Dollar Liquidity, Money and Credit in a Small Open Dollarized Economy

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Abstract

This paper analyzes the liquidity questions relating to financial dollarization. We formalize monetary mechanisms under dollarization, shedding light on the interconnection of the balance of payments with money and credit aggregates in a small open dollarized economy. After presenting the dollar money creation mechanism under financial dollarization, we propose a new measure of dollar liquidity in dollarized economies defined as the Gross Foreign Assets of the Locational Banks Sector, equal to the sum of the central bank's gross international reserves and the gross liquid foreign assets of the locational banks sector.

Our empirical results for Lebanon suggest that our measure of dollar liquidity has a significant and positive contemporaneous connection with total banks deposits and a lagged connection with total banks credit to the private sector in the period extending from 2002Q1 to 2017Q2. We test our results for robustness during the ongoing financial and monetary crisis period in Lebanon, that is in essence a dollar liquidity crisis.

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1 Introduction and literature review

Financial dollarization is a common feature in a large number of emerging and developing economies. Honohan (2008) notes that in 45 countries, more than half of total bank deposits were denominated in foreign currency at some stage since 1990. Rajan and Tokatlidis (2005) stress that dollarization is a response to institutional infirmities and that countries have to learn to "live with dollarization" until those infirmities are fixed. Having that in mind, dollar liquidity management should be approached as a persistent monetary policy concern in dollarized economies.

Our paper is an attempt to formalize monetary mechanisms in dual currency environments. A good understanding of those mechanisms is needed for monetary authorities in economies that allow any form of dollarization of their financial sector, in order to be able to better monitor inflation and achieve financial stability. This paper is singular in the sense that it focuses on the liquidity dimension linked to the dollarization of banking systems, while most past literature has focused on the currency mismatch that liability dollarization induces and its macroeconomic implications. We study the relationship between the balance of payments (BoP) and the deposit and credit components of the locational banks balance sheet in a dollarized small open economy. We use the term locational in order to refer to the residence criteria, following the terminology of the Bank for International Settlements.

This is, to our knowledge, the first analysis of its kind in the literature relating to dollarization. The literature on dollarization has mainly focused on the causes and determinants of deposits and liabilities dollarization, on the advantages and inconvenients of dollarization, on the effects of dollarization on macroeconomic performance, and on the implications of dollarization for monetary policy and for the choice of an exchange rate regime - see for example: Calvo and Vegh (1996), Balino, Bennett, and Borensztein (1999), Honohan and Shi (2001), De Nicolo, Honohan and Ize (2003), Ize and Levy-Yeyati (2003), Feige (2003), Havrylyshyn and Beddies (2003), Levy-Yeyati (2006), Honohan (2008), Haiss and Rainer (2012). Levy-Yeyati (2008) and Ize, Kiguel and Levy-Yeyati (2005) approach dollar liquidity in dollarized economies from the angle of the insurance against bank runs and the limit it imposes to the central bank as a lender of last resort. Our approach is different in the sense that we view dollar liquidity as an ongoing monetary policy concern.

In dollarized economies, banks generally hold foreign currency reserves at the central bank or alternatively hold foreign cash or bonds. One of the main contributions of our paper is to show that, in economies where banks are allowed to hold liquid foreign assets, the variation of the Gross Foreign Assets of the Locational Banks Sector aggregate (equal to the sum of the central bank's gross international reserves and domestic banks liquid foreign assets) is a better measure of the bottom line of the balance of payments (i.e. the sum of the net current and capital accounts and net financial inflows) than is the change in gross international reserves alone. It allows to account for the variation of the economy's international liquidity (dollar liquidity) more accurately than does

the change of the central bank's international reserves. We back our reasoning with the more general analysis of balance of payments transactions made in the recent paper by Kumhof, Rungcharoenkitkul and Sokol (2020). We show that standard textbook assumptions do not hold if domestic banks are allowed to hold foreign assets. The inflow of capital in a fixed exchange rate regime does not automatically lead to the growth of the domestic money base, resulting from the increase of the central bank's international reserves, if the resulting foreign liquid assets are not converted into domestic base money by the domestic banks sector.

We then explain how BoP flows impact in different ways deposits at domestic banks, depending on their nature: flows in the form of bank deposits transfers translate fully, FDI and portfolio flows translate partially, while loans of foreign banks to domestic banks do not have a direct impact on domestic banks deposits. We also argue that credit of domestic banks to the private non-bank sector responds with a lag to BoP flows[1]. The currency composition of deposits and credit (banks liabilities and assets dollarization ratios), that has been extensively studied in the literature, depends mainly on the domestic non-bank sector preferences.

The existing literature on dollar liquidity, resulting both from foreign banks loans and dollar bank deposits, has identified its effects on domestic banks credit[2], but no clear measure of the dollar liquidity of the economy has been defined so far. Previous papers used foreign currency liquidity proxies including flows measures, like gross and net capital inflows or foreign banks loans to domestic banks, and stock measures, like dollar deposits in the banking system or non-core foreign currency liabilities of domestic banks. Also, the

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[1]Historically, capital inflows have often fueled domestic banks credit in advanced and emerging economies alike - see for example: Mendoza and Terrones (2008), Montiel and Reinhart (2001), Magud, Reinhart and Vesperoni (2014), Boudias (2015), Lane and McQuade (2014), Calderon and Kubota (2012), Igan and Tan (2017). The standard textbook prediction tells us that in an economy with a free floating exchange rate regime, capital inflows would appreciate the domestic currency without any effect on monetary aggregates. Under a fixed exchange rate, the central bank would have to intervene, accumulating international reserves in order to maintain the peg. Part or all of this reserves accumulation can be offset through sterilization, effected through open market sales of domestic bonds by the central bank (see for example: Krugman et al. (2010); Calvo, Leiderman and Reinhart (1994); Dominguez (2009)). In practice, sterilization is often partial, and foreign exchange intervention is associated with an increase of the monetary base. Consequently, economies with less flexible exchange rate regimes are more likely to experience credit expansions in the presence of large capital inflows, as the expanding monetary base allows banks to expand their credit to the domestic non-bank sector. Also, the magnitude of the effect of capital inflows on domestic banks credit might vary, depending on their nature, i.e. Foreign Direct Investments (FDI), Portfolio Investments (PI), and Other Investments (OI - mainly capital transfers channeled through banks).

[2]As regards dollar liquidity, past literature has mainly focused on international dollar liquidity provision through cross-border interbank loans. Borio, McCauley and McGuire (2011) argue that, as emerging market central banks tighten monetary policy, they face the challenge of borrowers obtaining credit from abroad or in lower-yielding international currencies such as the US dollar. Private borrowers obtain credit directly from abroad or indirectly access credit that local banks obtain from abroad, mainly from foreign banks. Alper, Kilinc and Yorukoglu (2015) argue that foreign currency funding in the form of dollar client deposits can be considered as stable as other domestic sources of funds.

monetary mechanisms involved remained unclear. Referring to dollar liquidity, Levy-Yeyati (2008) and Ize, Kiguel and Levy-Yeyati (2005) are the only papers that we are aware of, that clearly state that in dollarized economies, "reserves holdings can be centralized at the central bank or decentralized at individual banks (in the form of reserve money or liquid asset requirements)". This view is in line with our monetary analysis results.

We compare our measure of dollar liquidity to the IMF's "foreign currency liquidity" and "international reserves" concepts. Then, we discuss the dollar liquidity risk implied by dollar loans made by domestic banks to the domestic non-bank sector, as well as the liquidity and FX risks implied by the conversion of domestic currency banks deposits into dollar deposits. We argue that the absence of a dollar lender of last resort in a dollarized economy warrants applying the strictest degree of liquidity standards for the foreign currency part of banks balance sheets.

We test the mechanisms we identified using quarterly data for Lebanon, whose deposit dollarization ratio varied from 51% to 77%, and credit dollarization ratio varied from 68% to 89%, during the 2002-2017 period. Our analytical results are confirmed as we find a contemporaneous positive effect of our favored measure of dollar liquidity on total locational banks deposits, and a lagged positive effect on banks private credit. For robustness, we perform the same tests during Lebanon's financial and monetary crisis period that started in October 2019, using monthly data. Our results are even more robust during the crisis.

Lebanon's crisis is a dollar liquidity crisis by essence, which justifies our analytical interest in the liquidity dimension linked to dollarized monetary systems that has been somehow neglected in the dollarization literature that focused mainly on the currency mismatch implications of liability dollarization. The main contribution of this paper is to stress the importance of monitoring dollar liquidity, as measured by the Gross Foreign Assets of the Locational Banks Sector aggregate, by the monetary authorities of dollarized economies. By doing so, they can have better control over monetary aggregates and credit and, consequently, achieve their inflation and financial stability targets, as well as exchange rate stability, and avoid costly monetary and banking crises.

