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Liquidity and the dynamic pattern of asset price adjustment: a global view

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Discussion Papers

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Liquidity and the Dynamic Pattern of Asset Price Adjustment: A Global View*

by

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Abstract

Global liquidity expansion has been very dynamic since 2001. Contrary to conventional wisdom, high money growth rates have not coincided with a concurrent rise in goods prices. At the same time, however, asset prices have increased sharply, significantly outpacing the subdued development in consumer prices. We investigate the interactions between money and goods and asset prices at the global level. Using aggregated data for major OECD countries, our VAR results support the view that different price elasticities on asset and goods markets explain the observed relative price change between asset classes and consumer goods.

JEL-Code: E31, E52, F01, F42

Keywords: Global liquidity, inflation control, monetary policy transmission, asset prices

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1. Introduction

Global liquidity has been expanding steadily since 2001. In most industrial countries and more recently also in some emerging market economies with a dollar peg, especially China, broad money growth has been running well ahead of nominal GDP. But goods price inflation had for a long time been widely unaffected by the strong monetary dynamics in many economies around the world. Only with a considerable lag surplus liquidity poured into raw material, food and goods markets. Over the same time horizon, however, many countries have experienced, in some cases two, sequential booms in real estate and share prices (Schnabl and Hoffmann, 2007). This sequence of increases of asset prices has been interpreted by many observers as the result of liquidity spill-overs to certain asset markets (Adalid and Detken, 2007, Greiber and Setzer, 2007). From 2001 to 2006, for instance, house prices strongly increased in the US (55%), the euro area (41%), Australia (59%), Canada (61%) and a number of further OECD countries; the HWWI commodity price index surged by 110% in the same period and stock prices more than doubled in nearly all major markets from 2003 to 2006.

From a monetary policy perspective, the different price dynamics of assets and goods prices in recent years raises the question as to whether the money-inflation nexus has substantially changed (thereby calling into question the close long-term relationship between monetary and goods price developments that was observed in the past) or whether effects from previous policy actions are still in the pipeline. To investigate the relative importance of these developments, this study tries to establish an empirical link among money, asset prices and goods prices. For this purpose, we estimate a variety of VAR models including a measure of global liquidity, proxied by a broad monetary aggregate in the OECD countries under consideration (United States, Euro area, Japan, United Kingdom, Canada, South Korea, Australia, Switzerland, Sweden, Norway and Denmark) and analyse the impact of a shock to global liquidity on global asset and goods price inflation. The basic idea is that different price

elasticities of supply lead to differences in the dynamic pattern of price adjustment to a global liquidity shock. While goods prices adjust only very slowly to changing global monetary conditions due to plentiful supply of consumer goods from emerging markets, asset prices such as housing and commodity prices react much faster since the supply of real estate and commodities cannot be easily expanded. Thus disequilibria on these markets are rather generally balanced out by rather quick price adjustments.

The main emphasis is on globally aggregated variables which implies that we do not explicitly deal with spill-overs of global liquidity to national variables. We strictly follow Ruffer and Stracca (2006, p. 8) in this respect and argue that the concept of global liquidity is useful but that it does not allow us to distinguish whether what we observe at a global level is due to the simple aggregation of the impacts in the individual economies or, at least to some extent, also to a spill-over across countries. We feel legitimized to proceed like this because recent research which corroborates that inflation is a global phenomenon. Up to now, the relation among money growth, specific classes of asset prices and goods prices appears still under-researched in an international context. However, a few authors suggested specific interactions of global liquidity with global consumer price and asset price inflation (Baks and Kramer, 1999, Sousa and Zaghini, 2006, and Ruffer and Stracca, 2006). However, so far we are not aware of any study which investigates the dynamic pattern of price adjustment to a global liquidity shock in a systematic fashion.

The remaining parts of the paper are organised as follows: in section 2, we develop a global perspective of the monetary transmission process. In section 3, we derive some theory to illustrate the importance of different supply elasticities as potential drivers of asset- and goods-specific price adjustments to global liquidity shocks. In section 4 we turn to an econometric analysis using the VAR technique on a global scale. Moreover, we conduct a wide array of robustness checks. Section 5 finishes with some policy conclusions.

2. A global interpretation of the monetary transmission process

There is strong evidence that the global instead of the national perspective is more important when the monetary transmission mechanism has to be identified and interpreted in terms of global inflation and to global liquidity performance. An example is Ciccarelli and Mojon (2005) who identify a significant robust error-correction mechanism which implies that deviations of national inflation from global inflation are corrected over time. In the same vein, Borio and Filardo (2007) claim that the traditional way of modelling inflation is too country-centred and argue in favour of a global approach.

With respect to the development of global liquidity over time, it is often discussed whether and to what extent global factors are responsible for it (Belke and Rees, 2009). Ruffer and Stracca (2006) do some research on this question, focusing on the G7 countries, based on a factor analysis. They come up with the conclusion that one is able to trace back about fifty percent of the variance of a narrow monetary aggregate to one common global factor. For instance, the expansionary monetary policy stance of the Bank of Japan (BoJ) during the last years represents a prominent example of such a global factor. The BoJ has accumulated a significant amount of foreign reserves and has set extremely low interest rates - at some time even approaching zero. Financial investors conducted carry trades, implying that they took up loans in Japan and invested the proceeds in currencies with higher interest rates. Such capital transactions have impacts on the evolution of monetary aggregates reaching far beyond the special case of Japan and national borders in general (Schnabl and Hoffmann, 2007).

An additional advantage of focusing on global instead of national liquidity is that national monetary aggregates have proven to be more difficult to interpret because of the huge increase of international capital flows. Just simply accounting for the external sources of money growth and then merely mechanically correcting for cross-border portfolio flows

and/or Mergers&Acquisitions activity, on the presumption of their likely less relevant direct effects on consumer prices, does clearly not appear to be a sufficient reaction. What is more, these transactions have to be carefully checked for their information content and potential wealth impacts on residents' income and on asset prices which might backfire again to goods prices (Papademos, 2007, p. 4, Pepper, 2006). Analogously, Sousa and Zaghini (2006) claim that global aggregates are most probably internalizing cross-country movements in monetary aggregates - as a consequence of capital flows between different regions - which could render the connexion among money, inflation and output more difficult to disentangle at the country level. Giese and Tuxen (2007) emphasize that in today's interlinked financial markets shifts in the money supply in one country tend to be absorbed by money demand in another country. However, simultaneous shifts in major economies may cause significant impacts on worldwide asset and goods price inflation.

It might be claimed by some that global liquidity, at least if it is measured in one currency, is only possible to change quantitatively if a fixed exchange rate system is assumed to prevail worldwide. However, we feel legitimized to argue that international liquidity spill-over effects may occur regardless of the exchange rate system. Under pegged exchange rate regimes official foreign exchange interventions ultimately lead to a transmission of monetary policy shocks from one country to another. Under a regime of flexible exchange rates, the validity of the "uncovered interest rate parity" (UIP) relationship should in theory prevent cross-border monetary spill-overs. According to the UIP, the expected appreciation of the low-yielding currency in terms of the high-yielding currency should be equal to the difference between (risk-adjusted) interest rates in the two economies.

However, one should acknowledge that the violation of the UIP – often also referred to as the “forward premium puzzle”- is a common empirical finding. The enduring existence of carry trades can be taken as evidence that exchange rates diverge from fundamentals for

lengthy periods, as the exposure of a carry trade position involves a bet that UIP does not hold over the investment period. It can be ascribed to flights to quality, excessive risk-taking or infrequent revisions of investor portfolio decisions.¹ More generally, the experience of Iceland whose monetary policy autonomy was undermined by carry trades can be mentioned here.

In addition, currency substitution may well enable international liquidity spill-overs in a framework of flexible exchange rates. Both older and recent studies have shown that investors hold an array of currencies, and that these money holdings change in response to changes in the relative opportunity cost of holding one currency instead of another (Miles 1978 and Santis, Favero and Roffia 2008). These international adjustments of money holdings allow the transmission of monetary shocks from one economy to another (via money demand) even in system of flexible exchange rates.

Note as well that exchange rates might quite rarely be considered as truly flexible across our estimation period anyway, as, for instance, Reinhart and Rogoff (2004) classify only 4.5% of the exchange rate regimes under their investigation as "freely floating". This assessment did also not change much in their more recent and updated data set.

The concept of "global liquidity" has attracted growing attention in the empirical literature in recent years. One of the first studies in this field is Baks and Kramer (1999) who use different indices of liquidity in seven industrial countries to explore the dimension of the relationship among liquidity and asset returns. The authors find evidence that there are important common components in G7 money growth and that an increase in G7 money growth is consistent with higher G7 real stock returns and lower G7 real interest rates.

¹ See in more detail Belke and Rees (200). Jylhä, Suominen and Lyytinen (2008) very clearly and conclusively demonstrate the failure of the UIP based on capital flows of the hedge fund branch. Brunnermeier, Nagel and Pedersen (2008) explicitly deal with the relation between carry trades and currency crises. Plantin and Shin (2008) show in a dynamic global games framework that carry trades can be destabilizing and lead to "exchange rate bubbles" within an elaborated model which derives the potential impact of carry trades on the UIP. Finally, Bacchetta and van Wincoop (2007) attribute the violation of the UIP to infrequent revisions of investor portfolio decisions.

Recently, a number of studies has applied VAR or VECM models to data aggregated on a global level. Important contributions include Ruffer and Stracca (2006), Sousa and Zaghini (2006) and Giese and Tuxen (2008). These studies find significant and distinctive reaction of consumer prices to a global liquidity shock. In contrast, evidence of a relationship between global liquidity and asset prices is found to be mixed. In the study by Ruffer and Stracca (2006), e.g., a composite real asset price index that incorporates property and equity prices does not show any significant reaction to a global liquidity shock. Giese and Tuxen (2007) find no evidence that share prices increase as liquidity expands; however, they cannot empirically reject cointegration relationships which imply a positive impact of global liquidity on house prices.

