Determinants of Commercial Bank Liquidity in the ECCU[1]

By

Allister Hodge[2]

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[1] The Views presented in this paper do not necessarily reflect the views or opinions of the Eastern Caribbean Central Bank

[2] Economist at the Eastern Caribbean Central Bank. Email allister.hodge@eccb-centralbank.org

Abstract

The aim of this paper was an investigation into the determinants of liquidity holdings within the Eastern Caribbean Currency Union (ECCU). While commercial banks' liquidity holdings are comfortably above legal or prudential requirements whilst good for financial stability, high systemic liquidity may nonetheless hinder economic development and financial markets development. This may reflect some structural weakness within the economies. Using a panel of commercial banks from the region two different estimation procedures are utilised those being panel corrected standard error model and a limited dependent model. The paper finds that the demand for precautionary liquidity buffers is associated with measures of bank size, deposit volatility, loan loss provision which reflects risk and most importantly liquidity buffers are persistent implying that banks target a level of liquidity in most cases beyond the legally stipulated limits. Improvements local currency capital markets, economic growth and other investment opportunities can perhaps help enhance financial systems' efficiency and promote intermediation in the region bearing in mind to not to compromise financial sector stability.

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Introduction

A bank should acquire proper liquidities when needed immediately at a sensible cost. Though sustaining the optimal level of liquidity is a real art of bank's management. The whole banking system is particularly reliant on the satisfactory degree of liquidity because if a single bank registers the liquidity crisis it will affect the whole financial institutions framework through the contagion effect (mainly because of interbank dependencies) and may ultimately raise the level of systemic risk. Achieving the optimum level of liquidity is extremely dependent on various properties such as: size, characteristics, nature and level of complexity of activities of a bank. Greuning and Bratonovic, (2004) explains the management of liquidity as the bank has to follow a decisional structure for managing liquidity risk; an appropriate strategy of funding, the exposure limits and a set of rules for arranging liquidities in case of need. Every bank must have a well-defined liquidity management policy that is communicated in the whole organization. There must be a liquidity control strategy that specifies certain rules regarding management of assets.

According to Bank for International Settlements many banks struggled to maintain adequate liquidity during global financial crisis. Unprecedented levels of liquidity support were required from central banks in order to sustain the financial system. Even with such extensive support, a number of banks failed, were forced into mergers or required resolution. Several years before the crisis, the liquidity of banking sector was sufficient. Funding was readily available at low cost. Liquidity risk and its management was not given a priority, especially comparing with other types of risks. However, the crisis completely changed market conditions and thus illustrated the importance of adequate liquidity risk measurement and management. Bank's liquidity indicates the ability to finance its transactions efficiently. If the bank is unable to do this it is known as the liquidity risk. As this risk increases the bank is considered unable to meet its obligations (such as deposits withdrawal, debt maturity and funds for loan portfolio and investment).

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.

In the ECCU a similar problem arose following the international financial crisis; liquidity tightened immediately following the crisis, the problem was most acute in the indigenous banking sector and very much asymmetric within that sector. Since then, the situation has changed. The overall level of liquidity in the system appears to be adequate to meet the needs of the market, however a few banks have experienced periods of extremely tight liquidity. While it is recognised that some banks would have to improve their performance and liquidity management practices, it is felt that a review of the system is timely.

The problem of low liquidity caused disruptions amongst the banks that did have an adequate level of liquidity. A liquidity constrained banking sector might hinder economic activity as banks reduce credit and thus impact on investment. In addition a liquidity constrained banking system can have negative effect on the payments system. Liquidity problems if not adequately and forcefully addressed can morph into solvency problems endangering not only the banking system but also the entire financial system. As was alluded to above the problem in the ECCU banking system is not the lack of liquidity but rather the lack of liquidity by some banks or the distribution thereof of liquidity. Therefore the question is what could be the potential reasons which account for banks apparent lack of liquidity.

As a first line of defence if there is liquidity in the system then the mechanism for redistributing this liquidity would be the interbank money market which is essential for the stability and efficiency of the financial system, as it allows for the optimal distribution of liquidity. The interbank money market can be divided into a secured lending market and an unsecured lending market. Secured lending requires the borrower to provide collateral to the cash provider in order to mitigate the credit risk that the lender takes on. Unsecured lending does not involve collateral, but relies on monitoring as the lender trusts the borrower well enough. The crisis has brought about a shift from unsecured to secured lending.

