NONLINEAR RELATIONSHIP BETWEEN GLOBAL LIQUIDITY AND ASSET PRICES: EVIDENCE FROM A PANEL THRESHOLD MODEL

Sophie BRANA, Larefi, Bordeaux University[1]

Stéphanie PRAT, Inseec Business School and Larefi, Bordeaux University[2]

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Abstract

From the mid-1990s, global liquidity appeared to have grown in excess compared to the growth of GDP with significant financial spillovers on emerging asset classes. However, beginning in mid-2007, subprime mortgage losses in the United States have resulted in episodes of liquidity shortages in financial markets strongly amplified by the collapse of Lehman thereafter. The response of major monetary authorities to the financial crisis turning into a full blown crisis have boosted global liquidity once more, while in the same time, capital flows from advanced to emerging markets dried up, leading to a severe drop in asset prices in those countries. This paper explores empirically the non-linear relationship between global excess liquidity and asset prices for a set of emerging market countries. We use a Panel Threshold Regression model to show that in times of financial stress in financial markets, global excess liquidity have no significant impact on emerging asset prices contrary to 'tranquil' periods where global excess liquidity generates significant financial spillovers for emerging markets.

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[1] brana@u-bordeaux4.fr

[2] sprat@groupeinseec.com

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1 Introduction

Global liquidity grew steadily from the beginning of the last decade and accelerated from mid-2007 when the financial crisis started with subprime mortgage losses and liquidity shortage among financial institutions in the United States. The crisis intensified with the collapse of Lehman, spreading across markets and countries and turning into a full-blown global financial crisis. In order to mitigate the effect of the crisis, monetary authorities, starting with the FED, responded aggressively by taking unprecedented measures, using traditional monetary policy tools as well as unconventional monetary policy actions, to counter disruptions in the supply of liquidity.

A related strand of literature has pointed out the strong implications of global liquidity on financial stability, in particular in relation to investors' risk appetite and the high level of volatility that characterizes cross-border capital flows (European Central Bank, 2011). In a context of abundant global liquidity and the accompanying decline in risk aversion, strong capital inflows from international investors searching for higher yield would likely have an impact on domestic financing conditions and exert upward pressures on exchange rates and asset prices in emerging markets receiving those flows. Indeed, to prevent their currencies from an excessive appreciation and a deterioration of cost-competitiveness, central banks in emerging markets' economies have been incited to pursue or reinforce foreign exchange accumulation. These foreign exchange interventions have forced monetary authorities to create additional money to absorb those dollar inflows. The result was an increase in the monetary base of these countries, sometimes transferred to the real economy through an increase in domestic credit supply.

During episodes of inflows, emerging markets face upward pressures on asset and real estate prices, sometimes well-above fundamental values, and on exchange rates leading to undesired real exchange rate appreciation which undermines competitive gains. Second,

those inflows bring lower funding costs which encourage the financial and non-financial private sector in emerging market economies to increase its debt leverage fueling balance sheet mismatches (i.e. a deterioration of the debt/equity ratio). It raises the issue of financial instability in the event of a wave of risk aversion, leading to a dramatic withdrawal of capital and a sudden hike in funding costs. Third, a large part of bond issues and cross-border banking credits appear to be denominated in dollars, also with a short maturity, causing foreign currency and maturity mismatches on balance sheets of the private sector. They expose non-exporting companies (whose revenue flows are likely to be denominated in local currency) to the risk of depreciation in the local currency but also to the risk of funding liquidity. Finally, other than the potential risks of capital inflows on financial instability, they also curb monetary policy management in emerging markets countries. Authorities are hesitant to continue tightening the monetary conditions even if inflationary pressure persists. Central Bank interventions to limit an appreciation of their currencies are also accompanied by an expansion of the monetary base (because interventions are not fully sterilized), encouraging the distribution of credit and thus feeding inflationary pressures.

Between 2003 and 2007, net private capital flows to emerging markets increased from roughly $280 bn to more than $1200 bn before dramatically falling in 2008 and 2009 by almost 50% to $622 bn and $602 bn respectively (according to the IIF estimates). Capital inflows in emerging markets revived sharply in 2010, reaching almost $910 bn on the back of strong economic fundamentals, and hence positive global risk perception in an environment of global excess liquidity. Therefore, global excess liquidity seems to have been strongly associated with capital flows from advanced countries to emerging markets for more than a decade.

