

The Effect on the Swedish Real Economy of the Financial Crisis*

Pär Österholm[#]

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[#] National Institute of Economic Research, Box 3116, 103 62 Stockholm, Sweden
e-mail: par.osterholm@konj.se Phone: +46 8 453 5972

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Summary in Swedish

Denna arbetsrapport undersöker den finansiella krisens effekt på den svenska reala ekonomin. I syfte att göra detta har ett index som beskriver tillståndet i den finansiella sektorn konstruerats. Indexet indikerar att tillståndet i den svenska finansiella sektorn har försämrats avsevärt under 2008 och det befinner sig nu på den högsta nivån sedan 1990-talskrisen. Arbetsrapportens fokus ligger på krisens effekt på real BNP-tillväxt. Den modell som används för att skatta denna är en bayesiansk VAR-modell med både amerikanska och svenska variabler. Modellresultaten tyder på att den svenska ekonomin kommer att växa avsevärt långsammare de närmaste åren på grund av den finansiella krisen.

Abstract

This paper investigates the effects of the financial crisis on the Swedish real economy. In order to do this, an index which describes the financial conditions of the Swedish economy is developed. The index indicates that domestic Swedish financial conditions have deteriorated substantially during 2008 and are now at the highest level since the crisis of the early 1990's. A Bayesian VAR model with both US and Swedish variables is used to assess the quantitative effects of the financial crisis on Swedish real GDP growth. Results suggest that the Swedish economy will grow substantially slower in the next couple of years due to the financial crisis.

JEL classification: E37, E44

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1. Introduction

During 2008, financial markets have been characterised by a global crisis which has its origin in the price correction on the US housing market. The background of the problem is complex but contributing factors include a number of years of highly expansive monetary policy, a political will to make home owning more widespread and overly generous credit to home buyers. The substantial securitisation that took place – in many cases with highly complex financial instruments – has, together with a high global risk appetite, spread assets related to US home loans around the world. As the US housing market has tumbled, banks and other financial institutions have experienced large losses and the lack of confidence in the financial system has led to extreme levels of interest rate spreads. The substantial decrease in risk appetite associated with the crisis has also changed the price of risk, causing large falls in stock markets globally.

Sweden has not been unaffected by the global financial turmoil. The stock market, for example, fell more than 40 percent between the beginning of 2008 and early December. However, whilst there are indications that Swedish banks may experience non-negligible credit losses in the Baltic states, they seem to have avoided large exposure to the most troubled asset types. The risk of a collapse of the financial system is the primary concern when a financial crisis hits an economy; such a collapse appears – with some assistance from the central bank and the legislative body – to be unlikely in Sweden today. Given that this crucial issue is no longer a major risk, the next concern of policy makers is typically the real economy. The question asked in this paper is accordingly what the effect of the financial crisis on the real Swedish economy will be. Our focus will be on real GDP growth, the variable that is the primary focus of most economists when discussing the real economy.

In order to investigate the effect of the financial crisis on real GDP growth, an index describing the financial conditions in the Swedish economy is developed. This is based on three variables of particular interest, namely the real interest rate, the interbank spread and the return on the stock exchange. The financial conditions index is then used in a Bayesian VAR model – together with both US and Swedish variables – to estimate the effect on Swedish real GDP growth. The information from three series is hence condensed into one index. This means that it is possible to model the relationship between the financial and real sector in a more robust way, since the issue of over-parameterisation – which typically plagues high-dimensional VARs – is substantially reduced. Estimation results show that both US and Swedish financial shocks have a negative impact on Swedish real GDP growth. That the crisis has a negative effect on growth is of course stating the obvious – the contribution of the paper is hence to quantify the effect and illustrate it in different ways. For forecasters in general and policymakers in particular, this information is obviously of substantial interest.

The remainder of this paper is organised as follows: Section 2 presents an index for the conditions of the Swedish financial markets. In Section 3, the modelling framework is described, the empirical analysis is conducted and the results are discussed. Finally, Section 4 concludes.

2. An index for the state of the Swedish financial markets

A number of different indices for financial market conditions have been developed in the literature; see, for example, Mayes and Virén (2001), Gauthier *et al.* (2004), Guichard and Turner (2008) and Swiston (2008). The purpose of a financial conditions index is typically either *i*) monitoring of financial markets, which often can be done in real time since financial data typically are available on a very high frequency, or *ii*) estimation of the impact of financial conditions on other parts of the economy. In this paper, we are primarily concerned with estimation of the effects of the financial crisis on the Swedish real economy. This has obviously affected the choice of variables included in the index, since we need a long enough series to make estimation both meaningful and reliable. From an econometric point of view, it should be beneficial to weight together the information from several financial variables into one index. Using fewer variables in the model means that the relation between financial markets and the real economy can be modelled in a simpler and more robust way. This should generate better estimates of the effect on the real economy as well as improved forecasts.

