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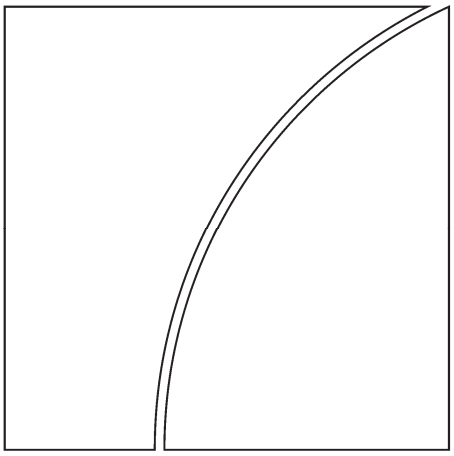

BIS Working Papers

No 402

Understanding Global Liquidity

by Sandra Eickmeier, Leonardo Gambacorta and Boris Hofmann

Monetary and Economic Department

February 2013

JEL classification: E5, E44, F3, C3

Keywords: Global liquidity, monetary policy, credit supply, credit demand, international business cycles, factor model, sign restrictions

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This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)

ISSN 1682-7678 (online)

Understanding Global Liquidity*

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January 2013

Abstract

We explore the concept of global liquidity based on a factor model estimated using a large set of financial and macroeconomic variables from 24 advanced and emerging market economies. We measure global liquidity conditions based on the common global factors in the dynamics of liquidity indicators. By imposing theoretically motivated sign restrictions on factor loadings, we achieve a structural identification of the factors. The results suggest that global liquidity conditions are largely driven by three common factors and can therefore not be summarised by a single indicator. These three factors can be identified as global monetary policy, global credit supply and global credit demand.

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*The views expressed in this paper are those of the authors only and do not necessarily reflect those of the Deutsche Bundesbank or the Bank for International Settlements. The paper was partly written while Sandra Eickmeier visited the Bank for International Settlements. We thank Claudio Borio, Andrew Filardo, Heinz Herrmann, Emanuel Mönch, Jim Nason, Michael Owyang and Tim Ng, seminar participants at the Deutsche Bundesbank, the BIS, the Banque de France, the Bank of England and participants at the 18th annual conference on "Computing in Economics and Finance" (Prague) and the workshop of the Eurosystem and Latin American Banks on "Macroeconomic policies, global liquidity and sovereign risk" (Rome) for useful comments. We are grateful to Patrick McGuire for sharing data with us and to Bilyana Bogdanova and Giovanni Sgro for excellent research assistance.

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1 Introduction

Global liquidity has become a popular term in the policy debate. For instance, the Asian crisis has been associated by some commentators with prior loose global liquidity conditions (e.g. Goldstein (1998)). In the context of the global financial crisis, ample global liquidity has been identified as a potentially important factor in the build-up of the pre-crisis financial imbalances (e.g. Borio (2008)). More recently, the term has been used in the context of the debate about spill-over effects of accommodative monetary conditions from the core advanced to emerging market economies (e.g. IMF (2010)).

Despite its widespread usage, the concept of global liquidity remains without an agreed definition. It usually refers to the availability of funds for purchases of goods or assets from a global perspective.[1] Traditionally, empirical studies have measured global liquidity conditions based on some global aggregates of broad money (e.g. Sousa and Zaghini (2004), Rueffer and Stracca (2006), D'Agostino and Surico (2009)). More recently, credit has been proposed as an alternative measure of global liquidity (Bruno and Shin (2012), Domanski et al. (2011), CGFS (2011)).[2] Changes in banks' funding practices, specifically banks' increased leverage and funding through non-core liabilities (i.e. liabilities other than retail deposits), suggest that credit is a more suitable measure of liquidity conditions from a financial stability perspective.[3] The recent literature has put particular emphasis on cross-border credit, which in many economies accounts for a significant share of overall credit (Borio et al. (2011), Avdjiev et al. (2012)) and has been an important source of banking sector vulnerability in the global financial crisis (Borio and Drehmann (2009)).

Besides these quantitative indicators, the literature has also considered price-based indicators of global liquidity. Specifically, global aggregates of the level of short-term money market and long-term capital market interest rates are regarded as important indicators of global funding liquidity conditions, while implied stock market volatility (VIX) is seen as a prime proxy for investor risk appetite and hence a key indirect indicator

[1] For instance, the CGFS (2011) defines global liquidity in broad terms as global financing conditions, or "ease of financing".

[2] Credit aggregates are in this context often characterised as representing the end of the financial intermediation chain and hence the final outcome of the interaction of different sources of liquidity. Specifically, credit is seen as reflecting the outcome of the interaction of funding and market liquidity, which respectively refer in broad terms to the availability of liquidity in funding markets and the ease of transforming assets into liquidity through asset sales on financial markets. At the same time, credit is also perceived to capture the interaction of public and private liquidity, where the former is the liquidity created by central banks through the various tools for providing funding to financial institutions while the latter refers to the liquidity created by financial institutions through credit creation. See Domanski et al. (2011) and CGFS (2011) for a more comprehensive discussion of these different liquidity concepts and their relation to credit aggregates.

[3] This notion is supported by evidence of good leading indicator properties of credit for the build-up of risks to financial stability presented e.g. by Borio and Lowe (2004) and Schularick and Taylor (2012). These papers also suggest that monetary aggregates are less useful than credit aggregates in predicting financial crises. However, in a recent paper, Hahm et al. (2012) present evidence indicating that banks' non-core liabilities, which are not included in conventional monetary aggregates (i.e. M1 and M2), provide useful information for growing risks to financial stability.

of the willingness to provide funding (see e.g. CGFS (2011), Agrippino and Rey (2012)).

In sum, the recent literature suggests that there is no single variable capturing global liquidity conditions, but that a whole range of variables, including both financial prices and quantities, needs to be considered. Starting from this notion, this paper takes a novel approach to measuring global liquidity based on a factor model estimated on a large quarterly cross-country dataset of financial variables representing indicators of liquidity conditions (including in particular domestic and cross-border credit aggregates, monetary aggregates, retail lending rates, money market rates, government bond yields and stock market volatility) and macroeconomic variables (including several measures of aggregate prices and economic activity). The data cover 24 advanced and emerging market economies over the period 1995-2011. Following previous papers which have measured the global business cycle and global inflation based on factors in output and inflation dynamics that are common across countries (e.g. Ciccarelli and Mojon (2010), Kose et al. (2003)), we measure global liquidity based on the common factors in the dynamics of liquidity indicators.

The analysis proceeds in three steps. In the first step, the paper explores the global commonality in the dynamics of liquidity indicators, defined as the share of the variance of financial variables explained by common factors which we estimate with principal components. We assess how financial comovements compare with macroeconomic comovements and the extent to which they merely reflect financial feedback effects of the global business cycle and global inflation measured by global macroeconomic factors. Since we aim to identify the independent global drivers of the dynamics of liquidity indicators, we associate global liquidity with those common dynamics that are not explained by global macroeconomic factors.

In the second step of the analysis, we identify the underlying structural drivers of global liquidity conditions using a novel approach based on sign restrictions imposed on factor loadings. In doing so, we overcome the well-known fact that factors and factor loadings are not identified separately, which impedes an intelligible interpretation of the factors estimated in the first step of the analysis. Specifically, we propose a set of theoretically motivated sign restrictions on credit growth and retail and money market interest rates that identify a global monetary policy factor, a global credit supply factor and a global credit demand factor. Our approach is conceptually similar to the sign restrictions-based approach to shock identification in structural (simple or factor-augmented) vector autoregressions. The structural factors that we identify, however, comprise, in addition to the shocks, also the systematic component of financial variables' dynamics.

In the third step of the analysis, we decompose a number of key liquidity indicators into the respective contribution of global macroeconomic and global liquidity factors. The latter is further decomposed into the contributions of the structural factors identified in the previous step. This structural decomposition is not only of academic interest, but also

has policy relevance as the appropriate policy response to perceived unsustainable global financial developments will depend on the assessment of the underlying structural forces that are driving them.[4]

Our main findings are as follows. First, global liquidity conditions cannot be assessed based on a single indicator. The bulk of financial variables' dynamics that are independent of global macroeconomic factors is driven by three common factors. In other words, there are three global liquidity factors. Second, these three factors can be identified as a global monetary policy factor, a global credit supply factor and a global credit demand factor. The evolution over time of these factors and the analysis of their contributions to the development of key liquidity indicators offer a number of interesting insights. Specifically, we find that global credit supply conditions eased markedly and contributed considerably to global financial developments between the mid-1990s and 2007, in particular in the years just before the global financial crisis. The run-up to the crisis has further been associated with loose monetary conditions and, at a late stage, a significant strengthening of credit demand. Finally, we find that since the outbreak of the global financial crisis in 2008, global monetary policy has been accommodative, while credit supply has been tight and credit demand has been weak. In other words, our analysis suggests that accommodative "official" liquidity conditions have partly offset the adverse impact of tight "private" liquidity conditions on financial dynamics during this period.

