

Global Excess Liquidity and Asset Prices in Emerging Markets: Evidence from the BRICS

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Abstract

Since the early 2000s, global liquidity has experienced very strong growth. Emerging Markets (EMs) have accumulated large foreign exchange reserves while developed markets have dramatically eased their monetary policies. Global excess liquidity has resulted in an increase in the size of international capital inflows, especially toward EMs and may significantly impact their financial stability. In this paper, we examine the impact of global excess liquidity on asset prices for the well-known BRICS countries. Using vector autoregressive and error correction frameworks, we estimate the interaction between global excess liquidity, economic activity and asset prices. Despite mixed results for commodity prices, we show that global excess liquidity causes significant increases in equity and bond prices, a real appreciation of exchange rates, a decrease in 10-year sovereign interest rates and a spread compression.

JEL Classification: C12, C32, E44, E52, G12

Keywords: Emerging Markets, BRICS, Global Excess Liquidity, Excess Liquidity Indicator, Asset Price, Vector Autoregressive Model, Vector Error Correction Model, Impulse Response Function

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“Excessive liquidity from the aggressive policy actions taken by central banks to stabilise their domestic economies have been spilling over into emerging market economies, fostering excessive volatility in capital flows and commodity prices.”

*Fourth BRICS Summit
New Delhi, March 2012*

1 Introduction

Since the early 2000s and the bursting of the internet bubble, global liquidity has experienced very strong growth and became excessive. We distinguish two different regimes of global excess liquidity. Firstly, the saving glut in Emerging Markets (EMs) has fuelled global excess liquidity, notably via the large accumulation of foreign exchange reserves. Secondly, and in response to the global financial crisis of 2007-08 and the European sovereign debt crisis of 2010, the central banks of the main Developed Markets (DMs) have considerably eased their monetary policies by lowering interest rates and through successive rounds of quantitative easing, mainly undertaken by the Federal Reserve (Fed), the Bank of England (BoE) and the Bank of Japan (BoJ). More recently, the European Central Bank (ECB) has also decided to increase the size of its balance sheet, to stop sterilising its Securities Markets Programme and to launch its own quantitative easing. Global excess liquidity has not resulted in a resurgence of inflation on a global scale, but rather in the increase in the size of cross-border capital flows, especially towards EMs. However, these capital flow surges, linked to global excess liquidity, are reversible and often end up in sudden stops. Moreover, the risks of macroeconomic and financial imbalances in EMs have been raised by many economists including Christine Lagarde¹, the IMF's current Managing Director:

“Accommodative monetary policies in many advanced economies are likely to spur large and volatile capital flows to emerging economies. This could strain the capacity of these economies to absorb the potentially large flows and could lead to overheating, asset price bubbles, and the build-up of financial imbalances.”

In the monetary sense, global liquidity is defined by the Bank for International Settlements (BIS, CGFS, 2011) as the funding provided unconditionally to settle claims through the monetary authorities. Excess liquidity can be measured by different aggregates such as the money supply, domestic credit or also the foreign exchange reserves in excess of GDP. Global excess liquidity appears to play a buffer role in the DMs' deleveraging and is a catalyst for growth in EMs. In the post-Lehman era, the Zero Interest Rate Policies (ZIRP) pursued by the Fed, the BoE, the BoJ and the ECB have fuelled massive capital inflows, notably via some carry trade operations, mainly in Brazil and

¹Annual Meeting of the International Monetary Fund (IMF) and the World Bank in Tokyo, World Economic Outlook, October 2012.

Russia. Furthermore, added to these ZIRP, the non-conventional monetary policies have exacerbated the procyclical nature of capital inflows towards EMs (Fratzscher *et al.*, 2012) and raise concerns about the emergence of bubbles in asset prices (Sidaoui *et al.*, 2011), even though the emerging financial markets are growing, *i.e.*, they are more liquid, larger and deeper. In this context, the EMs offer attractive returns for some risks which are still poorly assessed by investors.

In this paper, we explore how best to deal with global excess liquidity and to what extent it has caused a rise in equity prices, a larger decline in EMs real interest rates than in the United States, *i.e.*, a spread compression, and a real appreciation of exchange rates, which is a new issue that has not yet been discussed for EMs. Most studies have focused on the DMs and on the impact of monetary expansion on GDP growth, consumer price inflation, short-term interest rates or equity prices (Baks and Kramer, 1999; Gouteron and Szpiro, 2005; Ruffer and Stracca, 2006; Giese and Tuxen, 2007; Sousa and Zaghini, 2007 and 2008; Belke *et al.*, 2010b). Some of them have broadened the scope to include more assets, *e.g.*, bond, real effective exchange rate, commodity or real estate markets (Sousa and Zaghini, 2008; Belke *et al.*, 2010a and 2013). More recent literature has transposed this issue to EMs (Ruffer and Stracca, 2006; Hartelius *et al.*, 2008; Brana *et al.*, 2012). The large majority of authors who have worked on this topic have used Vector AutoRegressive (VAR) models to analyse the links between global excess liquidity and asset prices. They also have studied the Impulse Response Functions (IRFs) to know more precisely how a shock on global liquidity could affect asset prices.

Our first contribution is to build three different global excess liquidity aggregates to better understand the contemporary relationship between global excess liquidity and asset prices. Our second and main contribution is to analyse the impact of the rise in global excess liquidity on different asset classes such as equities, interest rates, spreads, exchange rates and some commodities, within VAR and Vector Error Correction (VEC) frameworks. Regarding the results, according to the global excess liquidity aggregate and the models held, the IRFs analysis leads us to conclude that there is a genuine link between global excess liquidity and asset prices, notably on the BRICS' real effective exchange rates. Overall, we find that global excess liquidity causes significant increases in equity and bond prices, a real appreciation of exchange rates, a decrease in 10-year sovereign interest rates and a spread compression. However, the results about the impact of global excess liquidity on commodity prices are more mixed.

The paper is organised as follows: As background, Section 2 focuses on the existing literature pertaining to global excess liquidity, its measures and its links with the asset prices. Section 3 introduces the economic and financial data as well the different indices of global excess liquidity we use. Section 4 presents our main findings, interprets them, and briefly points to some robustness checks. We conclude our study in Section 5.

2 Literature review

Here, we address both theoretical and empirical foundations of global liquidity, its excess as well as the links that may exist between global excess liquidity and asset prices.

2.1 Global excess liquidity and its measures

Global liquidity is a multifaceted and complex concept, which has often been suggested as an explanation for financial developments. Here, we lean on two definitions of global liquidity which are relevant both for policy makers and asset managers:

1. Monetary liquidity, which is defined as the ease of converting monetary assets into goods and services;
2. Financial market liquidity, which is defined as the ease with which large volumes of financial securities can be bought or sold without affecting the market price.

According to the BIS (CGFS, 2011), monetary liquidity refers to the concept of “official” or “public” liquidity and is defined as the funding provided unconditionally to settle claims through the monetary authorities, comprising central bank money and foreign exchange reserves. Concerning financial market liquidity, it refers to the concept of “private” liquidity, *i.e.*, created by the financial and non-financial sectors through, *inter alia*, cross-border transactions. Chatterjee and Kim (2010) argue that financial market liquidity at the micro level is related to a broader measure of liquidity at a macro level, *i.e.*, monetary liquidity. Adrian and Shin (2008) suggest that financial intermediaries raise their leverage during asset price booms and lower it during downturns, procyclical actions that tend to exaggerate the fluctuations of the financial cycle. They argue that the growth rate of aggregate balance sheets may be the most fitting measure of liquidity in a market-based financial system. Moreover, they show a strong

correlation between balance sheet growth and the easing and tightening of monetary policy. Monetary liquidity and financial market liquidity are similar notions and their own dynamics interact in a coordinated way, notably through domestic credit².

The academic literature on this topic allows us to identify several indicators of global liquidity. The most commonly used measures are the monetary and credit aggregates. In this line, Baks and Kramer (1999) as well as Sousa and Zaghini (2007) propose different global measures based on narrow (M1) and broad (M2 and M3) monetary aggregates for the G7 and G5 countries respectively. Gouteron and Szpiro (2005) and Alessi and Detken (2011) suggest using the domestic credit as it can be viewed as the main counterpart of monetary creation. Another stream of the literature focuses on the foreign exchange reserves to assess global liquidity. Indeed, this measure takes into account the increasing role of the liquidity created by EMs (De Nicolo and Wiegand, 2007; Darius and Radde, 2010). Beyond these quantitative indicators, price indicators can be used. Gouteron and Szpiro (2005) propose measuring global excess liquidity from the short-term real interest rate (three-month interbank rate) minus the natural interest rate³ and also from risk premiums⁴. However, we do not pursue these price indicators further, because we prefer to use volume-based measures to explain changes in asset prices.

In order to define more precisely the concept of global excess liquidity, we are using the quantity theory of money⁵. This theory specifies that money supply has a direct and proportional relationship with the price level. According to this theory and the liquidity measures that are listed above, we can draw several normative conclusions: there is excess liquidity when the money supply or the credit supply is too high in relation to

²Glocker and Towbin (2013) suggest that private liquidity shocks have a substantially larger effect on key financial and macroeconomic variables, than public liquidity shocks. Moreover, they also show that global liquidity shocks are more important on a medium-term horizon, than domestic liquidity shocks.

