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How Strong Are the Linkages?**

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Liquidity and asset prices: How strong are the linkages?

Christian Dreger, Jürgen Wolters¹

Abstract. The appropriate design of monetary policy in integrated financial markets is one of the most challenging areas for central banks. One hot topic is whether the rise in liquidity in recent years has contributed to the formation of price bubbles in asset markets. If strong linkages exist, the inclusion of asset prices in the monetary policy rule can eventually limit speculative runs and negative effects on the real economy in the future. We explore the impacts of liquidity shocks on real share and house prices and the influence of wealth prices on liquidity. VAR models are specified for the US and the euro area. To control for international spillovers, global VARs are also considered. Differences in the results can provide a measure on the impact of financial market integration. The specifications point to some impact of liquidity shocks on house prices, while asset prices are not affected.

Keywords: Liquidity shocks, asset prices, GVAR analysis, monetary policy

JEL Code: E44, G10, C32, C52

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1 Introduction

The appropriate design of monetary policy in integrated financial markets is one of the most challenging areas currently facing central banks; see for example De Santis, Favero and Roffia (2008). One important aspect is whether monetary policy should respond to asset price fluctuations, if they are driven by non fundamental factors such as herding behaviour (Shiller, 2000). Increases in asset prices can trigger inflationary pressures and might cause an inefficient allocation of resources. Positive shocks to asset markets can generate overconsumption patterns due to perceived wealth effects, and capital overaccumulation due to lower costs of capital (Dupor and Conley, 2004). Bursting bubbles can lead to financial crises that are transmitted to the real economy and undermine the growth perspectives for some time, like the collapse of the new economy boom after the turn of the century and the current subprime and financial crisis.

Eventually, a pre-emptive reaction of monetary policy might help to limit the buildup of financial imbalances and the risks for a crash in the future. Therefore, some authors have recommended that central banks should lean against the wind, see for example Bordo and Jeanne (2002), Borio and White (2004) and Borio (2006). On the other hand, Bernanke and Gertler (2001) and Mishkin (2007) have stressed that rules that directly target asset prices could have undesirable side effects. In periods of rapid price increases in asset markets, a tighter monetary policy stance can lead to significant output losses. Thus, monetary policy should respond to asset prices only insofar as they affect inflation and output expectations.

Besides the difficulties that central banks are required to identify bubbles in the development of asset prices in real time, a leaning against the wind behaviour assumes a robust link between monetary policy and asset markets. In particular, liquidity shocks should have predictable consequences on asset prices. In order to explore the relationship, country individual and global VAR models are estimated for the US and the euro area. As a further robustness check, asset prices are measured either by real share or real housing prices, respectively.

Generalized impulse response analysis and variance decomposition of forecast errors serve as the main tools of the analysis. The evidence shows that the impact of liquidity shocks on asset prices is far from being robust. While monetary policy does not affect

share prices, it might have an impact on house prices, especially in the US. Differences between the country individual and global VAR frameworks are often not substantial, implying that the ongoing integration in financial markets does not have a large impact on these results.

The rest of the paper is organized as follows. The main transmission channels between monetary policy and asset prices are reviewed together with the earlier empirical evidence in section 2. Section 3 discusses data properties and presents the results. Section 4 offers policy conclusions.

2 Monetary policy and asset prices

Several arguments point to an impact of monetary policy shocks on asset prices. A positive liquidity shock will affect the quantity and marginal utility of money holdings relative to other financial assets, consumption and capital goods. To restore equilibrium a rebalancing of the liquidity/asset ratio compatible with optimal portfolio allocation is required (Congdon, 2005). The adjustment process triggers higher asset demand and price increases (Friedman, 1988, Meltzer, 1995). According to Adrian and Shin (2008) this effect is amplified through a procyclical balance sheet management of financial intermediaries. The leverage, i.e. the ratio of total assets to equity is raised in asset price booms and reduced in downturns. In addition, the achievement of higher price stability has reduced risk premia and asset price volatility, thereby creating excess credit pressures and additional leverage (see Borio and Lowe, 2002). A higher degree of uncertainty can weaken the basic relationship, as it could lead to a higher liquidity share. Note that reverse causation is also justified from a money demand perspective. Higher asset prices increase demand for liquidity due to a rise in the net household wealth position. Greiber and Setzer (2007) and Dreger and Wolters (2009) have reported empirical evidence for this effect in the euro area.