3. The price adjustment process

As far as the impact of monetary policy on asset prices is concerned, the most recent and innovative studies are – with an eye on the subprime crisis not surprisingly - concerned with the relationship among monetary policy and house prices. However, we will show below that large parts of the arguments can be transferred without major modifications to other asset classes as well. Some authors have recently emphasized the role of housing for the transmission of monetary policy, although drawing on interest rate changes as policy instruments rather than on changes in money aggregates (see e.g. Del Negro and Otrok, 2007, Giuliadori, 2005, Goodhart and Hofmann, 2001, assuming that all asset prices react with a lag to monetary policy shocks, and Iacoviello, 2005, ignoring additional asset prices).²

Recently, the global aspects of house price developments have gained importance. A study by the IMF deals with this issue and analyses the recent house price boom from a global point of view.³ Similar to some of the studies mentioned above a factor analysis is performed

² Further examples are Goodhart and Hofmann (2007) and Mishkin (2007).

³ See the essay "The Global House Price Boom" in International Monetary Fund (2004), chapter 2.

and a global factor is extracted. It is estimated that 40% of national house price developments can be explained by global factors. The study concludes that there are strong international linkages of the factors that determine house prices and that the recent house price bubble has indeed been a distinctly global phenomenon. There are at least two possible explanations of these findings at hand.

First, there is empirical evidence for the existence of a global business cycle (Canova, 2007) and since house prices arguably move largely pro-cyclically, this can be seen as one major common force that drives house prices all over the world. Second, if there are arbitrage relationships between house prices and globally traded securities like shares, the global factors that affect these securities influence house prices as well (think, for instance, of a global stock market crash).⁴

One aspect which has been largely neglected by the previous literature is why house prices (and other asset prices) have risen so sharply in recent years while consumer price development has been subdued. Some insights into the relationship between money, asset prices and consumer prices can be gained from a deeper inspection of the dynamic price adjustment to a liquidity shock across different sectors of the economy. In the short run, an expansionary monetary policy providing the markets with more liquidity should trigger an immediate price reaction in sectors with low price elasticity of supply, but a more subdued price reaction in sectors with high elasticity of supply. Over time, however, elastic good prices also adjust to the new equilibrium by proportional changes of the price level, i.e. it is plausible to argue that in the long term changes in money supply do not lead to any effects on real money or real output.

Figure 1 illustrates (in an extreme form) the price-quantity changes as a result of a monetary expansion in markets with high (left graph) and low (right graph) price elasticity of

⁴ See IMF (2004) for this argument.

supply. The aggregated supply of price elastic goods S_e in the short-term (SR) is characterized by infinite price elasticity so that additional demand triggered by a liquidity shock (from D_{e1} to D_{e2}) can be satisfied without any price increase. Consequently, the liquidity shock translates into an increase in output achieving a new short-term equilibrium at p_{e1} . In contrast, goods characterized by restrictions in supply cannot be expanded easily and are thus quantity insensitive to a monetary expansion. Additional demand (shift from D_{i1} to D_{i2}) is then fully reflected in a rise of house prices to p_{i1} .

In the long run, prices will also react on the price elastic goods market as the well-documented neutrality of money holds; any change in money supply is met with a proportional change in the price level that keeps real money and real output in both sectors unchanged (at p_{e2} and p_{i2}).

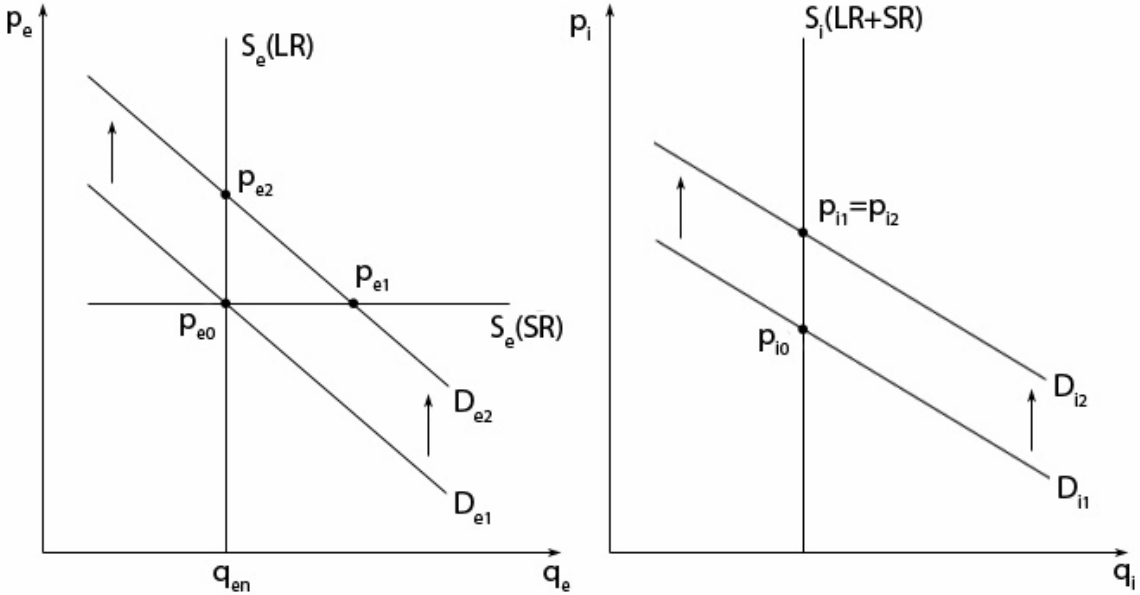


Figure 1: Short- and long-run impact of a liquidity shock to price elastic (left-hand side) and price inelastic good (right-hand side).

The possibility of different dynamic adjustment of price elastic and inelastic goods to a monetary shock may provide an explanation for the recent upward shift in relative prices

between assets and consumer goods.⁵ This assumption can be well motivated with developments in international trade. Due to high degree of competition in international goods markets and vast supply of cheap labour in many emerging markets around the world, which weighs heavily on the prices of manufactured goods, goods prices remain unaffected by the increase in aggregate demand in the short run. Only in the long run, increasing capacity utilization will translate into higher wages, putting upward pressure on prices.

In contrast, asset prices such as housing, but also commodity prices are generally assumed to be restricted in supply. Land cannot be expanded easily (Japan) and/or all real estate transactions involve high costs (continental Europe). The latter implies that housing supply is inelastic at least within a certain price interval.⁶ Thus, additional demand for housing is immediately reflected in a rise of house prices.

Similarly, a number of constraints in the commodity market such as finite supply prevent producers in the commodity market from adjusting quantities to short-term price incentives. Moreover, as argued by Browne and Cronin (2007), the price adjustment process in commodity markets is relatively fast because participants are more equally empowered with more balanced information and resources than their consumer goods counterparts. This enables them to react quickly to changes in monetary conditions.

4. Empirical analysis

4.1 Data description and aggregation issues

In the following empirical analysis, we analyze whether monetary transmission corresponds with our prior that different price elasticities of supply determine the ordering of the different asset/goods classes in the transmission process of global liquidity. For this purpose we use

⁵ Note that the supply elasticities that are noted above are short-and long-run elasticities. Hence, their empirical relevance will be checked later on within the impulse-response framework.

⁶ For a detailed discussion of the relevance of these arguments see Gros (2007), OECD (2005) and Shiller (2005).

quarterly time series from 1984Q1 to 2006Q4 for the United States, the euro area, Japan, United Kingdom, Canada, South Korea, Australia, Switzerland, Sweden, Norway and Denmark, so that in our analysis 72.2% of the world GDP in 2006 and presumably a considerably larger share of global financial markets are represented.⁷

For the aforementioned 11 countries, we gather real GDP (GDP), the GDP deflator (PGDP), the short term money market rate (IS), and a broad monetary aggregate (M). Further, to capture developments in asset and commodity markets, we include a nominal house price index (HPI) and the HWWI commodity price index (COM).⁸ The latter is already a global variable (measured in US dollars) so that no aggregation is needed. The monetary aggregate we use is M2 for the US, M3 for the Euro Area, M2 plus cash deposits for Japan, M4 for the UK and mostly M3 for the other countries. The data stem from the IMF, the OECD, the BIS and the ECB and are seasonally adjusted if available or treated with the X12-ARIMA procedure.⁹

In the next step, we aggregate the country-specific series to obtain global series considering the principles mentioned by Beyer, Doornik and Hendry (2000) and employing the same method as used by Giese and Tuxen (2007) in a similar context. First, we calculate variable GDP weights for each country by using market exchange rates to convert nominal GDP into a single currency. This is in contrast to previous literature which has mostly relied on aggregation by purchasing power exchange rates. However, precise purchasing power rates are difficult to measure and not uncontroversial. Moreover, as a stylized fact, deviations from actual and purchasing power rates have proven to be quite persistent and should therefore not be neglected (Taylor, 2000). Nevertheless, we check for the sensitivity of our results to the

⁷ Own calculations based on IMF data.

⁸ The HWWI commodity price index provides an encompassing gauge of price trends in commodity markets. It consists of crude oil (63%), industrial raw materials (23%), coal (4%), and foodstuffs (10%).

⁹ House price are based on OECD data (see Schich and Weth, 2008).

choice of exchange rates in our robustness section. The weight of a country i in period t therefore is:

$$w_{i,t} = \frac{GDP_{i,t} e_{i,t}}{GDP_{agg,t}} \quad (1)$$

with $GDP_{i,t}$ as the gross domestic product for country i at time t , $e_{i,t}$ the nominal exchange rate of the domestic currency to the US dollar, and $GDP_{agg,t}$ the aggregated GDP for all countries in our sample at time t .

Second, we compute for each variable (measured in domestic currency) the growth rate, denoted by $g_{i,t}$ and aggregate them by using the weights calculated in (1):

$$g_{agg,t} = \sum_{i=1}^{11} w_{i,t} g_{i,t} \quad (2)$$

Finally, aggregate levels are then obtained by choosing an initial value of 100 and multiplying with the computed global growth rates. This gives the level of each variable as an index:

$$index_T = \prod_{t=2}^T (1 + g_{agg,t}) \quad (3)$$

This method is applied to all variables except the interest rate, for which aggregation is performed without calculating growth rates.

