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

Ansgar Belke
University of Duisburg-Essen and DIW Berlin

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1 Introduction

- **Global** liquidity *expanding steadily* since 2001. In most industrial countries and more recently also in some EM with dollar peg (China) broad money growth has been running well ahead of nominal GDP.

- But for long time *goods* price inflation *unaffected* by strong monetary dynamics in many regions in the world. Only with considerable lag surplus liquidity poured into raw material, food and goods markets.

- Over same time horizon, however, many countries have experienced **sharp but sequential booms in asset prices**, such as real estate or share prices (Schnabl/Hoffmann 2007).

- Sequence of increases of asset prices result of liquidity spill-overs to certain asset markets? (Adalid/Detken 2007, Greiber/Setzer 2007).
1 Introduction

• Monetary policy perspective: different price dynamics of assets and goods prices raises question as to ...
  ... whether the money-inflation nexus has 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 relative importance of these developments, we try to establish empirical link among money, asset prices and goods prices.
• Estimate variety of VAR models including measure of global liquidity (broad monetary aggregate) in OECD countries and analyse impact of global liquidity shock on global asset and goods price inflation.
1 Introduction

• Basic idea: **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 large supply of consumer goods from EM, **housing and commodity prices** react **much faster** since ...

• ... the supply of real estate and commodities cannot be easily expanded.

• Disequilibria on these markets **balanced** out by quick **price adjustments**.

• Emphasis on **globally aggregated** variables => implies that we do not explicitly deal with spillovers of global liquidity to national variables. But we do this in Belke/Rees 2009 (DIW DP 922).
1 Introduction

- Rüffer/Stracca (2006, p. 8): concept of global liquidity useful but does not distinguish whether what we observe at global level is due to aggregation of impacts in individual economies or also to spill-over across countries.

- Motivated by recent research: inflation as a global phenomenon.

- So far, relationship among money growth, different categories of asset prices and goods prices has been little studied in an international context.

- Only recently, number of authors suggested specific interactions of global liquidity with global consumer price and asset price inflation (Baks/Kramer 1999, Sousa/Zaghini 2006, Rüffer/Stracca 2006).

- However, so far only a few studies have tried to systematically analyze the dynamic pattern of price adjustment to a global liquidity shock.
2. The global perspective of monetary transmission

• Global inflation and global liquidity: evidence becomes stronger that the **global** instead of the **national** perspective is more important when the monetary transmission mechanism has to be identified and interpreted.

• Ciccarelli/Mojon (2005) find empirical evidence of robust ECM: deviations of national inflation from global inflation corrected over time.

• Similarly, Borio/Filardo (2007) argue that traditional way of modelling inflation is too country-centred and a global approach is more adequate.

• Development of global liquidity over time: whether and to what extent **global factors** are responsible for it (we deal with this using FAVAR analysis in Belke/Rees 2009).
2. The global perspective of monetary transmission

• Some argue that global liquidity, measured in one currency, can only change in quantitative terms if one assumes fixed EXR system worldwide.

• International liquidity spill-over effects may occur regardless of the exchange rate system.

• Under pegged EXR regimes official foreign exchange interventions result in a transmission of monetary policy shocks from one country to another.

• With flexible EXR, validity of the "uncovered interest rate parity" (UIP) relationship should in theory prevent cross-border monetary spill-overs.

• According to UIP, 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.
2. The global perspective of monetary transmission

• However, the violation of the UIP - 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.

• More generally, the experience of Iceland whose monetary policy autonomy was undermined by carry trades can be mentioned here.
2. The global perspective of monetary transmission

- In addition, **currency substitution** may well enable international liquidity spill-overs in a framework of **flexible** EXR.

- 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/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 EXR **might quite rarely be considered as truly flexible** across our estimation period anyway, as, for instance, Reinhart and Rogoff (2004) classified only 4.5% of the exchange rate regimes under their investigation as "freely floating“. This did not change much in their update.
2. The global perspective of monetary transmission

• Recently, a number of studies has applied VAR or VECM models to data aggregated on a global level.