In the ECCU this market, for all intents and purpose, is just not fulfilling its role for the redistribution of liquidity. This brings into focus institution specific factors regarding liquidity such as the liquidity management framework, core funding base etc. in the foreign branch banking sector the banks do a liquidity polling arrangements whereby banks with liquidity shortfalls can borrow from the pool. However in the indigenous banking sector the problem remains fragmentation and each bank operating in its own silos

Objective

It is evident that liquidity and liquidity risk is very up-to date and important topic. The aim of this paper is therefore to identify determinants of liquidity of ECCU commercial banks. We look at bank specific factors and macro-economic factors as well to gauge the determinants of commercial banks liquidity.

A priori, one would expect the self-insurance motive to be especially important in the ECCU. Capital markets are underdeveloped, interbank markets are thin, and LOLR arrangements given the quasi currency board arrangement precludes a lender of last resort function except in exceptional circumstances where by a Lombard loan is given. 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.

Literature Review

Banks collect demandable deposits and invest these funds in long-term and illiquid assets, such as loans. For this reason banks may be vulnerable to liquidity shocks arising mainly from the liability side of their balance sheets. If a large fraction of depositors demand cash, the bank may need to liquidate illiquid assets. Since this entails a loss of value, a liquidity shortage may turn into a solvency crisis. Many banks in recent history have defaulted not because of lack of profits but because of short term liquidity problems.

The first symptoms of a liquidity crisis in the banking sector generally take the form of a liquidity deficit in the balance sheet of a bank. Liquidity risk may entail contagion. describes contagion in the context of peer monitoring of the money market, liquidation of interbank deposits in response to unexpected deposit withdrawals, expected scarce reserves or adverse selection in inter-bank lending when the solvency statute of interbank borrowers is unknown. They also describe factors which drive contagious failures of banks, such as the limited capacity of financial markets to absorb asset sales, the inefficiency of the

mechanisms at work when assets needs to be liquidated, the strength of direct balance sheet inter-linkages and phenomena related to changes in asset prices.

The three main sources of liquidity risk are:

1) on the liability side, there is a large uncertainty on the volume of withdrawals of deposits or the renewal of rolled-over inter-bank loans, especially when the bank is under suspicion of insolvency or when there is a temporary aggregate liquidity shortage,

2) On the asset side, there is an uncertainty on the volume of new requests for loans that a bank will receive in the future,

3) off-balance sheet operations, like credit lines and other commitments, positions taken by banks on derivative markets.

Notwithstanding there are some mechanisms that banks can use to insure against unexpected liquidity shocks:

1) Banks can choose to hold a buffer of liquid assets on the asset side of the balance sheet. A large enough buffer of assets such as cash, balances with central banks and other banks, debt securities issued by governments and similar securities or reverse repo trades reduce the probability that liquidity demands threaten the viability of the bank.
2) The second strategy is connected with the liability side of the balance sheet. Banks can rely on the interbank market where they borrow from other banks in case of liquidity demand. However, this strategy is strongly linked with market liquidity risk.

3) The last strategy concerns the liability side of the balance sheet, as well. The central bank typically acts as a Lender of Last Resort to provide emergency liquidity assistance to particular illiquid institutions and to provide aggregate liquidity in case of a system-wide shortage.

Liquidity risk is not an isolated risk but a consequential risk, with its own intrinsic characteristics, that can be triggered or exacerbated by other financial and operating risks within the banking business. For example, if a bank fails to meet its obligations as they come due (for example in the clearing house), besides exposing the bank to liquidity risk it may even give rise to legal action and reputational risk.

Therefore liquidity is not dependent simply on objective, exogenous factors (such as efficient market infrastructure, low transaction costs, large number of buyers and sellers, transparent characteristics of

traded assets), but is crucially influenced by endogenous forces, especially by the dynamic reactions of market participants in the face of uncertainty and changes in asset values. In favourable conditions, liquidity is easily available and cheap and can be determined by exogenous factors. But under stress conditions, liquidity becomes very scarce and expensive and it may become even effectively unavailable.