The main advantage of the chosen aggregation scheme is that it avoids a potential bias resulting from different national definitions of broad money. Given the different definitions of monetary aggregates across countries, the building of a simple sum of national monetary aggregates - a method frequently applied in the related literature - would under-represent countries with narrower definitions of the monetary aggregate and vice versa.

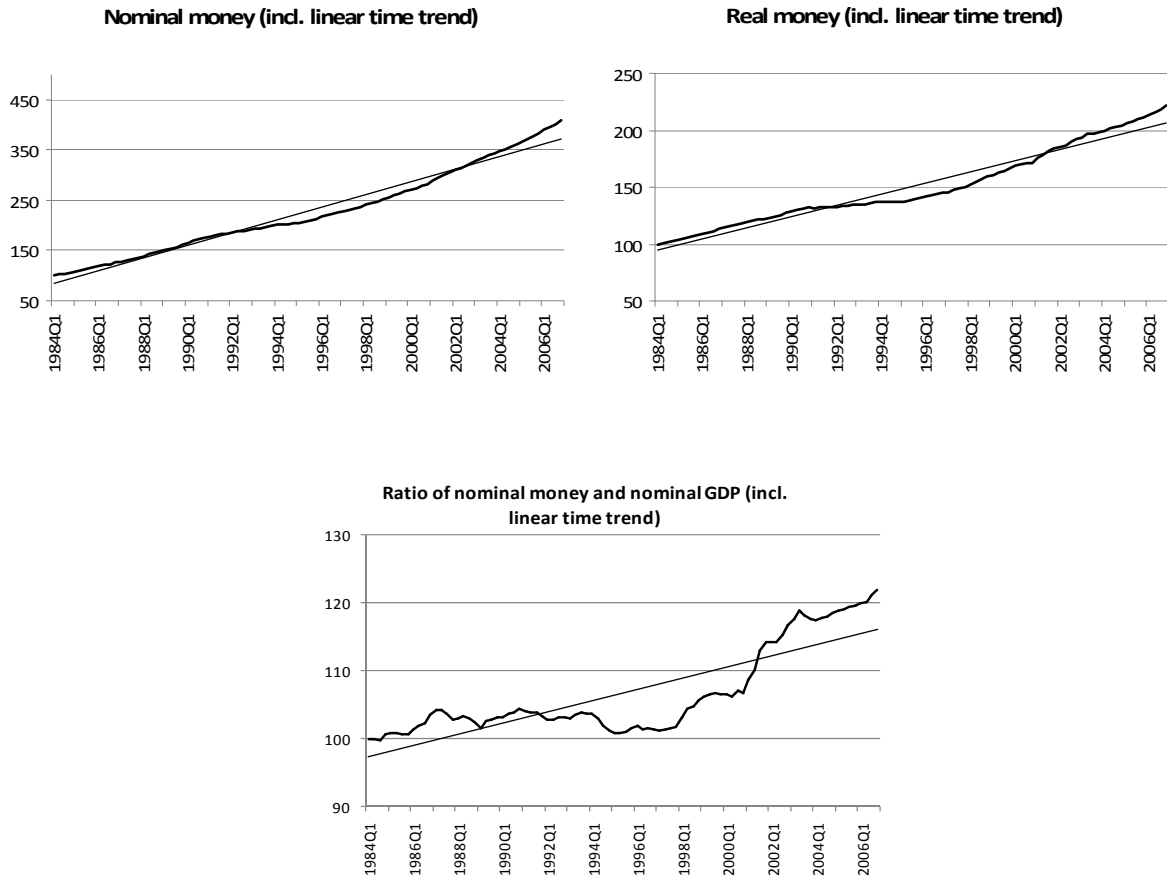


Figure 2: Global liquidity since 1984.

To illustrate the development of global liquidity since 1984, Figure 2 shows global monetary aggregates in absolute and relative terms as well as the inverse of income velocity of money. All three series find themselves above their time trend since about 2001 when monetary policymakers turned to a more expansionary policy in the course of the rapid downturn in stock markets and a number of further shocks such as September 11th. Money growth remained strong throughout the last years, as indicated by the persistent growth of the ratio of nominal money to nominal GDP – a measure frequently applied as an indicator of excess liquidity.¹⁰ Overall, the graphical inspection provides some first glance for the view that global liquidity is indeed at a high level and that the term excess liquidity can be justified rather easily when analyzing the most recent period.

¹⁰ See, for instance, Rüffer and Stracca (2006).

Figure 3 displays the remaining aggregated economic variables of interest. The GDP deflator series clearly elucidates the moderate inflation which started to emerge around the mid-90s and has persisted until 2006 although monetary aggregates expanded heavily in recent years. Global short-term interest rates were at a historically low level from 2002 to 2005, since the monetary policy stance was extremely loose during this period.¹¹ Interestingly, the global time series show that the recent years of global excess liquidity are accompanied by strong price increases in both housing and commodity markets. The ongoing discussion about the linkage of global excess liquidity and asset price inflation is not least based on this phenomenon. In the following econometric analysis we will investigate the causal connection of global liquidity and asset and commodity price inflation in a more formal framework.

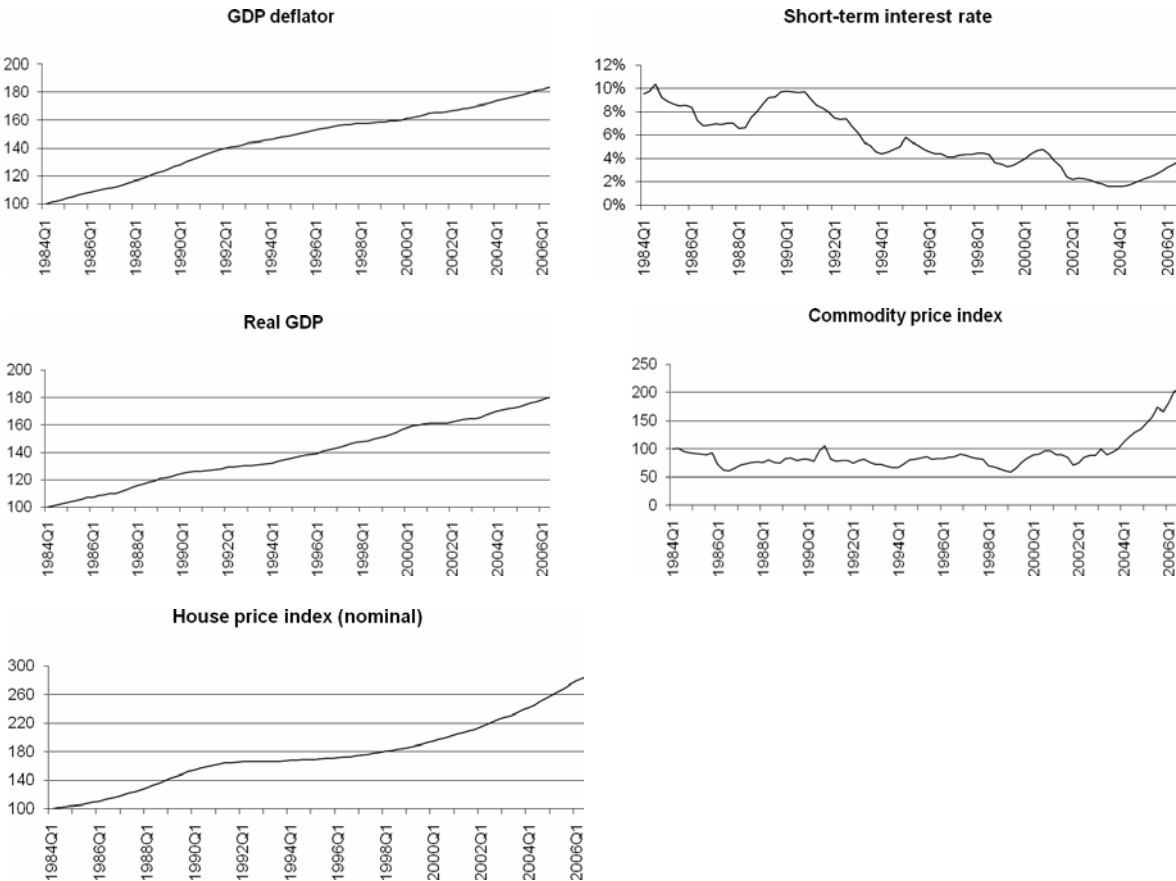


Figure 3: Global series of GDP deflator, short-term interest rate, real GDP, commodity prices and house prices

¹¹ One might regard the deviation from an estimated Taylor rate as a more accurate measure in this respect. However, these numbers create a rather similar picture. See International Monetary Fund (2007), Chapter 1, Box 1.4.

4.2 The VAR Methodology

The econometric framework employed is a vector autoregressive model (VAR) which allows us to model the impact of monetary shocks on the economy while taking care of the feedback between the variables since all of them are treated as endogenous.¹² Based on the VAR analysis, we apply impulse response analyses which provides insights into the short- and long-run relationship of our variables of interest.

Consider first the traditional reduced-form VAR model:

$$\Gamma(L)Y_t = CZ_t + u_t \quad (4)$$

where Y_t is the vector of the endogenous variables and $\Gamma(L)$ is a matrix polynomial in the lag operator L for which $\Gamma(L) = I + \sum_{i=1}^p A_i L^i$, so that we have p lags. Z_t is a matrix with deterministic terms, C is the corresponding matrix of coefficients, and u_t is the vector of the white noise residuals where serial correlation is excluded, so that:

$$E(u_t) = 0 \quad (5)$$

$$E(u_t u_s^1) = \begin{cases} \Sigma : t = s \\ 0 : t \neq s \end{cases} \quad (6)$$

Since Σ is not a diagonal matrix, contemporaneous correlation is allowed. In order to model uncorrelated shocks, a transformation of the system is needed. Using the Cholesky decomposition $\Sigma = PP'$, taking the main diagonal of P to define the diagonal matrix D and premultiplying (4) with $\Psi := DP^{-1}$ yields the structural VAR (SVAR) representation:

$$K(L)Y_t = C^*Z_t + e_t \quad (7)$$

¹² Of course, one could model exogenous variables as well, but this option is not used here. One reason is that we consider a world model, where there are no exogenous variables by definition. Moreover, from an econometric point of view, we refer to our point estimates. They reveal that no variable is weakly exogenous. Instead, all variables cannot be rejected to be endogenous.

$$K(L) = \Psi + \sum_{i=1}^p A_i^* L^i \quad (8)$$

The contemporaneous relations between the variables are now directly explained in Ψ , which is a lower triangular matrix with all elements of the main diagonal being one. The innovations e_t are by construction uncorrelated: $E(e_t e_t') = \Psi \Sigma \Psi' = \Psi P P' \Psi' = D P^{-1} P P' P^{-1} D' = D D'$. Similarly, the Cholesky decomposition is used to construct orthogonal innovations out of the moving average representation of the system which is the cornerstone of the impulse response analysis.