The remainder of the paper is structured as follows. In section 2 we present the data. In section 3 we explore the global commonality in financial and macroeconomic data based on a factor model. Section 4 outlines the sign restrictions approach used to identify structural global liquidity factors and discusses the development of these factors over time. In section 5 we examine the relevance of global macro and global liquidity factors for financial dynamics at both the global and the regional level. Section 6 concludes.

2 Data

The data used in the analysis comprise financial and macroeconomic variables from 24 economies over the period 1995Q1 until 2011Q2.[5] The set of countries includes 11 advanced economies (the US, Japan, the euro area, the UK, Canada, Switzerland, Sweden, Norway,

[4] For instance, if these dynamics reflect highly accommodative monetary policy, adjustments in the monetary policy stance might be indicated. If they reflect instead expansionary global credit supply or demand conditions, regulatory or fiscal measures aimed at tempering banks' credit supply and borrowers' credit demand could be suggested. At the same time, undesirable global liquidity dynamics which are traced to credit supply or credit demand developments might call for offsetting adjustments of the global monetary policy stance.

[5] Since some of the data, specifically cross-border credit aggregates and real economic activity measures, are only available in quarterly frequency, we perform the analysis based on quarterly data throughout. To this end, those series available in monthly frequency were converted into quarterly frequency by taking quarterly averages.

Denmark, Australia, New Zealand),[6] and 13 emerging market economies (China, Indonesia, India, Korea, Malaysia, Philippines, Thailand, Hong Kong, Singapore, Argentina, Brazil, Mexico, Chile). The country coverage and time series sample are determined by data availability.

The data series that are included in the database are listed in Table A.1 in the appendix. There, we also provide information about the sources of the data and how they were transformed prior to the analysis. The dataset covers a large set of quantity- and price-based liquidity indicators. These include in particular domestic and cross-border bank credit to the private non-bank sector (i.e. the sum of bank loans to the private non-bank sector and banks' holdings of private securities)[7] and business and mortgage loan rates. The inclusion of these variables reflects the notion that bank credit is a key quantitative gauge of liquidity conditions and that loans account for the bulk of bank credit to the private non-bank sector in both advanced and emerging market economies.[8]

The set of financial variables also contains quantity- and price-based indicators of funding and market liquidity conditions in national and global banking and financial markets. Base money M0 and broad money M2 enter as quantity-based indicators of funding liquidity conditions of banks.[9] We further include overnight interest rates, money market rates and long-term government bond yields as important price-based indicators of funding liquidity conditions faced by banks. Implied stock market volatility (VIX) is added as a proxy for investor risk appetite and key indirect indicator of the willingness to provide funding (CGFS (2011)).[10] Finally, in order to capture the role of funding and market liquidity conditions in the main global financial center for global liquidity conditions, we include 42 US financial series, drawing in part on the dataset compiled by Hatzius et al.

[6] We include the euro-area economy instead of the individual euro-area countries in the analysis because of the common monetary policy since 1999.

[7] The credit series are converted into constant 2011Q2 US-$ exchange rates and therefore exclude valuation effects of exchange rate movements (see Domanski et al. (2011)).

[8] For households, mortgage loans represent the main form of credit financing. Also for firms, despite the increase in bond issuance in recent years, bank lending remains the most important form of funding. For example, at the end of 2005 loans represented, on average, 90 percent of debt financing of non-financial corporations in the euro area, 80 percent in Japan, 74 percent in the UK, 61 percent in the US (Task Force of the Monetary Policy Committee of the European System of Central Banks (2007)). Given the more limited development of corporate bond markets, these ratios are even higher on average in the emerging market economies (e.g. more than 95 percent in Indonesia and Philippines, around 80 percent in Thailand and Singapore, 75 percent in Malaysia; see Gyntelberg et al. (2006)).

[9] We did not include banks' non-core liabilities, a variable that plays an important role in the analysis of global liquidity by Hahm et al. (2012), because of the short sample period over which this bank balance sheet item is available for the vast majority of countries.

[10] Implied stock market volatility indices are forward looking measures of stock index volatility computed based on option prices and measure market expectations of stock market volatility in the next 30 days. For a more detailed discussion of the VIX and its interpretation, see Whaley (2009). For those countries where a measure of implied stock market volatility was not available over the entire sample, we constructed backdata using actual monthly return volatilities following Bloom (2009). Specifically, we calculate actual volatility as the monthly standard deviation of the main stock market index and normalize it to the same mean and variance as that of the implied volatility index over the period when they overlap.

(2010). These data comprise money and capital market interest rates, various lending and risk spreads, financial transaction volumes, balance sheet data from the Flow of Funds Accounts as well as survey-based measures of credit supply.[11]

The second block of the database comprises a large set of macroeconomic data containing for each country real GDP, real personal consumption, real fixed investment as well as the consumer price index (CPI), the producer price index (PPI) and the GDP deflator.

Overall, the dataset comprises $N^L = 268$ financial data series and $N^M = 141$ macroeconomic data series. The dataset is unbalanced as some series are not available for all countries over the entire sample period. In order to obtain a balanced dataset, the expectation maximisation (EM) algorithm was used to interpolate those series where observations were missing (see Stock and Watson (2002a) for details). We only interpolate (and include) series for which at least five years of data are available.

Since the factor model requires stationary data, the variables were transformed accordingly. Interest rates and stock market volatility enter in levels while monetary and credit aggregates as well as the macroeconomic time series are included in year-on-year differences of the logarithms. Outliers were removed following the procedure proposed by Stock and Watson (2005).[12] Finally, we normalise each series to have a zero mean and a unit variance. We collect them for the analyses below in the N-dimensional vector of variables $X_t = (x_{1,t}, \ldots, x_{N,t})'$ for $t = 1, \ldots, T$, where X_t is either X_t^L (a vector of all financial data series), X_t^M (a vector of all macroeconomic series) or X_t^j (a vector of variable (j)-specific series of all countries where j stands, for example, for overnight rates. N^L, N^M and N^j denote the corresponding dimension of the vectors.

3 Global liquidity and global macro factors

This section explores the global commonality in the financial and macroeconomic data described in the previous section. We first assess how the commonality of financial variables compares to that of macroeconomic data which has already been studied extensively in the literature. In the next step, we then explore to which extent the comovements in financial variables is merely a reflection of global macroeconomic factors as opposed to independent global liquidity factors.

3.1 International comovement of financial and macroeconomic variables

We apply a factor model to X_t based on Stock and Watson (2002b) and Bai and Ng (2002). Each element of X_t is assumed to be the sum of a linear combination of r common factors

[11] These variables are generally not available for a sufficiently long-sample period for most of the other countries and are therefore consistently not included in the database for countries other than the US.

[12] Outliers are here defined as observations of the stationary data with absolute median deviations larger than 3 times the interquartile range. They are replaced by the median value of the preceding five observations.

$F_t = (f_{1,t}, \ldots, f_{r,t})'$ and an idiosyncratic or variable-specific component e_{it}:

$$x_{i,t} = \lambda_i' F_t + e_{i,t}, \quad i = 1, \ldots N \tag{1}$$

where λ_i is the $r \times 1$ vector of common factors loadings, and $\lambda_i' F_t$ is the common component of variable i. In the following analysis, the factors extracted from the financial dataset are denoted as F_t^L, those from the macroeconomic dataset as F_t^M, and the factors extracted from variable-specific datasets as F_t^j, with loadings, numbers of factors and idiosyncratic components labelled accordingly. The factors are mutually orthogonal and uncorrelated with the idiosyncratic errors. The latter can be weakly mutually and serially correlated in the sense of Chamberlain and Rothschild (1983).

The commonality (i.e. the variance shares explain by the common factors) of a given set of variables is given by $var(\lambda_i' F_t)/var(x_{i,t})$. The common factors are estimated as the first r principal components of $X = (X_1, \ldots, X_T)'$, $\widehat{F} = (\widehat{F}_1, \ldots, \widehat{F}_T)' = \sqrt{T}v$, where v is the matrix of eigenvectors corresponding to the first r eigenvalues of XX', and the loadings are estimated as $\widehat{\Lambda} = (\widehat{\lambda}_1, \ldots, \widehat{\lambda}_N)' = X'\widehat{F}/T$.

We first extract common factors from specific subsets of key financial and macroeconomic variables. Table 1 (a) provides the cumulated variance shares explained by the first 10 principal components for the datasets comprising respectively only overnight rates, domestic credit growth, cross-border credit growth, business lending rates, mortgage lending rates, stock market volatility and M2 growth. The last two columns show the variance shares for cross-country real GDP growth and CPI inflation which we take as a reference for the assessment of the degree of comovement amongst financial variables.

