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Credit Fuelled Asset Prices and Financial Stability

Is there a causal relationship between credit growth and stock market prices?

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Abstract

This thesis investigates the causal relationship between credit growth and stock market prices over the time period 1981-2017 in the US, the UK and Sweden. By performing a Granger causality test to examine if credit affects stock market prices, we find evidence that there is no statistically significant Granger causality. However, we do find that private credit growth is positively correlated with stock market prices. The role of credit in the macro economy and how it contributes to credit fuelled asset prices, which poses a threat for financial stability is a topic that is currently of great concern for researchers and policy makers. Furthermore, this thesis aims to investigate what financial variables can be used to identify threatening credit growth bubbles and how central banks should respond to fluctuations in asset prices.

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1 Introduction

1.1 Background

Credit booms have preceded many of the past financial crises such as the recent global financial crises starting in 2008, Mexico 1994, Scandinavia 1990-91, Chile 1982 and even further back the stock market crash in 1929 (Dell’Ariccia et al 2012). Since the Great Depression of the 1930s, policy makers have been aware of the damaging effects of large fluctuations in asset prices on the real economy. The experience of Japan in the 1990s has confirmed that boom and bust cycles in asset prices can be very damaging to the economy. Central banks and policy makers are since concerned with identifying the underlying causes of asset price changes that are not driven by fundamentals but of overly optimistic expectations to prevent financial instability. Recent literature has shown that analysing credit growth can be an important factor in identifying dangerous asset price bubbles.

Credit fuelled bubbles are considered to be a threat to financial stability and the credit growth along with the credit-to-GDP ratio are seen as useful indicators of credit fuelled asset price booms that can be used as financial variables to predict financial crises. This thesis aims to present previous literature in the area of asset price bubbles fuelled by credit growth and investigate the relationship between credit growth and asset price changes in the case of stock market developments. The stock market is extremely sensitive to any information relevant to future trends and market developments and it’s therefore interesting to investigate its relationship with credit growth. Credit driven booms are found to cause even more severe financial crises and the latest financial crisis together with Japans bubble in the 1980s has highlighted the importance of identifying leveraged bubbles before they burst. These events have shown the real effects of asset price bubbles when they go bust and makes identifying excessive credit growth associated with asset price increases an area of focus for researchers and policy makers.

1.2 Research Question

Previous studies on credit growth bubbles have focused on identifying excessive credit growth and to establish how it affects asset price levels in order to predict threats to financial stability. Consequently, the literature on the relationship between credit growth and stock price movements is less extensive. The hypotheses in this thesis seek to contribute to this area of study and discuss possible implications for policy makers. The hypotheses we investigate in this thesis are:

1. There is a Granger causality relationship between private credit growth and stock market prices in the US, the UK and Sweden.
2. There is a correlation between stock market prices and credit growth.

The first hypothesis tested in this thesis is that credit growth can be used to explain movements in stock market prices. We investigate this assumption by using an Autoregressive Distributed Lag Model with a Granger causality test, to see if the stock price time series can be explained by the time series of credit growth. This model allows us to investigate the causality between two variables in a time series that we can use to observe if two variables are related. This leads us to our second hypothesis that stock market prices and credit growth is correlated, which will be investigated by undertaking a correlation test.

1.3 Contributions and Purpose

The purpose of this thesis is to investigate the causal relationship between credit growth and stock market prices. This will be empirically analysed by performing a Granger causality test to examine if credit growth affects stock market prices over a time period from 1981-2017. This thesis will also investigate if stock market prices and credit growth are correlated. The contribution of this thesis will be made by analysing asset price levels through the lens of stock price movements and credit growth rates in three developed economies. This thesis will argue that excessive credit growth followed by rising stock market prices not driven by fundamentals is a useful predictor of financial instability and should be used by policymakers.

1.4 Delimitations

A number of delimitations are made in this thesis. We adjust for some of the factors that could influence stock market prices; these are real GDP and domestic interest rates. The sample size is limited to three countries, Sweden, the UK and the US, and a time period between 1981-2017 due to availability and a limited time to include more data. The number of data obtained differs between the countries; the Swedish data stretches only between 1993-2017, which will affect our results, in comparison with the data from the UK and the US that stretches from 1981-2017.

1.5 Results

We find that there is no obvious causal relationship between the private credit growth rates and stock market prices. In comparison with previous literature on asset prices and credit growth this is contrasting results. However, we do find that there is a positive correlation between credit growth and stock market prices in our three cases, which is in line with previous research.

1.6 Thesis Organisation

This thesis is organised as follows: in the next section, a literature review of previous research on credit growth and asset price bubbles is given. The literature review is followed by a theory review that explains existing theories of asset price bubbles used to identify threats to financial stability. The data and methodology section gives an overview of the empirical models we use to test our hypothesis before presenting our findings in the section results and analysis. This section is then followed by a conclusion.

2 Literature review

Asset price bubbles threatens economic stability and large swings in asset prices are of great consequence to the real economy. Previous research on the issue of asset price bubbles and boom-busts cycles in asset prices is concerned with why bubbles arise and how they threaten financial stability. The role of credit in creating and sustaining asset bubbles has been observed to be one of the main reasons why some bubbles have become more dangerous than others. Asset price bubbles are defined as price levels that significantly exceeds from fundamental values (Jones, 2014).

2.1 Stock market prices and fundamental values

To identify asset prices and stock market prices that deviate from fundamental values the Efficient Market Hypothesis developed by Fama (1970) is often used. The Efficient Market Hypothesis (EMH) states that the market prices of securities in an efficient market should be equal to the fair or fundamental value of those securities and therefore a reflection of current available information (Fama, 1970). The EMH is often compared with a 'fair game' where there is no systematic difference between the actual return on the game and the expected return on a game. Using the fair game model the mathematical expression of return on a security that corresponds to the EMH can be written as:

$$R_{it+1} = E\left(\frac{R_{it+1}}{I_t}\right) + U_{it+1}$$

where R_{it+1} is the actual rate of return on security i in period $t+1$; $E\left(\frac{R_{it+1}}{I_t}\right)$ is the expected rate of return on security i in period $t+1$ at time t given the information available at time t (that is I_t); U_{it+1} is the prediction error.

If stock market prices reflect the fundamental value of the asset, these prices are said to correspond with an efficient market and be driven by fundamentals. The efficiency of financial markets, although fundamental to modern stock market theory, has been questioned by many researchers and Shiller (1981) find that prices of financial assets seem to be far too volatile to accord with the EMH. In support of these findings volatility tests on the stock market made by LeRoy and Porter (1981) establish the observation of excessive price movements and challenges the EMH. Excessive movements in asset price levels give rise to boom-busts cycles in asset prices that create bubble like patterns.

Asset price bubbles are seen as events inconsistent with an efficient market and based on this theory researchers have become more concerned with identifying prices that do not reflect fundamental values in order to identify stock market bubbles. Blanchard and Watson (1982) find that if there is a bubble in one asset this will usually affect the price of other assets, even if they are not subject to bubbles. This makes bubbles in financial markets a potential threat to financial stability when a bubble in the stock market can create bubbles in other asset markets as well and they are therefore a major area of research and policy debate.