Furthermore, the use of the Cholesky decomposition implies a recursive identification scheme which involves restrictions about the contemporaneous relations between the variables. The latter are given by the (Cholesky) ordering of the variables and might considerably influence the results of the analysis. Therefore, different orderings are used to prove the robustness of our results.

Unit root tests indicate that all our series are integrated of order one. Thus the question arises whether one should take differences of the variables in order to eliminate the stochastic trend. However, Sims, Stock and Watson (1990) show that Ordinary Least Squares estimates of VAR coefficients are consistent under a broad range of circumstances even if the variables are nonstationary.¹³ Therefore, we strictly follow this approach and estimate the VAR model in levels.

¹³ Estimating the VAR in levels does not pose any problems, if all variables are stationary (I(0)). If some variables have a unit root (I(1)) and the series are not cointegrated, a VAR in levels or first differences makes no difference asymptotically. Taking first differences only tends to be better in samples smaller than ours (Hamilton, 1994, pp. 553, 652). However, if two or more variables are I(1) and cointegrated, the first difference estimates are biased if there is cointegration because the error-correction term is omitted. An alternative in the latter case would be to estimate a VECM, as done by us in a similar context in Belke, Bordon and Hendricks (2009). However, since it is hard to identify with any degree of accuracy the underlying structural parameters of a VECM which includes a large number of variables, for practical reasons we derive impulse responses from a VAR in levels, which due to its simplicity seems to be a more appropriate technique.

4.3 Empirical findings

4.3.1 The baseline model

We are starting our VAR analysis by estimating a benchmark model which includes the traditional macroeconomic variables output (GDP), GDP deflator (PGDP), short-term interest rate (IS), and broad money (M). Furthermore, we include the house price (HPI) and the commodity price index (COM) in our model in order to test for different price reactions of assets and goods to a liquidity shock. In addition, a constant and a linear time trend are added. All variables are specified in log-levels, except as usual the interest rate. Our benchmark specification is thus given by the following vector of endogenous variables (along with the corresponding Cholesky ordering):

$$x_t = (GDP, PGDP, COM, HPI, M, IS)_t \quad (9)$$

The Cholesky ordering of the basic specification follows the principle that monetary variables should be ordered last, since they are expected to react faster to the real economy than vice versa (Favero, 2001). As far as monetary variables are concerned, we impose the restriction that money does not react contemporaneously to interest rates which helps to interpret our liquidity shock as a money supply shock.¹⁴ The price variables *PGDP*, *COM* and *HPI* are ordered in the middle given that they are supposed to react to the monetary variables only with a lag. In general, the results are very robust to changes in the ordering within the three blocks. To determine the lag length, we apply the usual criteria.¹⁵ Most of the criteria indicate a lag length of two, which is also sufficient to avoid serial correlation among the residuals and seems to be appropriate in order to estimate a model which is parsimonious

¹⁴ For a money demand shock, interest rates should be ordered before money in order to enable economic agents to adjust their money holdings immediately to changes in the opportunity costs of holding money.

¹⁵ To be explicit, we used the Likelihood Ratio test, the Final Prediction Error, the Akaike information criterion, the Schwarz criterion and the Hannan-Quinn criterion.

where possible.¹⁶ While this is true not only for the benchmark specification but also for the following models we will continue with two lags for the whole analysis.

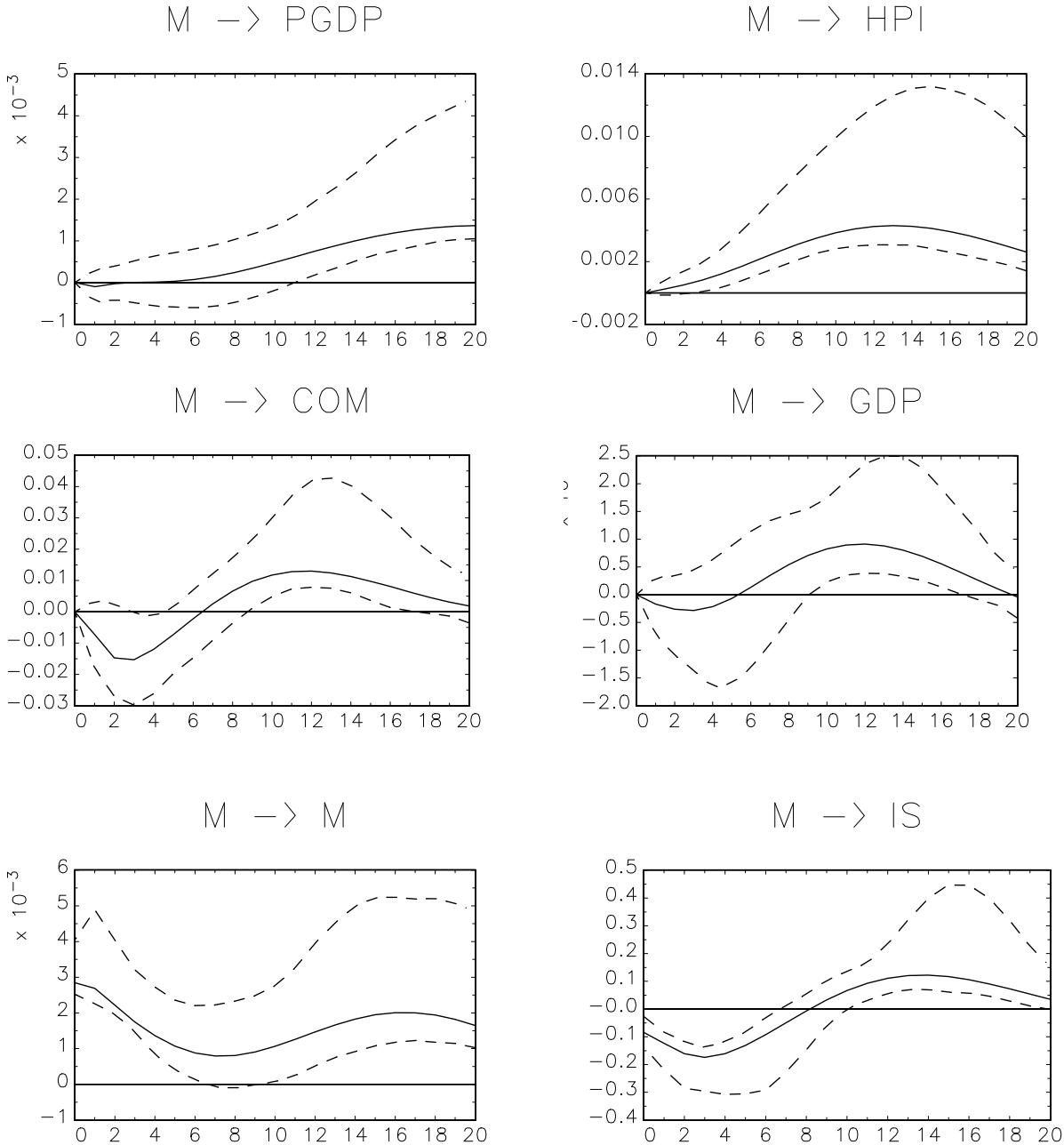


Figure 4: Impulse response analysis for benchmark specification¹⁷

¹⁶ To test for autocorrelation of the residuals, we performed the Lagrange Multiplier test.

¹⁷ The confidence intervals of our impulse responses display two standard deviations and are calculated via the studentized Hall bootstrap method.

Figure 4 displays the impulse responses with respect to an unexpected increase in global liquidity. (See the appendix for the whole array of impulse responses.) Referring to our theoretical considerations outlined above (see Figure 1), it helps us to disentangle short-run from longer-run elasticities. In particular for certain asset prices, but to a lower extent, also for consumer prices, the price elasticity of supply is time-varying, i.e. is low in the short run, but increases over time (see Fig. 1). Short-run elasticities correspond with the estimated short-run responses of the respective variable of interest, i.e. the different asset prices, to a global liquidity shock. Accordingly, long-run elasticities are mirrored by the long-run responses.

Figure 4 has all features expected from our theoretical considerations: The GDP deflator reacts slowly but moves upwards significantly after about eleven quarters. Thus, in our model money matters for and causes goods price inflation although substantial time lags have to be taken into account. Quicker positive responses to a global liquidity shock are given by the house price and the commodity price index (after three and nine quarters respectively). From a theoretical point of view, the lower price elasticity of supply in the housing and in the commodity market compared to the goods market should contribute to this finding. Initially, the spurt in demand will come up against an inelastic supply driving prices up sharply, especially if the spurt in demand is unanticipated as it is in the VAR methodology used here. This will provide the incentive for an increase in supply according to, say, a Tobin Q theory of investment. This, in turn, could lead to over-supply and a collapsing asset price. So, the money story that we are using can explain not just booming asset prices but also collapsing asset prices.¹⁸

These results also provide some interesting interpretations for the post-2001 period. Apparently, abundant global liquidity contributed to the bull market in the real estate sector. Following the downturn in the housing market triggered by the subprime crisis, money

¹⁸ We owe this point to an anonymous referee.

balances were then flowing largely into commodity markets putting upward pressure on commodity prices.

