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Macroeconomic uncertainty and banks' loan supply:

The case of the Nordic countries

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Abstract

The purpose of this paper is to investigate whether macroeconomic uncertainty has a negative effect on Nordic banks' loan supply. To test this a model is defined with a gross loans/total asset ratio as the dependent variable and a proxy for macroeconomic uncertainty is used as the explanatory variable. A crucial step is the definition of macroeconomic uncertainty. In this paper five different measures of uncertainty is utilized as an attempt to create robust and extensive results. Three of the measures are indices and the remaining two are model-based GARCH variables. In total, 21 OLS regressions are performed and the results indicate that there might exist a negative relationship between macroeconomic uncertainty and Nordic banks' loan supply. However, this result is not robust for all of the five macroeconomic uncertainty proxies. In general, the indices seem to have a greater impact on the dependent variable in comparison to the GARCH variables.

KEYWORDS: Macroeconomic uncertainty, loan supply, GARCH, Global Economic Policy Uncertainty Index, Survey of Professional Forecasters

Introduction

Due to financial crises, such as the one in 2007, macroeconomic uncertainty has been given increasingly much attention. A common definition of uncertainty is that it is a non-measureable risk, which is not to be confused with risk that can be foreseen (Knight, 1921). An example is throwing a dice; here there is a probability of one sixth that the dice will show a five. Hence, throwing a dice is not an uncertainty. Looking at this from an economic perspective, uncertainty is often generally defined as the conditional volatility of an unforecastable disturbance (Ng et al. 2015). To find a measure for macroeconomic uncertainty is in practice a challenge and there are numerous methods to approach this task. In this paper, five different measures of uncertainty will be used in order to examine whether there is a relationship between Nordic banks' loan supply and macroeconomic uncertainty.

Macroeconomic change can reach commercial banks in several different ways. One is through central banks' policy decisions. The fact that there exist a connection between policy decisions and macroeconomic uncertainty is widely proven and accepted. This connection can go both ways, meaning that macro events can alter central banks' policy decisions, but similarly a central bank can contribute to macroeconomic uncertainty in a country (Friedman, 1961). Mishkin (1986) discusses the discount rate, which a central bank can use to affect the economy, such as weaken a country's currency. In general, central banks possess a key role in an economy and for the monetary policy (Mishkin, 1996). For example, expansionary monetary policies from a central bank would increase a banks reserve and thus increase its supply of bank loans. Hence, a good understanding of the mechanisms through which monetary policy influence an economy is of great importance. When investigating this, there are usually two main channels that are mentioned, namely the balance-sheet channel and the bank-lending channel. The balance-sheet channel discusses the linkage between monetary policy actions and firms balance sheet, and the fact that changes in monetary policy alter the preferred financial positions for borrowers. Second, there is the bank-lending channel that is based on commercial banks special role in the society. The idea is that it does not exist a perfect substitute to bank loans; hence some borrowers are dependent on a bank providing them with financing (Bernanke & Gertler, 1995). These borrowers are typically smaller firm with fewer assets. Further, Gatev & Strahan (2003) argue that banks can insure firms from a decline in market liquidity due to their deposit inflow that function as a hedge for loan demand shocks.

Commercial banks can hold this special role in a society and provide loans to firms and individuals that no other institution would due to their extensive risk management and information collection (Baum et al. 2005). At the same time, these are also costly procedures and make the banks dependent on macro stability. The more volatile the market is the harder it becomes to predict future economic movements. Hence, there is evidence that banks tend to act more homogeneously when macro uncertainty increases since it becomes more difficult for bank managers to predict future returns on investments (Baum et al. 2005). Similarly, when the macro uncertainty decreases the banks are likely to behave more heterogeneously. In this context, a homogeneous behaviour means that the banks make similar kinds of decisions regarding their loans. Hence, the dispersion between banks loans in relation to their assets decreases.

Macroeconomic uncertainty seems to rise in recessions, and exogenous shocks such as financial panics and commodity price jumps also negatively affect uncertainty. These shocks has a direct affect, while recessions increase both micro and macro volatility and hence in return influence the economic uncertainty. This uncertainty also appears to vary between countries, where developing countries have about a third more in comparison to developed countries (Bloom, 2013). Baum et al. (2005) recognize the fact that there exists a variety of loans and that banks can treat loans differently when experiencing a volatile macroeconomic environment. However, there are still several unanswered questions. There is to my best knowledge not any previous research on the effect macroeconomic uncertainty have on banks loan supply in the Nordic countries. Therefore the focus will lie on the question if macroeconomic uncertainty affects banks lending behaviour in general. For the Nordic countries this is of interest since it is a relatively small and open region that is widely affected by the global economies development and backlashes. Staikouras, C & Wood, G (2004) present results that indicate that the profitability of European banks is affected both by their management but also from the external macroeconomic environment.

