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HOARDING INTERNATIONAL RESERVES AND GLOBAL LIQUIDITY EXPANSION, WHAT ARE THE LINKS AND DO THEY MATTER?

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ABSTRACT
Global liquidity expansion raises concerns amongst regulators and policy makers, especially since its evolution is closely related to destabilizing phenomena's, particularly for the financial sector. Despite that those effects are largely investigated in the advanced countries, the literature is scarce concerning the effects for the emerging and developing economies. In this paper, our objective is to investigate the links between the hoarding reserves observed in the Asian emerging economies and the development of the global liquidity conditions in the core countries. For this purpose, we study the theoretical relationships between the two phenomena and provide an empirical approach that evaluates the influences of the growing demand for reserves in the emerging countries into the main reserves issuing country. We particularly focus on macroeconomics consequences and the effects on the developments of global liquidity conditions.
JEL classification: C32, E42, E43, F41
KEYWORDS: *SVARs, Global liquidity, Emerging countries, International reserves*

INTRODUCTION

Although *Global liquidity spillover effects* on receiving economies have been greatly explored in the literature since Baks and Kramer's (1999), those consequences have not fully been developed yet, especially the effects of global liquidity expansion on emerging economies (EMEs). Recent studies suggest that global liquidity developments drive the same mechanisms in both emerging and advanced countries, namely strong money and credit growth, asset prices appreciation, and more importantly, downward pressure on the long term interest rates (ECB, 2011). While those consequences in the advanced countries have been largely reported in the literature, changes in global liquidity conditions induce slightly different consequences on the emerging markets. Specifically, EMEs are subjected to different concerns that may have important consequences on their economies, in particular greater financial vulnerabilities and dependence to exports relative to advanced economies. While the topic of reserve accumulation behavior in EMEs is quite well developed, the links between global liquidity expansion, mostly the official liquidity, and reserve accumulation lack consensus in the literature. Previous studies (Baduel, 2012; Djigbenou et al, 2015) have analyzed the link between global liquidity expansion and its consequences on the reserves progression in EMEs. However, the feedback outcomes of reserves accumulation behavior in the EMEs to the reserves issuing countries are not fully detailed yet. Our main objectives are to review theoretical relations between global liquidity expansion in the advanced countries and its implications on the reserve accumulation behavior in the EMEs, in particular in the Asian EMEs. We also investigate the feedback effects of the reserve accumulation trend on major reserve currency issuers and how this behavior affects the global liquidity conditions.

In order to investigate those feedback effects, the paper is structured as follows: in the first section we present the recent evolutions of reserve accumulation in the emerging countries and we analyze its drivers; in the second section, we undertake an analysis of the hoarding reserve behavior through the lens of demand and supply for reserve assets distortions; in the third section, we investigate the links between reserve accumulation and the global liquidity; the last section is dedicated to an empirical analysis of the macroeconomic consequences of the hoarding reserve trend in the Asian EMEs on the reserve issuer countries and on global liquidity conditions.

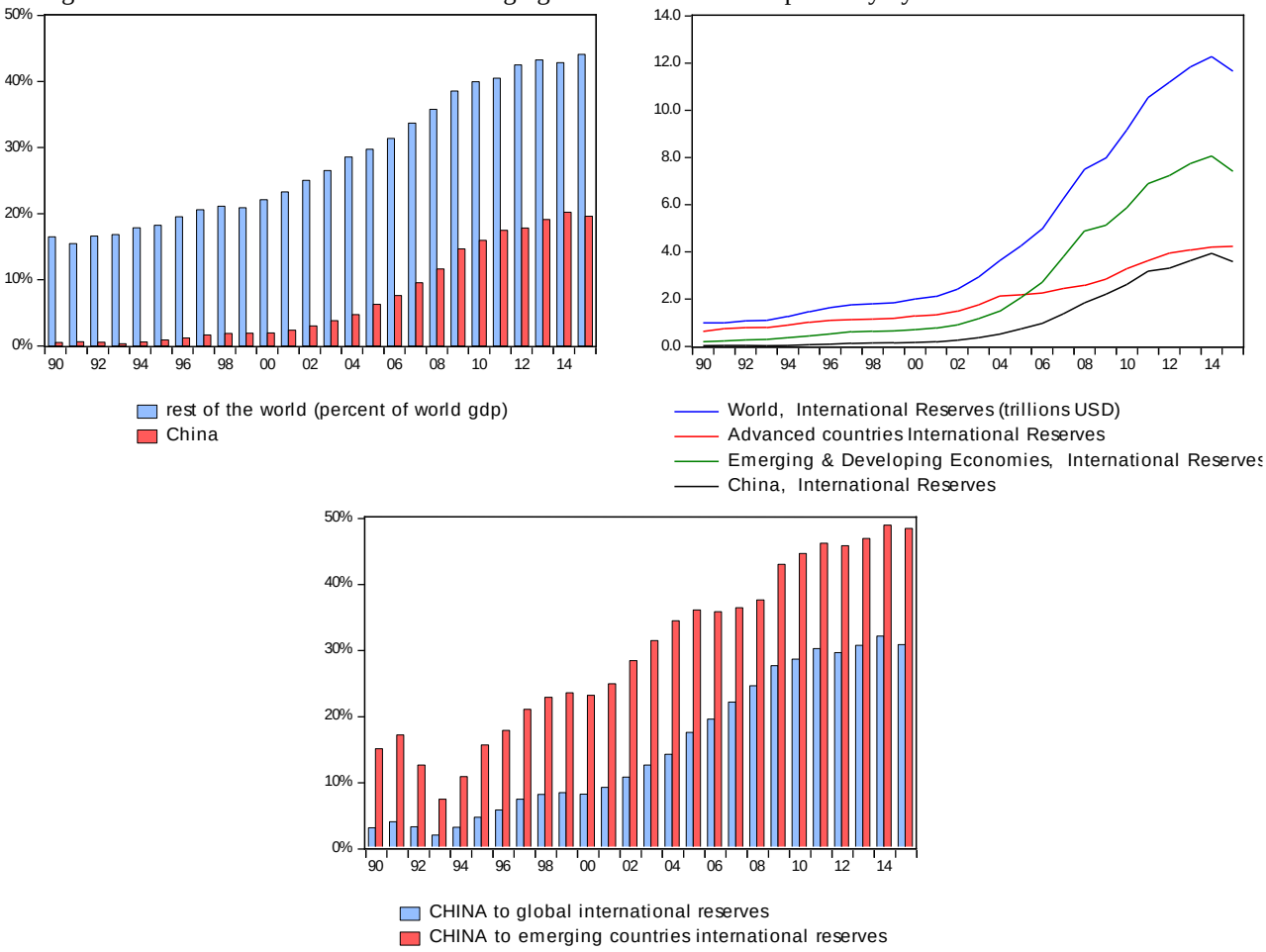
I. Understanding the reserve accumulation trend in the Emerging countries

Since Heller (1966), the question of the optimal level of foreign exchange level has been widely investigated in the literature, especially concerning their theoretical considerations. Nevertheless, the theme has gained new importance, as the reserve accumulation and their outcomes have become a new trend in the emerging Asian countries since the late 1990s.

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1. Recent trends concerning the global reserve accumulation

Since the late 1990s, the global reserve accumulation has increased abruptly, with an average annual growth of 31% during the period of 1996-2015 (approximately 800 billion usd per year). This strong growth is essentially led by two groups of countries (figure 1): the emerging market, in particular China, and the oil exporting countries. The reserve accumulation pace in the advanced countries in turn has slowed since the early 2000s and was surpassed by the emerging countries[1] in late 2005. Moreover, the global financial crisis (GFC) only slowed the reserve accumulation for a short period, since the trend recovered its pre-crisis pace by 2009 and reached its historical peak during mid 2014 at 12.78 trillion usd. By the end of the year, the global reserve accumulation growth had begun to slow as the Federal Reserve began to curtail their quantitative easing program ("tamper tantrums") and this decision had affected the emerging countries' reserve accumulation strategy as some Asian countries experienced capital flight and depreciation of their currencies. To fully understand how fast the pace of global reserve accumulation was during this period, it must be mentioned that the global reserve was 11.8 times their 1990 level; in comparison the world GDP was only multiplied by 3.1 times during the same period. This strong pace led to a maximum record at 23% of the ratio of global international reserve to world GDP in late 2014 before slowing down at the beginning of 2015 after the FED's decision. At a regional level, this trend has not been uniform since emerging and developing countries behaviors insofar as emerging countries are the main drivers of the global reserve accumulation trend since the late 1990s with an annual growth of 57.3% until 2015. The advanced economies, in turn, have had a steady reserve accumulation annual growth of 13.7%, which significantly equals the annual growth rate of the period 1980-1995 (17.9% per year). Finally, on a national level, China has displaced Japan as the largest international reserve holder as its assets represented 32% and 49% of the global international reserves and the emerging countries reserves respectively by the end of 2014.



Sources: IMF, authors' calculations

Figure 1: **Reserve accumulation in Emerging and developing countries**

[1] *Despite the growing importance of the Asian emerging countries, Japan remains the second largest reserves accumulator during the period.*

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2. Why do emerging countries accumulate reserve?

Considering the literature on the topic, two main causes have been put forth to explain the reserve accumulation trend in emerging countries: the precautionary motive and the mercantilist motive.

2.1. Precautionary motive

First, the precautionary driver for international reserve is closely related to crisis-insurance and "self assurance" motives in the aftermath of the Asian crisis in the late 90s. As the pegged exchange rate has been the predominant exchange rate regime adopted in the region during the pre-crisis period, the lessons learned from the rapid depletion of foreign exchange reserves during the crisis led regional policy makers to change their behavior concerning the international reserve optimal level. They started to rebuild their foreign assets in the early 2000s to insure themselves against future macroeconomic or financial shocks on their economies, since they wanted to protect themselves from the dreadful macroeconomic consequences of the crisis they had just experienced. Furthermore, they started this policy of building large international reserves to overcome the dependence on the international community during times of macroeconomic and financial stress. Also, because most of the emerging Asian countries experienced persistent current account surpluses, this situation has resulted in an unparalleled accumulation of international reserve and has also affected the countries that were not directly affected by the crisis (China, for instance). Moreover, the literature (Noyer, 2007) suggests that building large international reserves, not only tends to reduce the probability of speculative attack, but also allows lessening macroeconomic damages due to the Global Financial Crisis. Such results constitute an important incentive for Asian economies to continue their accumulation policy. They only slowed their reserve accumulation during the crisis to support their economies, as the growth rate of the reserve accumulation in the Asian countries slowed to 14.5% during the year following the crisis while it was 40.6% in 2007.

