The Determinants of Banks' Liquidity Buffers in Central America

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Abstract

Banks' liquidity holdings are comfortably above legal or prudential requirements in most Central American countries. While good for financial stability, high systemic liquidity may nonetheless hinder monetary policy transmission and financial markets development. Using a panel of about 100 commercial banks from the region, we find that the demand for precautionary liquidity buffers is associated with measures of bank size, profitability, capitalization, and financial development. Deposit dollarization is also associated with higher liquidity, reinforcing the monetary policy and market development challenges in highly dollarized economies. Improvements in supervision and measures to promote dedollarization, including developing local currency capital markets, would help enhance financial systems' efficiency and promote intermediation in the region.

JEL Classification Numbers: E44, G21, O16

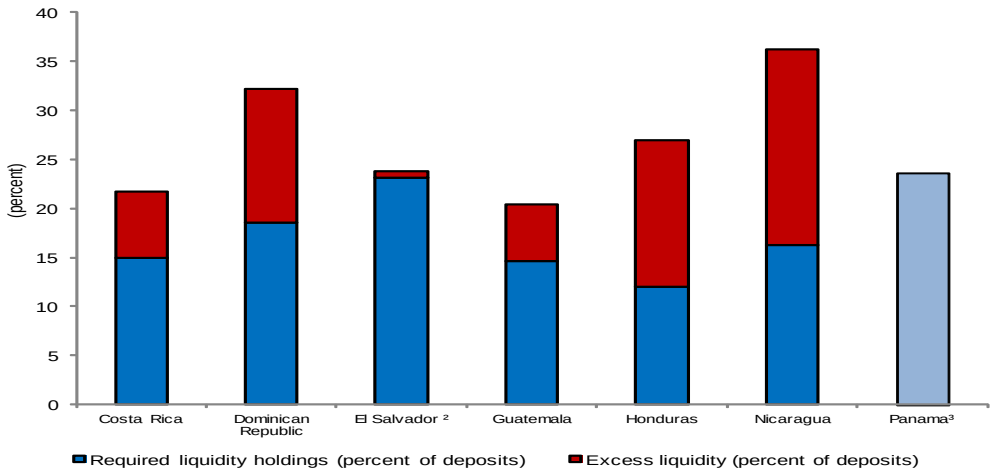
Keywords: Central America, bank liquidity, credit, dollarization, excess liquidity, foreign banks

1. Introduction

This paper studies the determinants of banks' liquidity buffers in Central America,[1] Panama and the Dominican Republic (CAPDR) using a panel of about 100 commercial banks over 2006-10. In particular, the paper examines whether CAPDR banks' liquidity buffers, defined as the liquid assets to deposits ratio, can be explained by bank and country-level characteristics, as predicted by theory and documented in some empirical studies. Of particular interest for the region is whether liquidity holdings are related to bank ownership (are public or foreign banks different?) or the economy's degree of dollarization.

CAPDR banking systems are highly liquid. Holdings of liquid assets as a share of total deposits averaged about 28 percent for the region in 2010, while reserve requirements were set at about 17 percent on average (Figure 1). Liquidity ratios are also high compared to larger South-American countries; liquidity ratios averaged about 15 percent for Brazil, Chile and Colombia in 2010. For monetary and supervisory authorities, ensuring that banks hold adequate amounts of high-quality liquid assets is essential for financial stability, as highlighted during the recent global financial crisis. However, if liquidity holdings are much above legal requirements, this may be costly in terms of foregone financial intermediation. Excess liquidity also hinders the development of interbank and money markets in all countries, and acts as "sand in the wheels" of the monetary transmission mechanism in countries with a monetary policy (Gray, 2011).

Figure 1. CAPDR Liquidity Buffers[1] (2010)



Sources: CAPDR Central Banks and Superintendencies' websites; and Fund staff calculations.

¹ Liquid assets to deposits ratio. Liquid assets include cash, central bank reserves and deposits abroad.
² Liquidity requirements.
³ Observed liquidity. Legal liquidity requirement (30%) is calculated as the ratio of liquid assets including securities to short term deposits.

[1] Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua.

From individual banks' point of view, holding sufficient liquidity is necessary to insure against liquidity risk (Diamond and Dybvig, 1983, Diamong and Rajan, 2001). As loans are relatively illiquid, large and unexpected deposit withdrawals can lead to insolvency as it may be too costly or not possible to raise liquidity on short notice, due to capital market imperfections. Instead of self-insuring, banks could resort to other forms of financing, such as accessing interbank markets, central bank liquidity windows, or external credit lines. However, asymmetric information may lead to coordination failures on the interbank market, and external credit lines may freeze (as seen during the recent financial crisis), so that solvent but illiquid banks would still fail, absent a Lender of Last Resort (LOLR) (Rochet and Vives, 2004). Thus banks hold a buffer of liquid assets as self-insurance, equating the marginal benefit of holding liquid assets to the marginal cost of alternative investments.

A priori, one would expect the self-insurance motive to be especially important in CAPDR. Capital markets are underdeveloped, interbank markets are thin, and LOLR arrangements remain limited or nonexistent. For the five partially dollarized economies, the high share of foreign currency assets and liabilities limits the ability of the central bank to act as a LOLR, while the two fully dollarized economies in the region, Panama and El Salvador, did not have a LOLR as of end-2010 (El Salvador formally approved the regulations to establish a liquidity facility in June 2012). Furthermore, while the region's predominant reliance on customer deposits is a likely reason for its resilience during the global financial crisis, it is also a potential source of vulnerability and calls for the holding of adequate liquidity buffers.

The reminder of the paper is structured as follows. Section 2 briefly reviews the theoretical and empirical literature on the determinants of liquidity holdings. Section 3 provides some background information on CAPDR banking systems. Section 4 describes the data and presents stylized facts on the distribution of banks' liquidity holdings. Section 5 discusses the econometric methodology and estimation results, and Section 6 concludes.

2. Determinants of Banks' Liquidity Buffers: Literature Review

The determinants of banks' liquidity buffers, as identified in the theoretical and empirical literature, can be classified into four broad categories. These are the opportunity costs of and shocks to funding, bank characteristics, macroeconomic fundamentals, and moral hazard motives, as discussed below.

2.1 Opportunity cost and shocks to funding

The early literature on bank liquidity uses the firm's theory of inventory decisions as a starting point. The cost of holding liquid assets (with low returns compared with other types of investments) is compared to the benefits of reducing risks of "running out" (Baltensperger, 1980, and Santomero, 1984). These models predict that the size of liquidity buffers should reflect the opportunity cost of holding liquid assets rather than loans. It should also relate to the distribution of liquidity shocks that the bank may face, and in particular be positively related to the volatility of the funding basis as well as the cost of raising additional funds.

Using aggregate time-series data for Thailand, Agénor, Aizenmann and Hoffmaister (2000) find that banks' demand for precautionary reserves (measured as the log of excess reserves over total deposits), is positively related to the penalty rate, proxied by either the discount or the money market rate, as well as to the volatility of the cash to deposit ratio. Dinger (2009) finds in a panel of Eastern European banks that liquidity buffers are negatively related to the real deposit rate but positively related to the interbank rate.

2.2 Bank characteristics

The newer generation of models explaining firms' (including banks') liquidity demand relies on some form of market imperfection to explain why banks cannot raise instantaneous and unlimited amounts of liquidity (financial frictions). The market imperfection is asymmetric information, either in the form of moral hazard (Holmstrom and Tirole, 1998) or adverse selection (Kiyotaki and Moore, 2008). Financially constrained banks would thus tend to hold more liquidity.[2,3]

Based on these models, bank characteristics affecting their ability to raise non-deposit forms of finance, such as bank size (small banks have more difficulties in accessing capital markets), profitability (more profitable banks can more readily raise capital and are thus less liquidity constrained), ownership (both public banks and foreign banks should be less liquidity-constrained than private and domestic banks, respectively, as public banks may have an implicit guarantee and foreign banks would have access to support from headquarters)[4] would affect banks' precautionary demand for liquidity buffers.