The hypothesis of this paper is that an increase in macroeconomic uncertainty leads to a decrease in the loan-to-asset ratio. Hence, a ratio between gross loans and total assets is utilized as the dependent loan variable. To be able to investigate if this hypothesis is true the definition of macroeconomic uncertainty is of high importance since that can alter the results. Thus, five different measures are employed in this paper. Two of them are the conditional variance of CPI and industrial production, constructed trough a GARCH (1,1) model. Further,

there are two measures, CPI forecast and GDP forecast, which consist of forecasts conducted by research economists at the Federal Reserve Bank of Philadelphia. The two measures are obtained with two different time lengths, time T and time T+4. Lastly, there is the GEPU, which is a global policy uncertainty index that measures society's perception of the macroeconomic environment through newspaper articles regarding these topics. Hence, there is a large difference between the constructed GARCH variables and the other indices. The GARCH variables are model-based and not as related to society and its human expectations and beliefs as the GEPU and the CPI and GDP forecasts.

A panel dataset is used for the period 1997Q1-2016Q3 for 21 Nordic banks. An OLS regression was performed for the five different macroeconomic uncertainty measures together with a number of control variables presented in Section 4. The results imply that macroeconomic uncertainty does decrease the banks loan supply. However, mostly in the long run. Moreover, the variables that are more connected to society and peoples perception of reality seem to have a greater impact on the loan-to-asset ratio in comparison to the model-based GARCH variables. Hence, these results imply that there is a force in what people think will happen, and that if we believe the world is more economically unstable there is a greater change it will be.

The paper is structured as follows. Section 2 presents the literature review, Section 3 presents the data, Section 4 presents the model, Section 5 presents the results and Section 6 concludes. The variables, the Nordic banks and the summary statistics are displayed in the Appendix.

2 Literature review

That macroeconomic policy can affect bank lending is usually agreed upon (Bernanke & Gertler, 1995). However, exactly how this plays out is far from decided. Bernanke & Gertler (1995) discusses the credit channel theory. This theory says that the monetary policy affects the interest rate, and that the relation is reinforced by the external finance premium. The external finance premium is defined as the difference between funds raised externally and funds generated internally. The authors discuss two potential linkages that connect actions taken by the central banks and the resulting effects on the credit market. These are the previously mentioned balance sheet channel and the bank-lending channel. The bank-lending

channel investigates the possible impact monetary policy actions have on the depository institutions loan supply. The idea is that the Federal Reserve can change banks loan supply by running open-market operations. The theory says that when frictions, for example asymmetric information, increases on the market the external finance premium should grow. This rise mirrors the dead weight loss that arises between lenders and borrowers.

There exists numerous of previous studies on macroeconomic uncertainty. For example, Ibrahim & Shah (2012) have examined the interrelations between financial uncertainty, macroeconomic conditions and bank lending in Malaysia. Amidu (2014) have looked at bank lending and through which channels it can be influenced for sub-Saharan Africa. Quagliariello (2007) performed a study for Italy to see how Italian banks manage their loans and risk-free assets when macroeconomic uncertainty increases.

Kashyap & Stein (2000) recognize the fact that changes in monetary policy create movements in aggregate bank lending volume, hence that the bank-lending channel exists. In their paper the researchers want to investigate if there are cross-sectional differences between banks with varying features, where one of the main ones is liquidity and another the size of the bank. Their data is from the period 1976Q1-1993Q2 and include US banks. Since there is no clear consensus of which proxy to utilise for monetary policy the paper present three different measures of monetary policy; Bosche-Mills index that consists of five categories regarding how expansionary/contractionary Fed policy is, the FED rate and one measure developed by Bernanke & Mihov (1998) who uses a VAR model based on assumptions about Fed operating procedures. They find that in small banks segment, banks with less liquid assets are mostly affected by alterations in monetary policy. However, even though the authors find significant results it is still difficult to know the economic importance of the bank-lending channel. For example, the authors does not fully know what the elasticity between bank and non-bank forms of credit is for potential borrowers on short notice. From a Swedish perspective there has been an increase in financial institutes providing small non-security loans for a relatively high interest rate. Several of these are directed towards customers who cannot obtain a bank loan or are in need of a loan quickly. Hence, the elasticity perhaps increases with this development in the short run. Such elasticity can be positive since it is then easier to gain liquidity for a firm or a person. However, in the long term this can be damaging since customers might experience insolvency.

As previously mentioned, macro uncertainty can be defined in more than one ways. Stein & Kashyap (1993) focus on Fed's possibility to affect banks loan, hence macroeconomic uncertainty is measured by contraction of the FED. The paper uses cross-sectional data and has the macroeconomic uncertainty as the dependent variable. The purpose of their paper was to discuss the lending view of monetary policy transmission and the main ingredient, namely the imperfect substitutability of bank loans and publicly issued bonds. They write that the lending channel coexists with the more traditional money channel and that they can function as complementary. In fact, the lending channel can be an influencing force on and change the distribution of the money channel (Stein & Kashyap, 1993). Bernanke & Blinder (1992) also use the contraction of the FED when they examine the monetary transmission channels. If the FED reduces the volume of the reserve this lower the aggregate demand since the amount of bank loans available is less. They find evidence that this is mainly in the long run since banks end old loans and do not offer new ones. This then affects the borrowers that are dependent on bank loans for credit. When defining macroeconomic uncertainty in this way the focus lies on the monetary transmission mechanism that was discussed in the introduction. However, this paper does not define macroeconomic uncertainty in this manner, and monetary transmission is only regarded as one potential channel through which macroeconomic uncertainty can arise.