³The natural interest rate may be defined as the interest rate that establishes the equilibrium between supply and demand on the goods and services market. It may notably be measured by the long-term economic growth.

⁴The thinking behind this proposal is that excess liquidity could reduce the investors' risk aversion. Thus, the spread between government and corporate bonds would constitute a measure of liquidity conditions.

⁵The quantity theory of money specifies the causal relationship between the quantity of money in circulation and the general price level. The first formulation of this theory goes back to the work of Jean Bodin in 1568 in which he studied the inflationary effects of the large influx of gold from Latin America; this influx caused a price increase across the European continent. The formalisation of this assumption is made in 1907 by Irving Fisher who, through an accounting identity, linked the money supply, its velocity, the general price level and the volume of transactions of goods and services. This theory is based on two presuppositions: (i) the change in the quantity of money induces price changes in nominal terms. In other words, the source of inflation is fundamentally derived from the growth rate of the money supply; (ii) Economic agents are supposed to be rational, *i.e.*, they know relative prices and are concerned only slightly in nominal prices. The accounting identity is written as follows: $M \cdot V = P \cdot Q$ where M is the total amount of money in circulation on average in an economy during a period, V is the velocity of money in final expenditures, P is the general price level and Q is the real output which equals real expenditures in macroeconomic equilibrium.

transactions by volume (goods and services or even assets). Baks and Kramer (1999) consider the average growth rate of nominal GDP as a norm for money growth. In other words, this is the level of liquidity that is consistent with the price stability. In the quantity theory of money, velocity is assumed to be relatively constant and given the real GDP growth and the money supply growth expectations, we can easily deduce the price trends. Following this hypothesis, the following relationship can be established:

$$M \cdot V = P \cdot Q \Leftrightarrow \frac{M}{P \cdot Q} = \frac{1}{V} = k \quad (1)$$

After linearisation and differentiation, we obtain:

$$\tilde{m}_t = m_t - g_t \quad (2)$$

where t denotes time, \tilde{m} denotes the observed excess liquidity, m denotes the growth rate of the chosen liquidity measure and g denotes the nominal GDP growth rate.

2.2 The links between global excess liquidity and asset prices

By analogy with the quantity theory of money, we may reasonably assume that a surplus of money that is not spent on the market of goods and services is highly likely to be spent on the financial markets. However, even if we have clarified the concept of global excess liquidity, the existence of links between rising global liquidity and rising asset prices via higher transactions remains to be demonstrated. In addition to the quantity theory of money, we need to find out more evidence on the links between monetary liquidity, funding liquidity⁶ and financial market liquidity. The following theories could explain these links:

According to Keynesian theory (Keynes, 1936), money demand satisfies three motives. Transactions and precautionary motives are an increasing function of the income and speculative motive is a decreasing function of the interest rate. Speculation takes the form of a trade-off between holding money and holding long-term bonds. Incurring debt to buy securities is particularly revealing of a process feeding bullish self-fulfilling expectations on asset prices. Based on this assumption, the existence of a positive relationship between liquidity and asset prices might seem almost trivial. With this in mind, we can easily realise that the credit channel is a financial accelerator encour-

⁶Funding liquidity is defined as the ease with which market players can obtain funding.

aging all the agents to indebtedness, causing a cumulative process characterised by an increase in prices and debt especially to acquire assets. In other words, we can establish that liquidity promotes the dynamics of accumulation and thus the valuation of assets.

As stated by Stiglitz and Weiss (1981), the role of money may also be studied through its counterpart of credit granting to the economy. Within this framework, a situation of abundant liquidity is equivalent to low interest rates. Given that interest rates represent the cost of capital, when interest rates are low, profitability is low and investors are willing to invest in riskier assets resulting, *de facto*, in an increase of the price of these assets. This allows us to establish that there is a negative relationship between interest rates and asset prices, and thus a positive relationship between liquidity and asset prices.

According to the seminal contribution of Friedman (1988), the holding of money, which is considered as an asset among others, is related to portfolio allocation. Thus, an increase in the money supply leads to a portfolio reallocation. Therefore, if we assume that the quantity of traded securities is fixed and the money supply increases, the price of other assets, *i.e.*, equities, bonds, commodities, etc., is expected to rise in the same proportions as the price of liquidity.

Furthermore, a common factor may lead to a simultaneous trend in monetary aggregates and asset prices. This shock, whether positive or negative, is viewed as a signal, *e.g.*, better economic prospects lead to better expectations about future profits (Baks and Kramer, 1999). Thus, the link between lower interest rates and an increase in the fundamental value of asset prices follows from all the monetary policy transmission channels. Indeed, an accommodative monetary policy informs agents on the willingness of financial authorities to support growth. Investors therefore see this as a better outlook for future profits and start buying greater amounts of risky assets.

Finally, Brunnermeier and Pedersen (2009) show that, under certain conditions (mainly boom vs. bust cycles and monetary easing vs. tightening), financial market liquidity and funding liquidity are mutually reinforcing, leading to liquidity spirals. They empirically explain that market liquidity (i) can suddenly dry up, (ii) has commonality across securities, (iii) is related to volatility, (iv) is subject to “flight to quality”, and (v) co-moves with the market. Without loss of generality and given the link between the different liquidity concepts, we can extrapolate these procyclical stylised facts to

monetary liquidity.

2.3 Previous empirical contributions

In recent years, global excess liquidity has been mostly induced by ultra-accommodative and non-conventional monetary policies conducted by the central banks of the major developed countries, *i.e.*, United States, United Kingdom, Japan and the Eurozone. These monetary policies have had, *inter alia*, the effect of lowering the cost of liquidity to international investors. This has led investors to search for yield by turning towards higher-return, and therefore riskier, assets as argued by the IMF (2010) and Matsumoto (2011). This resulted in massive capital inflows towards EMs notably through carry trade operations, with Brazil, Russia, India, China and South Africa⁷ topping the list. In addition, the post-crisis surge in capital flows has raised fears about the emergence of bubbles in asset prices (Sidaoui *et al.*, 2011), potential currency crises and the excessive growth of foreign exchange reserves, while, at the same time, the emerging financial markets are growing, *i.e.*, larger, deeper and more liquid. Indeed, the ZIRP pursued by the Fed, the BoE, the BoJ and the ECB in the post-Lehman era coupled with non-conventional monetary policies at the zero lower bound, *i.e.*, quantitative easing, credit easing and signalling, have exacerbated the procyclical nature of capital inflows towards EMs (Fratzscher *et al.*, 2012).

We may wonder to what extent the abundance of global liquidity is responsible for upward pressures on asset prices, especially in EMs. Few studies have directly investigated this issue. Most studies focused on DMs and about the impact of money growth on GDP trends, inflation, interest rate dynamics and equity prices. More recent literature transposes this problematic to EMs and broadens the spectrum of the relevant assets, *i.e.*, bonds, real effective exchange rates and commodities. The vast majority of researchers who have worked on this topic have used VAR models and have analysed IRFs.

Baks and Kramer (1999) study this issue for the G7 countries and conclude that global excess liquidity has a negative impact on real interest rates and a positive impact on equity prices. They also find some evidence for spillover effects from the volatility of money growth to the volatility of equity prices across countries. By contrast, Gouteron and Szpiro (2005) find that there is no common trend in asset prices, which is not sup-

⁷These five EMs are better known by the acronym BRICS.

portive of a global effect of excess liquidity. Ruffer and Stracca (2006) also examine the cross-border transmission channels of global excess liquidity in fifteen DMs and EMs and find an expansionary effect in the Eurozone and in Japan, though not in the United States. Furthermore, they highlight that global excess liquidity is a useful indicator of inflationary pressure at a global level. Giese and Tuxen (2007) show that the global excess liquidity has a positive impact on real estate prices but not on equity prices for six major DMs. Sousa and Zaghini (2007 and 2008) identify that a shock on global liquidity in the G5 countries has a positive impact on real GDP only in the short term and a positive lagged impact on aggregate prices. They also find a temporary appreciation of the real effective exchange rate of the euro. Hartelius *et al.* (2008) highlight a recent issue facing emerging bond markets: the spread compression with the United States. They conclude that the convergence of bond yields in EMs as a whole to those of the United States is largely due to improvement in fundamentals in EMs. However, they show that global excess liquidity plays an important role in spread compression. Belke *et al.* (2010a) study eleven major OECD countries and find that monetary aggregates may convey useful leading indicator information on real estate prices, gold prices, commodity prices and the GDP deflator at the global level. In contrast, they emphasise that equity prices do not show any positive response to a liquidity shock. Brana *et al.* (2012) find support that global excess liquidity generates significant spillover effects for sixteen major EMs taken as a whole. Global excess liquidity contributes to the increase in GDP and in consumer prices in these EMs. However, they conclude that the relationship between global liquidity shocks and equity prices or real estate prices is weaker. Finally, Belke *et al.* (2013) find that a positive long-term relationship exists between global liquidity and the trends in food and commodity prices.