[2] Holmstrom and Tirole (1998) and Kiyotaki and Moore (2008) make this argument for firms in general: Liquidity constraints, together with liquidity shocks, result in entrepreneurs not being able to raise the entire cost of their desired investment externally, so that they have to hold enough liquid assets to make a down payment for each unit of investment (there are also limits on the amount of equity that can be resold). This explains why, although the rate of return on cash is very low, entrepreneurs will choose to hold some in their portfolio. Liquidity shocks reduce the price of equity and increase the desired holdings of liquid assets.

[3] See for example Almeida, Campello and Weisbach, 2004, Kashyap, Rajan and Stein (2002), Kashyap and Stein (1997), Repullo (2003), and Rochet and Vives (2004).

[4] Freixas and Holthausen (2005).

Aspachs, Nier and Tiesset (2005) find that banks' liquidity buffers are related to bank characteristics such as loan growth and the net interest margin, with the coefficients on size and profitability being not significant. Kashyap and Stein (1997) and Kashyap, Rajan and Stein (2002), using a large panel of U.S. banks, find a strong effect of bank size on holdings of liquid assets, with smaller banks being more liquid as they face constraints in accessing capital markets. Dinger (2009) also finds that smaller Eastern European banks hold more liquidity, but with nonlinearities, and that foreign banks hold less liquidity.

Bank ownership may not only exert a direct influence on liquidity holdings, but may also affect the regression slope through interactions with other explanatory variables. In particular, Aspach, Nier and Thiesset (2005) find that, for the UK, foreign banks' liquid asset holdings are not affected by the availability of a domestic lender of last resort, while local banks are. Furthermore, in their sample foreign banks' liquidity holdings tend to react less to changes in the domestic policy rate and GDP growth, suggesting overall that they are subject to a somewhat different set of constraints than their local counterparts.

2.3 Macroeconomic fundamentals

The models mentioned above also have implications for the cyclical behavior of liquidity demand. If capital markets are imperfect, the demand for liquidity should be countercyclical, as banks would hoard liquid assets during recessions and offload them in good times given more opportunities to lend. This suggests that liquidity buffers would be negatively related to measures of the output gap or real GDP growth, credit cycle, and policy interest rates.[5]

The counter-cyclicality of liquidity buffers limits the effectiveness of monetary policy in trying to inject liquidity to stimulate the economy in a recession: liquidity buffers would remain stable or increase but credit would not necessarily pick-up. Moreover, financial frictions in terms of capital market imperfections should be expected to vary with structural factors such as the degree of financial development and the quality of financial institutions.

Aspach, Nier and Tiesset (2005) find that UK banks' liquidity buffers are negatively related to real GDP growth and the policy rate. Agénor, Aizenmann and Hoffmaister (2000) and Saxegaard (2006) find that excess reserves are negatively related to the output gap and the policy rate in Thailand and in sub-Saharan Africa, respectively. Dinger (2009) finds that liquidity holdings are negatively related to real GDP growth and real per capita GDP.

2.4 Moral hazard and safety nets

In theory, the strength of the financial safety net and in particular the availability of a LOLR arrangement, should reduce the banks' incentives to hold liquidity buffers (Repullo, 2003).

[5] Almeida, Campello and Weisbach (2004) develop and estimate on a large sample of U.S. manufacturing firms a model where financially constrained firms have a higher propensity to save cash out of cash flows.

Empirical studies of UK and Argentinian banks, where LOLR support is measured as the Fitch support rating and the availability of external credit lines in the context of the currency board, respectively, support this prediction (Aspach, Nier and Thiesset, 2005, and Gonzalez-Eiras, 2003).

Dollarization or credit and/or deposits reduces the effectiveness of the domestic LOLR, as partially dollarized economies are subject to currency and liquidity risk, but the central bank cannot issue foreign currency (Gulde et al., 2004 and Levy-Yeyati and Broda, 2002). One would thus expect banks to hold higher liquidity buffers, the higher the degree of deposit dollarization, though the incentives to hold such buffers would diminish in the presence of a large stock of central bank international reserves or external credit lines, as these would be a ready source of dollar liquidity in the case of a run on dollar deposits (Ize, Kiguel and Levy-Yeyati, 2005). Using a sample of about 100 countries, De Nicoló, Honohan and Ize (2005) find that deposit dollarization is associated with higher solvency and liquidity risk measured by deposit volatility. To our knowledge no empirical study has focused on the effects of deposit dollarization on banks' liquidity.

3. Some Background on CAPDR Banking Systems

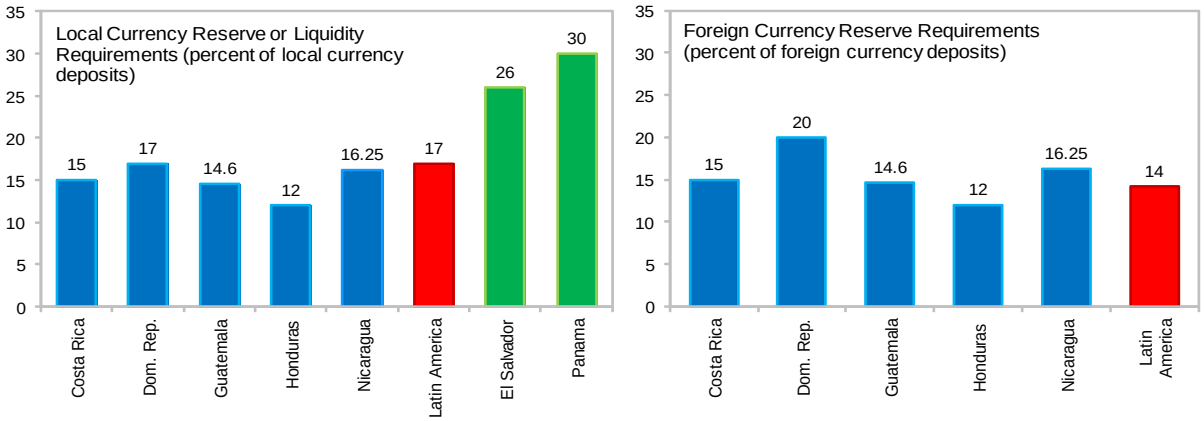
With the exception of Panama, the region's banking systems are relatively small, highly concentrated and dollarized to various degrees (Table 1). Panama stands out of the group in terms of the size of the system, which is four times greater than the sample average in terms of assets to GDP (Panama's offshore banks' assets represented only 50 percent of GDP at end-2010). In four countries (Honduras, Nicaragua, El Salvador and Panama) the share of foreign bank assets in total assets is more than 50 percent suggesting higher potential vulnerabilities from cross border linkages. While the presence of state banks is quite small in terms of number of banks and share of system's assets for the whole sample, state banks have a very strong presence in Costa Rica, with their assets accounting for 55 percent of total assets and 60 percent of deposits. Customer deposits are the main source of funding and show a high degree of dollarization, particularly in Nicaragua and Costa Rica. The share of short-term deposits is also relatively high in the region, although not in Panama.

Reserve requirements in CAPDR are in line with those of the Latin America region, and average about 15 percent for local currency deposits and 15.5 percent for foreign currency ones (Figure 2). The two officially dollarized economies rely on prudential liquidity requirements, held at the central bank in the case of El Salvador and by individual banks in the case of Panama.[6] Although they are potentially useful policy instruments,

[6] Honduras also imposes liquidity requirements to avoid maturity mismatches.

reserve/liquidity requirements are not actively managed in most countries, with the exception of El Salvador and Honduras (Appendix Table A1).[7]

Figure 2. CAPDR: Statutory Reserves and Liquidity Requirements by Currency, 2010.



Source: Central Banks and Superindendencies.