However, as suggested by Darius and Radde (2010), between boom and bust phases of the business cycle, the impact of liquidity may not be symmetric. Especially in periods of global crisis, we would expect a non-significant, even a negative rather than a positive relationship between liquidity and asset prices. The optimal monetary stance depends on economic condition in a nonlinear way (Bordo, Jeanne, 2002). Especially bust in asset markets may require deviations from the rule that prevail in normal time. Bernanke and Mishkin (1992) pointed out that, under specific situations, central banks may exhibit a "crisis

mentality". Thus, the study of the relationship between global liquidity, in connection with monetary policy, and asset prices must take into account these nonlinearities.

This study empirically investigates the relative impact of global excess liquidity on equity prices for a set of emerging countries. For this purpose, in a first step, we collect measures of monetary bases for industrialized and emerging countries, and then compute an indicator of global excess liquidity. Secondly, we estimate an econometric model with panel data in order to identify the impact of a shock of excess global liquidity[3] on emerging assets prices for a set of 11 emerging countries. We adopt a panel threshold regression (PTR) model similar to that proposed by Hansen (1999) and Hurlin (2002) in order to take into account two regimes: one corresponding to normal periods, the other to periods of crisis. The contribution of this paper is threefold. First, we focus on emerging countries as few studies have investigated the link between excess global liquidity and asset prices in those countries. Second, to our knowledge, the panel threshold specification used in this paper has not yet been investigated in previous studies on this topic. Third, we compute an original global liquidity indicator which represents roughly the monetary base at the world level, compared to others measures of global liquidity proxied by monetary aggregates in some developed countries. This allows us to take into account in particular the money supply of Asian or Oil producer countries which have affected the global liquidity conditions in recent years.

The remainder of the paper is organized as follows: Section 2 provides an overview and some stylized facts about global liquidity and several measures to assess periods of excess global liquidity. Section 3 presents a review of existing literature on the impact of global liquidity in terms of financial instability. Section 4 presents our data set as well as our empirical model, including details on methodology to construct our global liquidity indicator. Results on econometric tests are detailed in section 5. Section 6 concludes.

2 Measures of global excess liquidity

During the last global financial crisis, the excess of global liquidity combined with liquidity shortfalls on financial markets fuelled a "liquidity paradox" (Chandrasekhar and Ghosh, 2009). This points out the multiple dimensions of liquidity: the monetary versus

[3] Global liquidity in the spillover analysis excludes the 11 countries under investigation.

market and funding concepts. Monetary liquidity traditionally refers to the *official* liquidity and can be defined according to the BIS as the "funding that is unconditionally available to settle claims through central banks" (Bank of International Settlement, 2011). In this sense monetary liquidity represents overall funding conditions in the whole economy. Conversely market and funding liquidity broadly refers to the *private* liquidity, i.e. created by the financial and non-financial sectors through cross-border operations (BIS, 2011). More precisely, market liquidity can be defined as the ease with which to trade financial assets (i.e. without creating disruptions to these prices) whereas funding liquidity generally represents the ease for financial institutions to obtain funding. For our purpose, we will focus particularly on monetary liquidity.

Contributions to the literature provide several indicators to assess this concept of global liquidity. In particular, two categories of indicators can be identified: quantitative measures and price measures.

The main quantitative measures include monetary and credit aggregates. The former can be viewed as an extension of liquidity measures at the domestic level. Baks & Kramer (1999) proposed several aggregate indicators for the G-7 countries, based on narrow and broad money, using three different methods (GDP-weighted and unweighted growth rates of both narrow and broad money and lastly Divisia indices of global money growth). Domestic credit (scaled by GDP) was also used as a quantitative measure of global liquidity as it can be considered as the major counterpart of money supply (Gouteron & Szpiro (2005)). Another strand of literature focuses on foreign exchange reserves to assess global liquidity[4], which are associated with reserve money of advanced economies (United-States) (Darius & Radde (2010), De Nicolo & Wiegand (2007), Matsumoto (2011), Belke et al. (2013)). In addition, global liquidity can also be proxied by reserve money. Artus & Virard (2010) define global liquidity as "the money created by central banks around the world", i.e. all monetary bases. Indeed, these measures take into account the increasing role of liquidity created by emerging market economies.