Pesola (2001) chooses to express macro uncertainty as economic shocks. The data consists of panel data from 1980-2000 for the Nordic countries. Two different measures are used as the dependent variable: the ratio of banks' loan losses to lending and enterprise bankruptcies per capita. The results imply that the banking crises in Sweden, Norway and Finland were caused by negative macroeconomic surprises together with high indebtedness. Hence, from this a relation between banking and macroeconomic events can be derived. When undesirable macroeconomic incidents occur and the market becomes more volatile banks react to this. In the paper by Pesola (2001) the macroeconomic issue seem to arise not only from uncertainty, but also from borrowers not being able to repay their loans. Hence, there are both supply effects and demand effects to be taken into consideration. In this paper the emphasis will be on the supply, more precisely it will be tested if banks loan supply decline in relation to their total assets. This would mean that banks become more restrictive and contracting with their loans when macroeconomic uncertainty increases. Hoggarth et al. (2005) is another paper that contributes to this idea by performing a stress test on the UK banking system during the years

1993-2004 using a VAR-model. They find that an adverse output shock results in an increase in total loans write-off ratio.

Ibrahim & Eskandar Shah (2012) uses VAR models and impulse response framework in order to evaluate bank lending and financial uncertainty. Their data contains Malaysian banks on a quarterly basis from 1991Q1-2011Q2. Stock market volatility is used to measure financial uncertainty. One finding is the indirect effect market has on real output and bank credit through the changes in the interest rate. Additionally, they discover that real bank credits, real output, interest rate and stock prices appear to be depressed by market volatility.

Baum et al. (2005) have made large contributions to this field and their research is also an inspiration for this paper. They present another definition that model macro uncertainty as the conditional variance of industrial production or CPI inflation. The data covers essentially all banks in the US for the period 1979Q1-2003Q3. The paper aims at investigating if macroeconomic uncertainty has an impact on the dispersion of banks' loan-to-asset ratio. The authors use a reduced-form equation and set the cross-sectional dispersion of banks' loan-to-asset ratio as the dependent variable and macro uncertainty as the explanatory variable. Their hypothesis is that it is a negative relationship between the two variables, meaning that increased macro uncertainty lead to a smaller dispersion of banks' loan-to-asset ratios. Hence, a negative coefficient in front of the macro uncertainty variable is expected. In order to make the results more robust they look at three different loan components, total loans, real estate loans and commercial loans. The results confirm their hypothesis. More precisely, they find that a doubling of macroeconomic uncertainty lead to a 6-12 per cent decrease in the dispersion of the loan-to-asset ratio.

To divide the loan data and make it more specific is an interesting aspect since it is then possible to examine if the banks choose to treat the loans differently when reacting to macro uncertainty. However, for the Nordic countries this was not possible due to lack of data. Further, this paper focuses on the question if macro uncertainty affect banks loan behaviour in general and attention is instead paid on the definition of macro uncertainty.

Another similar paper is Baum et al. (2002) who also discuss the linkage between macroeconomic uncertainty and bank lending. The data used in the paper is both yearly and quarterly US level data and in line with Baum et al. (2005) the authors use the dispersion of

loan-to-asset ratio as their dependent variable. The macroeconomic uncertainty proxy is variation in industrial production. If the hypothesis hold the increasing variation will lead to banks behaving more conservatively. The authors find that changes in loan-to-asset ratio are greater among smaller banks when macroeconomic uncertainty increases. Also, banks that are higher rated and more profitable make considerably less alterations in their loan-to-asset ratios compared to lower rated and less profitable banks.

Banks play a special role in a society. Specifically, they function as an intermediary on the credit market where they acquire costly information on potential borrowers and provide credit based on this information (Baum et al. 2005). There exist several reasons for why banks' lending may differ over time. Firstly, since the banks need to obtain the information mentioned above economic uncertainty will make them change their lending strategies. Moreover, these changes might not change exactly as the macroeconomic variables leading to a potential distortion of the effective allocation of loanable funds. For example, a bank might react strongly to a relatively small increase in macroeconomic uncertainty, leading to changes in banks behaviour that is unmotivated. This is also what the results in Baum et al. (2005) depict. These results are promoting macroeconomic stability to stimulate the efficient allocation of resources.

The way of modelling that Baum et al. (2005) chooses has been used by several other authors. An example is Quagliariello (2007) who uses a sample from Italy for the years 1990Q1-2005Q1 including approximately the entire Italian banking system. The aim of the study is to observe if banks' choice between loans and risk-free assets change when macroeconomic uncertainty increases. Additionally, the authors divide the uncertainty into macroeconomic uncertainty and idiosyncratic uncertainty. The finding says that an increase in idiosyncratic risk will give better-informed banks a competitive advantage and thus they will behave differently in comparison to less-informed banks (Quagliariello, 2007). Also, Quagliariello (2007) finds that uncertainty in macroeconomic conditions does influence banks' investments strategies. During increasing macroeconomic uncertainty the banks will obtain more volatile signals on the expected returns of loans, hence they will operate more homogeneously.

Furthermore, Bynoe (2010) have investigated the impact of macroeconomic uncertainty on commercial bank lending behaviour in Barbados during the period 1996Q1 until 2009Q4. The author defines the dependent variable as the cross-sectional variance of the loan-to-asset ratio.

The result shows that there is a negative relation between the loan-to-asset ratio of commercial banks and macroeconomic uncertainty.