2.2 The risks of asset price bubbles to financial stability

Jordà et al (2015) examine housing and equity bubbles in 17 countries over the past 140 years and find that asset price bubbles fuelled by credit are significantly damaging to the economy. These findings show that credit is what makes some bubbles more dangerous than others and especially important that credit fuelled asset price bubbles are related to recessions and financial crises. In line with these findings Mishkin (2009) argue that there are two categories of asset price bubbles and the role of credit is what makes some bubbles more threatening to financial stability. The first type of bubble called a 'credit boom bubble' is fuelled by credit growth and results in increasing demand for some assets that raise prices. The higher prices encourage further lending against these assets, which increases demand and prices even more creating a positive feedback loop. A second type of bubble called 'irrational exuberance bubble' poses a limited threat to financial stability when it doesn't involve a cycle of leveraging against higher asset price levels. These findings coincide with previous literature where Kaminsky and Reinhart (1996) find in a study of crises in 20 countries that most financial crises are preceded by financial liberalization and significant credit expansions that caused an average rise in stock prices of about 40% per year. In support of these findings Mendoza and Terrones (2008), in their study of 48 countries over the period 1960-2006, find 27 credit booms in industrial countries and a clear connection between credit booms and financial crises. The connection between financial crises and credit fuelled asset price bubbles makes it interesting to further investigate the relationship between asset prices and credit growth to determine their interdependency.

Allen and Gale (2000) find that asset price bubbles are caused by an expansion in credit and these higher asset prices are in turn supported by expectations of further increases in asset prices. Furthermore, Allen and Carletti (2009) find that the anticipation of future credit expansion leading to rises in asset price levels have a great effect on the eventuality of a financial crisis. In support of these findings Martin and Ventura (2016) defines credit-boom bubbles as a situation where expansion in credit is not fuelled by expectations of future profits, but of expectations of future credit growth. This research suggest that not only credit growth is an important factor to consider when identifying threatening asset price bubbles, but also that the expectations of future credit growth plays an important part in creating dangerous bubbles.

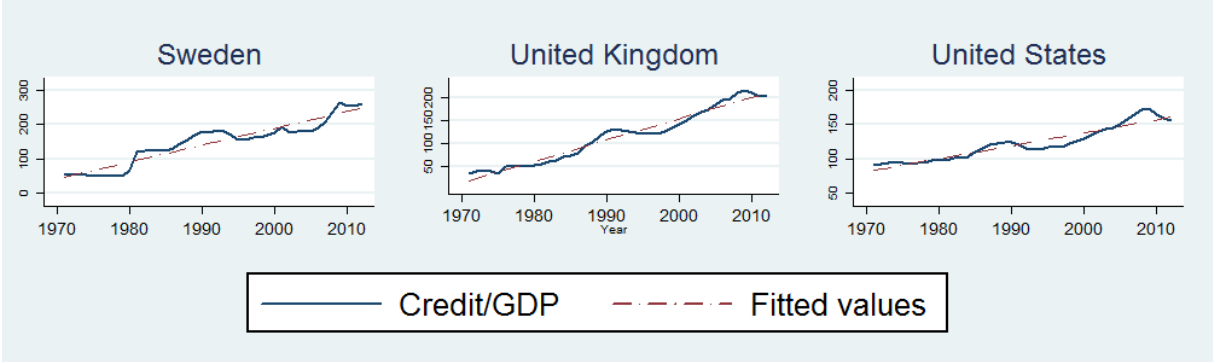
Rapid credit expansion resulting in asset price booms is seen as a dangerous situation for financial stability and Dell'Arrcica et al (2012) find that these are common characteristics leading up to financial crises but that every situation is different. In support of these findings Alessi and Detken (2017) argue that excessive credit growth threatens financial stability and that there is a correlation between credit growth and financial crises but that not all credit expansions are a risk to stability. To identify dangerous credit growth bubbles there is a need to calculate if credit developments are exceeding fundamental values or reflecting excessive risk taking and overly high future expectations.

2.3 Excessive credit growth and asset price changes

Past Financial crises have shown that excessive credit growth is related to risks for financial stability. Schularick and Taylor (2012) find that financial crises are credit booms gone wrong and the risk for financial instability increases with higher credit-to-GDP ratios. Coinciding with these findings Drehman et al (2011) find that excessive credit growth can be shown by the credit-to-GDP ratio along with its long run trend and becomes an early signal of impending financial crises. The credit-to-GDP ratio can be pushed higher by a fall in GDP or a rise in credit and can be calculated using different measurements of credit. In the recent financial crisis Drehman (2013) find that the bank credit-to-GDP gap didn't show any signs about a large credit build-up but the total credit-to-GDP gap showed a clear run-up in credit from the year 2000 and onwards. These findings suggests that dangerous credit growth bubbles can be identified by analysing different credit-to-GDP gaps and become a useful prediction tool of impending financial

crises. The credit-to-GDP ratios for Sweden, the UK and the US show a significant credit build-up as shown by increasing credit-to-GDP ratios since the 1970s (see figure 1).

Figure 1. Credit-to-GDP over the time period 1970-2010

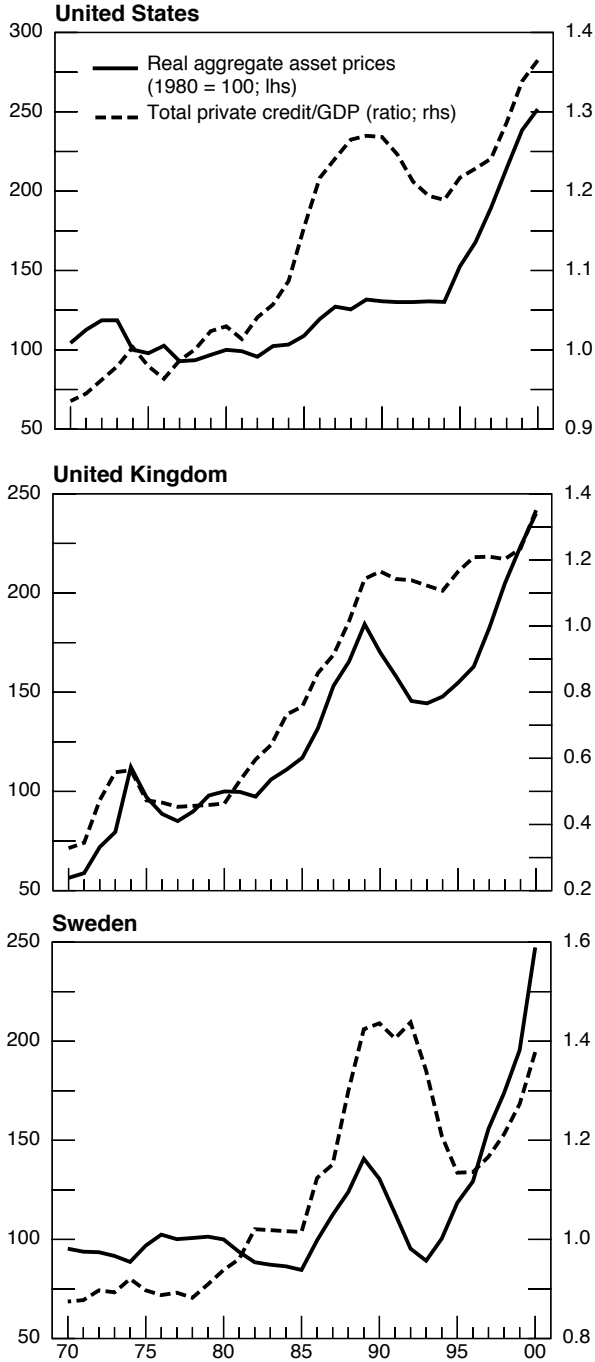


Notes and sources: In the sample period from 1970-2010 there is a significant increase in credit relative to GDP. Graphs and Data from Ventura and Martin (2016)

