation requirement could have helped investors in assessing the effect of the restriction on the profit and risk of the banks. This would go in line with the theory of representativeness heuristics. On the other hand, seeing that investors reacted slower to the extended requirement, representativeness heuristics seem less likely. Seeing that, the opposite of representativeness bias, namely conservatism bias, seems more reasonable to be present.

Going further, in the stock-specific regressions, evidence partly contradict the abovementioned findings. SEB A and SEB C has a large discrepancy in the **β** of market returns, implying large differences in risk, even though underlying assets are identical. In the stock-specific regression for Swedbank, the coefficient for day τ_{-1} is significantly different from zero at a 5% level of confidence. This result concerns another day in the event window than what the significant results from the other tests do. In addition, the significant coefficient for Swedbank indicates a small increase in the returns. The evidence for Swedbank could suggest that high mortgage loans-to-total assets are correlated with positive abnormal returns at the announcement of the extended amortisation requirement. By solely looking at the result from the firm specific regression models, support for H_{2c} is given. Given that the significant result is related to the announcement of the amortisation requirement, information leakage must have occurred. The effects of the restriction followed decreased levels of mortgage loans will most likely occur in the far future. The observed effect of Swedbank is small, however, as described in previous analysis, the reason why an effect is observed at all could be explained by hyperbolic discounting.

In summary, results from the standard event study that supports a rejection of the null hypothesis H_{0c}, implying that H_{1c} is true. However, the CAR provides no evidence for the hypothesis H_{2c}. On

the other hand, the stock-specific regression on Swedbank provides support for the hypothesis H_{2c} to be true. In result, with contradicting evidence, the hypothesis H_{2c} is inconclusive. In addition, no conclusions regarding H_{3c} can be made. Apart from the significant result from the firm specific regression on Swedbank, the results show a negative reaction. This goes in line with the findings from the announcement of the first amortisation requirement. Given that the restrictions will result in lower levels of mortgage loans, the results imply that investors value the decreased level of risk less than the forgone interest income.

6. Discussion

The three restrictions studied in this paper are borrower-based policies. The implication behind such policy is that they only impact mortgage lending firms indirectly. The fact that the restriction will result in decreased mortgage levels in the country seem to be a general accepted notion as support is given from multiple of previous research along with statements from the FSA. However, the fact that the restrictions only impacts mortgage lending firms indirectly makes the effect interesting to study, as it is unclear exactly what the outcome will be. The results from each event are analysed in chapter 5 above. In this section, reflections over the three events together are presented. Below follows a discussion over reflections of the three different events put together.

LTV cap versus amortisation restriction

The three different macroprudential policies were implemented to slow down the growth in household indebtedness (Swedish FSA 2016 & Hull 2017). In section 1.5, the implied intention for each restriction is described. The purpose of the restrictions is similar in terms of decreasing household indebtedness. Given that the overall intention of the three restrictions is to decrease debt, a reasonable outcome of this study is that the investor reactions resembles one another across the three different announcements. The results show that the reaction of the extended amortisation requirement is similar to that of the first amortisation requirement. However, the same does not apply for the LTV cap. While investors reacted negatively on the two macroprudential policies related to amortisation, the reaction of the LTV cap was positive. The result of this paper therefore points at the LTV cap affecting banks differently than what the amortisation requirements do.

In reports following the announcement of the restrictions, the FSA has mentioned each restriction to somehow have a negative impact on housing prices. Investor reactions' may also be connected

to a fear of decreased housing prices. Assuming that investors expect house prices to be affected negatively by the restrictions, an explanation to why investors display a positive reaction to LTV cap and negative reactions to amortisation requirements could relate to the risk level in mortgage loans after each regulation. If one assumes that house prices exhibits equally large declines following both LTV caps and amortisation requirements, the prior regulation type can be assumed to possess higher downside protection for the banks. When a mortgage loan is issued with a lower LTV ratio, the risk of default for an individual mortgage taker decline. More importantly, a lower LTV ratio will decrease the risk for the bank to obtain ownership of a collateral with a lower value than the original loan. For the amortisation requirement the bank can exempt the borrower from amortisation repayments if a mortgage borrower is in distress, which decreases default risk. However, an amortisation requirement takes much longer to repay until the LTV ratio is as low as with an LTV cap. In result, the LTV cap creates a larger buffer immediately, while it takes many years to create a buffer with amortisation payments. If a subsequent amortisation requirement has a similar house price decline, it is less likely to be viewed as positive since the buffer of mortgage loan borrowers will only increase over a long period of time.

Another reason for why the investor reaction of the LTV cap is not proven to be negative, as in the announcement of the amortisation requirement, could be because the restriction did not imply considerably large changes for banks. Prior to the LTV cap, mortgage lending firms were autonomous in credit approval processes. Looking at the LTV ratios prior to the implementation of the restriction, the share of mortgages with LTV ratios higher than 80% was relatively small (Swedish FSA, 2009). The statistics over the situation prior to the restriction gives clues that most mortgage loans would have the same characteristics in terms of LTV ratios if banks continued with full authority in the credit approval processes. In comparison, prior to the amortisation requirement, most mortgage loans were interest-only mortgages (Hull, 2017). The implementation of amortisation requirement therefore implicated relatively larger changes than the LTV cap. The difference in predicted impact on the mortgage lending between the different types of restrictions may therefore serve as an explanation for why the results of the investors reactions go in two different directions. However, this does not explain why part of the result of the LTV cap show a positive reaction, rather it explains the absence of a negative reaction.

Finally, another disparity between the two types of restrictions is related to the formulation of the policy. While the LTV cap is a general advice, the two amortisation requirements are binding rules. As mentioned in the results of the LTV cap, the slightly diffuse formulation of the policy may complicate investors assessment of the consequences for banks in terms of profit and risk. Uncertainties regarding the restriction's impact on the banks may therefore make stock returns ineffective in measuring the actual impact. However, with binding rules, the assessment of the restrictions' impact on banks by investors would be more correct. This suggest that despite results showing a discrepancy between the reaction of the LTV cap compared to the amortisation requirement, the actual impact on the banks does not necessarily have to differ. The reason why the reaction of the LTV cap differs from the amortisation requirement could be due to errors in investors' assessment of the impact.

This paper further investigates whether the effect of the restrictions is larger among banks with relatively more mortgage loans. The results of the CAR show no evidence supporting this hypothesis. Although no clear evidence of larger effects among the firms with relatively more mortgages, the results show that the effects do differ across firms. Balance sheet composition and level of risk is according to Clark (1986) important variables affecting banks' profits. This supports the notion that if firms are not identical, effects will differ across firms. In addition, the significant CAR of event 2 and event 3 belong to the same stocks. Although the result contradicts the predicted relationship explained in hypotheses H_{2b} and H_{2c}, the fact that the evidence of belongs to the same stock implies that the results are not random.