Three variables are used to build the financial index presented in this paper: The short real interest rate, the short interbank spread and the return on the stock exchange. The three variables are judged to be some of the most relevant when assessing the state of financial markets and should also have predictive power for the real economy since they capture several important aspects of how a financial crisis is transmitted to the real economy. The short real interest rate represents the cost of short-term liquidity and is defined as $r_t = i_t - \pi_t$, where i_t is the three month STIBOR rate and π_t is the twelve-month ended inflation rate in time t .¹ Both investment and consumption decisions of firms and households are functions of the real interest rate and these two variables make up approximately 60 percent of Swedish GDP. Large swings in the real interest rate can hence potentially have large effects on GDP growth, something that was painfully clear in the early 1990's when extremely high real interest rates emerged as a consequence of the attempts to defend Sweden's fixed exchange rate. The short interbank spread is defined as $s_t = i_t - i_t^{tb}$, where i_t^{tb} is the three-month treasury bill rate, and provides a measure of the counterparty risk in the banking system. More generally, it is related to risk appetite and will as such be linked to tighter credit condi-

¹ We use realised inflation rather than inflation expectations to calculate the real interest rate, which can be motivated by agents having backward looking expectations.

tions and more precautionary saving, both of which will lower investment and consumption.² Finally, the return on the stock exchange is given by $\rho_t = 100 \ln(P_t/P_{t-1})$, where P_t is the level of the OMX index. Obviously, the development in the stock market reflects many factors. Expected future profits can be seen as the summary measure but falling stock prices during the crisis can be an indication of a reduced risk appetite as investors abandon stocks for safer assets. In terms of the macroeconomic consequences, falling asset prices will in general generate lower consumption due to the lower wealth of households. It also means that it is harder to raise capital for firms through new share issues, which puts downward pressure on investment.³

Time series plots of the variables from 1988Q1 to 2008Q3 are shown in Figure 1 and reveal a number of interesting features. First, the short real interest rate has not reached any dramatic levels so far during the crisis. This is largely due to unexpectedly high inflation numbers lately but as energy and food prices are now coming down from earlier very high levels, inflation is likely to decrease rapidly. Second, the short interbank spread has increased substantially since late 2007. To a large extent, this is a sign of the lack of confidence between Swedish banks that emerged as the crisis spread globally. A combination of central bank actions, government guarantees and decreased uncertainty regarding the exposure of Swedish banks to troubled assets seems to have brought down these spreads during the fourth quarter of 2008 though. Third, the Stockholm stock exchange has – like many other across the world – fallen substantially during 2008.

Having looked at the individual time series, the next step is to generate a single index of the state of the Swedish financial markets. The return of the stock exchange initially gets a reversed sign, so that a falling stock exchange yields a positive number. The reason for this transformation is that we want a higher number of the index to indicate worsening financial conditions. The three time series are next standardised so that the mean of each series is zero and the standard deviation one. They are thereafter weighted together using the weights 1/3 for all three series.⁴ Finally, the index is normalised to have mean 100 and standard deviation 10 over the sample. The index is shown in Figure 2. As can be seen, the index indicates that financial conditions in Sweden are the worst they have been for roughly fifteen years. However, it is also clear that the present situation is judged less serious than it was at the peak of the 1990's crisis.

² The risk appetite aspect of the short interbank spread can also be seen by recalling that it includes flight-to-quality effects.

³ Other variables – such as implied volatilities, corporate bond spreads, CDS spreads or expected default frequencies – could obviously also be of interest but long enough time series are not available for Swedish data. No measure of credit conditions – similar to, for example, the Federal Reserve's "Senior loan officer opinion survey on bank lending practices" – is available either.

⁴ The three variables are accordingly considered equally important for describing the financial conditions. This approach can be contrasted with, for example, Guichard and Turner (2008) who base the weight a variable receives on the relative effect it has on GDP after four to six quarters. We prefer to first build the index and then investigate its effects on the real economy.

Figure 1. Components of the financial index.