Since the financial liberalization in the 1980s that led to an expansion in credit the credit-to-GDP ratios have risen steadily in the US, the UK and Sweden. In modern economics the role of credit has expanded in the macro economy as observed by Schularick and Taylor (2012) and the relationship between credit and GDP has changed. Countries experiencing fast credit growth and an increase in asset prices have done this in periods of intense financial liberalization leading to excessive risk taking for financial institutions. The recent financial crisis has made it evident that the costs of not identifying the build-up of systematic risk are enormous to financial stability and the real economy.

Jordà et al (2011) find that both the recent global financial crisis in 2007-2008 and the Great Depression starting in 1929 were preceded by large increases in asset prices. Supporting these findings Borio and Lowe (2002) find empirical evidence that the combination of increasing asset prices and high credit growth is a good indicator of financial instability. These findings indicate that a rise in asset prices and credit may increase the likelihood of a financial crisis. In the UK, the US and Sweden a positive relationship between real aggregate asset prices and private credit-to-GDP ratios are observed (see figure 2). In support of these findings Alessi and Detken (2017) conclude that the aggregate private sector credit-to-GDP gap has been a useful variable that signalizes build-up of excessive credit.

Figure 2. Real Aggregate Asset Prices and Total Private Credit-to-GDP ratios



Notes and sources: Relationship between real aggregate asset prices and private credit to GDP ratios. Graphs and Data from Borio and Lowe (2002)

Claessens et al (2010) find in their empirical analysis of countries affected by the recent global financial crisis that countries displaying rapid credit growth, high leverage and asset price bubbles were among the economies most severely hurt. Their findings, though, find it hard to find a ‘one-size-fits-all’ list of early indicators but they do point to areas of vulnerabilities that might be detected such as asset price bubbles fuelled by credit growth.

To summarize, there seems to be a positive correlation between credit growth and asset price bubbles leading to financial instability, posing a risk for the real economy. It has become more important to understand what determines asset price movements since asset prices has become an even more significant factor driving the economy after recent years of financial liberalization and innovation. Large increases in asset prices associated with high credit-to-GDP ratios and excessive credit growth could become a threat to financial stability and therefor an important factor to incorporate in policy decisions. However, not all credit booms are dangerous and identifying threatening credit growth bubbles where asset prices are fuelled by credit growth remains a challenge.

3 Theory Review

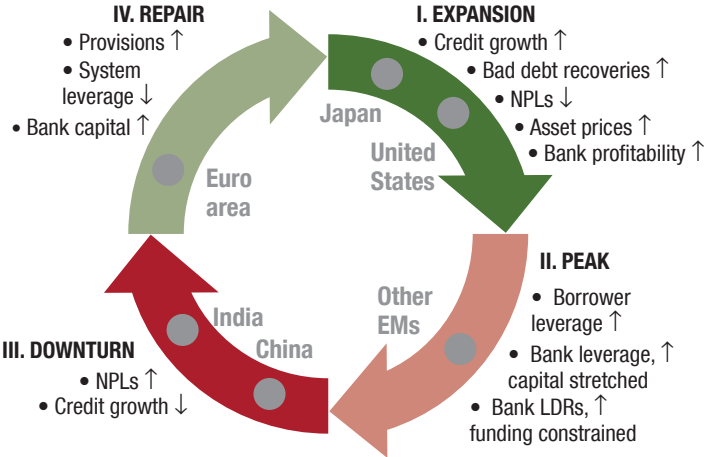
The notion that excessive credit growth is a threat to financial stability is not new. Since the Great Depression following the stock market crash in 1929 economists such as Fisher (1933), Minsky (1977) and Kindleberger (1978) have argued this view. Following the global financial crises in 2007-2008 this notion has been re-established.

3.1 The Credit Cycle

During an expansion of credit, asset prices rise and if fuelled by leveraged capital can give rise to speculative bubbles while a contraction of the credit cycle means there is a reduction in credit that causes asset prices to fall. Some economists regard the credit cycle to be the fundamental driving factor of the business cycle. An expansion of the credit cycle could also lead to an increase in the money supply, raising the demand for real goods and services that stimulates the economy that increases economic growth. It's therefor of vital importance to identify credit growth not driven by fundamentals but of speculative bubbles.

Figure 3. The Credit Cycle

1. Credit Cycle: Characteristics and Country Positions



Source: IMF Global Financial Stability Report October 2015

The credit cycle describes the consequences of credit growth on economic growth, asset prices and leverage. In a credit expansion with high credit growth borrowers' leverage increases and peaks, which is followed by a contraction or slowdown in credit growth and falling asset prices.

3.2 The Debt Deflation Theory

The debt deflation theory developed by Fisher (1933) states that borrowers trying to reduce their debt sell assets to raise money and repay their loans, which causes a contraction in the money supply and price level deflation. The theory suggests that depressions and recessions following financial crises are caused by an overall increase in real debt due to deflation, causing investors to default on their loans. This leads to bank assets declining and a surge in bank solvencies that leads to a reduction in bank lending affecting consumer spending.

3.3 The Financial Instability Hypothesis

Minsky (1977) elaborates on the model created by Fisher by incorporating the asset market. According to the hypothesis developed by Minsky a crisis starts with a macroeconomic shock that changes the economic outlook and anticipated profits, which is followed by a change in credit supply. This leads to firms and individuals borrowing more to take advantage of the new outlook that leads to an increase in market prices, which attracts investments. The increase in investments will escalate the growth rate of national income.

When more people want to take advantage of the possibility to profit from the new anticipated increase in prices it leads to a stage Minsky denoted as 'euphoria'. The term euphoria is used to describe a situation of overtrading and speculation, which involves buying commodities for the capital gain rather than for their use or buying securities for resale rather than investment. Overall, euphoria tends to increase the optimism about economic growth. This leads to a 'follow the leader' practice developing as people see others get rich and they get more eager to enter the market.