The fact that commodity prices react later than house prices to a shock of global liquidity is consistent with anecdotal evidence during the more recent food price hike when global demand, driven by “hunger for return”, turned to commodities after house prices had collapsed. On a more theoretical level, one could argue that house prices react faster than commodity prices to an unexpected increase in liquidity since expectations of future economic growth might be more important for commodities than for real estate and, thus, shocks to global liquidity only pour into commodity markets when economic growth accelerates.¹⁹ What is more, speculation may play a more important role in housing markets. If assets *can* be stored, people expecting a price rise can take some amount off today’s market, driving up the price now, in the expectation that they can sell it at a higher price later. Commodities which are characterized by a lower degree of storability than housing, then display less distinguished and slower price increases than housing (Krugman, 2008).

The remaining impulse responses of our benchmark model are also in line with economic theory. The negative reaction of the interest rate to a liquidity shock is consistent with the interpretation of our liquidity shock as a money supply shock. GDP moves up temporarily but not permanently as a result of the liquidity shock, which is in line with the theoretical assumption that money is neutral for the real economy in the long run. Interestingly, the price puzzle (the absence of a decline of the price level due to a positive interest rate shock), which is often found in similar VAR models, does not appear in our model (see Figure A1 in the appendix).

Note also that the response of our variables to an interest rate shock is very consistent with the dynamic adjustment to a global liquidity shock. Moreover, since a negative interest

¹⁹ Note the striking similarity in the impulse responses of a liquidity shock to output and to commodity prices.

rate shock has similar consequences for house and consumer prices as a positive liquidity shock, a pure money supply shock (a growing money stock accompanied by a decreasing interest rate) should give even higher effects than our money-only shocks given above. Further, it is of interest to see that house price shocks have predictive content for future goods price inflation suggesting that house prices should be taken into account by monetary authorities as they signal changes in expected goods price inflation (see Goodhart and Hofmann 2007 for similar results).

4.3.2 Augmenting the VAR with stocks and gold

Given that the dynamics of the benchmark model is found to be plausible, the next step in our VAR analysis is to augment our baseline model with further asset variables. Specifically, we include the gold price (in US dollars) and, alternatively, a globally aggregated stock price index in our model.²⁰ Similar to house and commodity prices these time series are characterized by significant upwards movements in recent years (Figure 5).

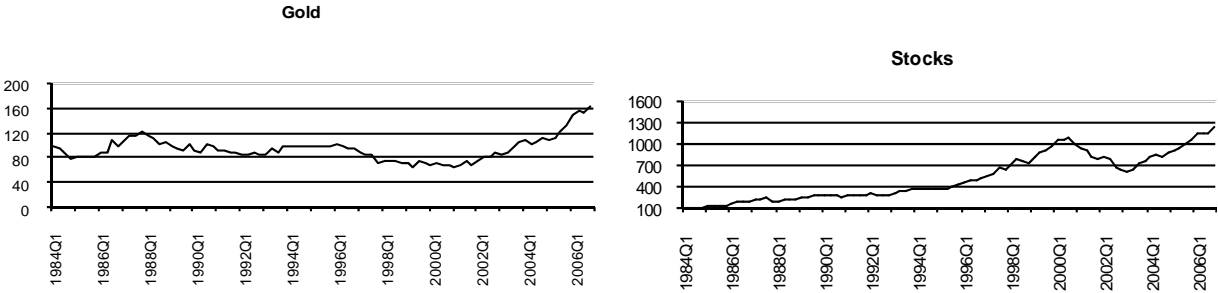


Figure 5: Gold and global stock prices.

Gold prices are of particular interest given that the actual amount of gold which can be produced in any year is only a minor share of the stock of gold. Thus the increase in the quantity of gold supplied in response to an aggregate demand shock is only a small fraction of the stock of gold, resulting a in a very steep supply curve.

²⁰ Note that the HWWI commodity price index does not include gold and thus there arise no problems of multicollinearity. Data for stock prices are from Datastream. For each country in our sample we use the key national stock market index and aggregate the series to a global index as described in section 4.1.

In the Cholesky ordering, we put gold just behind the house price index, given its well-known sensitiveness to monetary policy shocks; however, results are again very robust to changes in the ordering within the “price block”:

$$x_t = (GDP, PGDP, COM, HPI, GOLD, M, IS)_t \quad (10)$$

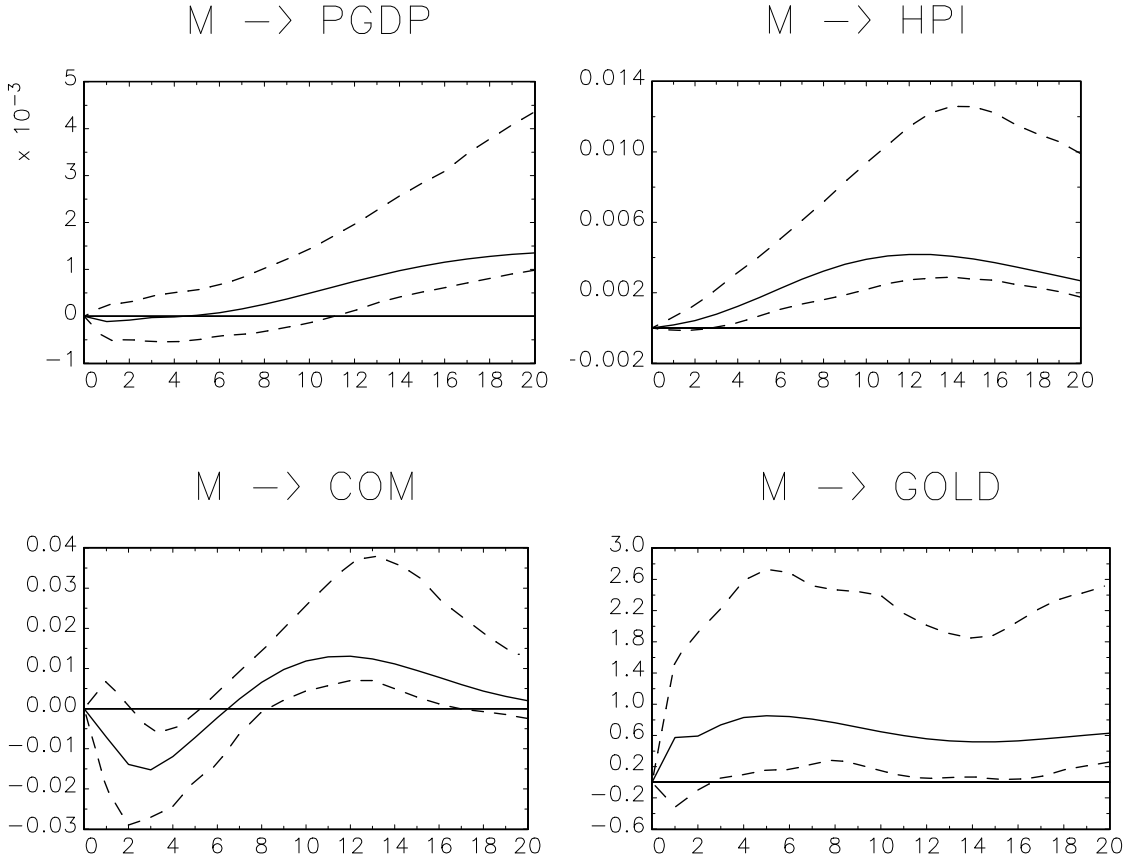


Figure 6: Impulse response analysis for model augmented with gold price.

Figure 6 displays the impulse responses of our extended model that are of main interest. Global liquidity shocks again positively and significantly influence the price level for goods and services (GDP deflator), housing and commodities. Interestingly, the response of the gold price is even faster. Gold prices react significantly after three quarters to an unexpected increase in global liquidity. This confirms our theoretical assumption that the price elasticity of supply is decisive to what degree global liquidity shocks are reflected in the price level. The quantity of gold cannot be easily extended so that the supply of gold is

relatively price-inelastic and the reaction speed of the gold price is therefore quicker compared to other asset prices.

As a further alternative we substitute gold prices with the global stock price index. As a financial market variable, stocks are last in our Cholesky ordering so that we now have the following vector of endogenous variables:²¹

$$x_t = (gdp, pgdp, com, hpi, m, IS, stocks)_t \tag{11}$$

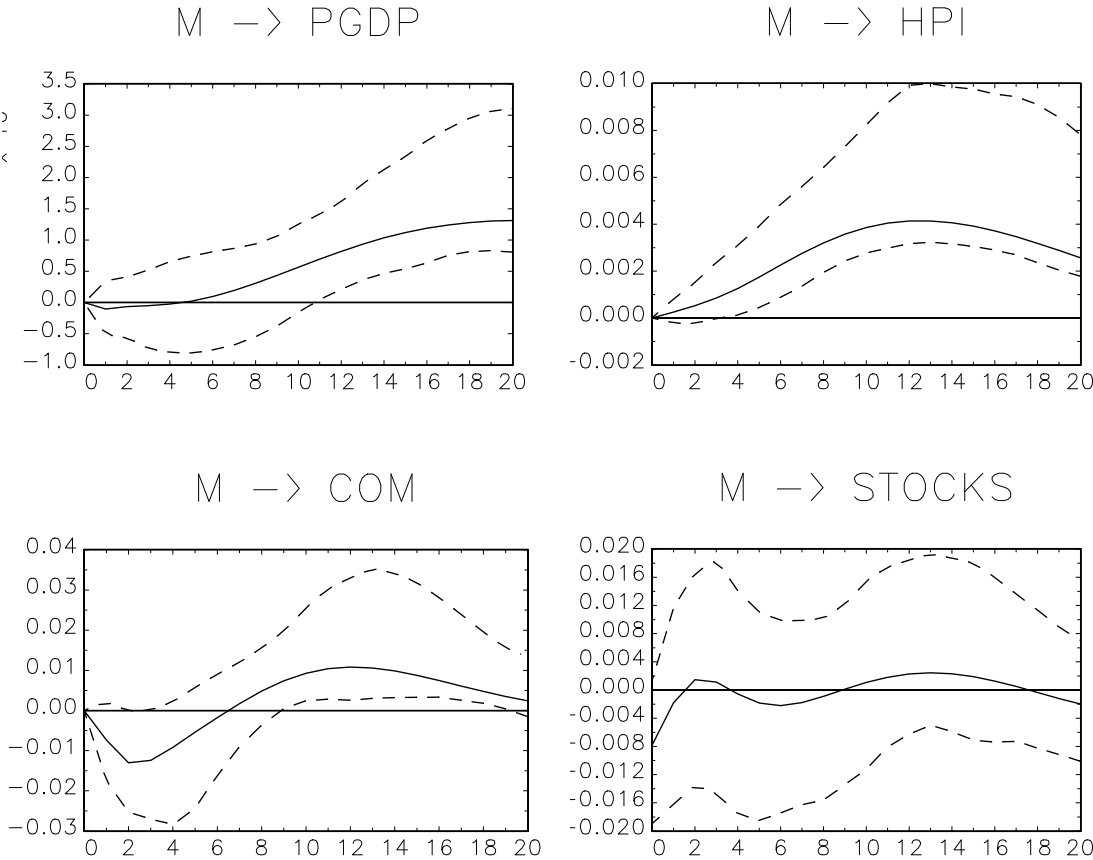


Figure 7: Impulse response analysis for model augmented with stock prices

As can be seen in Figure 7, the positive and significant reactions of the GDP deflator, the house price index and the commodity price index to a global liquidity shock prove to be stable. However, stock prices do not show a positive response to a monetary impulse. The