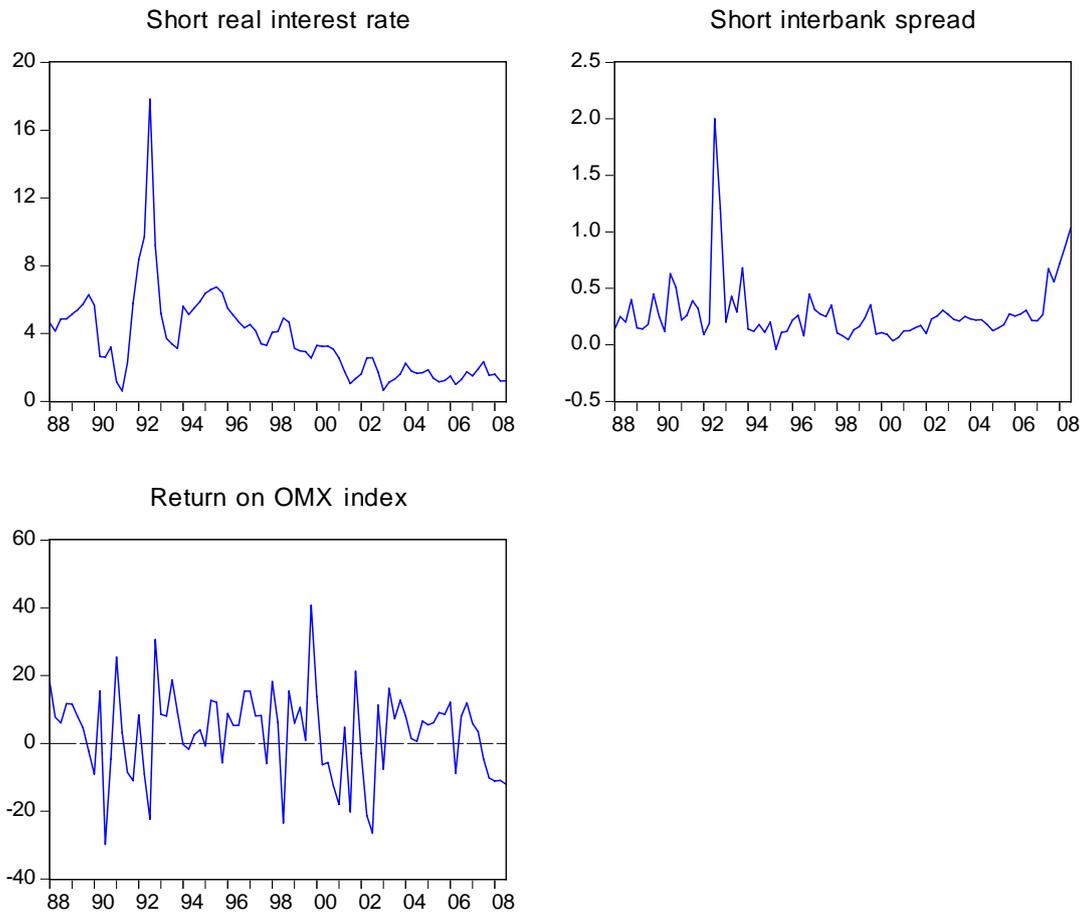
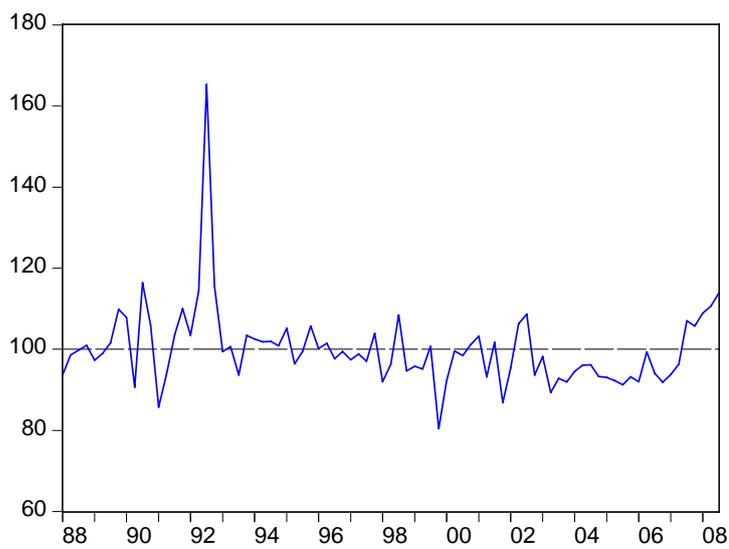


Figure 2. Financial index.



3. Empirical analysis

3.1 The model

In this paper, a Bayesian VAR (BVAR) model is used to assess the effect of the financial crisis on Swedish real GDP growth. BVAR models have become fairly popular in applied macroeconomics. One reason for this popularity is the improvement in forecast accuracy that BVARs are associated with relative to VAR models estimated with classical methods. The methodology employed has been developed by Villani (2008) and the model is given by

$$\mathbf{G}(L)(\mathbf{x}_t - \boldsymbol{\mu}) = \boldsymbol{\eta}_t, \quad (1)$$

where $\mathbf{G}(L) = \mathbf{I} - \mathbf{G}_1 L - \dots - \mathbf{G}_m L^m$ is a lag polynomial of order m , \mathbf{x}_t is an $n \times 1$ vector of stationary macro variables, $\boldsymbol{\mu}$ is an $n \times 1$ vector describing the steady-state values of the variables in the system and $\boldsymbol{\eta}_t$ is an $n \times 1$ vector of *iid* error terms fulfilling $E(\boldsymbol{\eta}_t) = \mathbf{0}$ and $E(\boldsymbol{\eta}_t \boldsymbol{\eta}_t') = \boldsymbol{\Sigma}$. The specification of the model is slightly unconventional as it is expressed in deviation from the steady state. The benefit from the approach is obvious though, as it means that an informative prior distribution for $\boldsymbol{\mu}$ often can be specified. This has, not surprisingly, been shown to be beneficial for forecasting performance; see, for example, Adolfson *et al.* (2007), Beechey and Österholm (2008) and Österholm (2008).

The priors on the parameters of the model used in this paper follow those in Villani (2008); the prior on $\boldsymbol{\Sigma}$ is given by $p(\boldsymbol{\Sigma}) \propto |\boldsymbol{\Sigma}|^{-(n+1)/2}$, the prior on $\text{vec}(\mathbf{G})$, where $\mathbf{G} = (\mathbf{G}_1 \dots \mathbf{G}_m)'$, is given by $\text{vec}(\mathbf{G}) \sim N_{mn^2}(\boldsymbol{\theta}_G, \boldsymbol{\Omega}_G)$ and the prior on $\boldsymbol{\mu}$ is given by $\boldsymbol{\mu} \sim N_n(\boldsymbol{\theta}_\mu, \boldsymbol{\Omega}_\mu)$. Regarding the priors on the dynamics, the Minnesota prior (Litterman, 1986) typically employed in the BVAR literature – that is, a prior mean on the first own lag equal to 1 and zero on all other lags – is theoretically inconsistent with the mean-adjusted model, as a random walk does not have a well-specified unconditional mean. In its place, the dynamics have been modified so that the prior mean on the first own lag is set equal to 0.9 for variables that are modelled in levels and 0 for variables modelled in differences; all subsequent lags have a prior mean of zero. The hyperparameters of the model are uncontroversial and follow the literature; see, for example, Doan (1992) and Villani (2008). The overall tightness is set to 0.2, the cross-variable tightness to 0.5 and we employ a lag decay parameter of 1. Regarding the details of the priors for $\boldsymbol{\mu}$, we return to these in the next subsection.