As the speculative boom continues insiders who owned the assets for a while start to collect some of the profit that the investments have rendered in. Newcomers buy these assets hoping to make the same profit as the insiders and as long as the securities are bought more often than sold the prices will continue to go up. If, however, the roles change and the sellers get more eager to sell, prices will decline. As buyers show less interest, sellers get more impatient to get out. If the prices fall sharply due to a period of financial distress, some highly leveraged investors may go bankrupt as the value of their

asset fall below the amount borrowed to buy them. As the prices continue to fall, more investors realize that the prices are unlikely to increase and that a quick exit is necessary in order to avoid further losses.

In cases where this speculative behaviour leads to a crisis it might turn into a race to get out of the market, which makes prices fall sharply. From here the race is on to get out and panic can occur as bankruptcies increase. Prices will then continue to fall until buyers start to return and confidence may be restored.

3.4 Kindleberger's Model

Aliber and Kindleberger (2005) presents a model for explaining the development of financial crises based on the theory developed by Hyman Minsky that describes the different stages of a bubble. In the model, the pro-cyclical change in supply of credit was highlighted in the identification of a bubble implying that credit supply would increase during a boom in the economy and decrease in the case of an economic slowdown. If the estimates of the profitability are revised upwards, investors want to borrow more for their investments. These findings show that asset bubbles are created following excessive credit growth. Kindleberger has argued that a stable economic environment creates a sense of optimism among investors that results in increased asset prices and investors use credit to drive prices up even further thus creating a credit growth bubble. This exposes the economy to financial instability and increases the risk of financial crises.

3.5 Reinhart and Rogoff's Theory of Financial Crises

Financial crises have occurred regularly over the past two centuries as stated by Reinhart and Rogoff (2009) who argue that the condition of each crisis is different but they are commonly preceded by increasing investment due to investors experiencing euphoria. They find that excessive debt accumulation and high private sector borrowing poses greater risk to financial stability and raises asset prices far beyond long-run sustainable levels.

4 Data and Methodology

4.1 Data Selection

All data used in this thesis is on a quarterly basis and collected from the Federal Reserve Bank of St. Louis (FRED) and the Bank of International Settlements (BIS). This study is based on time series data from three developed economies, the United Kingdom, the United States and Sweden over the time period 1981-2017. Our decision to analyse data from these specific countries came partly due to time limitation and the macroeconomic importance of these economies as well as personal interests. The UK, the US and Sweden are countries that in the moment are known to experience high credit growth, which makes it interesting in this study to see if it affects stock market prices.

Using quarterly data may not be optimal for this study but has been chosen due to availability. Data on a daily, weekly or monthly frequency would be preferable. The quarterly data for these countries will give enough observations in order to achieve statistical inference. To be able to draw any conclusions the sample size needs to be sufficiently large, there is a requirement of at least 80 observations for each of the variables from the countries in this study (Collins and Hussey, 2015, p.199). The Swedish data consist of a total of 99 observations and the data from the UK and the US is based on 148 observations.

4.2 Choice of Method

Granger causality analysis provides a method to empirically investigate the causal relationship between credit growth and stock market prices. Understanding the causal direction between credit growth and stock market prices is important, since it determines possible policy implications for fluctuations in these variables. There is strong evidence that credit growth and asset prices are positively correlated. However, this apparent comovement of asset prices and credit growth does not prove that increasing credit growth cause changes in asset prices. Therefore this thesis investigates the causal relationship between stock market prices and credit growth to determine their interdependency.

4.3 Variables

The independent variable of interest in this thesis is the credit growth variable. This thesis will analyse real private non-financial sector credit referred to as the credit growth variable. By using the credit growth as an independent variable makes it possible to empirically investigate if credit growth affects stock market prices.

The total share price index, expressed in index-points, is used as a dependent variable. Other relevant indexes to use would be the S&P 500 and OMXS30, these indexes however only include a relatively small number of stocks and a broader index will show more reliable results.

For the purpose of avoiding Omitted Variable Bias (OVB) two control variables are included in these tests, real GDP and a three-month (90 days) interest rate. The data on these two variables are both seasonally adjusted and adjusted for breaks.

4.4 Statistical Tests

4.4.1 Time Series Analysis

The aim with this thesis is to investigate some variables over a long period of time therefore a longitudinal study will be performed. This type of study is often associated with positivist methodology (Collis and Hussy, 2015, p.64). Positivism is referred to as one of two big paradigms that are most commonly used when it comes to business research. Since it assumes that social phenomena can be measured, positivism is often based on the statistical analysis of quantitative data (Collis and Hussy, 2015, p.44), which will be applied in this study.

A useful method when analysing quantitative data from a longitudinal study is to use time series analysis (Collis and Hussy, 2015, p.64). Time series analysis is when a variable is measured at regular intervals over time. The information from a variable measured over time, can be used to predict future values by regressing the variable on its previous lags (Stock and Watson, 2015, p.577). A regression model that relates a time series variable to its past values is called an Autoregression.

$$AR_{(p)} \text{ Regressors } Y_{t-1}, Y_{t-2}, \dots, Y_{t-p} \quad (1)$$

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots + \beta_p Y_{t-p} + u_t \quad (2)$$

Y_t = the dependent variable at time t
 β_0 = the intercept
 $\beta_1 Y_{t-1}$ = first lag of the dependent variable
 $\beta_2 Y_{t-2}$ = second lag of the dependent variable
 $\beta_p Y_{t-p}$ = the Pth lag of the dependent variable
 u_t = error term

The Autoregression model has different orders depending on how many lags that is included. The pth -order autoregressive model represents Y_t as a linear function of p of its lagged variables (Stock and Watson, 2015, p.577).

This study will determine if one time series can be used to predict another time series. The optimal model for this study is the Autoregressive distributed lag model (ADL), which is an extension of the ordinary Autoregressive model. In the ADL model the lagged variables of the dependent variables (Autoregressive) are included and the lagged variables of an additional predictor (distributed lag).

4.4.2 Granger causality

To investigate the causal relationship between credit growth and stock market prices a Granger causality test is performed. The Granger causality test is a statistical hypothesis test we can use to determine if one time-series is useful to predict another. The test is done by using a F-test where the null hypothesis implies that a variable has no predictive content and that the coefficient on all lags of that variable is zero. The F-statistic that we are using is called the Granger causality statistic.

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots + \beta_k Y_{t-k} + u_t \quad (3)$$

The first equation (3) displays a simple Autoregression, which will show if previous values of Y can be used to predict future values of Y.

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots + \beta_k Y_{t-k} + \alpha_{11} X_{t-1} + \alpha_{12} X_{t-2} + \dots + \alpha_p X_{t-p} + u_t \quad (4)$$

In the second equation (4) the lags of X are added to see if they can be useful in predicting the future value of Y.

Overall, Granger causality means that if X granger causes Y, then X is a useful predictor of Y given that other variables in the regression are kept constant providing a useful result for analysing the relationship between the two variables (Stock and Watson, 2015, s.589-590).

4.5 Econometric analysis

After obtaining data on credit growth, total share price, real GDP and three-month interest rate from the the BIS and FRED, we construct an Autoregressive distributed Lag model in order to find a causal relationship between the stock price index and credit growth. In order to do this a Granger causality test is performed. Nine different ADL models are constructed, three for each of the countries, Sweden, the US and the UK. Each country is regressed with one, two or three lags, hence the three different models.