Findings opposing the efficient market

This paper discusses economic theories including the efficient market hypothesis and behavioural economics. Certain results in this study support the efficient market hypothesis, while others do not entirely align with the assumptions of the theory. One of the main differences between the efficient market hypothesis and behavioural economics is that the first-mentioned theory relies on the assumption that investors are homogenous, while the latter do not. By examining all three events together, findings can be analysed with economic theories.

In this study, dual share classes of stocks are included for SEB and SHB. While the result show no clear difference between the stocks SHB A and SHB B, a discrepancy exists between SEB A

and SEB C through all three events. Although the stocks of SEB trade independently, the correlation between the stock returns should be close to 1 since the underlying assets are the same for both stocks. This holds true for SHB in event 1 and 2 with correlations of over 0.95, but not for SEB in any of the events.

For all three events, SEB A displays in absolute figures higher CAR than SEB C, which indicate that SEB A reacts more to the lending restrictions than SEB C. However, all of these results are not significant. Given that SEB A is traded more frequently than SEB C, it might be intuitive to explain the higher CAR with trading frequency. However, SEB C is still traded frequently[22] and approximately as much as SHB B. In addition, for SHB, there lie no discrepancy in CAR between the two classes of the stock. Therefore, trading frequency cannot be the explanation for the difference in CAR for the two stocks of SEB. Moreover, the market index coefficient for SEB A is significantly higher than that of SEB C in all three events. This is not true for the corresponding coefficients of SHB A and SHB B. There is no intuition to why investors find SEB A riskier than SEB C as the underlying assets are identical. An explanation for the difference in CAR and the market index coefficient could be that SEB A and SEB C are traded independently and that information is treated differently among investors for SEB A compared to SEB C.

According to the efficient market hypothesis, no arbitrage opportunities exist (Berk & DeMarzo, 2017, p. 105). However, with a discrepancy between SEB A and SEB C, that both have the same underlying assets the assumption of no arbitrage does not hold. In result, the efficient market hypothesis cannot explain the why a clear difference exists between SEB A and SEB C in terms of **β**.

Considering behavioural economics, the prospect theory might explain the situation. As described in the section 2.2.2, the prospect theory explains that investors value information differently depending on whether they expect a loss or expect a gain. If one assumes that the investors are not identical in SEB A and SEB C, the prospect theory could explain why information is treated differently. All information concerning the lending restrictions are equally affecting the SEB A and SEB C investors and should be valued identically, i.e. showing the same changes in returns.

[22] Appendix 3

However, if one group of investors, on average, expect a loss while the other investors expect a gain, two different group of investors would value information differently. Put in this context, investors of SEB A may have different expectations, on average, then the investors of SEB C. In result, the two types of investor groups value the lending restrictions announcements differently from one another. The results therefore support the idea that prospect theory can be present for investors of SEB A and SEB C.

7. Conclusion

This paper examines the impact of macroprudential policies, in the form of lending restrictions, on the profit and risk of mortgage lending firms in Sweden. The macroprudential policies examined in this paper are an LTV cap announced in 2010, an amortisation requirement announced in 2014 and an extended amortisation requirement announced in 2017. This study uses a standard event study approach to determine if the stock returns of mortgage lending firms were abnormal around the days of the announcement of each restriction. In addition, event study-based regression models are conducted to examine the size of the effects, both at portfolio level of all stocks, and at a stock-specific level.

The results from event 1, the announcement of the LTV cap, show a positive reaction from investors on the day before the announcement at a portfolio level of all stocks. Assuming that the information leakage did occur, investors did welcome an LTV cap. The result therefore points at the profit and risk of mortgage lending firms being positively affected by the lending restriction. A possible explanation for the result is related to the history as previously high LTV ratios were one factor leading to the bank crisis in the 90's. The significant result is however, only supported by one test. If the significant result is not related to the event, the absence of investor reaction may be explained by investor uncertainties in how to assess the restriction's impact on the firms. Since no significant results are found at a stock-specific level, no conclusions can be made regarding how firms with relatively more mortgage loans are affected compared to firms with less mortgage loans.

With the results from event 2, the announcement of the amortisation requirement, negative abnormal returns are statistically proven at a portfolio level on the day of the announcement. From the portfolio regression, an indication is given that the abnormal return at the event day is small,

however, with a p-value of 0.12, the size of the abnormal return cannot be concluded. Additionally, negative abnormal returns are proven at a stock-specific level for SEB A and Nordea, contradicting the hypothesis that the firms with higher mortgage loans-to-total asset ratios would become more affected. The size of the abnormal returns is statistically proven to be small for SEB A and Nordea. An explanation for why abnormal returns is small could be because an expected decrease in interest income following the restrictions will occur in the far future and are therefore heavily discounted by investors. All significant results from this event imply that the firms' profit and risk are negatively affected by the amortisation requirement. The FSA predicts that the amortisation requirement will decrease the demand of homes. The negative reaction of investors could therefore be explained by a fear of a price decrease in the housing market, making mortgage loans riskier assets for the mortgage lending firms.

The results of event 3, the announcement of the extended amortisation requirement, shows similar reactions as of the first amortisation requirement, but with a lagged effect. Negative abnormal returns are statistically proven for the portfolio of all stocks in the two days following the announcement. The portfolio regression shows that the abnormal return is small, however, the p-value of 0.12 makes size of the effect inconclusive. The relative size effect between the two amortisation requirements was expected to be similar but smaller for the extended requirement. Without significant results, the difference in size is however inconclusive. At stock-specific level, abnormal returns are proven for SEB A and Nordea, similar to the first amortisation requirement. Again, this contradicts the prediction of a larger effect of firms with higher mortgage loans-to-total assets ratios. No conclusions regarding the size of the abnormal returns for SEB A and Nordea can be made. Surprisingly, the stock-specific regression of Swedbank shows a significant positive reaction on the day before the announcement. The contradicting results of the stock-specific tests make the results inconclusive at stock-level.

Overall, the findings of this study suggest that investors reacted positively on the announcement of the LTV cap but negative on the announcements of the amortisation requirements. According to the results, the LTV cap is expected to affect the profit and risk of mortgage lending firms positively, while the amortisation requirement will affect the profit and risk negatively. An explanation for why the reactions differs between the two types of restrictions could be related to

the risk level of mortgage loans after the regulation. Assuming that house prices decline following the regulations, the effect of making mortgage loans less risky is more immediate with LTV caps than with amortisation requirements. Other explanations for why no negative effects are found for the LTV cap could be because the regulation did not imply large changes for the banks, or, the diffuse formulation of the restriction made investors uncertain of the impact. Another finding in this paper relates to the dual share classes of stock of SEB. Although the underlying assets of SEB A and SEB C are the same, the results show different reactions and different market index coefficient through all three events. The result could mean that investors of the SEB A and SEB C are not homogenous, contradicting the efficient market hypothesis.