3.2 Data

Turning to the empirical specification of the model, we define

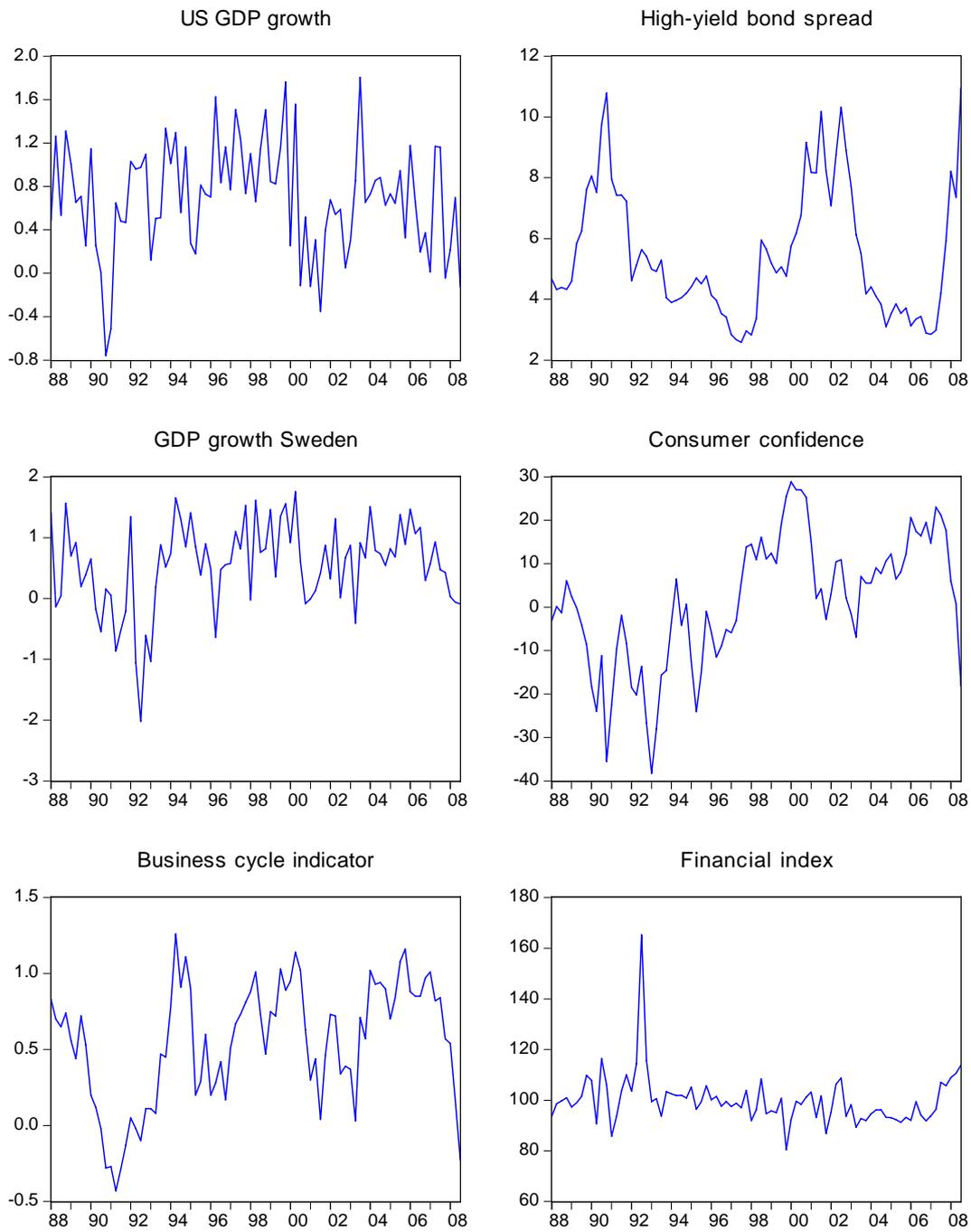
$$\mathbf{x}_t = (\Delta y_t^{US} \quad HY_t \quad \Delta y_t \quad KH_t \quad KI_t \quad FI_t)', \quad (2)$$

where y_t^{US} is the logarithm of US real GDP and HY_t the high-yield corporate bond spread in the United States. These variables are included because *i*) the United States is an important trading partner for Sweden and *ii*) the financial crisis has its origin in the United States. Both real and financial effects that the United States has on the Swedish economy should hence be captured.⁵ y_t is the logarithm of Swedish real GDP, KH_t is a household confidence measure based on a survey by the National Institute of Economic Research (NIER) and KI_t is a business cycle indicator based on business survey data, which also is provided by the NIER.⁶ Apart from having predictive power for GDP growth, it is not unreasonable to assume that KH_t and KI_t can provide good proxies for omitted variables in the system. Finally, FI_t is the financial index discussed in Section 2. The data are quarterly, range from 1988Q1 to 2008Q3 and are shown in Figure 3. Taking a brief look at the financial variables, it is clear that both the high-yield bond spread and the financial index presently are at high levels. Noteworthy is also the fact both the consumer confidence and business cycle indicator have fallen extremely rapidly during the last few quarters of the sample.