The models in this thesis are estimated using the ordinary least squares (OLS) method in order to evaluate the causal relationship between the stock price index and credit growth.

The following Autoregressive distributed Lag (ADL) model is estimated:

Sweden

$$\Delta STP_{i,t} = \beta_{10} + \beta_{11}\Delta STP_{i,t-p} + \beta_{12}\Delta CG_{i,t-p} + \beta_{13}\Delta X_{i,t-p} + u_{it} \quad (5)$$

UK

$$\Delta STP_{i,t} = \beta_{10} + \beta_{11}\Delta STP_{i,t-p} + \beta_{12}\Delta CG_{i,t-p} + \beta_{13}\Delta X_{i,t-p} + u_{it} \quad (6)$$

US

$$\Delta STP_{i,t} = \beta_{10} + \beta_{11}\Delta STP_{i,t-p} + \beta_{12}\Delta CG_{i,t-p} + \beta_{13}\Delta X_{i,t-p} + u_{it} \quad (7)$$

$\Delta STP_{i,t}$ = first difference Stock market price index for country i at time t

β_{10} = intercept

$\beta_{11}\Delta STP_{i,t-p}$ = first difference stock market price index for country i at time t-p

$\beta_{12}\Delta CG_{i,t-p}$ = first difference credit growth for country i at time t-p

$\beta_{13}\Delta X_{i,t-p}$ = first difference control variables for country i at time t-p

u_{it} = error term for country i at time t

To run this regression, we use the econometric program STATA 15.1. The stock market index for all shares in the observed country is the dependent variable, which is regressed on its previous lags and the lags of credit growth, the variable of interest in this model. The control variables, real GDP and the three-month interest rate are also included and represented by X. These variables are included in order to lower the risk of the model suffering from OVB. However, when regression models are used for forecasting, unbiased estimators of the causal effect are not the main concern since we are interested in the causal relationship between the variables rather than the spot estimation (Stock and Watson, 2015, p.377).

4.6 Test for robustness

To ensure that our results are consistent, some tests have been conducted. The Breush-Pagan test is used in order to detect heteroscedasticity and the Breush-Godfrey test is conducted to see if there is serial correlation in the variables. The results of this test lead to the regression being executed using Newey-West standard errors. These standard errors are used if either serial correlation or heteroscedasticity is present in the data set. We also conduct a test for multicollinearity or highly persistent variables, this is done by correlation matrix of the variables (see appendix) that are included in the model. The outset is the rule of thumb that say if the variables have a higher correlation than 0,9 or 0,9 then caution about these problems needs to be addressed. The variables that didn't pass this test are replaced by their first differences.

One of the assumptions when using time series data is that the dependent variable and the regressors are stationary. If either the dependent variable or the regressors turns out to be non-stationary, then the hypothesis tests, confidence intervals and forecast might be unreliable. The problem depends on the nature of the non-stationarity. The most common non-stationarities are trends (Stock and Watson, 2015, p.597).

The Augmented Dickey Fullers test is used to detect a stochastic trend in the variables, this is also the most common test for this purpose (Stock and Watson, 2015, p.603). By OLS, the Dickey fuller test computes a dickey fuller statistic that we compare against the critical value. However, it is very hard to be sure that a stochastic trend exists. If the test does not reject, we cannot say that the null hypothesis, of the time series having a unit root is true, only that we do not have enough evidence to reject it (Stock and Watson,

2015, p.607). If the variable did not reject the hypothesis about a unit root, the variable is replaced by the first difference of that variable.

In order to detect seasonality, each of the variables is regressed against quarterly dummies. If the joint hypothesis test of the dummies would turn out significant then that would be proof that the variable suffers from seasonality, however, most of the data we have found is adjusted for seasonality, hence the test did not show any sign of the data suffering from seasonality.

4.7 Correlation test

To determine if stock market prices and credit growth move in the same direction, a correlation test is conducted using STATA. Correlation analysis aims to find if there exist mutual variance between two variables, which can indicate that a relationship exists (Stock and Watson, 2015, p.78).

5 Results

5.1 Hypothesis 1. Granger causality test

In table one we display the results from running an OLS regression using an autoregressive distributed lag model. We then run a Granger causality test to see if credit growth granger causes stock prices in each of the countries. A problem with these results could be that they suffer from OVB, we therefore chose to include real GDP and the interest rate (see data and methodology section for further information) as control variables, but there could be other variables that should have been included in the model that have not been considered.

The reason why we chose to conduct a Granger causality test is to see if there is a causal relationship between the time series of credit growth and stock market prices. i.e. if credit growth granger causes stock price changes. If there is such a relationship, then a change in credit supply will affect stock market prices suggesting that stock market prices are indeed fuelled by credit growth, which could become a threat to financial stability as argued by Minsky (1977) and Kindleberger (1978).

Table 1. Granger Causality

Granger Causality	1 Lag	2 Lag	3 Lag
Sweden	-	-	-
UK	-	-	CG-->SMP*
US	-	CG-->SMP**	CG-->SMP***

Note: the symbol "-" indicates no causality while the arrow "-->" shows the direction of the causality. One, two or three stars "*" imply that the results are significant at 10%, 5% or 1% level.

5.1.1 Granger causality results for Sweden

First, we present our results for the Granger causality test for the Swedish stock market. Table 6 (see appendix 8.2) displays the sign of the coefficients for credit growth from the autoregressive distributed lag model for Sweden. When examining the results we are interested in the relationship rather than the point estimation. With three lags included, a negative relationship is observed for both the second and the third lag but positive for the first lag. Interestingly it seems that credit growth would have the expected positive effect in the short run but a negative effect in the long run. When we run the regression with one or two lags, then the coefficients turn out negative.

This implies that credit growth would lower the risk of a speculative bubble in the stock market rather than fuel it. However, these statements are not supported statistically since the Granger causality test couldn't find joint significance between the time series. As we can see in table one, Sweden did not show any significant results of causal relationship between credit growth and stock market prices (see appendix, Table 9 for p -values from the Granger causality test). These results are inconsistent with the findings of Allen and Gale (2000), which suggest that asset prices are fuelled by credit growth. It doesn't appear from our results that the Swedish stock market is evidence of such a relationship.

5.1.2 Granger causality results for UK

Secondly, we present our results for the UK. Similar to Sweden, the test finds no obvious causality relationship. One big difference is that the Granger causality test indicates significant results when three lags are included in the model (see table 1). This indicates that credit growth does affect stock market prices, however, the estimates are only significant at a ten-percentage level. Although insignificant, the results using one or two lags are interesting. The first lag indicates a positive relationship in all of the regressions regarding UK (see appendix, Table 7 for coefficient signs). This supports the idea that increased credit could be fuelling stock market prices in the UK, i.e. there is a higher risk that a 'credit boom bubble' could occur in this stock market. According to Kindleberger's model, a change in the credit supply would inflate asset prices. When we look at the results from the Granger causality test it suggests that stock market prices are somewhat affected by credit growth, which according to the findings of Jordà et al (2015) poses a threat to financial stability. These results are interesting since it gives a small indication of a causal relationship and therefore could be of interest for further studies.