Future research

In the future, when effects from the restriction are more visible, the effects should be possible to measure in other ways than in stock returns. Future research in the field could therefore examine the restrictions' impact on banks by measuring actual changes on the balance sheet or measuring credit defaults.

The lending restrictions studied in this paper are implemented with the objective of slowing down increased indebtedness among households. The effectiveness of the restrictions in achieving its goal will likely be evaluated continuously. Future research could take on a broader perspective by evaluating the restrictions overall economic impact in the society, by for example including the effects on mortgage lending firms and household indebtedness together.

Other macroeconomic variables, such as interest rates, may impact the expected changes in mortgage loan levels and bank risk and profits. A similar study could examine the impact of changes in interest rates on mortgage loan levels or bank profits and risk.

8. Outlook for Swedish banks

This study has focused on the effects on banks following lending restrictions. The banking industry faces challenges going forward that are outside the scope of this paper, but that are relevant to mention. Two topics are currently dominating the banking industry focus.

In the spring of 2019, headlines in Scandinavia have been dominated by reports on money laundering scandals involving Nordic banks (Ahlander, Vaish & O'Donnell, 2019; Milne, 2019). Danske Bank has admitted involvement and Swedbank are currently under investigation (Ahlander et al., 2019). Swedbank's money laundering allegations resulted in a 18% drop in share price within three days after the allegations surfaced (Nasdaq Nordic, 2019b). Failure to comply with AML[23] regulations is thus far costlier than effects of lending restrictions. The FSA stated in March that it will focus on strengthening AML supervision by reallocating resources (Swedish FSA, 2019). The increased focus by the FSA combined with the costliness of non-compliance will therefore result in increased attention to AML practices amongst Swedish banks.

The second focus is the disruption of Fintech[24] firms and applies not only to Swedish banks but also banks globally. The increased significance of Fintech firms is shown by Fuster, Plosser, Schnabl & Vickery (2019) in a study on mortgage lending in the US. The authors find that Fintech lenders increased their market shares from 2% to 8% from 2010 to 2016 in mortgage lending. Fintech firms operate in other activities than just mortgage lending which leads to increased competition for banks across several business segments. Hardie, Gee & Hannestad (2018) describe that increased competition from Fintech firms is a threat for banks revenues. The authors have estimated that bank revenues at risk are 38% in the Nordics, which is significantly higher than European counterparties. The high growth of Fintech firms and the significant risk of reducing income will likely be highly prioritized for Swedish banks going forward.

[23] Anti-money laundering
[24] Financial technology usually shortened to Fintech is defined as "... a new financial industry that applies technology to improve financial activities." (Schueffel, 2016)

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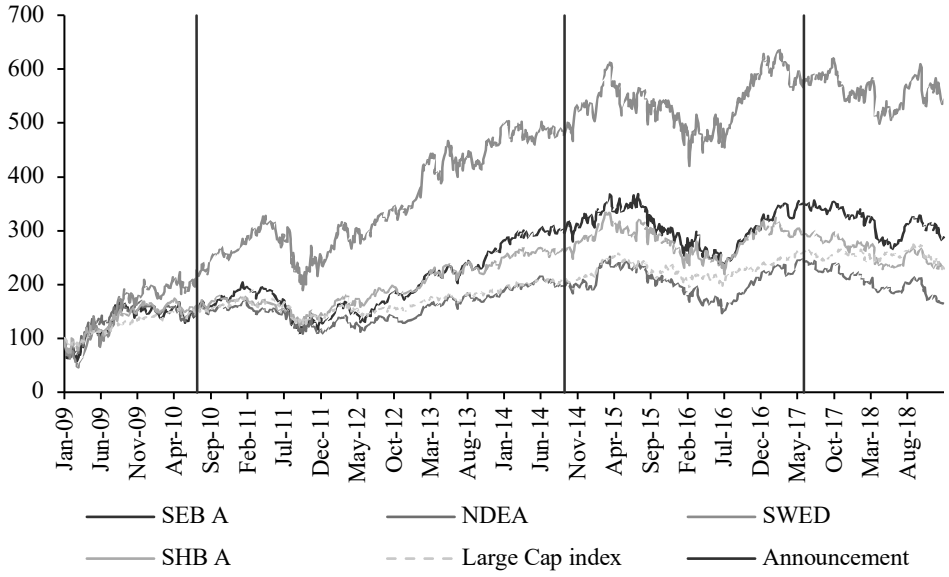
10. Appendices

Appendix 1

Stock price development 2009-2018

The figure contains stock price development from January 1, 2009 to December 31, 2018 of SEB A, Handelsbanken A, Swedbank and Nordea compared to Large cap index. Index = 100 in 2009.



	SEB A	***SHB A***	***NDEA***	***SWED***	***Large Cap index***
Dec-18	285.3	234.5	162.2	545.8	232.0
Jan-09	100.0	100.0	100.0	100.0	100.0
Change %	185%	135%	62%	446%	132%

Source: Nasdaq Nordic (2019b)

Appendix 2

Firms active in bank operations

The list contains all banks registered in bank operations and the criterions set up for inclusion in data set

Swedish bank corporations & foreign bank corporations with branches in Sweden	Publicly listed bank[1] during events	Offers mortgage lending[2] 2009 - 2017	Swedish mortgage loans-to-assets[3] >5%	Traded[4] >90% of estimation periods
Nordea Bank	✓	✓	✓	✓
Svenska Handelsbanken	✓	✓	✓	✓
SEB	✓	✓	✓	✓
Swedbank	✓	✓	✓	✓
Danske Bank, filial	✓	✓	×	✓
SBAB Bank	×	✓	n.a.	n.a.
Länsförsäkringar Bank	×	✓	n.a.	n.a.
Landshypotek Bank	×	×	n.a.	n.a.
Skandiabanken	×	✓	n.a.	n.a.
Sparbanken Skåne	×	✓	n.a.	n.a.
DNB Bank, branch	✓	×	n.a.	n.a.
IKANO Bank	×	✓	n.a.	n.a.
Volvofinans Bank	×	✓	n.a.	n.a.
Nordnet Bank	✓	×	n.a.	n.a.
Santander Consumer Bank, branch	✓	×	n.a.	n.a.
Avanza Bank	✓	×	n.a.	n.a.
Resurs Bank	×	×	n.a.	n.a.
Collector Bank	✓	×	n.a.	n.a.
Sparbanken Sjuhärad	×	×	n.a.	n.a.
Marginalen Bank	×	×	n.a.	n.a.
Nordax Bank	✓	×	n.a.	n.a.
ICA Banken	✓	✓	×	✓
Varbergs Sparbank	×	✓	n.a.	n.a.
SEB Kort Bank[5]	×	×	×	n.a.
Ålandsbanken, branch	✓	✓	✓	×
BNP Paribas Fortis Bank, branch	✓	×	n.a.	n.a.
Sparbanken Alingsås	×	✓	n.a.	n.a.
Sparbanken Rekarne	×	✓	n.a.	n.a.
Sparbanken Skaraborg	×	✓	n.a.	n.a.
Crédit Agricole CIB, branch	✓	×	n.a.	n.a.
PBB Deutsche Pfandbriefbank, branch	×	×	n.a.	n.a.
Carnegie Investment Bank	×	×	n.a.	n.a.
Forex Bank	×	×	n.a.	n.a.
Bluestep Bank	×	✓	n.a.	n.a.
Bank of China, branch	×	×	n.a.	n.a.
Sparbanken Lidköping	×	✓	n.a.	n.a.

