



Developing an Index of Liquidity-Risk Exposure:

**An Application to Latin
American and Caribbean
Banking Systems**

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Abstract*

After the 2007-2009 global financial crisis and previous financial crises in Latin America, the liquidity-risk exposure of banking systems is considered one of the most important vulnerabilities. At the same time, that exposure may also be the most mysterious of those vulnerabilities, as the dimensions of this risk are not yet well understood and good metrics have not been available. This goal of this paper is to provide a thorough review of previous contributions and to develop a set of measures of systemic liquidity-risk exposure of banking systems, with a focus on Latin American and Caribbean economies.

JEL classifications: G01, G21, G32

Keywords: Financial crisis, Liquidity-risk exposure, Banking systems

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1. Introduction

After the last three decades of experience with financial crisis in emerging markets and, in particular, after the recent crisis (the Crisis) the exposure to liquidity risk of the banking system is highlighted as a major source of vulnerability to a sudden worsening of external financing conditions. However, as of now, the literature lacks detailed metrics to monitor this vulnerability. Current metrics mostly make partial use of the information available and rely mostly on macroeconomic aggregates to monitor exposure.

This paper develops two metrics that capture the systemic exposure to liquidity risk of banking systems. We build on a methodology recently introduced by the Basel Committee on Banking Supervision (BCBS) that defines a new regulatory standard called the net stable funding ratio (NSFR). The NSFR is designed to capture the exposure to liquidity risk of a single institution, and it defines the weights of a large class of assets and liabilities according to their liquidity characteristics. In that sense, it is a tool that measures liquidity risk from balance sheet quantities. We build on this methodology to design an index that captures exposure at the system level. The indexes are constructed from microdata (i.e., banks' financial statements) obtained from Bankscope and incorporate three databases on aggregate variables for adjustment purposes.

We test the indexes using an event analysis around the Lehman bankruptcy, which constituted a large external financing shock for emerging markets and developing countries. For that reason we construct the index for the banking system of 40 emerging markets and developing countries, with a total sample of 1,700 banks. The results confirm that the systemic exposure to liquidity risk of the banking system is a relevant vulnerability explaining economic contractions after large external financing shocks.

The rest of this section defines liquidity risk and presents a detailed literature review. Section 2 summarizes traditional metrics used in the literature to measure this exposure both at the bank level and at the system level. Section 3 evaluates the performance of traditional measures in the Crisis, and Section 4 explains in detail the construction of our two metrics of exposure to liquidity risk. Section 5 specifies the metrics for eight Latin American and Caribbean countries, and Section 6 tests the metrics in the Crisis. Section 7 concludes.

1.1 Defining Liquidity Risk

Modern theory of financial intermediation portrays the creation of liquidity as a fundamental role of banks¹ in the economy. Bryant (1980) and Diamond and Dybvig (1983) were among the first to analyze the idea formally. The authors explain how banks create liquidity on the balance sheet by financing relatively illiquid assets (i.e., long-maturity information-intensive contracts that are hard to sell in the short run) with relatively liquid liabilities (i.e., short-maturity and typically fixed-value contracts that are effectively demanded in the short run). Holmstrom and Tirole (1998) and Kashyap, Rajan and Stein (2002) explain how banks also create liquidity off the balance sheet, entering into loan commitments and similar contracts that involve delivering cash in the future.

In the process of creating liquidity a bank becomes exposed to liquidity risk: the risk of being unable to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses.² Thus, the capital structure of banks is necessarily fragile (i.e., exposed to liquidity-risk) in order to conduct business.³ Since virtually every financial transaction or commitment has implications for a bank's liquidity, appropriate liquidity risk management is essential to ensure a bank's ability to meet cash flow obligations, which are uncertain as they are affected by external events and other agents' behavior.

Liquidity risk was not part of the international banking regulatory standards until very recent proposals by the Basel Committee on Banking Supervision (hereafter BCBS).⁴ In December 2009, BCBS issued a consultative document proposing a regulatory framework for liquidity risk. The proposals include two liquidity ratios that banks need to satisfy most of the time. See Appendix B for further details.

¹ The term "bank" in this document refers to wide range of financial institutions that extend credit, including commercial banks, cooperative banks, saving banks, real estate and mortgage banks, investment banks, bank holding companies, finance companies, government credit institutions, and micro-financing institutions.

² The literature usually defines two concepts of liquidity risk: *funding liquidity risk* and *market liquidity risk*. The first one refers to the risk of funding not being rolled over. The second one refers to the risk that a firm cannot easily offset or eliminate a position at the market price because of inadequate market depth or market disruption. The interaction of both sources of risk is complex and will be discussed. See Brunnermeier and Pedersen (2009).

³ See Diamond and Rajan (2001).

⁴ See BCBS (2009). Before the Crisis, international regulatory standards were predominantly focused on credit risk.

1.2 Evidence on the Relevance of Liquidity Risk at the Bank Level

The literature on the relevance of liquidity risk for bank performance is large and varied. Exploiting partial measures of exposure to liquidity risk, researchers showed that such exposure matters for the effect of monetary policy,⁵ for the origination of new lending⁶ and for the probability of failure of a bank in a financial crisis.⁷ More recent contributions include Raddatz (2010), who presents evidence that banks that relied more heavily on non-deposit funding, before Lehman Brothers' bankruptcy, experienced a significantly larger decline in stock returns in the days after; Demirgüç-Kunt and Huizinga (2009), who show that banks with business models that rely more on non-deposit short term funding and non-interest income tend to be riskier according to number of standard indicators; and Federico and Vázquez (2011), who show that regional banks with higher exposure to liquidity risks were more likely to fail during the Crisis.

1.3 Literature on Systemic Implications of Liquidity Risk

Although the concept of liquidity risk at the bank level has been analyzed extensively, both theoretically and empirically, much less work has been done on the systemic implications of liquidity risks. In mainstream macroeconomics the topic has just recently become part of the agenda. Perhaps the most relevant contributions so far can be found in the emerging markets' crises literature and in the corporate finance literature. However the profession still lacks comprehensive metrics to evaluate systemic liquidity risk, the focus of this paper.⁸

In a theoretical contribution, Diamond and Rajan (2005) explain how bank stresses can shrink the common pool of liquidity, creating, or exacerbating aggregate credit shortages, which in some cases can lead to a complete meltdown of the system. In their model they show that contagion can stem from an underlying real general equilibrium problem rather than just from lack of coordination among depositors. From a policy perspective, attempts to reassure investors through confidence-building measures will not work if panic and lack of coordination are not the reasons for a crisis. Cifuentes, Ferrucci and Shin (2005) explore liquidity risk in a system of interconnected financial institutions. In their model contagion comes from the market liquidity of

⁵ See Kayashap and Stein (2000).

⁶ See Cornet et al. (2011).

⁷ See Arena (2005).

⁸ We focus on an empirical relevant measure of exposure to liquidity risks of the banking system. Since in EMs bank credit accounts for a large proportion of total credit, we are comfortable with focusing on this sector of financial markets.

assets. The prices of assets become depressed as a result of fire sales by institutions under stress, producing distress in other institutions that were not originally affected. The authors show how both liquidity and capital requirements can be effective tools in forestalling contagious failures. Huang and Ratnovski (2011) model an environment with a costless but imperfect signal on bank project quality when short-term wholesale financiers have lower incentives to conduct costly information acquisition, and instead may withdraw based on negative but noisy public signals, triggering inefficient liquidations.