3 Data

In this study, we gather data for eight countries and one monetary union, representing nearly 70% of world GDP in Purchasing Power Parity (PPP) in 2014. This set of countries is composed of the G4 countries, *i.e.*, United States, United Kingdom, Japan and Eurozone, and the well-known BRICS countries, *i.e.*, Brazil, Russia, India, China and South Africa. The data are collected for each country or monetary union on a quarterly frequency over a sample period from Q1 1998 to Q1 2014, or 65 quarters.

3.1 Economic and financial data

We use economic and financial data from different sources across variables and countries; they include the IMF, the World Bank, the OECD, the Bank for International Settlements, Eurostat, Oxford Economics and Datastream databases. More formally, the data we use are:

1. Fundamental economic data: nominal GDP in local currencies and in USD, PPP GDP⁸ and consumer price indices;
2. Monetary and financial data: exchange rates against the USD, broad based real and nominal effective exchange rates⁹, M2 monetary aggregates, domestic credit aggregates and foreign exchange reserves;
3. Market data: MSCI in local currency¹⁰, EMBI Global¹¹ and 10-year sovereign interest rates;
4. Different indices and prices of the main commodities: GSCI¹², CRB¹³, LMEX¹⁴, gold¹⁵ and Brent crude oil¹⁶.

Some data are seasonally adjusted using the X-12-ARIMA procedure¹⁷ if necessary. Furthermore, we use *ex post* revised data for most of the economic, monetary and financial variables. Each variable, other than interest rates, were log-transformed. This

⁸Depending on the paper, the weights used to build the aggregates of global excess liquidity are done either with nominal GDP or with PPP GDP. In this study, we use nominal GDP weights to not underweight EMs in the aggregates but using PPP GDP weights leads to similar results.

⁹Real and nominal effective exchange rates indices (REER and NEER hereafter) are provided by the Bank for International Settlements and cover 61 economies including individual Eurozone countries and, separately, the Eurozone as an entity. REER and NEER are calculated as geometric weighted averages of bilateral exchange rates, adjusted by relative consumer prices in the case of REER. The weighting pattern is time-varying, and the most recent weights are based on trade from 2008 to 2010.

¹⁰The Morgan Stanley Capital International are the indices most regularly followed by market participants. They measure the performance of equity markets in countries or the aggregate of countries to which they refer. We also retain the MSCI BRIC in local currency. This index is a free float-adjusted market capitalisation weighted index that is designed to measure the equity market performance of the following four EM country indexes as a whole: Brazil, Russia, India and China.

¹¹The Emerging Markets Bond Index Global are indices of JPMorgan Chase which track the total returns of debt securities traded abroad in EMs. The EMBI Global indices are an expanded version of the EMBI+ indices.

¹²The Goldman Sachs Commodity Index is an index originally developed by Goldman Sachs and which the ownership has been transferred to Standard & Poor's. It serves as a benchmark for investment in the commodity markets and comprises 24 commodities from all commodity sectors.

¹³The Commodity Research Bureau is an index of listed commodities on New York Mercantile Exchange, London Metal Exchange and Chicago Mercantile Exchange. It comprises 24 commodities from all commodity sectors.

¹⁴The London Metal Exchange Index is the benchmark for the listing of six main nonferrous metals, *i.e.*, copper, tin, lead, zinc, aluminum and nickel. In recent years, the LME has become a speculative market. Indeed, the share of commodities actually delivered after establishing a contract on the LME fell below 1%.

¹⁵Gold spot price in USD per ounce.

¹⁶We chose Brent crude oil rather than West Texas Intermediate crude oil because Brent crude oil serves as a major benchmark price for purchases of crude oil worldwide. It is used to price two thirds of the world's internationally traded crude oil supplies. However, both kinds of crude oil are traded in a narrow range.

¹⁷The procedure is performed on *ex post* revised data. Nevertheless, some variables are already seasonally adjusted. Market data do not need to be seasonally adjusted.

especially allows a return to variables integrated of order one (*cf.* Section 4.2 for more details) and results to be analysed more easily: the estimated coefficient can be interpreted as elasticities.

The mechanism we seek to highlight in this study may be interpreted differently depending on whether we consider the nominal or real terms approach. From a theoretical point of view, the valuation of assets is related to their nominal incomes, which in turn depend on the level of prices of produced goods and services. This is the reason why we make this study on real data. To do this, we multiply the variables of interest by the GDP deflator of the country or monetary union and over the period being considered¹⁸. However, working with nominal data amplifies the highlights that emerge from this study.

3.2 The different global excess liquidity indices

In order to account for global excess liquidity, we proceed in two steps. The first step is to hold different measures of nationwide monetary liquidity. In a second step, we aggregate these indices to establish a snapshot of global excess liquidity. We hold three indices of excess liquidity on criteria such as economic relevance, data availability and homogeneity: (i) M2 monetary aggregate, (ii) domestic credit and (iii) foreign exchange reserves. Each of these measures is expressed as a share of GDP in local currencies for the first two indicators and in USD for the third one. Moreover, each of these aggregate measures were log-transformed to take into account the liquidity in excess of GDP. The aggregation of national series at a global level raises some issues from an economic standpoint. Indeed, such aggregate measures cannot be used for monetary and fiscal policy decisions at a global level¹⁹. However, the purpose of this study is to better understand how monetary liquidity behaves and interacts globally. There are different methods of aggregation but the non-stationarity of these time series and structural breaks imply that no optimal aggregation method exists (Giese and Tuxen, 2007). Nevertheless, Beyer *et al.* (2001) discuss various criteria in order to get a useful aggregate measure of the historical Eurozone data. To this end, the authors propose the following three criteria:

¹⁸In order to get real interest rates, nominal interest rates have been deflated by the annual average of domestic inflation.

¹⁹However, in an environment of global excess liquidity, and thus surges in capital flows, it is important for EMs to ensure financial and economic stability through improved financial regulation and other policy measures. Azis and Shin (2014) explore the range of policy options that may be deployed to address the impact of global liquidity on domestic financial and socio-economic conditions.

1. A unique price series should be obtained in the sense that the aggregate of the individual price deflators coincides with the price deflator of the aggregates;
2. When a variable increases or decreases in each country, then the aggregate measure should not move in the opposite direction;
3. Aggregation should work correctly when different local currencies are used and, *a fortiori*, when a common currency is used.

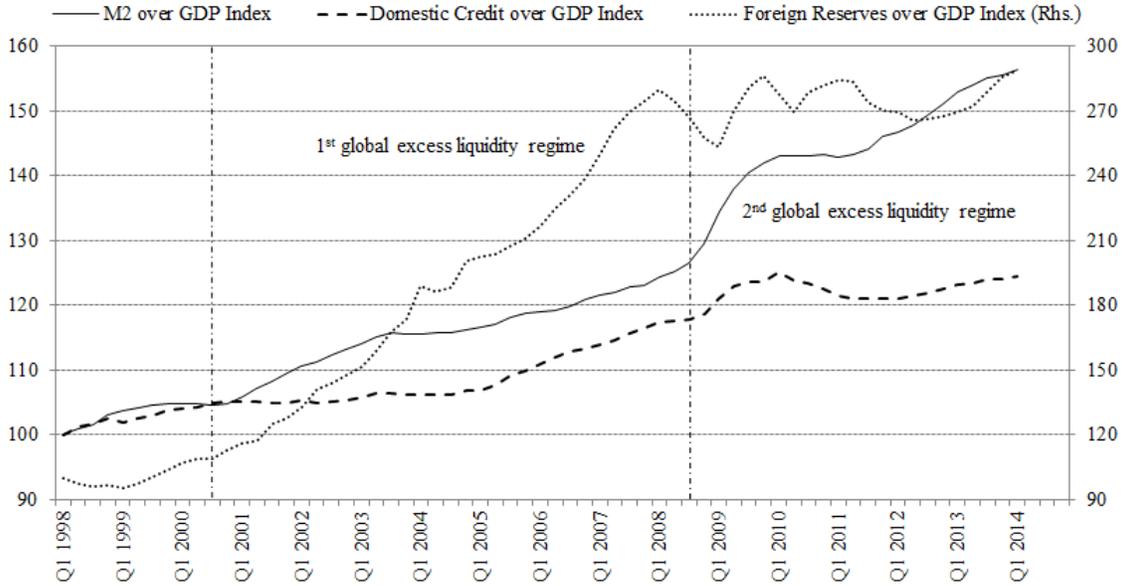
The method suggested by Beyer *et al.* (2001) uses variable weights to aggregate growth rates and proceeds in the following four steps (*cf.* Methodological Appendix for more details):

1. Calculate weights based on the relative share of the country or monetary union as regards the variable at each date, in a common currency, *e.g.*, in USD in this study;
2. Calculate within country or monetary union growth rates of each variable at each date, in local currency;
3. Aggregate growth rates of the second step using weights of the first step;
4. Cumulate aggregate growth rates to obtain aggregate levels. We use the Q1 1998 as the base to anchor the aggregate measures over time.