⁵ The high-yield bond spread is sometimes interpreted as reflecting risk appetite; see, for example, Levy Yeyati and González Rozada (2005) and Österholm and Zettelmeyer (2008). It is here seen as a "sufficient statistic" for the US part of the financial crisis. No equivalent series is available for Sweden and we accordingly use the slightly wider measure that the financial index constitutes.

⁶ The business cycle indicator is based on a dynamic factor model used for GDP growth forecasting; see Hansson *et al.* (2005) for details.

Figure 3. Data.



The steady-state priors are given in Table 1 and are presented as 95 percent probability intervals for the variable in question. The priors for US GDP growth and high-yield bond spread are centred on 0.625 percent and 4.5 percent respectively. These choices seem fairly uncontroversial and are similar to values suggested in the previous literature; see, for example, Gosselin and Lalonde (2006) and Österholm and Zettelmeyer (2008). Swedish GDP growth is assumed to have the same steady-state value as its US counterpart and is accordingly centred on 0.625 percent. For the consumer confi-

dence measure and the business cycle indicator, there is less guidance to be had from theory or institutional knowledge. We hence choose to make the prior distribution less informative for the steady state for these two variables and the values are chosen such that they roughly meet the arithmetic mean of the series during the sample. Finally, for the financial index, we centre the prior on 100 seeing that this is the mean of the series by construction.

Table 1. Ninety-five percent prior probability intervals for parameters determining the unconditional means.

Variable	Prior interval
Δy_t^{US}	(0.5, 0.75)
HY_t	(3.0, 6.0)
Δy_t	(0.5, 0.75)
KH_t	(-5.0, 5.0)
KI_t	(0.0, 1.0)
FI_t	(95.0, 105.0)

Note: Prior distributions are all assumed to be normal.

3.3 Estimation and results

Lag length in the model is set to $m = 4$. The dynamics of the system have been discussed above but it is also worth pointing out that in the following analysis, the US variables will be block exogenous with respect to the Swedish variables. This is based on the notion that the Swedish economy is unlikely to affect US GDP growth and high-yield bond spread. This block exogeneity is achieved with an additional hyperparameter which forcefully shrinks the parameters on Swedish variables in the US equations to zero; see Villani and Warne (2003) for details. The numerical evaluation of the posterior distributions is conducted using the Gibbs sampler;⁷ the number of draws is set to 10 000.

The issue of primary concern in this paper is the effect of the financial crisis on real GDP growth. We therefore turn to the dynamic properties of the system, where the initial focus will be on the impulse response functions. The impulse response functions are calculated using the Cholesky decomposition of the covariance matrix. We accordingly identify the orthogonal shocks $\boldsymbol{\eta}_t$ using the reduced-form shocks according to $\boldsymbol{\varepsilon}_t = \mathbf{P}^{-1}\boldsymbol{\eta}_t$, where \mathbf{P} is obtained as $\boldsymbol{\Sigma} = \mathbf{P}\mathbf{P}'$. The order of the variables is the same as in Equation (2). The choice of identification reflects the fact that the purpose of the paper is not to estimate a VAR where the structural shocks have “deep” economic interpretations. Rather, the goal is simply to generate orthogonal shocks corresponding to each vari-

⁷ See, for example, Tierny (1994) for a technical discussion.

able; the strategy is considered successful if the impulse response functions are in line with mainstream economic theory.

The impulse response functions are shown in Figure A1 in the Appendix. Shocks are ordered in columns and all have the magnitude one standard deviation. As can be seen, all of the impulse response functions are qualitatively in line with what one would expect. A shock to US GDP growth decreases the high-yield bond spread and increases Swedish GDP growth, consumer confidence and the business cycle indicator. It has no significant effect on the financial index though. A shock to the high-yield bond spread – where a standard deviation shock corresponds to roughly one percentage point – decreases GDP growth in both the United States and Sweden. The effect on the Swedish economy is both fairly large and drawn out. For example, Swedish GDP growth is decreased by almost 0.1 percentage point at the eight quarter horizon. The shock to the high-yield bond spread also lowers consumer confidence and the business cycle indicator. Given the degree of globalisation in financial markets, it is not surprising that it also causes a deterioration of Swedish financial conditions.

Turning to the shocks to Swedish variables, it can initially be noted that they have no effect on the US variables due to the block exogeneity assumption. Shocks to Swedish GDP growth raise both consumer confidence and the business cycle indicator though and lowers the financial index. A shock to household confidence raises Swedish GDP growth and the business cycle indicator and lowers the financial index. In a similar fashion, a shock to the business cycle indicator raises Swedish GDP growth and consumer confidence but lowers the financial index. Finally, a shock to the financial index – which is estimated to have a standard deviation of approximately seven units – lowers both household confidence and the business cycle indicator. The effect on Swedish GDP growth is also negative but appears to be moderate; it dies out fairly quickly and the maximum effect is at the two quarter horizon where growth is reduced by roughly 0.06 percentage point.

Overall, we believe that the impulse response functions suggest that the model has reasonable dynamic properties. The impulse response functions provide one way of quantifying the effect of the financial crisis on Swedish GDP growth. However, a slightly more intuitive way to illustrate the effect of the financial crisis is perhaps through the following exercise: The model is first estimated using data from 1988Q1 to 2007Q4, a point in time when some signs of financial turbulence had emerged but very few forecasters were expecting worsening financial conditions or a serious downturn in real activity. The model's endogenous forecast at 2007Q4 of the high-yield bond spread, the financial index and Swedish GDP growth are given by green dashed lines in Figures 4, 5 and 6. Forecasts are generated in a straightforward manner. For each draw from the posterior distribution, a sequence of orthogonal shocks, $(\boldsymbol{\varepsilon}_{T+1}, \dots, \boldsymbol{\varepsilon}_{T+H})$, is drawn and used together with the definition

$\boldsymbol{\eta}_t = \mathbf{P}\boldsymbol{\varepsilon}_t$ to generate future data. This way, 10 000 forecast paths are generated for each variable. Point forecasts are given by the median from the distribution. As can be seen from the figures, the model predicted that the deterioration in financial conditions which had taken place by then would be undone. Together with a normalisation of financial conditions, the model suggested that Swedish GDP growth would be fairly high.

