[START]

I will present my thesis, which topic is “The effects of financial stress on the Swedish economy”.

[AGENDA]

I will start with an introduction and provide some background to the topic, and then move to the method used and the study design, and after that present the results, some discussion and lastly any conclusions.

[BACKGROUND]

So for some background, historically there has been several financial stress events hitting the Swedish economy, such as the The Swedish Banking crisis in the 1990s, The Dotcom Bubbel in the 2000s and the Great Financial Crisis which we all might recognize. In general financial stress is unobservable, but exhibit key features such as increased degree of perceived risk and uncertainty. Financial stress shocks can thus be interpreted as the heightening of uncertainty from a so called stress event in the financial sector that propagate to the macro-economy. Financial systems also tend to be procyclical, in that credit growth, leverage and excessive risk taking happen during good times when the economy is booming which in some cases is the foundation of what financial imbalances stand on. The imbalances and overextensions generate vulnerabilities that may in a later time materialize. The consequences of financial stress are challenging to predict, as financial institutions are interconnected, and contagion is highly dependent on several factors. Financial stress events do not always materialize in macroeconomic consequences as they can depend on several unknowns such as severity, duration, and contagion. An example of a financial stress event that did not materialize in any great macroeconomic affects is the flash crash in 2010 where the Dow Jones Industrial Average dropped over a 1,000 points and recovered to previous values in fifteen minutes. What caused the said flash crash is in dispute, but there has been several similar stress events that had no known macroeconomic consequences.

[INTRODUCTION]

The question this study aims to shed light on is how a small open economy as Sweden would be affected by a shock to financial stress and what connection there is between financial stress and macroeconomic variables such as GDP growth, inflation, and interest rates. This study has its base to study the dynamics between these variables. I have chosen to limit this study to the Swedish economy as I noticed there are few studies about how financial stress affects the Swedish economy. This study is executed by using a Bayesian mean-adjusted VAR-model proposed by Villani (2009). The contribution of this study lies in explaining how the Swedish economy is affected by a shock to financial stress from the chosen variable over the period 1995-2021 mainly using impulse response functions.

[METHODOLOGY]

The empirical analysis is made in a Bayesian VAR framework using the mean-adjusted model. Villani (2009) proposed the mean-adjusted BVAR-model since he thought that all available priors for VARs focused on the dynamic coefficients, and for the most were non-informative about the deterministic component of the model. Villani’s adjustment of the BVAR-model allows to model the unconditional means of the variables, by setting the prior unconditional means of each variable explicitly. Since macroeconomic variables have relatively short sample size, we run the risk of over-parametrisation in a standard VAR. One way to deal with this issue, as suggested by Litterman (1986), is to impose prior information on the parameters which Bayesian VAR models do. Villani (2009) states that the steady-state BVAR-model is untractable, but that the distribution of each set of model parameters given the other parameters is tractable, and that a Gibbs sampler can be used to draw from the joint posterior. In this study, I have used 10,000 draws using a Gibbs sampler.

[DATA]

The data consists of quarterly observations ranging from 1995 to 2021 with respect to four macroeconomic variables. The SFSI data is originally daily observations, that have been aggregated to quarterly observations. The remaining variables are seasonally adjusted. The SFSI index was provided by the Riksbank, and the remaining data has been obtained from the FRED database. All variables are included in the model as stationary processes, where Δi is stationary in first difference while other variables are stationary in levels. Lag length is set to four, as determined by Akaike’s information criterion (AIC).

Financial stress indices have been adopted by several financial organisations and central banks over the years as a tool to monitor financial conditions since financial systems play a central role in the economy. For financial markets to function well, liquidity, trust and symmetric information is required so that participants can agree on fair prices. In distressed times, trust can deteriorate quickly and asset-values can suddenly shift leading to lower levels of liquidity. Funding can become more difficult and expensive as risk premium increases and liquidity risk premium increases.

The Riksbank’s FSI-index is calculated based of four sub-markets where there are three indicators for each sub-market. Each indicator is ranked by magnitude in relation to earlier observations as to increase the index’s ability to account for new information. The financial stress index is calculated as an equally-weighted mean value of the sub-market indicators, which are squared and adjusted with regards to the correlations between the sub-market indicators. As seen in the table, stress is measured in the form of factors such as volatility, spreads and valuation losses. These factors represent uncertainty about asset prices and flight to safe assets which can be considered important features of financial stress. SFSI index is the variable used to capture financial stress, uncertainty shocks in this thesis.

[STUDY DESIGN]

Since the VAR model is estimated in its reduced form, shocks are correlated meaning all variables are contemporaneously dependent. Some form of identification is needed to be able to identify structural shocks.