Based on these various indicators, norms have been established to distinguish periods of global excess liquidity to shortage liquidity periods. The leading works on this topic are largely based on those of Baks & Kramer (1999). They consider as a norm for global liquidity

[4] Foreign exchange reserves can be considered as the main counterpart of reserve money.

the rate of GDP growth in the economy. This threshold relies on the quantitative theory of money and occurs when the growth of money supply exceeds the growth rate of GDP. As underlined by Gouteron & Szpiro (2005), this threshold represents the one required for the "normal" economic development of the economy without creating a situation of overheating. In other words, it is the level of liquidity compatible with the objective of price stability.

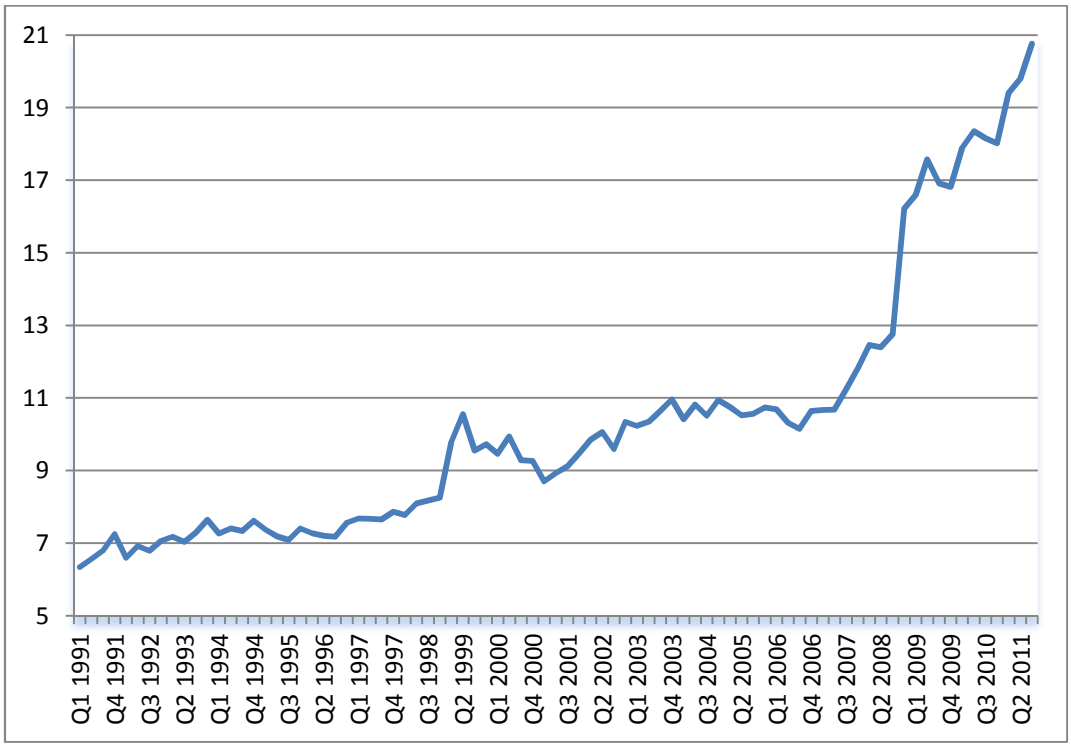
Other measures of excess liquidity have been used such as the money overhang, which represents the deviation between the actual level of money supply expressed in nominal terms with an equilibrium value being a function of long-term demand for money. A combination of this indicator and that of Baks & Kramer (1999) is the real money gap. It represents the deviation of the actual quantity of money in real terms. This is based on the quantitative theory of money and incorporates a specification of the velocity of circulation of money (Berger and Harjes, 2009). Other indicators are based on credit, featuring notably the differential in the growth rate of credit and that of GDP. Another measure, the credit gap, is proposed by Borio & Lowe (2002). A credit gap is defined when "the ratio of credit to GDP deviates from its tendency towards a specific value". According to these authors, the deviation (measured by the variance of the ratio) must exceed four percentage points from its trend to be described as excessive. The method used to determine the threshold is drawn from the works of Kaminsky & Reinhart (1999).