Malede (2014) present a study with Ethiopian commercial banks and what impact main determinants, such as gross domestic product, bank size and required reserves, has on banking. The data consists of eight commercial banks during the years 2005 to 2011. The dependent variable is bank lending and the model is an OLS. The results suggest that some determinants have a significant impact while some do not. More precisely, bank size, credit risk, gross domestic product and liquidity ratio are the determinants of significance. Another paper with similar objectives of the study is Amidu (2014) that examines the determinants of bank lending, namely the monetary policy stance, macroeconomic variables, and legal and financial structures, in sub-Saharan Africa. One result regards the concentration of banks and shows that there is a negative relation between bank concentration and bank lending.

Abaidoo (2013) uses quarterly US data spanning from 1960-2010 in order to show that loan supply can be significantly negatively influenced by expectations of inflation, growing budget deficits and macroeconomic uncertainty. Additionally, the study finds that there are more constraining effects on macroeconomic uncertainty from the explanatory variables in the long run than in the short run. However, in this paper a shorter time period is covered due to the fact that there does not exist very much data from before 1997 and therefore makes it difficult to cover earlier periods.

3 Data

The loan data and asset data for every bank are extracted from Capital IQ database; the industrial production, CPI and the control variables are from OECD.stat. The Survey of Professional Forecasters Index and the Global Economic Policy Uncertainty Index (GEPU) are published by the Federal Reserve Bank of Philadelphia and Economic Policy Uncertainty respectively. A full list of the variables is displayed in the Appendix.

The data span from 1997Q1 until 2016Q3 and covers 21 Nordic banks. A complete list of the banks is presented in the Appendix. The dependent variable is the ratio between gross loans and total assets. The reason for choosing gross loans and not total loans is that it was many

more observations available for gross loans. However, as a robustness check the regressions were performed with total loans as well (see Section 5). Several measures for macro uncertainty have been used. The decision of which one to choose is of great importance and can have large impact on the final results (Baum et al. 2003). Therefore, five measures were included in order to make the results more robust.

First, there is the framework from Baum et al. (2005) who use the conditional variance of industrial production and CPI. Out of these two the conditional variance of CPI is an attempt to capture the financial macro uncertainty. The reason for picking these two measure and not any other monetary aggregate is that signs of instability in the economy will arise initially in the behaviour of inflation and production (Baum et al. 2005).

Secondly, there is the macro uncertainty index developed by Federal Reserve Bank of Philadelphia and published for the "Survey of professional forecasters". The index consists of the cross-sectional forecast dispersion of several different macro variables between the 25% and 75% percentile. The dispersion consists of different analysts forecast of future variable movements. The more the analysts' forecasts differ from each other, the more uncertainty there is about the future macroeconomic environment. Here, the GDP and CPI will be utilised in order to obtain macro uncertainty proxies. GDP and CPI are chosen to match the variables from Baum et al. (2005). However, industrial production did not exist in the "Survey of professional forecasters" database and thus GDP was selected as its substitute. The index present quarterly forecast horizons that begins with the current quarter (T) and the following four quarters (T+1,…,T+4). The forecast is conducted in quarter T and made from projections on the basis of historical observations dated T-1. The current quarter (T) and the last quarter (T+4) are the ones that is included in this paper. This is in order to create a min-max setting and to observe if there could be a difference in banks loan behaviour in a shorter or longer forecast horizon.

Further, the Global Economic Policy Uncertainty Index (GEPU) is a macro uncertainty index that contains 16 countries around the world. It begin in 1997 and runs until 2016 on a monthly basis, which in this paper is modified into quarterly data. The index is constructed by observing the proportion of own-country newspaper articles that discuss economic policy uncertainty in that month. The researchers examine how frequently a trio of the words economy, policy and uncertainty appears in newspaper articles. One concern when relaying

on newspapers is their accuracy, potential bias and consistency. Bloom et al. (2015), who developed this index, address this in their paper where the authors continuously compare their index to other measures of economic uncertainty such as stock-market volatility. This is done in order to see if their index is somewhat reasonable. Further, the authors try to capture the macroeconomic effects of the policy actions, but also who makes the decisions and what policy actions that will be undertaken. They also highlight the fact that newspapers have existed in its present form for a very long time and around the entire globe. Combing this with modern computers and databases present huge possibilities to understand economic development and to perform empirical studies.

A common factor between all macro uncertainty measures is their global aspect. In fact, the world has become more globalized and interconnected. Hence, in order to capture and understand the macro economic environment a global perspective is needed. The reason for using the US industrial production and CPI respectively is due to the fact that the data consists of several smaller countries where all of them are dependent on economic waves and backlashes from larger counterparts such as the United States (Mishkin, 1986). Also, the "Survey of professional forecasters" index only exist for the United States and therefore it was reasonable to also develop the GARCH proxies from US data. The one proxy that is even more globalised is the GEPU. Again, this is an attempt to obtain the most global perspective possible. A main difference is that the GARCH variables are constructed variables, whereas the remaining three are based on professional forecasts and published newspaper articles regarding this topic. The idea of including these last three variables is to capture a more social and emotional aspect of the economy, where people's beliefs and ideas of the economy are taken into consideration. Hence, these three macro economic variables are more anchored to people's expectations regarding the macroeconomic environment in comparison to the constructed GARCH variables.