On the empirical front, Berger and Bouwman (2009) discuss four empirical measures of liquidity creation,⁹ and in Berger and Bouwman (2008) they show that banking crises in the US tend to be preceded by periods of abnormal liquidity creation. Adrian and Shin (2010) show how balance sheet quantities emerge as a key indicator of risk appetite of financial intermediaries and suggest that the traditional focus on money stock for the conduct of monetary policy may have more modern counterparts and suggest the importance of tracking balance sheet quantities for the conduct of prudential policy. Shin and Shin (2011) provide evidence that when credit is increasing rapidly, the traditional deposit funding is supplemented with wholesale funding.¹⁰ The authors argue that the aggregate balance sheet of financial intermediaries conveys information on the stage of the financial cycle.¹¹

In another strand of the literature, researchers interested in identifying the nature and origins of systemic banking crises in emerging markets focus on macroeconomic factors to assess countries' liquidity risk exposure. The next section discusses this literature.

1.4 The International Dimension of Liquidity Risk

In emerging markets the concept of liquidity risk has at least two additional dimensions. In the first place, the counterparties to wholesale funding, used by domestic banks to finance assets, are

⁹ The counterpart to liquidity risk exposure.

¹⁰ Customer deposits are considered a stable source of funding, while wholesale funding, which comes from the interbank market or from money market mutual funds, is considered an unstable source of funding. See BCBS (2009).

¹¹ The authors also show that in emerging markets with open capital accounts, wholesale funding takes the form of short-term foreign exchange liabilities, increasing the vulnerability to the outbreak of "twin crises," as explained by Kaminsky and Reinhart (1999). Section 1.4 further discusses liquidity risk in emerging markets.

non-residents of the country. In the second place, contracts are usually denominated in foreign currency.¹² These additional layers add complexity to the problem.

A liquidity crisis typically comes with non-residents not rolling over funding and with the currency coming under depreciation pressures. If the central bank is working under a floating exchange rate regime the depreciation of the currency almost certainly alters the credit risk profile of the assets of the banking system, with at least some portion of the loan portfolio becoming non-performing.¹³ Alternatively, if the central bank is working under a fixed exchange rate regime, the currency may come under attack. If liquidity pressures are sufficiently high, the central bank may abandon the fixed exchange rate regime. Ukraine is a recent good example.

It is important to note that the problem is not a currency mismatch but a liquidity mismatch where the currency specification of the contract is one additional characteristic to look at. As an example, a bank in an EM can obtain foreign funding to finance the purchase of US T-Bills, or the bank can use the same funding to finance long-term domestic loans to customers that are engaged in the production of non-tradable goods. From the perspective of a bank, in the first case there is no currency mismatch and no liquidity mismatch. In the second case there is no currency mismatch, but there is a major liquidity mismatch. In the scenario where there is no rolling over of foreign funding, the exchange rate will come under depreciation pressures, worsening the credit quality of the loan portfolio, which might exacerbate the drying up of funding.

Chang and Velasco (1998, 1999) argue that the 1997 Asian crisis could be explained by international illiquidity: a situation in which a banking system's potential short-term liabilities in hard currency exceed the amount of hard currency it can have access to on short notice. According to the authors, an ideal definition of the liquid international assets of the financial system should include the short-term external assets of private financial institutions, the amount of foreign currency available to the central bank for last resort lending and potential loans from international organizations. Similarly, an ideal definition of short-term international liabilities of the financial system would include its short-term foreign debt, demand deposits denominated in

¹² The foreign currency denomination seems a consequence of the financier being non-resident and having his/her consumption risk (payoff function) tied to the foreign currency. But there are additional extra reasons to think that, in itself, the financier being a non-resident could matter, as more severe asymmetric information and political economy considerations.

¹³ Kaminsky and Reinhart (1999) explain that currency crises are typically preceded by problems in the banking sector. In addition, currency crises intensify those problems.

foreign currency¹⁴ and, if there is a fixed exchange rate, demand deposits in domestic currency could potentially be included. However, in the empirical exercise the authors use short-term foreign debt over international reserves and M2 as a multiple of international reserves to perform a descriptive analysis.

The Crisis represents an excellent opportunity to perform event studies. Commonality of the shocks, heterogeneity in economic structures and differences in relative performance¹⁵ give researchers a unique opportunity to identify structural vulnerabilities of economic and institutional systems. Although previous studies do not include a well-defined metric for systemic liquidity risk of the banking system, they do include variables that are correlated with that measure, which are found to be highly significant in explaining cross-country heterogeneity. In a sample of emerging markets, Blanchard, Das and Faruqee (2010) find that short-term external debt is the most significant robust variable in explaining cross-country output declines. Trade variables also matter, but the relation is not as tight. The authors do not investigate which sector of the economy is holding short-term external debt, but an analysis of the sample they use and which countries are behind the result suggests that banking systems heavily exposed to short-term external debt were the problem. Lane and Milesi Ferretti (2010) find that the output decline during the current crisis was larger in countries experiencing large pre-crisis net capital inflows and fast credit growth. On the other hand, trade openness did not help cushion output declines. Berkmen et al. (2010) find that the loans/deposits ratio of the banking system and cumulative credit growth explain a large share of the variation in the forecast revision of output growth. Cecchetti, King and Yetman (2011) argue that economies featuring low private sector credit to GDP and little dependence on the United States for short-term funding were much less vulnerable to the Crisis.

1.5 Defining Systemic Liquidity Risk of the Banking System

From a systemic point of view, liquidity risks arise when the banking system is not able to finance upcoming obligations and/or growth in credit for the general economy. Although the definition seems similar to the bank level definition, there are critical differences. When a single bank faces liquidity problems, it might be able to obtain loans and equity injections or even

¹⁴ The difference being that the former are obligations to foreigners while the latter are obligations to domestic residents.

¹⁵ Performance is usually defined with a metric of output variation.

merge with a stronger bank in the system. Alternatively it can be assisted by the central bank without creating a major disorder in monetary policy. In addition, other healthy banks can compete for the market share of the bank in trouble. There is no reason to think that a single institution is going to bring down the aggregate level of credit at the economy level.¹⁶ On the contrary, if all the banks in the system face liquidity problems the likely result is a drastic reduction in credit growth with a large impact on the economy. Busting asset prices, deteriorating balance sheets of banks, sharply declining economic activity and a systemic banking crisis are all potential outcomes after aggregate liquidity shocks to a vulnerable system. The Crisis has presented us with numerous examples of these dynamics.

Moreover, when analyzing systemic exposure, the classification of assets/liabilities as liquid/illiquid differs from this classification from the point of view of a single bank. We discuss this point further in Section 4.

1.6 Our Goal

In this paper we construct a set of indexes of systemic liquidity risk exposure for banking systems in emerging markets (hereafter FPIs).¹⁷ The FPIs capture how vulnerable a banking system is to a sudden drying-up of liquidity (both international and local). Our approach is bottom-up: we depart from the analysis of individual banks' balance sheets and develop an aggregate index that relies on macroeconomic aggregates as well. The FPIs concentrate on the exposure of the banking system on its own and do not include either the policy framework in place in each country or potential access to funding from international organizations. The FPIs should eventually be complemented with analysis of those factors to determine potential implications for credit, output and employment. Nonetheless, as we will show in Section 6, the FPIs do very well in explaining cross-country variations in output decline.

The paper proceeds as follows. Section 2 presents a review of traditional measures of liquidity risks. Section 3 evaluates the suitability of traditional measures in explaining cross-country heterogeneity in performance during the Crisis. Section 4 describes in detail the construction of the systemic liquidity risk indexes, the FPIs. Section 5 specifies the FPIs for eight Latin American and Caribbean (LAC) economies, and Section 6 tests the performance of the FPIs during the Crisis. Section 7 concludes and discusses recent trends in LAC economies.