The global commonality in the different groups of financial variables is comparable to, and in some cases even considerably higher than that prevailing in output growth and inflation. The first factor explains respectively roughly 40 percent and 30 percent of the variance of output growth and inflation across countries, while the first three factors together account for respectively 70 and 60 percent. This confirms the findings of previous studies that a considerable part of output growth and inflation dynamics is driven by common global factors (e.g. Kose et al. (2003), Ciccarelli and Mojon (2010)). For key financial variables, the first factor explains in each case at least roughly a quarter of the variance across countries. The cross-country commonality is highest amongst interest rates, where the first factor explains roughly 60 percent of the total variance, while the first three factors explain about 80 percent of the total cross-country variation. For domestic and cross-border credit growth, the global comovement is comparable to that found for output growth and inflation. Interestingly, the commonality is somewhat higher for domestic credit growth than for cross-border credit growth. While the first three factors explain about two thirds of the cross-country variance of the former variable, they explain less than half of it in the case of the latter variable. This finding indicates stronger cross-country,

or cross-regional heterogeneity in cross-border credit growth. The commonality in broad money growth is similar to that prevailing in credit growth. For stock market volatility, the degree of global comovement is similar to that of policy rates, probably reflecting the forces of financial globalisation giving rise to a synchronisation of stock market dynamics globally.

The analysis of the commonality in the full dataset of financial variables on the one hand and in the full dataset of macroeconomic variables on the other suggests that the comovements among financial variables are slightly higher than that prevailing in macroeconomic data. This can be seen in the first two columns of Table 1 (b) which report the cumulated variance shares respectively explained by the first ten principal components in the two datasets. The first factor explains a quarter of the variance of the macroeconomic dataset, while it explains about a third of the variance of the financial data. The first three factors explain roughly 60 percent of the variance of the financial database, compared to a share of roughly 50 percent in the macroeconomic database.

3.2 Disentangling global macro and global liquidity factors

The commonality in financial variables' dynamics may merely reflect global comovements of macroeconomic variables, i.e. the common reaction of financial variables to the global business cycle or global inflation. For instance, the high degree of commonality in interest rates may reflect a close similarity in the systematic reaction of monetary policy to macroeconomic developments as monetary policy strategies have converged in many countries across the globe on maintaining macroeconomic stability (Ciccarelli and Mojon (2010), Rogoff (2003)). Alternatively, it may reflect other factors such as a significant role of external constraints in some economies' monetary policy conduct which might have given rise to global monetary policy spill-over effects (Hofmann and Bogdanova (2012)).

In order to disentangle liquidity dynamics that are driven by global macroeconomic developments from those reflecting independent global liquidity comovements, we purge the financial variables of the effects of global macroeconomic factors based on first stage regressions.[13] The underlying assumption behind the purging is that movements in the macroeconomic factors can affect the financial variables instantaneously, while liquidity factors cannot affect the macroeconomic variables on impact. In this sense, it represents an implicit zero restriction on the loadings of the macroeconomic variables on global liquidity factors. This assumption is in line, e.g., with SVAR or FAVAR studies by Ciccarelli et al. (2010), Eickmeier and Hofmann (2011), Buch et al. (2010) and Peersman (2010) who assume that macroeconomic variables cannot react immediately to financial shocks.

We determine the number of global macro factors r^M using an informal criterion

[13] This approach is similar to Hatzius et al. (2010) in their analysis of US financial conditions where they regress in a first stage individual financial variables on US growth and inflation.

based on the variance shares explained by each factor on average over all variables.[14] Specifically, we require r^M common factors to explain roughly 50 percent of the variation in the macroeconomic series and each factor to explain at least 10 percent of the variance. Following this criterion and given the results shown in the second column of Table 1 (b), we set $r^M = 3$ and estimate the factors with principal components which yields $\widehat{F}_t^M$. We then regress each financial variable x_{it}^L on $\widehat{F}_t^M$ and retain the residuals. Roughly 35 percent of these variables' variance is explained by global macroeconomic factors, suggesting that global macroeconomic factors are important drivers of global financial dynamics, but also that they are not able to explain a fairly large share of these dynamics.

In the next step, we estimate r^L latent factors, F_t^L, from the purged financial variables, i.e. from the residuals of the first stage regressions. These residuals are that part of each variable's dynamics that is not explained by (current) global macroeconomic factors and in this sense they represent independent liquidity dynamics. We therefore consider the global common factors driving the purged financial variables as measures of (independent) global liquidity dynamics. The third column of Table 1 (b) shows that there is indeed considerable comovement in global financial variables that goes over and above that explained by global macroeconomic developments. It also reveals that global liquidity cannot be represented by a single indicator. Applying the same criterion as for the macro factors, i.e. that we want to explain at least 50 percent of the independent dynamics of financial variables, we set $r^L = 3$. Therefore, three factors are needed to characterise global liquidity conditions. However, the standard factor analysis performed in this section cannot go beyond this basic insight. As is well known, the common factors and factor loadings are not identified separately (see, e.g., Bai and Ng (2006)). For this reason, there is no scope to plot the principal component estimates of the global liquidity factors or to look at the factor loadings in order to interpret or infer their structural meaning. In the following section we propose a way to overcome this impasse.

4 Identifying structural global liquidity factors

We aim to identify interpretable, structural global liquidity factors by imposing theoretically motivated sign restrictions on factor loadings. In doing so, we overcome what impeded further structural interpretation of the factors at the end of the previous section, namely that factors are identified only up to a rotation. For any invertible $r^L \times r^L$-dimensional matrix R^L we can write

$$\lambda_i^{L\prime} F_t^L = \lambda_i^{L\prime} R^L R^{L^{-1}} F_t^L = \overline{\lambda}_i^{L\prime} \overline{F}_t^L \tag{2}$$

[14] The information criteria suggested by Bai and Ng (2002) give inconclusive results and are therefore not used here.

with $\overline{\lambda}_i^{L\prime} = \lambda_i^{L\prime} R^L$ and $\overline{F}_t^L = R^{L^{-1}} F_t^L$. While this means that the raw principal component factors are not interpretable, it also means that factors can be identified by finding matrices R^L that yield economically meaningful factor loadings. More specifically, we rotate the r^L estimated latent liquidity factors $\widehat{F}_t^L$ and pick linear combinations of the elements of $\widehat{F}_t^L$ and $\widehat{\lambda}_i^L$ which yield signs on the factor loadings that are consistent with prior theoretical considerations.

Our approach is related to previous papers that construct interpretable factors by imposing zero restrictions on factor loadings in order to associate common factors with specific variables or regions (e.g. Kose et al. (2003), Belviso and Milani (2006)).[15] However, we aim at constructing interpretable liquidity factors not by linking the factors to a specific group of variables, such as interest rates or credit growth, but by trying to achieve a truly structural identification of the factors. To this end, we borrow from the literature on structural vector autoregressions (VARs), where theoretically motivated sign restrictions on the impulse responses are imposed in order to identify structural shocks and assess their dynamic effects (e.g. Uhlig (2005), Canova and De Nicoló (2003)). We apply such restrictions to factor loadings rather than the shock impulse responses in order to obtain measures of the structural drivers of global liquidity that reflects both the non-systematic components (i.e. the shocks) and the systematic components.

4.1 A sign restrictions approach to factor identification

We hypothesise that the three factors that drive the bulk of the independent dynamics in financial variables represent a global monetary policy factor, a global credit supply factor and a global credit demand factor. The sign restrictions employed to disentangle these factors are shown in Table 2. The loadings associated with the global monetary policy factor (reflecting an expansionary monetary stance) are non-positive for the policy interest rate and (business and mortgage) lending rates, while they are non-negative for (domestic and cross-border) credit growth and for the spreads of the lending rates over the policy rate. The (positive) credit supply factor is assumed to have non-negative loadings for credit growth and non-positive loadings for the lending rates as well as for the spreads of the lending rates over the policy rate. Finally, the loadings associated with the (positive) credit demand factor are non-negative for credit growth and the lending rates.

These sign restrictions follow from a standard demand and supply framework of the loan market together with short-term sluggishness in loan rates and are consistent with DSGE models incorporating a banking sector such as the model of Gerali et al. (2010).[16]

[15] While Kose et al. (2003) try to disentangle global, regional and country-specific factors in business cycles, Belviso and Milani (2006) estimate US interest rate, money and credit factors by imposing zero restrictions on loadings associated with interest rates, monetary aggregates and credit aggregates, respectively.