²¹ Stock prices are often ordered last in similar VAR models. See e. g. Millard and Wells (2003) and Thorbecke (1997).

non-significant reaction of stock prices to monetary impulses may appear puzzling at first glance, given that the simple plot of share prices along with other asset classes seems to suggest a quite high correlation (Figures 3 and 5). However, a closer inspection of the time series also reveals significant differences across asset classes. The empirical realisation of the coefficient of variation calculated over our whole sample period amounts to 0.61 for stock prices but only to 0.27 for house prices. The dot.com bubble and its burst are fully reflected in the stock price time series whereas no such accentuated blip becomes obvious in the house price time series.

These observations are in line with the suggestion by many scholars that house prices tend to move in long cycles whereas stock prices as a stylized fact can be best characterized as random walks (see, for instance, Gros, 2007). Moreover, our result is consistent with theoretical considerations according to which the relationship between money and stock prices is less pronounced than for other asset classes (Deutsche Bundesbank, 2007, Fischer, Lenza, Pill, and Reichlin, 2008). On the one hand, higher liquidity tends to increase household's assets, and a part of the associated wealth increase may be held in the form of shares. On the other hand, high (expected) returns to securities make the holding of shares more attractive than holding money. This may trigger important substitution effects, i.e. shifts between money and shares. As a result, the relationship between the developments in the stock market and money holdings is not clear cut.²²

4.4 Robustness checks

To check for the robustness of our results, we additionally estimated several alternative versions of our model. First, we changed the lag lengths (especially 4 lags) with nearly no consequences for our results. Second, we used different Cholesky orderings in order to avoid

²² The ambiguous relationship between money and stock prices is also reflected in the results of other empirical studies. While Kontolemis (2002) finds a dominant substitution effect in the relationship between money and stock prices, Bruggemann, Donati, and Warne (2003) obtain a prevalent wealth effect.

that our results rely on any particular assumption regarding the structural equations of our VAR model. No major changes in the results occurred (see Figure 8).

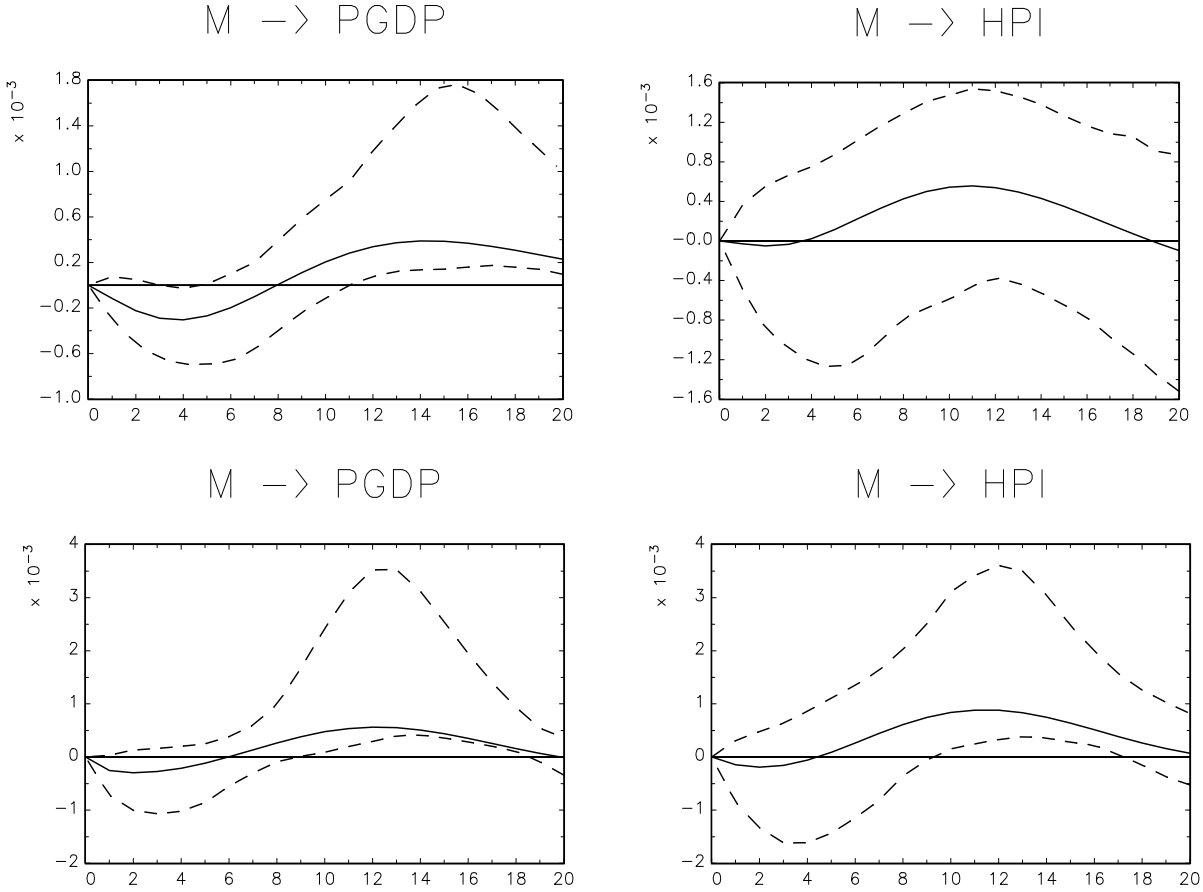


Figure 8: Impulse response analysis for sample period beginning in 1990 (first row) and 1995 (second row)

As a third robustness check, we restricted the sample to the period from 1990 and 1995 on, respectively. This is motivated by the insight that the widespread capital account and trade liberalization since 1990 should have contributed to the different dynamics in the price-money relationship. To overcome the problem of increasing estimation variability due to declining degrees of freedom, we used just one lag for this analysis. As is revealed by Figure 7, the results remain pretty stable and especially the main direction of the liquidity shocks is once again confirmed. Thus, we see some evidence supporting the view that the different adjustment paths of consumer and asset prices to a liquidity shock are phenomena which are

not only related to the most recent period but exist throughout our observation period (although they may be more apparent in recent years given the large expansion in liquidity in the post-2001 period). Again, there is a significant transmission mechanism reaching from housing markets to consumer markets. However, the results should be interpreted with care due to the short sample period.

Fourth, we used an alternative aggregation scheme for our global aggregates in order to find out if the results are sensible in this respect. As we used market exchange rates so far for the calculation of the individual country weights we also checked for the alternative of using PPP exchange rates in the aggregation procedure. (This results in a substitution in equation (1): $e_{i,t}^{PPP}$ instead of $e_{i,t}$).²³ Figure 9 displays selected impulse responses of our benchmark model when using PPP aggregation. (See Appendix A2 for the full set of impulse responses.) The main empirical findings are not affected. Global liquidity shocks again lead to a temporary increase of the output variable and to a permanent and significant increase of the GDP deflator, the house price index and the commodity price index. The high robustness of the results to the aggregation scheme should not come as a surprise given that many variables in our sample are highly correlated at an international level – a phenomenon which renders the form of aggregation less important.

²³ The base year for our PPP exchange rates is 1999.

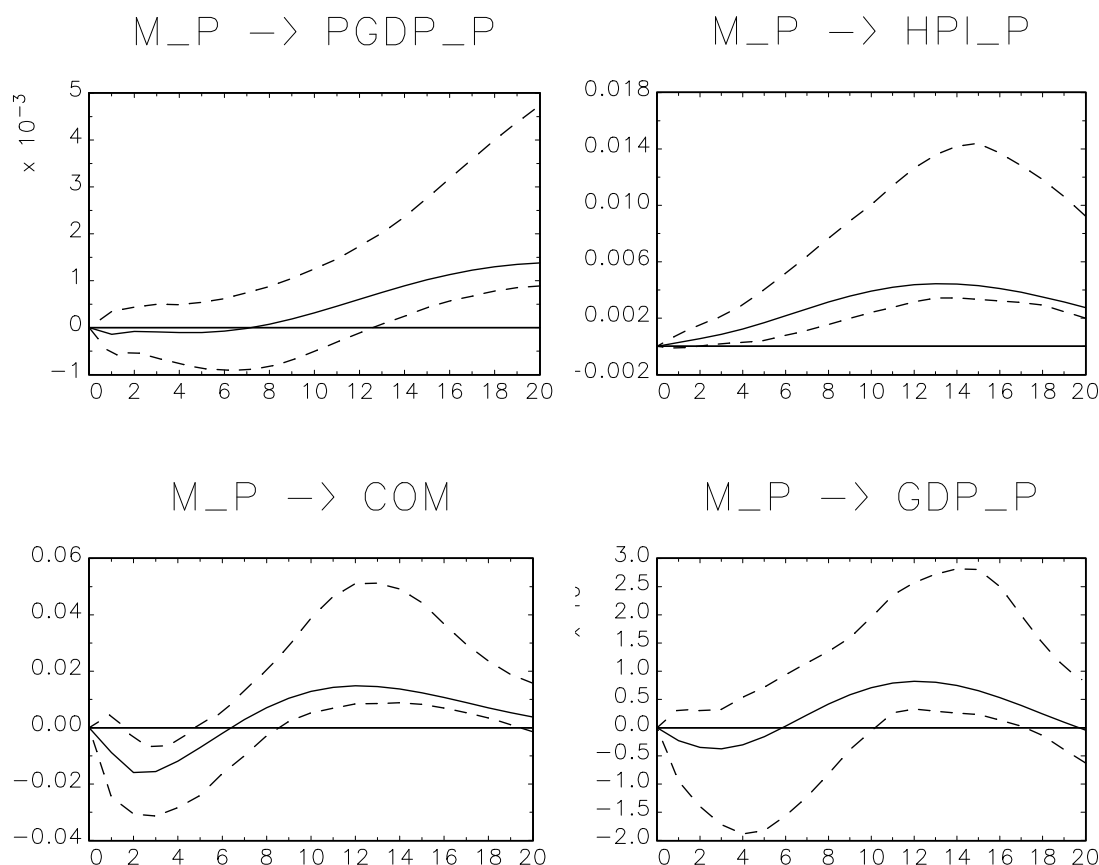


Figure 9: Impulse response analysis for benchmark specification; aggregation with PPP exchange rates