¹⁶ We are not considering the “too big to fail” problem in this description.

¹⁷ This work is based on Federico (2011).

2. Traditional Measures of Liquidity Risk

There are a large set of measures that analysts currently use to assess the exposure to liquidity risks, both for individual banks and for the banking system. We describe them below. In Section 3 we test the power of the system-level measures.

2.1 Bank-Level Measures

Several indicators are used to measure exposure to liquidity risk at the bank level. Some concentrate on the asset side of the balance sheet and others on the liability side; still others consider both sides at the same time. The latter are more appropriate, since any comprehensive indicator needs to capture the liquidity characteristics of assets relative to liabilities. The most cited examples are:

- Liquid assets to total assets: measures the amount of liquidity resources that the bank can use to honor obligations coming due with immediacy. Liquid assets traditionally include loans and advances to banks, trading securities, reverse repurchase agreement and cash collateral, cash and due from banks.
- Loans to assets: measures illiquid resources as a share of total assets. Loans to customers are typically the most illiquid category on the asset side of the balance sheet since they are hard to sell in the short term without depressing their price.
- Short-term funding to total funding: measures the percentage of liabilities that needs to be roll-over on a regular basis. This measure is based on the contractual maturity of liabilities rather than on their effective maturity (which takes into account the typical behavior of the liability holder) and thus can overestimate exposure (for example, demand deposits have very short contractual maturity but are generally rolled over¹⁸). The next measure addresses this concern.
- Wholesale short-term funding to total funding: measures the percentage of liabilities that are of short maturity and that typically are not rolled over in liquidity stresses. The main instruments within this group are: deposits from

¹⁸ Demand deposits are usually implicitly or explicitly guaranteed by governments.

banks, repurchase agreements and cash collateral, promissory notes of less than a year and other money market funding.

- Liquid assets to short-term funding (or wholesale funding): the ratio of available cash to potential demands of cash.
- Net Stable Funding Ratio (NSFR): the recently introduced Basel III measure of structural liquidity mismatch. It defines weights for every component of the balance sheet that are used to compute a ratio. The weights are defined on an effective maturity basis, making it relevant. Appendix B offers a summary of the NSFR.

2.2 Banking System-Level Measures

The following macrofinancial measures have been used to assess vulnerabilities liquidity risk:

- Central bank reserves to short-term external debt: this measure attempts to capture the potential assistance of foreign currency liquidity to sectors in the economy with short-term external funding. Ideally one should include reserves that have not been committed to other goals.¹⁹
- Total external debt to GDP: this measure attempts to capture the potential perverse balance-sheet effects that a sharp devaluation of the currency might bring about, causing financial stresses and bankruptcy.
- Short-term external debt to GDP: this measure captures the potential need for hard-currency liquidity relative to a country's GDP.
- Growth rate of M2 relative to GDP: in a financial system that is dominated by deposit-taking banks that rely on liabilities included in broad money, the growth of M2 can signal excessive expansion of the financial system. However, this measure may be outdated, as explained by Shin and Shin (2011). In the case of emerging markets, the financial system is still dominated by deposit-taking banks, but rapid credit expansions are being

¹⁹ As an example, in the Mexican crisis of the mid-1990s, reserves had been committed to the repayment of Tesobonos and were thus unavailable for other uses.

financed by liabilities that are not included in the monetary aggregates (such as international interbank funding).²⁰

- Growth rate of repo transaction and financial commercial paper: this measure is especially relevant for financial systems with a large participation of non-deposit-taking institutions. Shin and Shin (2011) show evidence that in the US the stock of liabilities, which are not included in any money measure, grew extremely large before the Crisis.
- Repo transaction and financial commercial paper to M2: a way to normalize the measure described in the previous section.
- Liquid assets to total assets of the banking system: similar to the interpretation at the bank level, this measure captures the ratio of the liquid assets to most illiquid assets of the banking system relative to total assets.
- Loans to assets of the banking system: similar to the interpretation at the bank-level, this measure captures the ratio of the most illiquid assets of the banking system relative to total assets.
- Loans to deposits of the banking system: intends to capture the relative liquidity of assets and liabilities. On the one hand, loans are typically the most illiquid component of the assets of a bank. On the other hand, deposits, here referring to customer deposits, are the largest stable component of liabilities. Thus, a ratio higher than one typically implies that the bank is financing illiquid assets with non-stable liabilities (wholesale funding).
- Bank Credit Growth to GDP: the literature has identified rapid expansions of bank credit as an element that has preceded most of the crises in emerging markets in the past.
- Currency composition of assets and liabilities: “foreign currency denominated loans/total loans” and “foreign currency denominated liabilities/total liabilities” are other common measures to assess

²⁰ In the case of developed economies such as the United States, the measure might also be outdated since a large part of the financial system consists of institutions other than deposit-taking banks (investment banks, SIVS, etc.).

vulnerabilities of financial systems. An important caveat regarding these measures is that they are not publicly available on a multi-country basis, and it is therefore difficult to test their relevance/accuracy.

In the next section we present an econometric analysis testing most of the measures listed above.

3. Performance of Traditional Measures in the Crisis

In this section we test most of the system-level measures described in the previous section. We start by describing the sample we work with, the measure of output decline we think is relevant for the analysis and a large set of regressors that we group into two sets: the “main” set, which includes the regressors that have been identified in the literature as the best performing, and indeed are the regressors with the best explanatory power in our sample too; and the “alternative” set, which includes regressors for which there are reasonable hypotheses for why they should perform well, although they actually do not. Before moving to the analysis we need to acknowledge a caveat: the small size of the samples we work with restricts the amount we can ask of the data.

3.1 Sample Selection

We work with two samples. The “core” sample is composed of 27 emerging markets taken from the analysis of Blanchard, Das and Faruqee (2010).²¹ The “extended” sample consists of 40 countries²² and includes the 27 in the core sample with an additional 13 that were selected according to the following criteria: we include every emerging markets as classified by the following analysts: the 20 countries in FTSE, the 21 countries in MSCI, the 19 countries in the S&P, the 35 countries in Dow Jones, the 22 countries in the *Economist* and the 11 countries in the Next 11. We additionally include the main sample of Berkmen et al. (2009).