Suppose that the model in 2007Q4 instead had received the information that financial conditions would worsen dramatically during the coming three quarters. By taking this information into account, a model-based forecast for Swedish GDP growth is generated under the assumption of financial turbulence. Specifically, the high future values of the high-yield bond spread and the financial index are taken into account by conditioning on the actual values for these two variables between 2008Q1 and 2008Q3.⁸ Forecasts from this exercise are given by the dashed black line in Figure 6. As can be seen from the figure, the assumption of future financial turbulence makes the model's forecasts of Swedish GDP growth substantially lower than what was suggested endogenously. Moreover, the forecasts are fairly well in line with the actual numbers between 2008Q1 and 2008Q3, suggesting that the model's transmission of financial shocks appears reasonable. By comparing the two growth forecasts in Figure 6, a model estimate of the effect of the financial crisis on the real economy is also provided. Quarterly growth numbers are on average a touch more than 0.4 percentage points lower between 2008Q1 and 2010Q4 when the model takes the financial crisis into account; looking at the implied annual growth rates for 2008, 2009 and 2010, this translates into growth being 1, 2 and 1.7 percentage points lower in the respective years.

⁸ The difference between the unconditional and conditional forecasts is that in the unconditional case, the entire vector $\boldsymbol{\varepsilon}_t$ generated randomly at each horizon. In the conditional case, only the orthogonal shocks belonging to US and Swedish GDP growth, household confidence and the business cycle indicator are created randomly. The shocks of the high-yield bond spread and the financial index are implied by the assumed conditioning paths. For a given set of randomly generated orthogonal shocks of the variables that have not been conditioned upon and a given path of the conditioning variables, the implicit shocks of the conditioning variables and the forecasts for all variables are generated sequentially, one horizon at a time.

Figure 4. High yield bond spread. Actual values and endogenous forecast at 2007Q4.

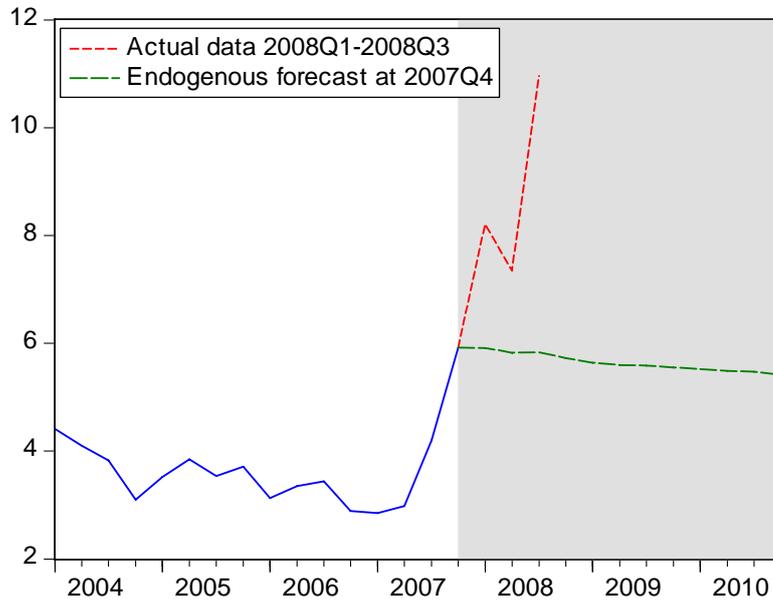


Figure 5. Financial index. Actual values and endogenous forecast at 2007Q4.