4 Model

The following model is used to examine if macro uncertainty affects the loan-to-asset ratio[1]:

$$LTA_{i,t} = MU_{i,t}^{k} + I_{t-1} + CE/TA_{i,t-1} + IP_{t-1} + \ln TA_{i,t-1} + FED_{t-1} + \varepsilon_{i,t}\,, \qquad \varepsilon \sim IID(0, \sigma^2) \qquad (1)$$

[1] All regressions are performed in Eviews.

where the dependent variable, $LTA_{i,t}$, is the ratio between gross loans and total assets. $MU^{k}_{i,t}$ is equal to the macroeconomic uncertainty, where the index k refers to the different macro uncertainty measures. Namely, the conditional variance of industrial production, the conditional variance of CPI, the cross-sectional dispersion of GDP or CPI, extracted from the "Survey of professional forecasters", and finally the Global Economic Policy Uncertainty Index. Further, $I_{i,t}$ is inflation, $CE/TA_{i,t}$ is the ratio of common equity and total assets, $IP_{i,t}$ stands for industrial production, $\ln TA_{i,t}$ is the logarithm of total assets, FED_{t-1} is the effective federal funds rate, and lastly, $\varepsilon_{i,t}$ is the error term. The subscripts i and t represent the cross-sectional and the time aspect of the series respectively. The time period is lagged one period for the control variables and for the macro uncertainty measures, except for the GARCH variables since they are by construction already based on lagged observations. The reasoning behind lagging the variables is that banks base their loan decision on existing data and the most recent observation is the one from the previous period that affects banks behaviour in the current period.

The following AR (1) mean equation is used to obtain the measure for macroeconomic uncertainty in the industrial production series and CPI series:

$$X_t^m = C_0 + C_1 X_{t-1}^m + \varepsilon_t \qquad \varepsilon \sim N(0, \sigma_t^2), \qquad (2)$$

where m is the superscript for the two different series, namely CPI and industrial production.

The error term, ε_t, is assumed to follow GARCH (1,1) process:

$$\sigma_t^2 = a_0 + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \qquad (3)$$

In order to use the conditional variance from a GARCH the series must display clustering volatility behaviour. When optically observing the series they do show clustering volatility, and when running the two original series as GARCH regressions the coefficients are statistically significant on a ten per cent level. Additionally, a heteroscedasticity test was performed on the two series, which rejected the null of homoscedasticity.

The conditional variance from the industrial production and CPI that is obtained in Equation (3) is then utilised as macro uncertainty proxies in the main equation (Equation 1). Further, the two indices (GEPU and Survey of professional forecasters) are inserted without any modification into the equation and ran as an OLS with cross-sectional fixed effect. The fixed effect is introduced in order to capture the dynamics of the two variables and not how much they differ between the banks within the sample.

The model contains several control variables starting with the logarithm of total assets, which is added in order to incorporate the size of the banks. Baum et al. (2005) have a large dataset for US banks and choose to include a size dummy since banks' amount of assets can influence their loan supply. In this paper there are not as many banks in the sample and even though there are some size differences (yet most of the banks are large) it makes more sense to add a continuous size control variable. Further, Baum et al. (2003) presents findings that suggest that smaller banks increase their loan supply more in comparison to larger banks. Hence, size is something to be controlled for. The common equity/total assets ratio is a typical proxy for the leverage of a firm. Bernanke & Gertler (1995) mention the impact of leverage and how a central bank can use the short-term interest rate to change the leverage of the banks and influence the banks cost of capital. The inflation, industrial production and FED rate are all macro variables that could alter a bank's loan behaviour. Therefore, these controls are also added to the model.

In order to examine whether the series are stationary, a unit root test was performed on all the series. For total loans/total assets, gross loans/total assets, GEPU and common equity/total assets the null hypothesis of a unit root could not be rejected. Hence, the variables were transformed in three ways and result in three different results for each model. First, all series were made into first difference. Second, the series were linearly de-trended. When optically examining the heteroscedastic series some of them showed signs of non-linear trending. Thus, lastly the heteroscedastic series were also non-linearly de-trended, assuming a quadratic trend.

In the following two tables the descriptive statistics and the correlation table are presented.