[16] The DSGE model of Gerali et al. (2010) includes a standard loan demand-supply framework with loan rate stickiness which yields dynamic effects of a loan supply and a monetary policy shock that are

Suppose industry-standard loan demand and loan supply functions. Loan demand (L^D) is assumed to depend negatively on the lending rate (i^L) and positively on variables (Y) that increase firms and households willingness and ability to increase their borrowing, such as economic activity or asset prices:[17] $L^D = -\alpha i^L + \beta Y$ (see e.g. Stein (1998), Hofmann (2004)). Loan supply is assumed to be given by a loan rate mark-up equation of the form $i^L = i^M + \mu$ where i^M is the monetary policy rate and μ is a mark-up influenced by risk and marginal cost of intermediation of lending which could vary over time. Such a specification of loan supply follows from economic theory on oligopolistic (and perfect) competition in the loan market according to which lending rates should be set as a mark-up over banks' marginal cost of refinancing (see Freixas and Rochet (1997)).[18] Further suppose that there is short-term sluggishness in the adjustment of loan demand and loan supply to their long-run levels. Specifically, we assume that lending rates adjust to changes in policy rates in a sticky way which can be motivated by the presence of menu costs in loan rate adjustment or relationship banking and is consistent with the empirical evidence.[19]

With this framework at hand, we can derive the sign restrictions in Table 2 in an intuitive way. In the L (loan quantity) and i^L(loan rate) space, the loan supply function is a horizontal line and shifts when the level of the policy rate i^M or the level of the mark-up μ changes. The loan demand function is downward sloping and shifts with changes in the vector of variables Y. A loosening of monetary policy and an increase in loan supply, respectively represented by a decrease in the policy rate and a decrease in the loan rate mark up, shift the loan supply curve down, decreasing the loan rate and increasing the loan quantity. An increase in loan demand, i.e. an upward shift in the loan demand function trough an increase in Y reflecting e.g. higher economic activity or asset prices, is associated with an increase in the loan quantity. In order to disentangle an increase in loan demand from an increase in loan supply, we restrict loan rates not to decrease after an upward shift in loan demand. This restriction is consistent with our framework and

consistent with the sign restrictions in Table 2. The sign restrictions for the credit supply factor are more generally consistent with DSGE models containing a banking sector (as summarized in Table 2 in Hristov et al. (2012)). Similar restrictions have been used in previous empirical work to identify credit supply shocks (Helbling et al. (2011), Busch et al. (2010), Peersman (2010), Hristov et al. (2012), Bean et al. (2010), Meeks (2011), De Nicoló and Lucchetta (2010), Eickmeier and Ng (2011)). Another example is Chen et al. (2012) who use sign restrictions similar to ours in a small scale VAR to identify supply and demand shocks to banks' core and non-core liabilities and assess their macroeconomic effects at the global and individual country level.

[17] For a more detailed discussion of the determinants of credit demand, see Hofmann (2004) who also presents cross-country evidence showing that credit demand is negatively linked to short-term interest rates and positively linked to economic activity and property prices.

[18] This framework is also valid for the pricing of long-term loans. Long-term loan rates, such as mortgage rates, are usually set as a mark-up over longer-term bond yields rather than short-term money market rates. This mark-up relationship can however be reformulated to yield a mark-up equation in terms of the policy rate with the yield spread incorporated in the mark up.

[19] See Gerali et al. (2010) for a more detailed discussion. For empirical evidence on the sluggishness in the adjustment of loan rates to changes in policy rates, see e.g. Hofmann and Mizen (2004), Gambacorta (2008) and Eickmeier and Hofmann (2011).

allows also for an upward sloping loan supply curve as assumed e.g. by Aoki et al. (2009).

The restrictions on the spread of the loan rate over the policy rate, which are critical to disentangling the monetary policy factor from the credit supply factor, follow from the assumption of short-term stickiness in loan rates. If lending rates are sticky, the spread of lending rates over the policy rate falls when policy rates rise. In other words, we assume the loading of policy rates on the monetary policy factor to be larger than that of lending rates. By contrast, the loading of loan rates on the credit supply factor is assumed to be larger in absolute terms than that of the policy rate, so that the loading of the loan rate spread is positive. This reflects the notion that loan rates would be expected to be more closely associated with credit supply movements than policy rates.

We impose the sign restrictions on the unweighted averages of the loadings over all countries and implement them using the approach suggested by Rubio-Ramírez et al. (2010) for impulse response functions. We randomly draw $r^L \times r^L$ orthonormal rotation matrices R^L and select those rotations that yield loadings which satisfy the sign restrictions. More precisely, for each R^L, we estimate

$$x_{i,t}^L = \widehat{\lambda}_i^{M\prime} \widehat{F}_t^M + \widehat{\overline{\lambda}}_t^{L\prime} \widehat{\overline{F}}_t^L + e_{i,t}, \quad i = 1, \dots N \tag{3}$$

where $\widehat{F}_t^M$ denotes global macro factors and $\widehat{\overline{F}}_t^L = R^{L^{-1}} \widehat{F}_t^L$ the rotated estimated financial factors. Based on these regressions, we verify if the unweighted averages across countries of the loadings $\widehat{\overline{\lambda}}_t^L$ of $\widehat{\overline{F}}_t^L$ are consistent with the sign restrictions in Table 2 and retain R^L if this is the case. We draw until we have 100 valid R^Ls. Among these valid rotation matrices, we select the one which yields factors most closely related to the median factors, R^L, according to the "Median Target" methodology proposed by Fry and Pagan (2007). The factors we are interested in are given by $R^{L^{-1}} \widehat{F}_t^L$, and the corresponding $r^L \times 1$-dimensional loadings for variable i are $R^{L\prime} \widehat{\lambda}_i^L$.

Table 3 reports the shares of countries for which the restrictions hold and the loadings significantly differ from zero as well as the shares of countries where the loadings do not significantly differ from zero (i.e. the restrictions are not violated in a strict sense). The loadings satisfy the sign restrictions in the strong sense in more than half of the countries in most cases. In the weak sense, i.e. the loading has the "right" sign or is not significantly different from zero, the restrictions tend to hold for at least 2/3 of the countries for all variables and factors.

4.2 Some comments on the approach

Before presenting the results, a few clarifying comments on our approach are in order. First, the structural factors we identify are broadly defined. They incorporate any possible shifter of credit demand or credit supply, such as e.g. asset price movements affecting firms', households' and banks' balance sheets, heightened investor risk aversion, increased

preference for housing or change in time preference of households, financial innovation etc. They also include macroeconomic influences, such as productivity shocks or preference shocks. While we aim to filter out macroeconomic influences based on a first stage regression as explained in the previous section, this captures only the contemporaneous but not the lagged dynamic effects. However, this broad-based nature of the identified factors is exactly what we are aiming at, since the goal of our analysis is to identify factors that represent the structural drivers of global liquidity conditions in the broadest sense rather than the effects of some narrowly defined specific structural drivers of liquidity dynamics, such as a shock to bank capital or entrepreneurs' net worth.

Second, the loadings reflect the effects of movements in the factors on specific variables. At the same time, the factors are estimated as weighted averages of the variables in the dataset. Hence, the loadings also reflect the weights of each variable when forming the factors. When looking at unidentified factors, the two meanings of the loadings cannot be disentangled. When identifying factors, we restrict the loadings so that the factors have the desired (directional) effects in order to obtain factors that would reflect monetary, credit demand and credit supply conditions. For instance, the restriction that the monetary policy factor is positively associated with credit growth ensures that any contemporaneous systematic reaction of monetary policy to the credit cycle will not be reflected in the monetary policy factor.

Third, the factors are orthogonal by construction. Orthogonality of the factors is an identifying assumption just like for structural shocks. This assumption is, however, not exceedingly restrictive since nothing prevents the factors to affect each other with a lag.

Finally, we note that we associate the monetary policy factor with central banks' interest rate policies as the restrictions are derived based on considerations of the effects of a change in the policy rate. After 2008, interest rates have in many countries reached their zero lower bound and central banks have provided additional monetary stimulus through large-scale balance sheet policy measures. Our sign restrictions are not inconsistent with such a situation as we identify the monetary policy factor based on a non-positivity restriction on the policy rate loadings. That means that the policy rate does not necessarily go down, and therefore could also not move at all after a loosening of the monetary stance which would be the case at the zero lower bound of interest rates. We repeat the analysis for the sample which ends before the global financial crisis and the introduction of unconventional monetary policies in the robustness check section below and show that our conclusions do not change.

4.3 Measuring global monetary policy, global credit supply and global credit demand conditions

Figure 1 shows the evolution of the three structural global liquidity factors over the sample period. In order to facilitate interpretation, we normalise the monetary policy factor to be positively correlated with interest rates (on average over all countries). The two credit factors are positively correlated with domestic bank credit growth (as already imposed by the sign restrictions in Table 2). Furthermore, the monetary policy factor is scaled to have the same standard deviation as the global policy rate (computed as GDP-weighted average of all policy rates), and the credit supply and credit demand factors are scaled to have the same standard deviation as global domestic credit growth (computed as year-on-year growth of the sum of all countries' domestic credit in percent). The normalisation implies that a monetary policy factor above (below) zero indicates a tight (loose) monetary policy stance, while credit supply and credit demand factors above (below) zero would indicate a loose (tight) global credit supply and strong (weak) global credit demand conditions.