Previous papers have explored the impact of monetary shocks on asset prices, but the results are far from being conclusive. Baks and Kramer (1999) stressed that a rise in global liquidity coincides with a decrease in real interest rates and an increase in stock market returns. Due to Roffia and Zaghini (2007), periods of strong monetary growth are likely to be followed by periods of high inflation, provided that money growth is

accompanied by asset price inflation. A monetary expansion appears to be less harmful to overall inflation if asset prices do not accelerate. Adalid and Detken (2007) found that monetary policy and asset prices are associated over mechanically identified boom and bust cycles in asset markets. Shocks to real liquidity appear to be a major driver of real estate prices in boom episodes and have some explanatory power for the depth of post boom recessions. Belke, Orth and Setzer (2008) have emphasized that a global liquidity shock leads to a rise in consumer and global house prices, where the latter reaction is more pronounced. However, the results cannot be generalized, as there is no impact on share prices. Likewise, Ruffer and Stracca (2006) failed to detect any significant reaction of asset prices to liquidity shocks.

3 Data issues and results

According to Giuliadori (2005) and other authors, the linkages between liquidity shocks and asset prices are investigated by means of VAR models, as these tools are built upon the interactions between the relevant variables. However, the findings at the individual country level might blur the effects actually at work. Liquidity shocks in one region can be absorbed by other regions in integrated financial markets, see Giese and Tuxen (2007) and Assenmacher-Wesche and Gerlach (2008). To obtain robust evidence, both country individual and global VARs are specified. Differences in the results can provide a measure on the impact of financial market integration.

In a global VAR, the development of domestic variables can be driven by foreign series, since international linkages are taken into account, see Pesaran, Shuermann and Smith (2004) and Déés, Di Mauro, Pesaran and Smith (2007). Foreign variables refer to a weighted average of variables from other regions and can enter contemporaneously and with lags. Weights are chosen, for example, with respect to GDP or trade shares. However, if only a few countries are involved, aggregation is not strictly required. Due to the block diagonality of the matrices of the domestic and foreign parameters, a global VAR can be re-written as an ordinary VAR for all variables of the system, see the appendix. Hence, aggregation cannot blur the results. Normally, the individual VARs augmented with foreign variables are estimated and the global VAR is then obtained by solving for the contemporaneous explanatory variables from the individual estimates. Since there

are only two regions with five endogenous variables in this study, we have a sufficient number of degrees of freedom to estimate the global VAR in a direct way. The individual country VARs are specified for the US and the euro area (initial member states) and comprise five variables: the nominal money stock as a liquidity measure (m), the nominal interest rate for financial assets with long periods to maturity (i), the price level (p), real income (y), and real asset prices (w), the latter proxied either as real share or housing prices. The global VAR is based on these ten variables, i.e. the same set of variables for both regions. In addition, the oil price enters as an exogenous variable in all models. Generalized impulse responses and variance decompositions of forecast errors are employed to avoid problems caused by the ordering of the variables (Pesaran and Shin, 1998).

The analysis is built on quarterly seasonally adjusted data ranging from 1985.1-2007.4. Nominal monetary aggregates refer to end of period values for M2 in the US and M3 in the euro area. Nominal income is GDP at current prices. Asset prices are share prices on the stock market or price indexes for new houses and series in real terms are obtained by deflating the respective nominal measure with the GDP deflator (2000=100). The long term interest rate is the yield for government bonds with 10 years to maturity. The main data source is the World Market Monitor provided by Global Insight. GDP figures for the pre-euro area period are taken from Brand and Cassola (2004). All series are expressed in logarithms, except for interest rates.