Although dollar liquidity crises in dollarized economies have not been extensively analyzed in past literature, we could find few papers that alluded to them. Rajan and Tokatlidis (2005) pointed that a dollar shortage arising from a variety of causes including excessive government borrowing, an external liquidity shock, or an overvalued exchange rate, can be magnified by a dollarized banking system, and lead to a total collapse of the financial system, the exchange rate, and other asset prices. Also, dollar deposits convertibility risk in dollarized economies[3], resulting from the lack of their coverage in foreign liquid assets, has been mentioned in few academic papers. Rogers (1992) discusses the dollar convertibility risk of Mexdollars, i.e. dollar denominated demand deposits held in Mexican banks, after Mexdollars were forcibly converted to pesos amid

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[3]Dollar denominated deposits convertibility should not be confused with the domestic currency convertibility, which is the ease with which a country's currency can be converted into gold or another currency.

a severe balance of payments crisis in August 1982. Honohan (2008) sees forced conversion as one of the risks inherent to dollarized banking systems.

The remainder of the paper is organized as follows: Section 2 is dedicated to the analysis of monetary mechanisms and their relation to the balance of payments in a dollarized economy. Section 3 is dedicated to the empirical analysis in the case of Lebanon in the period 2002-2017. In section 4, we test the robustness of our results during Lebanon's monetary and financial crisis period. Section 5 concludes.

2 Monetary mechanisms and the balance of payments in a dollarized economy

2.1 Deposits dollarization

Dollarization of deposits is the willingness and the ability of the economy's residents to hold bank deposits denominated in a currency other than the domestic currency. Liabilities (or credit) dollarization is the willingness and the ability of the economy's residents to borrow money from a domestic bank in a currency other than the domestic currency. We will call the foreign currency "dollar" in the following sections, but that does not exclude that Euro and other major currencies can play that role.[4]

We will start our analysis of the dollar money supply mechanisms in a dollarized economy by the initial trigger of a dollar deposit in a domestic bank, which is the receipt of a payment, an income transfer or a capital transfer X from a foreign country by the client a of domestic Bank A (any form of fund transfer relating to a BoP flow) - Table 1. We will call the foreign country "United States" (US) in the following sections.

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[4]Looking back at the motives for holding deposits and contracting loans in dollar, we see that hyperinflation is the main trigger of dollarization, as documented in most past research - See for example: Calvo and Vegh (1996), Balino, Bennett, and Borensztein (1999). Hyperinflation deteriorates the ability of the domestic currency to play its roles as a store of value, unit of account and sometimes as a medium of exchange. Monetary authorities can forbid domestic banks by law from accepting dollar deposits and/or providing dollar loans. However, forced de-dollarization has had adverse effects in the past (for example: Bolivia in 1982, Peru in 1985), as it led to capital outflows and had negative impacts on output growth in many economies.

Table 1: Deposits dollarization

Bank A		US Bank	
1. Dollar Deposit at US Bank = X	2. Dollar Deposit of Client a = X	1. Loan to US non-bank sector = X	2. Dollar Deposit of Bank A = X
Total = X	Total = X	Total = X	Total = X

We show the case where dollar deposits are allowed in domestic banks and subject to reserve requirements at the rate r in Table 2. Banks reserve requirements on dollar deposits are held in the form of dollar deposits of the central bank at US Banks. They are of the same nature as other assets included in the international reserves of the central bank. However, the nature of reserve requirements holding makes the use of these deposits for foreign exchange intervention unadvised. From a liquidity risk point of view, if these reserves were used for foreign exchange interventions, and the dollar deposits they are linked to get withdrawn from the domestic banks by their non-bank depositors, the central bank would not be able to release these deposits to banks. Therefore, it is best practice for central banks in dollarized economies to separate reserve requirements amounts from international reserves amounts.

The IMF's "international reserves and foreign currency liquidity - guidelines for a data template (2013)" specifies that foreign currency deposits held at the monetary authorities by commercial banks of the reporting country in respect of the regulatory reserves/liquidity requirements, as well as foreign currency deposits with a remaining maturity of one year or less, should be deducted from the reported international reserves amount. Some emerging economies central banks currently abide by this rule while others do not[5].

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[5]For example: Lebanon's central bank includes dollar reserve requirements amounts in its international reserves figure.

Table 2: Deposits dollarization with reserve requirements

Bank A		US Bank		Domestic Central Bank	
1. Dollar Deposit at US Bank = X.(1-r)	3. Dollar Deposit of Client a = X	1. Loan to US non-bank sector = X	2. Dollar Deposit of Bank A = X.(1-r)	1. Dollar Deposit at US Bank = X.r	2. Dollar Reserves of Bank A = X.r
2. Dollar Reserves at CB = X.r			3. Dollar Deposit of CB = X.r		
Total = X	Total = X	Total = X	Total = X	Total = X.r	Total = X.r

2.2 Credit dollarization and dollar creation

Dollar denominated loans made by a domestic bank to the non-bank sector should be met by a stable dollar source (a dollar term deposit at the domestic bank or a loan from an international bank) in order to limit the dollar liquidity risk. The domestic central bank cannot act as the lender of last resort, in case of international payments, or dollar cash withdrawals out of the domestic bank's dollar deposits resulting from the dollar loan. The alternative would be emergency dollar facility lines that the domestic bank can contract with a US bank, ideally covering the total amounts of dollar loans granted.

We present in Table 3 the case of a domestic bank A that holds a dollar deposit of an amount X and gives a dollar loan of the same amount to the non-bank sector client a'.

By giving a dollar loan, the domestic bank "creates dollar money"[6]. While the domestic banking sector's gross dollar assets held at the US Bank is X, the dollar money aggregate in the domestic economy is 2X. The simple transaction of giving a dollar denominated loan financed by a dollar deposit in a dollarized economy is money creation in a currency (the dollar) other than the sovereign currency. In other words, while its gross dollar assets are X, the banking system "multiplied" this amount (by a factor of 2 in our example) in the same way the banking system multiplies the domestic base money in a standard fractional reserves monetary system. Thus, gross dollar assets of the locational banks sector (including the central bank) could be seen as the "dollar money base" of the economy. Gross dollar assets of the locational banks sector are either originated

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[6]The only paper we are aware of, that mentions this dollar creation process is Rodriguez (1993), that refers to locally created dollar as "argendollars" for Argentina, and "perudollars" for Peru. It makes a narrative analysis of the current account implications of the increased dollar supply, but does not analyze the dollar creation process per se.

as counterparts of real transactions (operations of the current/capital accounts of the balance of payments), or as counterparts of financial flows (operations of the financial account of the balance of payments). The domestic banks sector bears a dollar liquidity risk as a result of this operation.

If the gross dollar assets of the domestic banking system are obtained through long term dollar loans from foreign banks, dollar loans given by domestic banks to the domestic non-bank sector do not multiply dollar deposits. If the amount of credit to the domestic non-bank sector does not exceed the amount of those foreign banks loans, this could be seen as full "funding" through foreign banks loans. The domestic banks sector does not bear a dollar liquidity risk as a result of this operation.

Table 3: Credit dollarization

Bank A		US Bank		Domestic Central Bank	
1. Dollar Deposit at US Bank = X.(1-2r)	4. Dollar Deposit of Client a = X	1. Loan to US non-bank sector = X	2. Dollar Deposit of Bank A = X.(1-2r)	1. Dollar Deposit at US Bank = X.2r	2. Dollar Reserves of Bank A = X.2r
2. Dollar Reserves at CB = X.2r	5. Dollar Deposit of Client a' = X		3. Dollar Deposit of CB = X.2r		
3. Dollar Loan to Client a' = X					
Total = 2.X	Total = 2.X	Total = X	Total = X	Total = X.2r	Total = X.2r

2.3 The BoP balance and the Gross Foreign Assets of the Locational Bank Sector (GFA_LBS) aggregate

In financially dollarized economies, domestic banks hold deposits in foreign currencies, either exclusively at the central bank, or at both the central bank and at foreign correspondent banks, if the holding of foreign currency accounts at foreign banks is allowed by law. In this case, and in contrast to the standard textbook assumption (see for example: Krugman et al., 2010), dollar inflows to the domestic banking system as a result of balance of payments surpluses, only translate into domestic base money if they are converted into domestic currency by banks and the central bank intervenes in the foreign exchange market to avoid the appreciation of the domestic currency. In that event, the central bank

increases its international reserves in exchange for domestic currency deposits of domestic banks at the central bank[7]. Therefore under dollarization, if banks are allowed to hold foreign assets, balance of payments surpluses in a fixed exchange regime do not automatically lead to an increase in the central bank international reserves.