Figure 1 informs us on the global liquidity trend since Q1 1998 through three different indices, namely the M2 over GDP index, the domestic credit over GDP index and the foreign exchange reserves over GDP index. It shows two distinct regimes of global excess liquidity. Firstly, and after the financial crisis that followed the Internet bubble bursting, the saving glut in EMs has fuelled global excess liquidity, notably via the large accumulation of foreign exchange reserves. Secondly, and in response to the global financial crisis of 2007-08 and the European sovereign debt crisis of 2010, the central banks of the main DMs have considerably eased their monetary policies by lowering interest rates and through non-conventional tools, mainly undertaken by the Fed, the BoE, the BoJ and more recently by the ECB. These highly accommodative monetary policies have led to a drastic increase in the monetary base M0 and consequently in

Figure 1: Trends in the different global excess liquidity indices

Note: The figure plots the M2 over GDP index (continuous line), the domestic credit over GDP index (dashed line) and the foreign exchange reserves over GDP index (dotted line). We distinguish two different regimes of global excess liquidity. Firstly, and after the financial crisis that followed the Internet bubble bursting, the saving glut in EMs has fuelled global excess liquidity, notably via the large accumulation of foreign exchange reserves. Secondly, and in response to the global financial crisis of 2007-08 and the European sovereign debt crisis of 2010, the central banks of the main DMs have considerably eased their monetary policies by lowering interest rates and through non-conventional tools, mainly undertaken by the Fed, the BoE, the BoJ and more recently by the ECB. These highly accommodative monetary policies have led to a drastic increase in the monetary base M0 and consequently in the monetary aggregates like M2 since the end of 2008 and the announcement by the Fed of its first round of quantitative easing. Moreover, the period of credit crunch that started in 2001 seemed to find an ending at the dawn of the first announcements of quantitative easing. Unfortunately, the announcement effect only lasted a short time and domestic credit contracted once again even though the M2 monetary aggregate continued to increase. For more details on the trends in the different global excess liquidity indices by regional aggregates, *cf.* Appendix 1.



the monetary aggregates like M2 since the end of 2008 and the announcement by the Fed of its first round of quantitative easing. Moreover, the period of credit crunch that started in 2001 seemed to find an ending at the dawn of the first announcement of quantitative easing. Unfortunately, the announcement effect only lasted a short time and domestic credit contracted once again even though the M2 monetary aggregate continued to increase. For more details on the trends in the different global excess liquidity indices by regional aggregates, *cf.* Appendix 1.

4 Impact of global excess liquidity on BRICS' asset prices

In this context, it seems interesting to investigate the potential impacts of global excess liquidity on EM asset prices, and more particularly in the BRICS countries, as well as on commodities which are mostly exported by these same EMs. After describing the economic and financial environment in which this study is conducted, we develop the framework of the model and look into the main results.

4.1 Economic and financial analysis

From an economic standpoint, the BRICS countries alone represent more than 28% of world GDP in PPP in 2014 for more than 3 billion people, almost half of the Earth's population. According to the IMF, this group of EMs will account for nearly a third of world GDP in PPP in 2020. These five EMs, *i.e.*, Brazil, Russia, India, China and South Africa are respectively the seventh, sixth, third, second and twenty-fifth largest economies in the world²⁰. Table 1 provides information about the average weights of each country or monetary union over the whole sample period as a percentage of GDP in PPP in each of the three aggregates considered. In the light of this table, we can say that China and India are in the BRICS countries aggregate what the United States and Eurozone are in the G4 countries aggregate, *i.e.*, the largest contributors to global growth. The GDP per capita of the BRICS countries is growing very rapidly, but it is expected to remain far below the standards of DMs even on a very long-term horizon. The BRICS countries are currently strengthening their economic and financial cooperation. Indeed, we can mention for example the New Development Bank, formerly referred to as the BRICS Development Bank, which is a multilateral development bank operated by the BRICS countries as an alternative to the existing United States-dominated

²⁰This ranking stems from the IMF list of countries by GDP in PPP in 2013.

World Bank and IMF. This New Development Bank was agreed by BRICS countries leaders at the fifth BRICS summit held in Durban, South Africa on March 2013 and was ratified at the sixth BRICS summit held in Fortaleza, Brazil on July 2014. It is in this way, *i.e.*, by creating multilateral supervisory and regulatory agencies, that the EMs and, *a fortiori*, the BRICS countries are becoming the most attractive financial markets in the world. Brazil and Russia produce and export crude oil and natural gas in large quantities, while China and India are undergoing an accelerated industrialisation process, which requires a lot of energy. Meanwhile, South Africa extracts metals and minerals from its mines.

Table 1: Average weights of each country or monetary union over the entire sample period

Note: The table provides information about the average weights of each country or monetary union over the entire sample period as a percentage of GDP in PPP in each of the three aggregates considered. Standard deviations are in parentheses. In light of this table, we can say that China and India are in the BRICS countries aggregate what the United States and Eurozone are in the G4 countries aggregate, *i.e.*, the largest contributors to global growth. Moreover, if we look at how the weights have changed over time, it appears that the weight of the G4 countries have tended to decline in favour of those of the BRICS countries. Indeed, the weight of China rose from slightly more than 9% in early 1998 to nearly 24% in early 2014. During the same period, the weights of the United States and the Eurozone fell from about 34% and 26% to 28% and 19%, respectively.

Country/Area	Aggregate	G4 countries	BRICS countries	All
United States		45.9% (0.9%)		31.5% (2.2%)
Eurozone		33.6% (0.5%)		23.2% (2.3%)
United Kingdom		6.8% (0.1%)		4.7% (0.4%)
Japan		13.7% (0.5%)		9.5% (1.1%)
Brazil			13.6% (2.6%)	4.1% (0.1%)
Russia			13.6% (1.8%)	4.1% (0.3%)
India			21.6% (0.4%)	6.7% (1.2%)
China			47.8% (5.2%)	15.2% (4.6%)
South Africa			3.4% (0.6%)	1.0% (0.0%)

Although the responsibility of central banks in global excess liquidity that has fed spec-

ulative bubbles in the DMs has often been mentioned, it is not trivial that the same phenomenon occurred in EMs. Indeed, in a global economy with a structurally high savings rate, low employment rate and where the global excess liquidity has no impact on the prices of goods and services, we may wonder if there is an inflation of asset prices in EMs and if it is actually fuelled by global excess liquidity. According to Artus and Virard (2010), at the end of 2009, the root causes of the financial imbalances have not disappeared because the two liquidity making machines, *i.e.*, the very accommodative monetary policies of major central banks in DMs and the accumulation of foreign exchange reserves in EMs, continued to run at full speed. Moreover, we can say that these mechanisms are still at work in 2014 even though they are of different forms. At the present time, even though the Fed and the BoE have stopped their non-conventional monetary policy, the BoJ continues to inject a lot of liquidity and the ECB has recently launched a major quantitative easing coupled with an Asset-Backed Securities Purchase Programme and a Covered Bond Purchase Programme. Regarding EMs, the People's Bank of China joined their developed counterparts in boosting liquidity to address weakening growth and promote credit expansion. In addition and in response to the appreciation of the dollar induced by the tightening of the Fed's monetary policy, the EMs will have to resume their policy of accumulating foreign exchange reserves to protect themselves against the depreciation of their currencies. As we have seen above, we distinguish two different regimes of global excess liquidity. Firstly, and after the financial crisis that followed the Internet bubble bursting, the saving glut in EMs has fuelled global excess liquidity, notably via the large accumulation of foreign exchange reserves. Secondly, and in response to the global financial crisis of 2007-08 and the European sovereign debt crisis of 2010, the central banks of the main DMs have considerably eased their monetary policies by lowering interest rates and through non-conventional tools, mainly undertaken by the Fed, the BoE, the BoJ and more recently by the ECB.

The first regime of global excess liquidity is typical of a global economy where distortions in terms of liquidity are exacerbated. Indeed, during the first regime of global excess liquidity, *i.e.*, from 2001 to 2008, we see a significant accumulation of foreign exchange reserves. This increase in the foreign exchange reserves to GDP ratio mainly comes from the BRICS countries. Over this period, Russia saw its foreign exchange reserves to GDP ratio multiplied by almost four, China and India by more than three, Brazil and South Africa by around two and a half. The G4 countries increased their for-

eign exchange reserves sparingly, Japan at the top of the list. Japan adopted, through its central bank, a highly accommodative monetary policy in order to support its own currency.

The second regime of global excess liquidity is characterised by a jump in the global M2 to GDP ratio. This ratio has increased very rapidly in both EMs and DMs and has resumed a more sustainable trend thereafter. However, there is an apparent dichotomy between the G4 countries and the BRICS countries. Indeed, although the acceleration of the increase in M2 over GDP indices is fairly similar in the two groups of countries, the G4 countries have higher ratios than the BRICS countries. According to the World Bank, in 2013, the M2 to GDP ratios are quite disparate for the G4 countries but very high: around 90% for the United States and the Eurozone, 160% for the United Kingdom and nearly 250% for Japan. The M2 to GDP ratios for the BRICS countries are relatively lower: 56% for Russia, between 70% and 80% for South Africa, India and Brazil and nearly 200% for China. With regard to China, this very high M2 to GDP ratio reflects the excessive monetisation of the financial system and the indebtedness promoted by the Chinese authorities, notably to control their currency.