The VAR models are specified for the series defined in their levels. For integrated variables this leads to consistent estimates, as cointegrating relationships are implicitly embedded (see Sims, Stock and Watson, 1990). The lag length is determined by the Schwarz criterion, as this measure is the most accurate one for integrated data and the relevant sample size (Ivanov and Kilian, 2005). The lag length is equal to 2 in the country models and equal to 1 in the global VAR environment. All specifications are estimated with a constant, a linear time trend and the nominal oil price as a truly exogenous variable. As the impulse responses are estimated rather imprecisely, one standard error confidence bands obtained by Monte Carlo methods are preferred instead of the conventional significance levels, as recommended by Sims and Zha (1999).²

² All calculations have been performed with EViews 6.

-Figure 1 about here-

First, individual country models are estimated without asset prices, see Figure 1. These models serve as a benchmark for the further analysis. Most responses are in line with theoretical reasoning. In line with standard models of money demand, a positive income shock raises liquidity in the euro area in the short and long run. In the US this effect holds in the long run. Furthermore, prices and long term interest rates are expected to increase due to higher inflation pressure. A shock in liquidity leads to an interest rate cut in the US, but to a rise in the euro area. The latter reaction might be plausible, however, because prices also increase, and inflation expectations are embedded in the nominal interest rate. By the same sort of argument, a positive response of prices and income to higher interest rates can be justified. In the US, money declines after a positive price shock. This might indicate portfolio shifts from liquid to real assets. Overall, the benchmark does not produce implausible results and seems to be appropriate to investigate the linkages between liquidity and wealth.

Figure 2 displays the interactions between liquidity and asset prices, when the latter is proxied by share prices, while figure 3 has the same information for the house price alternative. The two columns on the left are obtained from the individual country models, and the columns on the right hand side are extracted from the global VAR. In order to save space, only these interactions are exhibited. The entire set of impulse responses is available from the authors upon request.

-Figures 2 and 3 about here-

The evidence turns out to be broadly similar for the individual country and the global VAR, i.e. does not depend heavily on the degree of international spillovers.³ According to Figure 2, a significant long run effect of liquidity to share prices is observed for the

³ If short term interest rates are used instead of the money stock, the differences between the results are not substantial.

US VAR. Taken international spillovers into account, this effect vanishes. Reversed significant effects are not existent. As a striking feature, house prices react to liquidity shocks. However, a positive reaction is limited to the US economy (Figure 3). The multipliers become negative in the euro area in case of the global model. This might be linked to institutional differences in the mortgage markets. The reversed channel, i.e. rising liquidity as a response to an increase in wealth seems to be more relevant and could be interpreted as an indication for the presence of wealth effects on money demand. In any case, these results cast serious doubts on the existence of a strong link running from liquidity to asset prices.

The variance decomposition exercise is broadly in line with the impulse responses, see Tables 1 and 2. According to some specifications, the variance of forecast errors in asset prices at longer forecasting horizons can be traced to a large extent to liquidity shocks, see the share price model in the US and the house price model for the euro area. However, this evidence is far from being robust. Specifically, it cannot be replicated in the global VAR environment. In this sense, these results are blurred due to the exclusion of international spillovers.

-Table 1 and 2 about here-

4 Conclusions

The appropriate design of monetary policy in integrated financial markets is one of the most challenging areas for central banks. One hot topic is whether the rise in liquidity in recent years has contributed to the formation of price bubbles in asset markets. If strong linkages exist, the inclusion of asset prices in the monetary policy rule can eventually limit speculative runs and negative effects on the real economy in the future. We explore the impacts of liquidity shocks on real share and house prices and the influence of wealth prices on liquidity for the period from 1985.1 to 2007.4. VAR models are specified for the US and the euro area. To control for international spillovers, global VARs are also considered. Differences in the results can provide a measure on the impact of financial market integration. The specifications point to some impact of liquidity shocks on house prices, while asset prices are not affected.