Besides these quantitative indicators, price indicators can be considered. There is a fairly close relationship between prices and quantities. De Nicolo & Wiegand (2007) propose an indicator of global excess liquidity based on the deviation of the short-term nominal interest rate from the Taylor rate. The Taylor rate results from reactions of monetary authorities to output gap and inflation differential and reveals the preference of central banks underlying the conduct of monetary policy. Therefore, the gap between this threshold (Taylor rate) and the short run nominal interest rate could reflect an excess of money supply. A second approach is presented by Gouteron & Szpiro (2005). According to them, excess of monetary liquidity would be assessed by the difference between the short term real interest rate and the natural interest rate deriving from the long run growth.

Empirical studies generally include three types of indicators: money or credit gap (the ratio between broad or narrow money or credit and nominal GDP), short term nominal interest rates, or simply broad or narrow monetary aggregate.

We have collected data on monetary bases (i.e. M0) for a large sample of 49 advanced and emerging market countries[5]. All data are drawn from the IMF's International Financial Statistics. As monetary bases are expressed in local currencies, we convert all time series in the same unit by using nominal exchange rates against the dollar. Finally we create a series called the "world" monetary base by simply adding up monetary bases for all countries from our sample for each period. The "world" monetary base is expressed in billions of dollars. We also create a series called "world" GDP by adding up nominal GDPs for our set of countries expressed in dollar terms for each period. Then the indicator of excess global liquidity at the aggregate level is calculated as the ratio of "world" monetary base to "world" nominal GDP expressed in percentage (Figure 1).

Figure 1. Global liquidity indicators (% GDP)



Sources: Datastream, IMF International Financial Statistics.

[5] The sample includes United States, Canada, United Kingdom, Japan, Australia, New Zealand, Sweden, Denmark, and the Euro zone for developed countries. For emerging countries, we include China, South Africa, Brazil, Venezuela, India, Philippines, Argentina, Chile, Colombia, Mexico, Peru, Malaysia, Taiwan, South Korea, Thailand, Hong Kong and Singapore and some countries from Central and Eastern Europe (Poland, Hungary, Czech Republic, Bulgaria and Romania), including Russia and Turkey. The sample also comprises three oil exporting countries: Qatar, Kuwait and Saudi Arabia.

Global liquidity stayed fairly stable up to 1995 and has increased sharply from this date. From 1995, global liquidity started to grow on the back of several interest rate cuts, led by the Japanese monetary authorities, prompted by the banking and financial crisis that hit the economy. The low interest rate environment in Japan coupled with the introduction of the Euro in 1999, which has been accompanied by an increase of money supply above the target established by the ECB (+ 4.5%)[6], could also have played a major role. The excess liquidity indicators started to climb again on the back of large expansionist monetary policies pursued by central banks in advanced countries (Federal Reserve, ECB, etc.) after the 2000 dot.com crisis. The excess liquidity is obvious, except between 2005 and 2006 where major Central Banks in advanced countries tightened monetary conditions. Foreign exchange reserves have also raised exponentially from the 2000's onwards with the development of Brazil, India and China and the huge oil revenues generated by the OPEC countries. These countries with current account surpluses along with Japan have considerable available resources that can earn a return on the capital markets. Finally the current financial crisis and measures adopted by monetary authorities have boosted liquidity once more. The impact of the recent financial crisis on global liquidity appears extremely large.

3 The impact of global excess liquidity on emerging economies

In a global environment characterized by excess liquidity, which can be attributed in large part to monetary easing in advanced countries, international investors increase their demand for higher-return assets to optimize the risk-return ratio of their portfolio. This excess liquidity encouraged capital flows to emerging markets, leading upward pressures, sometimes excessive, on both asset prices and exchange rates in these countries. But few studies have empirically investigated this issue. The first studies have focused on the impact of global liquidity on output, inflation and asset prices using VAR models, though only for advanced economies. Baks and Kramer (1999) find for the G7 countries that global excess liquidity (using G7 money growth) has a negative impact on real interest rates but a positive impact on equity prices. They also emphasize cross-country spill-over effects on stock

[6] This argument must be viewed carefully in the context of exogenous factors linked to institutional and statistics changing.