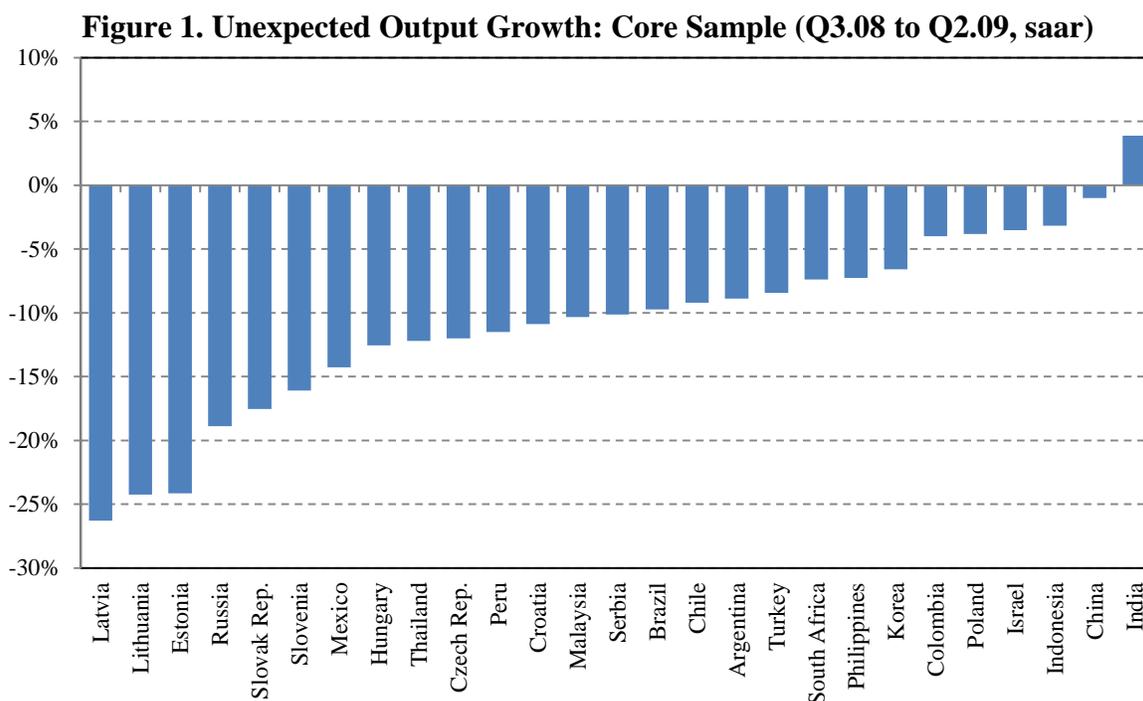
Given that there is overlapping of countries in each list, and that the information required for the analysis is not available in all the cases, we end up with an extended sample of 40 countries. Table A.1 in Appendix A details both the core and the extended sample.

²¹ Blanchard, Das and Faruqee (2010) work with a core sample of 29 emerging markets, but data are not publicly available for all the variables we constructed in two of the cases: Taiwan and Venezuela.

²² Most are categorized as emerging markets, and some as developing countries.

3.2 Measure of Output Collapse

In the econometric analysis, the dependent variable to explain is the unexpected output growth rate, measured as the forecast error for output growth during the three quarters that go from the end of the third quarter of 2008 (Q3.08) to the end of the second quarter of 2009 (Q2.09). The forecast (i.e., expected) output growth rates are taken from WEO, as of April 2008. Actual output growth rates are taken from IFS. The difference between the two is presented in Figure 1 for the core sample, and in Figure A.1 for the extended sample.



Source: Author's calculations based on IFS and WEO data.

3.3 Main Set of Regressors

The main set of regressors includes four variables that have been identified in the recent literature as the most relevant in explaining cross-country output declines after the Lehman collapse.²³ The set includes one variable that captures trade-related channels and three variables that capture finance-related channels. The trade-related measure, unexpected partner growth, captures the unexpected decline in GDP of the main trading partners of a country,²⁴ where the

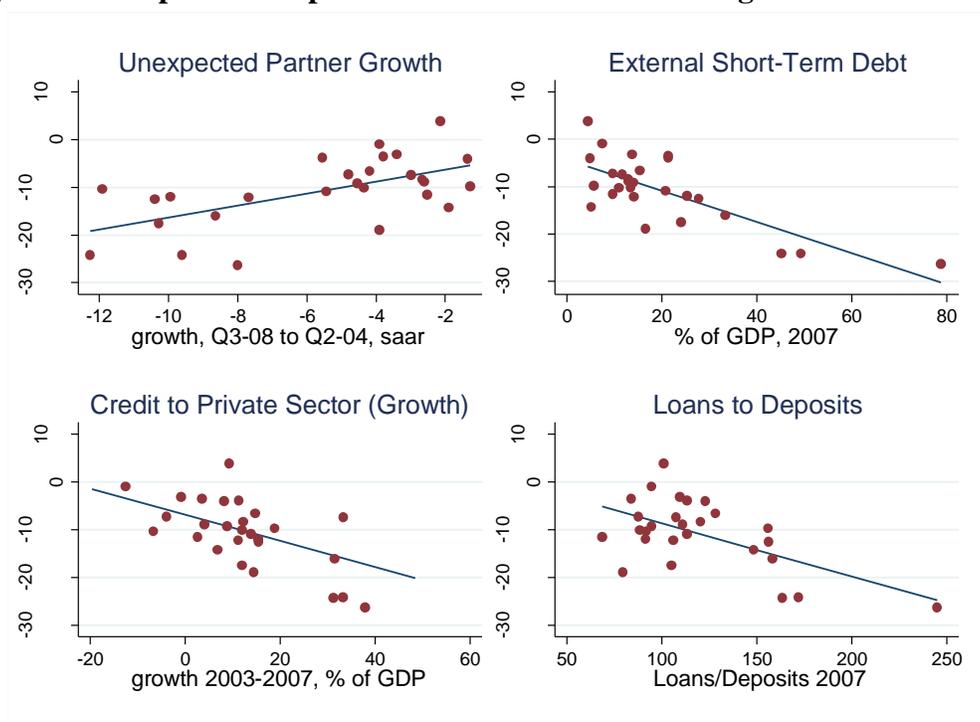
²³ See Blanchard, Das and Faruquee (2010), Berkmen et al. (2011) and Cecchetti, King and Yetman (2011).

²⁴ The unexpected output growth of the partners follows the methodology of the dependent variable. With the main 25 trade partners of each country we account for at least 80 percent of the total trade of each of them.

output declines of the partners are weighted by the export share of the partner in total exports and, in addition, the sum is weighted by the country's share of exports in GDP. The finance-related variables have been identified historically as relevant indicators of systemic problems (Section 2.2) and include i) external short-term debt to GDP, ii) the growth of credit to the private sector²⁵ and iii) the ratio of loans to deposits of the banking system.²⁶ Table C1 in Appendix C summarizes the aggregates for the countries in the sample.

Figure 2 below presents a scatter plot of the main set of regressors for the core sample. Figure A.2 in Appendix A shows the scatter plots for the extended sample.

Figure 2. Unexpected Output Growth and Main Set of Regressors: Core Sample



Source: Author's calculations based on DOT, GDF, IFS, WEO and WDI data.

We specify a simple empirical model with the trade-related variable and each of the finance-related variables at the time. The results, presented in Table 1, are analogous to those found in the literature.²⁷ Table A.1 in Appendix A presents the results for the extended sample. All these measures are highly statistically significant when included in these pairs. When all four

²⁵ In the version of this variable used here we normalize it by GDP.

²⁶ Blanchard also experimented with total external debt but found that, although statistically significant, the coefficient is much smaller (in absolute value) than the one on short-term debt.

²⁷ See Berkmen et al. (2009) and Blanchard, Das and Faruqee (2010).

are included together, only the trade-related variable remains statistically significant. Perhaps the sample is too small to obtain statistical significance on variables that are correlated (see Tables A.3 and A.4 in Appendix A).

Table 1. Explaining Unexpected Output Growth (Main Set): Core Sample
(dependent variable: projected minus actual semester growth Q3.08 to Q2.09, saar)

Regressor			
Unexpected Partner Growth ²	0.45 *	0.95 ***	0.97 ***
Short-Term External Debt ³	-0.27 ***		
Credit to Private Sector (Growth) ⁴		-0.21 ***	
Loans to Deposits ⁵			-0.09 ***
Constant	-2.88	-2.41	4.89
N	27	27	27
R-sq	0.60	0.58	0.54

¹ Robust standard errors, *** p<0.01, ** p<0.05, * p<0.1

² Forecasted minus actual GDP growth of trade partners (Q3.08 vs Q2.09, saar), weighted by trade and multiplied by home export share of nominal GDP in 2007.

³ Short Term debt with remaining maturity of less than one year, as a percentage of GDP in 2007.

⁴ Credit as a percentage of 2007 GDP minus 2003 GDP.