5.1.3 Granger causality results for the US

Lastly, we present our results for the US where the most surprising results were found in this thesis. The Granger causality test show that credit growth does granger causes stock prices when three or two lags are included in the model, surprisingly the test indicates a significant negative causality between the two variables (see appendix. table 8), at a one and five-percentage level when two lags are included.

These findings indicate that a high credit growth lowers the risk of stock prices being fuelled by credit and therefore decreases the probability of a ‘credit boom bubble’ developing in the US stock market. When three lags are included the coefficients of the lags shows a different sign, which makes it hard to establish what kind of relationship credit growth has with stock market prices in the US. What we do observe is that it seems that credit growth further back in time will affect the stock market prices positively while more recent credit growth will have the opposite effect. This kind of relationship is challenging to explain but an interesting topic for further investigation. When only one lag is included in the model the coefficient turns out negative.

It’s difficult to establish the existing relationship between credit growth and stock market prices since the credit growth lagged variables show different signs for all of the investigated countries. Some are positive and some are negative. However, the few variables that were individually significant were all positive. None of the lagged credit growth variables that showed a negative relationship was significant at any level. This weakly indicates a positive relationship.

5.2 Hypothesis 2. Correlation test

First, we provide summery statistics of our data. In table 2 we can see the averages of growth rates for stock market prices and credit growth on a quarterly basis. The UK and the US averages are computed based on every quarter from 1981 to 2017 while Sweden has a shorter time period, 1993 to 2017 due to the lack of data during the whole period. As table 2 shows, the average rates are quite close to each other, which supports our hypothesis about a correlation between stock market prices and credit growth. Sweden shows the biggest difference between the two rates with a difference of 1,3 percentage points while the UK and the US only has a difference of 0,2 and 0,4 percentage points. As the observed periods for the countries differ, the fact that Sweden has a different pattern raise a new question, does the correlation differ between long, medium or short term? This is an interesting subject of further investigation.

Table 2. Average growth rates

Country	Avg SMP Growth Rate	Avg Credit growth rate
Sweden	2,8	1,5
UK	1,9	2,1
US	2	1,6

Note: Rates in the table are expressed in percentage and is the average growth rate for each quarter.

Further, table 3 displays a correlation matrix between the variables stock price index and credit growth. In support of our second hypothesis, all countries show high correlation between credit growth and stock price movements. The US shows the highest correlation with 0,95 while Sweden and UK have similar correlation of 0,85 and 0,86. These results are consistent with the findings of Borio and Lowe (2002) that show how asset prices and credit expansions are positively correlated. The correlation between credit growth and stock prices in this case could mean that there is a threat to financial stability in these countries.

Table 3. Correlation Matrix

<i>SWE</i>	<i>SMP</i>	<i>CG</i>
<i>SMP</i>	1.0000	
<i>CG</i>	0.8518	1.0000
<i>UK</i>	<i>SMP</i>	<i>CG</i>
<i>SMP</i>	1.0000	
<i>CG</i>	0.8656	1.0000
<i>US</i>	<i>SMP</i>	<i>CG</i>
<i>SMP</i>	1.0000	
<i>CG</i>	0.9506	1.0000

Note: this correlation matrix displays the correlation between SMP (stock market price) and CG (credit growth) for Sweden, UK and the US.

It appears that there is no obvious Granger causality between the variables but as perceived by the graphical presentation below, there seems to be a connection between the credit growth rates and price indexes for all the countries. This suggests that movements in stock market prices are not completely unrelated to movements in credit growth.

We have visualized in figure 1.1 the real private credit growth in domestic currency in billions over time and in figure 1.2 the stock market price index in domestic currency over time for the UK.

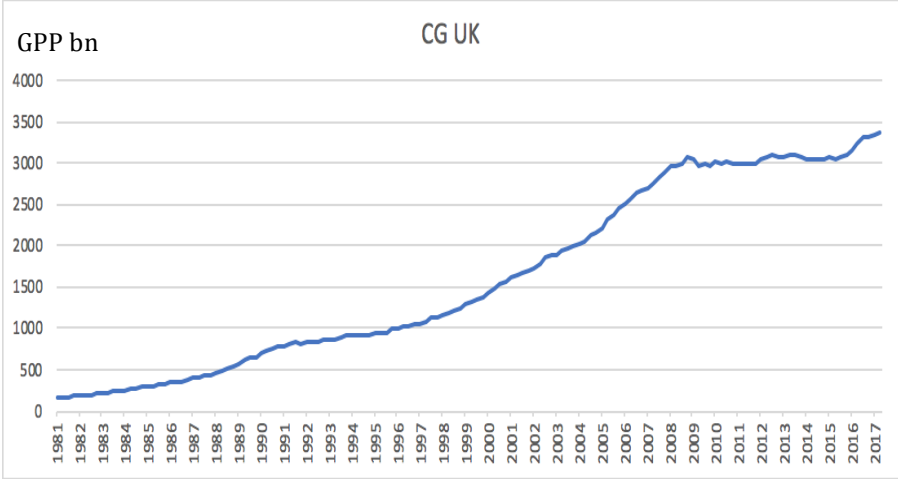


Figure 1.1 Private Credit Growth in the United Kingdom from 1981 to 2017

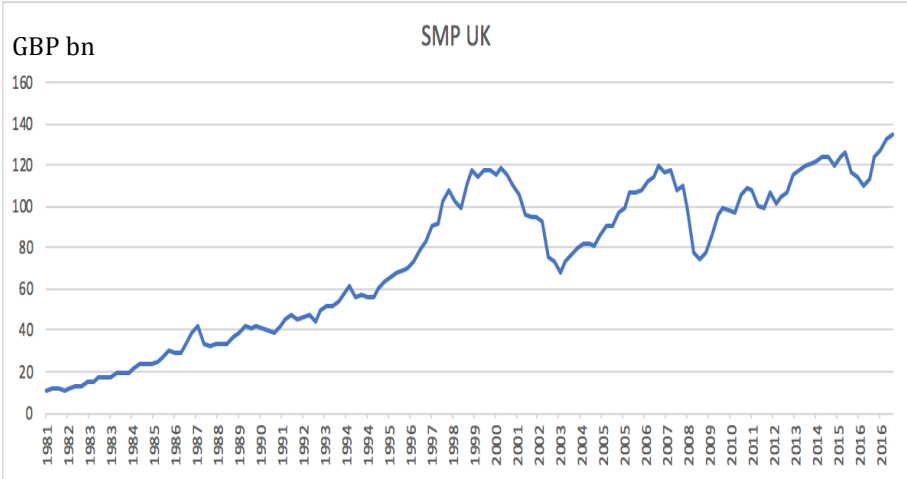


Figure 1.2 Stock Market Price Index in the United Kingdom from 1981 to 2017

In figure 2.1 the real private credit growth in domestic currency in billions over time is displayed and in figure 2.2 the stock market price index in domestic currency over time is displayed for the US.