Second, from theoretical and empirical perspectives, the precautionary driver for holding reserve was originally underlined by Heller (1966) in his pioneering works using a cost-benefit approach. The author stressed that this driver is preeminent than the transaction driver usually used in the previous studies and showed that the precautionary driver for reserve holding is determined by three parameters; the cost of adjusting to an external imbalance; the opportunity cost of holding reserves and the likelihood of a situation where the need for reserves would occur. Heller determined that holding international reserves helps funding transitory deficits from external trade shocks and lessen the costs adjustments in terms of welfare. More recent works on the optimal demand of reserves tend to focus on the financial openness than trade openness by introducing new vulnerabilities (capital account openness, foreign liabilities, external debt, etc.) and their consequences on the domestic financial systems (currency mismatches and probability of capital flight) by using extended buffer-stock models introduced by Frenkel and Jovanovic (1981) since this framework offers a broader perspective on the optimal level of reserve issue. For instance, latest studies show that the importance of financial variables is increasing at the expense of the trade openness variables, especially the variables of modeling external financing whose influence has being growing since the last decade (Cheung and Ito, 2009). Additional determinants are introduced in recent studies such as financial stability underlined by Obstfeld et al. (2010) in which they show that the probabilities of sudden stops and capital flight episodes could explain the reserve accumulation over the recent years. These results are confirmed by Mendoza (2010) who shows that the explanatory power of the driver is growing in the Asian countries after the crisis period since those countries had experienced financial stability concerns. He finds that these countries tend to build large reserves for self-insurance since they do not have access to other forms of contingency measures and instruments.

2.2. The mercantilist/transaction motive

According to Dooley and al. (2003, 2007) and Noyer (2007), the mercantilist approach explaining the foreign reserve accumulation in Asian countries is justified by the export-led growth strategies adopted in those countries. Asian emerging economies are intentionally pursuing these policies by maintaining undervalued exchange rate in order to promote their exports. As a corollary they affect the US current account deficit, since the US is the main outlet of their products. In addition, Asian emerging economies are historically on the receiving end of direct foreign investment, the authors underlined that excessive reserve accumulation behavior may act as "collateral" guaranteeing that foreign investment. This link between the US consumption (and saving) patterns and the emerging Asian countries economic growth is at the heart of the discussion on the global imbalances topic.

From a theoretical standpoint, the attention regarding the mercantilist motive has been growing over recent years because the precautionary motive failed to fully explain the recent trend regarding the reserve accumulation in the emerging countries since the early 2000s (Aizenman and Lee, 2007). This approach explains the accumulation behavior observed in the emerging Asian countries as a consequence of their current account surpluses specifically the export-led strategies explained previously. As a result, the hoarding reserves behavior observed in China and

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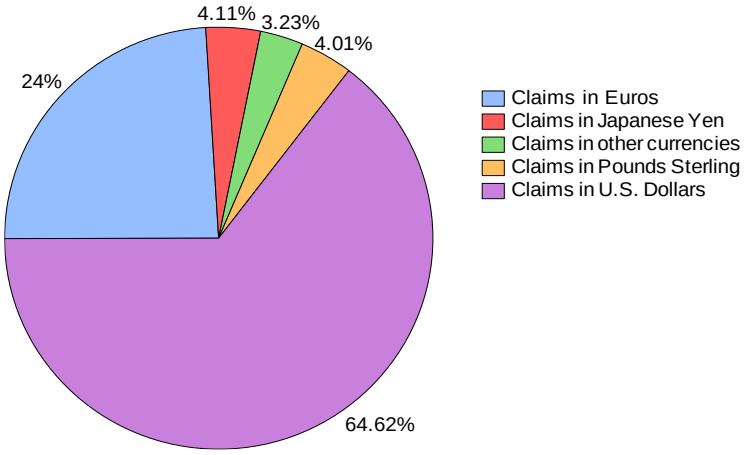
the other emerging Asian countries (Aizenman, 2009), is explained by the trade competitions between those countries instead of the self insurance motive from the late 90s to 2006 before the GFC (Aizenman, Cheung and Ito, 2014). According to the mercantilist motive, the optimal level of reserve is associated with the degree of reserves that maintains external competitiveness and preserves the exchange rate at undervalued levels. However, this motive has also its flaws since it cannot fully explain the excessive trend in reserve accumulation despite it has more explanatory power than the precautionary motive.

3. Remarks on the determinants of international reserves

As there is no consensus in the literature explaining the surge of hoarding reserves in the Asian countries during the last decade, it is important to take into account the outcomes of the GFC on the hoarding international reserve (IR) behavior as its determinants may evolve over time. According to Aizenman, Cheung and Ito (2014), the GFC and the underlying structural changes experienced by China and Korea, for instance, are associated with new patterns of hoarding international reserves. They showed that during the pre-GFC period, the hoarding international reserves pattern in emerging Asian countries is related to the hoarding rivalry motive and especially the precautionary buffer motive as those countries experience commodity price volatility; this results stand in line with IMF (2010). In other words, the pre-crisis IR determinants are closely related to the precautionary motive. During the 2007-2009 GFC, neither of the two main determinants could explain the international reserve patterns, as the factors associated with those determinants could not be measured because of the market turmoil preventing the normal economic relationships from holding. Finally, during the 2008-2012 post-GFC period, the previous determinants explained the IR accumulation pattern despite the lower explanatory power of the precautionary motive. In addition to these determinants, several factors may explain the current trend such as the macro-prudential policy factor, which is found to complement the international reserve accumulation.

II. The hoarding reserves, what are the consequences?

Since the repeal of the Bretton Woods system, the US dollar is currently the major reserve currency and represents approximately 70% of the world allocated reserves before the creation of the euro and falls to 63.9% in 2015; in comparison, the reserves in euro represent only 19.8% of the allocated reserves during the same year. Despite the growing importance of the euro, the dollar's central role is even more significant considering the fact that the total reserves grew by 393% during the period 1999-2015. As seen in the previous section, this growth is essentially explained by the hoarding of international reserve consisting essentially of US dollars initiated by the emerging Asian countries. By the end of 2015, China's reserves alone represent 48% of the emerging countries' reserves and 31% of the world's total reserves. According to Farhi, Gourinchas and Rey (2012), the dollar hegemony and especially the importance of US Treasury bill as the main reserve asset is due to its fundamental characteristics: first, the liquidity of US T-bill provides several benefits for various reasons, especially during crisis period as this asset acts as a safe haven asset, and second, the fiscal capacity and integrity of the issuer which is closely related to the solvability of the US economy. To fully understand the challenges raised by the international reserve accumulation and the central role of the US dollar as a reserve currency, we develop in the following sections the consequences of the IR accumulation on supply side and demand side for safe assets. We also explore the outcomes of this behavior in the safe assets issuing countries and in the applicant countries. Finally, we examine the short term and long term consequences of the IR accumulation behavior.



Sources: IMF, IFS, author's calculations

Figure 2: **total allocated reserves by currency in 2014**

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1. US dollar's hegemony: indications from the reserve asset market

1.1. The "great convergence" and the reserve assets demand

From a historical standpoint, there is a continuous increase in both public and private components of demand for assets reserves during the last decades. This increase is explained at first by the catching up process of the emerging countries, since their economic development is approaching to that of the developed countries. While economic development frequently precedes financial development, convergence affects the demand for assets in two different ways. First, there is an increase in the private component of the demand for assets reserves in emerging countries. The rise in demand from households is driven by insufficient supply of domestic reserve assets because of the inability of their domestic financial systems of these states to provide reliable reserve assets. The private sector demand has its origin in the household retirement concerns, as they want to transfer their purchasing power over time and meet their long-term need, it is important to stress that this demand for safe assets is structural insofar as many emerging countries have weak social welfare systems. Second, there is also an increase in the public demand for reserve assets explained by the inter-temporal approach of the commodity exporting countries; for instance oil producing countries seek to recycle their petrodollars and build a "war chest" to protect themselves against long-term effects of the depletion of their natural resources. In both cases, the rise of reserve asset demand in the emerging countries is the result of public institutions 'failure in the issuance of domestic reserve assets.

1.2. Reserve accumulation policy and reserve assets demand

The second factor affecting the reserve assets demand is related to the reserve accumulation behavior in the emerging countries insofar as this strategy affects directly the demand's public component. As seen in previous section, this behavior is partially driven by the precautionary motive, particularly the "self assurance" motive to cope with the international financial instability. Although this behavior is a source of concerns at global level, principally affecting the evolution of long-term interest rates and global imbalances, recent empirical studies, the IMF (2010) for example, suggests that these countries were less affected by the crisis' outcomes in comparison of the developed economies. During the period, they only slowed their reserve accumulation at the peak of the crisis to support their economy and resumed the international reserve hoarding once again in 2009.

1.3. Reserve asset supply and the emergence of alternative safe reserve assets

On the public side, US dollar's hegemony as quintessential reserve currency is explained by the lack of alternative reserve currencies. Indeed, the euro is the only currency whose the size of its issuer is comparable relative to the US dollar, but unlike the latter it suffers from various structural weaknesses that limit its attractiveness. One of its flaws stem in the fiscal independence of the euro area countries which results in limited integration of its fiscal structure although individually, some countries have financial depth necessary to produce safe and reliable reserve assets. This fiscal independence and the different situations of public debt in the euro zone are the main limits of the euro as reserve currency. During the crisis, there has been a repositioning of the reserve assets demand from central banks to dollar to the detriment of euro, which saw a significant drop in demand and resale of existing reserves to the dollar. At the intra-European level, due to the disparities of budget situations and the quality the public debt that differs across countries, there has also been a repositioning of the flow from peripheral countries to the core countries that offer more satisfactory guarantees. Finally, although the Chinese authorities are actively working on the Yuan's internationalization, it still has a very limited role as a reserve currency. This state of affairs regarding the public supply of reserve currency shows a lack of diversification of the supply of reserve currency, thereby putting the dollar at the center of challenges of the reserve assets market

2. Consequences of the evolutions of demand and supply for reserve assets

On the demand side, there is an increasing demand for reserve assets on a global level, mainly explained by strong demand from the emerging Asian countries and commodity exporting countries. As seen previously, this important growth in emerging countries is explained by several factors, including the lack of a domestic reserve asset, absence or weak development of financial markets, structural weaknesses that limit the creation safe assets, and the households' concerns about their future in countries where these guarantees are lacking.

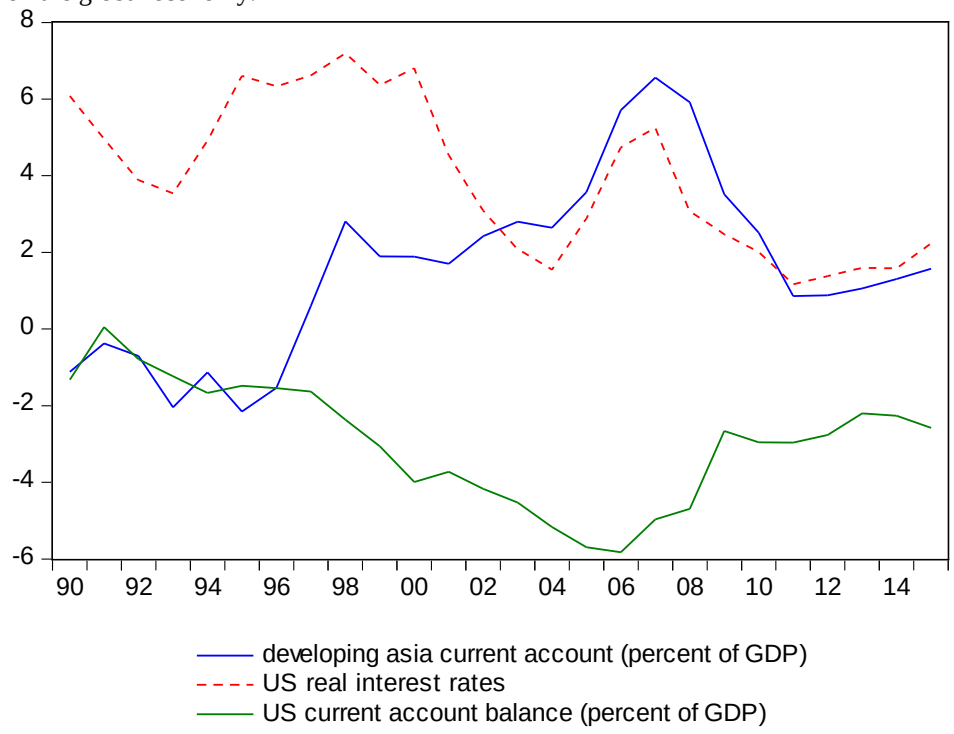
On the supply side, the dollar and US T-bill hegemony against other reserve assets is reflected in the reserves structure of central banks in emerging countries where the dollar is predominant as main asset reserves. This leading role of the US dollar is explained by lack of diversification in terms of supply of reserve assets with the structural weaknesses of the euro that limit its expansion, a bond market not integrated in the euro area and the minor internationalization of Chinese Yuan. Nevertheless, the dollar's role could reduce in the medium term with implications for the reserve assets supply. These limits will come from the internal development of the US economy.