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Figure 1: Impulse response analysis, benchmark model: United States

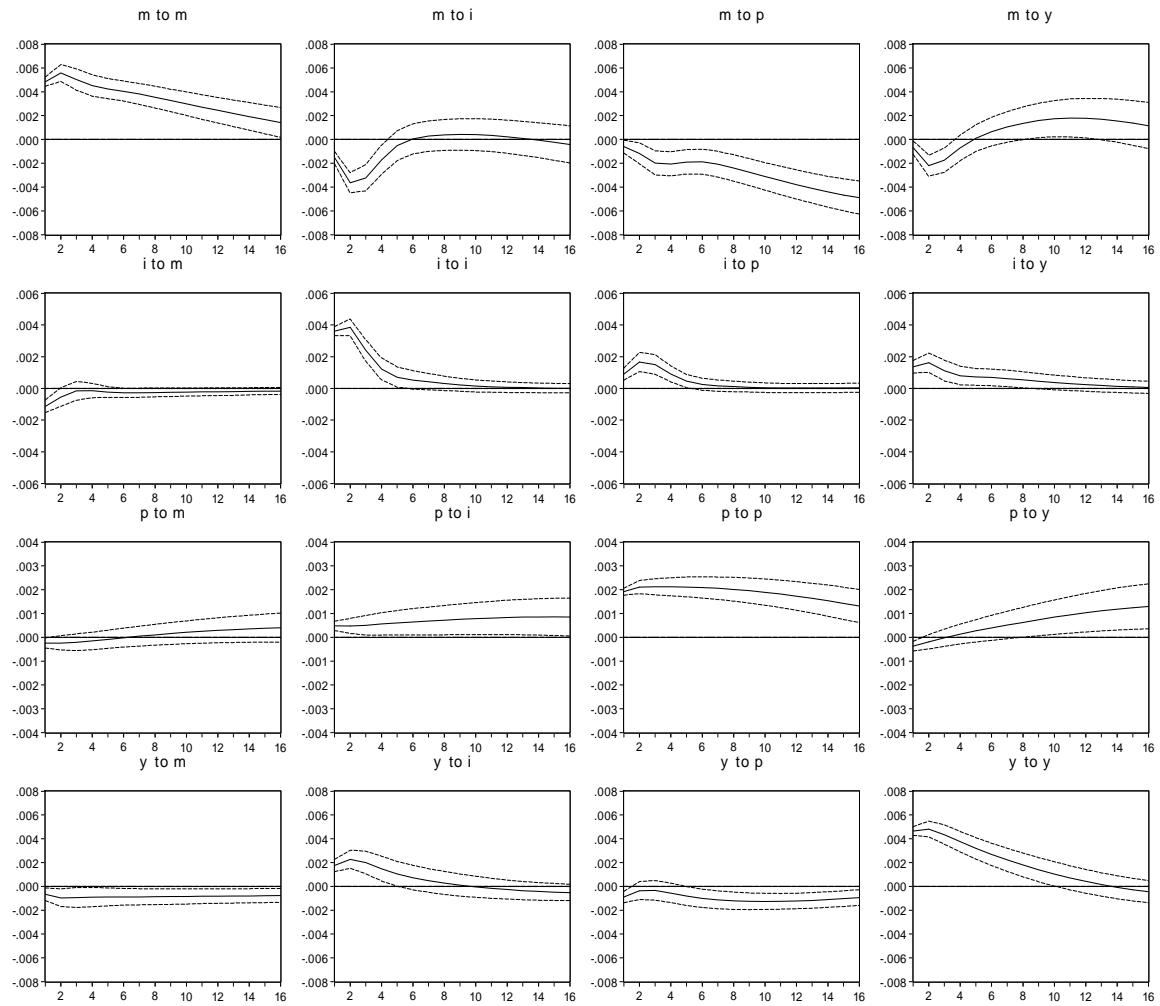