Empirical Literature Review

Although liquidity problems of some banks during global financial crisis re-emphasized the fact that liquidity is very important for functioning of financial markets and the banking sector, an important gap still exists in the empirical literature about liquidity and its measuring. Only few studies aim to identify determinants of liquidity.

Estimation of the demand function of banks for excess reserves – studies try to estimate the demand function for excess reserves (or liquid assets) by commercial banks usually use the model of Agénor, Aizeman,.Hoffmaister (2000) which specified the demand for liquidity as a function of the ratio of excess liquid assets over total bank deposits, the ratio of required liquid assets to total bank deposits, current and lagged values of the coefficient of variation of the cash-to-deposit ratio, the deviation of output from trend, and the discount rate. Studies following this paper usually modify variables used for estimation of the demand function, e.g. Fielding, A., (2005) or Moore, W.(2010)

Vodava (2011) who studied the liquidity of Czech's commercial banks and the determinants of it showed that there is a significant relationship between the liquidity and the resources sufficiency. Shin and Adrian (2007) showed that in a chaotic economic era the liquidity position is that much concerned that any changes in it may change the whole banking network. Their study showed that backing of liquidity is stable and often decreased in tumult phase so it is necessary to consider the liquidity management. Moreover liquidity is very important for both predictable and unpredictable losses. It deals with cash and cash equivalents, investment in securities and placement with other banks. It can help to reduce losses and enhance the chances of banks profitability that's why liquidity is a very essential measure. Basel committee (2009) explained that the sustainability of commercial banks is dependent upon the liquidity position; in return it measures the bank's inner role towards the maintenance of cash flow. Aikaeli (2006) indicated the determinants of surplus liquidity and found that credit risks, high rate of funding, cash

preferences and instability of deposit holders are basic determinants of surplus liquidity in commercial banks.

Aspachs, O., Nier, E., Tiesset, M (2005) investigated bank-specific and macroeconomic determinants of liquidity of English banks. They assumed that the liquidity ratio as a measure of the liquidity should be dependent on following factors (*estimated influence on bank liquidity in parenthesis*):

1) Probability of obtaining the support from lender of last resort, which should lower the incentive for holding liquid assets (-); 2) Interest margin as a measure of opportunity costs of holding liquid assets (-); 3) bank profitability, which is according to finance theory negatively correlated with liquidity (-); 4) Loan growth, where higher loan growth signals increase in illiquid assets (-); 5) Size of the bank (?), 6) Gross domestic product growth as an indicator of business cycle (-); 7) Short term interest rate, which should capture the monetary policy effect (-).

The authors proceed by making a distinction between foreign owned and UK domestically owned by banks. Therefor the authors created a dummy variable for foreign owned banks and interacted this variable with the list of other independent variables to assess the impact of foreign owned banks from UK owned banks. The results from their analysis showed that liquidity buffers held by UK commercial banks tends to depend on the support that they are expected to receive from the LOLR in case of shortage. In particular, as predicted by Repullo (2003), for UK-owned banks, the strength of LOLR support has a negative effect on banks' liquidity holdings. Second, monetary policy, proxied by the short-term interest rate, appears to affect liquidity buffers. The negative coefficient on the short interest rate suggests that when policy rates are high (low) UK banks respond by holding a smaller (larger) amount of liquid assets real GDP growth does appear to affect banks' liquidity holdings. As indicated by the negative coefficient on GDP growth, banks appear to hold smaller (larger) amounts of liquidity, relative to both total assets and total deposits, in periods of stronger (weaker) economic growth. In other words, banks appear to build up their liquidity buffers during economic downturns and draw them down in economic upturns. The interest margin - a proxy for the opportunity cost of holding liquid funds - had a negative effect on liquidity holdings, as predicted by inventory models of optimal liquidity holdings. For foreign owned banks, by contrast, the interest margin appears to have the opposite effect on liquidity, perhaps reflecting remittances of liquidity from the centre of the group when UK interest margins are high. It was also shown that more profitable banks appear to hold larger buffers on average, even though this result is not significant at conventional levels. Larger banks tended to hold larger buffers, but again this result is not significant at conventional levels. Finally, as one might expect, banks that experienced stronger loan growth tended to reduce their liquidity holdings. This is consistent with the results of Kashyap and Stein

[2000], and suggests that banks adjust their liquidity according to their current lending opportunities, increasing liquidity when lending opportunities are poor and decreasing liquidity when lending opportunities improve. This in turn suggests that banks cannot fully rely on external funding, and therefore have to manage their internal funds to optimally invest (lend) over time.