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In sum, these developments concerning supply and demand of reserve assets will affect both the issuing and the holding countries' reserve assets in different ways. These consequences could be summarized into four points: the short and medium term consequences; and the implications of the demand and supply distortions.

2.1. Short term consequences

The continuous growth of the public demand for reserve assets has consequences for the amplifications of imbalances mechanisms involved during the pre-GFC period, in particular the effects of low, long-term interest rates. Indeed, the excessive demand for safe assets in emerging countries greatly contributes to lowering the global interest rates and exerts influence on the liquidity cost. In turn, these extremely low interest rates will lead to a "search for yield" race by financial markets' participants. Such behavior may lead to financial assets and house prices bubbles that have strong macroeconomic destabilizing implications. These developments that led to the GFC and are still relevant today as the combination of quantitative easing outcomes and the continuing demand for safe assets still contribute for the financial instability. Furthermore, high demand for reserve assets from emerging countries and commodity exporting countries which are associated with a high level of gross saving influences the patterns of the current account in the reserve issuing countries, particularly the United States. The hypothesis of high level of gross saving in the emerging countries affecting the US current account was previously developed by Bernanke (2006, 2011) under the hypothesis of "global saving glut", which included the main short term consequences of the hoarding reserves with the persistence of the "global imbalances" and their consequences on the global economy.



Sources: IMF, World Bank

Figure 3: **Evolutions of current account and US real interest rates**

2.2. Medium term consequences

The continuous growth for safe and reliable reserve assets may contribute to the emergence of a modern version of the Triffin's dilemma in the medium run as the US economy cannot sustain indefinitely the reserve asset supply to meet the increasing demand from the rest of the world. However, are those assumptions still relevant? According to Farhi et al (2012) and especially Smaghi (2011), there are several reasons explaining the presence of a modern version of Triffin's dilemma.

The first factor is related to the reserve accumulation of the emerging countries, which causes distortions on the reserve asset market since those countries add their own public demand in addition to the private demand for US safe reserve assets. As a result, this situation leads to the "Lucas paradox" where the EMEs become net exporters of capital at the expense of the developed countries that become net importers of capital even though according to the theory, the emerging countries are still the historical destination of capital flows. This situation increases vulnerabilities in the US financial markets by driving down real interest rates and risk premiums, which uplift

financial innovation and develop the destabilizing effects that led to the GFC. Furthermore, as in the Triffin's Dilemma, the high demand for US reserve asset induces the same mechanisms since that privilege contributes to a loosening of US economic policy as they tend to rely on the easy credit through the capital flows received from the reserve holding countries during the normal periods. On the other side, during a period of crisis they tend to rely on expensive macroeconomic policies that lead to excessive US indebtedness.

The second reason is related to the observed lack of a credible anchor for international monetary and financial stability as in Triffin's Bretton Woods days. The independent macroeconomic objectives of the key issuers and holders of reserve assets have destabilizing effects on the International monetary system and would not serve those countries' interests in the long term. Particularly, those policies would not take account of the negative externalities for other countries and especially for the global financial stability, as they tend to produce unsustainable imbalances and produce vulnerabilities in the global financial system. The credible factors contributing to these imbalances have been largely developed in the literature, especially under the hypothesis of global liquidity glut and global saving glut. Moreover, according to Farhi et al (2012), contrary to the gold standard during the BW era, we must consider the fiscal position of the safe assets issuing countries, especially the US, as a reliable anchor for the global monetary system to understand the new Triffin's dilemma. In the medium term, US cannot sustain the strong growth of the world economy; especially through the supply for safe assets as the US dollar monopoly as currency reserve will tend to a multipolar reserve currency perspective.

In sum, there is still no credible mechanism for symmetric adjustment of imbalances nowadays despite several differences from Triffin's times, such as the wide usage of exchange rates, higher capital mobility due to more financial integration, and higher private international liquidity.

2.3. Distortions in the demand for reserve assets and consequences

As we have seen above, the excessive demand in the reserve assets market is largely explained by the hoarding reserves by emerging Asian countries following the painful episode of the Asian crisis. This policy has allowed these countries to protect themselves from the whims of the global economy but this behavior is a source of negative externalities. Indeed, one can understand this precautionary behavior of Asian countries by the analogy of the consumer precautionary savings behavior at microeconomic level (Leland, 1968 and Sandmo, 1970). For lack of alternative, this policy is the only solution used by these countries to stabilize their economies and allow them to be isolated from external developments. This behavior is entitled as a self-insurance behavior by accumulation of precautionary savings. At a macroeconomic level, although this behavior is rational from the consumer's standpoint; self-insurance leads to an aggregate of excess savings situation whose principal consequences are clearly stated by Bernanke (2006, 2011) as maintaining real interest rates extremely low over a long period and the persistence of global imbalances as this situation reflects the market imperfections in the presence of incomplete markets. This analysis from the consumer behavior and its effects at macroeconomic level can also be transposed in the study of hoarding reserves from the EMEs. In this context, these countries want to protect their economies against macroeconomic shocks by performing an accumulation of assets by analogy to precautionary savings. Reserve accumulation is the only option of insurance possible to deal with various potential macroeconomic shocks. Consequently, there is a situation of an over-accumulation of reserves that causes a downward pressure on the long-term interest rates at global level. This prolonged decline in long-term interest rates enhance the possibility that the global economy is in a liquidity trap situation with consequences undermining the stability of the global economy.

2.4. Distortions in the supply of reserve assets and consequences

This excessive strength on the demand side is coupled with imperfections in the supply of safe assets. Indeed, the very low interest rates that followed the excess demand will cause several consequences, the most important of which will be the weakening of the financial system. Thus, maintaining low interest rates over a long period will cause several distortions, including the emergence of "search for yields" behavior. This will also contribute to the emergence of speculative bubbles whose appearance and disappearance are sources of instabilities and macroeconomic volatilities. Then, the principal distortion resides in the supply side of reserve assets due to the high demand in this market. Indeed, we witness the increase of national indebtedness in developed countries, primarily in the US, and the creation of "virtually safe" assets through securitization that can be summed as an attempt from the private sector to create safe assets. However, this attempt has shown its limits during the GFC, because it is precisely the wrong assessment of those assets that triggered the financial crisis. Finally, this situation has also conducted change of the behavior of financial intermediaries that led to the weakening of their balance sheets along with the excessive uses of short-term financing that are inherently fragile to financial shocks and can lead during periods of stress to fire asset sales.

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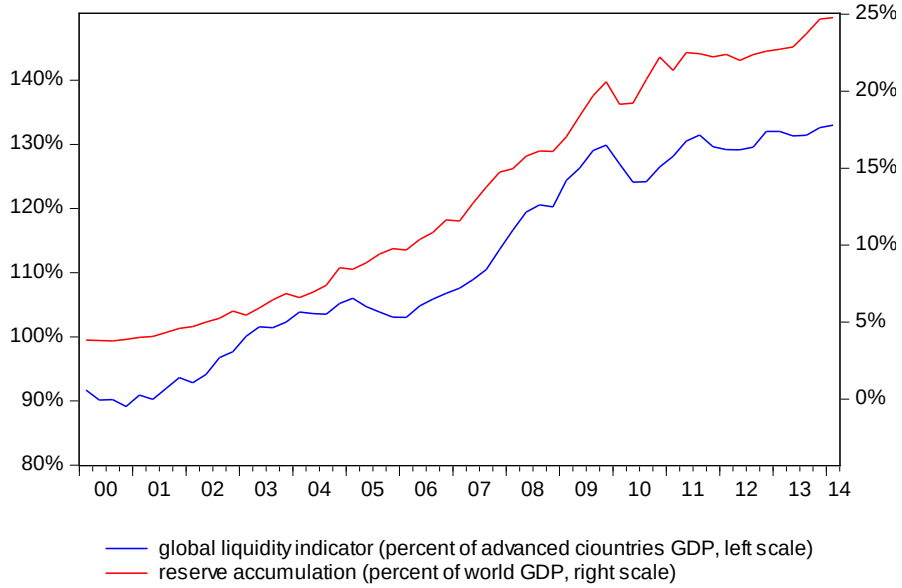
This approach gives us a complete overview of the consequences of the hoarding reserves from EMEs on supply and demand for reserve assets, and this behavior's influence on the real and financial sphere, especially in the US that almost has a monopoly of the supply of reserve assets.

III. Global reserves accumulation and global liquidity

1. Global liquidity and reserve accumulation's literature overview

Since the early 2000, the world has experienced unparalleled expansions of both global liquidity and reserve accumulation. Concerning the global liquidity, the growth was fueled before the crisis by accommodative monetary policies that enhanced the public liquidity available in the advanced countries and affected in turn the financial market by enhancing the creation of private liquidity through financial innovation. After the crisis, the growth was led by the accommodative policies (QE) implemented by central banks in the advanced countries to sustain their economies from the GFC negative externalities. These developments are related to macroeconomic and financial concerns in the global liquidity receiving economies such as asset prices appreciations (Baks and Kramer, 1999; Ruffer and Stracca, 2006; Brana and Prat, 2011), increase in house prices (Djigbenou, 2014) and commodity prices (IMF, 2010), a change in monetary conditions in the receiving economies and their output level (Souza and zaghini, 2004). Another strand of the literature investigate the relations between the global liquidity dynamics and global imbalances (Brake and Fidora, 2006; Park, Fourel and Djigbenou, 2015) which introduced concerns relating the growing global liquidity observed nowadays and the evolution of the reserve accumulation in the emerging countries. On the reserve accumulation side, the growing reserves in the EMEs are explained by the surge of capital inflows into these countries as spillover effects of global liquidity expansion (Psalida and Sun, 2011). Several studies are also investigating the feedback link between the global liquidity and global imbalances with the reserve accumulation as primitive concern (Choi and lee, 2010) as global liquidity expansion account partially to the large current account surplus in the EMEs and the evolutions of sterilized interventions in the foreign exchanges market have consequences on the domestic reserves asset and domestic level investment level. The authors showed that an increase of sterilized interventions conduct the capital inflows to be reallocated into reserve accumulation in place of ending in the domestic investment and in turn, the reserve accumulation lowers the US interest rates diminishing the shrinking process of the global imbalances. A new approach on the global liquidity and global imbalances topic have been developed under the hypothesis of "global liquidity imbalances" (Gourinchas, 2012), in which the author supports that the traditional approach using the net imbalances and current account does not work anymore. Instead, the approach that does work involves gross imbalances, particularly regarding the liquidity component of those imbalances. He underlined that the gross external position is a better indicator of external position than the standard current account indicator.