5. Conclusions

In this paper, we have analyzed the effects of global liquidity shocks on goods prices and a variety of asset prices. We come up with the following empirical results: First, we find support of the conjecture that monetary aggregates may convey useful leading indicator information about variables such as house prices, gold prices, commodity prices and the GDP deflator at the global level. In contrast, stock prices do not show any positive response to a liquidity shock - a result which might be related to the relatively higher importance of substitution effects for this asset class. Second, our VAR results support the view that different price elasticities on asset and goods markets explain the recently observed relative price change between asset classes and consumer goods. In line with theory, the reaction of asset prices takes place faster than with goods prices. Third, we find significant spill-over

effects from housing markets to goods price inflation suggesting that a forward-looking monetary policy has to take asset price developments into account. In sum, we would therefore like to argue that global liquidity deserves at least the same attention as the worldwide level of interest rates has received in the recent intensive debate on the world savings versus liquidity glut hypothesis, if not possibly more.

Against the background of our results the still high level of global liquidity has to be interpreted as a threat for future stable and low inflation and financial stability. Since global excess liquidity is found to be an important determinant of asset and goods prices, there might be at least three implications for the adequate conduct of monetary policy. First, monetary policy has to be aware of different time lags in the transmission from liquidity to different categories of prices. In particular, strong money growth might be a good indicator of emerging future bubbles in the real estate sector and later on also of bubbles in gold and commodity markets. However, it does not seem to be a good leading indicator in case of stock prices. Second, this pattern should, on the contrary, also be taken into account when assessing the consequences of a slowing down or smooth reversal in global excess liquidity - for instance, the risks and options in the light of Bretton Woods II. Let us now turn to the third one.

If it is indeed true that floating exchange rates no longer impart monetary autonomy to national monetary policies, this has serious implications for the future organization and operation of monetary policy.²⁴ If global liquidity plays a significant role within the transmission mechanism on a global or on a national level, central banks almost certainly tend to lose influence. From the perspective of central banks, this is a clear disadvantage of globalization for monetary policy (up to now the discussion focused more on the advantages as, for instance, the inflation curbing effects). For instance, the traditional interest rate channel could be distorted in some countries. Imagine a central bank raises its policy rate in order to

²⁴ We are grateful to an anonymous referee for calling our attention to this point.

fight inflationary pressures. Thereupon parts of global excess liquidity pour into the home country in order to profit from the interest rate differential and counteract the restrictive interest rate policy. A further research question raised by our paper is to what extent the phenomenon of global excess liquidity makes a coordination of national monetary policies useful (abstracting from practicability issues). Go-it-alone policies by national central banks in order to prevent unsolicited effects of global excess liquidity on national variables potentially evaporate.

If excess liquidity - as reflected by our orthogonal money shock variables - creates such huge distortions in asset prices (severe misalignment) and in overall inflation, along with the severe misallocation of resources that goes along with these, and arguably the global systemic collapse we are currently undergoing, then either long-run neutrality of money is compatible with huge real economic distortions in the wake of strong money expansion or it is even hard to claim that money is neutral in the long run (as we find in the impulse response analysis), unless this long run is chronologically so far in the future that it becomes irrelevant to any policy consideration. However, this is a more general issue, not unique to our paper and, hence, left to further research.

References

- Adalid, R., Detken, C., 2007. Liquidity Shocks and Asset Price Boom/Bust Cycles. ECB Working Paper Series 732, European Central Bank, Frankfurt/Main.
- Baks, K., Kramer, C. F., 1999. Global Liquidity and Asset Prices: Measurement, Implications, and Spillovers. IMF Working Papers 99/168, International Monetary Fund, Washington, D.C.
- Belke, A., Gros, D., 2007. Instability of the Eurozone? On Monetary Policy, House Prices and Labor Market Reforms. IZA Discussion Papers 2547, Bonn.

- Belke, A., Rees, A., 2009. The Importance of Global Shocks for National Policymakers - Rising Challenges for Central Banks, DIW Discussion Papers 922, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin, September.
- Belke, A., Bordon, I., Hendricks, T., 2009. Global Liquidity and Commodity Prices - A Cointegrated VAR Approach for OECD Countries, DIW Discussion Papers 898, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin, May.
- Beyer, A., Doornik, J.A., Hendry, D.F., 2000. Constructing Historical Euro-Zone Data. *Economic Journal* 111, 308-327.
- Borio, C. E. V., Filardo, A., 2007. Globalisation and Inflation: New Cross-Country Evidence on the Global Determinants of Domestic Inflation. BIS Working Papers 227, Basle.
- Browne, F., Cronin, D. 2007. Commodity Prices, Money and Inflation. ECB Working Paper 738, European Central Bank, Frankfurt a. M.
- Brunnermeier, M.K., Nagel, S., Pedersen, L.H., 2008. Carry Trades and Currency Crashes. NBER Working Paper 14473, National Bureau of Economic Research, Cambridge/MA,
- Bruggemann, A., Donati, P., Warne, A. (2003). Is the Demand for Euro Area M3 Stable?, ECB Working Paper 255, European Central Bank, Frankfurt/Main.
- Canova, F., Ciccarelli, M., Ortega, E., 2007. Similarities and Convergence in G-7 Cycles. *Journal of Monetary Economics* 54 (3), 850-878.
- Ciccarelli, M., Mojon, B., 2005. Global Inflation. ECB Working Paper 537, Frankfurt a.M.
- Congdon, T., 2005. Money and Asset Prices in Boom and Bust. The Institute of Economic Affairs, London.
- Deutsche Bundesbank, 2007. The Relationship between Monetary Developments and the Real Estate Market. Monthly Report, Frankfurt/Main, July, 13-24.
- Del Negro, M., Otrok, C., 2007. 99 Luftballons: Monetary Policy and the House Price Boom across US States. *Journal of Monetary Economics* 54 (7), 1962-1985.

- Favero, C. A., 2001. *Applied Macroeconometrics*. Oxford University Press, New York.
- Fischer, B., Lenza, M., Pill, H., Reichlin, L., 2008. Money and Monetary Policy: the ECB Experience 1999-2006. In Beyer, A., Reichlin L. (eds)..*The Role of Money: Money and Monetary Policy in the Twenty-First Century*. Conference Volume of the 4th ECB Central Bank Conference, 102-175.
- Giese, J. V.,Tuxen, C. K., 2007. *Global Liquidity, Asset Prices and Monetary Policy: Evidence from Cointegrated VAR Models*. Unpublished Working Paper. University of Oxford, Nuffield College and University of Copenhagen, Department of Economics.
- Giuliodori, M., 2005. The Role of House Prices in the Monetary Transmission Mechanism Across European Countries. *Scottish Journal of Political Economy* 52 (4), 519-543.
- Goodhart, C. A. E., Hofmann, B., 2001. *Asset Prices, Financial Conditions, and the Transmission of Monetary Policy*. Federal Reserve Bank of Kansas City Proceedings, March.
- Goodhart, C. A. E., Hofmann, B., 2007. *House Prices and the Macroeconomy: Implications for Banking and Price Stability*. Oxford University Press, Oxford.
- Greiber, C., Setzer, R., 2007. *Money and Housing: Evidence for the Euro Area and the US*. Deutsche Bundesbank Discussion Paper Series 1: Economic Studies 07/12, Frankfurt/Main.
- Gros, D. (2007): *Bubbles in Real Estate? A Longer-Term Comparative Analysis of Housing Prices in Europe and the US*, CEPS Working Document No. 276, October, Brussels.
- Hamilton, J. D. 1994, *Time Series Analysis*, Princeton University Press, Princeton, NJ.
- Krugman, P., 2008. *Commodity Prices (Wonkish)*, New York Times, March 19th.
- Kontolemis, Z. 2002. *Money Demand in the Euro Area: Where Do We Stand (Today)?*. IMF Working Paper 185, International Monetary Fund, Washington, D.C.
- Iacoviello, M., 2005. House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle. *American Economic Review* 95 (3), 739-764.