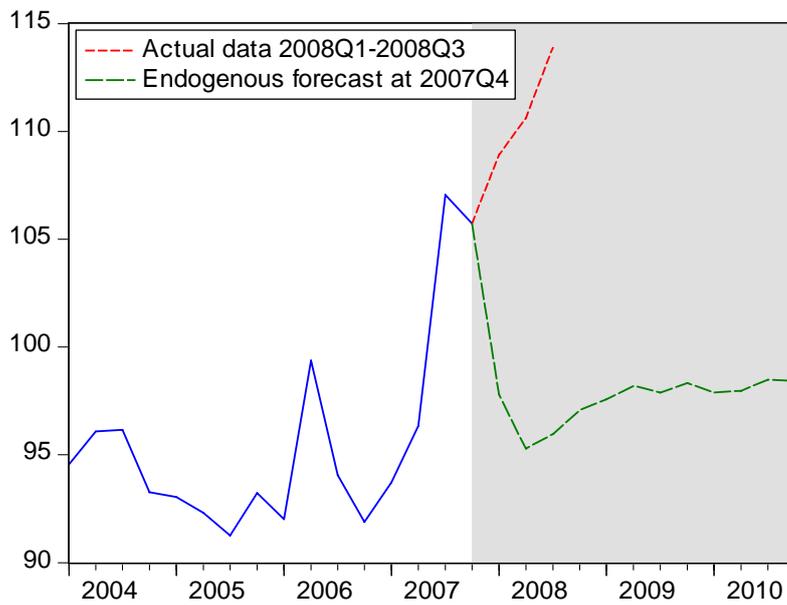
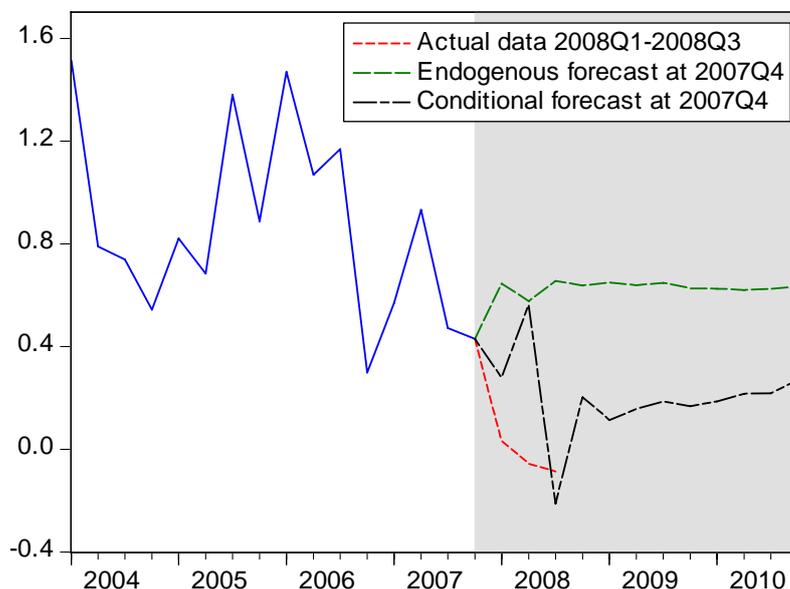


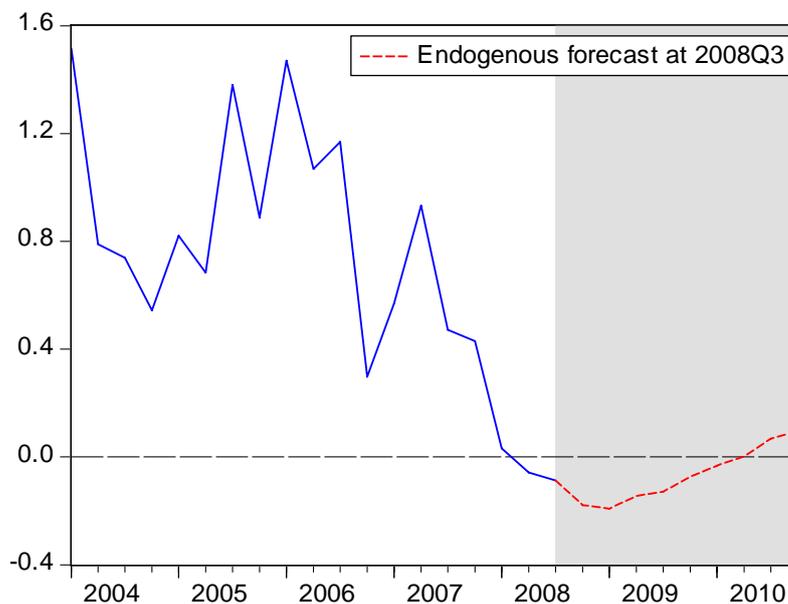
Figure 6. Swedish GDP growth. Actual values, endogenous forecast at 2007Q4 and conditional forecast at 2007Q4.



The empirical analysis has focused on quantifying the effects of the financial crisis on the Swedish economy. However, an issue of substantial interest to policy makers and forecasters is of course what the model predicts regarding future Swedish GDP growth and we finally turn to this subject. Figure 7 shows the endogenous forecast from the model standing at 2008Q3. The model predicts that GDP growth will decline even further the coming few quarters and that growth numbers will be negative during all of 2009. The recovery is predicted to be slow, with moderate growth also during 2010. Translated into annual growth rates, the numbers in Figure 7 correspond to 0.7, -0.6 and -0.1 percent rates for 2008, 2009 and 2010.

The above model-based analysis suggests that the present financial crisis will put substantial downward pressure on the Swedish real economy for quite some time to come. This is of course based on the historical patterns in the data, so a relevant question to ask is then if there are any reasons to believe that the response to shocks will be different now relative to earlier in the sample and the 1990's crisis in particular. Two aspects appear particularly interesting from this perspective, namely the external environment and the fiscal stance of the Swedish government.

Figure 7. Swedish GDP growth. Endogenous forecast at 2008Q3.



The fact that the financial crisis is global means that external demand will be weak in the near future. This could be problematic for a country with a large export sector such as Sweden and can potentially put further downward pressure on GDP growth. Moreover, the substantial depreciation of the Swedish krona that followed the abandoning of the fixed exchange rate in November 1992 had highly stimulatory effects on the Swedish economy. Effects of the same magnitude are unlikely to be seen in association with the present crisis despite the fairly large depreciation of the krona that has taken place during the second half of 2008.