This short overview on the global liquidity and reserve accumulation concerns present the actual challenges between these phenomena. The next section is dedicated to determining the possible links and consequences of the combined evolutions of the global liquidity and hoarding reserves on advanced countries and emerging countries.



Sources: IMF, COFER, author's calculations

Figure 3: **Reserve Accumulation in Asian EMEs and Global liquidity evolutions**

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2. Global liquidity and reserve accumulation framework

For the purpose of our analysis, only the public component of global liquidity is considered in this section. We define the official public component of global liquidity as the monetary aggregates issued by monetary authorities and used by domestic agents inside and outside their own monetary areas for transactions purposes. This public component of global liquidity is essentially fueled through the policies implemented by the central banks in the advanced countries. Those monetary policies are defined individually by each central bank according to their macroeconomic objectives and conditions. In turn, these actions contribute to the growth and declines of global liquidity conditions, particularly since the GFC and the beginning of the quantitative easing programs in the United States and the other advanced countries, which reveal accurately the effects of the independent decisions for monetary authorities over the evolutions of global liquidity. Since the crisis, one of the main drivers of global liquidity expansion is the quantitative easing in the advanced countries and reintroduction of excessive global liquidity concerns. Additionally, these domestic developments leading to the increase of the global monetary liquidity affects the emerging countries' monetary conditions as the advanced countries' official liquidity are also transferred to other receiving economies by affecting their economies and markets through different channels, particularly the foreign exchange reserves, if the capital flows into these countries are not correctly sterilized.

According to previous studies on the global liquidity topic, it is important to consider the Mundell-Flemming framework, particularly the Mundell trilemma to understand the global liquidity and reserve accumulations dynamics between the core issuing countries and the receiving countries of the global liquidity. The Mundell trilemma or the "impossible trinity" shows that a country cannot simultaneously achieve financial openness, monetary policy independence, and exchange rate stability; the monetary authorities have to choose only two of these objectives. In this context, conventional and non-conventional monetary policies are labeled as "push" factors as they induce the same mechanism in a two-country framework (Park, Djigbenou, Fourel, 2015; ECB, 2011). Firstly, an accommodative monetary policy in the first country, especially in the US as the leading country, drives upward the interest rates' differences between the two countries and redirects the capital flows to the second country with the attraction of local financial assets. Moreover, those capital flows induce currency appreciations in the second country and also affects the competitiveness of their local product. To cope with their asset and currency appreciations and to prevent capital outflows, the monetary authorities in the second countries may have to reduce their key interest rates to rebalance the interest rates differences between both countries. Secondly, when quantitative easing and other non-conventional policies are implemented in the core country, it impacts essentially investor's portfolios through assets prices evolutions. So to protect themselves from these external developments, investors redefine the allocation of domestic and foreign assets in their portfolio to maintain their risk and return expectations because of the asset prices appreciation in the second country. This measure affects the global liquidity conditions as well since the monetary authorities in the second country will have the choice between letting the markets self-correct and choosing to implement an accommodative policy to counter the effects of the policy conducted in the core country. As a result, the combined actions in of the monetary authorities in both countries enhance the official component of global liquidity.

Since the global liquidity expansion and strong capital flows into the receiving economies result in several concerns for financial stability, the most important of which are strong upward pressures on asset prices, undesired exchange rates appreciations that could undermined the competitiveness of the economy. As seen in the previous sections, the reserve accumulation in the receiving economies may act partially as buffer against future crises for precautionary purposes and as a tool for maintaining export competitiveness by controlling the domestic currency path for mercantilist purposes. These motives are important as it introduces the feedback effect of reserve accumulation behavior on global liquidity. So according to ECB (2011), the accumulation of reserves can contribute to global liquidity through its effects on the global liquidity conditions, as it affects the global bond yield configurations, as capital flows are channeled from emerging markets to advanced countries. The effects are particularly relevant concerning the US economy, as the US Treasury bonds are the main reserve assets globally. As a result, the strong demand for safe and reliable asset from emerging countries exerts downward pressures on yields and hence has an impact on the global liquidity.

IV. Global reserves accumulation Effects on the global liquidity conditions in the core country.

In this section, we undertake an empirical analysis about the outcomes of the global reserve accumulation in the emerging Asian countries on the main reserves issuer country, the United States. For this purpose, we implement a Structural Vector autoregressive (SVAR) model to determine the effects on the US economy, especially their contemporaneous effects on the path of the US current account and the global liquidity conditions.

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1. Data and preliminary transformation

1.1. Data

For the purpose of our analysis, we collect series in quarterly frequency from the first quarter of 2000 to the third quarter of 2015. Two groups of countries are considered in this investigation: on the one hand, the United States as the main issuer of international reserves, and, on the other hand, the Asian EMEs and Japan as the main region accumulating foreign reserves. The database contains the following US domestic variables:

- The current account balance to represent the effect of reserve accumulation on US current account.
- The US 10 year Treasury bond yields as the benchmark for the long-term interest rates.
- Indicator of performance in the US financial market to represent the US asset prices from the OECD share prices NYSE composite index.
- The real estate prices in the US using OECD house prices index.
- Indicators for US consumption, saving and investment.
- The US consumer price index (CPI).

Additionally, as a proxy of reserve accumulation in US dollars, we use the holdings of US Treasury bills by EMEs, particularly Asian Emerging countries. We choose this indicator contrary to the traditional metrics[2] (Short time Debts, Imports cover,…) of reserve accumulation, as our main objective is to review the destabilizing effects of the hoarding reserves in the issuing countries, it is important to distinguish claims in dollars from claims in other currency. Moreover, we focus exclusively on US reserve asset because of the main importance of the US safe assets in the safe reserve market.

Finally, such data are available from the Treasury securities (TIC) database, the IMF, BEA and Macrobond databases.

1.2. Data issues and preliminary treatment

Before implementing the SVAR procedure, some data requires to be treated afore beginning the estimation.
Firstly, it turns out that several series as TIC securities or the consumer price index are only available in monthly frequency, so the quarterly transformation is applied to these data. Then, we choose to transform the data into constant term by using the consumer price index for the consumption, saving and investment series; then we use the inflation in the US to determinate the real long-term interest rates using the 10-year treasury yield. The series modeling the house price index and asset price are extracted directly in constant prices so they do not need any further treatment. Also, before proceeding to the next treatment, we express some of our variables in logarithm (share and house prices, reserve accumulation variables) and the other variables are expressed in percent of US GDP (consumption, current account balance).

Secondly, we choose to detrend our series by using the Hodrick Prescott filter (1980), despite the voices arguing against the use of the HP filter in a VAR framework (VAR-in-level models). Particularly, considering the Ashley and Verbrugge (2009) comments which indicate that the model using this kind of data has a less explanatory power than the Lag augmented VAR models suggested by Toda and Yamamoto (1995) and the first difference VAR models when it comes to identifying the Granger causality relationships and estimating confidence levels.

---

[2] *The traditional metrics to measure the reserve adequacy, which is largely used and cited in the academic literature, are summarized into the simple following rules of thumb. Despite their simple definition and relevance, these metrics are difficult to interpret.*

Ratio of reserves to imports *is defined as a measure of the number of month's imports that should be sustained by the foreign exchange reserves during a crisis, in particular when export revenue and external financing cease. This rule is especially relevant for low incomes countries (LICs). Indeed, such countries are relatively immune to international financial shocks -as their level of international financial integration is still low- but very sensitive to trade shocks due to their dependence on commodity exports. According to this measure, the traditional benchmark is three months of imports covered by international reserves.*

Short-term debt (STD) *or the thumb rule of "Greenspan-Guidotti" is the indicator of reserve adequacy usually used by EMEs with open financial account. This indicator has the advantage to be a measure of crisis risk for market access countries and its common measure proposes to cover 100% of STD for one year. The 12 months coverage is essentially arbitrary and depends on the definition of "short term" but it is important that the country should able to "be out of the market for one year" (IMF, 2010) because of the uncertainty of the crisis duration.*

Broad money (M2) *or the ratio reserve to M2 (20 percent level is the consensus amongst policymakers) is an indicator that captures the risk of capital flight during financial crises. This indicator rests in the fact that such crises tend to be linked to bank runs. In this context, the monetary aggregate M2 gives a proxy to estimate the amount of liquid domestic assets that domestic and foreign agents can easily concert in foreign reserves.*

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However, according to Bernanke et al. (1997), the VAR-in-level models using HP filtered data is relevant in a business cycles framework and more broadly in a dynamic general equilibrium model. Furthermore, the choice of the HP filtered data is also motivated by the fact that we do not test for Granger relationship in the SVAR framework as we aim to discuss the transmission channels of the reserve accumulation behavior into the reserves issuer country by identifying the short term consequences of this accumulation behavior. In other words, we do not seek to demonstrate the medium consequences through a cointegration analysis between our variables.
Thirdly, we check every variable for the existence of multiple breakpoint tests by using the Bai-Perron (1998) methodology. The results[3] suggest the existence of structural breakpoints on the intercept of each series that may lead to non-significant results for our estimations. We deal with this particular issue by introducing dummy variables during the dates of break and we are careful to not fall into the "dummy trap" by not treating at least one of our variables with this method, particularly the reserve variables.
Fourthly, despite the fact that we decide to perform a SVAR in level, we undertake unit root tests[4] to verify that all of our variables are currently I(0) after the HP filter is conducted.
Finally, The previous transformations allow us to create the following endogenous vector for our analysis. The following endogenous vector gathers all the variables useful for our approach. However, as we aim to test different models, the endogenous vector may differ across specifications.

$$y_t = (reserve_t; i_t^{lt}; house_t; asset_t; consumption_t; saving_t; Investment_t; CA_t) \qquad (1)$$

2. Methodology

2.1. Structural VAR model

Our modeling strategy is based on the Structural VARs models developed by Amisano and Giannini (1997), under the *AB model* approach. The main purpose of this method is to obtain a non-recursive orthogonalization of the error terms for impulse response analysis. This methodology is an alternative to the recursive Cholesky orthogonalization that requires that we impose enough restrictions to identify the orthogonal (or structural) components of the error terms.
We consider y_t a k-element of the vector of endogenous variables and $\Sigma = E[e_t e_t']$ the residual correlation matrix. Considering the recommendations on the SVAR topic, the AB model that we consider may be written as follow:

$$Au_t = B\varepsilon_t \qquad (2)$$

Where u_t and ε_t are vectors of length k; ε_t is considered as observed (or in reduced form) residuals while u_t is the unobserved structural innovations. A and B are $k \times k$ matrices to be estimated. The structural innovations u_t are assumed to be orthonormal as its covariance is an identity matrix $E[u_t u_t'] = I$. The assumption of orthonormal innovations u_t imposes the following identifying restrictions on A and B as follow:

$$A\Sigma A' = BB' \qquad (3)$$

Considering that the expressions on both sides are symmetric, we can follow the setting for linear restrictions on the A and B matrices explained formally by Breitung et al (2004). As there are altogether $2K^2$ elements in the structural matrices, and the maximum number of identifiable parameters in these matrices is $K(K+1)/2$, we need $2K^2 - K(K+1)/2$ further restrictions for exact identification. The identifying process of the restrictions is discussed in the next section.