We show the factors associated with all models satisfying the sign restrictions in black and the "Median Target" factors in red. Given the large cross section we do not need to account for estimation uncertainty (see also Bernanke et al. (2005)). The range of factor estimates therefore only reflects the amount of identification (or model) uncertainty. The factor range is for most periods fairly tight. Hence, identification uncertainty does, in general, not seem to be a major issue. An interesting observation is, however, that the amount of uncertainty changes over time. This might reflect the varying degree of the global comovement in monetary policy, credit supply and credit demand conditions. When the commonality is higher, the global factors are more clearly identified (i.e. model uncertainty is lower), and the range of factor estimates is narrower. For instance, the range of the identified monetary policy factors is very narrow after the Lehman collapse when essentially all central banks around the globe cut policy rates. After 2010, the range is in contrast much wider, possibly reflecting increasing global divergence in the conduct of monetary policy, with some emerging market and small advanced economy central banks raising policy rates while central banks in the core advanced economies left them at their effective lower bound.

The global monetary policy factor (upper left graph) indicates a period of high uncertainty surrounding the monetary policy stance up until the end of the 1990s, followed by a period of policy tightening until the bursting of the dot.com bubble in 2000/2001 when monetary conditions started to ease. Between 2003 and the end of our sample period (mid-2011), monetary conditions have been mostly accommodative, tightening only briefly between 2007 and the outbreak of the global financial crisis in late-2008. The subsequent aggressive interest rate cuts by central banks are reflected in a steep fall of the monetary policy factor, which has since then remained below zero thus indicating accommodative

global monetary conditions at the end of the sample period. Overall, the indications coming from the global monetary policy factor are broadly consistent with findings obtained from more conventional analytical approaches. For instance, the Taylor rule-based analysis by Hofmann and Bogdanova (2012) arrives at a very similar assessment of the evolution of the global monetary policy stance over the same sample period. In this context, it is important to recall that our monetary policy factor only reflects central banks' interest rate policies and does not capture the effects of central banks' balance sheet policies adopted in response to the global financial crisis. This suggests that the global monetary policy stance at the end of the sample period has probably been even more accommodative than indicated by our monetary policy factor.

The global credit supply factor (upper right graph) displays a significant gradual increase since the start of the sample in the mid-1990s up until the outbreak of the global financial crisis. Starting out from tight levels, global credit supply conditions loosened until the late-1990s and early-2000s, when they suffered a short set-back in the wake of the dot.com crisis. Between 2003 and 2007, the credit supply factor rose steeply, indicating a significant loosening of credit supply conditions. With the beginning of the financial turmoil in mid-2007, the credit supply factor started to decline sharply. The median target model indicates that credit supply conditions since 2009 are almost as tight as they were at the beginning of the sample. However, the factor range is rather wide and includes the zero line, implying that this assessment is surrounded by a high degree of uncertainty.

The global credit demand factor (lower left graph) indicates strong global credit demand at the beginning of the sample period, which then weakened sharply during the Asian crisis. Credit demand subsequently recovered quickly but weakened again in the aftermath of the unwinding of the dot.com bubble. In the run-up to the global crisis, the credit demand factor rose only slowly, indicating strong global credit demand only after 2006. In the wake of the global financial crisis, the credit demand factor contracted sharply, suggesting that credit demand has been very weak at the end of the sample period.

From a bigger picture perspective, the patterns of the structural global liquidity factors suggest three main conclusions. First, a sustained loosening of global credit supply conditions between the mid-1990s and 2007, possibly driven by financial deregulation and globalisation. Second, the run-up to the global financial crisis was primarily associated with accommodative global monetary conditions and loose global credit supply conditions. This is consistent with the view that both factors played a role in the built up of pre-crisis imbalances. Third, since the outbreak of the global financial crisis in 2008, the global monetary policy stance has been accommodative, while credit supply and in particular credit demand conditions have been weak. This implies that looser "official" liquidity conditions have at least partly compensated for tighter "private" liquidity conditions.

For our understanding of the movements of the factors in certain periods, it turned out to be instructive to replicate the analysis with the financial variables without prior purging

of macroeconomic influences. The sign restrictions in Table 2 are indeed also valid for the unpurged financial variables. The only difference is that those shifts of the credit demand and supply curves that are driven by macroeconomic developments are now not filtered out but are instead incorporated in the global liquidity factors. The Median Target factors obtained from the unpurged financial database are shown in Figure 2, together with the baseline Median Target factors. The charts reveal in particular that the spikes in credit supply and demand in 2009 are induced by the purging of the financial variables of the effects of macroeconomic factors. The spikes therefore reflect that credit contracted by less than the macroeconomy during the sharp global recession. Also, the global monetary policy factor looks considerably more accommodative at the end of the sample period when extracted from the unpurged dataset. This suggests that the prevailing low levels of global policy rates are in part due to weak macroeconomic conditions.

4.4 Robustness analysis

In this section we check the findings of the previous section for robustness. To this end we replicate the analysis for a number of different modelling approaches and compare the obtained structural factors with the baseline factors.

We consider four different alternatives for identifying the structural liquidity factors. First, we are interested in the robustness of the results to an alternative approach to filter out macroeconomic effects. Specifically, instead of regressing the financial variables on global macroeconomic factors, we regress them on national real GDP growth and national CPI inflation. Under this approach, the idiosyncratic components only reflect financial dynamics that are fully independent from macroeconomic dynamics as captured by real output growth and inflation, while they comprised both national financial and macro developments that were not captured by the global macro factors in the baseline model. The drawbacks of this alternative approach to purging out macro influences are that we can no longer assess the role of global macroeconomic factors for financial dynamics and that a narrower set of macroeconomic indicators is used (i.e. only real GDP growth and CPI inflation instead of a larger set of macroeconomic indicators).

Second, we explore the effect of imposing the sign restrictions used for factor identification on the weighted rather than the unweighted average of countries. The weights are constructed based on PPP-adjusted GDPs in 2008, which are taken from the World Economic Outlook database of the IMF. The purpose of this exercise is to give larger countries which play a more important role in the global macroeconomy a higher weight.

Third, we reconstruct the structural factors using data only up to the beginning of the global financial crisis, i.e. over a sample period ending in 2008Q3. The crisis obviously had a major impact on global macroeconomic and liquidity dynamics which might, as a consequence, have a dominant effect on the structural factors we identify. For this reason

it is useful to check whether the factor patterns for the pre-crisis period are robust to the exclusion of the crisis observations.

Fourth, and finally, we identify the structural factors based on a model comprising four instead of three factors. We leave the fourth factor unidentified, but restrict it not to have the same characteristics as the other three factors. The additional common factor can absorb the commonality that is not explained by the three identified structural factors.

The structural global liquidity factors turn out to be broadly robust to these alternative modelling approaches. This is the main message from Figure 3, which shows the Median Target factors for the baseline specification and for the four robustness checks, and from Table 4, which shows the correlation of the alternative factors with the baseline factors. The factors move closely together and the correlation coefficients essentially all exceed 0.8, in most cases even 0.9. Notable divergences emerge only in periods when identification uncertainty in the baseline case was high (i.e. the factor range as shown in Figure 1 was wide), specifically at the beginning and at the end of the sample period. Overall, we can therefore conclude that the structural liquidity factors and their indications about global monetary policy, global credit supply and global credit demand conditions are robust across a variety of alternative modelling approaches.

5 The role of global liquidity at the global and regional level

As the final step of our analysis, we assess in this section the role of global liquidity factors in the dynamics of a number of key liquidity indicators. To this end, we perform variance and historical decompositions based on the three global macro factors that were purged out of the financial data in Section 3 and the Median Target estimates of the global liquidity factors as shown in Figure 1. Table 5 presents the results of the variance decompositions for global and regional averages as well as for the G3 economies.[20] The last three columns of the table report the global and regional averages of the estimated factor loadings for each of the structural liquidity factors. Figure 4 shows the results of the historical decompositions for global aggregates of the financial variables. Figure 4 (a) shows the total contributions of global macro factors and of global liquidity factors to the evolution of the variables over time, while Figure 4 (b) shows the individual contributions of the three structural global liquidity factors.

From a global perspective, three main results emerge. First, as was already indicated by the analysis in section 3, global macro factors explain a sizeable share of global liquidity dynamics. Roughly 40 percent of the variation of interest rates and roughly 30 percent of the variation of credit and money growth and of stock market volatility are explained by the macro factors. Macro factors have made a sizeable contribution to the high growth

[20] We do not report more individual country results for the sake of focus and brevity. These results are available upon request.

rates of credit and money before the global financial crisis. In particular, they have been the main driver of the sharp drop in policy rates and credit growth as well as of the elevated level of the VIX in 2009, reflecting the strong impact of the Great Recession on financial dynamics in this period (see Figure 4 (a)).