4.2 Model specification

In order to study the dynamic contemporary relationships between our aggregates of global excess liquidity and the BRICS' asset prices²¹, we follow the standard practices of time series analysis assuming that the properties of linear regressions are biased for non-stationary variables. We therefore start by testing the stationarity of our three aggregates of global excess liquidity, the real GDP of each of the five EMs, the different asset prices, yields, spreads and exchange rates of each of these same five EMs and some commodity prices with Augmented Dickey-Fuller (1981, ADF hereafter) and Phillips-Perron (1987 and 1988, PP hereafter) unit root tests²². The unit root tests results show us that in more than 85% of cases, the series are integrated of the same order, namely the order one, *i.e.*, $I(1)$. In addition, all of our global excess liquidity aggregates and real GDP of each of the five EMs are $I(1)$. Only a handful of EMs' interest rates and

²¹As we have seen before, each variable, other than interest rates, were log-transformed but we deliberately omit to specify that our variables are transformed for the sake of convenience.

²²The use of several tests to conclude on the nature of stationarity of the studied variables is essential to disambiguate on some test results. Indeed, the PP unit root tests differ from the ADF tests mainly in how they deal with serial correlation and heteroskedasticity in the errors. In particular, where the ADF tests use a parametric autoregression to approximate the ARMA structure of the errors in the test regression, the PP tests ignore any serial correlation in the test regression.

spreads are stationary in level, *i.e.*, $I(0)$. Since the overwhelming majority of our series are $I(1)$, it is highly possible that these series are cointegrated.

Then, to test whether the series are cointegrated and, if so, how many cointegrating relationships exist, we use the Johansen procedure (Johansen, 1991). After having used Akaike and Schwarz information criteria to determine the optimal number of lags that would need to be considered²³, we conclude that, in more than 60% of cases, at least one cointegration relationship exists. Then, we perform Granger non-causality tests (Granger, 1969) on the remaining 40% to find out if the different global excess liquidity aggregates Granger-cause the different asset prices. According to these tests, in almost 10% of cases, some short-term relationships exist as opposed to the long-term relationships of cointegrated models. Finally, in about 30% of cases, we do not estimate any model to avoid spurious regressions, either because the variables which are integrated of a different order cannot be cointegrated, or because no causal relationship exists.

In this study, we use the standard time series modelling taking into account the results of the preliminary tests explained above, *i.e.*, ADF, PP, Johansen cointegration and Granger non-causality tests. We use two different models to better capture the nature of the relationships between our time series. In the case where at least one cointegration relationship exists, we estimate a VEC model as in (3) and in the case where no cointegration relationship exists but that the global excess liquidity appears to be causal, in the Granger sense, for asset prices, we estimate a VAR model as in (4):

$$\Delta Y_{it} = c_i + \sum_{l=1}^L \gamma_{il} \Delta Y_{it-l} + \delta_i (a_i + b_i \cdot trend_i + \beta_i Y_{it-1}) + \varepsilon_{it} \quad (3)$$

$$\Delta Y_{it} = c_i + \sum_{l=1}^L \gamma_{il} \Delta Y_{it-l} + \varepsilon_{it} \quad (4)$$

where i denotes the different BRICS countries, t denotes time and l denotes the optimal number of lags with $L = \{1, 2, 3, 4\}$. Y denotes a vector containing the endogenous variables of the system, *i.e.*, the different assets (alternatively equity prices, bond yields, spreads, exchange rates and some commodity prices), the real GDP and the global excess liquidity (alternatively one of the three global excess liquidity aggregates). For each of the two different models, c denotes the constant term and ε the error term. In the VEC model in (3), $(a + b \cdot trend + \beta Y_{t-1})$ represents the cointegration relationship

²³In most cases, minimising Akaike and Schwarz information criteria leads us to conclude that the optimal number of lags is one. In some cases, this optimal number goes up to two or three.

and eventually includes a constant term and/or a linear trend. In addition, a long-run relationship exists only if δ , which measures the speed of adjustment of the endogenous variables towards the equilibrium, is significantly negative.

All in all, over the 123 estimable models²⁴ and according to the preliminary tests results, more than 70% are indeed estimated. In order to validate the stationarity and stability of these models, we propose a kind of robustness check. It is well known in the literature on VAR and VEC models that the stationarity and stability properties depend on the roots of the lag polynomial. In particular, if all the inverted roots of the lag polynomial are strictly inside the unit circle, then the VAR process is stationary. For the VEC process, $k - r$ roots should be equal to the unity and so $k(p - 1) + r$ inverted roots should be strictly inside the unit circle, where k is the number of endogenous variables, r is the number of cointegration relationships and p is the largest lag. According to this robustness check, only one VEC model is unstable and hence, this estimate is excluded from the study.

4.3 Global excess liquidity promotes the search for yield

Here, we want to highlight the positive impacts of global excess liquidity in some BRICS' assets. Depending on the countries and assets, responses to a shock on liquidity have the expected sign in more than half of cases. Finally, to better identify their sensibility to some economic and econometric changes, we propose two additional robustness checks. First, we compare the results of our estimates in real terms with estimates in nominal terms and second, we estimate our model in a panel approach.

4.3.1 Impulse response functions and variance decompositions

We want to see how the different BRICS' assets are impacted by the increase in global liquidity as measured by our three different indicators of global excess liquidity. To do this, we look at how the assets react to a positive one standard deviation shock on the logarithm of each liquidity aggregate. We focus on reviewing the Impulse Response Functions (IRFs). According to the common practices, we estimate the IRFs with their confidence intervals. We compute these confidence intervals using Monte-Carlo

²⁴The 123 estimable models break down as follows: five EMs, each with seven different assets, plus six different global assets, *i.e.*, MSCI BRIC, some commodities and some commodity indices, and three different global excess liquidity aggregates for a total of $(5 \cdot 7 + 6) \cdot 3 = 123$.

simulations in the case of the VAR model and using the bootstrap method²⁵ in the case of the VEC model. If confidence intervals do not contain 0, the IRF is significant. If confidence intervals contain 0, the IRF is not significant but we keep the sign of the IRF as a result.

As we can see in Table 2, global excess liquidity has played an important role in the evolution of some asset prices. Overall, global excess liquidity pushed up equity prices and exchange rates, while it brought down the fixed income rates and has more or less tightened the interest rate spreads depending on the countries. With more granularity, several highlights appear:

1. The asset class which is the most impacted by global excess liquidity is the BRICS' equity markets. All countries except South Africa have seen their MSCI indices increase with global liquidity. We obtain the same results for the MSCI BRIC in local currencies. It is the variation in the foreign exchange reserves over GDP aggregate which has the greatest impact on the equity prices.
2. On the fixed income side, the foreign exchange reserves over GDP aggregate and, to a lesser extent the M2 over GDP aggregate, contributed to lower sovereign 10-year interest rates in all the BRICS. According to the M2 over GDP aggregate, spread compression is significant for Brazil, Russia and South Africa.
3. Concerning the foreign exchange markets, the currencies have globally appreciated against USD and in real effective terms. Except for Brazil, once again, it is the foreign exchange reserves over GDP aggregate which is the most significant measure of global excess liquidity for EMs.
4. Finally, as for the three different global excess liquidity aggregates, the results for the main commodity prices, *i.e.*, the GSCI and the Brent, are more mixed. They were positively impacted during the first regime of global excess liquidity, when EMs accumulated some large foreign exchange reserves from early 2001 to mid-2008, by the yardstick of the global financial crisis; whereafter the second regime of global excess liquidity takes place. In this second regime, the commodity prices

²⁵Theoretically, it is possible to compute analytical confidence intervals using an asymptotic approximation, but this may lead to misleading confidence intervals because asymptotic formulas are known to give a poor approximation of the finite-sample properties.

²⁶For the MSCI BRIC, we can only consider the nominal terms approach because it could be difficult and misleading to deflate an aggregated equity index.

Table 2: Summary results of the IRFs

Note: The table provides information about the results of the simulated IRFs based on the estimated VAR and VEC models. For each BRICS country, we analyse the IRF of each asset price or exchange rate to a positive one standard deviation shock on the logarithm of each liquidity aggregate, except for the MSCI BRIC and commodity prices which are dealt with more globally. The symbol “-” denotes a negative and significant impact to a given asset price of a one standard deviation shock on a given liquidity aggregate; “-” denotes a negative and non-significant impact; “0” denotes no impact; “+” denotes a positive and non-significant impact; “++” denotes a positive and significant impact; an empty cell denotes that no model has been estimated according to the preliminary unit root and cointegration tests. For example, in the case of the MSCI Brazil, a one standard deviation shock on the M2 over GDP aggregate is associated with an increase in equity prices but the impact is non-significant according to the 95% confidence interval. However, a one standard deviation shock on the domestic credit over GDP aggregate or on the foreign exchange reserves over GDP aggregate (FX Reserves in the table below) is associated with a significant increase in equity prices. We can therefore conclude that the global excess liquidity has a positive impact on the price of Brazilian equities as reflected by the MSCI Brazil.