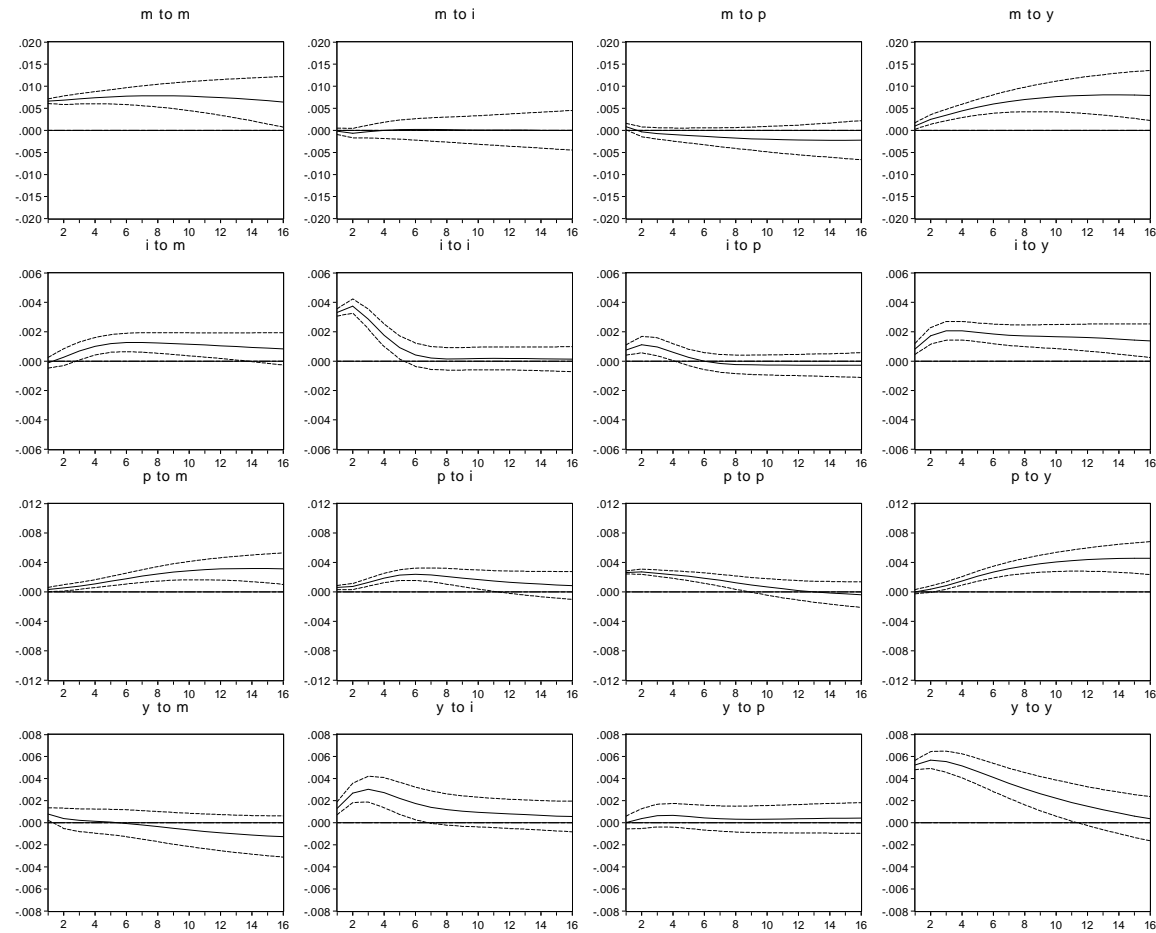
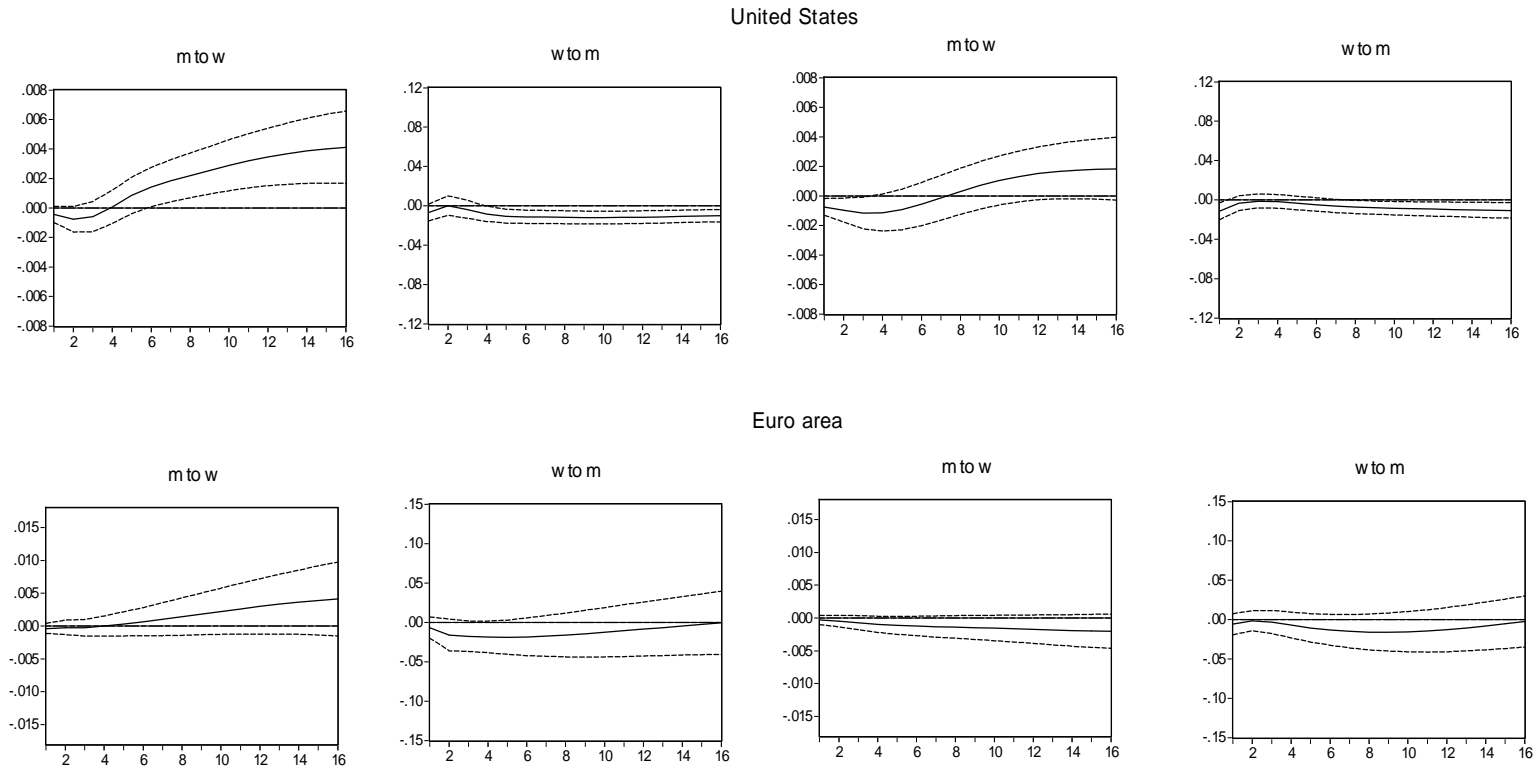