Second, global liquidity factors explain a similarly large share of financial variables' variance as the global macroeconomic factors. Taken together, the global macro and liquidity factors generally explain more than 50 percent of the variables' variation, in the case of interest rates even more than 80 percent. Figure 4 (a) further reveals that global liquidity factors have also played an important role in shaping financial dynamics in particular in the run-up and in the aftermath of the global financial crisis. Specifically, the combination of low interest rates and rapid monetary expansion before the crisis as well as the low levels of interest rates and money and credit growth after 2010 have been mainly driven by the global liquidity factors. Figure 4 (b) suggests that global credit supply was a major driving force of rapid credit expansion and declining lending rates in the run-up to the global financial crisis in 2004-2007. In contrast, weak credit demand seems to be the main factor behind low interest rates and weak monetary growth at the end of the sample period.

Third, the relative importance of the three structural global liquidity factors varies across variable groups. Specifically, Table 5 and Figure 4 (b) reveal that the global credit demand factor is a relatively important driver of interest rate dynamics, interestingly more so than the global monetary policy factor. This finding reflects the strong systematic positive association between credit growth and interest rates which is picked up by the credit demand factor. It could be interpreted as reflecting a systematic reaction of policy rates to credit demand conditions which we have filtered out of the monetary policy factor by imposing the restriction that this factor is negatively associated with credit growth. The monetary policy factor is in turn strongly positively associated with the dynamics of stock market volatility (see the factor loadings in Table 5 as well as Figure 4 (b)), consistent with recent empirical evidence on the interlinkages between monetary conditions and financial market sentiment (e.g. Bekaert et al. (2010)) and a risk-taking channel of monetary policy (Borio and Zhu (2008)). The credit supply factor is strongly negatively related to stock market volatility, supporting the notion of a negative association between investors risk appetite and credit supply conditions as suggested by CGFS (2011).

From a regional perspective, the main observation from Table 5 is that the global liquidity factors are more closely associated with financial variables in advanced economies. Specifically, the monetary policy and credit demand factors explain a considerably larger share of the variance of advanced economy interest rates, while the credit supply factor explains a relatively larger part of the variance of those economies' domestic credit growth rates. This finding is consistent with the notion that advanced economies are the main driving force of global liquidity conditions through the dominant role of their financial

systems. It also explains the finding of the previous section that the results do not change much when the advanced economies get a larger weight in the identification of the factors. Interestingly, domestic credit growth in the major advanced economies is positively correlated with the monetary policy factor. This finding may reflect previous evidence suggesting that business loans rise in response to a contractionary monetary policy shock as firms are able to temporarily avoid the negative effects of a monetary policy tightening by increasing their credit demand.[21]

6 Conclusions

This paper has explored the concept of global liquidity through the lens of a factor model using a large set of financial and macroeconomic variables from 24 advanced and emerging market economies for the period 1995-2011. Our main findings are twofold. First, global liquidity, defined here as the commonality in financial dynamics across countries that is not explained by global macroeconomic factors, cannot be summarised in a single indicator. Instead, global liquidity conditions are driven by three common factors. Second, by imposing theoretically motivated sign restrictions on factor loadings, these three global liquidity factors can be identified as a global monetary policy factor, a global credit supply factor and a global credit demand factor.

The analysis of the patterns of the structural global liquidity factors and of the factors' contributions to the development of key liquidity indicators offers a number of interesting insights. Three points stand out. First, global credit supply conditions loosened markedly between the mid-1990s and 2007. This suggests that financial deregulation and globalisation over this period fostered a sustained increase in liquidity supply that ended with the global financial crisis. Second, the run-up to the financial crisis was primarily associated with loose credit supply conditions, but accommodative monetary conditions, strong credit demand at a later stage of the pre-crisis boom and also global macroeconomic factors played a role. The global build-up of financial imbalances ahead of the crisis was thus not caused by a single driver but rather by the combined effects of a number of different forces. Third, since the outbreak of the global financial crisis in 2008, the global monetary policy stance has been accommodative, while credit supply has been tight and credit demand has been weak. This implies that accommodative "official" liquidity conditions have been countervailing the adverse effects of weak "private" liquidity conditions on financial dynamics over this period, though without being able to fully offset them.

[21] A number of empirical studies find business credit (which is an important component of our credit measures) to go up (temporarily) after a monetary policy tightening (see Bernanke and Gertler (1995) and Giannone et al. (2009) for the euro area). This "perverse" reaction has mainly been interpreted as reflecting positive loan demand effects triggered by a monetary policy tightening, such as the need to finance an increase in inventories (Bernanke and Gertler (1995)) or firms' ability to draw on credit lines at pre-specified rates when the interest rates on new loans increase (Peersman (2011)).

Going forward, future research could be directed towards two issues that go beyond the scope of this paper. First, the role of regional factors could be investigated. A number of papers have explored the relevance of global and regional factors for global business cycle dynamics (e.g. Mumtaz et al. (2010)). A similar type of analysis for the dynamics of the financial variables included in our dataset would certainly also be interesting.[22] Second, as pointed out by Hirata et al. (2012), the conceptual framework we have developed to identify the structural liquidity factors could also be used to identify structural global liquidity shocks and explore their dynamic effects.

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Table 1: Cumulated variance shares explained by the first 10 principal components (in percent)

(a) Variable-specific datasets

# factors	Overnight rate	Domestic credit growth	Cross-border credit growth	Business lending rate	Mortgage rate	VIX	M2 growth	Real GDP growth	CPI inflation
1	58	28	25	65	65	53	22	40	28
2	70	50	36	76	75	64	41	58	48
3	78	63	46	82	82	71	52	67	59
4	84	71	54	88	87	77	62	73	67
5	88	78	61	92	91	81	71	78	73
6	91	82	67	94	95	84	77	82	78
7	94	85	72	95	97	87	81	85	82
8	96	88	77	97	98	89	84	87	86
9	97	91	80	97	98	91	88	90	88
10	98	93	84	98	99	93	90	91	91

(b) Large datasets

# factors	All financial variables	All macro variables	All financial variables after purging of the macro factors
1	34	23	30
2	47	37	44
3	57	48	54
4	64	56	61
5	70	62	65
6	74	67	69
7	76	71	72
8	79	74	75
9	81	77	77
10	83	79	79

Table 2: Sign restrictions on loadings

	Overnight rate	Business and mortgage lending rates	Business and mortgage lending rate spreads	Domestic and cross-border credit growth
Monetary policy factor	≤0	≤0	≥0	≥0
Credit supply factor		≤0	≤0	≥0
Credit demand factor		≥0		≥0

Table 3: Share of countries satisfying the sign restrictions (in percent)

	Overnight rate	Business lending rate	Mortgage rate	Business lending rate spread	Mortgage rate spread	Domestic credit growth	Cross-border credit growth
(a) Share of countries satisfying the sign restrictions and loadings differing significantly from 0							
Monetary policy	48	64	76	57	63	43	33
Credit supply		82	76	62	57	52	29
Credit demand		91	88			57	38
(b) Share of countries for which loadings do not differ significantly from 0							
Monetary policy	30	27	12	19	19	26	54
Credit supply		5	18	38	25	17	63
Credit demand		5	12			39	58

Table 4: Correlations with baseline factors for different robustness checks

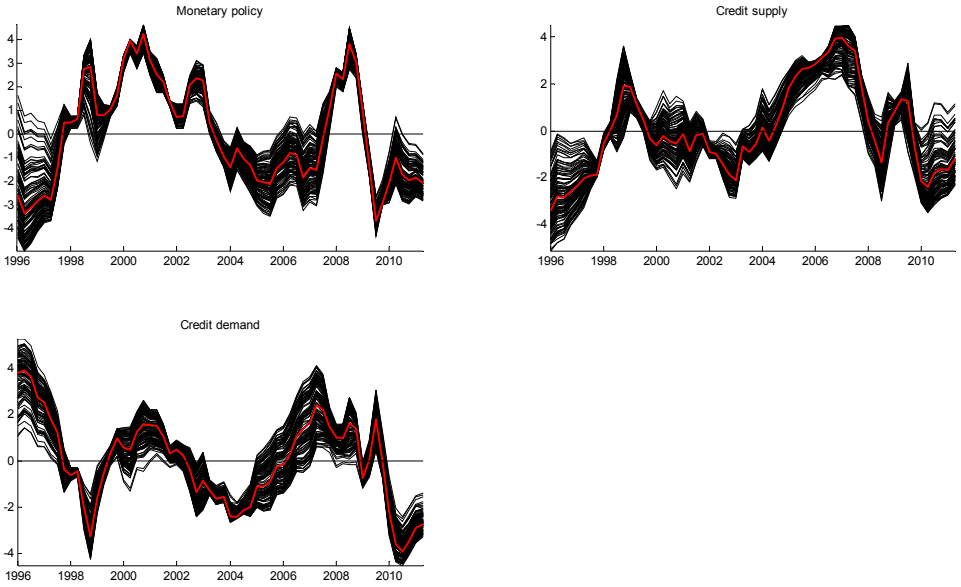
	Monetary policy	Credit supply	Credit demand
Pre-crisis sample	0.81	0.93	0.85
Restr. on weighted average	0.94	0.92	0.94
4 financial factors	0.97	0.79	0.89
Purging based on national macro variables	0.90	0.88	0.79

Notes: The table displays the correlation of the Median Target structural global liquidity factors obtained under the different robustness checks with those obtained in the baseline case.