The standard textbook implicit assumption is that domestic banks are either forbidden by law or do not have the willingness to hold liquid foreign assets, in the form of deposits at foreign banks or foreign bonds. In practice, every balance of payments flow materialized by a nonresident counterpart transferring funds to the domestic economy creates a liability (deposit) of a foreign bank in favor of a domestic counterpart bank. In that regard, a recent paper by Kumhof, Rungcharoenkitkul and Sokol (2020) highlights the role of the banking system, as an inseparable component of all cross-border real and financial flows and stocks. They point to the fact that any economic transaction, including both physical and financial trades, consists of two inseparably linked components or "legs", the second of which always involves the transfer of a retail or interbank monetary settlement medium. Any gross financial or real inflow must be matched by an inseparable automatic (thus unintentional) gross outflow resulting from settlement mechanics, in line with the balance of payments double-entry bookkeeping rules. This translates in practice into a short term liquid liability (a deposit) of the foreign bank, in favor of the domestic bank. That deposit is acquired ultimately by the central bank in a fixed exchange rate regime, increasing its international reserves (see for example: Krugman et al., 2010 - Chapter 13 p. 312-313). Thus, the bottom line of the BoP must be the sum of the current account and capital account balances, plus the non-banks and the long term commercial banks portion of the financial account balance (and not only the non-reserve portion of the financial account balance). This definition excludes cross-border short term interbank flows from the standard textbook BoP bottom line definition, as they only constitute counterparts of real and financial transactions, and not independent economic decisions.

If the unrealistic textbook assumption is eased, in an economy where domestic banks are allowed to hold liquid foreign assets, the bottom line of the BoP (i.e., the variation of the economy's international reserves) must be equal to the variation of the Gross Foreign Assets of the Locational Bank Sector (GFA_LBS), and not only the variation of the central bank's gross foreign assets (central bank's international reserves). GFA_LBS is the sum of the central bank's gross foreign liquid assets (gross international reserves) and the locational domestic banks gross foreign liquid assets. In practical terms, the computation of this aggregate should only include the liquid gross foreign currency assets of the central bank and the liquid gross foreign currency assets of domestic banks whose counterparts are non-resident agents. The level of the Gross Foreign Assets of the Locational Bank Sector in the economy is equal to the cumulative balances of the current and capital accounts plus the non-banks and the long

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[7]The central bank could sterilize this increase in the domestic currency base money subsequently.

term commercial banks portion of the financial account of the BoP (i.e. excluding the short-term interbank portion of the financial account of the BoP), adjusted to valuation changes[8].

The GFA_LBS aggregate is key in dollarized economies:

- It is an important aggregate alongside the central bank's international reserves when it comes to the ability to maintain a currency peg. The central bank can potentially borrow liquid foreign assets from domestic banks, and use them to defend the external value of the domestic currency. Alternatively, the central bank can oblige domestic banks to place their foreign liquid assets in the form of deposits at the central bank by means of regulations, in order to increase the amount of its gross international reserves.

- It can be seen as the "dollar liquidity" or "dollar money base" in the economy. The ratio of dollar deposits in the locational banking system to the GFA_LBS can be seen as the "dollar multiplier".

2.4 "Dollar Liquidity" and IMF's "Foreign Currency Liquidity"

The IMF's concept of "foreign currency liquidity" defined in the "international reserves and foreign currency liquidity - guidelines for a data template (2013)", is broader than that of IMF's concept of international reserves in at least three respects:

(1) while reserve assets refer to external assets of the monetary authorities, foreign currency liquidity concerns foreign currency resources and drains on such resources of the monetary authorities and the central government.

(2) while reserve assets represent the monetary authorities' claims on nonresidents, foreign currency liquidity relates to the authorities' foreign currency claims on and obligations to residents and nonresidents.

(3) while the concept of reserve assets is based on the balance sheet framework, the concept of foreign currency liquidity encompasses inflows and outflows of foreign currency that result from both on and off-balance-sheet activities of the authorities.

Our measure of "dollar liquidity" (GFA_LBS) is different to the IMF's concept of "foreign currency liquidity" in the following respects:

(1) it does not only include assets of the monetary authorities (and of the central government generally), but also liquid foreign assets of the banking system.

(2) it only includes claims on and obligations to non-residents.

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[8] As documented in the academic literature on capital flows, an economy attracts capital due to a positive interest rate differential to the rest of the world. Thus, the GFA_LBS aggregate is a function of this interest rate differential, in addition to other traditional pull and push factors. The structural part of this aggregate is important in economies that attract capital for reasons such as bank secrecy laws, home bias of expatriates, etc... This aggregate can be directly influenced as well by the ability of domestic banks and the central bank to contract loans with foreign banks, foreign central banks and international organizations. Also the level of the GFA_LBS is a function of structural imbalances in the current/capital accounts of the economy, like long term trade competitiveness and income remittances of expatriates.

Our measure of "dollar liquidity" is similar to the IMF's concept of "foreign currency liquidity" in the following respect:

(3) it encompasses inflows and outflows of foreign currency that result from both on and off-balance-sheet activities. Any potential drain of foreign currency resulting from off-balance-sheet activities of authorities and banks, should be deducted from the dollar liquidity aggregate.

2.5 The "dollar multiplier" and dollar liquidity risk

From a macroprudential point of view, if the "dollar multiplier" (the ratio of dollar deposits in the locational banking system to the GFA_LBS) exceeds 1, the domestic banking system bears a dollar liquidity risk, in the absence of a dollar lender of last resort. The dollar liquidity risk can typically come (but not only) from the standard bank intermediation maturity mismatch between dollar sight deposits (that could be withdrawn out of the banking system in the form of notes - or transferred abroad) and dollar credit to the domestic non-bank sector that is of longer maturity.

At the level of the economy, in case dollar liquidity (GFA_LBS) is generated through sight or short term dollar client deposits, this could be seen as unstable funding. In case dollar liquidity (GFA_LBS) results from foreign banks dollar loans, this is to be seen as stable funding if the maturity of the loans that domestic banks obtain from foreign banks equals or exceeds the maturity of the loans that domestic banks grant to domestic agents. Foreign banks dollar loans to domestic banks, do not increase total deposits in the locational domestic banks balance sheet directly, but increase domestic banks dollar non-core liabilities.

Also, dollar liquidity risk should be considered at the individual bank level. Liquidity standards similar to those of Basel III - LCR and NSFR[9] – should be applied. However, the Basel III standards do not put enough emphasis on multi-currency environments and the availability of foreign currency liquidity in the hands of the locational domestic banking systems. They only account for the currency risk resulting from any currency mismatch between assets and liabilities. However, the absence of a dollar lender of last resort in a dollarized economy warrants applying the strictest degree of liquidity standards for the foreign currency part of banks balance sheets.

We consider the example below (Table 4) where dollar liquidity (GFA_LBS) is generated by short term deposits (Client a) for half (X/2) and by foreign banks loans (or long term deposits) for the other half (X/2), and where the domestic banks sector grants dollar credit to the domestic non-bank sector (Client a') equal to the total amount of GFA_LBS (X). The final amount of dollar deposits is 1.5 X, thus the dollar multiplier is 1.5 in this case, as part of dollar funding (X/2) is done through long term stable sources. If all the dollar liquidity in the domestic banks sector results from long term foreign banks loans, there

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[9]For details on the Basel 3 liquidity standards see:
- Basel 3: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools (2013), Basel Committee on Banking Supervision.
- Basel 3: The Net Stable Funding Ratio (2014), Basel Committee on Banking Supervision.

is no multiplication - it is simply a foreign funding of dollar loans, as is well documented in the literature on international banking and foreign currency intermediation.

Table 4: Banks dollar credit and the "dollar multiplier"

Locational Banks Sector (Bank A + Central Bank)		US Bank	
1. Dollar Deposit at US Bank = X	3. Dollar Deposit of Client a = X/2	1. Loan to US non-bank sector = X/2	2. Dollar Deposit of (Bank A + Central Bank) = X
	4. Loan from US Bank = X/2	2. Loan to Bank A = X/2	
2. Dollar Loan to Client a' = X	5. Dollar Deposit of Client a' = X		
Total = 2.X	Total = 2.X	Total = X	Total = X

2.6 Bank deposits currency conversion, dollar liquidity and FX risk

In a partially dollarized monetary system, money supply is made of two components: (1) domestic money supply (domestic currency bank deposits and bank notes) and (2) dollar money supply (dollar bank deposits and bank notes)[10]. The interaction between the two components of the money supply happens only when the domestic non-bank sector converts domestic money into dollars or the other way round. Foreign exchange transactions between domestic banks and between domestic banks and the central bank do not affect money supply as these are operations involving banks reserves in dollar and banks reserves in

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[10]We will not make an analysis of the determinants of the degree of deposits and liabilities dollarization in this paper as this question has been extensively studied in the literature relating to dollarization. Monetary analysis of small open dollarized economies can be performed independently from the dollarization ratio consideration that mainly relates to the degree of confidence that domestic economic agents have in their domestic currency and the arbitrages they can make in a dual currency system.

domestic currency at the central bank (base money), without any effect on the denomination of the non-bank sector deposits at domestic banks.