returns and interest rates of a shock on liquidity in a given country. Belke et al. (2010) studied the interaction between global liquidity and the level of goods and asset prices for eleven OECD countries. Whereas monetary aggregates provide leading information on property prices, gold prices and a global GDP deflator, equity prices do not react to liquidity shocks. These results are in line with Giese and Tuxen (2007) who showed that global liquidity has an impact on property prices but not on stock prices. Darius and Radde (2010), also find for the G7 countries that global liquidity provides useful information on property prices – although domestic variables play a more significant role than global variables– though not on equity prices (based on the MSCI world index). All these analyses were conducted by using VAR models and impulse functions. More recently Alessi and Detken (2011) have tested several early warning indicators for costly asset price boom/bust cycles using data for 18 OECD countries. They showed that global measures of liquidity[7] are the best indicators and are more useful than domestic variables.

Studies concerning the impact of liquidity on emerging countries are rather scarce and more recent. Chudik and Fratzscher (2011) compare the role of the tightening of monetary conditions (estimated by the change in the 3-month money market interest rate) and the collapse in risk appetite (evidenced by a shock on the VIX index or the TED spread) in the global transmission of financial crises measured by the change in the stock market index. They show that liquidity shocks influence more leading countries, while emerging economies are affected more by changes in risk appetite. The IMF (2010) examines the link between growth in global liquidity and asset prices (equity returns) in "receiving" emerging countries. The regression (panel data) indicates that global liquidity is positively associated with equity investments between 2003 and 2009, which may explain the rise in returns. Lastly, Matsumoto (2011) uses the change in worldwide international reserves plus US money supply and the VIX as the measure of respectively the availability of funds for safe and for risky assets. Whatever the global liquidity measure, he finds a positive impact on equity returns for some Latin American countries.

[7] They use GDP weighted averages of the 18 countries of seven financial variables (private credit, M1, M3 as ratios to GDP, nominal short rates, and the VAR shocks for M1, M3 and credit growth). Global private credit gap and global M1 gap are the best performing indicators.

4. Methodology

The purpose of the paper is to investigate the impact of excess global liquidity on asset prices for a set of emerging market countries using a threshold regression model. This approach allows the model to account for a threshold effect of global liquidity on emerging asset prices depending on the level of global risk aversion in international financial markets. Following the strand of empirical literature on the impact of global liquidity on asset prices (Baks and Kramer, 1999; Giese and Tuxen, 2008; Becker 2007, 2009; Psalida and Tao Sun, 2011 among others), our analysis refers also to empirical research underlying the role of changes in global investors' sentiment in assessing financial stability. For example Forbes and Warnock (2012), Bruno and Shin (2012) or Gonzales-Hermosillo (2008) have highlighted the role of global risk appetite on gross capital flows and financial contagion, whereas Jaramillo and Weber (2012) pointed out the impact of a shift in investors' sentiment on bond yields in emerging market countries. More precisely, we use a global investors' sentiment indicator as regime-switching indicator separating periods of financial 'tranquility' from periods of 'financial stress'. Our underlying intuition is that a shift in global risk aversion could affect the traditional positive relationship between global excess liquidity and emerging asset prices.

Considering that the transition from the state of 'tranquil period' to a period of 'financial stress' is brutal, our empirical approach is based on Hansen's (1999) estimation and inference theory for non-dynamic panel data models. The Panel Threshold Regression (hereafter PTR) model with individual specific effects is given by:

$$y_{it} = \mu_i + \beta_1' x_{it} \mathbb{I}(q_{it} \leq \gamma) + \beta_2' x_{it} \mathbb{I}(q_{it} > \gamma) + \varepsilon_{it} \quad (1)$$

where $\mathbb{I}(\cdot)$ is the indicator function, q_{it} is the threshold variable and γ the optimal threshold value. The subscripts $i$and t stand for the cross-section and time dimensions respectively. The error term ε_{it} is assumed to be independent and identically distributed (iid) with zero mean and finite variance σ^2.

The dependent variable y_{it} and the threshold variable q_{it} are scalar matrices, the regressor x_{it} is a $k \times 1$ vector of explanatory variables. All variables are assumed to be stationary to avoid spurious regression model.