2.2. Specifying the identifying restrictions

The benchmark model of our analysis includes five US domestic variables and one external endogenous variable:

$$y_t = (reserve_t; i_t^{lt}; house_t; asset_t; consumption_t; CA_t) \qquad (4)$$

The previous vector yields to the reduced form for disturbances: $u_t^r, u_t^i, u_t^h, u_t^a, u_t^c, u_t^{CA}$. The model for innovations $Au_t = B\varepsilon_t$ is specified as:

[3] *See annex p.43*
[4] *See annex p.42*

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$$\begin{pmatrix} 1 & a_{12} & 0 & a_{14} & 0 & 0 \\ 0 & 1 & a_{23} & a_{24} & a_{25} & a_{26} \\ 0 & 0 & 1 & a_{34} & a_{35} & 0 \\ 0 & 0 & a_{43} & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & a_{56} \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} u_t^r \\ u_t^i \\ u_t^h \\ u_t^a \\ u_t^c \\ u_t^{CA} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} \end{pmatrix} \begin{pmatrix} \varepsilon_t^r \\ \varepsilon_t^i \\ \varepsilon_t^h \\ \varepsilon_t^a \\ \varepsilon_t^c \\ \varepsilon_t^{CA} \end{pmatrix} \quad (5)$$

In the expression (5), the structural shocks represent respectively the reserve accumulation in the Asian countries shockε_t^r; long-term interest shock ε_t^i; house price shock ε_t^h; financial assets prices shock ε_t^a; US consumption shock ε_t^c and finally the current account shock ε_t^{CA}. Our identification scheme of A matrix follows the hypothesis below:

- The first row represents the reserve hoarding process in the Asian countries. As we only consider the accumulation for US reserve assets, we assume that the hoarding process contemporaneously affect the interest rates in the US markets through the liquidity feedback into US economy hypothesis developed in the previous sections. Also, considering the fact that the US financial markets are highly integrated, the evolution in the US bond markets may have consequences in the other segments of the financial markets. We assume that the asset prices are responding to the high demand in the reserve asset market.
- The second row represents the global liquidity conditions[5], which affect the US domestic variables in the short term through its impacts on long-term interest rates. Consequently, consumption, asset prices, house prices and the US current account react to the US interest rates. For instance, the push factors (Baks and Kramer, 1999) induced by the global liquidity expansion may heighten the reserve accumulation in the receiving countries and in turn, they affect the path of interest rates in the issuing countries which also influence the evolutions of the asset prices and the house prices. Furthermore, this situation also intensifies the US current account deficit (Park, Djigbenou and Fourel, 2015) and affects the consumption, saving and investment patterns (Bernanke, 2006, 2011).
- The third and fourth rows express the links between the real estate markets and the financial markets in the US as their evolutions are closely related during normal times. So the house prices contemporaneously affect the asset prices and reversely. Additionally, the third row expresses the housing wealth effect (Carrol and Zhou, 2010) as the evolution of the housing prices and the stock prices affect the consumption of the US households. Particularly, as stressed by Aciovello (2011), there is a causal link between the consumption and the housing wealth as they tend to move together empirically despite the fact that theoretically, an increase in housing health should have a negative consequences on non-housing consumption.
- The fifth row represents the relation between US consumption and the current account patterns. This row underlines that the US current account may also react in the short run to US consumption as a growth in level of consumption in the US may intensify the imports of foreign goods that deepen the current account deficit.
- The sixth row represents the current account innovations. We assume that it does not have any contemporaneous effect on other endogenous variables.

2.3. SVAR estimation strategy

As our final objective is to investigate the consequences of the hoarding reserve on the US domestic variables through impulses function responses and variance decomposition analysis, we use the following estimation strategy:

First, we have to estimate the underlying VAR model before applying the SVAR framework. For this purpose, we need to define the optimal lag length by computing the information criterion. We follow Ivanov and Killian (2005) recommendations by giving in priority the choice to Akaike information criterion (AIC) and the Hannan-quinn information criterion (HQC) since those information criteria tend to produce accurate quarterly VAR for a sample size fewer than 120 quarters.

Second, we introduce subset restrictions for our underlying VAR model by using a the sequential elimination of regressors strategy developed by Lütkephol and Brüggemann (2001) that sequentially delete the regressors which lead to the largest reduction of the AIC criterion until no further reduction is possible. The procedure eliminates only a single regressor in each step and new t-ratios are computed for the reduced VAR model at each step. This procedure improves the accuracy of the underlying VAR estimation and improves the impulse response functions.

[5] *We consider only the effect of the evolution of long term interest rates as main transmission channel*

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Third, we estimate the structural VAR model from the underlying VAR by using maximum likelihood from scoring algorithm (Amisano and Giannini, 1997; Breitung et al., 2004). The SVAR estimation use the variance-covariance matrix of the reduced VAR model and the restrictions imposed for the structural form. We then check if the system is overidentified by implementing a likelihood ratio test. For example, the benchmark model is overidentified by five restrictions , as our AB model requires 51 restrictions for exact identification.

Fourth, the Impulse Responses functions are calculated from the coefficient of the newly estimated SVAR model. We then construct confidence intervals (CIs) by bootstrap computing method. For the purposes of our analysis, we consider two CIs: the standard percentile interval by Efron and Tibshirani (1993) and Hall's studentized interval by Hall (1992) to check for the robustness of our IRFs results.

Fifth, we compute the Forecast error variance decomposition (FEVD) based on the structural innovations. But unlike the standard VAR FEVD, it may not be possible to associate the structural innovations uniquely with the variables of the system (Lütkepohl, 2004). The SVAR FEVD is not decomposed into contributions of the different variables but into the contributions of the structural innovations, so we center our analysis on the contributions of these structural innovations.

3. Empirical results

3.1. Asian hoarding reserves behavior: Benchmark model

3.1.1. Preliminary results

As underlined in the previous section, the restrictions for the benchmark model are represented by equation (5). We consider in this first model that the $reserve_t$ endogenous variable represent the total US Treasury securities (TIC securities) held by foreign emerging Asian countries[6]. Furthermore, according to the preliminary steps of the SVAR procedure, the optimal lag length minimizing to the information criterion (AIC, HQ) is one lag. We implement a VAR (1) model whose estimation results for the VAR coefficient are below:

$$y_t = \begin{bmatrix} 0.877 & 0 & 0 & -0.124 & 0 & 0 \\ 0 & 0.663 & 3.755 & 0 & 0 & 0.124 \\ 0.030 & -0.007 & 1.059 & -0.034 & 0 & -0.005 \\ 0.361 & 0 & 0.877 & 0.768 & 0.105 & 0.042 \\ 0 & -0.055 & 1.465 & 0 & 0.477 & 0 \\ -1.224 & 0.312 & -3.036 & -1.094 & 0 & 0.434 \end{bmatrix} y_{t-1} + \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.422 & -0.367 & 0 \\ 0 & -0.008 & -0.007 & 0 & 0 & 0.002 \\ 0 & 0.035 & 0.037 & -0.047 & -0.056 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -0.313 & 0 \end{bmatrix} Dum_t + u_t$$

Where y_t represents the endogenous vector (3). The SER strategy allows rejecting 39 not significant regressors. The current VAR model is the model minimizing the AIC information criterion used in the SER procedure.
From the VAR (1) model, we estimate the SVAR(1) associated with the restrictions described in (4) and the estimated structural parameters of the AB model is described by the following results:

$$\tilde{A} = \begin{bmatrix} 1 & -0.0174 & 0 & 0.1647 & 0 & 0 \\ 0 & 1 & 1.7078 & 0.9664 & 0.2782 & 0.0073 \\ 0 & 0 & 1 & 0.2811 & -0.0353 & 0 \\ 0 & 0 & -18.9187 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & -0.1298 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \text{ and } \tilde{B} = \begin{bmatrix} 0.0247 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.2117 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.0113 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.1683 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.0126 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.2628 \end{bmatrix}$$

Since the structural parameters are not informative compared to the impulse functions analysis, we also display the estimated contemporaneous impact matrix obtained from the Maximum Likelihood estimates of the structural parameters before performing the IRFs analysis:

$$\tilde{A}^{-1}\tilde{B} = \begin{bmatrix} 0.0247 & 0.0037 & -0.0062 & -0.0042 & -0.0034 & -0.0009 \\ 0 & 0.2117 & -0.0359 & -0.0118 & -0.0543 & -0.0152 \\ 0 & 0 & 0.0018 & -0.0068 & 0.0008 & 0.0002 \\ 0 & 0 & 0.0339 & 0.0243 & 0.0147 & 0.0036 \\ 0 & 0 & 0 & 0 & 0.01392 & 0.0341 \\ 0 & 0 & 0 & 0 & 0 & 0.2628 \end{bmatrix} \times 10^{-2}$$

[6] *We take also into account the contributions of Japan, as they are the second TIC securities holder amongst Asian countries behind China.*

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Fruthermore, we note that according to the LR test for 5 overidentifying restrictions, the null hypothesis of overidentified model at $\propto = 5\%$ cannot be rejected. However, the restrictions are weakly rejected at $\propto = 10\%$.

LR	P-value
9.3222	0.0969*

Table 1: **Test for Overidentifying Restrictions**

3.1.2. IRFs and FEVD Analysis

In this first model, we investigate the effects of the reserve asset accumulation by Asian economies in the main issuer country of reserve asset, the United States. We find that a transitory positive shock (figure 4) in the reserve accumulation, which corresponds to a temporary increase of demand for reserve asset, has a mitigated effect on long-term interest rates and the housing price despite an appreciation effect of the real estate price. However, the shock has significant effects on the US consumption, the asset prices and the current account. Indeed, the shock induces significant appreciation effect on the US asset prices during the 8 first quarter of the model validating the push factors effects of the liquidity inflowing to the US economy. We note also a delayed relative significant effect – considering the Studentized CI- of the shock on US consumption during the second quarter. We cannot fully comment on the housing wealth effect on consumption since the evolution of house prices is not significant. Nevertheless, we conclude that house prices and domestic consumption follows the same movement, corroborating previous empirical results on this topic, particularly Aciovello (2011). Furthermore, we observe that an increase in the reserve hoarding process affects negatively the path of US current account and the effects persist for 8 quarters after the initial shock. This last result highlights the relationship between the hoarding process – which is an indication of high gross saving and current account surpluses in the EMEs – and the current account deficit in the US as the hoarding reserve contribute to the persistence of the global imbalances.

The previous results from the transitory shock are confirmed by the accumulated responses of our endogenous variables after a permanent structural shock of reserves. We confirm – considering our restrictions- that the long-term interest rates, the house prices and consumption do not have any significant effects to an accumulated reserve structural shock. In this configuration, a continuous increase in demand for US reserve assets from the emerging Asian countries does not have effect on the interest rates in the reserve issuing countries. In other words considering this particular configuration, a surge in demand does not influence the global liquidity conditions despite the fact that reserve accumulation triggers excessive liquidity flow into the US economy, enhances the available liquidity in the US economy and finally, increases global liquidity. However, significant effects are observed and they are in line with the theoretical hypothesis. Indeed, we note that a permanent structural shock of reserve induces a permanent change in asset prices and the current account path. So, the hoarding of reserves has an effect on the current account deficit in the reserve country issuer. The last results are in line with previous empirical studies as Bracke and Fidora (2008) and Park, Djigbenou, Fourel, (2015) that showed the persistence of the global imbalances after a positive liquidity flow, particularly a positive shock of reserve, into the advanced countries.