We now consider the case where half of the domestic currency money supply (e.X/2; initial domestic currency money supply is determined by banks credit in domestic currency to Client a", equal to e.X in our example) gets converted into dollar deposits by the domestic non-bank sector (Table 5). The dollar multiplier becomes equal to 2 as a result of this currency conversion. Also, Table 5 shows a currency mismatch on the locational banks balance sheet: the currency composition of banks assets does not vary while banks dollar liabilities share increases. In sum, the conversion of the domestic currency component of the money supply into dollar deposits creates additional liquidity risk as well as FX risk on the locational banks sector balance sheet. At the individual bank's level, FX risk could be covered, with the central bank bearing the residual FX risk. If the exchange market pressure reaches a degree at which the central bank is not capable (considering its international reserves level) or unwilling to maintain the stability of the domestic currency exchange rate, the domestic currency would depreciate.

Table 5: Deposits currency conversion, dollar liquidity and FX risk

Locational Banks Sector (Bank A + Central Bank)		US Bank	
1. Dollar Deposit at US Bank = X	3. Dollar Deposit of Client a = X/2	1. Loan to US non-bank sector = X/2	3. Dollar Deposit of (Bank A + Central Bank) = X
	4. Loan from US Bank = X/2	2. Loan to Bank A = X/2	
2. Dollar Loan to Client a' = X	5. Dollar Deposit of Client a' = X		
6. DC Loan to Client a" = e.X	7. DC Deposit of Client a" = e.X/2		
	8. Dollar Deposit of Client a" = X/2		
Total = 3.X	Total = 3.X	Total = X	Total = X

2.7   BoP surpluses, banks deposits and banks credit

Net capital flows (excluding locational banking system short-term flows) added to the balance of the current and capital accounts of the BoP, should translate directly or indirectly into a variation of the deposits of the locational bank sector, as the point of entry of most of those flows is through the transfer of funds to the domestic economy in the form of bank deposits. Capital inflows in the form of bank transfers (Other Investments) directly feed domestic banks total deposits. However, Other Investments also include foreign banks dollar loans to domestic banks, that do not increase total deposits in the locational domestic banks balance sheet directly, but increase domestic banks dollar non-core liabilities. This foreign funding of domestic banks has been extensively analyzed in the literature on capital flows and bank credit in emerging markets.

Capital inflows in the form of FDI and Portfolio Investments translate totally or partially into domestic banks deposits if the beneficiary companies use the proceeds of these flows to finance their domestic investments and working capital, in which case they will need to transfer their foreign funds into deposits in the domestic banking system. In a bank based economy where the financial market is absent or of small size, the share of banks deposits transfers tends to be higher than Portfolio Investments. Consequently the effect of BoP inflows on total banks deposits is larger and comes without a significant lag.

As a result, the bottom line of the BoP (variation of GFA_LBS) should be positively correlated to the increase of banks total deposits. The currency denomination of this increase in deposits is either fully in domestic currency if dollarization of deposits is legally forbidden, or both in the domestic currency and foreign currencies if foreign currency deposits are allowed. The central bank can reverse (totally or partially) the increase of the total deposits amount at domestic banks, if it reacts to capital flows by sterilizing them through the open market sales of securities.

The increase of dollar liquidity in the economy due to balance of payments flows gives room for domestic banks to expand dollar credit to the non-bank sector. Also, the conversion of dollar deposits into domestic currency deposits by non-bank depositors creates simultaneously an equal amount of domestic currency base money (as banks convert their foreign assets to domestic currency deposits at the central bank to avoid any currency mismatch in their balance sheet) and domestic currency deposits at banks, in the same way as described in standard textbooks. The additional domestic currency base money gives the possibility to banks to offset the facilities they may have had from the central bank previously. This increase in domestic base money can also be used to create domestic money via the standard money multiplier mechanism: banks can use these surplus domestic currency reserves to extend domestic currency loans to the domestic non-bank sector. However, this process is not automatic as loan demand by the non-bank sector is mainly determined by their activity needs and the loans nominal (and real) interest rate level. Also, the willingness of banks to offer loans to the private non-bank sector will depend on the risk adjusted return they can achieve in alternative uses of this liquidity, mainly central bank term deposits, government bonds, and foreign bonds. Therefore, increasing banks liquidity (either in the domestic currency or in dollar) should not be seen as an automatic trigger of credit growth to the domestic non-bank private sector. It should also be noted that a lag could be observed between the time the excess banks liquidity is observed and the time banks release loans to the non-bank sector, due to the administrative process involved in banks credit provision.

The results of the monetary and liquidity analyses we performed help explain the empirical findings of past studies:

- Net current account balances induce a variation of both banks total deposits and the economy's dollar liquidity (GFA_LBS). These effects can sometimes come with a lag.

- Deposits transfers of non-residents increase domestic banks total deposits

and the economy's dollar liquidity (GFA_LBS), in the same period they are effected.

 - Foreign banks loans to domestic banks increase the economy's dollar liquidity (GFA_LBS) in the same period, but not total banks deposits directly.

 - Portfolio Investments and FDI increase both dollar liquidity (GFA_LBS) and total banks deposits, sometimes partially and with a lag. This can explain the weaker impact of Portfolio Investments and FDI on domestic banks credit. However, the main reason of the weak impact of FDI and Portfolio Investments on domestic banks credit remains the fact that these flows are not directly intended at increasing domestic banks liquidity, as are foreign banks loans to domestic banks, whose main economic motive is to allow the latter to expand credit to the domestic economy.

 - The increase of dollar liquidity (GFA_LBS) resulting from BoP flows, can boost both dollar credit and domestic currency credit of domestic banks. This impact would come with a lag, and is conditional on the existence of a demand for credit by the non-bank sector.

3 Empirical analysis: the case of Lebanon

We test the interconnections we identified in the previous section, between our favored measure of dollar liquidity (GFA_LBS) and total banks deposits and credit to the non-bank sector, in the case of Lebanon in the period 2002-2017. We also look into the use that Lebanese domestic banks made of their dollar liquidity, particularly in the form of liquid foreign assets and deposits at the central bank. In the last stage, we check our results for robustness during Lebanon's monetary and financial crisis that started in October 2019. That crisis is by essence a dollar liquidity crisis, which further justifies our focus on the liquidity dimension of dollarized monetary systems.

 Lebanon has known one of the most complete forms of financial dollarization for more than three decades. Dollarization started during the Lebanese civil war that witnessed recurring depreciation episodes of the domestic currency. At present, Lebanese banks hold dollar deposits and provide dollar loans to their resident customers, alongside domestic currency deposits and loans. The deposits dollarization ratio was 70.67% and the loan dollarization ratio is at 68.46% at 2018 end, just before the start of the country's crisis. As a consequence, all the mechanisms emphasized in our analysis would fully play in the country's context. Lebanon's exchange rate regime is classified as "stabilized arrangement" in the IMF AREAER[11] for 2016. The exchange rate of the US dollar (USD) has been fixed since December 1997 at the mid rate of 1507.5 Lebanese Pounds (LBP), thanks to daily interventions of Banque du Liban in the domestic interbank foreign exchange market. From the adoption of the de facto fixed exchange rate regime until October 2019, the country has not experienced episodes of high inflation, as was the case during and after the civil war

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[11] International Monetary Fund - Annual Report on Exchange Arrangements and Exchange Restrictions.

(1975-1989). In the period 2002-2017, the average annual real GDP growth rate was 4%, and the average annual inflation rate was 3.3%[12].

3.1 Data

We obtained balance of payments and locational domestic commercial banks balance sheet data from the Banque du Liban website "statistics and research" section. We obtained Lebanon's annual real GDP growth figures from the IMF WEO October 2017. The sample for the empirical analysis is the period from January 2002 to September 2017 as the data is available for all the aggregates during that period. All the data has been converted into USD Billions. Whenever the data is in LBP, it has been converted at the official USD/LBP exchange rate of 1507.5, which has been fixed since December 1997. The fact that during the sample period starting in January 2002 the exchange rate has been fixed excludes any bias that could come from currency valuation changes. We converted monthly series to quarterly series in the 2002-2017 period analysis by summing flow aggregates over the quarter, and by using quarter end figures for stock aggregates.