• These studies find significant and distinctive reaction of consumer prices to a global liquidity shock.

• Evidence on relationship between global liquidity and asset prices mixed.

• In Rüffer/Stracca (2006) a composite real asset price index that incorporates property and equity prices does not show any significant reaction to a global liquidity shock.

• Giese /Tuxen (2007) find no evidence that share prices increase as liquidity expands; but they find cointegration relationships which imply positive impact of global liquidity on house prices.
3 The price adjustment process

There are at least two explanations of these findings.

1. There is empirical evidence of the existence of a global business cycle (Canova 2007); since house prices move largely pro-cyclically, this is one major common force that drives house prices all over the world.

2. If there are arbitrage relationships between house prices and globally traded securities (shares), global factors that affect these securities should influence house prices as well (global stock market crash).
3 The price adjustment process

- In the short run, **expansionary monetary policy** providing the markets with ample liquidity may trigger **immediate** price reaction in **housing** sector, but a more **subdued** price reaction in **consumer** goods market.

- Over time, however, consumer prices also adjust to new equilibrium by proportional changes of the price level => in the long run, **changes in money supply** do **not** lead to any effects on **real** money and output.

- The possibility of different dynamic adjustments of house prices and consumer prices to a monetary shock may also provide an explanation for the **recent shift in relative prices between housing and consumer goods**.
3 The price adjustment process

- Supply of consumption goods characterized by an infinite price elasticity so that additional demand can be satisfied without any price increase.
- High degree of competition in international goods markets and vast supply of cheap labour in many EM prices of manufactured goods remain unaffected by increase in aggregate demand in short run.
- Only in long run, increasing capacity utilization will translate into higher wages, putting upward pressure on prices.

- Housing is generally assumed to be restricted in supply and cannot be expanded due to natural constraints (Japan) and/or all real estate transactions involve high costs (continental Europe) and ...
- ... each piece of real estate is a different case and at least slightly different from even the adjacent plot => Elasticity of housing supply vis-à-vis house price changes quite limited.
3 The price adjustment process

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

- 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, 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 (Browne/Cronin 2007).

- This enables them to react quickly to changes in monetary conditions.
4 Empirical analysis
4.1 Data description and aggregation issues

• **Quarterly** time series from **1984Q1 to 2006Q4**.

• **Countries**: United States (US), the Euro area, Japan, United Kingdom (UK), Canada, South Korea, Australia, Switzerland, Sweden, Norway and Denmark => 72.2% of world GDP in 2006 and even larger share of global financial markets represented.

• **Variables**: real GDP (Y), GDP deflator (PGDP), short-term money market rate (IS), broad monetary aggregate (M) and nominal house price index (HPI). Plus commodity (COM), gold (GOLD) and stock (STOCKS) prices. Monetary aggregate is M2 for US, M3 for Euro Area, M2 plus cash deposits for Japan, M4 for UK and mostly M3 for other countries.

• **Data sources**: HWWI, IMF, the BIS and ECB; seasonally adjusted if available or treated with the X12-ARIMA procedure.
4 Empirical analysis

• **Aggregate** country-specific series to obtain **global** series considering the principles mentioned by Beyer, Doornik and Hendry (2000) and employing the method used by Giese and Tuxen (2007) in the same context.