[CHOELESKY]

The Cholesky decomposition is a common way used to identify shocks as structural shocks, where the ordering of the variables is of importance. To order the variables one has to use economic reasoning and theory. In this model, the financial stress index is ordered first where the identifying assumption is that it affects GDP growth, inflation and interest rates and that the other variables do not affect the financial stress index in the same period but with a lag. In other words, the index is contemporaneously independent of all shocks but its own. Given the frequency of publishment of GDP and inflation data, it is not available for the markets in real term and thus cannot be acted upon or reflected in real time market variables. The ordering is also based on the assumption that financial stress shocks contemporaneously affect the sub-market indicators that the financial stress index is constructed of. This ordering with the stress or uncertainty variable ordered first has been established in previous studies such as Bloom (2009), Baker et al. (2012).

[ALTERNATIVE ORDERING]

Later to verify whether the results are robust or if they are sensitive to the recursive ordering of the Cholesky decomposition, one can estimate a new model with different ordering and see if there is significant difference in the produced IRFs. A common method to order economic variables is to order slow variables first and lastly fast moving variables. An example of this ordering is given by Stockhammer & Osterholm (2017) stating that this ordering is reasonable. Following their reasoning would in this case mean that the financial stress index changes daily taking new information into account, such as GDP, while economic variables such as inflation and GDP are sluggish and information from the financial stress index is not taken into account by firms and consumers in the short term when making investment or consumption decisions.

[SIGN RESTRICTIONS]

Sign restriction is another method to identify structural shocks. We know, for example that positive demand shock increases both output and price while a positive supply shock increases output and decreases prices, this suggests that the sign or the set of values of the effect can be set given a positive shock on a variable in a VAR over a horizon. This approach of sign restrictions does not require a specific ordering of the variables as when using the Cholesky decomposition. Uhlig, (2017) covers two principles on using sign restrictions, mainly to impose those restrictions you can reasonably impose. All identified shocks are presented in the table. A requirement is that each shock is uniquely identified, meaning no other shock has the same set of restriction and if that is not the case, shocks cannot be distinguished. While there is considerable literature and theory on sign restrictions for demand, supply and monetary policy (Pearsman & Straub (2009)), there is little for financial stress shocks. Since the interest is to study the effect of GDP growth and inflation to a shock of financial stress, those are left unrestricted as to not prejudge the outcome. And restrictions are instead imposed on SFSI and change in interest rates. In response to the great financial crisis 2008, the Riksbank cut the policy rate by 4.5 percentage points over the course of six month and announced to offer fixed rate loans to lower short term interest rates and improve financial conditions. The effect of these announcements was later estimated to have led to a decline of short-term interest rates of 0.3 percentage points (Elm´er et al., (2012)). This provides historical evidence albeit anecdotal of policy response aimed at stabilizing financial conditions as well as trying to affect the shorter end of the yield curve. In the event of flight to safe assets, demand for government bonds increase pushing prices of those assets up. Since yield of bonds are inversely related to it’s price, interest rates decrease consequently. Although there is an ”inflation puzzle” depending on if financial stress shocks are modeled as demand or supply shocks. Hence, sign is depended on which effect that is the greatest. Abbate et al., (2020) provide evidence that a financial stress shock temporarily increases inflation because of increased borrowing cost and credit following a financial shock, suggesting financial shocks act as supply shocks. While were financial stress shocks are modeled as demand shocks, inflation decreases due to decreased consumption and investments. Looking at Bjellerup & Shahanazarian (2012) we reasonably expect that a positive shock to financial stress reduces GDP growth through higher credit costs and lower consumption and investments.

[PRIOR INTERVALS]

For the priors we need to explicitly set our steady-state priors. Since there is no theory on the prior for SFSI, I have imposed a rather diffuse prior with a wide distribution around the prior mean. For the steady state prior of Swedish GDP growth, I have used Villani (2009) and for inflation rate Beechey & Österholm (2010) provide steady state intervals for annual inflation rate. Since data used in this study is quarterly, the interval specified by the authors was adjusted to quaterly inflation rate. For the steady state prior for 3 months interest rate, I have set a prior around the zero mean since it is in first difference.

[RESULTS CHOLESKY ]

We find that a shock of the SFSI has a significant effect on Swedish GDP growth, with a maximum effect where growth is reduced with 0.41 percentage points. The effect of the shock goes to zero after five quarters. The other economic variables show no significant effect over the horizon. Inflation rate is reduced with a maximum effect of 0.12 percentage point were the effect disappears after 10 quarters.

In the historical decomposition, we see the contribution of each structural shock to the historical dynamics of the variables meaning the historical value is decomposed into different components. We find that most of the historical fluctuations is contributed by the variables own shocks over time. During the period of the great financial crisis in 2007-2009 and the euro crisis in 2009-2013 we see that the increased financial stress contributes to a large extent of the reduced GDP growth. The following period of normalizing financial conditions we also see that it attributes almost all the GDP growth the following three quarters to the decreased financial stress conditions. In the later period of 2020, when the pandemic took place, we see that financial stress played little or no role in the reduced GDP growth. For the inflation rate we find that financial stress produces similar results as to GDP growth.