3.2 Stylized facts

Descriptive statistics of the balance of payments components and capital flows sub-components quarterly series are detailed in Table 6. Detailed variables description can be found in Table 11 in the Appendix. Looking at the means and the sums over the period, we notice a negative net (current/capital) account balance that is overcompensated by net capital inflows, leading to a substantial increase in the gross international reserves of the central bank[13]. Over the period BdL's international reserves have increased by a cumulative amount of USD 35.25 Bn (not accounting for valuation changes). We can notice that other investments (OI) are more important than portfolio investments (PI) and direct investments (FDI) in the composition of net capital flows, with a higher mean, sum and standard deviation over the period. This is explained by the fact that the Lebanese financial sector is essentially bank based, with a small size capital market, as is the case in the majority of small open emerging economies. We show the movements of BoP components (Figure 1) as well as capital flows components (Figure 2) quarterly series for the study period (Q1 2002 – Q2 2017).

Figure 3 shows the evolution of the Lebanese domestic commercial banks locational balance sheet components, from Q1 1997 to Q3 2017. We notice that the large increase in the total bank deposits amount (BK_TOTAL_DEP) has been mainly translated into an increase of the banks' deposits at the central

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[12]Source: IMF WEO - October 2017.

[13]The balance of payments accounting identity holds in every period: RES_CHANGE = CAP_FLOWS + CURR_ACC + EO.

Figures are expressed in USD Billions.

bank (DEP_CB). We notice that the increases of the credit to the domestic non-bank private sector (CR_PRIV), the credit to the government sector (CR_PUBLIC) and banks foreign assets holdings (BK_FOREIGN_ASSETS) have been relatively moderate, in comparison to the large increase of total banks deposits.

BdL made no specific sterilization effort to counter the impact of large BoP inflows, but its facilities to domestic banks were naturally reduced to a minimum, as a consequence of their high liquidity balances. This is evidenced by the large deposits (denominated in both domestic currency and dollar) of commercial banks at the BdL, as well as their foreign assets holdings in the form of deposits at foreign banks and foreign bonds. This abundant liquidity and the increase of monetary aggregates ratios to GDP did not translate into high inflation, thanks to the exchange rate peg that proved to be a strong nominal anchor.

Figure 4 shows the evolution of the ratio of total foreign currency deposits (of residents and non-residents) to the GFA_LBS. This ratio reached a maximum level of 2.05 during the analysis period, and has been constantly above 1. This shows that the domestic banks system has multiplied the amount of its gross dollar assets, by granting dollar denominated loans to the domestic non-bank sector. The co-movement of this ratio with the ratio of foreign currency denominated bank credit to the private non-bank sector to the GFA_LBS is clear visually. This shows the multiplying effect of foreign denominated loans on the foreign currency money supply. However, no direct mathematical relationship exists between the two ratios, as the choice of the currency of denomination of banks deposits depends ultimately on depositors preferences[14].

Table 6: Balance of Payments Components - Descriptive Statistics

	CURR_ACC	EO	RES_CHANGE	CAP_FLOWS	PI	OI	FDI
Mean	-1.414788	-0.026300	0.568676	2.009763	0.181786	1.291592	0.536385
Median	-1.378880	-0.021035	0.280700	1.705120	0.091370	1.209025	0.477130
Maximum	0.884890	3.829250	4.451590	6.617240	2.535400	3.670490	1.396760
Minimum	-3.300940	-5.278950	-1.878830	-1.285860	-2.124680	-1.483700	-0.069210
Std. Dev.	0.929704	1.672484	1.195253	1.577724	0.798354	1.226430	0.290598
Sum	-87.71688	-1.630630	35.25789	124.6053	11.27071	80.07872	33.25586
No. Obs	62	62	62	62	62	62	62

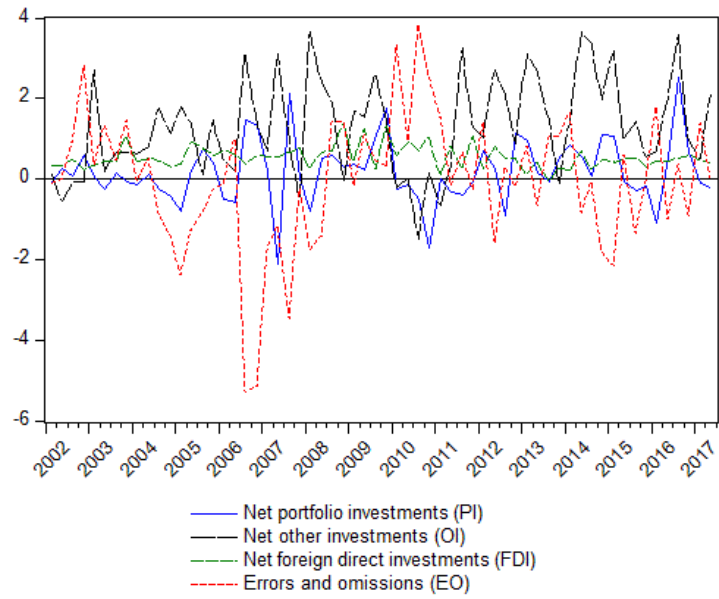Note: All aggregates are in USD Billions.

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[14]Analysis of agents preferences with regards to the use of domestic currency and dollar is outside the scope of our paper.

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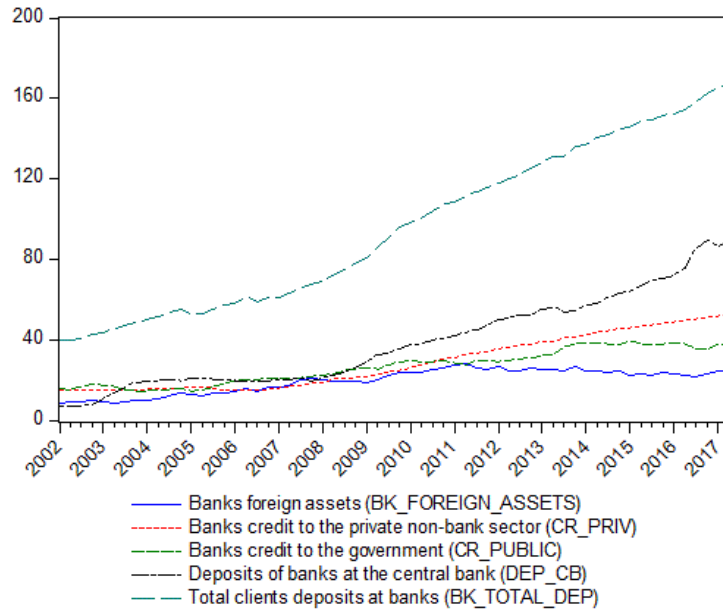Figure 1: Balance of Payments Components

Note: All aggregates are in USD Billions.
Data Source: Banque du Liban.
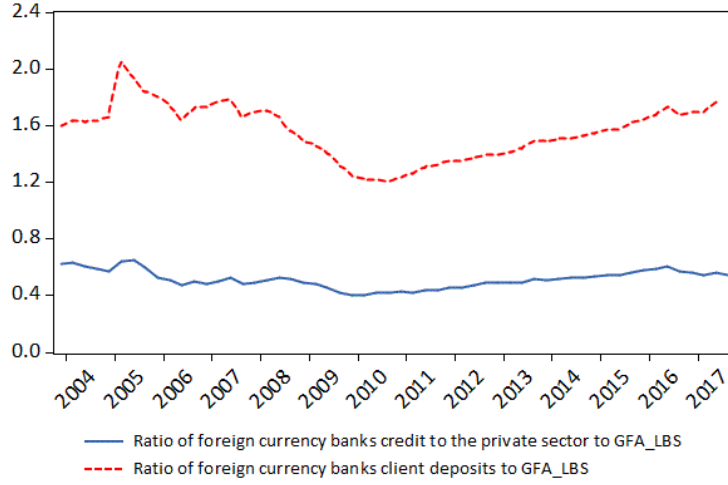
19
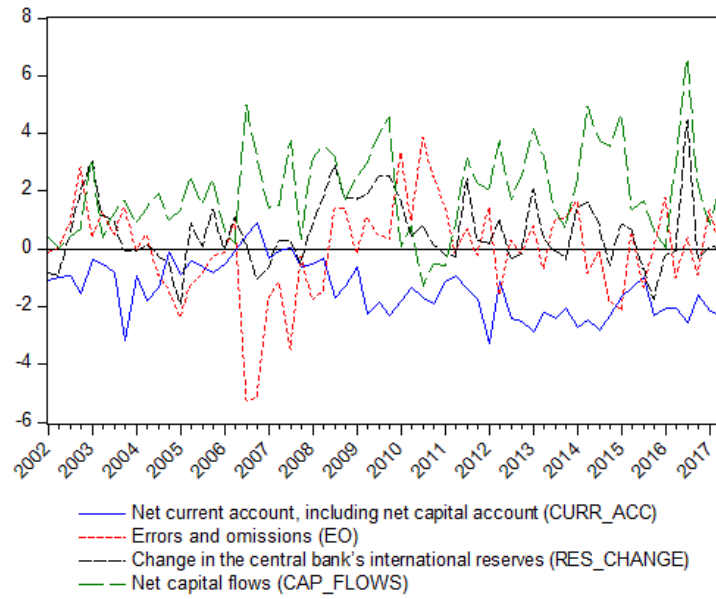
Figure 2: Capital Flows Components

Note: All aggregates are in USD Billions.
Data Source: Banque du Liban.