An analysis of how the liquidity of commercial bank assets is affected by the exchange rate regime of the country in which they operate was analysed by Bunda, I., Desquilbet, J. B (2008). The liquidity ratio as a measure of bank's liquidity assumed to be dependent on individual behaviour of banks, their market and macroeconomic environment and the exchange rate regime, i.e. on following factors:

1) Total assets as a measure of the size of the bank (-); 2) The ratio of equity to assets as a measure of capital adequacy (+); 3) The presence of prudential regulation, which means the obligation for banks to be liquid enough (+); 4) The lending interest rate as a measure of lending profitability (-); 5) The share of public expenditures on gross domestic product as a measure of supply of relatively liquid assets (+); 6) The rate of inflation, which increases the vulnerability of banks to nominal values of loans provided to customers (+); 7) The realization of a financial crisis, which could be caused by poor bank liquidity (-); 8) The exchange rate regime, where banks in countries with extreme regimes (the independently floating exchange rate regime and hard pegs) were more liquid than in countries with intermediate regimes.

The main results from the paper are that the nature of the exchange rate regime has an impact on bank liquidity. In extreme regimes at both ends of the spectrum, i.e. in the independently floating exchange rate regime at one end and hard pegs at the other end, bank assets are more liquid than in intermediate regimes, especially when liquidity is measured in absolute terms. The authors coined this result "bank liquidity smile across exchange rate regimes". Under 'hard pegs', observed high bank liquidity complies with the theoretical model put forward by Chang and Velasco (2000): lender of last resort operations are severely limited, so that bank runs and financial panics are not easily prevented, unless banks themselves keep a sufficient amount of liquid assets. The higher liquidity under 'independently floating' exchange rates is not as obviously explained in their model as under 'hard pegs'.

The empirical analysis of the hypothesis that interest rates affect banks' risk taking and the decision to hold liquidity across European countries provides Lucchetta, M. (2007). This study takes into account variables connected with interbank market, specific characteristics of banks and proxies for bank risk-taking behaviour. The liquidity measured by different liquidity ratios should be influenced by:

1) Behaviour of the bank on the interbank market – the more liquid the bank is the more it lends in the interbank market (+)

2) Interbank rate as a measure of incentives of banks to hold liquidity (+)

3) Monetary policy interest rate as a measure of banks' ability to provide loans to customers(-)

4) share of loans on total assets and share of loan loss provisions on net interest revenues, both as a measure of risk-taking behaviour of the bank, where liquid banks should reduce the risk-taking behaviour (-),

5) Bank size measured by logarithm of total bank assets (+).

The effects of the financial crisis on the liquidity of commercial banks in Latin America and Caribbean countries investigated Moore,W. (2010). Liquidity should depend on:

1) Cash requirements of customers, captured by fluctuations in the cash-to-deposit ratio (-),

2) Current macroeconomic situation, where a cyclical downturn should lower banks' expected transactions demand for money and therefore lead to decreased liquidity (+),

3) Money market interest rate as a measure of opportunity costs of holding liquidity (-).

The main results suggested that there was persistence in the liquidity measure i.e. the lagged loan-to-deposit ratio of commercial banks showed considerable persistence. Liquidity tends to be inversely related to the business cycle in half of the countries studied, suggesting that commercial banks tend to error on the side of caution by holding relatively more excess reserves during downturns. As the author notes that while this may be good by erring on the side of caution this may be bad in times of recession by deepening the recession as the reduction in the provision of credit lowers investment and the ability of the economy to rebound from the cyclical downturn. a rise in interest rates, which represents the opportunity cost of holding liquidity is positively and significantly related to the interest rate in some countries. However, the coefficient on this variable was negative and significant in some countries, suggesting that rising interest rates have a larger impact on supply of deposits relative to the supply of loans. The results show that, on average, commercial bank liquidity is about 8.0 per cent below what is consistent with economic fundamentals during a crisis