		Country	Brazil	Russia	India	China	South Africa
Asset Class/Asset/Liquidity Aggregate							
Equity	MSCI	M2	+	+	+		
		Dom. Credit	++				
		FX Reserves	++	++	++	++	
Equity	MSCI BRIC ²⁶	M2					
		Dom. Credit					
		FX Reserves			++		
Fixed Income	10Y Interest Rate	M2	-	+	-	-	+
		Dom. Credit	-	-	-	-	-
		FX Reserves	-	-	-	--	--
Fixed Income	EMBI Global Spread	M2	--	--	0	0	--
		Dom. Credit	-	+		0	+
		FX Reserves	-	+	0	0	
Exchange Rate	Exchange Rate vs. USD	M2		-	+	+	
		Dom. Credit	++	+		+	
		FX Reserves	-	+	++	0	++
Exchange Rate	REER	M2	-	-		-	++
		Dom. Credit	+			+	
		FX Reserves	-	++	+	-	
Commodity	GSCI	M2			--		
		Dom. Credit					
		FX Reserves			++		
Commodity	Brent	M2			--		
		Dom. Credit					
		FX Reserves			++		

started to fall since the developed central banks have injected significant liquidity until 2015.

While IRFs evaluate the effects of a shock to one endogenous variable on the other variables in VAR or VEC models, variance decomposition separates the variation in an endogenous variable into the component shocks to VAR or VEC models. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in VAR or VEC models. In order to remain consistent in our approach, we will consider only the variance decomposition for the models we discussed above.

By analysing the relevant variance decompositions (some examples are available in Appendix 2), we can draw several conclusions. First, after sixteen quarters, more than 80% of the BRICS' asset innovations are explained by their own innovations in about two thirds of cases. Second, in the remaining one third, the BRICS' asset innovations are mainly explained by the different global excess liquidity aggregates innovations. Third, the more significant the IRF, the more the variance decomposition is explained by the different global excess liquidity aggregates innovations. Lastly, within the global excess liquidity aggregates, it is the foreign exchange reserves and, to a lesser extent, the M2 aggregate which explain the BRICS' asset innovations.

4.3.2 Robustness checks

In order to ensure the robustness of our results, we propose two robustness checks. First, we follow the same time series methodology replacing data in real terms by data in nominal terms. Second, we estimate a Panel Dynamic Ordinary Least Squares model (PDOLS hereafter) with country fixed effects. This PDOLS model, introduced by Kao and Chiang (2000) and refined by Mark and Sul (2003), involves augmenting the panel cointegrating regression equation with cross-section specific lags and leads of the explanatory variables in first difference to eliminate the asymptotic endogeneity and serial correlation.

For our first robustness check, we apply exactly the same methodology to the data in nominal terms²⁷. The conclusion is that the same aggregates of global excess liquidity

²⁷We use non-deflated economic and financial data. For example, for each country and each asset class, we use the

lead the same assets upward or downward whether in real or nominal terms (for more detailed results, *cf.* Appendix 3). The main difference between this two estimates is the amplitude of the IRFs to a shock on global liquidity. Indeed, in the broader sense, global excess liquidity causes a significant increase in equity and bond prices, an appreciation of exchange rates, a decrease in 10-year sovereign interest rates and a spread compression both in real and nominal terms. Moreover, the IRFs in nominal terms are more significant than the IRFs in real terms. In the case of Russia and compared with the real terms approach, a one standard deviation shock on the foreign exchange reserves aggregate leads to a higher increase in the NEER. In the case of India, the IRF on the NEER to a shock on the foreign exchange reserves aggregate remains positive, as for the REER, but becomes significant. The same is true in other settings, *e.g.*, for the Brazilian and Chinese equity markets, for the Russian and Chinese 10-year sovereign interest rates, and for the Brazilian and South African spread compressions. Regarding the variance decompositions in the nominal terms approach, we get the same qualitative conclusions as for the real terms approach. In addition, after sixteen quarters, the BRICS' asset innovations are more explained by the different global excess liquidity aggregates innovations in the nominal terms approach than in the real terms approach. Overall, this first robustness check attests to the relevance of our main results.

Our second robustness check consists in the estimation of a PDOLS model. We chose this panel model because it has several advantages. First, the panel approach, with its structure in two dimensions, provides more complete information than in the time series approach. More precisely, we can better understand our issue and provide a more global answer together with more granularity on the question of the different global excess liquidity regimes. Second, according to Kao and Chiang (2000) and Mark and Sul (2003), the PDOLS estimators appear to outperform all other panel estimators for non-stationary panel data, *e.g.*, the Panel Fully Modified OLS. In order to avoid some statistical bias in the estimates of the links between global excess liquidity and the EMs asset prices, we add a control variable that reflects the implied volatility of S&P 500 index options, *i.e.*, the VIX index. Well-known as a “fear index” for worldwide asset markets, it reflects both stock market uncertainty and a variance risk premium. The first step of the panel analysis is to investigate the statistical properties of our stacked data. Hence, we perform some panel stationarity and unit root tests and we reasonably conclude that our variables are non-stationary in level and $I(1)$ (for more

nominal GDP growth, the 10-year nominal sovereign interest rate, the nominal effective exchange rate, etc. Obviously, our three global excess liquidity aggregates are also used in nominal terms for consistency.

detailed results, *cf.* Appendix 4). Then, we perform some panel cointegration tests²⁸ in order to verify the presence of a long-run relation between the variables in our dataset and we conclude that our series are cointegrated in more than 85% of cases²⁹. However, we do not find evidence that there could be some cointegration relationships on the two sub-periods that characterise the two global excess liquidity regimes, *i.e.*, from Q3 2000 to Q2 2008 and from Q3 2008 to Q1 2014. After having highlighted the presence of cointegration relationships in the full sample period, we estimate a PDOLS model as in (5):

$$Y_t = c_i + \sum_{l=-L_1}^{L_2} \gamma_{ijl} \Delta X_{jt+l} + \delta_j X_{jt} + \varepsilon_t \quad (5)$$

where i denotes the different BRICS countries, t denotes time and l denotes the optimal number of lags and leads³⁰ with $L_1 = \{1, 2, 3, 4\}$ and $L_2 = \{1, 2, 3, 4\}$. Y denotes the different dependent variables, *i.e.*, the different assets (alternatively equity prices, bond yields, spreads, exchange rates and some commodity prices). X_j denotes the j different explanatory variables, *i.e.*, the real GDP, the VIX index and the global excess liquidity (alternatively one of the three global excess liquidity aggregates). Country fixed effects are denoted by c and ε denotes the error term. In addition, the short-run dynamics coefficients γ are allowed to be cross-section specific.

Table 3 presents the results of the PDOLS estimates in (5) which reflect the links between global excess liquidity and asset prices. Regarding the model with a cointegration relationship, we conclude that the global excess liquidity aggregates are significant in about 90% of cases and are in the expected direction in all these cases. On the VIX index, even though it is significant in more than half of cases, we highlight that the VIX index is rather weakly significant or not significant to explain the changes in BRICS' asset prices, *i.e.*, excluding commodity prices. The R^2 should be interpreted only within the estimates and we observe that our PDOLS models fit better for equity prices, exchange rates and commodity prices than for bond prices and spreads. Overall, this second robustness check attests to the relevance of our main results.

²⁸Here, we use the well-known panel cointegration tests proposed by Pedroni (1999).

²⁹Because of the huge number of cointegration tests and space limitation, the panel cointegration tests results are not reported but available upon request.

³⁰In most cases, minimising Akaike and Schwarz information criteria leads us to conclude that the optimal number of lags and leads is often the same. In some cases, this optimal number of lags and leads may be different.

Table 3: Summary of PDOLS estimates of the links between global excess liquidity and asset prices

Note: The table presents the results of the PDOLS estimates in (5) which reflect the links between global excess liquidity and asset prices. Standard errors are in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% level of confidence, respectively. According to the panel cointegration tests proposed by Pedroni (1999), our series are not cointegrated in only three cases, denoted by “No cointegration”. Regarding the models with a cointegration relationship, we conclude that the global excess liquidity aggregates are significant in about 90% of cases and are in the expected direction in all these cases. On the VIX index, even though it is significant in more than half of cases, we highlight that the VIX index is rather weakly significant or not significant to explain the changes in BRICS’ asset prices, *i.e.*, excluding commodity prices. The R^2 should be interpreted only within the estimates and we observe that our PDOLS models fit better for equity prices, exchange rates and commodity prices than for bond prices and spreads.