The FEVD of the benchmark model shows that the reserves structural shock has limited effects on the variance decomposition of the other variables. The main results indicate that it is essentially each endogenous variable's structural innovations that explain their variance decomposition. The most notable effect is represented by the variance decomposition of asset prices and the current account balance in which the shock's structural innovations has relative important parts in the explanation of the variance decomposition of these two variables, respectively 11% for asset prices and 16% for current account

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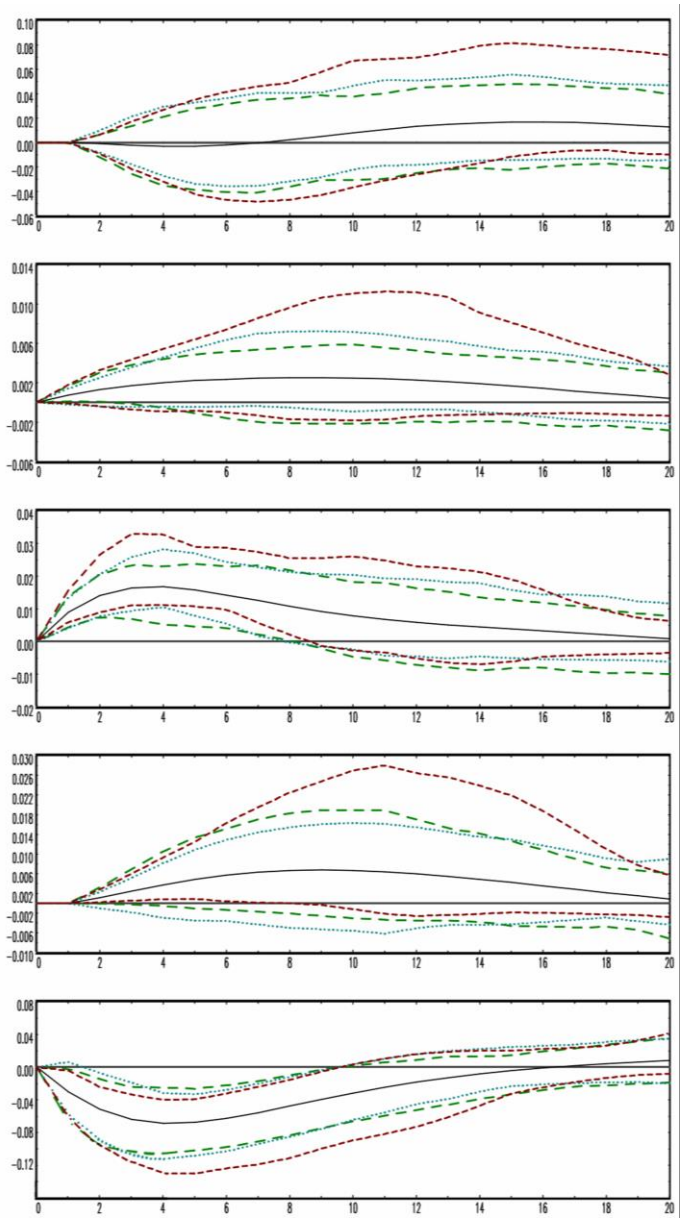


Figure 4: Responses of interest rates, house prices, asset prices, US consumption and US current account (top to bottom) to a transitory shock of international reserve with standard percentile (green) and studentized hall percentile (red) 95% bootstrap confidence intervals based on 1000 bootstrap replications

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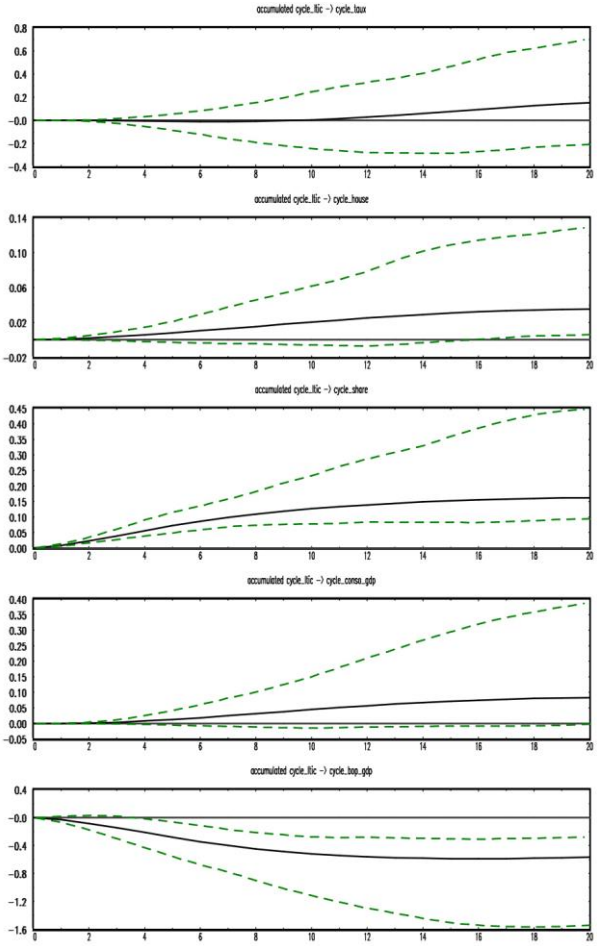


Figure 5: Accumulated responses of interest rates, house prices, asset prices, US consumption and US current account (top to bottom) to a permanent shock of international reserve with studentized hall percentile 95% bootstrap confidence intervals based on 1000 bootstrap replications

Table 2 **percent of FEVD explained by the Reserve accumulation shock's structural innovations**

	1 quarter	5 quarter	10 quarter	15 quarter	20 quarter
Interest rates	0	0	0	1	1
House prices	0	2	3	5	5
Asset prices	0	12	13	11	11
Consumption	0	0	1	1	1
Current account	0	10	17	16	16

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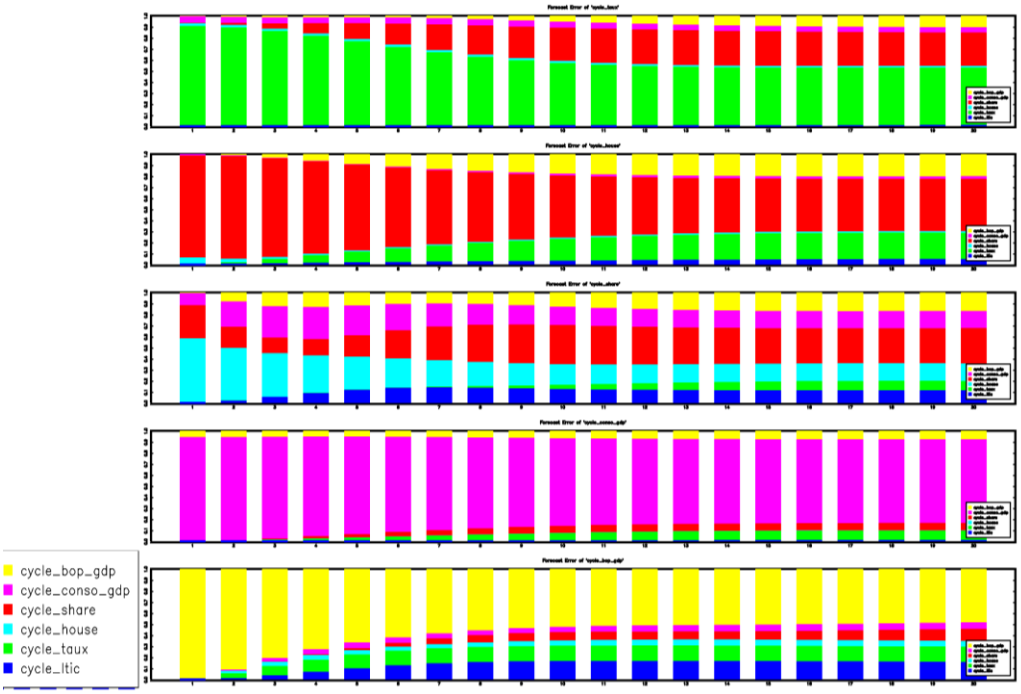


Figure 6 : **Forecast error variance decomposition (top to bottom) of interest rates, house, assets price, consumption, US current account variables**

3.2. Alternative model IRFs and FEVD

To strengthen our results, the second model considers an alternative hypothesis concerning the reserve endogenous variable as we choose a GDP weighted variable[7] to measure evolution the reserve asset accumulation in the emerging countries and contrary to the previous variable, this particular version of the reserve variable follows Ruffer and Stracca (2006) methodology to express the excess accumulation of reserve by EMEs. We implement the same estimation strategy and use the same underlying restrictions developed in (4) for our second SVAR estimation to verify the robustness of our previous results. The main results from the preliminary estimation procedure shows that our model is overidentified after the LR overidentification test[8].

We conduct the same analysis procedure than in the benchmark model and we focus on the transitory shock first. The results[9] (figure 7, table 3) show that a transitory structural shock of reserve in the emerging countries drives the same mechanisms as we highlighted in the previous model with slight differences. We notice the relative significant effects of the structural shocks on the house prices according the Efron standard CI[10] and consumption according to the Hall studentized CI but we cannot completely conclude on the housing wealth effect on consumption. Nevertheless, we confirm the same reactions of the other endogenous variables, particularly the weak response of the long-term interest rates. As a result, hoarding reserves do not exert an influence on US long-term interest rates and its later effects on the global liquidity conditions.

The previous benchmark results are also confirmed in the accumulated responses and the FEVD of our second model. We confirm that the only variables that were durably affected by the structural shock of demand of reserve in the EMEs are the current account and asset prices. So the liquidity inflows provided by the reserve accumulating countries can trigger a speculative bubble in the reserve currency issuer, especially in the United States. Finally, the reserve accumulation dynamics perpetuate the US current account deficit giving de facto credit to the perpetuation of the global imbalances.

---

[7] *The new variable is constructed as follow:* $reserve_t = \frac{TIC_t}{GDP} \times 100$ *. The new variable is also treated with the HP filter before the SVAR estimation*

[8] *The LR test shows that the null hypothesis cannot be rejected since P-value* $= 0.2 > \propto = 0.05$.

[9] *Alternative model IRFs and FEVD results annex p. 38-39.*

[10] *The SVAR China's IRFs and FEVD are in annex p.39-40.*

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3.3. China's Accumulation Behavior

In this section, we analyze China's accumulation behavior and its consequences on the US economy. This distinction from the previous model is particularly relevant since China is the main holder and buyer of US reserves assets worldwide. We undertake the same estimation strategy as in the previous models, consider a quantity based variable[11] for measuring China's accumulation behavior and use the same restrictions developed in (4) for our SVAR model. The main results from the preliminary estimation procedure shows that our model is overidentified after the LR overidentification test[12]. At this point, we consider a SVAR(1) model considering the results of the information criteria.