Liquidity created by Germany's state-owned savings banks and its determinants has been analysed by Rauch, C., Steffen, S., Hackethal, A., Tyrell, M. (2009). They focused particularly on macroeconomic factors but they captured bank specific characteristics as well. The authrors used two different methods to calculate banks' liquidity creation: first, the "BB-Measure" as proposed by Berger and Bouwman (2009), and second, the "Liquidity Transformation (LT) Gap" as proposed by Deep and Schaefer (2004). According to this study, following factors can determine bank liquidity:

1) Monetary policy interest rate, where tightening monetary policy reduces bank liquidity (-); 2) Level of unemployment, which is connected with demand for loans (-); 3) Savings quota (+); 4) Level of liquidity in previous period (+); 5) Size of the bank measured by total number of bank customers (-); 6) Bank profitability (-).

The results from their model showed that macroeconomic indicators as well as bank characteristic variables have the strongest influence on liquidity. In contrast, bank performance and size indicators do not show any significant influences. The regression results show a strong influence of monetary policy on liquidity creation, especially of the yield curve spread. We show that an increase in the yield curve leads to a slightly lagged increase in liquidity creation. Additionally, the results suggest that there is a positive relationship between general economic health and liquidity creation: in times of an expanding economy, banks create more liquidity.

Entirely unique is the approach of Fielding, D., A (2005). Except of bank specific and macroeconomic variables, they pay attention to the influence of political instability. The author was basically trying to uncover how Islamist violence in Egypt affects the real economy: by generating excess liquidity in the banking sector. Accordingly the authors looked at how acts of violence interrupt the real economy, given the close of real economic activity with banking sector performance means that banks' liquidity ratios are likely to vary with the level of violence. As the level of violence increases, the risk of loan default increases, motivating an increase in liquidity. In times of political turmoil, when depositors suspect that the rate on default on bank loans is going to be very high, higher liquidity ratios may be the only way of preventing banking runs. They considered these determinants of liquidity:

1) Level of economic output (+),n2) Discount rate (+), 3) Reserve requirements (?), 4) cash-to-deposit ratio (-), 5) Rate of depreciation of the black market exchange rate (+), 6) Impact of economic reform (-), 7) violent political incidence (+).

Vodava (2011) studied the liquidity of Czech's commercial banks and the determinants of it. The results showed that there is a significant relationship between the liquidity and the resources sufficiency.

Studies cited above suggest that commercial banks' liquidity is determined both by bank specific factors (such as size of the bank, profitability, capital adequacy and factors describing risk position of the bank) as well as macroeconomic factors (such as different types of interest rates, interest margin or indicators of economic environment). It can be useful to take into account some other influences, such as the realization of financial crisis, changes in regulation or political incidents.

Notwithstanding the plethora of variables described for determining bank liquidity notably missing is the quality of management which is extremely difficult to measure and quantify. However the effects of bank management decision play a crucial role in determining the level of liquidity with a bank.

Description of Methodology

For the purpose of this research we will use for evaluation of liquidity positions of commercial banks in the ECCU following four different liquidity ratios (1) – (4):

L1=(liquid assets)/(total assets)

The liquidity ratio L1 should give us information about the general liquidity shock absorption capacity of a bank. As a general rule, the higher the share of liquid assets in total assets, the higher the capacity to absorb liquidity shock, given that market liquidity is the same for all banks in the sample.

Nevertheless, high value of this ratio may be also interpreted as inefficiency. Since liquid assets yield lower income liquidity bears high opportunity costs for the bank. Therefore it is necessary to optimize the relation between liquidity and profitability.

L2=(liquid assets)/(deposits + short term borrowing)

The liquidity ratio L2 uses concept of liquid assets as well. However, this ratio is more focused on the bank's sensitivity to selected types of funding (we included deposits of households, enterprises and other financial institutions). The ratio L2 should therefore capture the bank's vulnerability related to these funding sources. The bank is able to meet its obligations in terms of funding (the volume of liquid assets is high enough to cover volatile funding) if the value of this ratio is 100 % or more. Lower value indicates a bank's increased sensitivity related to deposit withdrawals. For ECCB requirement banks are required to have a minimum of 25 per cent, i.e. banks should have enough liquid assets to cover a quarter of their deposits and short term borrowing for liquidity.