Note: Reserve requirements for all countries excluding Panama and Salvador (liquidity requirements). Liquidity requirement for Panama is defined as the ratio of liquid assets including securities and obligations payable to banks within 186 days, as a share of short-term deposits.

Table 1. CAPDR: Banking System Indicators, 2010

(in percent, unless otherwise indicated)

	Number of banks [5]	Number of State banks [2]	State bank assests in total assets	Number of foreign banks [3]	Foreign bank assets in total assets	Percent of assets in 5 largest banks	Assets to GDP	Credit to GDP	Assets in foreign currency in total assets	Credit in foreign currency in total credit	Deposits in foreign currency in total deposits	Demand deposits in total deposits
Costa Rica	16	3	55	9	26	78	60	46	46	47	41	53
Guatemala	18	1	2	7	13	79	44	30	23	30	24	41
Honduras	17	1	1	9	50	75	68	50	24	28	30	22
Nicaragua	6	1	0.01	4	67	97	62	34	72	90	73	31
Dominican Republic	15	2	31	4	29	87	32	18	26	21	30	18
El Salvador [1]	12	2	6	10	83	85	61	40	…	…	…	26
Panama [1, 4]	49	2	14	28	57	57	200	91	…	…	…	15

Source: Central American Monetary Council (SECMCA), International Financial Statistics, IMF staff calculations.

[1] Officially dollarized economies. [2] State share of more than 50 percent. [3] Banks with 50 percent of capital in foreign hands, excludes offshore.

[4] Domestic banking system; [5] April 2011.

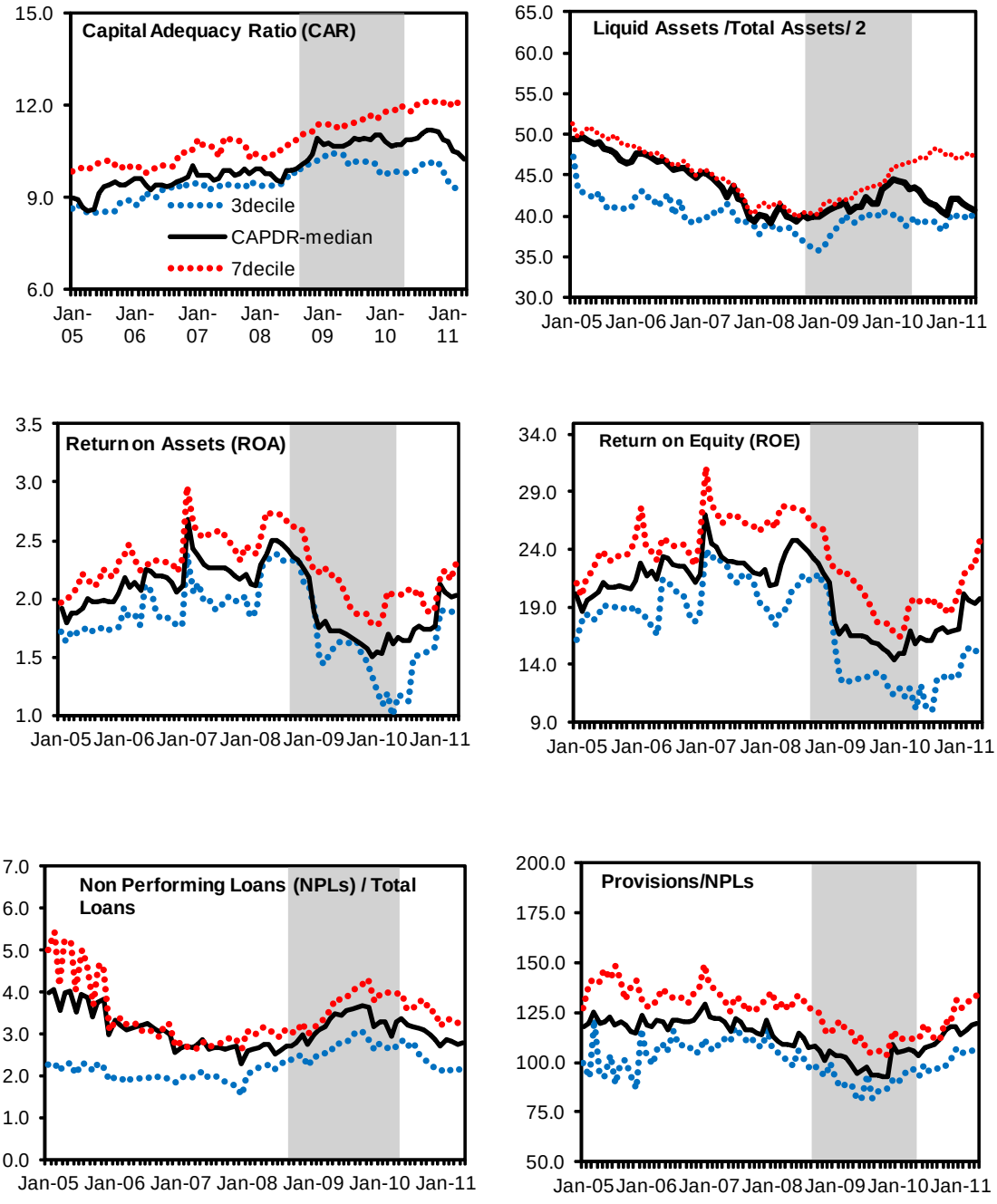
Overall, banking sectors in the region are well-capitalized, liquid and profitable. Financial systems remained resilient in the face of the 2009 global financial crisis mostly due to their strong initial positions (Figure 3). Despite rapid credit growth, the region did not experience any excessive credit booms and there was very limited exposure to toxic asset-backed

[7] Given this, excess liquidity is probably best analyzed in the context of single country time-series studies. In the panel context, our preferred definition of liquidity buffers for the empirical analysis in section 4 is the liquid assets to deposit ratio. The liquid assets to total assets ratio is used for robustness checks.

securities, as well as to wholesale funding. Stress tests of liquidity risk suggested that banks had adequate coverage of their liquid liabilities, and could withstand deposit withdrawal shocks of 15–20 percent during a 30 day period.[8] However, although banking supervision has improved over the past decade, compliance with Basel Core Principles remains uneven and below that of LA6 (Delgado and Meza, 2011). Financial safety nets remain incomplete, and financial markets are underdeveloped, including interbank markets.

[8] See Financial System Stability Assessments for the countries in the region, available at www.imf.org.

Figure 3. CAPDR: Financial Soundness Indicators, 2005-11/1



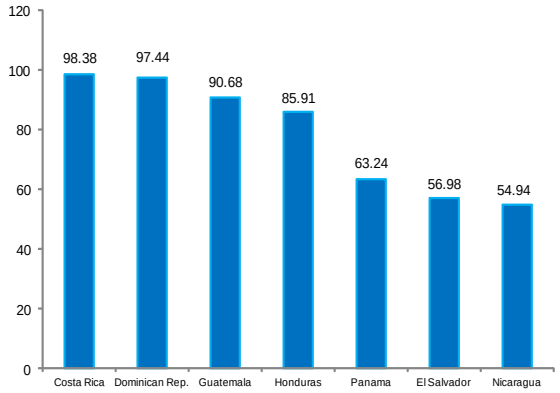
Source: Central American Monetary Council (SECMCA).
1/ Shaded area represents the 2008-09 global financial crisis.
2/ Liquid assets include short term investments.