The observations are divided into two regimes depending on whether the threshold variable q_{it} is smaller or greater than the threshold value γ. The individual effects μ_i are assumed to be the same in the two regimes. So the two regimes are distinguished by differing regression slopes β_1 and β_2.

Equation (1) can also be written in a compact form:

$$y_{it} = \mu_i + \beta' x_{it}(\gamma) + \varepsilon_{it} \tag{2}$$

$$x_{it}(\gamma) = \begin{pmatrix} x_{it}\mathbb{I}(q_{it} \le \gamma) \\ x_{it}\mathbb{I}(q_{it} > \gamma) \end{pmatrix}$$

Where $\beta = (\beta_1' \ \beta_2')'$

Following Hansen (1999), taking averages of (2) over the time index t produces:

$$\bar{y}_i = \mu_i + \beta' \bar{x}_i(\gamma) + \bar{\varepsilon}_i \tag{3}$$

Where $\bar{y}_i = \frac{1}{T}\sum_{t=1}^{T} y_{it}$, $\bar{\varepsilon}_i = \frac{1}{T}\sum_{t=1}^{T} \varepsilon_{it}$

And

$$\bar{x}_i(\gamma) = \frac{1}{T}\sum_{t=1}^{T} x_{it}(\gamma) = \begin{pmatrix} \frac{1}{T}\sum_{t=1}^{T} x_{it}\mathbb{I}(q_{it} \le \gamma) \\ \frac{1}{T}\sum_{t=1}^{T} x_{it}\mathbb{I}(q_{it} > \gamma) \end{pmatrix}$$

The difference between (2) and (3) yields

$$y_{it}^* = \beta' x_{it}^* + \varepsilon_{it}^* \tag{4}$$

Where $y_{it}^* = y_{it} - \bar{y}_i$, $\quad x_{it}^*(\gamma) = x_{it}(\gamma) - \bar{x}_i(\gamma)$,

And $\varepsilon_{it}^* = \varepsilon_{it} - \bar{\varepsilon}_i$

Let

$$y_i^* = \begin{bmatrix} y_{i2}^* \\ \vdots \\ y_{iT}^* \end{bmatrix}; \qquad x_i^* = \begin{bmatrix} x_{i2}^*(\gamma') \\ \vdots \\ x_{iT}^*(\gamma)' \end{bmatrix} \qquad \text{and} \qquad \varepsilon_i^* = \begin{bmatrix} \varepsilon_{i2}^* \\ \vdots \\ \varepsilon_{iT}^* \end{bmatrix}$$

then, let Y^*, $X^*(\gamma)$ and ε^* denote the data stacked over all individuals. Using this notation, (4) is equivalent to

$$Y^* = X^*(\gamma)\beta + \varepsilon_{it}^* \tag{5}$$

Then, for any given value of the threshold parameter γ, the slope coefficients β_1 *and* β_2 can be estimated by OLS. That is

$$\hat{\beta}(\gamma) = \left(X^*(\gamma)'X^*(\gamma)\right)^{-1}X^*(\gamma)'Y^* \tag{6}$$

Furthermore, the sum of squared errors (SSEs), dependent on any given value of γ is given by

$$SSE_1(\gamma) = \hat{\varepsilon}^*(\gamma)'\hat{\varepsilon}^*(\gamma) \tag{7}$$

To estimate endogenously the threshold parameter γ, Chan (1993) and Hansen (1999) recommend to estimate the threshold value by least squares. This can be achieved by minimizing the sum of squared errors $SSE_1(\gamma)$. Therefore the least square estimator of γ is

$$\hat{\gamma} = Arg\ \min_{\gamma} SSE_1(\gamma) \tag{8}$$

According to Hansen (1999) to avoid the issue of estimating a threshold value that sorts too few observations into one or the other regime, it would be convenient to restrict the set of values of γ by excluding the smallest and largest η% values of the threshold variable q_{it} in order to assure that a minimal percentage of the observations is situated in each regime. In this paper, lowest and highest 5% values are excluded. Then given the estimated values of $\hat{\gamma}$, coefficients for each regime are given by $\hat{\beta}_1(\hat{\gamma})$ and $\hat{\beta}_2(\hat{\gamma})$.

The following step is to determine whether the threshold effect is statistically significant validating the non-linearity of our model. This can be achieving by testing the null hypothesis $H_0: \beta_1 = \beta_2$ for which there is no threshold effect.