Table 5: Variance decomposition of financial variables (in percent)

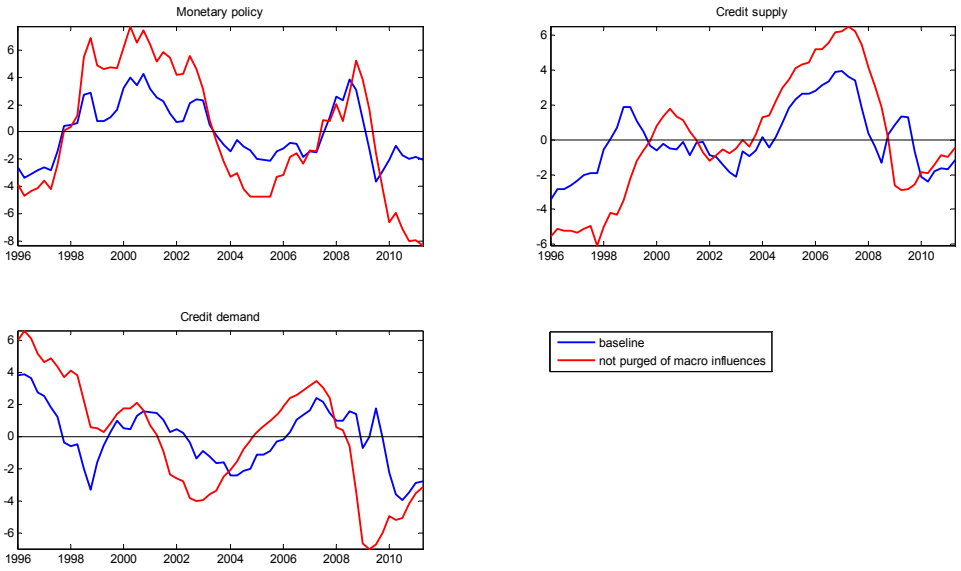
		Variance shares explained by					Loadings		
		MP factor	CS factor	CD factor	Macro factors	Idio	MP factor	CS factor	CD factor
Overnight rate	Global	10	4	25	39	22	0.19	-0.23	0.58
	Advanced economies	16	2	34	31	17	0.25	0.01	0.48
	USA	4	4	33	52	7	0.21	0.23	0.67
	Euro area	19	0	48	19	13	0.30	-0.06	0.55
	Japan	0	1	32	40	27	-0.01	-0.02	0.11
	Emerging market economies	4	5	18	47	26	0.14	-0.43	0.67
	Emerging Asia	5	5	21	49	20	0.03	-0.20	0.53
	Emerging Latin America	2	5	12	43	39	0.38	-0.94	1.00
Domest credit growth	Global	10	18	10	28	34	-0.46	0.23	0.67
	Advanced economies	9	26	11	22	33	0.28	0.90	0.47
	USA	18	19	13	8	42	0.53	0.62	0.52
	Euro area	19	34	15	17	15	0.57	0.88	0.58
	Japan	4	1	6	60	29	-0.32	-0.13	0.41
	Emerging market economies	11	12	10	33	34	-1.08	-0.33	0.85
	Emerging Asia	14	14	11	26	34	-1.07	-1.15	0.85
	Emerging Latin America	5	6	6	47	36	-1.11	1.53	0.85
Cross-border credit growth	Global	6	6	7	25	56	-1.49	0.90	1.76
	Advanced economies	4	8	5	28	56	0.04	1.59	0.16
	USA	2	2	11	47	38	-0.73	0.95	2.19
	Euro area	8	10	3	38	42	1.37	1.75	0.90
	Japan	9	0	8	24	59	-3.97	-0.58	-4.22
	Emerging market economies	8	4	8	23	57	-2.79	0.32	3.11
	Emerging Asia	10	4	8	20	59	-3.84	0.23	3.33
	Emerging Latin America	4	3	10	32	51	-0.43	0.51	2.60
Business lending rate	Global	7	8	23	45	16	0.18	-0.35	0.53
	Advanced economies	11	10	32	36	11	0.15	-0.17	0.44
	USA	5	5	31	46	14	0.18	0.21	0.52
	Euro area	7	10	56	20	8	0.17	-0.23	0.55
	Japan	0	16	31	47	6	0.02	-0.11	0.15
	Emerging market economies	4	7	16	52	20	0.21	-0.50	0.60
	Emerging Asia	2	8	19	59	12	0.03	-0.27	0.44
	Emerging Latin America	9	6	10	36	39	0.60	-1.04	0.98
Mortgage rate	Global	13	7	19	40	17	0.11	-0.16	0.34
	Advanced economies	13	9	29	28	11	0.17	-0.13	0.37
	USA	9	2	39	43	7	0.15	-0.08	0.36
	Euro area	7	17	49	22	4	0.15	-0.26	0.44
	Japan	0	0	0	0	0	0.00	0.00	0.00
	Emerging market economies	12	5	10	50	23	0.07	-0.19	0.32
	Emerging Asia	3	7	15	65	10	0.06	-0.29	0.45
	Emerging Latin America	33	2	0	14	51	0.08	0.05	0.02
VIX	Global	27	3	3	24	44	1.69	-0.21	0.21
	Advanced economies	31	5	2	24	38	1.78	-0.42	-0.10
	USA	33	10	1	29	26	1.94	-1.25	-0.29
	Euro area	19	9	6	34	32	1.70	-1.30	-1.07
	Japan	23	9	0	30	38	1.72	-1.26	0.13
	Emerging market economies	23	1	4	24	48	1.61	-0.03	0.47
	Emerging Asia	23	1	5	25	46	1.66	-0.05	0.65
	Emerging Latin America	23	0	2	22	53	1.50	0.02	0.06
M2 growth	Global	9	10	8	31	42	-0.42	0.24	0.47
	Advanced economies	6	15	6	30	42	0.00	0.49	0.38
	USA	31	4	5	31	29	0.47	0.18	0.22
	Euro area	11	26	16	7	40	0.43	0.76	0.59
	Japan	1	15	0	49	35	0.04	-0.20	-0.01
	Emerging market economies	12	6	9	31	42	-0.78	0.03	0.54
	Emerging Asia	14	8	8	27	44	-0.69	0.19	0.67
	Emerging Latin America	5	3	14	41	37	-0.98	-0.30	0.24

Figure 1: Structural global liquidity factors



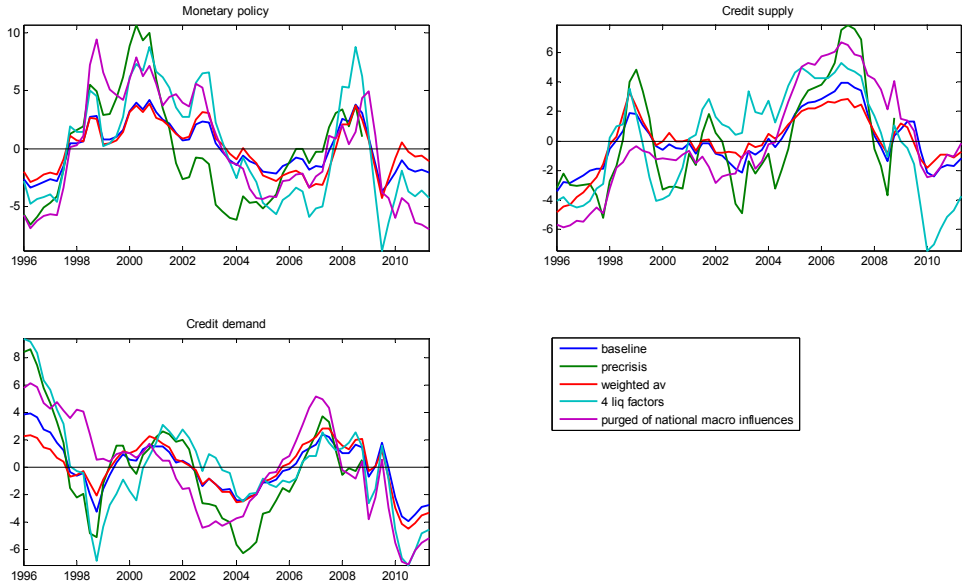
Notes: Black lines are the factors from all 100 models satisfying the sign restrictions on the factor loadings in at least 50 percent of the countries. The red lines are the "Median Target" factors (based on Fry and Pagan (2011)).