As in the previous estimations, we first focus on the transitory shock with the following results (figure 9 and 10, table 4). We reach the same significant conclusions as in previous analysis concerning the evolutions of share prices and the current account. However, contrary to the previous estimations, the Chinese reserve accumulation shock has significant effects on the evolution of long-term interest rates imposing a downward pressure according to the CIs, particularly regarding the studentized Hall CI. Moreover, despite the significant results, the evolution of house prices is unexpected since the reserve shock should trigger house prices appreciations, not a decrease. Finally, the pattern of US consumption is also not in line with our theoretical hypothesis and our earlier findings, nevertheless the reserve shock is not significant on US consumption.

Considering the results from the accumulated responses to the Chinese reserve accumulation and the FEVD, the previous transitory results are confirmed as the reserve shock permanently deviates the patterns of interest rates, the share prices and the US current account accumulated responses. We also notice that the accumulated responses of house prices and consumption are not significant to a permanent structural shock. The FEVD results confirm the previous finding about the limited consequences of the structural shock on the variance decomposition of the other endogenous variables.

4. Policy implications: what to address concerning the excessive demand for international reserves?

Our main results confirmed the destabilizing effects of the accumulation behavior in the reserve issuing country, particularly the notable effects on asset prices, current account and in a lesser extent, the long term interest rates in the US. These findings are in line with the literature investigating the links between global liquidity and reserve accumulation, particularly Djigbenou et al (2015). As hoarding reserves tend to exert destabilizing influences in the reserve issuing countries, an important question for policymakers is what policies to adopt in order to mitigate such influences. According to IMF (2010, 2011, 2012) and Farhi and al (2012), these policy recommendations could be summarize into two points: on one hand, policies to mitigate the demand for international reserves and, on the other hand, recommendations for the diversification of supply of reserve assets. As we focused our empirical analyze on the consequences of the hoarding reserves, we only review the recommendations' considering the flaws in the demand for reserve assets. Accordingly, the need to mitigate the demand of international reserve makes consensus amongst policy makers, but there is still discussion concerning the policies to address it. In particular it is important to distinguish the policies according to the precautionary and non-precautionary motives for IR accumulation. Moreover, several issues as capital flow volatility and the ease of financing, needs to be taking into account by policy makers on these recommendations.

4.1.1. Dampening precautionary reserve accumulation

Despite the difficult task of differentiating the different motives for reserve accumulation, Obstfeld et al. (2008) investigate the concerns about reserve holding, the trilemma and financial stability for a sample of 71 countries over the period from 1980 to 2004. They consider different factors explaining the reserve hoarding behavior, such as financial openness, access to foreign capital markets, potentially convertible domestic financial liabilities and exchange rate policies. Their results suggest that the precautionary motive represents half to two thirds of the total reserve holding. According to IMF (2010), one possible solution to this driver is a concerted reduction in accumulation of precautionary reserves, attributing the difficult mission of providing guidance on desirable ranges of precautionary levels to a supranational organization as the IMF. These recommendations could take into account each country's specificities (IMF, 2011), discriminating the countries between Advanced economies (AMs), EMEs and Low income countries and the particular shocks that they may face. The countries in turn, could agree to align their reserve accumulation policies to these proposals over time.

[11] *We consider a new variable* $reserve_t = log\ (TIC_t^{china})$.
[12] *The LR test shows that the null hypothesis cannot be rejected since P-value* $= 0.9 > \propto = 0.05$.

For instance, EMEs countries are vulnerable to shocks affecting the capital account such as sudden stop and currency crisis. This vulnerability rests on their increasing integration to world capital markets and also from the accumulation of financial imbalances. Interestingly, traditional metrics (STD, Broad money and Import cover) do not explain well the actual reserve holding for this group of countries. As a result, the desirable reserve for precautionary purpose should be based on models addressing in a formal way reserve adequacy. Such model-based approaches have the advantages to define the appropriate level of reserves by solving an optimization problem under various parameters assumptions according to the countries specificities. The hypotheses used in these models are typically the costs-benefits of holding reserves lowering the probability of crisis and smoothing consumption during a crisis (Garcia and Soto, 2004). Some parameters are especially important, such as the probability of sudden stop, the potential loss in output and consumption, the opportunity cost of holding reserves and the degree of risk aversion. The model commonly used by IMF is the framework developed by Jeanne and Rancière (2006), which includes the previous assumptions, and in addition, the degree of risk aversion of policy makers whose main objective is to maximize welfare in a small open economy vulnerable to sudden stops in capital flows. Moreover, to determine the desirable range of reserve, the IMF could use alternative methodology in order to take into account country specific adverse scenario (IMF, 2011). This approach tests the consequences of specific shocks to various components of the current account and the financial account over a period of time. The magnitudes of these shocks are determined considering the country's specificities, past experiences and projections. The resulting financing gap compared to the country projection is converted into potential drains on reserves that provide information on adequacy of reserve. This methodology has the benefit of yielding information that numerical metrics are unable to provide.

4.1.2. Mitigating non-precautionary reserve accumulation

According to IMF (2010), as the non-precautionary reserves is not a policy objective in itself, but the consequence of other policy choices such as export-led growth strategy or country structural characteristics (running large current account surpluses or large public savings), this driver should not be mitigated through policy adjustments. Considering the fact that non-precautionary accumulation have negative externalities on the international financial stability and specifically on the international monetary system (IMS), the solutions to mitigate this driver is more challenging since it requires that every reserve accumulating countries have a common understanding of the factors allowing the stability of the IMS. In addition, it is important to appraise to what extent the factors driving non-precautionary reserves may harm this stability. Two approaches are considered by policy-makers to address the non-precautionary motive. The first concerted approach requires a multilateral framework amongst the members of the Funds and requires that they implement policy adjustments for the sake of the IMS. For example, the systemic countries should adopt pre-specified horizon flexible exchange rate with limited or no interventions on the foreign exchange market, or they should shift their peg currency to a fully flexible currency. On the other hand, reserve issuing countries should adopt a medium term fiscal rules policy to sustain the credibility of their currencies and reduce the concerns of a modern version of the Triffin' dilemma. The second approach is the restrictive solution whose objective is to internalize the negative externalities due to excessive reserves in the demanding countries or the deficits experienced by the issuing countries. According to the literature (Eichengreen, 2009a), this binding solution should be based on penalties, for instance systemic countries running persistent current account imbalances should be penalized with an automatic tax when they reach a certain threshold. The penalties could be based in term of global GDP to capture the systemic impacts of the reserve accumulation on the IMS.

CONCLUSION

At the crossroad between the global liquidity and the reserve accumulation topics, our main objective in this paper has been to review the challenges raised by the hoarding reserves observed in the Asian EMEs and identify the links between the reserve accumulation and its influence on the development of the global liquidity. To this end, we choose to undertake an empirical analysis based on SVAR methodology to distinguish the destabilizing consequences of the hoarding reserve on the main reserve issuing country, i.e. the United States. In addition to the consequences on macroeconomics and financial variables, we isolate the main transmission channel of the surge of demand for safe reserve into the US economy by choosing to focus on the US TIC as one of the main reserve assets desired by the EMEs. Our main results confirmed some destabilizing consequences of the surge in demand for reserve assets, particularly the significant effects on asset prices and the current account imbalances in our benchmark model, and the significant results on the long-term interest rates in the United States when we focus on the Chinese behavior. However, this later finding must be interpreted with caution considering the mixed results across our specifications.

In line with previous studies investigating the links between global liquidity and reserve accumulation (Djigbenou et al, 2015; Baduel, 2012), our contribution is twofold. On the one hand, we use an original indicator to modelize the hoarding behavior in the EME. On the other hand, we focus on the consequences on the main issuing country. It is important to stress that, to our best knowledge, few empirical studies investigate these two topics in a unique empirical framework. Specifically, the choice of the SVAR methodology is not random since this approach allows us to meticulously identify theoretical relationships between the selected variables and isolate the main transmission channel of the liquidity flow from the surge in demand to the reserve assets issuing country. However, further research is needed to complete this study by generalizing the results to other issuing countries such as the euro area and investigating on the long-term consequences of the hoarding behavior by testing for example the probability of Triffin dilemma in issuing countries.

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APPENDIX

A. SVAR model results

1. SVAR alternative model IRFs and FEVD

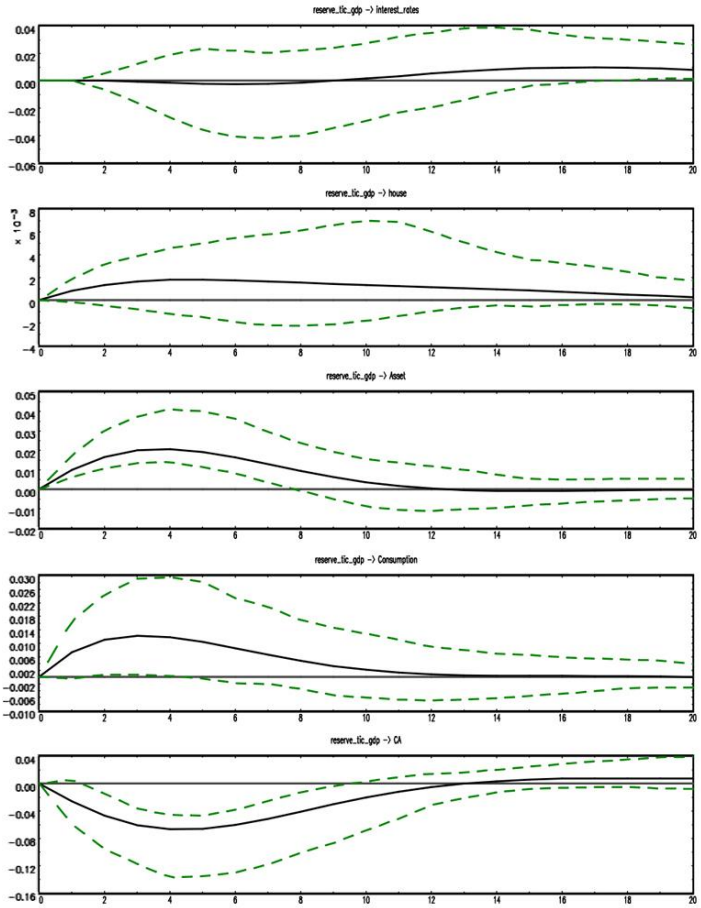


Figure 7: **Responses of interest rates, house prices, asset prices, US consumption and US current account (top to bottom) to a transitory shock of international reserve with studentized hall percentile 95% bootstrap confidence intervals based on 1000 bootstrap replications**

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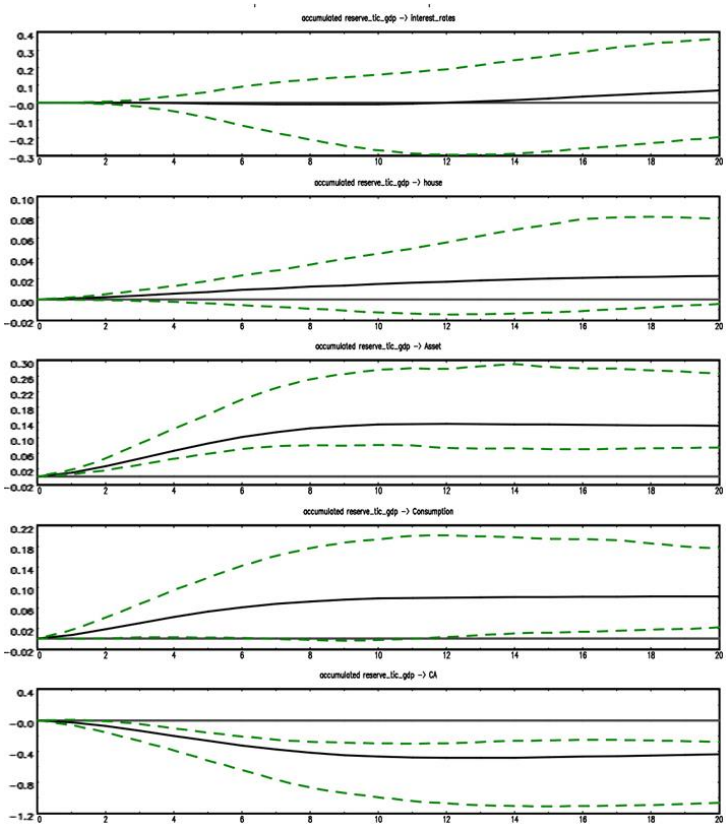