Table 1: Descriptive statistics

	GL/TA	TL/TA	GEPU	CPI (T)	CPI (T+4)	NGDP (T)	NGDP (T+4)	GARCH CPI	GARCH Ind Prod	Inflation	FED Rate	Log Tot Assets	Ind Prod	CE/TA
Mean	0.7245	0.6994	116.3453	1.2673	0.7030	48.0945	173.2635	32.6557	16.7228	0.0199	1.2988	10.7090	0.0023	0.0646
Median	0.7276	0.7163	111.6760	1.1500	0.6476	46.0002	154.6233	32.6106	16.7330	0.0189	0.1800	10.4802	0.0055	0.0586
Maximum	0.9834	0.9996	262.7891	3.7443	1.4000	108.3308	386.7859	33.0455	17.1563	0.0530	6.5300	13.6050	0.0208	0.2420
Minimum	0.3010	0.0000	54.1624	0.4000	0.3950	22.3290	63.0000	31.2617	15.5786	-0.0162	0.0700	7.0556	-0.0559	0.0275
Std. Dev.	0.1263	0.1594	42.6030	0.6708	0.2026	15.0924	62.5639	0.2155	0.2786	0.0131	1.8184	1.7082	0.0139	0.0314
Skewness	-0.5112	-1.0746	0.8581	1.9352	1.0303	1.3447	1.6503	-0.2002	-1.8728	-0.2572	1.3189	-0.0192	-2.2403	2.7289
Kurtosis	2.8829	4.6570	3.8350	7.2443	3.9284	6.3637	5.9222	4.0119	8.6284	3.2257	3.1819	1.6515	8.7923	12.964
Jarque-Bera	34.1082	237.2011	117.3294	1062.702	164.5211	597.3793	625.9217	38.1422	1472.153	10.1626	225.1659	58.61888	1727.248	4157.224
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0062	0.0000	0.0000	0.0000	0.0000
Sum	560.0679	540.6530	89934.91	979.6406	543.3997	37177.05	133932.7	25242.85	12926.68	15.3569	1003.990	8278.015	1.7435	49.9687
Sum Sq. Dev.	12.3149	19.6089	1401192	347.3316	31.6981	175845.9	3021791	35.8479	59.9397	0.1334	2552.657	2252.636	0.1490	0.7616

Table 2: Correlation table

	GL/TA	TL/TA	GEPU	NGDP (T)	NGDP (T+4)	CPI (T)	CPI (T+4)	GARCH CPI	GARCH Ind Prod	Inflation	Log Tot Assets	FED Rate	Ind Prod	CE/TA
GL/TA	1	0.7685	-0.2109	-0.0847	0.0109	0.0030	0.0523	0.1853	0.1250	0.1866	-0.6397	0.2773	-0.0296	0.1659
TL/TA		1	-0.0449	0.0874	0.0742	0.0389	0.0756	0.0070	-0.0497	0.0349	-0.6438	-0.0003	-0.0470	0.2224
GEPU			1	0.1783	0.1667	-0.0426	0.0953	-0.2801	-0.1232	-0.1693	0.0393	-0.5516	-0.1750	0.1327
NGDP (T)				1	0.6779	0.3092	0.3299	-0.1200	-0.7557	-0.5487	-0.0374	-0.3842	-0.4904	0.0552
NGDP (T+4)					1	0.2092	0.5634	0.1302	-0.7028	-0.4066	-0.0504	-0.2796	-0.4726	-0.0412
CPI (T)						1	0.2243	-0.2000	-0.1897	-0.1247	-0.0271	0.0618	-0.4884	-0.0326
CPI (T+4)							1	0.2138	-0.2705	-0.0028	-0.0704	-0.1605	-0.2040	-0.0658
GARCH CPI								1	0.1120	0.0366	-0.0522	-0.0013	0.1955	-0.1784
GARCH Ind Prod									1	0.6721	0.0230	0.3975	0.2653	-0.0669
Inflation										1	-0.0288	0.51071	0.2094	-0.0952
Log Tot Assets											1	-0.0156	0.0041	-0.4681
FED Rate												1	0.0802	-0.1837
Ind Prod													1	0.0650
CE/TA														1

5 Results

Table 3 presents a summary of the results and reports coefficient estimates for the macroeconomic uncertainty variables in each of the specifications. The Global Economic Policy Uncertainty index results enter with a negative but non-significant coefficient in the first difference model. For the two de-trended models they both enter with a negative and significant coefficient. Hence, this indicates that an increase in macroeconomic uncertainty leads to a decrease in banks loan supply volume. This is in line with previous literature; such as Ibrahim & Eskandar Shah (2012) who found evidence that suggest that market volatility depress bank loan supply. Moreover, all three coefficients are quite small, which means that the economic magnitude is limited. Turning to the CPI forecast variables all three modifications have significant coefficients at time T, yet they do not have the same sign, which complicates the analysis. Regarding the time period T+4 the non-linear de-trended coefficient loses its significance, but every coefficient is now negative. Thus, what could be said is that it seems as if the negative impact an increase in macroeconomic uncertainty has does not always cause an immediate change in the bank loan supply. The GDP forecasts only gives one significant results, which is at time T+4 in the first difference modification. This could imply that the CPI forecast is a better proxy for macroeconomic uncertainty in comparison to the GDP forecast. In general, the results for the two forecast variables are not robust for the different modifications. Still, at longer horizons it seems as if the CPI forecast variable does affect macroeconomic uncertainty negatively. This is an interesting observation and will be discussed further below.

Examining the size of the coefficients discussed above none of them is very large. The non-linear de-trended CPI (T+4) with a coefficient of (-0, 0293) is in fact the largest coefficient in absolute term, yet is still a quite modest number.