⁵ Total bank claims over deposits in depositary corporations other than Central Banks.

3.4 Additional Set of Regressors

We test a variety of other regressors that have been identified in the literature as potential indicators of systemic problems (see Section 2). They do not, however, explain the cross-country variation of unexpected output growth in either sample. Our results are consistent with Berkmen et al. (2009) and Blanchard, Das and Faruquee (2010). We present the results for the core sample in Table 2 and for the extended sample in Table A.5 of Appendix A.

Table 2. Explaining Unexpected Output Growth (Alternative Set): Core Sample
(dependent variable: projected minus actual semester growth Q3.08 to Q2.09, saar)

Regressor						
Unexpected Partner Growth ²	1.42 ***	1.73 ***	1.93 ***	1.24 **	1.71 ***	1.57 ***
Reserves to Short-Term External Debt ³	0.02 **					
Reserves to GDP ⁴		0.13				
Bank Capital to Total Assets ⁵			-0.86			
Bank Liquid Assets to Total Assets ⁶				0.11		
Bank Credit to Private Sector to GDP ⁷					0.02	
M2 Growth ⁸						-0.29
Constant	-9.93	-7.65	4.45	-11.2	-6.62	-4.44
N	27	27	27	21	27	26
R-sq	0.42	0.36	0.42	0.29	0.35	0.35

¹ Robust standard errors, *** p<0.01, ** p<0.05, * p<0.1

² Forecasted minus actual GDP growth of trade partners (Q3.08 vs Q1.09, saar), weighted by trade and multiplied by home export share of nominal GDP in 2007.

³ Reserves over Short-term debt with remaining maturity of less than one year, 2007.

⁴ Reserves to GDP, 2007.

⁵ Aggregate bank capital to aggregate bank assets, 2007.

⁶ Aggregate bank liquid assets to aggregate bank assets, 2007.

⁷ Aggregate bank credit to the private sector over GDP, 2007.

⁸ Growth of M2 as a percentage of GDP from 2004 to 2007.

Although reserves to short-term debt has the expected sign and is significant, both the result on reserves to GDP and on short-term debt to GDP seem to indicate that the denominator is explaining the variation, confirming the finding of Blanchard, Das and Faruquee (2010). Reserves did not seem to attenuate the consequences of carrying short-term external debt. Perhaps the most relevant during the Crisis was Russia, which suffered an unexpected annualized growth of GDP of -16 percent despite its large stock of reserves and a comfortable ratio of reserves to short-term debt of 216 percent.²⁸

Aggregate bank capital was not a good indicator of vulnerabilities either. This result does not imply by any means that capital is not a good buffer against shocks, but rather that the Crisis could be understood as a massive liquidity shock and that different levels of capital could serve

²⁸ Trivedi and Ahmed (2010) also find that the level of reserves did not affect output. However the author finds that larger reserves buffers resulted in a lower rise in country risk premiums and smaller fall in exchange rates.

as a buffer in the case the economy was heavily exposed to liquidity risks. The stock of liquid assets to total assets of the banking system was not significant, either, although it had the expected sign. Perhaps the measure is too simplistic, as argued in Section 2, thereby failing to capture the relative liquidity of assets and liabilities.

The relationship between the level of credit to GDP and unexpected output growth is a complex one, and it can have several interpretations. Perhaps the main interpretation, as an indicator of private sector leverage, has the implication that we should expect a negative coefficient, which was not the case.

As explained in Section 2, the literature has suggested using the growth of broad money as an early warning indicator of vulnerabilities in economies where the financial sector is mainly composed of domestically based deposit-taking banks. A drawback of this indicator, though, is that in most emerging economies in which credit is growing rapidly banks finance themselves with liabilities that do not enter into the definition of broad money (e.g., foreign currency interbank funding), and this indicator thus lacks power in a modern financial system. Although the sign is the expected one, it is not significant.

3.5 Understanding the Results as Banking System Illiquidity

The results in the previous sub-section indicate that the three financial variables are highly relevant in explaining cross-country output performance after the crisis. When these explanatory variables are regressed together we still obtain a high R-sq, but each individual coefficient becomes statistically not significant. This last result can be explained both because of the modest size of our sample and because the financial variables are highly correlated with each other.²⁹

We argue that the results obtained so far can be interpreted as capturing high exposure to liquidity risks of the banking system. Short-term external debt is typically the form of financing that banks in rapidly growing emerging markets rely on (in the last decade Eastern Europe was the best example); at the same time it is the form of financing that most exposes a bank to liquidity shocks. Therefore this variable might well be pointing to vulnerabilities specifically in the banking system. Ideally, with debt data disaggregated by sectors of the economy, we should test whether debt accumulated by an specific sector is more/less problematic than when accumulated by other sectors, but these data are not available on a multi-country basis.

²⁹ Tables A.3 and A.4 in Appendix A present the correlations for the core and the extended sample, respectively.

Credit growth to the private sector can be understood along those lines as well. In emerging markets it is typically the case that when credit is growing fast the local deposit base does not grow at the pace required to finance the increase in credit, and banks rely increasingly on wholesale interbank funding, which makes them more vulnerable to liquidity shocks.³⁰

Loans to deposits is perhaps the one with the most obvious relationship. The loans that are not financed with local deposits need to be financed with wholesale short-term funding, long-term debt or equity. The gap is filled to a large extent by the first type of financing and only to a lesser degree with the other two. A bank might well have less leverage with a high loan to deposit ratio, but it is almost certainly more exposed to liquidity risks. Thus, our interpretation of loans to deposits is one based on liquidity rather than on leverage, as in Berkmen et al. (2009).

This implication motivates us to develop a comprehensive measure of systemic liquidity risk of the banking system to better measure the vulnerability a country is facing, an effort we undertake in the next section.

4. Construction of the FPIs

In this section we develop two measures that capture systemic exposure to liquidity risks (hereafter FPIs). The framework extends the methodology recently introduced by Basel III and used to compute the NSFR. Four main steps will be explained below: i) the selection of the institutions to be included and the appropriate consolidation level of their balance sheet; ii) the computation of a bank-level vulnerability measure: “cash shortages;” iii) the aggregation of the previous measure and the mapping of aggregate liquidity shortages into aggregate lending problems; and iv) the normalization of the measures. The measures rely on bank-level information obtained from Bankscope.

4.1 Step 1: Selection of the Institutions Included in the Analysis

The banking system is defined in a broad way. In addition to depositary corporations we include other institutions that perform similar functions in the economy. Following the Bankscope classification we include: Commercial Banks, Cooperative Banks, Real Estate & Mortgage Banks, Saving Banks, Finance Companies (Credit Card, Factoring and Leasing), Investment

³⁰ Shin and Shin (2011) provide evidence of this argument.

Banks, Micro-Financing Institutions, Specialized Governmental Credit Institutions and Other Non-Banking Credit Institutions.

Bank holding companies are not included in the analysis when data for the commercial bank belonging to the holding company are available. The risk profile of the balance sheet of holding companies is usually influenced by other non-banking subsidiaries.

We use, when possible, the unconsolidated balance sheet of the institutions. Consolidated balance sheets often present a problem when subsidiaries of the bank include insurance companies, dramatically changing the amount of securities and ergo the exposure to liquidity risk.³¹ It is worth noting that when Bankscope does provide the unconsolidated balance sheet of institutions, we still use the consolidated one.