**Dependent Variable: Asset
Q2 1998 - Q1 2014**

Variable		Real GDP	VIX Index	Liquidity Aggregate	Number of Observations	Adj. R-Squared
Asset/Liquidity Aggregate						
MSCI	M2	0.542*** (0.210)	-0.364 (0.298)	0.474 (0.559)	309	0.89
	Dom. Credit	-0.319* (0.171)	-0.503** (0.207)	5.866*** (0.846)	304	0.94
	FX Reserves	-0.243 (0.174)	-0.343* (0.179)	0.801*** (0.142)	302	0.95
10Y Interest Rate	M2	2.381 (2.289)	4.322 (2.808)	-22.888*** (5.957)	280	0.70
	Dom. Credit	4.037* (2.262)	5.274** (2.514)	-53.371*** (10.937)	280	0.73
	FX Reserves	6.363** (2.749)	-0.232 (2.486)	-12.793*** (2.004)	274	0.78
EMBI Global Spread	M2			No cointegration		
	Dom. Credit			No cointegration		
	FX Reserves	0.432 (0.323)	1.430*** (0.341)	-1.090*** (0.264)	303	0.81
Exchange Rate vs. USD	M2	-0.361** (0.144)	-0.221 (0.157)	0.894*** (0.325)	307	0.98
	Dom. Credit	-0.232* (0.132)	-0.133 (0.156)	0.803* (0.420)	297	0.98
	FX Reserves	-0.386*** (0.091)	0.175 (0.115)	0.469*** (0.091)	298	0.99
REER	M2	0.137 (0.109)	0.002 (0.136)	0.484* (0.281)	311	0.60
	Dom. Credit			No cointegration		
	FX Reserves	0.263*** (0.090)	-0.038 (0.102)	-0.011 (0.081)	306	0.74
GSCI	M2	0.685*** (0.120)	-0.432*** (0.157)	0.916*** (0.307)	319	0.82
	Dom. Credit	0.327*** (0.106)	-0.739*** (0.113)	3.421*** (0.501)	319	0.86
	FX Reserves	0.295*** (0.083)	-0.616*** (0.089)	0.557*** (0.070)	303	0.94
Brent	M2	0.870*** (0.162)	-0.568*** (0.213)	1.614*** (0.416)	319	0.84
	Dom. Credit	0.461*** (0.148)	-1.029*** (0.159)	4.878*** (0.701)	319	0.87
	FX Reserves	0.612*** (0.132)	-0.770*** (0.144)	0.616*** (0.114)	299	0.93

5 Conclusion

Over the last fifteen years, global liquidity has become overabundant in different forms and encouraged the search for yield by investors who may have access to this excess liquidity. In this paper, we have examined the impact of global excess liquidity on asset prices for the well-known BRICS countries. First, we built three global excess liquidity aggregates based on the foreign exchange reserves, the M2 money supply and the domestic credit. Second, we estimated the interaction between global excess liquidity, economic activity and asset prices through vector autoregressive and error correction models. We focused on a wide range of asset classes, such as equities, interest rates, spreads, exchange rates for BRICS and some commodities.

Overall, global excess liquidity pushed up equity prices and exchange rates, while it brought down the fixed income rates and has more or less tightened the interest rates spreads depending on the countries. Regarding exchange rates, global excess liquidity is a factor that explains the appreciation trend both against the dollar and in real effective terms. Moreover, we found that foreign exchange reserves have a genuine link with asset prices considering the overall results of this paper. Indeed, this key measure of the first global excess liquidity regime explains the trend in asset prices in the desired direction in almost two thirds of cases. The global money supply M2 is the measure of the second global excess liquidity regime and explains the trend in asset prices in the desired direction in more than four out of ten cases, while it is only in about one third of cases for the global aggregate of domestic credit. Country by country, the Brazilian, Russian and Indian assets have been the most impacted by the global excess liquidity, whatever the regime. For China, the growth of domestic credit and M2 money supply reflects the excessive monetisation of the financial system and the indebtedness promoted by the Chinese authorities, notably to control their currency. The results for South Africa are less eloquent. Last but not least, according to our robustness checks, the results are broadly weakly sensitive to some economic and econometric changes.

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Methodological Appendix:

The method suggested by Beyer *et al.* (2001) uses variable weights to aggregate growth rates and proceeds in the following four steps:

1. Calculate weights ω_{ijt} based on the relative share of the country or monetary union i as regards the variable Y_j ($j = M2, Domestic\ Credit, Foreign\ Reserves$) at time t , in a common currency, *e.g.*, in USD in this study:

$$\omega_{ijt} = \frac{Y_{ijt}}{\sum_{i=1}^9 Y_{ijt}} \quad (6)$$

2. Calculate within the country or monetary union growth rates X_i of each variable Z_j (where $Z_j = \frac{Y_j}{\sum_{k=t-3}^t GDP_{ik}}$) at time t , in local currency:

$$\Delta \log (X_{ijt}) = \Delta \log (Z_{ijt}) \cdot GDP\ Deflator \quad (7)$$

3. Aggregate growth rates of (7) using weights of (6):

$$\overline{X_{jt}} = \sum_{i=1}^9 \omega_{ijt} \Delta \log (X_{ijt}) \quad (8)$$

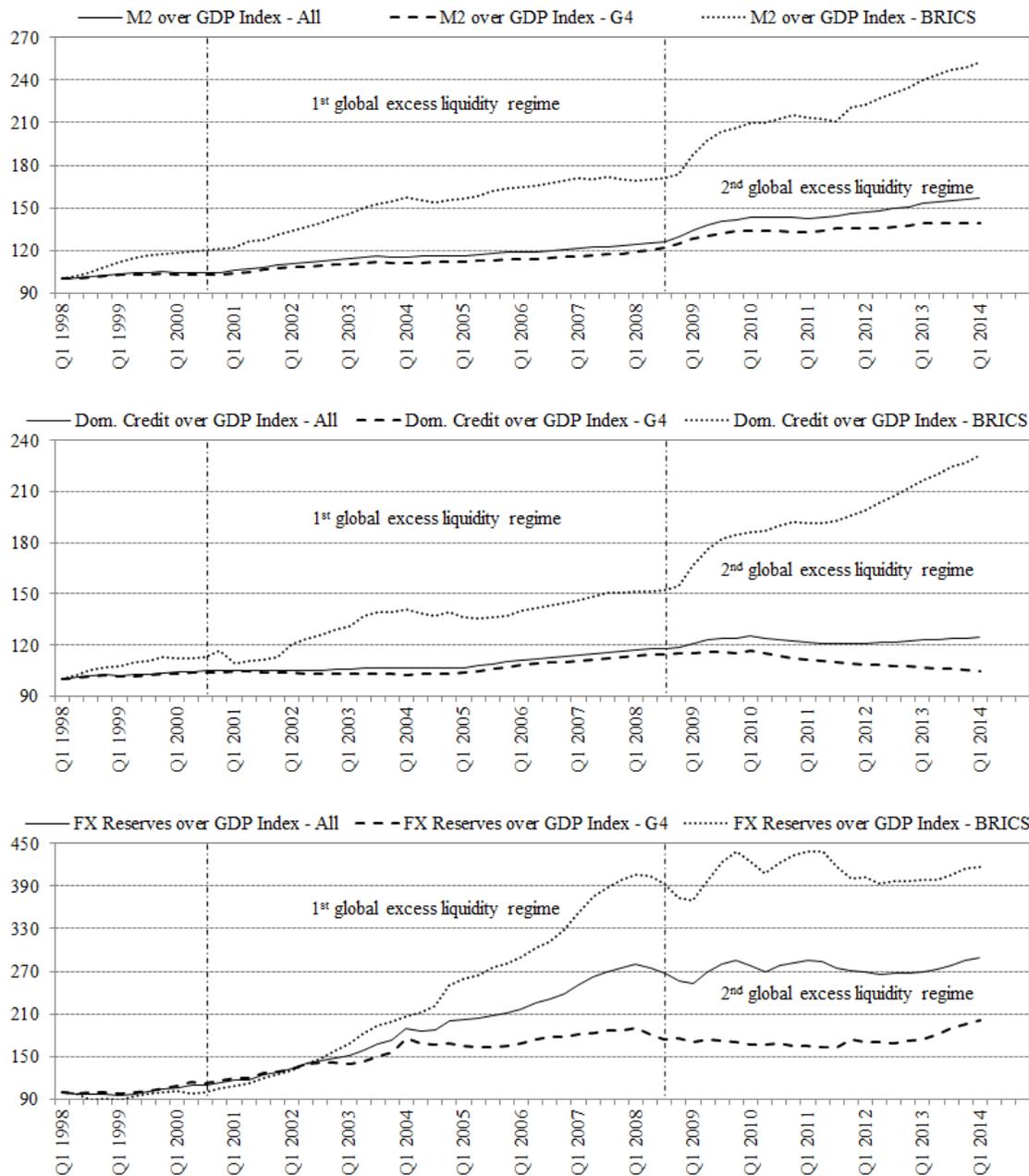
4. Cumulate aggregate growth rates to obtain aggregate levels. We use the Q1 1998 as the base to anchor the aggregate measures over time:

$$Y_{jt} = Y_{jt-1} \left(1 + \overline{X_{jt}} \right) \quad (9)$$

with $Y_{j,Q1\ 1998} = X_{ij,Q1\ 1998} = 100 \ \forall i$ and $\forall j$.