4. Determinants of Banks Liquidity Buffers in CAPDR

4.1 Data and Variable Definitions

Our sample combines annual data for 96 CAPDR banks over 2006–10 from the BankScope data base,[9] with country-level macroeconomic fundamentals and structural variables drawn from regional monetary and supervisory authorities' websites and other publicly-available databases as described in Table 2 below and Appendix B Table B1. It covers 72 percent of all commercial banks in the region and about 80 percent of total banking system assets, though admittedly the coverage is not homogeneous across all countries in the region (Figure 4).[10]

Figure 4. Bankscope Sample Coverage of Total Banking System's Assets (2006-10 average, in percent)

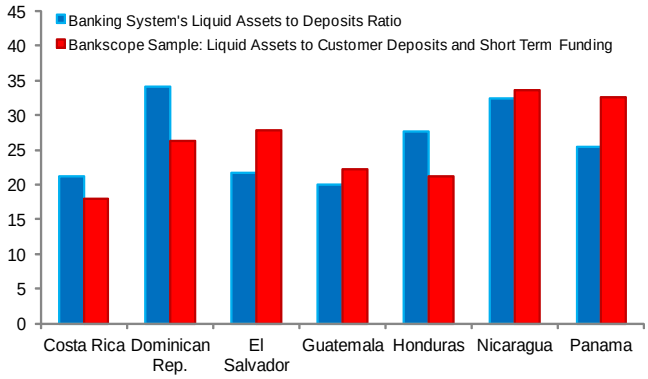


Source: BankScope database, CAPDR Central Banks and Superintendencies' websites, IMF staff calculations.

4.2 Definition of liquidity buffers

Liquidity buffers are measured by the ratio of liquid assets to customer deposits and short-term funding. Liquid assets include cash and cash-like assets, quoted or listed government bonds, and short-term claims on other banks. Although the breakdown of the numerator components is not available, there are relatively few listed government securities in the region (Shah et al., 2007b). The denominator includes banks' customer deposits and short-term interbank deposits. Customer deposits are the main source of funding in the region, with very low reliance on short-term funding (the share of customer deposits in the denominator is 93 percent for the whole sample). Overall, the ratio of liquid assets to customer deposits and

Figure 5. Liquidity Ratios at the System Level and in the Bankscope Sample (2006-10 average, in percent)



Source: BankScope database, CAPDR Central Banks and Superintendencies' websites; IMF staff calculations.

[9] A financial database supplied by Bureau van Djik.

[10] The information on coverage averaged over banks/years. A caveat is that missing institutions may not be random. The time period is restricted to the interval for which data for most CAPDR banks were available.

short-term funding is close to system-wide liquidity ratios, defined as liquid assets (cash and cash-like, excluding securities) to deposits (Figure 5). We use it as our main dependent variable, and use the ratio of liquid assets to total assets for robustness checks.[11]

4.3 Choice of explanatory variables

4.3.1 Opportunity cost, liquidity shocks and bank characteristics

We use the spread between the lending and the deposit rate as a measure of the opportunity cost. The probability of a liquidity shock can be proxied by a measure of the volatility of total deposits at the system level (we can calculate a monthly coefficient of variation of total deposits for each country, but have only annual bank-level data), or by the volatility of inflation. Past liquidity shocks may also matter: a history of banking crisis could lead banks to become more risk-averse and hold more liquidity.

Given the importance of public and foreign banks in Central America's banking systems, we are particularly interested in testing whether liquidity buffers vary systematically according to bank ownership (public/private and foreign/domestic).

We control for other bank characteristics such as size, measured as the log of total assets. The squared value of this variable captures possible non-linearities in the impact of bank size on liquid asset holdings (Dinger, 2009). Capitalization is measured as the ratio of equity to total assets. Profitability is measured by the ratio of the net interest margin to interest-earning assets. The loan-loss reserves to gross loans ratio should capture the banks' degree of risk aversion or perceived riskiness of the loan portfolio.

4.3.2 Macroeconomic fundamentals and safety nets

We use output growth in CAPDR to capture the economic cycle. Financial development is captured by private sector credit to GDP ratio, a traditional proxy for financial depth. Dollarization is measured as the share of dollar deposits in total system deposits (no currency breakdown is available for bank-level data in BankScope). Net international reserves holdings capture the dollar LOLR function of central banks.

4.4 Data

Table 2 below presents the variable definitions, expected sign and data sources, and Appendix B, Table B1 in annex describes the data. Overall there is significant variation in liquidity holdings in the sample. Liquidity holdings in terms of customer deposits and short-term funding are on average 25 percent in our sample, and represent about 18 percent of total assets. Average capitalization is relatively high at about 13 percent, as noted in Basso,

[11] Empirical studies use both ratios, see Aspach, Nier and Thiesset (2005) and Dinger (2009). The ratio of liquid assets to liabilities is the most consistent with the notion of CAPDR banks self-insuring against deposit shocks, though banking theory also emphasizes asset-side liquidity problems (Diamond and Rajan, 2005).

Delgado and Meza (2012). Foreign banks represent 45 percent of observations, and private banks about 90 percent. Deposit dollarization amounts to about 50 percent, though with wide variations across countries (see Table 1).

Table 2. Variables Used in the Empirical Estimation

Variable Name (expected sign)	***Concept***	***Measurement***	***Data source***
Dependent variable			
Liquidity ratio	Liquid assets to customer deposits and short-term funding	(Cash, short-term claims on other banks (including CDs) and where appropriate the trading portfolio)/Customer deposits and short-term funding.	BankScope
	Liquid assets to total assets	(Cash, short-term claims on other banks (including CDs) and where appropriate the trading portfolio)/total assets.	BankScope
Explanatory variables			
Bank Characteristics			
Lagged liquidity ratio (+)	Liquidity buffers should be persistent over time	See above for definition	BankScope
Capitalization (-)	Better capitalized banks should have easier access to markets and thus hold less liquidity.	Ratio of equity to total assets.	BankScope
Net Interest Income to Average Earning Assets (-)	Profitability: more profitable banks should hold less liquidity.	(Interest income-interest paid)/ interest earning assets.	BankScope
Loan-loss reserves ratio (+)	Perceived riskiness by banks of their loan portfolio: banks anticipating higher losses should hold higher liquidity buffers.	Ratio of loan-loss reserves to gross loans.	BankScope
Size (-)	If small banks are financially constrained than they should hold more liquidity.	Natural logarithm of total assets.	BankScope
Foreign ownership (-)	Foreign banks should be less financially-constrained than domestic banks and thus hold lower levels of liquid assets.	Dichotomous variable (1 for foreign; 0 for domestic). A distinction is also made between foreign subsidiaries and branches.	BankScope,
Private ownership (+)	Public banks could have less incentives to hold liquid assets as they benefit from an implicit state guarantee	Dichotomous variable (1 for private; 0 for public).	BankScope,
Macroeconomic fundamentals			
Real GDP growth (-)	Imperfect capital markets imply that liquidity buffers should be countercyclical.	Annual growth rate of real GDP per capita.	International Financial Statistics (IFS)

Interest Rate Spread (-)	Measure of the opportunity cost of holding liquid assets.	Difference between average lending and deposit rate	IFS
Country Characteristics			
Deposit volatility (+)	Higher aggregate deposit volatility forces banks to hold more liquid assets to hedge against unanticipated deposit withdrawals.	Coefficient of variation of monthly system-wide deposits during one year.	Executive Secretariat of the Centroamerican Monetary Council (www.secmca.org)
Inflation volatility (+)	High inflation volatility is a proxy for macroeconomic instability.	Coefficient of variation of monthly inflation during one year.	IFS
Credit-to-GDP ratio (-)	Captures financial development. More developed economies should have less financial constraints.	Total credit to the private sector as percent of GDP.	Executive Secretariat of the Centroamerican Monetary Council (www.secmca.org)
Moral hazard and safety nets			
Deposit dollarization (+)	The higher the dollarization, the lower the effectiveness of the domestic lender of last resort.	Share of foreign-exchange deposits in total deposits (system-wide).	Executive Secretariat of the Centroamerican Monetary Council (www.secmca.org)
Net international reserves (-)	In partially dollarized economies, NIR capture the capacity of the central bank to act as a lender of last resort in case of a foreign currency shock.	Natural logarithm of net international reserves	IFS

5. Stylized Facts

Table 3 summarizes the relationships between key explanatory variables and liquidity ratios. More specifically, it shows the sample mean of explanatory variables by liquidity quartile (with the quartiles being ranked from low to high). We are interested in whether the characteristics of banks with high liquidity buffers (in the fourth quartile) are different from those with low liquidity buffers (first quartile). Thus the last column of the table shows whether the difference in the means of the variables for banks in the 4^{th} liquidity quartile versus the first quartile is statistically significant.