• First, calculate variable **weights for each country** by using market (and in robustness checks also PPP) **exchange rates** to convert nominal GDP into a single currency. The weight of a country $i$ in period $t$ is therefore (eq. 1):

$$w_{i,t} = \frac{GDP_{i,t} e_{i,t}^{PPP}}{GDP_{agg,t}}$$
4 Empirical analysis

• Secondly, we take the growth rates of the variable in domestic currency and aggregate these to global growth rates by using the weights calculated in eq. (1) (eq. 2):

\[ g_{agg,t} = \sum_{i=1}^{11} w_{i,t} \cdot g_{i,t} \]

• Aggregate levels were then obtained by choosing an initial value of 100 and multiplying with the global growth rates. Hence, the level of the variable \( v \) is (eq. 3):

\[ index_{v,T} = 100 \cdot \prod_{t=2}^{T} \left( 1 + g_{agg,t} \right) \]
4 Empirical analysis

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

• Avoids potential bias resulting from different national definitions of broad money => Taking simple sum of national monetary aggregates would under-represent countries with narrower definitions of the monetary aggregate and vice versa.
4 Empirical analysis

Figure 2: Development in global liquidity since 1984
4 Empirical analysis

Figure 3: Global series of GDP deflator, short-term interest rate, real GDP, commodity prices and house prices
4 Empirical analysis
4.2 The VAR Methodology

• The econometric framework employed by us 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.

• Since the macroeconomic variables included in the analysis are likely to be non-stationary the question arises whether one should take differences of the variables in order to eliminate the stochastic trend.

• Sims/Stock/Watson (1990) show that OLS estimates of VAR coefficients are consistent under a broad range of circumstances, even if the variables are non-stationary and are used in levels.

• We work strictly along this approach and estimate the VAR in levels.
4 Empirical analysis

4.2 A cautionary note on our VAR methodology

• Estimating VAR in levels does not pose problems, if all variables are I(0).

• If some variables are I(1) and the series are not cointegrated, a VAR in levels or 1st 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.

• Alternative would be to estimate a VECM (we do this in Belke/Bordon/Hendricks 2009, DIW DP 898). However, since it is hard to identify with any degree of accuracy the underlying structural parameters of a VECM with a large number of variables, we estimate a VAR in levels.
4 Empirical Analysis

• **Cholesky ordering** follows the principle that **monetary** variables should be **ordered last**, since they are supposed to react faster to the real economy than vice versa (Favero (2001)).

• 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.

• 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.

• Results are very robust to changes in the ordering within the three blocks.
4 Empirical Analysis

• Variables are taken in log-levels, except the short-term interest rate. A constant (but not a time trend) is added to the model.

• We apply the usual criteria to determine the lag length.

• Most of the criteria indicate a lag length of 2, which is also sufficient to avoid serial correlation among the residuals and seems to be appropriate in order to estimate a model which is as parsimonious as possible.

• 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.
4 Empirical analysis

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).

• We also include house price (HPI) and the commodity price index (COM) 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.

• Our benchmark specification is thus given by the following vector of endogenous variables (along with the corresponding Cholesky ordering):

\[ x_t = (\text{GDP}, \text{PGDP}, \text{COM}, \text{HPI}, \text{M}, \text{IS})_t \] (9)
4 Empirical analysis

Figure 4: Impulse response analysis for benchmark specification\textsuperscript{17}
4 Empirical analysis

• 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.
4 Empirical analysis

• Results also provide interesting interpretations for the post-2001 period.
• Abundant global liquidity contributed to bull market in real estate sector.
• Following downturn in housing market triggered by the subprime crisis, money balances were then flowing largely into commodity markets putting upward pressure on commodity prices.
• Commodity prices react later than house prices to global liquidity shock.
• Consistent with anecdotical evidence during the recent food price hike when global demand, driven by “hunger for return”, turned to commodities after house prices had collapsed.
4 Empirical analysis

- 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.

- Moreover, 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).
4 Empirical analysis
4.3 Empirical findings

4.3.2 Augmenting the VAR with stocks and gold

• Given that dynamics of the benchmark model is found to be plausible, the next step 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.

• Similar to house and commodity prices these time series are characterized by significant upwards movements in recent years (Figure 5).

• Note that the HWWI commodity price index does not include gold and thus there arise no problems of multicollinearity.