4.2 Step 2: Computing the “Cash Shortage” of Individual Banks

4.2.1 Using NSFR weights

The FPI uses as a building block the methodology defined by BCBS (2009) for the purpose of computing the net stable funding ratio (NSFR). This methodology assigns weights to assets and liabilities according to their liquidity characteristics. Table B.1 in Appendix B presents the weights in a simplified version of a financial statement, following the “universal model” in Bankscope.³²

Using those weights we compute the value of i) liabilities not considered stable and ii) assets that do not require stable funding. Item i) accounts for the monetary value of liabilities that can potentially be demanded (not rolled over), and item ii) accounts for the monetary value of assets that can be converted into cash with immediacy. Thus, the value of i) minus ii) reflects the shortage of cash a bank can face in a liquidity stress. Formally, the cash shortages for bank i in country j are given by:

$$cs^{i,j} = \sum_k (1 - W_{L_k}) L_k^{i,j} - \sum_h (1 - W_{A_h}) A_h^{i,j}$$

where W_{L_k} and W_{A_h} refer to the weight assigned by BCBS (2009) to liability k and to asset h respectively, as described in Table B.1.

³¹ Consolidated balance sheets can distort the analysis of exposure to liquidity risk for other reasons as well. Double counting is also a concern when the ownership structure is such that a parent bank consolidates banks in the database.

³² A few weights have been slightly adjusted following IMF (2011).

Using Bankscope has two major advantages. First, the coverage is fairly comprehensive, with sampled banks accounting for about 90 percent of total assets in each country, according to the source. Second, accounting information at the bank level is presented in standardized form, after making adjustments for differences in accounting and reporting standards across countries. On the other hand, the data have some limitations. Data on account details, such as a breakdown of loan portfolios by maturity, by currency or by borrower types, are generally unavailable, implying that our measure of liquidity exposure will not be as precise as we would like. One of the main concerns is the breakdown of liabilities by currency, an issue we address below.

4.2.2 Adjusting for Currency Mismatches

Since Bankscope does not provide disaggregated data on the currency denomination of assets and liabilities, we need to use another source to account for the implications of currency specification for liquidity risk. Since bank-level data are unavailable for most countries, we are forced to use aggregate information on external debt of banks to adjust cash shortages.

Our strategy is to employ country-level information on external debt using three databases: quarterly external debt statistics (QEDS), international financial statistics (IFS) and BIS locational banking statistics (BIS-LBS). Both QEDS and IFS include, in principle, all the external liabilities of banks (other than central banks or other depository corporations) and should coincide. QEDS has a breakdown between short-term and long-term liabilities and by type of instrument. The maturity of a contract is specified on a contractual basis rather than on a remaining basis; this is a caveat, but this specification is the best available. On the other hand, BIS-LBS include the assets and liabilities of BIS reporting banks with banks³³ and non-banks of a large set of countries. The information is based on the residence principle and thus is consistent with national accounts and balance of payment data. A potential caveat is that it does not include the borrowing that the banking system in a particular emerging market is taking from non-banks in foreign countries. For example, it may not include the borrowings of the banking system of Peru from money market mutual funds or fixed-income asset managers in the United States or Europe.³⁴

³³ In the definition of banks of BIS-LBS, Tables 6 and 7, the monetary authority of host countries is included in banks.

³⁴ Entities of this type are not classified as banks in BIS-LBS calculations.

We rely primarily on QEDS and use the other sources when information is not available in this preferred source.³⁵ Using QEDS we compute the proportion of external debt, both short-term and long-term, on total liabilities of banks at the system level. Then we apply a penalization factor³⁶ to the estimated proportions and the corresponding weights, as defined in Section 4.2.1. The weight is 100 percent in the case of estimated short-term external debt and corresponds to one minus the weight of Item 1.a.ii in “Liabilities and Equity” of Table B.1 in Appendix B, and the weight is 25 percent in the case of the estimated long-term external debt and corresponds to one minus the weight of Item 1.b.i in the same table. Formally, the adjusted cash shortages of bank i in country j are given by:

$$acs^{i,j} = cs^{i,j} + (1 - W_{L_{bd}})\varphi \left(\frac{b_S^j}{b_T^j} \right) \sum_k L_k^{i,j} + (1 - W_{L_{sd}})\varphi \left(\frac{b_L^j}{b_T^j} \right) \sum_h L_h^{i,j}$$

where b_S^j , b_L^j and b_T^j represent the amount of external short-term, external long-term and total external debt that the banking system in country j has; $W_{L_{bd}}$ and $W_{L_{sd}}$ are the weights on “bank deposits” and “senior debt” of liabilities, and φ is the penalization factor.

4.3 Step 3: Compute the “Coverage of New Lending” and “Impaired New Lending” at the System Level

In this step we map the previous measures into an aggregate lending problem. Let us define $rnl^{i,j}$ as the amount of loans that need to be refinanced to keep the size of the loan portfolio constant, which is computed as:

$$rnl^{i,j} = \omega \sum_{k \in loans} A_k^{i,j}$$

where $\sum_{k \in loans} A_k^{i,j}$ captures the loan portfolio (i.e., the accounts in the asset side that represents loans to customers, as opposed to securities, deposits in the central bank or cash in vaults) and ω is a parameter that measures the typical refinancing share of the loan portfolio.³⁷

³⁵ We use IFS and BIS-LBS in that order.

³⁶ The penalization factor can be understood as a typical depreciation rate that would increase the domestic currency value of foreign liabilities when a liquidity shock realizes, producing exchange rate pressures. The parameter is calibrated to 0.4. Sensitivity analysis shows that the results are robust in a range of 0.1-0.7.

³⁷ The parameter is calibrated to 2/7. We have conducted a sensitivity analysis and the results are robust. The tests were conducted in the range of reasonable values defined by 1/3 and 1/5.

Then $cnl^{i,j} = rnl^{i,j} - acs^{i,j}$ is the covered new lending of bank i in a scenario of aggregate liquidity stress.

Heterogeneity in bank positions can situate a bank in one of the following three scenarios: i) $acs^{i,j} < 0$, in which case $rnl^{i,j}$ is fully refinanced and the surplus cash, $-acs^{i,j}$, finances other banks in the system that are less liquid or captures market share (the procedure is explained below); ii) $0 < acs^{i,j} < rnl^{i,j}$, in which case $cnl^{i,j}$ is rolled over; and iii) $acs^{i,j} > rnl^{i,j}$, in which case the bank cannot roll over any loans and is potentially facing default if not financed by other banks in the system. The aggregate covered new lending (hereafter CNL) of country j follows from aggregating each case:

$$CNL^j = \sum_i I_{(a)}^{i,j} rnl^{i,j} + \sum_i I_{(b)}^{i,j} cnl^{i,j} + \sum_i I_{(c)}^{i,j} rnl^{i,j} - \sigma \sum_i I_{(a)}^{i,j} acs^{i,j}$$

where $I_{(a)}^{i,j}$, $I_{(b)}^{i,j}$ and $I_{(c)}^{i,j}$ are indicator functions. $I_{(a)}^{i,j} = 1$ when bank i in country j belongs to group i) (that is, when $acs^{i,j} < 0$). $I_{(b)}^{i,j} = 1$ and $I_{(c)}^{i,j} = 1$ when bank i in country j belongs to group ii) and iii), respectively. The parameter σ captures the sharing of extra liquidity of banks in group i) with banks in other groups.