Figure 3: Banks Locational Balance Sheet Components

Note: All aggregates are in USD Billions.
Data Source: Banque du Liban.

Figure 4: Foreign Currency Deposits and Credit to GFA_LBS

Data Source: Banque du Liban.

3.3 Empirical strategy

The empirical case of Lebanon is relevant to illustrate the mechanisms we iden-
tified, as the country has a longstanding history of both assets and liabilities
dollarization, as well as open current, capital and financial accounts of the BoP.
The country's de facto fixed exchange rate regime since 1997 improves the qual-
ity of the analysis by making the bottom line of the balance of payments more
salient, in the sense that balances are not automatically offset via exchange
rate movements. Also the fixed exchange rate avoids any statistical discrepancy
relating to exchange rate movements.

We aim at analyzing the interconnections between BoP total flows and do-
mestic banks locational balance sheet components. We perform a series of OLS
regressions between flow variables, in order to reveal the short-run dynamic in-
terconnections that we emphasized in the previous section of the paper. Long
run regressions are not necessary, as our analysis focuses on short run mechan-
ics. The variables used in our regressions have been tested for unit roots: flow
variables and stock variables in first difference do not show unit roots[15].

We estimate the following equations:

$$\Delta Y_t = \gamma_0 + \sum_{k=1}^{p} \psi_k \Delta Y_{t-k} + \sum_{j=1}^{m} \sum_{l_j=0}^{q_j} \beta_{j,l_j} \Delta X_{j,t-l_j} + \epsilon_t \qquad (1)$$

Where ΔY_t is the dependent flow variable or the first difference of the de-
pendent stock variable at time t, γ_0 is a constant, ψ_k are coefficients associated

[15]Unit root tests results are available upon request.

with lags of ΔY_t, β_{j,l_j} coefficients associated with lags of m regressors $\Delta X_{j,t}$ (flow variables or first difference of stock variables) for $j = 1, ..., m$, and ϵ_t is the standard error term.

We test the relationships of total banks deposits growth, banks credit to the private non-bank sector growth, and banks credit to the government growth (as dependent variables), with the BoP bottom line (explanatory variable). We also test the relationships of the two forms of banks dollar liquidity i.e. banks deposits at the central bank (that translate into international reserves of the central bank) and banks foreign assets (as dependent variables), with the BoP bottom line (explanatory variable). We first use our favored measure of the bottom line of the BoP (change in GFA_LBS), then the traditional measure of the bottom line of the BoP (change in the central bank's international reserves).

The change in the central bank's gross international reserves data series could be obtained directly from the balance of payments statistics and can be considered of good quality as it is directly taken from the accounting of the central bank. However, it was impossible to construct the GFA_LBS data series from balance of payments data as it would ideally have been done, as it requires the breakdown of banking flows into short-term and long-term flows, which is unavailable in Lebanon's statistics. This breakdown is also unavailable in other countries BoP statistics at present, but it is a desirable development both for dollarized and non-dollarized economies. Therefore, we proxied the GFA_LBS flow data using the first difference of its stock data, i.e. the sum of central bank's gross international reserves and commercial banks liquid foreign assets. This approximation integrates valuation effects, that are inherent to any stock-flow relationship, to the constructed GFA_LBS flow data series. However, in Lebanon's case valuation effects could be deemed to be minor as the exchange rate has been fixed through the study period, and the constituents of GFA_LBS are safe liquid assets whose market values are not very volatile.

Our regressions series is intended at uncovering the contemporaneous and lagged correlations of the locational banks balance sheet components with the BoP bottom line measures. We do not aim at performing fully fledged econometric analyses intending at explaining the determinants of each of those banks balance sheets components (thus, we do not introduce any control variable in the regressions). We include two lags (or three lags, if the third lag shows high statistical significance) of the dependent variables in order to account for their statistical inertia and to compensate for part of the information lost with omitted variables, that would be contained in the lagged dependent variables.

We focus on total bank deposits and total bank credit, and not on dollar denominated deposits and credit, as the inflow of dollar liquidity is deemed to impact LBP liquidity (through USD liquidity conversion into LBP liquidity), and consequently, the supply of LBP denominated credit. Also, as discussed in the previous section, the currency denomination of clients bank deposits is mainly determined by their preference and their assessment of currency risk.

In the private credit regression, the impact of credit demand could be accounted for by including real GDP growth, following Den Haan, Sumner and Yamashiro (2007). However, the unconditional correlation between the change

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in GFA_LBS and real GDP growth over the study period is high (equal to 0.39), which suggests a pro-cyclical inflow of capital into the economy. Therefore, when we include both variables as explanatory variables, real GDP growth becomes insignificant. This makes it impossible to disentangle the impact of real GDP growth on dollar liquidity inflows (determinant of credit supply) from its impact on credit demand. An econometric identification allowing to disentangle credit supply and credit demand effects would require the availability of more granular banking data, in the spirit of Khwaja and Mian (2008). Therefore, the relationship we identify between domestic banks credit to the private non-bank sector and dollar liquidity could be seen as correlational (not causal), as it is conditional on the behavior of credit demand that we are not able to identify separately with our set of data.

3.4 Econometric results

Effect of GFA_LBS variation on banks deposits, banks credit to the private non-bank sector, banks credit to government, banks deposits at the central bank, and banks foreign assets.   In Table 7 we show the results of the regression of the total deposits of the locational commercial banks balance sheet (BK_TOTAL_DEP) in first difference on GFA_LBS in first difference[16]. The regression result shows a clear contemporaneous positive relationship between the GFA_LBS in first difference and total deposits in first difference. We regress the credit to the private non-bank sector in first difference over the GFA_LBS in first difference and its first, second and third lags. We find a strongly significant positive relationship with lag 3. The result of this second regression shows that over the period, the liquidity resulting from BoP flows has been used by banks to provide credit to the private non-bank sector with a lag of 3 semesters, which could be the average lag needed for banks credit process. We do not find any statistical relationship between the first difference of the GFA_LBS and the credit of commercial banks to the public sector. In the case of Lebanon, domestic banks credit to the public sector has been steadily increasing, without a dynamic connection with banks dollar liquidity.

We also look into the use commercial banks make of their dollar liquidity. We find a strongly significant positive contemporaneous relationship between the GFA_LBS in first difference and the growth of commercial banks deposits at the central bank. The regression also shows an alternating inertia in the banks' deposits at the central bank time series between quarters (i.e., a positive correlation with lags 1 and 3 and a negative correlation with lag 2). We also find a significant positive contemporaneous relationship between commercial banks foreign assets in first difference and the GFA_LBS in first difference.

We compute the cumulative dynamic multipliers of GFA_LBS, as the sum of its point estimates for statistically significant lags, for all the dependent

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[16]We use this measure in the absence of the change of the Gross Foreign Assets of the Locational Bank Sector (as the bottom line of the BoP) - the latter is not available to us as part of the BoP statistics. This is a minor concern in our case as valuation changes are of small magnitude, as explained in the previous section.

variables. We have multipliers of 0.68 for total bank deposits, 0.12 for bank credit to the private sector, 0.37 for banks deposits at the central bank, and 0.48 for banks foreign assets.