Table 3: Results for Gross Loans/Total Assets

GL/TA	First difference	Linear detrended	Non-linear detrended
GEPU	-1.53E-05	-7.15E-05*	-6.96E-05*
CPI (T)	-0.0071***	0.0061**	0.0073**
CPI (T+4)	-0.0102*	-0.0258***	-0.0293
NGDP (T)	-3.69E-05	-3.61E-05	9.88E-05
NGDP (T+4)	6.73E-05*	-3.07E-05	-4.41E-05
GARCH CPI	-0.0096	0.0112**	0.0207
GARCH Ind. Prod.	0.0016	0.0443***	0.0207***

Column 1,2 and 3 displays the coefficient values for the three different modifications where *= p <0,1, **= p <0,05 and ***= p< 0,01

When examining the first difference industrial production GARCH variable it has a positive, non-significant coefficient. The de-trended industrial production GARCH variables have positive, significant coefficients. Further, the CPI GARCH variables only significant result is for the linear de-trended modification where it has a positive coefficient. Similarly to the forecast variables results these are also non-coherent and not robust. Another similarity regards the economic interpretation of the coefficients. The coefficients are relatively small, where the largest one is the linear de-trended industrial production GARCH with a coefficient of 0,0443. This implies that a one point increase in the industrial production GARCH results in an increase in the ratio between gross loans and total loans with 0,0443. This could then be put in relation to the gross loans/total asset variable that in this sample has a value between around 0, 41 and 0, 95. When examining the standard deviation for the industrial production GARCH in Table 1, it has a value of 0, 2786, which is a rather big number in comparison to 0, 0443. Still, the coefficient cannot be completely neglected. Yet, the only significant results the GARCH variables present are with a positive coefficient. This could mean that the previous observation of industrial production and CPI has not been given enough time for it to be reflected in banks lending behaviour. This idea is also supported by the fact that all of the CPI forecasts did not have a negative impact on macroeconomic uncertainty before time T+4. As written in Section 2, Bernanke & Blinder (1992) also find that the bank loan supply changes only in the long run when old loans are not renewed. Also, Bernanke & Gertler (1995) find that the response on investments and on firms' inventories following a tightening of monetary policy occurs with a lag. At the same time, Bloom (2013) find the relationship to be negative in the short-run, but that the picture is less clear in the long run due to the fact that macroeconomic uncertainty might have a positive consequences for R&D. The mechanism behind this is that uncertainty causes higher volatility, and hence higher expected return. Thus, more investments might be made. Bloom (2013) presents the dot-com boom in the late

1990s as an example of this. The worst outcome is that a firm loses the developing costs of their new websites, but the potential profits if the Internet succeeds are much greater.

To further investigate if there do exist a delay, the regressions including a GARCH variable were performed with four lags. When performing such regressions on this data the results show no significant negative coefficients, which implies that there does not exist a delay and that this type of estimation does not capture macroeconomic uncertainty in a good way.

Significant and positive coefficients, and it can of course be due to a delay in responsiveness in the bank loan supply. Yet, suppose it is not. For example, the NGDP forecast has a positive and significant coefficient at time T+4. From a Swedish point of view (and also for several other countries including Norway and Iceland) the Riksbank has an inflation target as their main priority. As previously stated in this paper a central bank can affect banks behaviour through open market operations. Hence, forecasts of CPI might be of greater interest for the Riksbank than forecasts of NGDP. This could mean that the Riksbank chooses not to act as much on the NGDPs expected development, but more on the CPI values. This would then mean that the banks' loan supply is more affected by the CPI as well, through the bank-lending channel. Thus, a positive NGDP coefficient and that the CPI forecasts has a greater influence on the loan-to-asset ratio is not impossible, which is also the case as seen in Table 3.

Another observation regarding Sweden is that at this moment the inflation is very low and the Riksbank is maintaining a low interest rate. Hence, the Swedish banks now offer low interest rates on their bank loans and the citizens have relatively high mortgages in comparison to their assets. Meanwhile, there is a fear that the interest rates will increase and that it will become difficult for people to pay their loans. Hence, there is a possible conclusion stating that there is uncertainty on the market, and banks still provide many loans to a low price.

As mentioned in Section 3 the macroeconomic uncertainty proxies used in this paper can be divided into two groups. First, there is the model-based group, where the GARCH variables are included. The second group consists of the GEPU index and the forecast indices. If we use this division when evaluating the results there is a clear difference between the two. Looking at the GEPU index, all the coefficients are negative and they are significant on a ten per cent level for two out of three modifications. This implies that an increase in the GEPU index, and hence, an increase in macroeconomic uncertainty does have a negative impact on a banks

gross loans/total assets ratio. Moreover, the six CPI forecast coefficients are all significant except for one. Additionally, every one of the coefficients becomes negative in time T+4, even if they are not all negative at time T. In line with the GEPU results, this signals that an increase in macroeconomic uncertainty do decrease the supply of bank loans. However, it might not show on the market directly as seen by the fact that some of the negative signs does not occur before time T+4. Lastly for the group are the NGDP forecasts, which do not provide as strong results as the other two and overall a weaker proxy. Turning to the GARCH variable group the results show no significant and negative coefficients, but instead three positive and significant coefficients. As previously stated, the results are not consistent and this way of modelling macroeconomic uncertainty does not seem to function to well under these circumstances.

In conclusion, the group of variables that are more dependent on human interaction and expectations on the economic environment seem to be a better proxy than the model based GARCH variables that is constructed from raw data. This is an interesting observation and well in line with the idea that society and the people in it can create future macroeconomic outcomes by simply believing in them.