Toyota Kreditbank, branch	✓	×	n.a.	n.a.
Citibank Europe, branch	✓	×	n.a.	n.a.
Sparbanken Eken	×	✓	n.a.	n.a.
Bergslagens Sparbank	×	✓	n.a.	n.a.
Tjustbygdens Sparbank	×	✓	n.a.	n.a.
MedMera Bank	×	×	n.a.	n.a.
Sparbanken Göinge	×	✓	n.a.	n.a.
Ölands Bank	×	✓	n.a.	n.a.
TF Bank	×	×	n.a.	n.a.
Erik Penser Bank	×	×	n.a.	n.a.
OK-Q8 Bank	×	×	n.a.	n.a.
Lån & Spar Sverige, branch	×	×	n.a.	n.a.
Vimmerby Sparbank	×	✓	n.a.	n.a.
Svea Bank	×	×	n.a.	n.a.
Aareal Bank, branch	✓	×	n.a.	n.a.
UBS UK Stockholm, branch	✓	×	n.a.	n.a.
Deutsche Bank, branch	✓	×	n.a.	n.a.
National Westminster Bank, branch	✓	×	n.a.	n.a.
UBS Europe, branch	✓	×	n.a.	n.a.
Societe Generale Bank, branch	✓	×	n.a.	n.a.
Evli Bank, branch	✓	×	n.a.	n.a.
Bigbank, branch	×	×	n.a.	n.a.
Adyen Nordic Bank, branch	✓	×	n.a.	n.a.
Barclays Bank, branch	✓	×	n.a.	n.a.
Catella Bank, branch	✓	×	n.a.	n.a.
Credit Suisse, branch	✓	×	n.a.	n.a.
HSBC Private Bank, branch	✓	×	n.a.	n.a.
J.P. Morgan Europe, branch	✓	×	n.a.	n.a.
J.P. Morgan Securities, branch	✓	×	n.a.	n.a.
Klarna Bank	×	×	n.a.	n.a.
Netfonds	×	×	n.a.	n.a.
Northern Trust Global Services, branch	×	×	n.a.	n.a.
Renault Finance Nordic bank branch	✓	×	n.a.	n.a.
Standard Chartered Bank, branch	✓	×	n.a.	n.a.

Foot notes

[1] Only firms that have been publicly listed during the event period of 2009-2017 are included

[2] Only firms that have offered mortgage lending during the full period are included

[3] Firms that do not fulfil the two first criterions have not had mortgage-to-asset ratio calculated and receive value not applicable (n.a.)

[4] Firms that do not fulfil the three first criterions have not had trading frequency calculated and receive value not applicable (n.a.)

[5] Part of SEB Group

Source: Swedish Bankers' Association (2018b)

Appendix 3

Average number of trades per day and number of zero trades days

The table displays the average number of trades per day for the firms on each event

Estimation period	*SEB A*	*SEB C*	*Nordea*	*Swedbank*	*SHB A*	*SHB B*	*Ålands banken A*	*Ålands banken B*
Third event	5,414	222	6,396	5,215	4,521	291	5	11
Second event	4,601	149	5,705	4,992	3,743	197	3	9
First event	5,624	123	4,649	5,777	2,987	119	1	5

Source: Nasdaq Nordic (2019b)

Appendix 4

Press releases during the days around the event window

The press releases and timeline of studied firms in the event window are described

		Number of press releases								
		t-4	t-3	t-2	t-1	*t*	t+1	t+2	t+3	t+4
Company	Total	4/7/10	5/7/10	6/7/10	7/7/10	8/7/10	9/7/10	10/7/10	11/7/10	12/7/10
SEB	1									1
Swedbank	0									
Nordea	0									
SHB	0									

Description

SEB 12/7: Announcement of divestment (SEB, 2010)

		Number of press releases								
		t-4	t-3	t-2	t-1	*t*	t+1	t+2	t+3	t+4
Company	Total	7/11/14	8/11/14	9/11/14	10/11/14	11/11/14	12/11/14	13/11/14	14/11/14	15/11/14
SEB	0									
Swedbank	0									
Nordea	0									
SHB	0									

Description

		Number of press releases								
		t-4	t-3	t-2	t-1	*t*	t+1	t+2	t+3	t+4
Company	Total	27/5/17	28/5/17	29/5/17	30/5/17	31/5/17	1/6/17	2/6/17	3/6/17	4/6/17
SEB	0									
Swedbank	0									
Nordea	0									
SHB	0									

Description

Relevant mentions in news during days around the event window

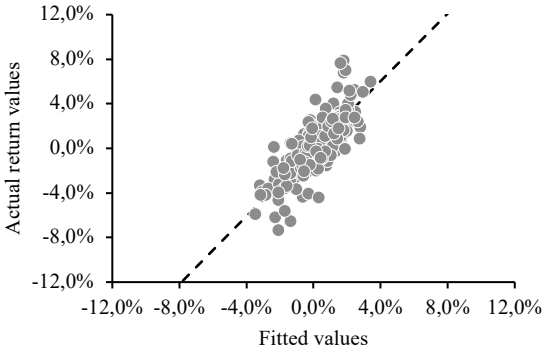
The relevant news concerning studied firms in the event window are described. Only relevant stock specific news articles that might have an impact on a stock price is described and is presented from one source only

Number	Date	Description
1)	12/07/2010	Santander Buys German SEB Branches (Suess & Penty, 2010)
2)	13/11/2014	Nordea Asset Management wins ESG award (CFI, 2014)
3)	26/05/2017	Customers leaving Nordea upon announced plans of moving HQ (Svenska Dagbladet, 2017)