The external economic environment is presently weak but the fiscal stance of the Swedish government is, on the other hand, stronger than it has been for a long time. The larger part of the 2000's has been associated with budget surpluses and the government debt has fallen as a share of GDP. Compared to the 1990's crisis in particular, this development is dramatically different; in the 1980's, the budget deficits were very large and the government debt grew rapidly. Given that the real effects of the financial crisis could be substantial, fiscal policy has – in addition to monetary policy – widely been mentioned as a way of stimulating the economy. This seems like a reasonable claim, particularly as the monetary policy transmission mechanism might be less efficient than usual due to a less well-functioning financial sector. The Swedish government's ability to conduct expansionary fiscal policy in the present situation appears good and if actions are more aggressive than what historical patterns imply, the real effects of the financial crisis might be less dire than what has been suggested above.

4. Conclusions

A global crisis has characterised financial markets during 2008. The magnitude of the crisis is large and many observers suggest that this financial crisis is the worst since that of the 1930's.⁹ Harsh financial conditions might have serious consequences for the real economy as both investment and consumption are likely to be substantially reduced. This paper has quantified the effect of the financial crisis on Swedish real GDP growth – a task which perhaps is particularly interesting from a fiscal policy point of view. Not only has fiscal policy been suggested as a way to lessen the effects on the real economy of the financial crisis but tax revenues and many expenditures – for example, those related to unemployment insurance – are functions of the development of the real economy. The econometric analysis was conducted using a Bayesian VAR model with both US and Swedish variables. Results indicate that financial shocks – and primarily US such – have substantial negative effects on Swedish real GDP growth. Forecasts from the model accordingly suggest that the Swedish economy will grow slowly the next few years.

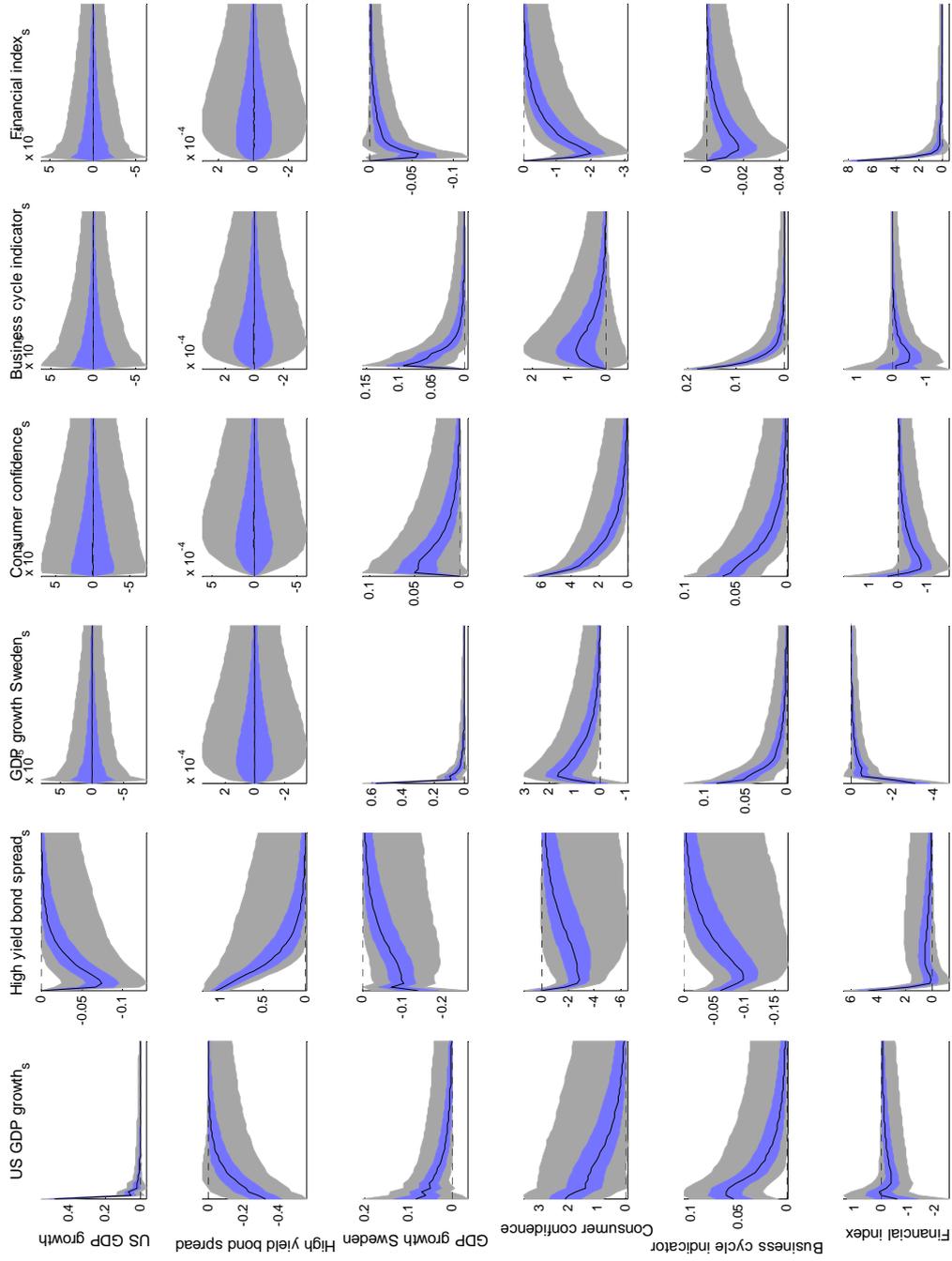
⁹ See, for example, International Monetary Fund (2008).

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Appendix

Figure A1. Impulse response functions.



Note: Black line is the median. Coloured bands are 50 and 90 percent confidence bands. Maximum horizon is 40 quarters.

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