Table 7: GFA_LBS Regressions Results

D(BK_TOTAL_DEP)	Coefficient	Prob.
C	0.824471***	0.0014
D(BK_TOTAL_DEP(-1))	0.003027	0.9716
D(BK_TOTAL_DEP(-2))	0.325182***	0.0003
D(GFA_LBS)	0.686727***	0.0000
Adj. R-squared	0.578813	
No. observations	63	
Sample (adj)	2002Q1 2017Q3	

D(CR_PRIV)	Coefficient	Prob.
C	0.110121	0.2866
D(CR_PRIV(-1))	0.185565	0.1396
D(CR_PRIV(-2))	0.466968***	0.0005
D(GFA_LBS)	0.009152	0.8273
D(GFA_LBS(-1))	-0.037541	0.3651
D(GFA_LBS(-2))	0.049498	0.2378
D(GFA_LBS(-3))	0.122388***	0.0050
Adj. R-squared	0.427085	
No. observations	60	
Sample (adj)	2002Q4 2017Q3	

D(DEP_CB)	Coefficient	Prob.
C	0.406157	0.2213
D(DEP_CB(-1))	0.512206***	0.0001
D(DEP_CB(-2))	-0.575145***	0.0000
D(DEP_CB(-3))	0.593751***	0.0000
D(GFA_LBS)	0.372886**	0.0145
Adj. R-squared	0.390054	
No. observations	63	
Sample (adj)	2002Q1 2017Q3	

D(BK_FOREIGN_ASSETS)	Coefficient	Prob.
C	-0.166760	0.2771
D(BK_FOREIGN_ASSETS(-1))	-0.036713	0.7382
D(BK_FOREIGN_ASSETS(-2))	-0.065165	0.5556
D(GFA_LBS)	0.480201***	0.0000
Adj. R-squared	0.294976	
No. observations	63	
Sample (adj)	2002Q1 2017Q3	

Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Effect of the change in the central bank's international reserves (RES_CHANGE) on banks deposits, banks credit to the private non-bank sector, banks credit to government, banks deposits at the central bank, and banks foreign assets. In Table 8 we perform the same regressions over the traditional measure of the bottom line of the BoP i.e. the change in the central bank's international reserves (RES_CHANGE) - and its first, second and third lags for the credit to the private sector. RES_CHANGE is equal in accounting terms to the sum of the net current account, the net capital account and the net financial flows, adjusted to net errors and omissions. We find a clear contemporaneous positive relationship between RES_CHANGE and total banks deposits in first difference.

We regress the credit to the private non-bank sector in first difference over

RES_CHANGE and its lags. The result of this regression shows again that during the analysis period BoP flows have been translated into banks credit to the private non-bank sector with a lag of 3 semesters. We do not find any statistical relationship between RES_CHANGE and banks credit to the public sector.

As regards the uses commercial banks make of their dollar liquidity, we find a strongly significant positive contemporaneous relationship between RES_CHANGE and banks deposits at the central bank. However, we find a significant negative contemporaneous relationship between commercial banks foreign assets in first difference and RES_CHANGE. This last result contrasts with the result we obtained when we regressed commercial banks foreign assets in first difference over GFA_LBS in first difference. This comes from the fact that GFA_LBS in first difference includes the variation of commercial banks foreign assets, while RES_CHANGE accounts for the variation of the central bank's international reserves only. Although GFA_LBS and the central bank's international reserves are closely related aggregates in the case of Lebanon, due to the fact that international reserves account for a large share of GFA_LBS through our study period, the last regression shows the superiority of GFA_LBS as a measure of dollar liquidity. In order to explain the negative relationship between RES_CHANGE and commercial banks foreign assets growth, we regress banks deposits at the central bank in first difference over banks foreign assets in first difference (Table 9) and find significant negative contemporaneous and lag 1 statistical relationships. This last regression shows the trade-off between Lebanese banks deposits at the central bank and their holding of foreign assets, as part of their foreign currency liquidity management. This interchangeability between banks gross foreign assets and their deposits at the central bank (feeding the central bank's international reserves) - the two constituents of GFA_LBS - is another backing for our argument in favor of the GFA_LBS change being a more adequate measure of the BoP bottom line than is the change of the central bank's international reserves.

Table 8: Change in Central Bank's International Reserves Regressions Results

D(BK_TOTAL_DEP)	Coefficient	Prob.
C	1.052413***	0.0018
D(BK_TOTAL_DEP(-1))	-0.031900	0.7880
D(BK_TOTAL_DEP(-2))	0.398525***	0.0006
RES_CHANGE	0.481869***	0.0012
Adj. R-squared	0.284962	
No. observations	62	
Sample (adj)	2002Q1 2017Q2	

D(CR_PRIV)	Coefficient	Prob.
C	0.154177	0.1064
D(CR_PRIV(-1))	0.371595***	0.0055
D(CR_PRIV(-2))	0.304045**	0.0218
RES_CHANGE	-0.008716	0.8625
RES_CHANGE(-1)	0.022563	0.6668
RES_CHANGE(-2)	-0.078400	0.1262
RES_CHANGE(-3)	0.178075***	0.0005
Adj. R-squared	0.458646	
No. observations	59	
Sample (adj)	2002Q4 2017Q2	

D(DEP_CB)	Coefficient	Prob.
C	0.340497	0.2448
D(DEP_CB(-1))	0.374903**	0.0023
D(DEP_CB(-2))	-0.339296**	0.0193
D(DEP_CB(-3))	0.447415***	0.0015
RES_CHANGE	0.674223***	0.0001
Adj. R-squared	0.357164	
No. observations	62	
Sample (adj)	2002Q1 2017Q2	

D(BK_FOREIGN_ASSETS)	Coefficient	Prob.
C	0.426860**	0.0124
D(BK_FOREIGN_ASSETS(-1))	-0.133859	0.2909
D(BK_FOREIGN_ASSETS(-2))	-0.024406	0.8482
RES_CHANGE	-0.263673**	0.0342
Adj. R-squared	0.045213	
No. observations	62	
Sample (adj)	2002Q1 2017Q2	

Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Table 9: Banks Deposits at the Central Bank and Banks Foreign Assets Correlation Regression

D(DEP_CB)	Coefficient	Prob.
C	0.808135***	0.0063
D(BK_FOREIGN_ASSETS)	-0.896955***	0.0001
D(BK_FOREIGN_ASSETS(-1))	-0.343592**	0.0457
D(DEP_CB(-1))	0.231849*	0.0552
D(DEP_CB(-2))	-0.036564	0.7696
D(GFA_LBS)	0.699199***	0.0001
Adj. R-squared	0.320250	
No. observations	62	
Sample (adj)	2002Q1 2017Q2	

Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

In sum, our results suggest that BoP inflows positively impact banks total deposits contemporaneously, while their positive effect on credit to the private non-bank sector is three quarters lagged. The lag we identified could be explained by the time the private sector credit process takes to materialize. Dollar liquidity does not have a direct impact on domestic banks credit to the government, during our analysis period. Also, increasing dollar liquidity in the banking system is invested in the same quarter, either in central bank deposits or in foreign assets (international banks deposits and international bonds).

Our result on the relationship of dollar liquidity with domestic banks credit is in line with the results of previous studies of the link between international capital flows and credit cycles in emerging and developing economies. However, by focusing on dollar liquidity, we accounted for the bottom line of the balance of payments (i.e. the sum of net capital flows and the net current account), not only capital flows.

4 Robustness test: Lebanon's 2019 monetary and financial crisis period

The initial study has been performed during the period spanning from January 2002 to September 2017, which could be considered a stable financial and monetary era in Lebanon, despite the occurrence of the 2008-2009 global financial crisis that did not affect the country's economy substantially as it did in other parts of the world. However, we decided not to publish this paper until now, in order to test our results for robustness during the monetary and financial crisis that hit Lebanon in October 2019 and that is still ongoing at the time we are finalizing this paper. The reason is that this crisis is a dollar liquidity crisis in essence, and thus, we wanted to test whether the monetary mecha-

nisms we highlight in this paper hold during stressed periods. Figure 5 shows the rapid decrease of dollar liquidity (GFA_LBS) and its two components, i.e. gross international reserves and the gross liquid foreign assets of the banking sector in Lebanon, in the three years period leading to the crisis and during the crisis. Figure 6 shows the evolution of the ratio of total USD bank deposits over GFA_LBS in Lebanon during the three years leading to the crisis and after the onset of the crisis. The coverage of USD bank deposits by the dollar liquidity in the hands of the locational bank sector (GFA_LBS) has substantially deteriorated during the crisis. This has led to the suspension of the convertibility of domestic banks USD deposits into international dollar deposits (funds transfers to overseas banks) and into US dollar notes.

Secondly, since the start of 2017, Banque du Liban started publishing monetary and financial statistics following the IFRS9 standards, which entailed a substantial change in data computing methods. Finally, a third change we made in our robustness tests is that we use the monthly frequency for the crisis period, instead of the quarterly frequency that we used for the initial study. All three changes constitute substantive robustness checks to our initial results.