Overall most proposed explanatory variables exhibit the predicted relationship to liquidity buffers, though not all the differences between the first and last quartile are significant. As compared to those in the first liquidity quartile, observations (bank/years) for which observed liquidity is high also tend to be less profitable, smaller, and private. They also have a lower probability to be in a country with a relatively low interest rate spread, low deposit

dollarization. High liquidity also seems associated with lower international reserves.[12] However, high liquidity also seems to be associated with lower inflation volatility.

Table 3. Dependent Variables Means by Liquidity Ratio Quartiles

	Liquidity ratio quartile					
	1st	*2nd*	*3rd*	*4th*	*(4th - 1st quartile)*	*p-value 1/*
Mean of Liquidity to customer and short-term funding ratio	*11.93*	*18.91*	*25.38*	*46.87*		
Loan Loss Reserves to Gross Loans	3.47	3.11	3.14	3.16	-0.32	0.46
Net Interest Margin	9.73	8.71	8.53	8.09	-1.64	0.26
Capitalization (equity to asset ratio)	13.69	11.52	11.88	15.55	1.86	0.23
Bank Size (log of total assets)	12.87	13.00	13.02	12.36	-0.51	0.03
Foreign ownership dummy (=1 if foreign bank)	0.41	0.38	0.53	0.43	0.02	0.74
Private ownership dummy (=1 if private bank)	0.88	0.89	0.94	0.94	0.07	0.07
Real GDP growth	3.24	4.40	3.50	4.04	0.80	0.32
Net International Reserves	7.94	8.09	7.91	7.76	-0.17	0.00
CPI volatility	2.27	2.10	2.01	1.87	-0.40	0.01
Interest rate spread	9.41	8.32	8.12	7.28	-2.13	0.00
Deposit volatility	3.91	4.06	3.53	3.94	0.03	0.91
Deposit dollarization	37.56	44.21	52.39	64.93	27.36	0.00
Credit to GPD (%)	43.86	44.52	48.86	54.81	10.94	0.00
Memorandum item						
Number of observations	120	109	112	107		

Source: Authors' calculations.

1/ P-value from a test of statistical difference of the means of the 4th quartile versus the 1st quartile.

6. Empirical Analysis

6.1 Baseline Specification

In line with the discussion in the previous section and similar to other studies (Aspach et al., 2005, Barajas et al., 2010, and Dinger, 2009), we estimate the determinants of the liquidity buffers based on bank characteristics, macroeconomic fundamentals and country specific-characteristics.

[12] Given that our time dimension is relatively short, and that it covers the period of the global financial crisis period, we are also interested in testing whether the behavior of the main explanatory variables was different pre-, during- and post-crisis. We find that for the crisis years (2008-09) the main relationships identified for the whole sample continue to hold (Tabulations available upon request).

The baseline specification can be represented by equation (1):

$$L_{it} = \beta_0 + \beta_1 L_{ij,t-1} + \beta_2 bank_{ijt} + \beta_3 macro_{jt} + \beta_4 country_{jt} + \mu * j + \nu * t + \xi_{ijt} \quad (1)$$

Where the subscripts *i, j* and *t* refer to bank, country and time (year) respectively. *L* represents bank level liquidity buffers. We include a lagged dependent variable: if, as predicted by theory, banks target an optimum level of liquidity holdings, then we should expect these holdings to be persistent over time, as shown by Opler et al. (1999) in the case of U.S. firms. *Bank* denotes variables measuring bank fundamentals and are derived from the balance sheets of banks. *Macro* represents the macroeconomic determinants of individual banks' liquidity buffers such as real GDP growth and interest rates, and *country* are observable country level characteristics, including, for ease of presentation, the moral hazard and safety net variables presented in the previous section and Table 2. Unobservable country and time effects are captured by country (j) and time (t) dummy variables.

6.2 Hypotheses of interest

Based on our review of the theoretical and empirical literature as well as stylized facts on liquidity data for CAPDR countries, we will pay particular attention to the following:

(i) Does ownership matter? We test separately for the effect of private vs. public ownership, and domestic vs. foreign. As discussed in Section III, ownership may not only on exert a direct influence on liquidity holdings, as discussed in section of ownership on liquidity holdings, but may also affect the regression slope through interactions with other explanatory variables. To test this hypothesis, we interact the relevant ownership dummy variable (own_{ijt}) with the other explanatory variables as shown in Equation (2):

$$L_{it} = \beta_0 + \beta_1 L_{ij,t-1} + \beta_2 bank_{ijt} + \beta_3 macro_{jt} + \beta_4 country_{jt} + (\beta_5 bank_{ijt} * own_{ijt}) + (\beta_6 macro_{jt} * own_{ijt}) + (\beta_7 country_{jt} * own_{it}) + \mu * j + \nu * t + \xi_{ijt} \quad (2)$$

(ii) We use the same framework to test whether liquidity buffers (banks perceived need for self-insurance) are higher in countries with more dollarized banking systems, as measured by the share of foreign currency deposits in total deposits. We also test whether liquidity buffers might be higher in countries with less comprehensive financial safety nets.

6.3 Estimation Methodology

Equations (1) and (2) are first estimated by Ordinary Least Squares (pooled OLS). This methodology enables us to introduce and identify bank, country and time effects on bank level liquidity. However, there may also be unobserved bank-specific and/or country specific time-invariant heterogeneity, which could bias our estimates if not properly accounted for. The error term may contain time varying bank or country-specific characteristics which may be correlated with banks' liquidity ratios. Another issue is potential endogeneity of some of the explanatory variables such as credit to GDP.

To address these concerns, we also estimate equations (1) and (2) using the *Generalized Methods of Moments (GMM)* developed by Blundell and Bond (2000) and Bond (2002). GMM estimators are particularly appropriate to address the dynamic panel bias that arises in the presence of lagged dependent variables in samples with a large number of groups (N) and a relatively small number of time periods (T), such as ours. Given persistent liquidity ratios, our preferred estimator is the Systems GMM as it helps overcome the weak instrument problem (past changes do contain information about current levels), and results in improvements in the efficiency of the estimates (Arellano and Bond, 1991, Roodman, 2006).[13]

7. Results

Table 4 present GMM estimation results of a parsimonious robust specification of equations 1 and 2 above, using the ratio of liquid assets to customer and short-term funding as a dependent variable.[14]

7.1 Baseline specification

Estimation results from the baseline specification are very robust to the choice of financial development variable (Table 4, columns 1 and 2). They show that liquidity buffers in CAPDR are persistent: the coefficient on the lagged dependent variable is positive and

[13] This was implemented in STATA using Roodman's (2006) xtabond2 routine. To avoid instrument proliferation, we restrict the number of lags for the GMM instruments to 2 (Roodman, 2009). We treat the bank size, country and year dummy variables as predetermined and the rest as endogenous. In addition to OLS (whose estimate of the lagged dependent variable coefficient is biased upward) we also estimated the model with robust fixed effects (with the coefficient on the lagged dependent variable is biased downward). Results of the fixed effects estimations are in line with those from OLS and GMM estimates (shown for the baseline specification in Appendix B, Table B2).