Figure 8: **Accumulated responses of interest rates, house prices, asset prices, US consumption and US current account (top to bottom) to a permanent shock of alternative reserve variable with studentized hall percentile 95% bootstrap confidence intervals based on 1000 bootstrap replications**

	1 quarter	5 quarter	10 quarter	15 quarter	20 quarter
Interest rates	0	0	0	0	0
House prices	0	2	2	2	2
Asset prices	0	19	13	11	11
Consumption	0	2	2	2	2
Current account	0	8	14	14	13

Table 3 : **percent of FEVD explained by the alternative shock's structural innovations**

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2. SVAR China model IRFs and FEVD

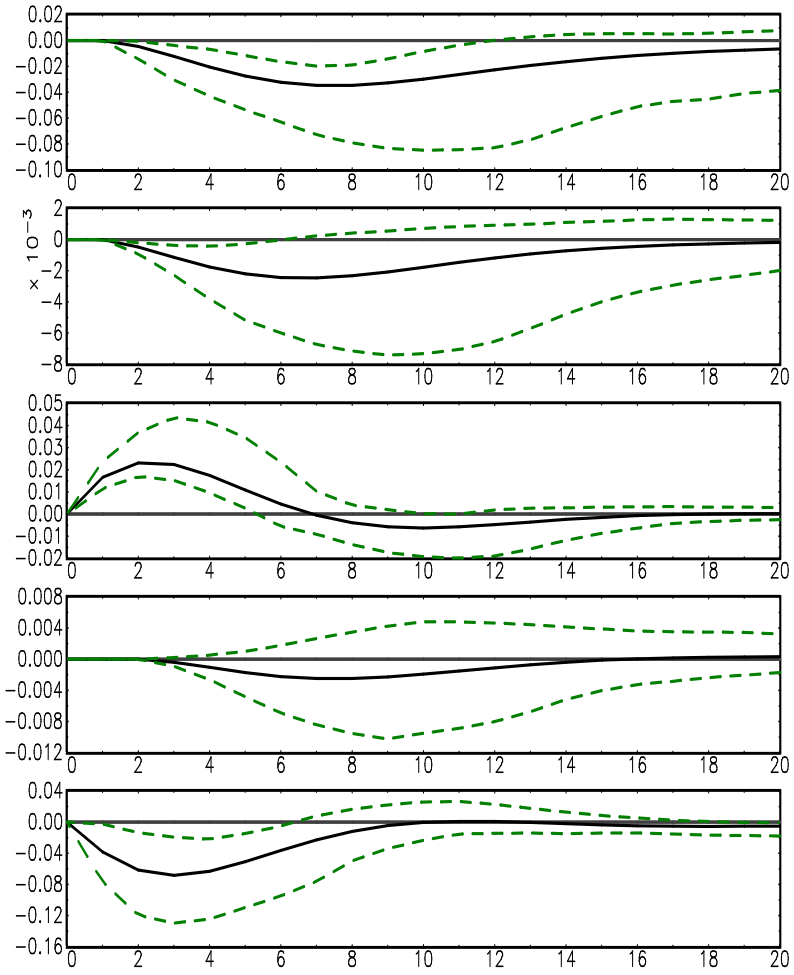


***Figure 9*: Responses of interest rates, house prices, asset prices, US consumption and US current account (top to bottom) to a transitory shock of international reserve with studentized hall percentile 95% bootstrap confidence intervals based on 1000 bootstrap replications**

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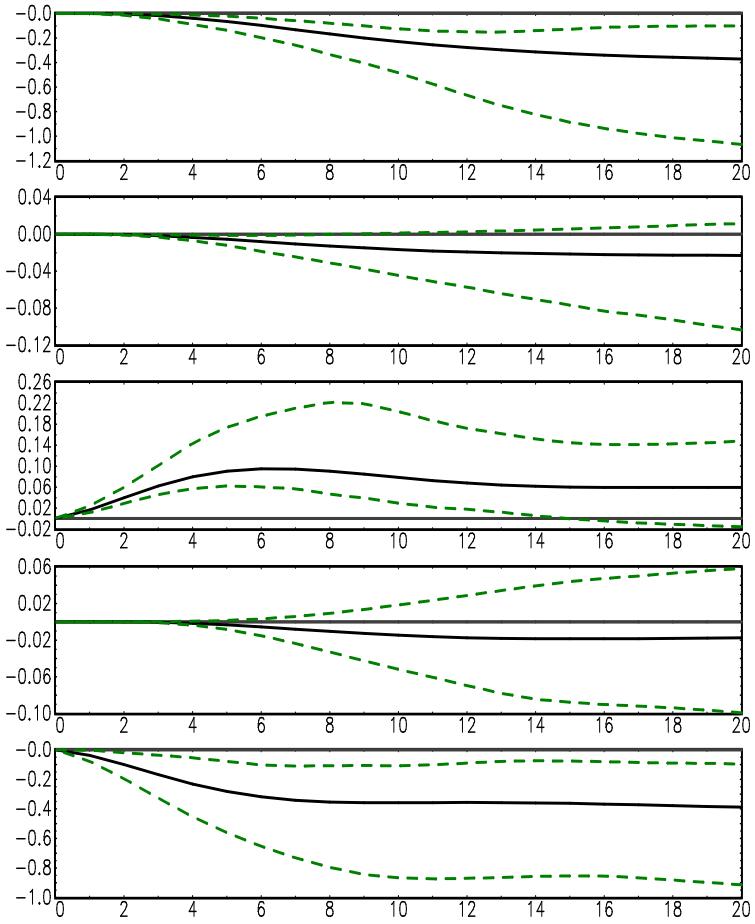


Figure 10: **Accumulated responses of interest rates, house prices, asset prices, US consumption and US current account (top to bottom) to a permanent shock of alternative reserve variable with studentized hall percentile 95% bootstrap confidence intervals based on 1000 bootstrap replications**

Table 4 : **percent of FEVD explained by China reserve shock's structural innovations**

	1 quarter	5 quarter	10 quarter	15 quarter	20 quarter
Interest rates	0	1	4	5	5
House prices	0	1	4	4	4
Asset prices	0	18	14	14	14
Consumption	0	0	0	0	0
Current account	0	9	9	9	9

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B. Preliminary Tests

1. Unit Root Tests

Variable	ADF			Philippe Perron		
	Model	t-stat	p-value	Model	t-stat	p-value
$reserve_t^1$	No intercept and trend	-3.92***	0.00	No intercept and trend	-2.60***	0.00
$reserve_t^2$	No intercept and trend	-2,48***	0.01	No intercept and trend	-2.17***	0.03
$reserve_t^{china}$	No intercept and trend	-4.67***	0.00	No intercept and trend	-3.71***	0.00
i_t^{lt}	No intercept and trend	-2.89***	0.00	No intercept and trend	-2.89***	0.00
$house_t$	No intercept and trend	-2.32***	0.02	No intercept and trend	-1.64*	0.09
$asset_t$	No intercept and trend	-3.71***	0.00	No intercept and trend	-2.69***	0.00
$consumption_t$	No intercept and trend	-3.88***	0.00	No intercept and trend	-3.93***	0.00
CA_t	No intercept and trend	-3.21***	0.00	No intercept and trend	-3.21***	0.00

Note: The signs ***, ** and * means respectively the rejection of null hypothesis at 1%, 5% and 10% significance level

2. Bai-perron multiple breakpoints tests

Variables	Significant F-statistic largest Breaks	F-statistic For the largest break	Scaled F-statistic For the largest break	Wheighted F-statistic For the largest break	Critical Value	Estimated Break dates
$consumption_t$	5	14.40*	14.40*	31.60*	3.91	2003Q2 2006Q2 2008Q3 2010Q4 2013Q1
$house_t$	5	72.08*	72.08*	158.1860*	3.91	2002Q2 2005Q1 2008Q2 2011Q1 2013Q2
$asset_t$	5	17.39*	17.39*	38.17*	3.91	2002Q2 2006Q1 2008Q1 2011Q1 2013Q2
i_t^{lt}	5	14.44*	14.44*	31.70*	3.91	2002Q3 2005Q4 2008Q1 2011Q1 2013Q2
CA_t	5	12.72*	12.37*	27.16*	3.91	2002Q2 2004Q3 2006Q4 2009Q1 2011Q2

Note: * means significant at 5% level

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The Model

We consider a standard multiple linear regression model with T periods and m potential breaks, producing $m + 1$ regimes. For the observations $T_j, T_{j+1}, \dots, T_{j+1} - 1$ in regime j we have the following regression model:

$$y_t = X_t'\beta + Z_t'\hat{\delta}_j + \varepsilon_t$$

For the regimes $j = 0, \dots, m$. The regressors are divided into two groups, the X variables are the variables whose parameters do not vary across regimes, while Z variables have coefficients that are regime specific.

Theoretical Framework

The multiple breakpoint tests implemented in our study are based on the *Global L breaks VS None* hypothesis proposed by Bai and Perron (1998). This particular approach is a generalization of the Quandt-Andrews test (Andrews, 1993) in which we test the equality of δ_j accros multiple regimes. The procedure test the null hypothesis of no breaks against an alternative of l breaks. The test use an F-statistic to evaluate the null hypothesis that $\delta_0 = \delta_1 = \cdots = \delta_{l+1}$. The general form of the bai-perron statistic (bai-perron, 2003a) is:

$$F(\hat{\delta}) = \frac{1}{T}\left(\frac{T - (l+1)q - p}{kq}\right)\left(R\hat{\delta}\right)'\left(R\hat{V}\left(\hat{\delta}\right)R'\right)^{-1}R\hat{\delta}$$

Where $\hat{\delta}$ is the optimal l-break estimate of δ, $\left(R\hat{\delta}\right)' = \left(\hat{\delta}_0' - \hat{\delta}_1', \dots, \hat{\delta}_l' - \hat{\delta}_{l+1}'\right)$, and $\hat{V}\left(\hat{\delta}\right)$ is the estimate of the variance covariance matrix of $\hat{\delta}$ which may be robust to serial correlation and heteroskedasticity. For further informations about the formulae and the large number of cases, see Bai-Perron (2003a)

This particular version of the Bai-perron procedure assumes that the maximum alternative number of breakpoints l is prespecified (we assume that $l=5$ according to our sample size). For simplicity, we choose to only focus on the F-statistics than using the alternative *UDmax* and *WDmax* test statistics, described by Bai and Perron (2003b).