Figure 2: Structural global liquidity factors – baseline and not purged of macro factors



Notes: Median Target factors (based on Fry and Pagan (2011).

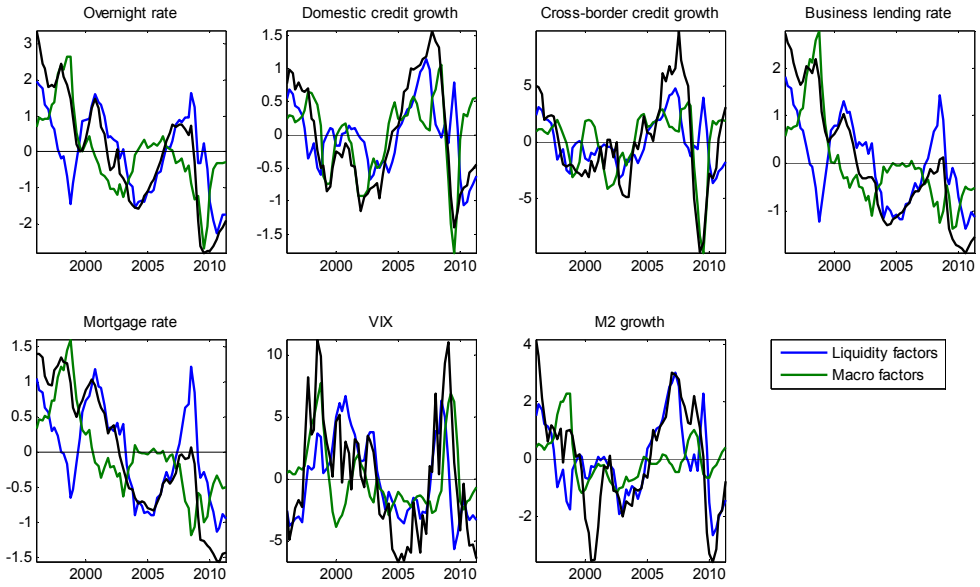
Figure 3: Robustness checks



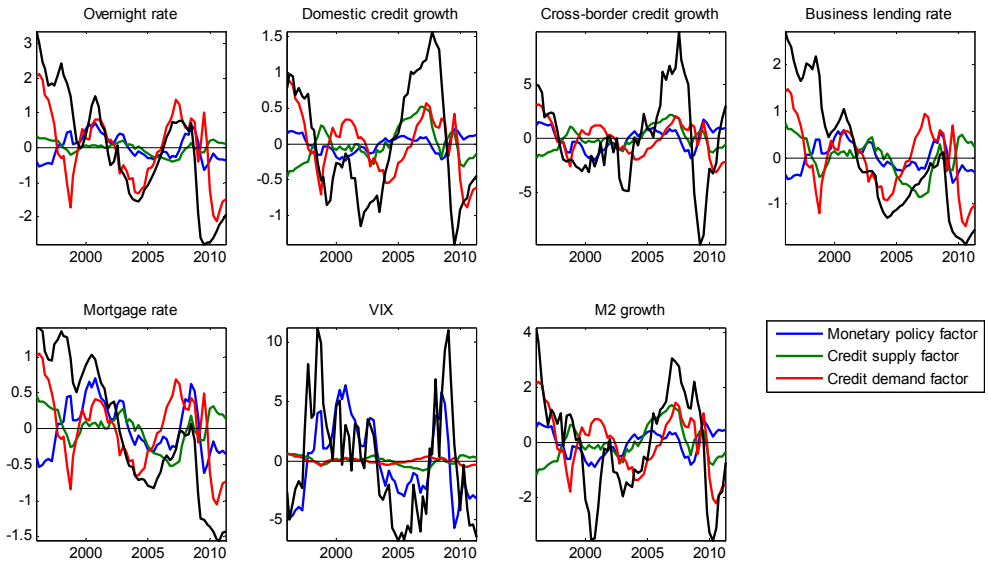
Notes: Median Target factors (based on Fry and Pagan (2011) from robustness checks and from baseline model.

Figure 4: Historical decompositions

(a) The role of global liquidity and global macro factors



(b) The role of global monetary policy, credit supply and credit demand factors



Appendix

Table A.1: Data

#	Variable	Country	Transf	Source
Financial dataset				
23	Money market rate	all	0	IFS/IMF, Datastream
23	Overnight rate	all	0	IFS/IMF, Datastream
22	Business lending rate	all	0	IFS/IMF, national sources
17	Mortgage lending rate	all	0	IFS/IMF, national sources
23	10y government bond yield	all	0	IFS/IMF, Datastream
24	Cross-border credit	all	1	BIS
23	Domestic credit	all	1	IMF/IFS, BIS
24	M2	all	1	IFS/IMF
24	M0	all	1	IFS/IMF
23	Implied volatility	all	0	Datastream, own calculations
1	BAA/10y Treasury spread	US	0	Federal Reserve Board
1	High yield/BAA spread	US	0	Merril Lynch/Federal Reserve Board
1	Auto finance comp. car loan rate/ 2y Treasury spread	US	0	Federal Reserve Board
1	30y conv. mortgage rate/10y Treasury bond spread	US	0	Federal Reserve Board
1	TED spread	US	0	Federal Reserve Board
1	3m Libor/OIS spread	US	0	Federal Reserve Board
1	Bank car loan rate/ 2y Treasury spread	US	0	Federal Reserve Board
1	Bank personal loan rate / 2y Treasury spread	US	0	Federal Reserve Board
1	Commercial paper outstanding: All issuers	US	1	Federal Reserve Board
1	Commercial paper issuance (relative to 24 months moving average)	US	1	Federal Reserve Board
1	Total financial sector: Liabilities, Security RPs	US	1	Federal Reserve Board
1	ABS Issuers: Assets, Consumer credit	US	0	Federal Reserve Board
1	ABS Issuers: Assets, Commercial mortgages	US	1	Federal Reserve Board
1	ABS Issuers: Assets, Mortgages 1-4 family structures	US	1	Federal Reserve Board
1	Broker Dealer leverage	US	1	Federal Reserve Board
1	NFIB: % reporting that credit was harder to get last time	US	0	National Federation of Independent Business
1	Michigan Survey: Good/bad conditions for buying large HH goods spread	US	0	University of Michigan
1	Michigan Survey: Good/bad conditions for buying houses spread	US	0	University of Michigan
1	Michigan Survey: Good/bad conditions for buying autos spread	US	0	University of Michigan
1	FRB Senior loan officer survey: Net tightening of C&I loans to large firms	US	0	Federal Reserve Board
1	FRB Senior loan officer survey: Net tightening of C&I loans to small firms	US	0	Federal Reserve Board
1	FRB Senior loan officer survey: Net increased willingness to make consumer loans	US	0	Federal Reserve Board
1	AAA corporate yield	US	0	Federal Reserve Board
1	BAA corporate yield	US	0	Federal Reserve Board
1	3 months certificate of deposit rate	US	0	Federal Reserve Board
1	6 months certificate of deposit rate	US	0	Federal Reserve Board
1	1y Treasury bond yield	US	0	Federal Reserve Board
1	2y Treasury bond yield	US	0	Federal Reserve Board
1	3y Treasury bond yield	US	0	Federal Reserve Board
1	5y Treasury bond yield	US	0	Federal Reserve Board
1	7y Treasury bond yield	US	0	Federal Reserve Board
1	20y Treasury bond yield	US	0	Federal Reserve Board
1	30y Treasury bond yield	US	0	Federal Reserve Board
1	1m Treasury bill yield	US	0	Federal Reserve Board
1	3m Treasury bill yield	US	0	Federal Reserve Board
1	6m Treasury bill yield	US	0	Federal Reserve Board
1	1m Eurodollar deposit rate	US	0	Federal Reserve Board
1	3m Eurodollar deposit rate	US	0	Federal Reserve Board
1	6m Eurodollar deposit rate	US	0	Federal Reserve Board
1	Conventional mortgage rate	US	0	Federal Reserve Board
1	Total non-bank credit	US	1	Federal Reserve Board
1	Total private sector debt	US	1	Federal Reserve Board
Macroeconomic dataset				
24	Real GDP	all	1	IFS/IMF
23	Real personal consumption	all	1	IFS/IMF
23	Real fixed investment	all	1	IFS/IMF
24	CPI	all	1	IFS/IMF
24	PPI	all	1	IFS/IMF
23	GDP deflator	all	1	IFS/IMF

Notes: 0: levels, 1: log year-on-year differences.