[14] Given the limited time span of our panel, the coefficients on the macroeconomic variables (real GDP growth, interest rate spread) were overall consistent with predictions but not significant nor very robust, as part of the effect of these variables on liquidity buffers was likely captured by the country and time dummies. GMM estimation of the full model also became difficult as the number of instruments was becoming too large relative to available observations.

significant. This is consistent with the view that banks target an optimal or desired level of precautionary liquidity holdings, but could also be attributed to the presence of structural obstacles to credit that lead banks to hold higher liquidity buffers.

Liquidity ratios are related to bank size, though with non-linearities: liquidity holdings increase with bank size, but there is a point at which bank size begins exhibiting a marginal decreasing effect on liquidity. This is the opposite of what is found by Dinger (2009) in Eastern Europe, and may be explained by differences in the distribution of bank size in both regions. In CAPDR, the distribution of banks is highly skewed with quite high concentration of assets in a few large banks, as indicated in Table 1.[15]

Liquidity holdings are also negatively related to the loan-loss reserve ratio, indicating that banks with higher savings against potential losses or riskier loan portfolios also tend to have lower liquidity buffers in CAPDR. They are negatively associated (though the relationship is not as robust as for the previous two variables) with the net interest margin, as expected. The coefficient on capitalization is negative and significant in the baseline, indicating that better capitalized banks would tend to hold less liquidity (the coefficient remains negative but is generally no longer significant in the specifications with interaction terms). This is somewhat counterintuitive, as the expectation would be that better capitalized banks would also hold more liquidity buffers, if higher capitalization is indicative of a prudent business model. In The credit-to-GDP ratio is negatively related to liquidity buffers, in line with predictions (though the coefficient is not significant).[16]

7.2 Specifications with interaction terms—the role of bank ownership

Results indicate that ownership has some effect on liquidity holdings, though mostly through the interaction terms. Our results do not show any significant evidence that private ownership does affect liquidity buffers, though the coefficient on private ownership is positive in the GMM specification (consistent with Table 3). Foreign banks tend to hold less liquidity, but the coefficient on ownership is not statistically significant either. Foreign banks with riskier loan portfolios or which are more conservative regarding expected loan losses do tend to have higher liquidity buffers (Table 4, column 6). This is consistent with predictions and findings in Detragiache, Tressel and Gupta (2008), which show that foreign banks tend to be more prudent and lend to less risky customers.

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[15] In estimations without the quadratic term the coefficient on bank size is negative and robust across specifications as expected from theory and found in related empirical studies (results available upon request).

[16] Estimating a more comprehensive model including all macroeconomic fundamentals presented in Table 2 indicate that the results on bank characteristics and variables of interest remain robust. However, as indicated before the macroeconomic variables are not very precisely estimated in our short panel and although coefficients on these variables are overall in line with predictions they are neither always consistent nor significant.

7.3 Specifications with interaction terms—deposit dollarization

As indicated in columns 7–8 of Table 4, deposit dollarization is robustly and significantly associated with higher liquidity buffers. The individual effect is quite large: a one standard deviation (34 percent) increase in deposit dollarization leads to a 150 percent increase in the liquidity to deposit ratio.[17] The strong positive association between deposit dollarization and liquidity buffers may however not necessarily indicate a direct causal relationship. The same factors that cause households and firms to hold more dollar deposits could very well also lead banks to hold more precautionary liquidity.[18] Nonetheless, the positive relationship between dollarization and high liquidity holdings would provide yet another reason why the monetary transmission mechanism is slower in more dollarized economies (as in Medina Cas, Carrion-Menendez and Frantischek, 2011).

The interaction with the loan-loss reserve ratio also indicates that prudent banks or banks with risky loan portfolios in dollarized economies tend to hold more liquidity (though the coefficient is not significant in the GMM specification). More profitable banks in dollarized economies tend to hold less liquidity.

7.4 Robustness checks

As a main robustness check, we estimate our model using the ratio of liquid assets to total assets as our dependent variable (Table 5). Overall results are broadly consistent with the findings presented in Table 4, at least in terms of signs of coefficients. The coefficient on the lagged dependent variable is about twice as large, and the coefficient of the dollarization variable remains significant and relatively large.

Appendix B, Table B2 presents further robustness checks. These include showing both the results of the pooled OLS and the fixed effects regressions as discussed in footnote 13 above (columns 1-3), and looking into the interactions of foreign ownership and dollarization only for the private banks of the sample (columns 4-5). One caveat is that limiting the number of observations increases the risk of overfitting the model due to too many instruments. Nonetheless, the Hansen statistic's p-value remains reasonable for all specifications.

These additional regressions support our main findings. The relative size of the coefficient on the lagged dependent variable in the pooled OLS, fixed effects and GMM is consistent with expectations: in OLS this coefficient is correlated with the error term and biased upward, while in the fixed effects specification it is the opposite. Good estimates of the true parameter should lie in between or near these values, which is the case here (see column 2 of Appendix

[17] Given that reserve requirements are set at the same rate for local and foreign currency deposits in most countries, and that actual liquidity holdings are held above requirements, it is unlikely that this result is driven mechanically by reserve requirements. However, the large standard deviation is in part due to the fact that the share of foreign deposits in total is 100 percent in El Salvador and Panama.

[18] De Nicoló, Honahan and Ize (2005) find in a large cross-country sample that the credibility of macroeconomic policy and the quality of institutions are key determinants of deposit dollarization.

B Table B3). Previous results on ownership, dollarization and safety net hold in the private banks sample, particularly as regards the role of credit institutions in highly dollarized economies or economies with a less comprehensive safety net.

Table 4. Determinants of Banks' Liquidity Buffers in CAPDR - GMM Estimates

Dependent variable is the ratio of total liquid assets to customer deposits and short-term funding	Baseline	Variable = Private	Foreign	Dollarization
	(1)	(2)	(3)	(4)
Liquid assets ratio (-1)	0.189***	0.218*	0.231**	0.223**
	(0.044)	(0.114)	(0.099)	(0.092)
Bank size	7.994***	8.545***	10.381**	5.639**
	(1.875)	(2.299)	(4.137)	(2.635)
Bank size squared	-0.371***	-0.392***	-0.483**	-0.244*
	(0.092)	(0.126)	(0.203)	(0.129)
Capitalization	-0.321**	-0.505	-0.316	-0.017
	(0.123)	(0.336)	(0.305)	(0.542)
Net interest margin	-0.123	-0.089	-0.593	0.404
	(0.076)	(1.067)	(1.199)	(0.331)
Loan-loss reserve ratio	-0.282	-0.035	-0.550	-0.799
	(0.252)	(0.588)	(0.506)	(0.624)
Credit to GDP ratio	-0.323	0.404	-0.441	-0.041
	(0.292)	(0.664)	(0.344)	(0.679)
Credit Institutions 1/				
Variable		42.500	-13.249	**1.491*** **
		(36.406)	(18.512)	(0.470)
Capitalization*variable		0.077	0.161	-0.001
		(0.616)	(0.647)	(0.014)
Net interest margin*variable		0.036	0.309	-0.022
		(1.128)	(1.058)	(0.015)
Loan-loss reserve ratio*variable		-0.077	**2.858** *	0.027
		(0.827)	(1.291)	(0.022)
Credit to GDP ratio*variable		-1.283	0.169	-0.012
		(0.880)	(0.282)	(0.009)
Credit Institutions*variable 1/				
Observations	321	321	321	321
R-squared				
No. of groups	96	96	96	96
No. of instruments	64	54	54	64
Hansen test p-value	0.348	0.192	0.132	0.232
A-B AR(2) test	1.283	1.027	1.040	1.562
A-B AR(2) test p-value	0.199	0.305	0.298	0.118

Source: Authors' calculations.

Notes: Robust standard errors in parentheses. *** Coefficient significant at the 1 percent level; ** at the 5 percent level; * at the 10 percent level.