• 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.
4 Empirical analysis

Figure 5: Gold and global stock prices.
4 Empirical analysis

• Gold prices of particular interest given that 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 in a very steep supply curve.

• In 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”:

\[ x_t = (GDP, PGDP, COM, HPI, GOLD, M, IS) \] (10)
4 Empirical analysis

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

- 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.

\[ x_t = (gdp, pgdp, com, hpi, m, IS, stocks)_t \]
4 Empirical analysis

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

• Positive and significant reactions of GDP deflator, house price index and commodity price index to a global liquidity shock prove to be stable.

• But stock prices do not show positive response to monetary impulse.

• Non-significant reaction of stock prices to monetary impulses may appear puzzling at first glance, given that simple plot of share prices along with other asset classes suggests a quite high correlation (Figures 3 and 5).

• However, closer inspection of the time series also reveals significant differences across asset classes.

• Coefficient of variation calculated over our whole sample period amounts to 0.61 for stock prices but only to 0.27 for house prices.

• Dot.com bubble and its burst fully reflected in stock price series whereas no such accentuated blip becomes obvious in the house price time series.
4 Empirical analysis

• Observations in line with suggestion that house prices move in long cycles whereas stock prices are random walks (Gros 2007).

• Also consistent with observation that the relation among money and stock prices less pronounced than for other asset classes (Deutsche Bundesbank 2007, Fischer/Lenza/Pill/Reichlin 2008).

• Higher liquidity tends to increase household’s assets, and a part of the associated wealth increase may be held in the form of shares.

• But high (expected) returns to securities also make the holding of shares more attractive than holding money.

• May trigger substitution effects, i.e. shifts between money and shares.

• Relation between developments of stock market and money holdings ambiguous.
4 Empirical analysis

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 that our results rely on any particular assumption regarding the structural equations of our VAR model.

• No major changes in the results occurred.
4 Empirical analysis

• As a third robustness check, we **restricted the sample** to 1990-1995.

• Widespread capital account and trade liberalization since 1990 should have contributed to the different dynamics in price-money relationship.

• To overcome problem of increasing estimation variability due to declining degrees of freedom, we used just one lag for this analysis.

• Figure 8: results remain pretty stable and especially the main direction of the liquidity shocks is once again confirmed.
4 Empirical analysis

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

1. **Monetary aggregates is leading indicator** of house prices, gold prices, commodity prices and GDP deflator at the global level. In contrast, stock prices do not show any positive response to a liquidity shock (substitution effects?).

2. **Different price elasticities** on asset and goods markets can explain the recently observed relative price change between asset classes and consumer goods. In line with theory, reaction of asset prices takes place faster than that of goods prices.

3. Significant **spill-over effects** from housing markets to goods price inflation suggest that a forward-looking monetary policy has to take asset price developments into account.

Global liquidity deserves at least the same attention as the worldwide level of interest rates has received in the debate on the world savings versus liquidity glut hypothesis, if not possibly more.
5 Conclusions

- High level of global liquidity is threat for stable and low inflation and financial stability.

- Since global excess liquidity is found to be important determinant of assets and goods prices, at least three implications for adequate conduct of monetary policy (details in Belke/Rees 2009, DIW DP 922).

- First, monetary policy has to be aware of different time lags in the transmission from liquidity to different categories of prices.

- 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, no good leading indicator of stock prices.

- Second, this pattern should also be taken into account when assessing the consequences of a slowing down or smooth reversal in global excess liquidity - risks and options in the light of Bretton Woods II.
5 Conclusions
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.

- 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).
5 Conclusions

- **Traditional interest rate channel** could be **distorted** in some countries. Imagine CB raises policy rate in order to fight inflationary pressures. Thereupon, parts of global excess liquidity pour into home country to profit from INTR differential and counteract restrictive INTR policy.

- Further research question 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 CBs in order to prevent unsolicited effects of global excess liquidity on national variables potentially **evaporate**.