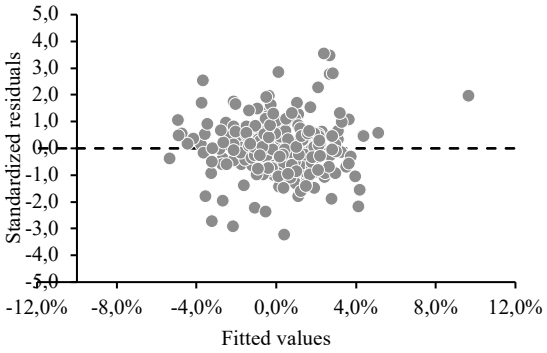
Appendix 5

Residual plots LTV cap

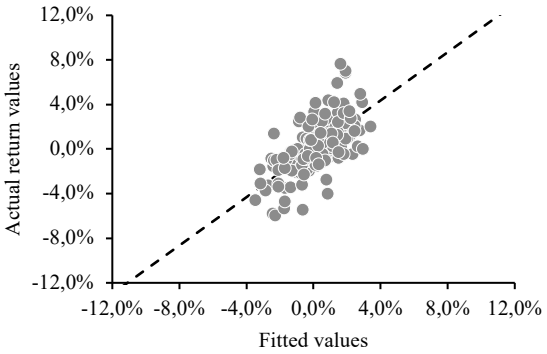
Residual plots for the predicted values vs actual values in the market model