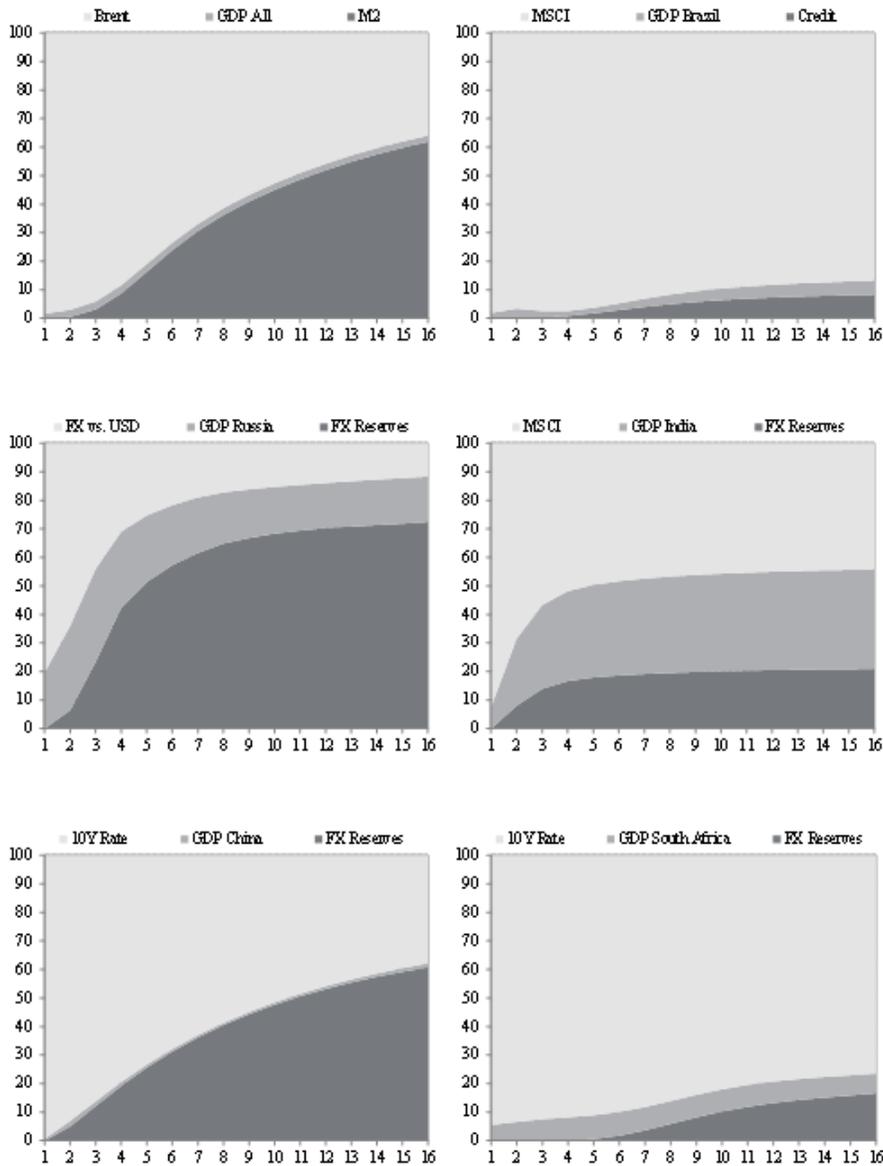
Appendix 1: Trends in the different global excess liquidity indices by regional aggregates

Note: The figures plot the different global excess liquidity indices by regional aggregates, namely the All aggregate (continuous line), the G4 countries aggregate (dashed line) and the BRICS countries aggregate (dotted line). As in Figure 1, we distinguish two different regimes of global excess liquidity. The first one occurs between Q3 2000 and Q2 2008 while the second one takes place from Q3 2008 to Q1 2014.



Appendix 2: A bunch of variance decompositions

Note: The figures plot the variance decompositions of some of the most impacted asset class by global excess liquidity. Light grey represents the own innovations of the asset, grey represents the GDP innovations and dark grey represents the global excess liquidity innovations. For instance, after sixteen quarters, Brent innovations are explained by around 62% by M2 innovations, 2% by GDP innovations and 36% by its own innovations. Overall, within the global excess liquidity aggregates, it is the foreign exchange reserves and, to a lesser extent, the M2 aggregate which best explain the BRICS' asset innovations.



Appendix 3: Summary results of the IRFs in nominal terms

Note: The table provides information about the results of the simulated IRFs based on the estimated VAR and VEC models in nominal terms. For each BRICS country, we analyse the IRF of each asset price or exchange rate to a positive one standard deviation shock on the logarithm of each liquidity aggregate, except for the MSCI BRIC and commodity prices which are dealt with more globally. The symbol “-” denotes a negative and significant impact to a given asset price of a one standard deviation shock on a given liquidity aggregate; “-” denotes a negative and non-significant impact; “0” denotes no impact; “+” denotes a positive and non-significant impact; “++” denotes a positive and significant impact; an empty cell denotes that no model has been estimated according to the preliminary unit root and cointegration tests.

Asset Class/Asset/Liquidity Aggregate		Country	Brazil	Russia	India	China	South Africa
Equity	MSCI	M2	++	+	+		
		Dom. Credit	++				
		FX Reserves	++	++	++	++	+
	MSCI BRIC	M2			+		
		Dom. Credit					
		FX Reserves			++		
Fixed Income	10Y Interest Rate	M2	-	+	-	--	+
		Dom. Credit	-	-	-	--	-
		FX Reserves	-	--	-	--	--
	EMBI Global Spread	M2	--	--	0	0	--
		Dom. Credit	-				0
		FX Reserves	--	+	0	0	-
Exchange Rate	Exchange Rate vs. USD	M2		-	+	+	
		Dom. Credit	++	+		+	-
		FX Reserves	-	+	++	0	++
	NEER	M2	-	-		-	++
		Dom. Credit	+			+	
		FX Reserves	-	++	++	-	
Commodity	GSCI	M2			--		
		Dom. Credit FX Reserves			++		
	Brent	M2			--		
		Dom. Credit FX Reserves			++		

Appendix 4: Panel stationarity and unit root test results

Note: The table presents the results of the most commonly used panel stationarity and unit root tests, *i.e.*, Hadri (2000), Levin, Lin and Chu (2002, LLC hereafter), Im, Pesaran and Shin (2003, IPS hereafter), Maddala and Wu (1999) for Fisher-type tests using ADF and PP tests. The figures reflect the test-statistics in level (in first difference) of the panel stationarity and unit root tests with country fixed effects. *, ** and *** denote rejecting the null hypothesis at the 10%, 5% and 1% level of confidence, respectively. In Hadri (2000), the null hypothesis is the stationarity of the variable. In LLC, the null hypothesis assumes a common unit root. In IPS, ADF Fisher and PP Fisher, the null hypothesis assumes an individual unit root. According to the Hadri (2000) stationarity tests, all the variables are $I(1)$. According to LLC, IPS, ADF Fisher and PP Fisher unit root tests, the results are more mixed for some variables, *i.e.*, the 10-year sovereign interest rates, the exchange rates against the USD and the VIX. Nonetheless and in the light of all these tests results, it is reasonable to conclude that our variables are non-stationary in level and $I(1)$.

Variables	Tests	Hadri	LLC	IPS	ADF Fisher	PP Fisher
MSCI		7.02*** (-0.62)	-0.53 (-17.28***)	-0.97 (-14.84***)	15.21 (172.30***)	16.02* (172.04***)
10Y Interest Rate		9.24*** (1.76*)	-1.02 (-8.29***)	-2.67*** (-11.18***)	23.96*** (123.49***)	38.62*** (106.23***)
EMBI Global Spread		6.00*** (-1.15)	-0.83 (-15.95***)	-1.63* (-13.09***)	18.27* (148.99***)	12.66 (129.20***)
Exchange Rate vs. USD		3.45*** (1.80*)	-1.67** (-10.76***)	-3.42** (-10.14***)	64.07*** (109.48***)	45.35*** (107.21***)
REER		8.03*** (0.14)	0.64 (-14.66***)	-0.31 (-15.31***)	11.03 (179.21***)	13.20 (178.32***)
GSCI		11.61*** (-1.29)	-1.76* (-15.72***)	-0.15 (-12.67***)	6.89 (144.85***)	4.07 (102.95***)
Brent		11.97*** (0.57)	-2.33** (-14.91***)	-0.69 (-12.97***)	9.30 (149.07***)	5.55 (125.26***)
Real GDP		12.98*** (-0.62)	-1.04 (-13.47***)	0.77 (-12.99***)	6.89 (148.82***)	2.81 (182.55***)
VIX		1.51** (-1.30)	-2.10** (-20.77***)	-1.80** (-17.94***)	16.06* (214.88***)	15.98 (230.05***)
M2 Aggregate		12.68*** (-0.81)	1.00 (-1.88**)	3.87 (-4.26***)	0.47 (36.15***)	0.20 (40.19***)
Dom. Credit Aggregate		12.40*** (-1.04)	0.12 (-7.34***)	2.75 (-8.57***)	1.11 (86.48***)	1.95 (92.10***)
FX Reserves Aggregate		11.76*** (3.52)	-2.31** (-6.61***)	-1.00 (-9.71***)	11.25 (101.67***)	6.78 (102.00***)