However, under H_0 the threshold value γ is not identified and the asymptotic distribution of F_1 is not standard. To overcome this issue, generally known as the 'Davies Problem' (Davies, 1977, 1987), Hansen (1996) suggested using a bootstrap procedure to attain the first-order asymptotic distribution of the likelihood ratio test of H_0.

$$F_1 = \frac{SSE_0 - SSE_1(\hat{\gamma})}{\hat{\sigma}^2}$$

Where $\hat{\sigma}^2$ is the residual variance of the Panel Threshold Regression, SSE_0 is the sum of squared errors obtained from the linear model. So the p-values constructed from the bootstrap are asymptotically valid. The null hypothesis of no threshold effect is rejected if the p-value is smaller than the desired critical value.

5. Empirical analysis

We investigate the impact of global excess liquidity on equity prices for a sample group of 11 emerging economies in Latin America and Asia (Argentina, Chile, Colombia, Mexico, Peru, Malaysia, Taiwan, South Korea, Thailand, Hong Kong and Singapore) over a period from 1993-Q3 to 2011-Q3 with a quarterly frequency. The data are drawn from IMF's international financial statistics

To assess the threshold effect between global excess liquidity and asset prices, the Panel Threshold Regression proposed by Hansen (1999) is applied. As previously shown, the econometric model can be specified as follows:

$$EqReturns_{it} = \begin{cases} \mu_i + \delta_1 M0Y_{it} + \lambda_1 GDP_{it} + \theta_i CPI_{it} + \varphi_i 3Mrate_{it} + \alpha_1 M2_{it} + \varepsilon_{it} & if\ q_t \leq \gamma \\ \mu_i + \delta_2 M0Y_{it} + \lambda_2 GDP_{it} + \theta_2 CPI_{it} + \varphi_2 3Mrate_{it} + \alpha_2 M2_{it} + \varepsilon_{it} & if\ q_t > \gamma \end{cases} \quad (9)$$

This model can be expressed in a compact form as:

$$EqReturns_{it} = \mu_i + \xi_1' X_{it} \mathbb{I}(q_t \leq \gamma) + \xi_2' X_{it} \mathbb{I}(q_t > \gamma) + \varepsilon_{it} \quad (10)$$

Where $\xi_j = (\delta_j \ \lambda_j \ \theta_j \ \varphi_j \ \alpha_j)'$ for $j = 1,\ 2$ and $X_{it} = (MOY_{it}\ GDP_{it}\ CPI_{it}\ 3Mrate_{it}\ M2_{it})'$ and $\mathbb{I}(\cdot)$ the indicator function.

$EqReturns_{it}$ represent nominal equity returns (in USD). μ_i are country specific effects and ε_{it} is the i.i.d error term with zero mean and finite variance σ^2. Following standard literature on global excess liquidity and asset prices (see for example IMF (2011)), explanatory factors can be divided into two groups:

1) Domestic or fundamentals factors include the real GDP growth (GDP_{it}), the inflation rate based on the CPI (CPI_{it}), the three-month interbank rate ($3Mrate_{it}$), and the growth in money supply ($M2_{it}$);
2) Global factors include the global external excess liquidity indicator ($M0Y_{it}$) build for each emerging country of our sample. This indicator is calculated as the ratio of "world" monetary base to "world" nominal GDP expressed in percentage. So as to avoid endogenous bias, we remove the domestic monetary base of each country of

our sample from the "world" monetary base. Thus, $M0Y_{it}$ is the global excess liquidity been addressed 'specifically' to each country of our sample.

As previously mentioned, the regime-switching variable q_t should reflect global investors' sentiment. We consider to that purpose the implied volatility of the *S&P500* stock index option prices (the Chicago Board Options Exchange Market Volatility Index, VIX) (Jaramillo and Weber, 2011). This risk variable can also been considered as a liquidity market indicator (*i.e. private* liquidity), becoming a complementary factor to our global excess liquidity measure which rather refers to *official* liquidity.