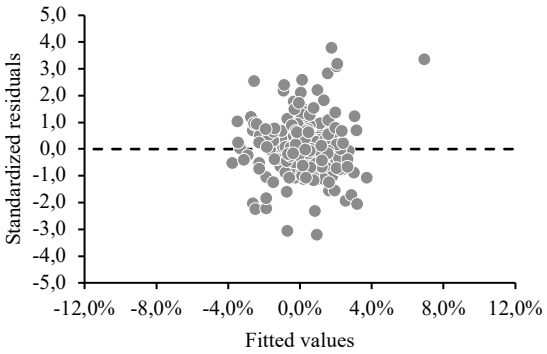
SEB A



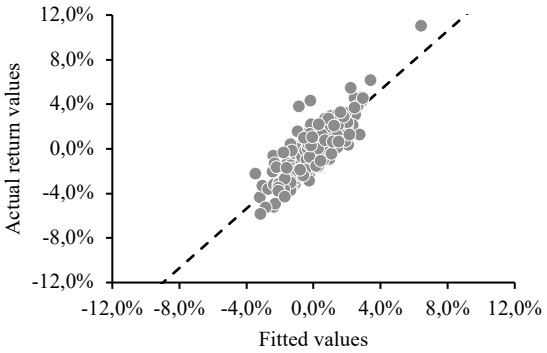
SEB A residuals



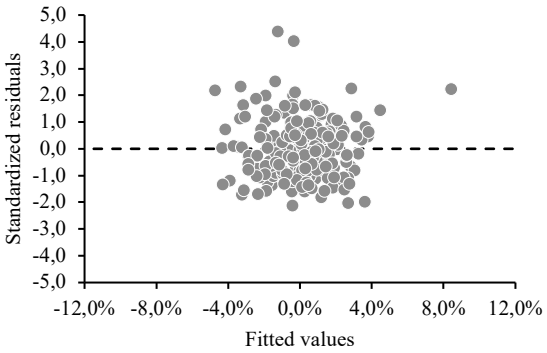
SEB C



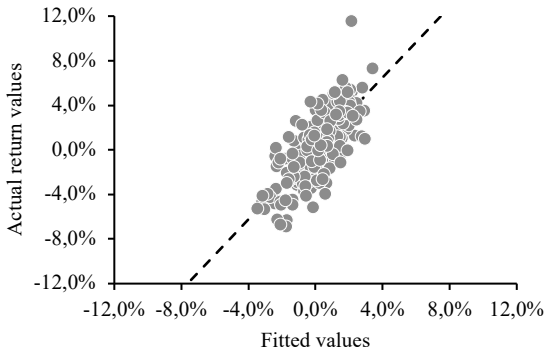
SEB C residuals



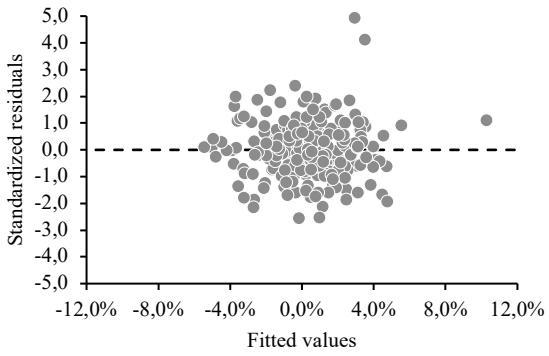
NDEA



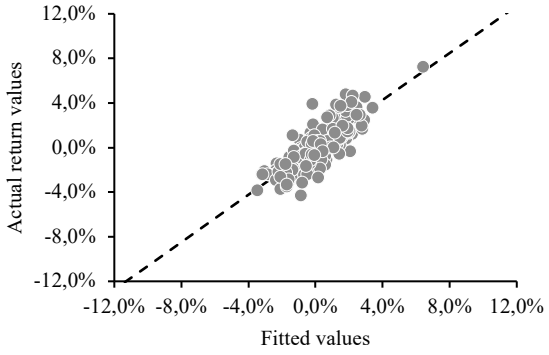
NDEA residuals



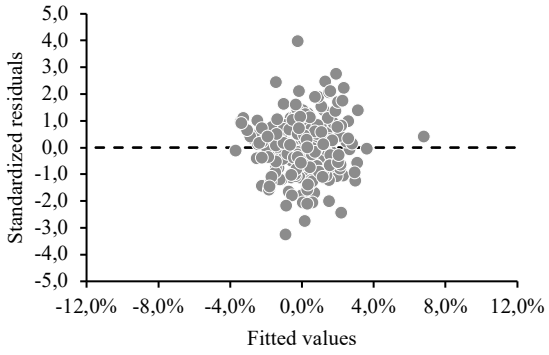
SWED



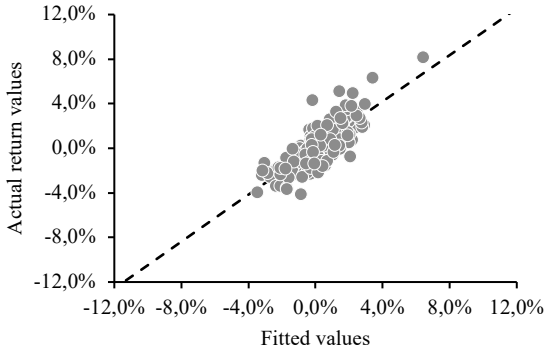
SWED residuals



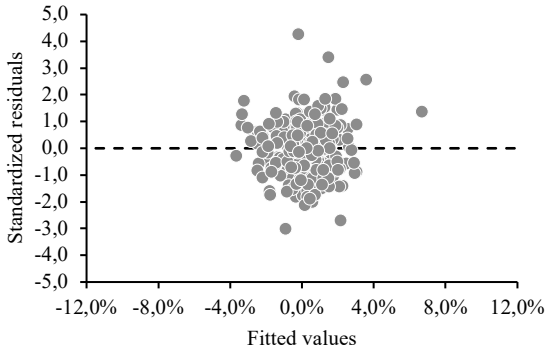
SHB A



SHB A residuals



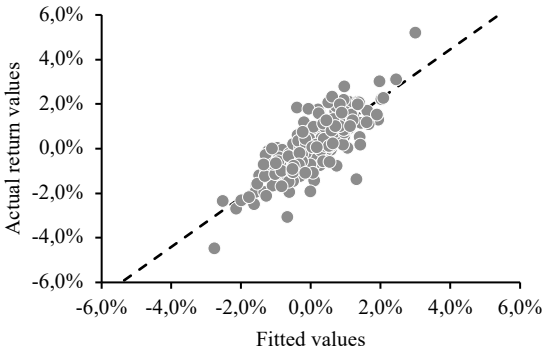
SHB B

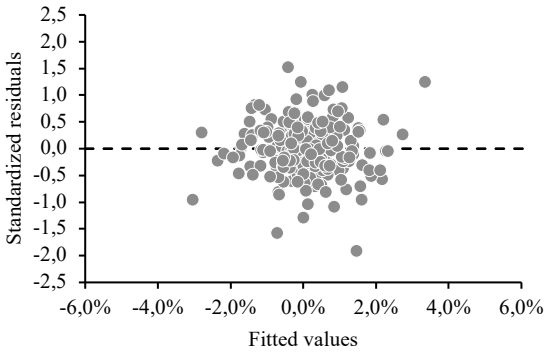


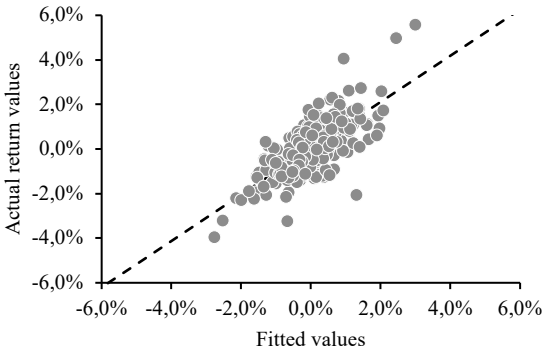
SHB B residuals

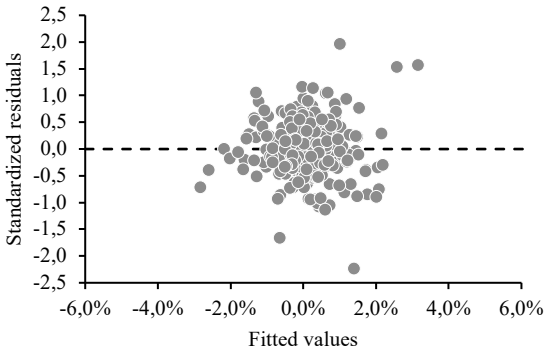
Residual plots amortisation requirement

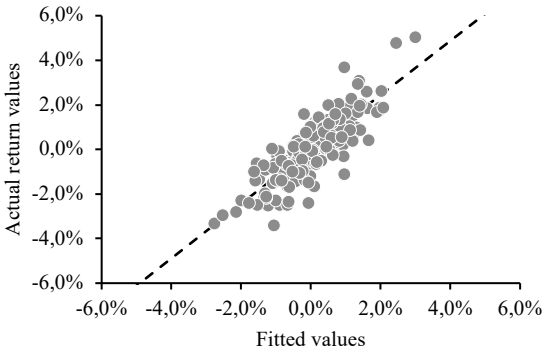
Residual plots for the predicted values vs actual values in the market model