- International Monetary Fund, 2004. The Global House Price Boom, in: World Economic Outlook - The Global Demographic Transition, Chapter II, pp. 71-89. September 2004, Washington, D.C.
- International Monetary Fund, 2007. What is Global Liquidity?, in: World Economic Outlook - Globalization and Inequality, Chapter I, pp. 34-37. October 2007, Washington, D.C.
- Jylhä, P., Suominen, M. and Lyytinen, J.-P., 2009. Arbitrage Capital and Currency Carry Trade Returns. Paper presented at the American Finance Association (AFA) Conference, January 3-5, San Francisco.
- Miles, M.A., 1978. Currency Substitution, Flexible Exchange Rates, and Monetary Independence. *American Economic Review* 68, 428-436.
- Millard, S. P., Wells, S. J., 2003. The Role of Asset Prices in Transmitting Monetary and other Shocks. BoE Working Papers 188, Bank of England, London.
- Mishkin, F. S., 2007. Housing and the Monetary Transmission Mechanism. NBER Working Paper 13518, National Bureau of Economic Research, Cambridge/MA.
- OECD, 2005. Recent House Price Developments: The Role of Fundamentals, in: OECD Economic Outlook 78, Chapter III, Organisation for Economic Co-operation and Development, Paris, pp. 193-234.
- Papademos, L., 2007. The Effects of Globalisation on Inflation, Liquidity and Monetary Policy. Speech at the conference on the "International Dimensions of Monetary Policy" organised by the National Bureau of Economic Research, S'Agar`o, Girona, June 11th 2007.
- Pepper, G. with Olivier, M., 2006. *The Liquidity Theory of Asset Prices*. Wiley Finance.
- Plantin, G., Shin, H.S., 2008. Carry Trades and Speculative Dynamics. Available at SSRN: <http://ssrn.com/abstract=898412>, February.
- Reinhart, C. M., Rogoff, K. S., 2004. The Modern History of Exchange Rate Arrangements: A Reinterpretation. *Quarterly Journal of Economics* 119 (1), 1-48.

- Roffia, B., Zaghini, A., 2007. Excess Money Growth and Inflation Dynamics. ECB Working Paper 749, European Central Bank, Frankfurt/Main.
- Rueffer, R., Stracca, L., 2006. What Is Global Excess Liquidity, and Does It Matter? ECB Working Paper 696, European Central Bank, Frankfurt/Main.
- De Santis, R. A., Favero, C., Roffia, B., 2008. Euro Area Money Demand and International Portfolio Allocation. ECB Working Paper 926, European Central Bank, Frankfurt/Main.
- Schich, S., Weth, M., 2008. Demographic Changes and Real House Prices. Forthcoming. Deutsche Bundesbank, Frankfurt a. M.
- Schnabl, G., Hoffmann, A. 2007. Monetary Policy, Vagabonding Liquidity and Bursting Bubbles in New and Emerging Markets – An Overinvestment View. CESifo Working Paper 2100, Munich.
- Shiller, R., 2005. Irrational Exuberance. 2nd edition. Princeton University Press, New Jersey.
- Sims, C. A., Stock, J. H., Watson, M. W., 1990. Inference in Linear Time Series Models with Some Unit Roots. *Econometrica* 58 (1), 113-144.
- Sousa, J. M., Zaghini, A., 2006. Global Monetary Policy Shocks in the G5: A SVAR Approach. CFS Working Paper 2006/30, Frankfurt/Main.
- Taylor, M., 2000. Purchasing Power Parity Over Two Centuries: Strengthening the Case for Real Exchange Rate Stability, *Journal of International Money and Finance*, 19, 759-64.
- Thorbecke, W., 1997. On Stock Market Returns and Monetary Policy. *Journal of Finance* 52 (2), 635–654.

Appendix

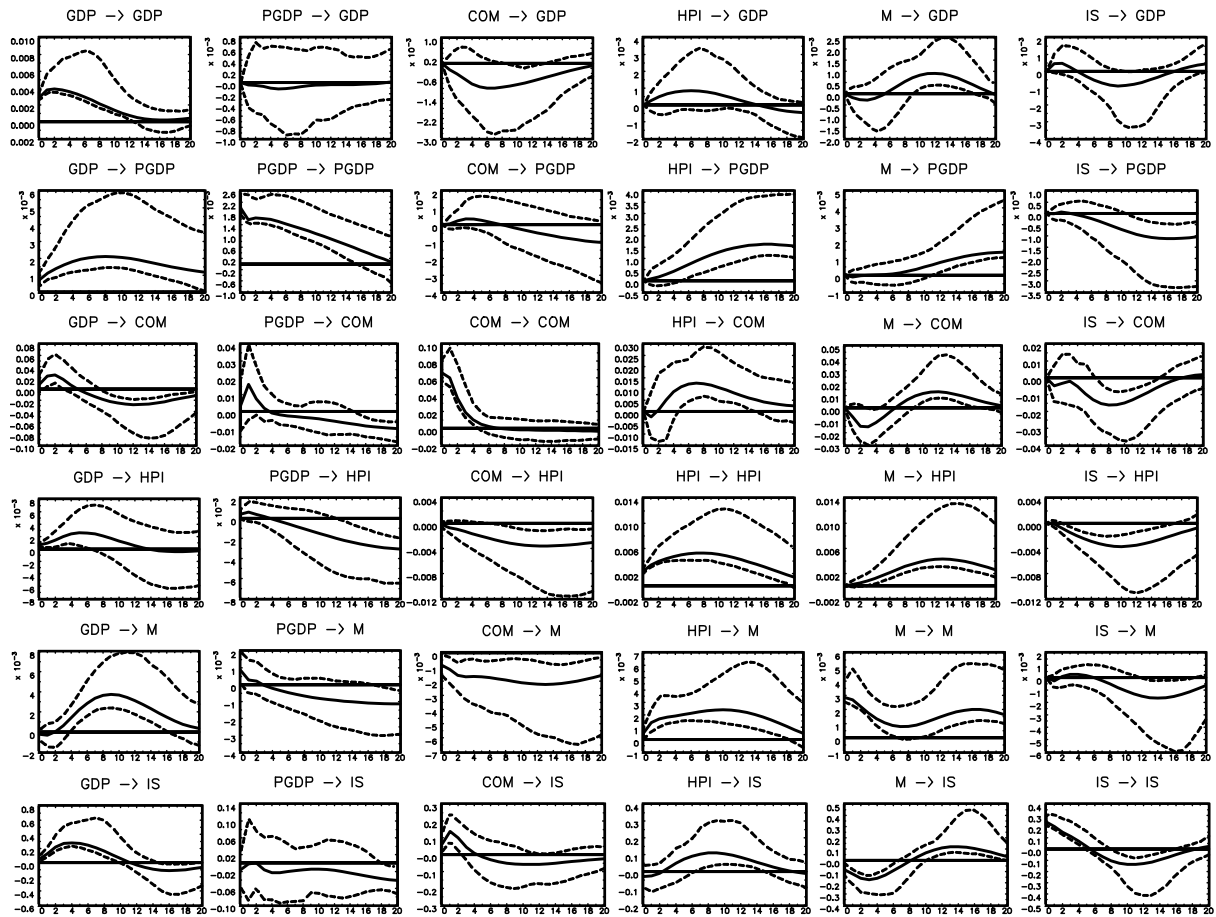


Figure A1: Impulse responses for benchmark specification, aggregated with market exchange rates.

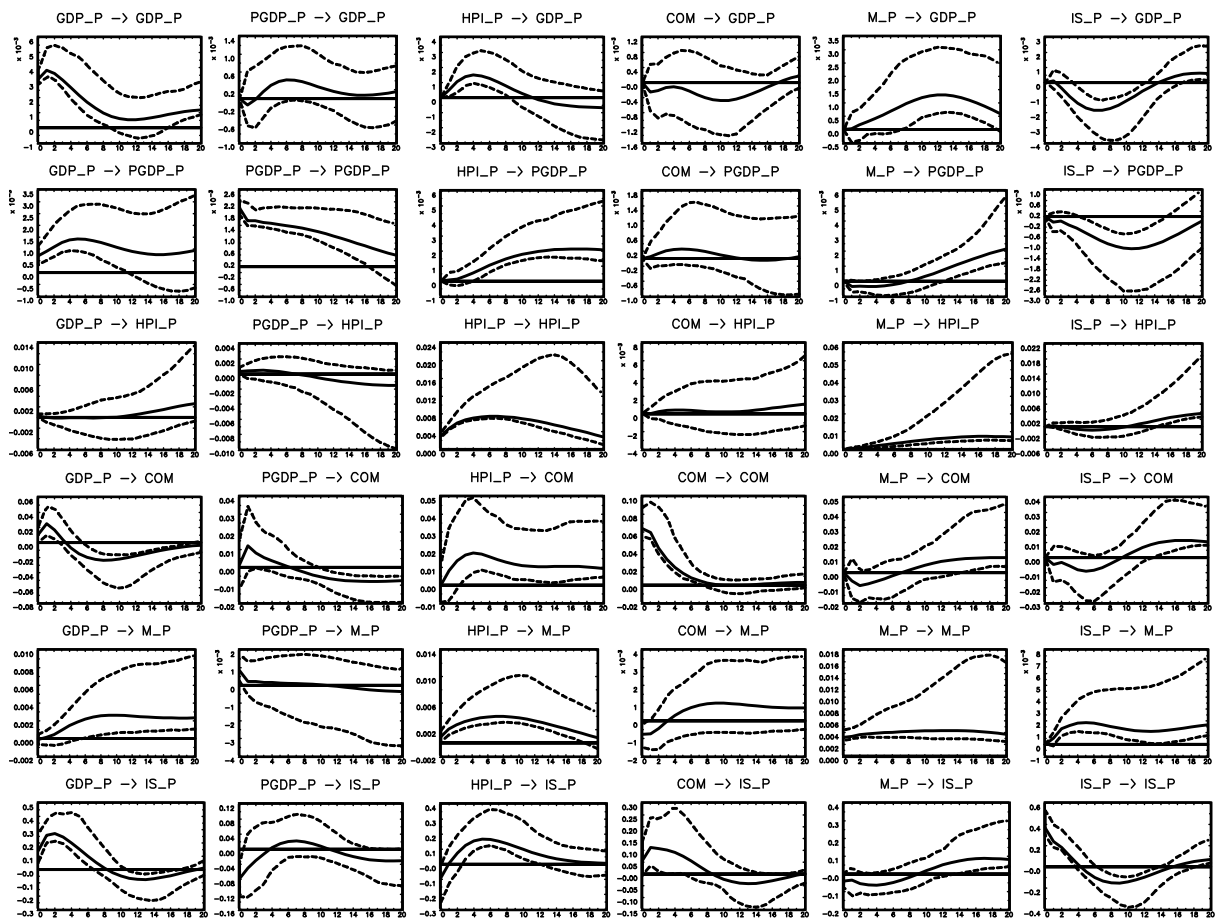


Figure A2: Impulse responses for benchmark specification, aggregated with PPP exchange rates.