L3= (loans)/ (total assets)

The ratio L3 measures the share of loans in total assets. It indicates what percentage of the assets of the bank is tied up in illiquid loans. Therefore the higher this ratio the less liquid the bank is. For ECCB requirement banks are required to not let their loans (illiquid asset) exceed 78 to 85 per cent of their deposits.

L4=loans/ (deposits+short term financing)

The last liquidity ratio L4 relates illiquid assets with liquid liabilities. Its interpretation is the same as in case of ratio L3: the higher this ratio the less liquid the bank is.

In line with the discussion in the previous section and similar to other studies the model for the determinants of liquidity buffers based on bank characteristics, macroeconomic fundamentals and country specific characteristics.

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.

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. 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) would affect banks' precautionary demand for liquidity buffers.

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.	
	Liquid assets to total assets	(Cash, short-term claims on other banks (including CDs) and where appropriate the trading portfolio)/total assets.	
Explanatory variables			
Bank Characteristics			
Lagged liquidity ratio (+)	Liquidity buffers should be persistent over time	See above for definition	
Capitalization (-)	Better capitalized banks should have easier access to markets and thus hold less liquidity.	Ratio of equity to total assets.	
Net Interest Income to Average Earning Assets (-)	Profitability: more profitable banks should hold less liquidity.	(Interest income-interest paid)/ interest earning assets.	
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.	
Size (-)	If small banks are financially constrained than they should hold more liquidity.	Natural logarithm of total assets.	
Real GDP growth (-)	Imperfect capital markets imply that liquidity buffers Should be countercyclical.	Quarterly GDP growth rate	
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.	

Interest Rate Spread (-)	the spread between the lending and the deposit rate as a measure of the opportunity cost		

Econometric Specification

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

$$L_{it} = \beta_0 + \beta_1 L_{i,j,t-1} + \beta_2 bank_{i,j,t} + \beta_3 macro_{j,t} + \beta_4 country_{j,t} + \mu * j + \vartheta * t + \xi_{i,j,t}$$

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. Bank denotes variables measuring bank fundamentals and is 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. Unobservable country and time effects are captured by country (j) and time (t) dummy variables.

As suggested by Pesaran and Breitung (2005), in panels where *N* is small (less than 10) and *T* is relatively large the standard approach is to treat the equations from the different cross-section units as a system of seemingly unrelated regression equations (SUR), and then estimate the system by generalized least squares (GLS) techniques. An advantage of this type of model is that correlation across units becomes a natural part of the specification, whereas in large *N* small *T* panels this type of correlation is typically assumed away. In other words, the main attraction of the GLS-SUR procedure lies in the fact that it allows contemporaneous error co-variances to be freely estimated.

Since the covariance matrix of the errors is never known in practice, an estimate is used. This is done by using the residuals computed from the OLS-consistent estimates of the parameter coefficients, using a procedure known as feasible GLS (FGLS). FGLS performs well in large samples and in the limit has all the asymptotic properties of maximum likelihood. Beck and Katz (1995), however, suggest several problems that might arise when using this model in small samples. In particular, they found that FGLS tends to underestimate the true variability of the estimator when the time points (*T*) are not substantially larger than the cross-sectional units (*N*). In this context, they suggest using Panel Corrected Standard Errors (PCSE) in the case of non-spherical disturbances. This estimator is in effect the OLS estimator as it

would look under the assumption that the disturbances are non-spherical. The PCSE also has the advantage that it does not require a time dimension (*T*) that is significantly larger than (*N*). The paper therefore focuses on the use of Katz and Beck (1995).

However, there may also be unobserved bank-specific and/or country specific time-invariant heterogeneity, which could bias the 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.

To address these concerns, we also estimate the model 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).

In the second stage estimation a probit model used to answer the question what is the probability that a bank will hold liquidity in excess of regulatory stipulations. In this model excess liquidity for a bank is defined as anything above the average holdings of liquidity for a bank. In the previous model it was established that liquidity levels was persistent meaning that banks target a particular level of liquidity on average. Having unearthed this result anything that is above a banks normal average is defines as excess, therefore the questions is asked what is the probability that a bank will hold liquidity in excess of its own internal norms.