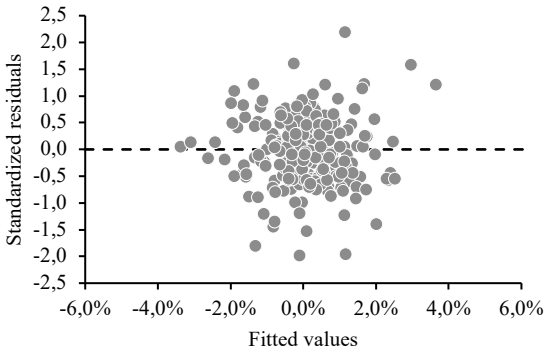


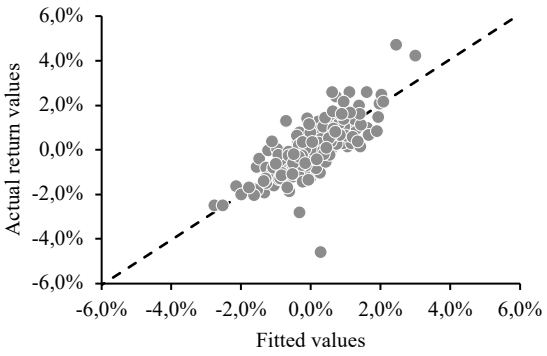




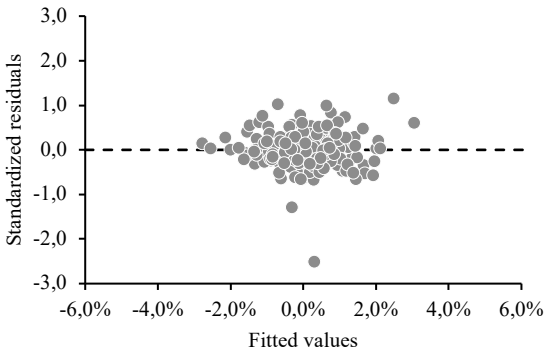




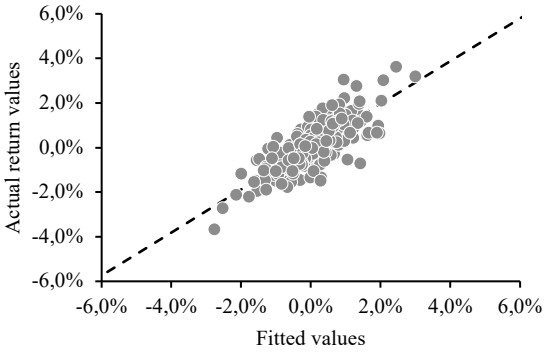




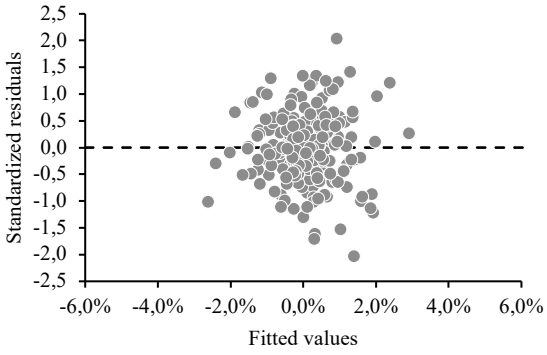
SWED



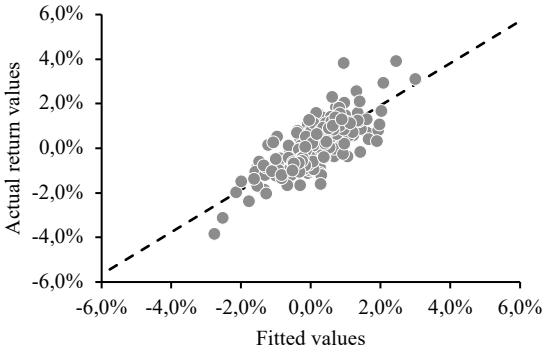
SWED residuals



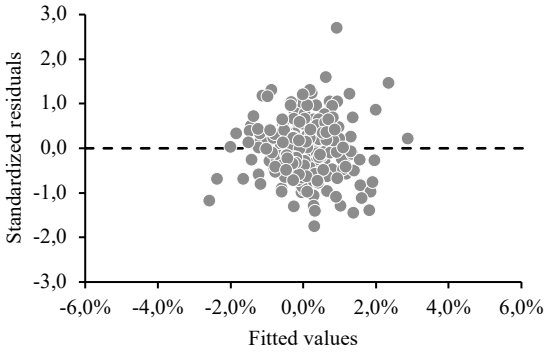
SHB A



SHB A residuals



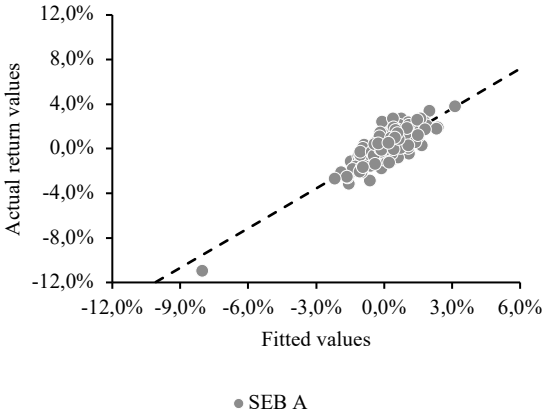
SHB B

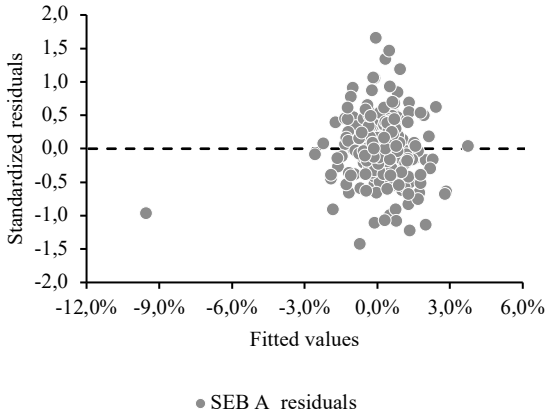


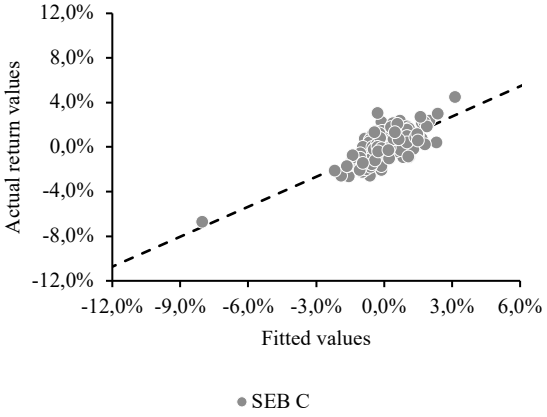
SHB B residuals

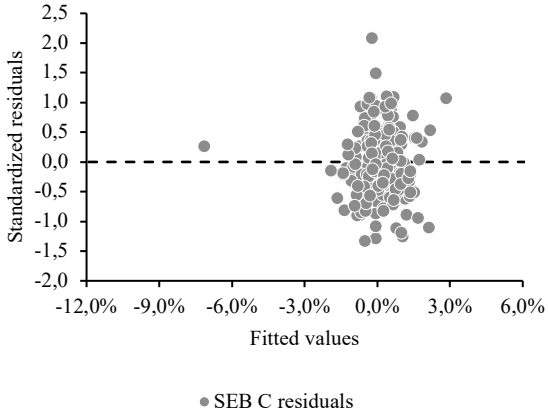
Residual plots extended amortisation requirement

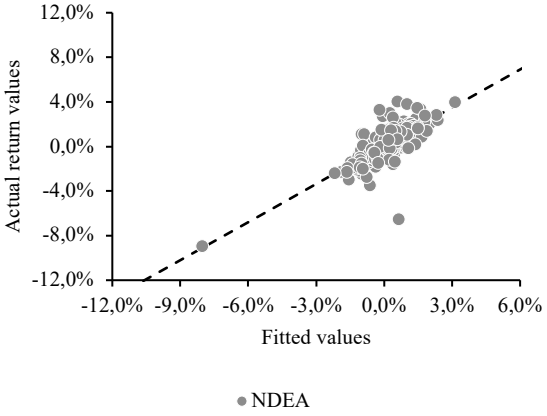
Residual plots for the predicted values vs actual values in the market model