The first step of the estimation is to examine the threshold effect. Repeating the bootstrap procedures 100 times we obtain the approximation of the *F*-statistic and associated *p*-value The reported *F1-* statistic assessing the null hypothesis of no threshold is 103.6187 with a bootstrap *p*-value of 0.0000 allowing us to clearly reject the linear structure of the model. The estimated threshold value of the VIX index ($\hat{\gamma}$) is 25.61 with a 95% confidence interval = [13.08, 26.85][8].

The next step consists in estimating the slope coefficients of the PTR models with two regimes. The results are reported in Table 1.

Table 1. Threshold regression estimations results

	Regime 1: VIX ≤ 25.61		*Regime 2: VIX > 25.61*	
	Coefficient estimate	**t-stats**	**Coefficient estimate**	**t-stats**
Global excess liquidity	1.9305	4.9559***	-0.1801	-0.5016
Real GDP growth	2.2813	6.5826***	1.4640	3.7829***
Inflation rate	3.1393	2.9626***	1.7636	3.0316***
Three-month interbank rate	-1.7694	-3.1787***	-1.4883	-2.9626***

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively

The results indicate that in period of tranquil times *i.e.* when global risk aversion is below the threshold value, global excess liquidity has a significant positive impact on emerging asset prices. This result is consistent with those obtained among others by Becker (2009) (see *infra*). The estimated coefficients for control variables are all significant at the 1% level with expected signs. However in period of financial stress, it seems that global excess liquidity do not continue to have a significant impact on equity prices on emerging markets as the coefficient associated to M0Y become statistically no significant. This implies that

[8] The Matlab codes have been provided by Candelon, Colletaz and Hurlin (2011) and Hurlin (2012).

global excess liquidity has strong spillover effects in emerging markets during over-optimistic phases. But this relationship appears to be nonlinear. This effect disappears with the investors' sentiment shift and the rise of risk aversion.

We also have included the domestic $M2$ rate of growth in the model in order to take into account the domestic monetary creation. The results are presented in Table 2.

Table 2. Threshold regression estimations results

	Regime 1: VIX ≤ 12.99		*Regime 2: VIX > 12.99*	
	Coefficient estimate	**t-stats**	**Coefficient estimate**	**t-stats**
Global excess liquidity	2.4226	3.0526***	0.2503	0.6625
Real GDP growth	1.7701	1.8695**	2.9846	10.3116***
Inflation rate	5.3644	2.7986***	1.5791	1.1553
M2	-0.4313	-0.7288	0.3667	1.3314
Three-month interbank rate	-3.5162	-3.1884***	-1.1633	-2.2948***

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively

The test results for a single threshold is significant the F1-stats = 30.9176 with a bootstrap p-value = 0.0000 allowing us to reject the linear structure of the model. The estimated threshold value of the VIX index ($\hat{\gamma}$) is 12.99 with a 95% confidence interval = [11.56 40.00]. As in previous estimations, we find that global excess liquidity has a positive significant impact on asset prices when the investors' sentiment is positively-oriented, *i.e.* when the VIX is below the estimated threshold. Its impact becomes no statistically significant when the VIX exceeds the threshold. All control variables have the expected signs and are statistically significant at the 1% level when the global risk aversion index is low. However the estimated coefficient of M2 is not significantly different from zero. So global monetary aggregates seems to have a greater impact on emerging asset prices than domestic ones.

6 Conclusion

The global excess liquidity, regardless of the indicators used, increased from the mid-nineties, before accelerating again in early 2000 with the easing of monetary policies of industrialized countries, following the collapse of the Internet bubble in the U.S., then in 2008-2009 during the subprime crisis. So far, the relationship between money growth and asset prices has been studied very little in an international context, and manly for industrialized countries. In this paper, we analyze the impact of global monetary shocks on

emerging countries. By focusing on spillover effects of global liquidity and on emerging countries, this paper contributes to the debate. Moreover, our broad liquidity measure allows us to consider the role of international reserves. We find support that an excess of global liquidity contributes to the increase in share prices. The findings of this paper are broadly in line with previous studies applied to industrialized countries. We show however that this relation is nonlinear. The relationship between global excess liquidity and emerging equity prices is strong during low risk aversion periods, but disappears during financial stress periods.

Our results confirm that monetary policy has no longer only domestic effect but has global impact. Moreover, variables have very different behaviors during normal periods and crisis periods. Finally, that means that monetary policy must be cautious during optimistic periods and must have a pre-emptive action.

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