Forecast error variance lets us interpret how important a shock is in explaining the fluctuations of the variables in the model, it also allows us to see how the importance of a shock changes over time. We can see that financial stress can explain very little of the fluctuations in the economic variables over all periods. For GDP growth the 5-6 percent of the variance is explained by shocks to financial stress.

[RESULTS CHOLESKY 2]

The IRFs produced from this model shows no significant effect on GDP growth from a shock to financial stress compared to the original ordering of the model. Since results are not robust to changes in ordering it implies weak model identification and that the results depend on the assumptions of the contemporaneous effect of the shocks.

[RESULTS SIGN RESTRICTIONS]

From the impulse response functions we see that a positive financial stress shock did not have a significant response to GDP growth or inflation rate. While the response is negative nothing can be said about magnitude of the response, and the expectation was that a positive shock to financial stress would reduce GDP growth. Inflation rate also has a negative albeit insignificant response to the shock and given the ”inflation puzzle” the negative sign suggests that financial stress shock acts more as a demand shock than a supply shock. From the forecast error variance in, financial stress shocks are shown to explain up to 12 percent of the variations in GDP growth, staying stable over all periods, where the increased explanatory power of financial stress is true for the other economic variables as well. And in the historical decomposition we see that demand shocks dominate the period during GFC, and that financial stress had a moderate roll in the fluctuations in GDP, and a larger part in fluctuations in inflation rate.

[DISCUSSION]

Since ordering of the variables impacted the results, and specifically resulted in no significant responses from any of the economic variables from a shock to financial stress, this implies that the structural shocks are sensitive to the assumptions of the dynamics in the system and that a choice between the models is ambiguous and dependent on the assumed dynamics. Applying a different identification strategy, mainly sign restriction allow us more flexibility. The advantage of sign restrictions is not having to specify the recursive ordering of the variables. The issue with sign restriction models is to uniquely identify shocks. The shock of interest in this case is a positive shock to financial stress and as stated in Uhlig (2017) one should be reasonably sure that no other shock has the same sign implication. This proposes an immediate threat to the identification since a positive financial stress shocks might have the same sign implication as a negative demand shock, and that events such as the great financial crisis can be seen as both a negative demand shock and positive financial stress shock using this identification. Another threat being Fry & Pagan (2009) pointing out that sign restrictions is rather weak and should be used in conjunction with parametric restrictions. They also point out that both sign restrictions and recursive ordering only solves the structural identification but not the model specification.

[COMPARATIVE RESULTS]

Results from previous literature Bloom (2009) finds that the impact of macro uncertainty shock in the US having an effect of lowering aggregate output with 0.98 percentage points. While Stockhammar & Osterholm (2014) found that euro area policy uncertainty shock had an impact of minus 0.1 percent GDP growth in Sweden, Abbate et al. 2020 investigated financial shocks and inflation dynamics on US data and found significant increase in inflation rate of 0.1 percentage points as well as decrease in output of 0.6 percentage points. Further, van Roye (2011) found a significant decrease in both GDP, inflation and interest rates in the euro area to a shock to a financial market stress indicator. Comparing results with previous literature shows mixed results dependent on both area and uncertainty indicator as well as identification assumptions, making it challenging to validate and compare model output with the previous literature.

[OTHER IDENTIFICATION METHODS]

Other identification method that are more widely adopted, such as narrative shocks and high-frequency identification and external instruments (Proxy SVAR), can be used to provide exogeneity. The challenge using these methods respectively is constructing narrative series and identifying events or having available data. For external instruments, the challenge is having an instrument fulfilling the relevance and exogeneity condition. In this case, that would be an instrument that is correlated with financial stress as well as uncorrelated with other structural shocks, meaning demand, supply and monetary policy shocks. Hence, finding a strong instrument can prove to be extremely challenging.

[CONCLUTION]

The purpose of this study was to investigate the dynamics between shocks to financial stress and the Swedish economic variables such as GDP growth, inflation rate and interest rates using a mean-adjusted Bayesian VAR model specification. The findings from the recursive model were not robust to changing the order of the variables, implying weak identification. Changing identification strategy from Cholesky to sign restrictions, produced similar results as the recursive model, main difference being insignificant although negative effects on both GDP growth and inflation rate. Since results were not robust to changes to identifying assumptions in the recursive model and financial stress shocks could not reasonably be distinguished from negative demand shocks using sign restrictions identification, this raises the question on how it can be improved for further studies. Given that one can find an instrument for financial stress to remove contemporaneous shocks that satisfies the exogeneity and relevance condition, a proxy SVAR model would allow for greater inference and macroprudential policy implications to mitigate effects of financial stress and spillovers on the real economy.