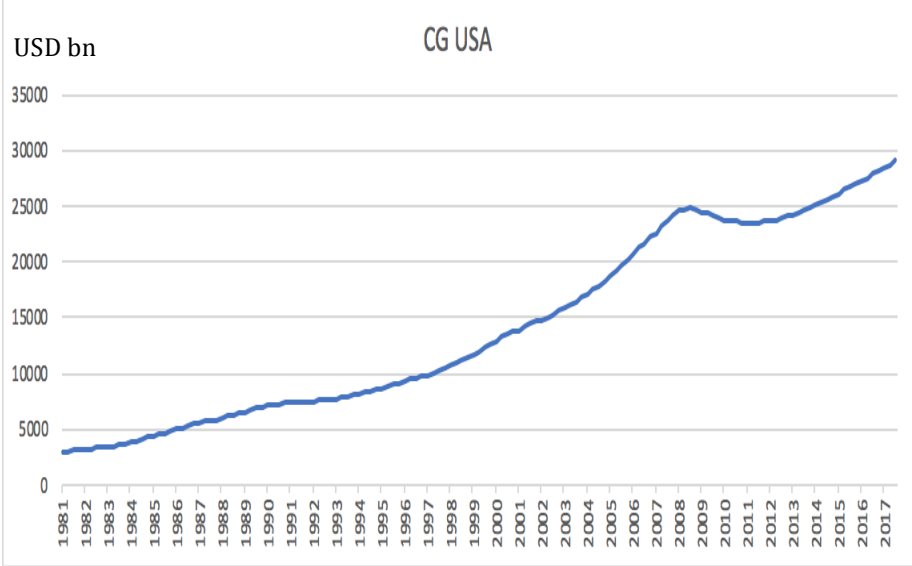


Figure 2.1 Private Credit Growth in the United States from 1981 to 2017

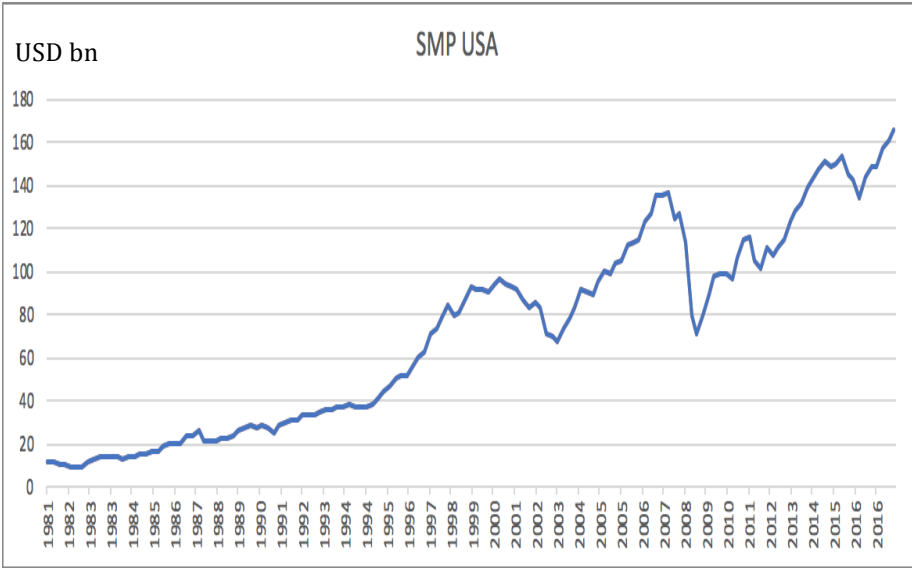


Figure 2.2 Stock Market Price Index in the United States from 1981 to 2017

In figure 3.1 we have presented the real private credit growth rate in domestic currency in billions over time and in figure 3.2 the stock market price index in domestic currency over time for Sweden.

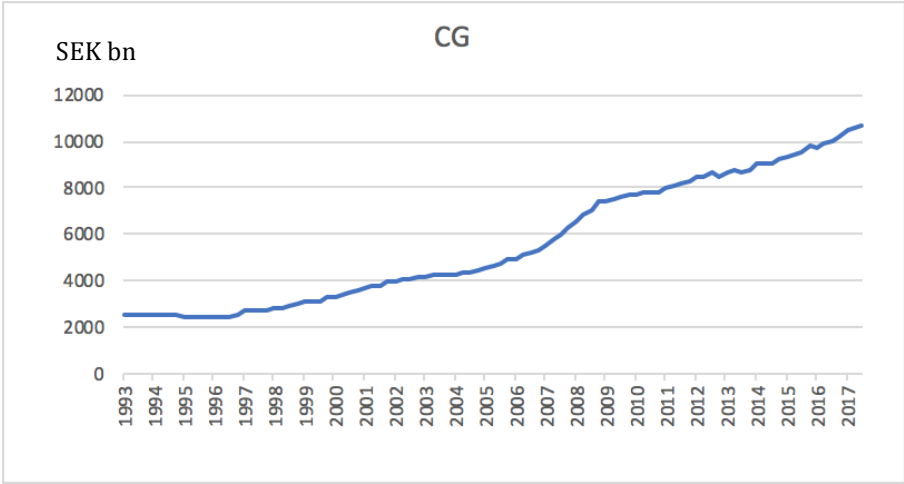


Figure 3.1 Private Credit Growth in Sweden from 1993 to 2017

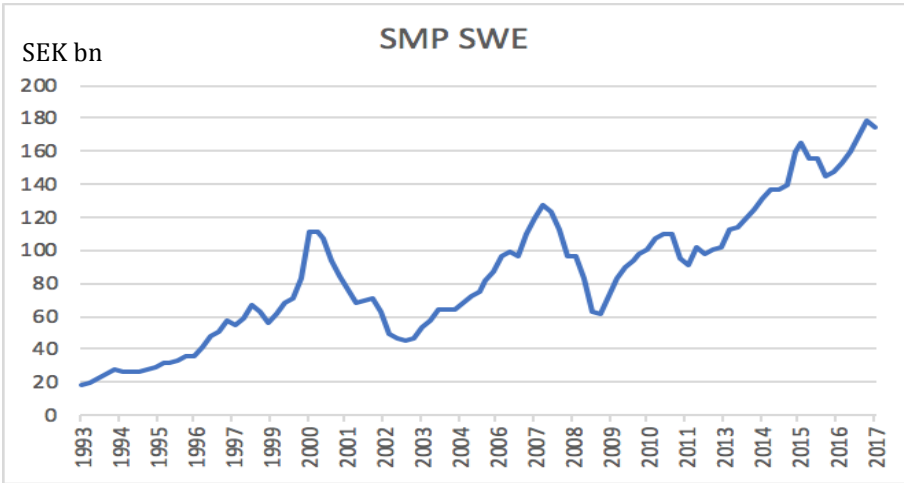


Figure 3.2 Stock Market Price Index in Sweden from 1993 to 2017

Summarising the answer for our first hypothesis, there seems to be no Granger causal relationship between private credit growth rates and stock market price indexes, i.e. there is no obvious indication that increasing stock market prices is the result of increasing credit growth rates. Although not statistically significant, the results of the Granger causality test still weakly indicates that stock market prices are somewhat affected by private credit growth rates. However, the estimates in the regression show both negative and positive relationships depending on how many lags that's included in the model.