Figure 1 (cont'd): Euro area



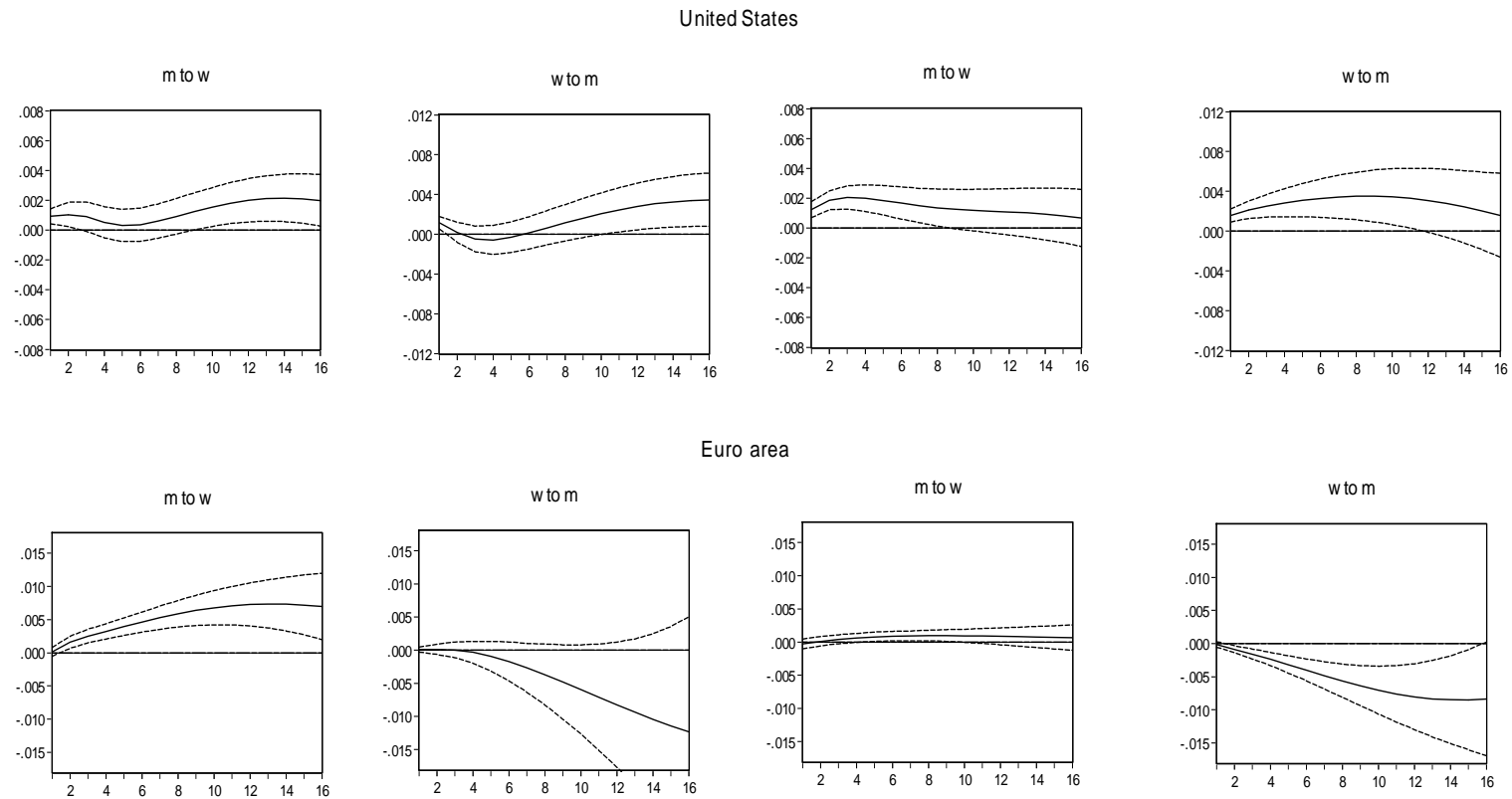
Note: Generalized impulse responses. Dashed lines denote one standard error band.

Figure 2: Impulse response analysis, share price model



Note: Generalized impulse responses. Dashed lines denote one standard error band. First and second column country model, third and fourth column global model.

Figure 3: Impulse responses, house price model



Note: Generalized impulse responses. Dashed lines denote one standard error band. First and second column country model, third and fourth column global model.

Table 1: Forecast error variance decomposition of liquidity shock

Share price model

| Steps | Country VAR | | | | Global VAR | | | |
|-------|---------------|----------|-----------|----------|---------------|----------|-----------|----------|
| | United States | | Euro area | | United States | | Euro area | |
| | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> |
| 4 | 87.8 | 0.3 | 88.6 | 0.0 | 54.2 | 0.1 | 87.6 | 0.8 |
| 8 | 79.5 | 6.8 | 74.8 | 0.9 | 47.5 | 0.3 | 63.3 | 2.6 |
| 16 | 47.8 | 22.5 | 58.5 | 6.0 | 32.3 | 3.3 | 31.5 | 5.6 |

House price model

| Steps | Country VAR | | | | Global VAR | | | |
|-------|---------------|----------|-----------|----------|---------------|----------|-----------|----------|
| | United States | | Euro area | | United States | | Euro area | |
| | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> |
| 4 | 81.6 | 2.6 | 85.1 | 8.1 | 48.6 | 1.0 | 90.4 | 0.9 |
| 8 | 71.9 | 2.1 | 51.2 | 42.9 | 40.4 | 1.8 | 66.8 | 8.0 |
| 16 | 41.8 | 2.2 | 18.8 | 75.9 | 32.2 | 1.7 | 64.9 | 9.2 |

Note: Entries show the percentage share of the forecast error variance of liquidity or asset prices, respectively, that are related to liquidity shocks.