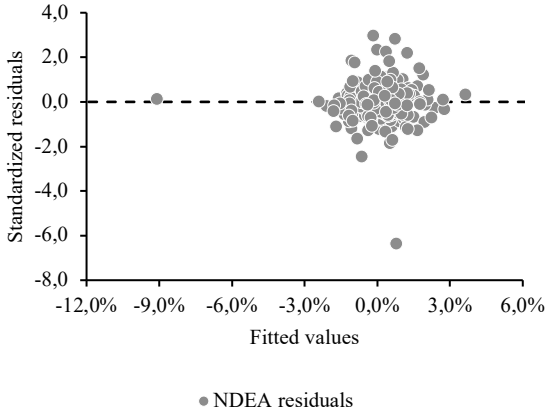


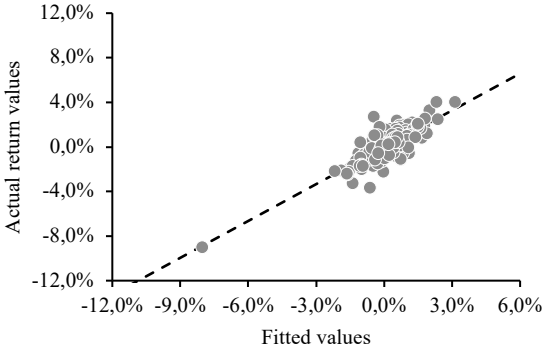




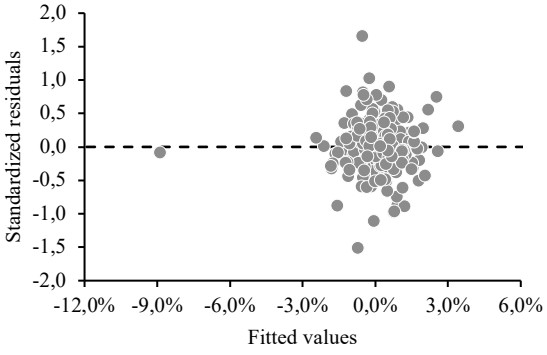




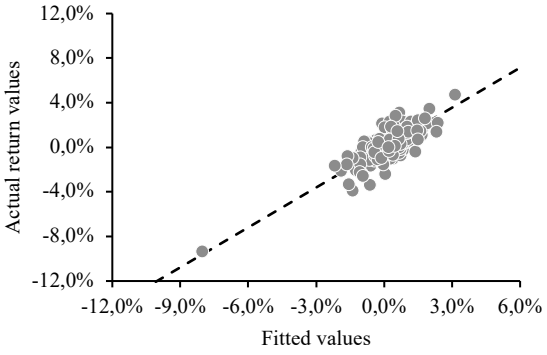




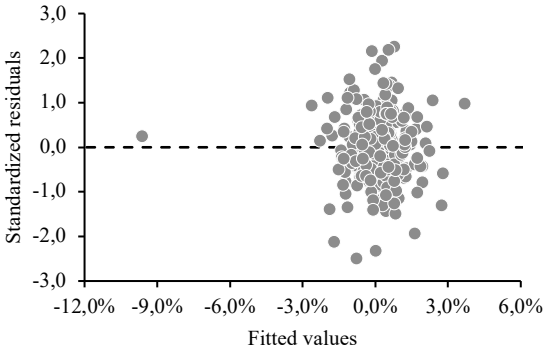
SWED



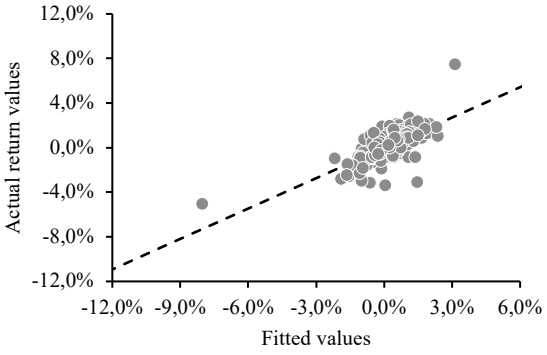
SWED residuals



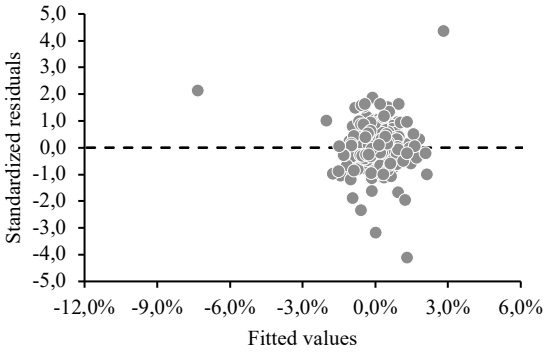
SHB A



SHB A residuals



SHB B



SHB B residuals

Appendix 6

Market model regression output

The market model regression output to calculate normal returns and corresponding R-squared values

	LTV Cap					
Variable	*SEB A*	*SEB C*	*NDEA*	*SWED*	*SHB A*	*SHB B*
Intercept	-0.0006	0.0001	-0.0008	0.0010	0.0000	0.0000
Large cap index	1.5200	1.0850	1.3333	1.5906	1.0631	1.0482
Adj. R-squared	0.6508	0.4670	0.7047	0.5440	0.6517	0.6316
No. of observations	254	254	254	254	254	254

	Amortization requirement					
Variable	*SEB A*	*SEB C*	*NDEA*	*SWED*	*SHB A*	*SHB B*
Intercept	0.0003	0.0004	-0.0001	0.0002	0.0003	0.0004
Large cap index	1.1095	1.0388	1.2188	1.0119	0.9596	0.9472
Adj. R-squared	0.6235	0.5191	0.6630	0.5823	0.6142	0.5869
No. of observations	254	254	254	254	254	254

	Extended amortization requirement					
Variable	*SEB A*	*SEB C*	*NDEA*	*SWED*	*SHB A*	*SHB B*
Intercept	0.0004	0.0005	0.0007	-0.0002	-0.0003	-0.0002
Large cap index	1.1923	0.8971	1.1407	1.1027	1.1943	0.9091
Adj. R-squared	0.7209	0.5227	0.5481	0.6823	0.6629	0.4895
No. of observations	254	254	254	254	254	254

Appendix 7

Equations for AAR and ACAR

A second step taken in the event study method is to aggregate abnormal returns across securities. In this way, conclusions can be draw about the event's overall effect on the sample. One drawback with aggregating abnormal returns across securities is that event clustering problems may cause estimators to become biased. Therefore, AAR and ACAR are not applied in this study.

The equation for AAR follows:

$$AAR_{\tau} = \frac{1}{N}\sum_{i=1}^{N}\sigma_{\varepsilon_i}^2 \quad \textbf{(16)}$$

The variance for the AAR is calculated with the following equation:

$$Var(AAR_{\tau}) = \frac{1}{N^2}\sum_{i=1}^{N}\sigma_{\varepsilon_i}^2 \quad \textbf{(17)}$$

Similar to the variance for CAR, the variance equation for AAR requires a large sample.

The AAR is aggregated over the event window, generating Average cumulative abnormal returns (ACAR):

$$ACAR(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AAR_{\tau} \quad \textbf{(18)}$$

The variance for ACAR is calculated with the following equation:

$$Var\big(ACAR(\tau_1, \tau_2)\big) = \sum_{\tau=\tau_1}^{\tau_2} Var(AAR_{\tau}) \quad \textbf{(19)}$$

Appendix 8

Stock return correlation

The tables contain correlation matrices for each estimation window

2010	*SEB A*	*SEB C*	*NDEA*	*SWED*	*SHB A*	*SHB B*
SEB A	1					
SEB C	0.81	1				
NDEA	0.74	0.64	1			
SWED	0.78	0.68	0.65	1		
SHB A	0.73	0.57	0.77	0.64	1	
SHB B	0.72	0.57	0.76	0.64	0.96	1

2014	*SEB A*	*SEB C*	*NDEA*	*SWED*	*SHB A*	*SHB B*
SEB A	1					
SEB C	0.86	1				
NDEA	0.78	0.69	1			
SWED	0.75	0.66	0.72	1		
SHB A	0.78	0.69	0.74	0.79	1	
SHB B	0.76	0.72	0.72	0.78	0.95	1

2017	*SEB A*	*SEB C*	*NDEA*	*SWED*	*SHB A*	*SHB B*
SEB A	1					
SEB C	0.82	1				
NDEA	0.79	0.65	1			
SWED	0.83	0.70	0.73	1		
SHB A	0.83	0.70	0.74	0.81	1	
SHB B	0.69	0.70	0.64	0.69	0.83	1