Our results suggest that these price indexes are not driven by credit growth rates and therefore this test can't be used to identify stock market prices that are fuelled by credit growth. We do observe a positive correlation between credit growth and stock market price indexes indicating that credit growth and stock market prices move in the same direction, which supports our second hypothesis.

Since the recent financial crisis the problem of credit fuelled asset prices has become an even greater concern for governments and central bankers. The real effects of busting credit-fuelled bubbles have been seen in the US and many European countries during the recent years of economic recession. The currently high levels of credit growth observed in many developed economies raises new questions about its' potential threats to the macro economy and how policy makers can ensure financial stability to avoid another global financial crisis.

Previous literature have focused on how credit fuelled bubbles become a threat to financial stability and what monetary policy should be adopted to deal with asset price bubbles. Central Banks can influence the money supply and therefor price stability becomes a natural objective, but should they also incorporate asset prices and trying to target bubbles? Busts in the asset price cycle often cause contraction in real economic activities as previously mentioned in this thesis. The recent decades rise in stock market prices makes researchers and policy makers' wonder how central banks should respond to asset price volatility. Bernanke and Gertler (2000) argue that monetary policy should not respond to changes in asset prices because of the uncertainty incorporated in determining asset prices that deviates from fundamentals. The Bank of International Settlements argue that even though research suggests it can be beneficial using financial variables to predict financial crises or economic recessions it is difficult to predict the exact timing of a turning point in the business cycle making it difficult to implement an effective policy response.

The future challenges facing central banks remains to identify the underlying causes of asset price changes and the build-up of financial imbalances in order to find the appropriate policy response

6. Conclusion

This thesis initiates with a description of the risks to financial stability associated with asset price bubbles and shows how credit plays an important role in determining dangerous bubbles. In this thesis we have addressed this issue in the context of stock price levels. By using a Granger Causality test we've analysed the correlation between credit growth and stock market prices in three developed economies, the US, the UK and Sweden over a time period between 1981 and 2017. The results suggest there is no obvious Granger causality between credit growth rates and stock market prices but we can see they are positively correlated.

Our findings are in line with previous results from Borio and Lowe (2002) that show a positive relationship between private credit growth and asset prices. However, our results from the Granger causality test differs from previous literature where Allan and Gale (2000) find that asset prices deviate from fundamental values due to an expansion in credit that drive prices up. We find that increasing stock market prices cannot be explained by higher credit growth rates and our results suggest that the stock markets of the US, the UK and Sweden are not evidence of credit fuelled asset price bubbles. These results do not take into account the expectations of future credit growth that Allen and Carletti (2009) and Martin and Ventura (2016) find can affect asset price levels. In our investigation we have focused on trying to explain changes in asset prices when looking at stock market indexes that are caused by an expansion in credit but have found no such connection. It's difficult to evaluate the relationship between credit growth and stock market prices since there is a lot of information that affects stock market prices that we have not analysed in this thesis. Our results provide some insights into the relationship between credit growth and stock market prices that can be used for further and more extensive studies to evaluate possible implications for macro prudential policy.

The findings in this thesis raise several questions to be investigated by future researchers. Should monetary policy be concerned with asset price stability and try to target asset price bubbles driven by credit? Secondly, this thesis presents weak evidence that stock market prices are fuelled by credit even if they are correlated as been suggested by previous literature. This needs to be investigated further in order to determine how credit growth affects asset prices and more specifically stock market prices.

Finally, we think that despite this thesis limitations it provides some answer to our primary research question, that is to say there is not a statistically significant causal relationship between stock market prices and credit growth although they are positively correlated suggesting that stock market prices are not fuelled by credit growth.

7 References

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8 Appendixes

7.1 Test for robustness

Table 4. Test for serial correlation and heteroscedasticity

Variables	Sweden	UK	US
Breuch- Pagan	0,0000	0,0001	0,0001
Breuch-Godfrey	0,0000	0,0000	0,0000

Note: displayed values are P-values of the null hypothesis that the variance is constant. For the Breusch-Godfrey test the null hypothesis is that serial correlation is not present in the dataset. The reported Breusch-Godfrey test has a lag of 1. Furthermore, we tested higher levels of lag and the results also indicated serial correlation present in the samples.

As table three displays, both the assumptions for heteroscedasticity and serial correlation are violated for all the countries. This thesis use Newey-West standard errors to correct for this violation. The assumption about multicollinearity is also violated since; some of the variables exceed the rule of thumb of a correlation of 0,9, which this type of error was corrected by using the first differences of these variables.

Table 5. Time significance and seasonality

Variables	Sweden	UK	US
Seasonality	0,1075	0,9642	0,9826
Time	0,3420	0,1343	0,2543

Note: displayed values are p-values where the null hypothesis is that time does not have a significant effect and that no seasonality is present.

We do not include a time variable in the regression since it did not turn out significant. The reason for this is probably that most variables have used their first differences, which also have a de-trending effect. The test for seasonality was not significant for any country, most of the data that we found was already adjusted for seasonality.

7.2 Statistical tests

Table 6. Coefficient signs for Sweden

Sweden	1 lag	2 lag	3 lag
Lags included			
1	-		
2	-	-	
3	+	+	-

Note: the signs of the coefficients indicate what kind of relationship there is between Stock prices and credit growth. a negative sign “-” indicates a negative relationship and a positive “+” sign indicates a positive relationship. 1 lag, 2 lag, 3 lag is the name of the variables and 1, 2, 3 is how many lags was included in the model

significance
 *** = 1% level
 ** = 5% level
 * = 10% level

Table 7. Coefficient signs for the UK

UK	1 lag	2 lag	3 lag
Lags included			
1	+		
2	+*	-	
3	+	-	+**

Note: the signs of the coefficients indicate what kind of relationship there is between Stock prices and credit growth. a negative sign “-” indicates a negative relationship and a positive “+” sign indicates a positive relationship. 1 lag, 2 lag, 3 lag is the name of the variables and 1, 2, 3 is how many lags was included in the model

significance
 *** = 1% level
 ** = 5% level
 * = 10% level

Table 8. Coefficient signs for the US

US	1 lag	2 lag	3 lag
Lags included			
1	-		
2	-**	-	
3	-	-	+*

Note: the signs of the coefficients indicate what kind of relationship there is between Stock prices and credit growth. a negative sign “-” indicates a negative relationship and a positive “+” sign indicates a positive relationship. 1 lag, 2 lag, 3 lag is the name of the variables and 1, 2, 3 is how many lags was included in the model

significance
 *** = 1% level
 ** = 5% level
 * = 10% level

Table 9. P-values granger causality test

Country	1 lag	2 lag	3 lag
Sweden	<i>0,621</i>	<i>0,4389</i>	<i>0,3197</i>
UK	<i>0,130</i>	<i>0,1847</i>	<i>0,0555</i>
US	<i>0,254</i>	<i>0,0475</i>	<i>0,0096</i>