Table 2: Forecast error variance decomposition of wealth shock

Share price model

| Steps | Country VAR | | | | Global VAR | | | |
|-------|---------------|----------|-----------|----------|---------------|----------|-----------|----------|
| | United States | | Euro area | | United States | | Euro area | |
| | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> |
| 4 | 1.2 | 90.0 | 2.1 | 92.0 | 4.1 | 37.2 | 0.3 | 78.6 |
| 8 | 4.5 | 83.7 | 3.4 | 85.9 | 14.4 | 30.7 | 2.1 | 59.5 |
| 16 | 10.5 | 76.9 | 3.5 | 70.8 | 19.6 | 23.9 | 3.6 | 46.2 |

House price model

| Steps | Country VAR | | | | Global VAR | | | |
|-------|---------------|----------|-----------|----------|---------------|----------|-----------|----------|
| | United States | | Euro area | | United States | | Euro area | |
| | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> | <i>m</i> | <i>w</i> |
| 4 | 0.8 | 82.9 | 0.1 | 91.5 | 4.5 | 31.8 | 13.0 | 52.8 |
| 8 | 0.7 | 75.1 | 2.8 | 89.9 | 5.8 | 16.4 | 35.2 | 29.8 |
| 16 | 6.3 | 40.1 | 19.0 | 71.5 | 7.9 | 9.4 | 59.1 | 13.7 |

Note: Entries show the percentage share of the forecast error variance of liquidity or asset prices, respectively, that are related to shocks in asset prices.

Appendix: VAR and GVAR models

The starting point of the analysis is a global VAR (GVAR) environment. Without loss of generality, the model is specified for two variables y and x and two countries. Foreign country variables are indicated with an asterisk, and t denotes time. The variables from one country can affect those from the other country contemporaneously, i.e.

$$y_t = a_{11}y_{t-1} + a_{12}x_{t-1} + b_{11}y_t^* + b_{12}x_t^* + e_{1t}$$

$$x_t = a_{21}y_{t-1} + a_{22}x_{t-1} + b_{21}y_t^* + b_{22}x_t^* + e_{2t}$$

$$y_t^* = c_{11}y_{t-1}^* + c_{12}x_{t-1}^* + d_{11}y_t + d_{12}x_t + e_{1t}^*$$

$$x_t^* = c_{21}y_{t-1}^* + c_{22}x_{t-1}^* + d_{21}y_t + d_{22}x_t + e_{2t}^*$$

The equations might be re-written in the matrix format

$$\begin{pmatrix} y_t \\ x_t \\ y_t^* \\ x_t^* \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 \\ 0 & 0 & c_{11} & c_{12} \\ 0 & 0 & c_{21} & c_{22} \end{pmatrix} \begin{pmatrix} y_{t-1} \\ x_{t-1} \\ y_{t-1}^* \\ x_{t-1}^* \end{pmatrix} + \begin{pmatrix} 0 & 0 & b_{11} & b_{12} \\ 0 & 0 & b_{21} & b_{22} \\ d_{11} & d_{12} & 0 & 0 \\ d_{21} & d_{22} & 0 & 0 \end{pmatrix} \begin{pmatrix} y_t \\ x_t \\ y_t^* \\ x_t^* \end{pmatrix} + \begin{pmatrix} e_{1t} \\ e_{2t} \\ e_{1t}^* \\ e_{2t}^* \end{pmatrix}$$

or more compactly

$$Y_t = AY_{t-1} + BY_t + E_t \rightarrow$$

$$(I - B)Y_t = AY_{t-1} + E_t \rightarrow$$

$$Y_t = (I - B)^{-1}AY_{t-1} + V_t, \quad V_t = (I - B)^{-1}E_t$$

The latter specification refers to an ordinary VAR framework comprising the four variables of the system.