The other side of the coin of CNL is the amount of lending that cannot be rolled over. This measure, “Impaired New Lending” (hereafter INL), and is computed as the aggregate required new lending minus CNL:

$$INL^j = \sum_i rnl^{i,j} - CNL^j$$

4.4 Step 4: Normalization of CNL and INL

Both CNL and INL are expressed in monetary terms. To be able to compare the measures in a cross country regression we normalize them by i) total gross loans and ii) GDP. Measure i) closely captures the health of the banking system, while measure ii) takes into account the relevance of credit in the production process, and should be more relevant to capturing potential declines in economic activity. To compute ii) we need to rescale CNL and INL because Bankscope offers varying coverage of the banking system in each country. To address that

concern we adjust the measures using the ratio of gross loans of banks in the sample and aggregate figures of credit to the private sector.³⁸

Table C.2 in Appendix C summarizes selected items of the balance sheet for the sample of banks used to compute the indexes.

5. Specification of FPIs for LAC

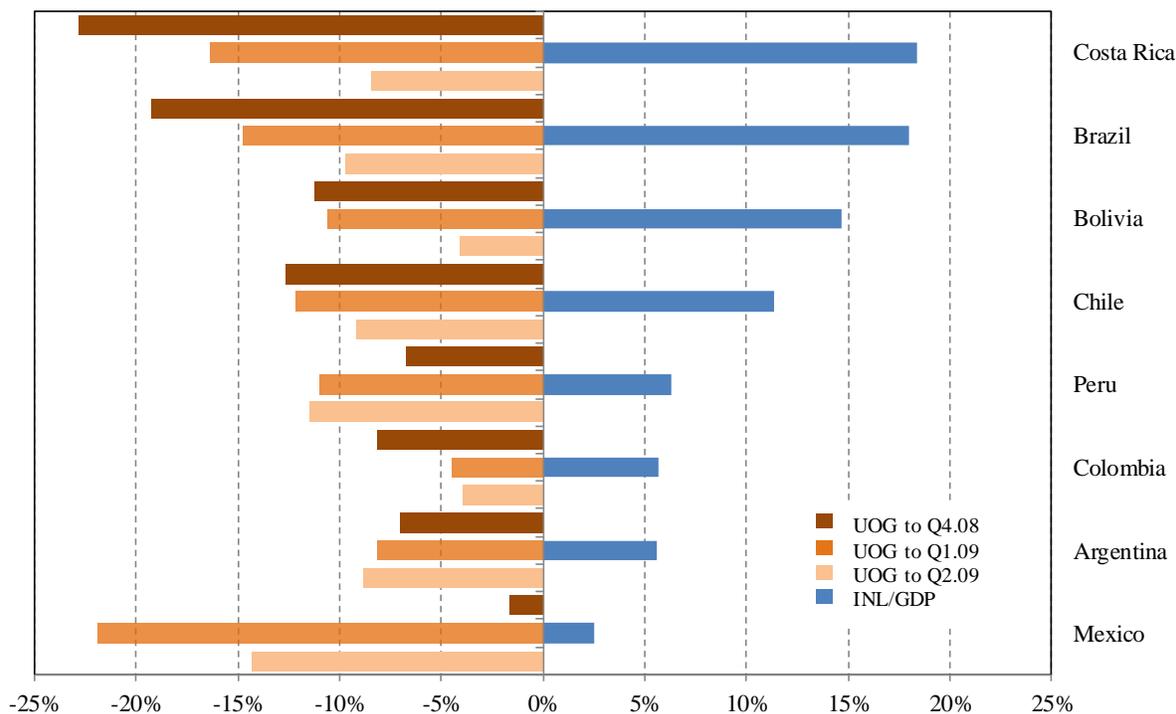
In this section we specify the FPIs for all the Latin American and Caribbean countries included in the extended sample (hereafter LAC8), namely: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico and Peru.

The first step is to select the banks, with their relevant balance sheet, to be included in the analysis. We follow the criteria specified in Step 1 of the previous section. Once the balance sheets are selected it is useful to analyze Bankscope's coverage. For that purpose we compare the sum of gross loans of the banks in each country with several measures of credit published in the World Development Indicators and International Financial Statistics. When performing the comparison it is useful to keep in mind that Bankscope does not provide a break-out of banks' assets/liabilities between public sector holdings and those in other sectors of the economy, a key difference in the four indicators presented for comparison. Tables A.6 and A.7 in Appendix A show that Bankscope generally offers good coverage of LAC8 countries.

Figures 3 and 4 show the aggregate INL and CNL, normalized by GDP, for LAC8. In both figures countries are ranked by each measure, starting with the most vulnerable country. On the left side of each figure we plot unexpected output growth for several horizons.

³⁸ Tables A.6 and A.7 in Appendix A show examples of coverage for eight LAC countries.

Figure 3. INL (to GDP) and Unexpected Output Growth, LAC8

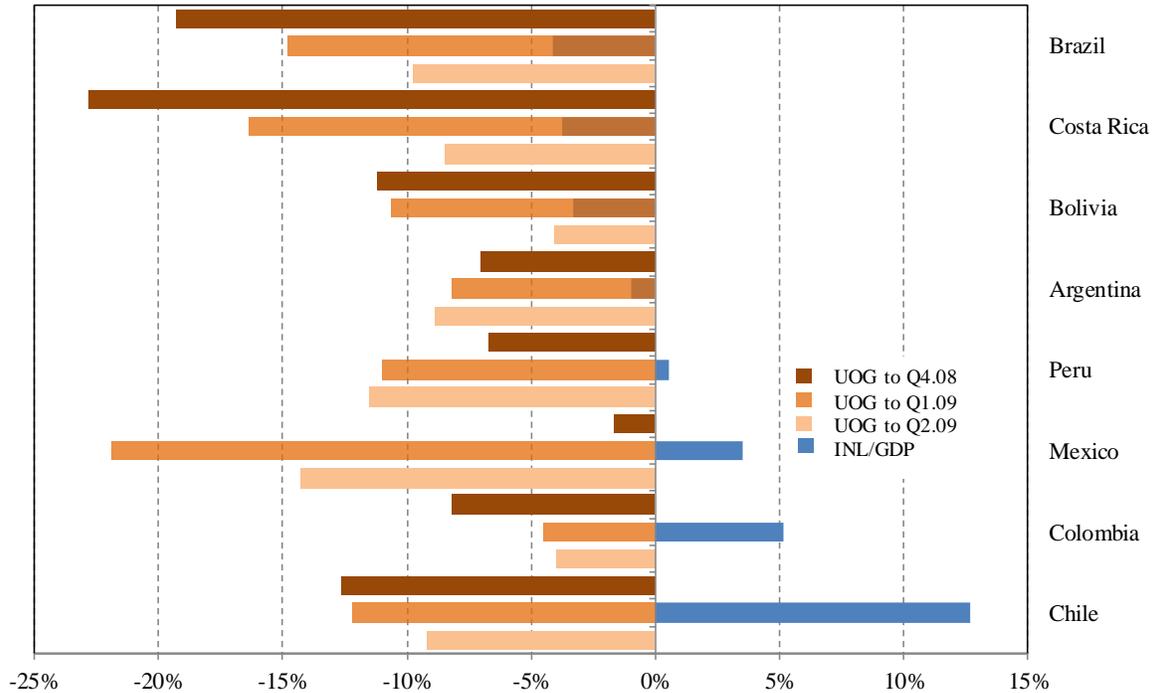


Notes: (1) CNL is calculated at December 2007, (2) Unexpected GDP growth refers to the projected minus actual semester growth Q3.08 to Q2.09, saar.

Source: Author's calculations based on Bankscope, BIS, IFS, QEDS and WEO data.

The figures provide a first assessment of the FPIs. Aggregate INL displays good performance ranking the countries in LAC8, especially at shorter horizons. Costa Rica and Brazil were arguably the two economies in LAC8 with the highest exposure to liquidity risks, and they are the ones who suffer the largest immediate declines in output. The most obvious outlier is Mexico, which has a relatively small exposure but suffers a relatively large decline in output in the semester after the Lehman shock. Perhaps the channels that affected Mexico are more related to its large share of trade with the United States. Aggregate CNL also performs well, capturing the most vulnerable economies in LAC8.