Results

The results are presented for banks in Antigua and Barbuda below. Liquidity buffers are found to be very persistent in that banks appear to be targeting a certain level of liquidity. This is hardly surprising given the fact that banks are subject to prudential requirements of sustaining at least 25.0 per cent of their deposits and short term liabilities in liquid assets. Deposit volatility (DV) appears to not have any impact on bank holding of liquidity, intuitively one would expect that as volatility rises that banks would hold more liquidity. The loan loss provision (LLP) is significant and positive but only in the PCSE model this indicates that as the perception of a riskier or anticipation of losses banks hold more liquidity. From a stand point of sound banking practices this makes sense. Contrary to the a priori assumption that

profitability (NIM) and GDP growth (RGDP) would affect banks decision to hold liquidity appear not be a factor, both variables turned up insignificant in both estimation. Size (LTA) enters the regressions with negative significant coefficients; whereas size squared (LTA2) has positive statistically significant coefficients. We interpret this result as evidence that larger banks hold less liquid assets than smaller ones. Nevertheless, the diversification effect of size seems to be exhausted at a certain level.

Antigua Model

Variable	Coefficient		P-Values	
	PCSE	GMM	PCSE	GMM
LLADST(-1)	**.823***	**.759***	0.00	0.00
DV	.002	-.003	0.56	0.31
LLP	**.013***	.008	0.01	0.17
NIM	-.001	-.002	0.41	0.78
RGDP	.001	.002	0.37	0.30
LTA	**-.907***	**-2.316***	0.03	0.00
LTA2	**.038***	**.092***	0.02	0.00
IRS	**.051***	**.062***	0.01	0.00
C	5.482	14.867	0.05	0.00

The key factors affecting the liquidity decision of bank in Dominica are deposit volatility (DV), loan loss provision and size.

Dominica

Variable	Coefficient		P-Values	
	PCSE	GMM	PCSE	GMM
LLADST(-1)	**.794***	**.749***	0.00	0.00
DV	**.012***	**.016***	0.00	0.00
LLP	**-.032***	.014	0.07	0.51
NIM	.008	-.013	0.78	0.71
RGDP	.002	.003	0.15	0.45
LTA	.000	-.013	0.95	0.44
LTA2	.753	**13.538***	0.25	0.03
IRS	-.029	**-.516***	0.28	0.03
C	-.187	-87.752	0.30	0.03

The results for banks in Grenada are quite interesting. The results from the PCSE model indicates that liquidity decisions of banks in Grenada are driven by deposit volatility in that as volatility increases banks tend to increase their holding of liquidity, the same holds for loan loss provisioning (LLP). In terms of profitability, it was found that as profitability increases bank's reduce their level of liquidity, it was also found that as a bank size increases it holds more liquidity but beyond a certain size banks reduce their holding of liquidity as measured by the squared value of total assets (LTA2).

Grenada

Variable	Coefficient		P-Values	
	PCSE	GMM	PCSE	GMM
LLADST(-1)	**.744***	**.871***	0.00	0.00
DV	**.017***	**.018***	0.00	0.01
LLP	**.023***	**.019***	0.00	0.03
NIM	**-.148***	.0386	0.00	0.74
RGDP	.000	-.001	0.76	0.66
LTA	**2.743***	-17.108	0.02	0.28
LTA2	**-.109***	.640	0.02	0.28
IRS	0.002	.000	0.89	0.97
C	-16.344	114.545	0.03	0.27

Liquidity holdings for banks in St Kitts and Nevis appear to be driven by the variables with the exception of GDP growth. For the PCSE all the variables carried all the a priori signs with the exception of the interest rate spread (IRS). In the case of the GMM estimation an increase in deposit volatility was found to reduce liquidity holdings. The variable for profitability also carried the wrong sign in that an increase in profitability results increase holdings of liquidity.

St Kitts and Nevis Model

Variable	Coefficient		P-Values	
	PCSE	GMM	PCSE	GMM
LLADST(-1)	**.741***	**.410***	0.00	0.00
DV	**.003***	**-.035***	0.06	0.00
LLP	**.004***	**.015***	0.06	0.00
NIM	**-.112***	**.0634***	0.00	0.07
RGDP	.002	-.000	0.33	0.87
LTA	**.642***	**6.527***	0.04	0.01
LTA2	**-.021***	**-.228***	0.09	0.00
IRS	**.057***	**.019***	0.00	0.31
C	-4.095	-44.457	0.04	0.00

Deposit volatility, loan loss provision, profitability and bank size were found to be the driving factors of bank liquidity holding in Saint Lucia, these results are found for the PCSE model. In the case of the GMM results only loan loss provision was found to be the key factor.