Figure 5: GFA_LBS, gross international reserves, and banks gross liquid foreign assets (USD Bn)

Data source: BdL Website

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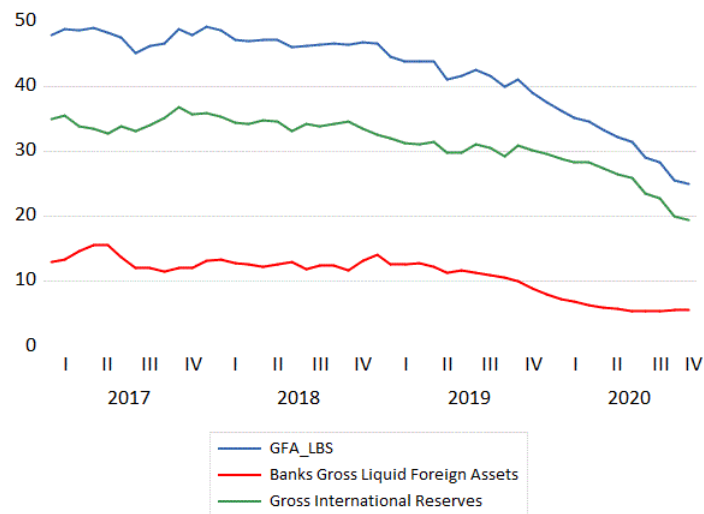
Figure 6: Ratio of USD deposits at domestic banks to GFA_LBS

USD denominated bank deposits to GFA_LBS ratio
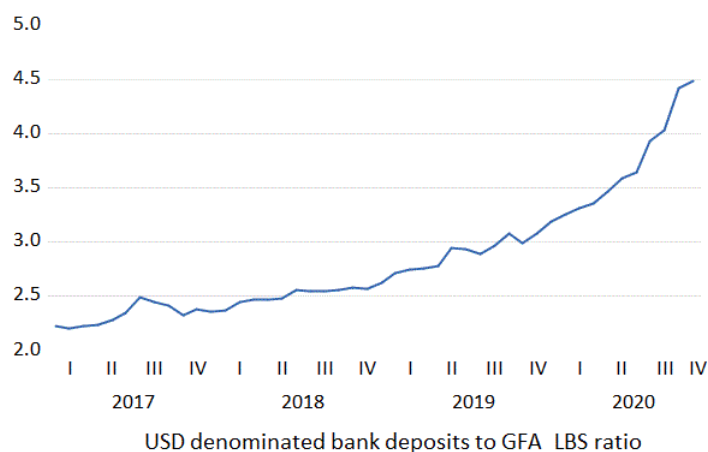
Data source: BdL Website

The results in Table 10 show that the positive contemporaneous relationship between the GFA_LBS in first difference and total deposits in first difference holds during the crisis period (the sample for these regressions comprise monthly data from March 2017 to January 2021). Also, a positive contemporaneous correlation is revealed between credit to the private non-bank sector in first difference and the GFA_LBS in first difference during this period. While the correlation of GFA_LBS with total bank deposits is quantitatively comparable to the one we obtained in the quiet period, its correlation with credit to the private non-bank sector does not come with any lag. This reflects the capital flight, that could not be fully contained by the informal capital control measures adopted by the banking system since the onset of the crisis, that happened in parallel with the reimbursement of dollar denominated bank loans by non-bank sector borrowers who were worried to be left with excessive liabilities in case of an official devaluation of the Lebanese pound - that did not happen so far, despite the large depreciation of the LBP versus the USD on the black FX market that emerged since the onset of the crisis. Thus in this crisis episode, the reduction of banks credit to the private non-bank sector was primarily explained by borrowers demand behavior, not by the diminished supply of loans by banks as a consequence of their shrinking dollar liquidity.

The bottom line is that the strong statistical relationship of dollar liquidity as defined by the GFA_LBS and total bank deposits holds even in crisis periods, in the presence of capital flight and (informal) capital controls.

Table 10: GFA_LBS Regressions Results - Crisis Period

D(BK_TOTAL_DEP)	Coefficient	Prob.
C	0.034890	0.8576
D(BK_TOTAL_DEP(-1))	0.529227***	0.0000
D(GFA_LBS)	0.611795***	0.0005
Adj. R-squared	0.475684	
No. observations	47	
Sample (adj)	2017M03 2021M01	

D(CR_PRIV)	Coefficient	Prob.
C	-0.064170	0.4335
D(CR_PRIV(-1))	0.657159	0.0000
D(GFA_LBS)	0.184409	0.0086
Adj. R-squared	0.597798	
No. observations	47	
Sample (adj)	2017M03 2021M01	

Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

5   Conclusion

We aimed in this paper at filling a gap in the literature relating to dollarization by analyzing the main monetary mechanisms in dollarized economies. We focused on the liquidity dimension linked to financial dollarization, that is often overlooked in the literature. We stressed the importance of a strict liquidity risk management of banks in a dollarized economy, in the absence of a dollar lender of last resort. We shed light on the interconnection between balance of payments flows, money and credit in small open dollarized economies. The empirical study in the case of the small open dollarized economy of Lebanon confirmed the results of our analysis. We found positive short-run connections between our favored measure of dollar liquidity (the Gross Foreign Assets of the Locational Banks Sector aggregate) and total banks deposits, banks foreign assets and banks deposits at the central bank. We also found a lagged positive connection with credit to the private non-bank sector. However, the data did not show any connection between dollar liquidity and the credit of commercial banks to the Lebanese government. This study also uncovered the preferences of Lebanese banks in the use they make of the dollar liquidity resulting from balance of payments flows.

Our results stress the importance of managing the Gross Foreign Assets of the Locational Banks Sector aggregate by the monetary authorities of dollarized economies, because of its impact on monetary aggregates and credit, and ultimately on inflation, the exchange rate, and financial stability. Lebanon's ongoing crisis is in essence a dollar liquidity crisis of the country's dollarized banking system. This induces a necessity to closely monitor the balance of payments bottom line. Large balance of payments surpluses (i.e., a rapid growth of GFA_LBS) inject excess liquidity and can lead to the overheating of the economy and potentially to financial crises. Large balance of payments deficits (i.e., a rapid decrease of GFA_LBS) drain dollar liquidity and can lead to a disruption of the economic activity. This monitoring can be achieved through the simultaneous management of capital flows and of the current account. However, policymakers have to bear in mind that net capital inflows and current account

surpluses are not equal sources of dollar liquidity. While current account surpluses increase the net foreign assets of the economy, net capital inflows are liabilities that need to be reversed ultimately. This last observation suggests that persistent external imbalances (i.e. recurring current account deficits financed by capital inflows) would ultimately threaten the availability of dollar liquidity in dollarized economies as is currently the case in Lebanon, leading to a dollar liquidity crisis. Thus, dollarization provides an additional incentive for policymakers to avoid exchange rate overvaluation and large external deficits.

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Appendix

Table 11: Variables Description

Variable	Description
CURR_ACC	sum of the net current account and the net capital account of the balance of payments
CAP_FLOWS	net total capital flows computed as the sum of other investments, portfolio investments and direct investments
EO	errors and omissions component of the balance of payments
RES_CHANGE	change in the central bank's international reserves component of the balance of payments
PI	net portfolio investments component of capital flows
FDI	net foreign direct investments component of capital flows
OI	net other investments component of capital flows
BK_TOTAL_DEP	total deposits including resident and non-resident sight and term deposits at commercial banks both in LBP and USD
DEP_CB	total amount of LBP and USD deposits of commercial banks at the central bank, including mandatory reserve requirements
CR_PRIV	total amount of commercial banks credit to the private non-bank sector both in LBP and USD
CR_PUBLIC	total amount of commercial banks credit to the Lebanese government both in LBP and USD, comprised mainly of LBP government bonds and bills and USD Eurobonds
BK_FOREIGN_ASSETS	total amount of foreign assets held by banks mainly in the form of USD deposits at foreign banks and foreign investment grade bonds
GFA_LBS	gross foreign assets of the locational banks sector (= IR_EX_GOLD + BK_FOREIGN_ASSETS)
FX_DEP / GFA_LBS	ratio of the sum of total residents foreign currency deposits and total non-residents deposits in Lebanese commercial banks over GFA_LBS
FX_CR_PRIV / GFA_LBS	ratio of total foreign currency credit of Lebanese commercial banks to the private non-bank sector over GFA_LBS
IR_EX_GOLD	BdL international reserves excluding gold