Dependent variable is the ratio of total liquid assets to customer deposits and short-term funding. GMM is two-step system GMM estimator with Windmeijer standard error correction. Columns (2) through (4) test the hypotheses that ownership (foreign/domestic and public/private), degree of dollarization and coverage of the financial safety net affect banks' liquidity buffers. Ownership is captured by dummy variables (1 if the bank is private; 1 if the bank is foreign), dollarization by the share of dollar deposits in total deposits at the country level. All regressions include time and country dummies. Constant estimated but not reported.

Table 5. Determinants of Banks' Liquidity Buffers in CAPDR - GMM Estimates

Dependent variable is the ratio of liquid assets to total assets	Baseline	Variable= Private	Foreign ownership	Dollarization
	(1)	(2)	(3)	(4)
Liquid assets ratio (-1)	0.557***	0.567***	0.483***	0.519***
	(0.098)	(0.089)	(0.101)	(0.093)
Bank size	3.861***	4.077***	5.484***	3.815***
	(0.866)	(1.048)	(1.908)	(1.257)
Bank size squared	-0.180***	-0.197***	-0.262***	-0.179***
	(0.044)	(0.056)	(0.085)	(0.061)
Capitalization	-0.211***	-0.192	-0.175*	-0.063
	(0.070)	(0.124)	(0.099)	(0.215)
Net interest margin	-0.037	-0.799	-0.593*	0.216
	(0.033)	(1.193)	(0.311)	(0.151)
Loan-loss reserve ratio	-0.036	0.277	-0.292*	-0.178
	(0.145)	(0.280)	(0.166)	(0.395)
Credit	-0.181	0.117	-0.295	0.249
	(0.181)	(0.355)	(0.251)	(0.553)
Variable		16.285	-5.554	**1.336*** **
		(24.600)	(7.717)	(0.346)
Capitalization*variable		-0.071	-0.161	-0.003
		(0.251)	(0.212)	(0.004)
Net interest margin*variable		0.756	0.487	-0.012
		(1.186)	(0.328)	(0.008)
Loan-loss reserve ratio*variable		-0.291	1.340	0.005
		(0.456)	(0.903)	(0.017)
Credit *variable		-0.444	0.100	-0.013
		(0.424)	(0.130)	(0.009)
Observations	321	321	321	321
R-squared				
No. of groups	96	96	96	96
No. of instruments	64	67	67	77
Hansen test p-value	0.337	0.267	0.283	0.448
A-B AR(2) test	1.075	1.152	0.891	1.427
A-B AR(2) test p-value	0.282	0.249	0.373	0.154

Source: Authors' calculations.

Notes: Robust standard errors in parentheses. *** Coefficient significant at the 1 percent level; ** at the 5 percent level; * at the 10 percent level. Dependent variable is the ratio of liquid assets to total assets. GMM is two-step system GMM estimator with Windmeijer standard error correction. Columns (2) through (4) test the hypotheses that ownership (foreign/domestic and public/private), and degree of dollarization affect banks' liquidity buffers. Ownership is captured by dummy (=1 if the bank is private, =1 if the bank is foreign), dollarization by the share of dollar deposits in total deposits at the country level. All regressions include time and country dummies. Constant estimated but not reported.

7.5 A Closer Look at Excess Liquidity

We use the specification in column 4 of table 4 to retrieve the predicted value of liquidity buffers, and we construct an "excess liquidity" variable as the difference between actual and predicted levels of liquidity buffers. Such a two-step approach is in the spirit of Agenor, Aizenmann and Hoffmaister (2004), who first estimate the demand for excess reserves before using the residual to identify whether the credit crunch in Thailand was driven by supply or demand factors.

We find preliminary evidence that excess liquidity is negatively associated with credit growth, both in bivariate correlations and in simple pooled OLS regressions of real GDP growth, real lending rates and excess liquidity (Table 6). The robustness of this finding would need to be further investigated in a careful study of the determinants of credit in the region. As both loans and liquidity are part of banks' assets, decisions on lending and liquidity holdings are likely to be made simultaneously by banks. However to our knowledge, and while the literature on the determinants of bank credit is vast, there is no unified theoretical model of both credit supply and liquidity demand .

Table 6. Excess Liquidity and Bank Credit

Dependent variable is bank credit growth	(1)	(2)
Real GDP growth	1.497**	1.434**
	(0.589)	(0.620)
Real lending rate	-1.577***	-1.199**
	(0.548)	(0.562)
Excess liquidity		-1.024*
		(0.530)
Constant	48.344***	34.345***
	(13.296)	(9.006)
Observations	350	321
R-squared	0.09	0.11

Source: Authors' calculations.

Notes: Robust standard errors in parentheses.
*** Coefficient significant at the 1 percent level;
** at the 5 percent level; * at the 10 percent level
Regressions include time and country dummies.

Our results still need to be considered against the caveat of data limitations. The uneven coverage of individual countries' banking systems and short estimation time frame may affect the coefficient estimates from the regressions. Nevertheless, some useful policy lessons already emerge from our analysis. These are discussed in the following section.

8. Conclusions and Policy Lessons

Our study of liquidity buffers in CAPDR finds that they are comfortably above legal and prudential requirements. With average liquidity ratios of about 25 percent of deposits, banks in the region have handled and are able to handle historic deposit volatility levels outside of crisis episodes.

A closer look at the reasons for which banks would want to hold liquidity buffers above legal or prudential requirements indicates that CAPDR banks appear guided at least in part by rational precautionary motives. As found in other countries or regions, bank characteristics that influence their ability to raise additional funding on demand play an important role: smaller, lower-capitalized, less efficient and less profitable banks tend to hold higher liquidity buffers. Foreign banks tend to hold less liquidity, possibly because they have access to emergency lines from headquarters. Surprisingly, banks with riskier loan portfolios also hold less liquidity overall, though this is not the case for foreign banks and banks in highly dollarized economies.

A first policy lesson stemming from these results would be to continue with ongoing efforts to strengthen financial sector supervision, enhance financial safety nets and develop financial markets. Greater confidence in the system and more opportunities for investment and intermediation (through stronger credit institutions) could help lower banks' precautionary liquidity buffers without compromising financial stability.

Strengthened supervision would help address the issue of the negative relationship between the loan-loss ratio and liquidity buffers, which may indicate that domestic banks, in contrast with foreign banks which are likely subject to strict internal guidelines, may not fully internalize the costs of riskier lending practices. As mentioned, further progress in risk-based supervision would be especially warranted: in spite of notable progress, CAPDR countries still do not meet minimum international standards and lag behind larger South American countries.

Another important lesson relates to the dollarization of CAPDR economies and banking systems and calls for strengthening the credibility of macroeconomic policy and institutions, as well as the coverage of financial safety nets. Our findings show that, in our sample, banks' precautionary demand for liquidity is associated to the degree of deposit dollarization, and the safety net, in each country. Given the lack of dollar LOLR in all countries and the lack of a LOLR in the two fully dollarized economies, our findings suggest that continuing with ongoing efforts to strengthen financial safety nets would be efficient. El Salvador has approved legislation to provide emergency liquidity support to banks, and Panama is considering establishing a similar facility.

Furthermore, maintaining higher liquidity buffers because of dollarization also has negative implications for the development of financial markets, and for the adequate functioning of the monetary policy transmission mechanism. For the countries in the region that aim at transitioning to inflation targeting, tackling the root causes of deposit dollarization should be an important part of their strategy.

With causality likely running both from policies to dollarization and back, measures that would help create a "virtuous cycle" of de-dollarization and lower precautionary liquidity holdings could be informed by the experience of de-dollarization in South America. In particular, in a study of financial de-dollarization in Bolivia, Paraguay, Peru and Uruguay, Garcia-Escribano and Sosa (2011) find that successful, market-driven de-dollarization was associated with (i) stronger macroeconomic policies and institutions, credibly and consistently implemented over time, (ii) active management of reserve requirement differentials and the introduction of other prudential measures; and (iii) domestic currency capital market development. As discussed in this paper, there is ample room for more active liquidity management on the part of the CAPDR monetary and prudential authorities. Finally, measures to develop local currency capital markets, starting with public domestic debt markets, would enhance financial systems' efficiency, diversify sources of funding and investment opportunities.