It is not only banks behaviour that can change when there are variations in macroeconomic uncertainty. Firms demand is also likely to respond to these changes. There is evidence that when macroeconomic uncertainty increases, firms potentially substitute non-banking finance for banks loans since that provides a safer option (Baum et al. 2005, Baum et al. 2003). This could be regarded as a change in demand and not a change initiated from the banks. Still, banks will most likely be affected by the new demand. Banking problems often arise from a decline in asset quality, for example from a collapse in real estate prices or from an increased number of bankruptcies in the society (Kaminsky & Renhart, 1996). Hence, banks are not always the first actor to respond to macroeconomic changes, but might react to other counterparties.

5.1 Robustness check

As a robustness check the dependent variable was changed from gross loans/total assets to total loans/total assets. The results are depicted in Table 4. These results confirm that the findings are not robust to changes. Here, the two de-trended CPI forecasts immediately have a

significant negative coefficient and become positive at time T+4. This is almost the complete opposite to the main result with gross loans/total assets as the dependent variable. Still, there is some indication that there is a negative relation between macroeconomic uncertainty and bank loan supply, but it is not very persistent. Furthermore, the GARCH variables lose almost all its significant values, only the linear de-trended industrial production GARCH has a negative significant coefficient.

Table 4: Results for Total Loans/Total Assets

TL/TA	First difference	Linear detrended	Non-linear detrended
GEPU	-0.0002*	1.65E-05	1.82E-05
CPI (T)	0.0006	-0.0099*	-0.0082*
CPI (T+4)	-0.0079	0.0637***	0.0349***
NGDP (T)	4.81E-05	0.0006	0.0003
NGDP (T+4)	5.57E-05	5.37E-05	-5.43E-06
GARCH CPI	-0.0186	0.0095	-0.0012
GARCH Ind. Prod.	0.0136	-0.0347*	0.0002

Column 1,2 and 3 displays the coefficient values for the three different modifications where *= p <0,1, **= p <0,05 and ***= p< 0,01

When running the lagged GARCH values there are no significant values, which strengthen the idea that this way of modelling macroeconomic uncertainty is not suitable.

Notably is that the GEPU and CPI forecasts seem to be the strongest proxies for both of the dependent variables. Hence, again the more people and society based variables appear to have the largest impact. Also, this strengthens the idea that CPI might be a stronger proxy due to central banks inflation targeting.

6 Conclusion

The purpose of this study has been to investigate whether macroeconomic uncertainty affects Nordic banks loan supply during the period 1997-2016. Five different measures of macroeconomic uncertainty have been utilised in order to obtain a robust result, but also to capture a broader picture and observe what kind of macroeconomic uncertainty that has the most influence. Three of the proxies are indices developed by professional economists, and the other two are conditional variance proxies that were constructed from GARCH models. In order to test these, 21 different OLS regressions were performed. The results imply that the

indices, which are more based on human expectation and the society, have a greater influence in comparison to the model-based GARCH models. Additionally, CPI appears to be a better proxy in comparison to GDP, which might be due to the fact that many central banks have inflation targets. An idea for further studies is to use other definitions of macroeconomic uncertainty. Also, dividing the loan supply variable into different loan groups in line with Baum et al. (2005) could be interesting in order to obtain a more detailed picture of this topic.

6.1 Limitations

Ng et al. (2015) present some critique regarding the GARCH estimates. Even though the GARCH estimates have the advantage of being observable the proxies are dependent on how strongly correlated they are to the stochastic process itself. Here it can sometimes be hard to differentiate between what is actually caused by macroeconomic uncertainty and what is caused by other factors. Moreover, when fitting a GARCH to quarterly data the model might find very small persistence of shocks (Baum et al. 2003). Another potential drawback of the GARCH is that it does not really measure uncertainty but more precisely volatility. Moreover, it measures past volatility that policy makers have already been forced to act upon (Quagliariello, 2007). Furthermore, during times of higher uncertainty banks with less liquid assets have a tendency to lend more then banks with more liquid assets (Baum et al. (2003). This is not controlled for, but is not believed to have had any greater impact on the final results. Lastly, there is a potential problem with lack of data. This issue limited the analysis to the chosen time period. Still, for some of the banks there were a number of observations missing for several variables in the chosen time period as well.

7 Appendix

Variable	Source
GEPU	Economic Policy Uncertainty
NGDP (Forecast)	Federal Reserve Bank of Philadelphia
CPI (Forecast)	Federal Reserve Bank of Philadelphia
Industrial Production	OECD.stat
CPI	OECD.stat
Gross Loans	Capital IQ
Total Loans	Capital IQ
Total Assets	Capital IQ
Inflation	OECD.stat
Common Equity	Capital IQ
FED Rate	OECD.stat

Table 5: Variables and source

List of Nordic Banks	Country
NORDEA	SE
SEB	SE
SWEDBANK	SE
SHB	SE
SYDBANK	DK
JYSKE BANK	DK
DANSKE BANK	DK
DNB	NO
SPAREBANK 1 SR	NO
SPAREBANK 1 OSTFOLD	NO
HELGELAND SPAREBANK	NO
SPAREBANK 1 SMN	NO
SPAREBANK 1 NORD	NO
SPAREBANKEN MORE	NO
SPAREBANKEN VEST	NO
SPAREBANKEN OST	NO
LANDSBANKINN	IS
NORDEA FINLAND	FI
OP FINANCIAL GROUP	FI
AKTIA BANK	FI
DANSKE BANK FINLAND	FI

Table 6: List of banks

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