Saint Lucia

Variable	Coefficient		P-Values	
	PCSE	GMM	PCSE	GMM
LLADST(-1)	**.716***	**.518***	0.0000	0.00
DV	**.013***	-.010	0.0046	0.308
LLP	**.0212***	**.080***	0.0001	0.007
NIM	-.040*	-.001	0.0848	0.977
RGDP	-.004	-.010	0.1755	0.110
LTA	**1.211***	-5.464	0.0126	0.479
LTA2	**-.041***	.2383	0.0256	0.439
IRS	.006	.019	0.7616	0.635
C	-8.055	31.793	0.0116	0.511

Overall the results for the different countries highlight one specific result and that is liquidity buffers in the ECCU are very persistent: the coefficient on the lagged dependent variable is positive and significant in all specification and estimation. This is consistent with the view that banks target an optimal or desired level of precautionary liquidity holdings and is consistent with meeting prudential requirements, 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, with non-linearities as in the case of Grenada, St Kitts and Nevis and Saint Lucia: 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 the ECCU, the distribution of banks is highly skewed with quite high concentration of assets in a few large banks. Deposit volatility was to be significant in most cases as a contributing factor in determining liquidity buffers in that as the volatility in deposits increased banks tended to increase their liquidity buffers.

In cases loan loss provision it was significant and positive in all the countries except Dominica, indicating that banks with higher savings against potential losses or riskier loan portfolios also tend to have larger liquidity buffers in the ECCU. The variables which represent profitability and capitalization were usually insignificant which is rather counterintuitive given the fact that one would expect that as profitability increasing banks would lower their liquidity buffers i.e the expected sign on the coefficient was expected

to be negative in both cases. 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.

The results from the probit model which are not presented here for purposes of brevity suggest that in the case of Antigua and Barbuda the probability of bank holding liquidity buffers above its norm increases positively with loan loss provisioning, real GDP. However when profitability is increasing banks tend to hold less liquidity, liquidity also tends to increase with bank size however in a non linear fashion.

In the case of Grenada the probability of a bank holding liquidity above its average tends to increase with a rise in deposit volatility, loan loss provisioning and real GDP growth, just as in the case of Antigua and Barbuda an increase in profitability as measured by NIM tend to reduce banks holding of any excess liquidity. In terms of bank size this variable was found not to affect bank liquidity. The results for the banking sector in St Kitts and Nevis suggest that banks have a larger probability of reducing their excess liquidity when profitability is increasing hence an inverse relationship additionally banks tend to follow a procyclical buffers in that they increase excess liquidity during economic growth and reduce it during downturns. The probability of excess liquidity in banks in Saint Lucia suggest that banks increase their liquidity when they increase their levels of loan loss provisioning, when real GDP growth is increasing and when the banks size is increasing. Consistent with almost all other countries the probability of bank reducing its excess liquidity tends to happen when profitability is increasing.

Overall the results suggest that there is an increased probability of excess liquidity by banks when loan loss provisioning which is a proxy for risk increases. Likewise there is consistent prediction of reduced excess liquidity when profits by banks are on the increase. Additionally there appears to be evidence an increasing probability of excess liquidity when bank size as measured by total assets increases. Real GDP growth also tends to increase the probability that banks will hold excess liquidity. Deposit volatility and interest rates tend to have no impact on the probability of bank holding excess liquidity. Given that the time dimension 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).

Conclusion

Our study of liquidity buffers in the ECCU finds that they are comfortably above legal and prudential requirements. With average liquidity ratios exceeding the stipulated limits of 25.0 per cent of deposits, banks in the region have handled and are able to handle historic deposit volatility levels outside of crisis episodes. Therefore, the adoption of the new Basel III liquidity requirements in the region should not have much impact on banks' balance sheet. Liquidity holdings in the region already meet or exceed the new Basel III ratios.

A closer look at the reasons for which banks would want to hold liquidity buffers above legal or prudential requirements indicates that the ECCU 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, less efficient and less profitable banks tend to hold higher liquidity buffers.

A first policy lesson stemming from these results would be to continue with on-going 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 liquidity buffers without compromising financial stability.