Finally, further research could usefully look into the relationship between high/excessive liquidity and financial depth. If there are indications that liquidity holdings in excess of what would be demanded by banks for precautionary motives are associated with lower bank lending, measures to promote more active bank liquidity management and reduce macroeconomic volatility would be warranted.

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Appendix A. Table A1: Legal Reserve and Liquidity Requirements in CAPDR (2010)

Country	Reserve requirements		Remuneration (percent)	Liquidity requirement (percent)	Eligible Liabilities	Compliance Assets	Averaging	Penalty	Purpose/ Last change
	Local Currency (percent)	Foreign Currency (percent)							
Costa Rica	15	15	n.a		Demand, foreign currency, time, interbank, government. Excludes interbank deposits.	Deposits at the central bank (only those at the reserve account) in the some currency than the deposits	15 days maintenance period	Interest rate of discount window over the reserve deficiency	Monetary policy
Guatemala	14.6	14.6	0.6	n.a	All deposits	Cash in vault and deposits at the central bank in the some currency than the deposits	Monthly	n.a	Monetary policy
Honduras	6 (unrem), 12 (remun)	12(unrem), 10(remun)	Only compulsory investments are remunerated at ½ of the policy rate.	Yes; 2 1/	Deposits, expired term deposits, reduced capital contracts and savings stamps and others	Cash in vault, deposits at the central bank, and government bonds in the case of compulsory investment in local currency in the some currency than the deposits	Over a two-week period	Penalties depend on the currency of denomination and the type of institution.	Monetary policy/ 2008-09
Dominican Republic	17	20	Foreign currency reserves are remunerated at Feds overnight rate - 200bps	n.a	Demand, foreign currency, time, interbank, government. Excludes interbank deposits.	18 % in deposits with central bank and 2% cash in vault allowed.	Weekly, holding period ends on Friday	n.a	Monetary Policy/2009
Nicaragua	16.25	16.25	n.a	on excess reserves (n.a.)	All deposits	Cash of CB securities	n.a	Interest charged based on internbank int rate (greater than 1%)	Monetary policy/2005-06
El Salvador	23	n.a	n.a	3	All deposits	25 % in demand deposits at CB or foreign bank, 25% in deposits or CB securities, 50% in CB securities issued for liquidity purposes	Over a two-week period	n.a.	Prudential
Panama	n.a	n.a	n.a	30; 20 (Applies to all onshore general license banks and state-owned Banks at 30.0 for general licence banks; 20.0 for general licence banks that maintain average interbank quarterly deposits exceeding 80 percent of total deposits.	Demand, term deposits up to 186 days (unless portion that guarantees loans in the bank itself), savings deposits. Deposits received from the parent company, branch, subsidiary or affiliated abroad are excluded.	Legal tender in Panama, bank deposits in Panama, bank deposits abroad, obligations issued by foreign governments, obligations issued by foreign private and government agencies, banking obligations payable in Panama up to 186 days, installments of payable obligations up to 186 days, other Liquid Assets.	n.a	n.a	Prudential

Sources: CAPDR Central banks and Superintendencies w ebsites.

1/ Honduras also imposes specific liquidity requirements, based on temporal bands for maturity mismatches. For the first band, the maturity mismatch in cash flow s for the next month must be low er than the amount of liquid assets, w hile the for the second band the maturity mismatch in cash flow s for the next three months must be low er than 1.5 times the liquid assets.

Appendix B. Table B1: Descriptive Statistics

Variable	*No. observations*	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Liquid assets to customer deposits and short-term funding ratio	448	25.3	18.3	2.0	191.0
Liquid assets to total assets ratio	448	18.9	10.4	0.9	75.6
Capitalization (equity to asset ratio)	448	13.2	9.3	2.6	83.0
Loan Loss Reserves to Gross Loans	417	3.2	3.1	0.0	25.0
Net Interest Income to Average Earning Assets	428	8.8	10.5	1.0	87.0
Loan to Asset ratio	448	58.9	17.1	3.3	90.6
Loan growth (y/y, percent)	350	24.0	55.6	-66.2	594.5
Bank Size (log of total assets)	448	12.8	1.7	4.1	16.5
Foreign ownership dummy (=1 if foreign bank)	480	0.4	0.5	0.0	1.0
Private ownership dummy (=1 if private bank)	480	0.9	0.3	0.0	1.0
Interest rate spread	480	8.3	2.9	3.1	16.8
Real GDP growth	384	3.9	5.7	-7.9	15.3
Net international reserves	480	7.9	0.4	6.7	8.6
Deposit dollarization	480	50.2	34.2	13.5	100.0
Credit to GPD (%)	480	48.8	25.9	17.2	93.7

Sources: International Financial Statistics, World Economic Outlook Database, Bankscope Database, CAPDR Central banks and Banking Supervision websites; authors' calculations.

Appendix B. Table B2. Determinants of Banks' Liquidity Buffers in CAPDR - GMM Estimates (unless otherwise specified)

Dependent variable is the ratio of liquid assets to customer deposits and short-term funding	Baseline 1/			Foreign	Dollarization
	(1)	(2)	(3)	(4)	(5)
	Pooled OLS	GMM	Fixed Effects		
Liquid assets ratio (-1)	0.347***	0.189***	0.169***	0.164**	0.227***
	(0.064)	(0.044)	(0.025)	(0.069)	(0.072)
Bank size	7.401***	7.994***	16.804	11.172**	7.848**
	(1.448)	(1.875)	(10.703)	(5.221)	(3.038)
Bank size squared	-0.350***	-0.371***	-0.886*	-0.553**	-0.381**
	(0.064)	(0.092)	(0.476)	(0.218)	(0.152)
Capitalization	-0.355***	-0.321**	-0.502***	-0.453	-0.424
	(0.060)	(0.123)	(0.184)	(0.516)	(0.477)
Net interest margin	-0.156**	-0.123	0.011	-1.169	0.332
	(0.064)	(0.076)	(0.325)	(0.833)	(0.335)
Loan-loss reserve ratio	-0.224	-0.282	0.221	-0.984	-1.032
	(0.160)	(0.252)	(0.290)	(0.810)	(0.704)
Credit-to-GDP ratio	-0.213	-0.323	-0.337*	-0.904**	-0.860
	(0.272)	(0.292)	(0.199)	(0.387)	(0.675)
Variable				-18.363	**1.201*** **
				(15.445)	(0.412)
Capitalization*variable				-0.070	0.000
				(0.711)	(0.008)
Net interest margin*variable				0.973	-0.021
				(0.891)	(0.015)
Loan-loss reserve ratio*variable				**3.021***	0.036
				(1.552)	(0.022)
Credit to GDP ratio*variable 1/				0.212	-0.003
				(0.214)	(0.009)
Observations	321	321	321	289	289
R-squared	0.55		0.19		
No. of groups		96	96	88	88
No. of instruments	.	64		67	77
Hansen test p-value		0.348		0.117	0.135
A-B AR(2) test		1.283		0.770	1.574
A-B AR(2) test p-value		0.199		0.442	0.116

Source: Authors' calculations.

Notes: Robust standard errors in parentheses. *** Coefficient significant at the 1 percent level; ** at the 5 percent level; * at the 10 percent level. Dependent variable is the ratio of liquid assets to customer deposits and short-term funding. Two-step system GMM estimator with Windmeijer standard error correction. Ownership is captured by dummy variables (=1 if the bank is private, =1 if the bank is foreign), dollarization by the share of dollar deposits in total deposits at the country level. All regressions include time and country dummies. Constant estimated but not reported.

1/ Baseline specification as in column (1) of Table 4.

2/ Columns (4)-(5) show GMM estimation results for the sample of private banks (excluding public banks).