Figure 4. CNL (to GDP) and Unexpected Output Growth, LAC8



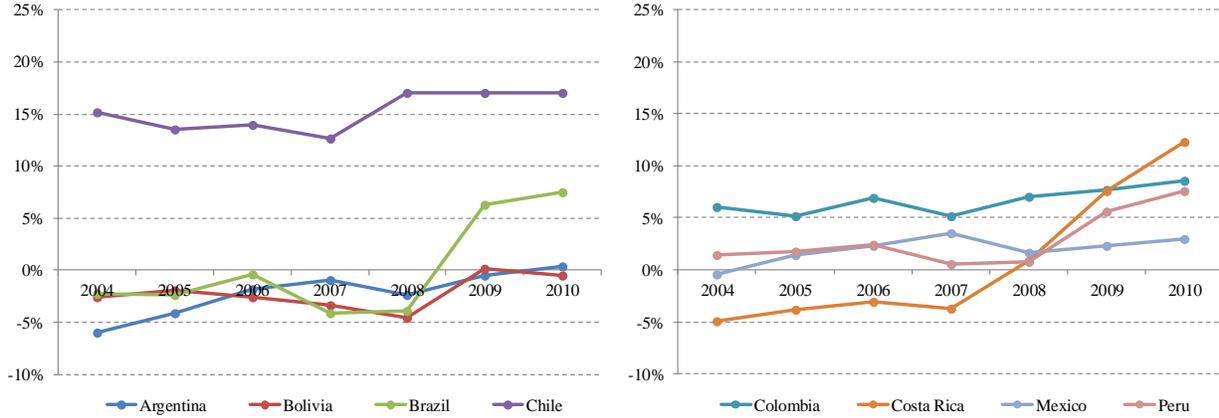
Notes: (1) CNL is calculated at December 2007, (2) Unexpected GDP growth refers to the projected minus actual semester growth Q3.08 to Q2.09, saar.

Source: Author's calculations based on Bankscope, BIS, IFS, QEDS and WEO data.

Below we show the evolution of both CNL and INL, normalized by GDP, in LAC8. We can observe that there is a buildup of vulnerabilities in the years before the Lehman collapse. This trend is observed mainly in Chile, Bolivia, Brazil, Peru and Costa Rica. Also remarkable is the adjustment that took place right after the shock. In all of these economies, exposure decreases considerably in 2009 and 2010. Section 1 explained how liquidity risk exposure is the other side of the coin of liquidity creation by banks. When less of this risk is taken, less liquidity is created, which impacts economic activity. Figure A.3 in Appendix A shows the dynamics of aggregate CNL and INL for the three most affected and the three least affected economies in Eastern Europe.³⁹

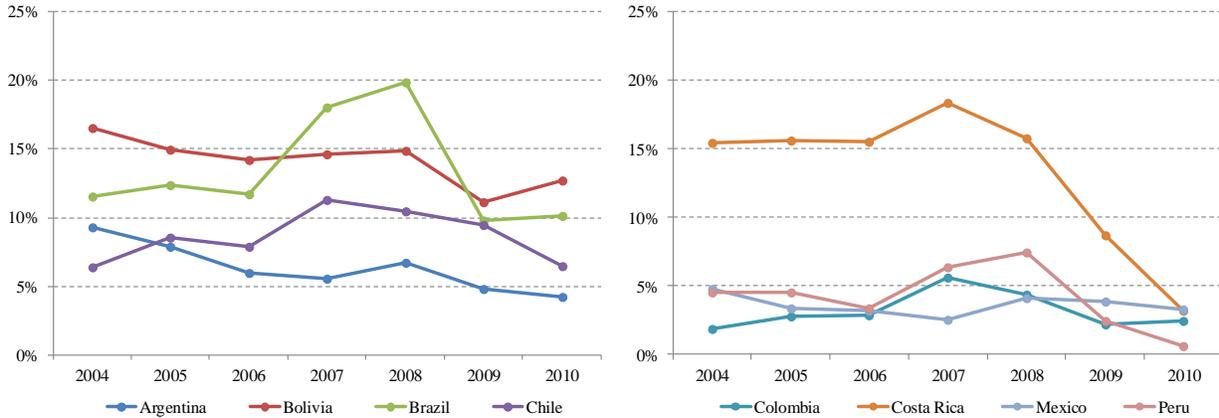
³⁹ Evaluated with unexpected output growth.

Figure 5. Evolution of CNL (to GDP) in LAC8



Source: Author's calculations based on Bankscope, BIS, IFS, QEDS and WEO data.

Figure 6. Evolution of INL (to GDP) in LAC8



Source: Author's calculations based on Bankscope, BIS, IFS, QEDS and WEO data.

6. Test of FPIs in the Crisis

In this section we test the performance of the indicators in the framework described in Section 3, adding both aggregate CNL and INL to the benchmark empirical models. In Section 3 we hypothesized that three financial aggregates found as good explanatory variables are capturing exposure to liquidity risks of the banking system. If that hypothesis is correct, and the FPIs are a more robust and direct way to measure this exposure, we expect them to be significant in the regression and to take most of the explanatory power of the financial aggregates. Table 3 shows the results for the core sample and Table A.8 for the extended sample. The results give support to our hypothesis.

In the core sample, aggregate CNL performs extremely well. It is a robust explanatory variable even when we include the three financial variables in the main set. This happens despite the high correlation between them (see Tables A.3 and A.4 in Appendix A). On the other hand, the significance of the coefficients on the financial variables decreases substantially. The results are showing that at least part of the explanatory power of the three financial variables was attributed to their capacity to capture the banking system's exposure to liquidity risk. According to the results, aggregate INL is not as robust as aggregate CNL.

Table 3. Testing the FPIs, Core Sample
(dependent variable: projected minus actual semester growth Q3.08 to Q2.09, saar)

Regressor								
Unexpected Partner Growth ²	1.03 ***	0.71 ***	0.97 **	0.99 ***	0.79 **	0.46 *	0.86 **	0.85 **
Aggregate CNL	0.29 ***	0.20 *	0.21 **	0.25 **				
Aggregate INL					-0.22 ***	-0.04	-0.07	-0.10
Short-Term External Debt ³		-0.13				-0.24 **		
Credit to Private Sector (Growth) ⁴			-0.09				-0.18 **	
Loans to Deposits ⁵				-0.02				-0.06
Constant	-6.46 ***	-5.17 *	-5.18 *	-3.63	-3.24	-2.88	-2.50	2.50
N	27	27	27	27	27	27	27	27
R-sq	0.63	0.66	0.65	0.64	0.52	0.60	0.59	0.56

¹ Robust standard errors, *** p<0.01, ** p<0.05, * p<0.1

² Forecasted minus actual GDP growth of trade partners (Q3.08 vs Q2.09, saar), weighted by trade and multiplied by home export share of nominal GDP in 2007.

³ Short Term debt with remaining maturity of less than one year, as a percentage of GDP in 2007.

⁴ Credit as a percentage of 2007 GDP minus 2003 GDP.

⁵ Total bank claims over deposits in depository corporations other than Central Banks.

7. Conclusions

This paper develops two metrics of systemic exposure to liquidity risk of banking systems. The metrics are built from bank-level data and extend a methodology recently introduced by international banking regulators. We check the validity of these metrics by showing their robustness in explaining output contractions across emerging markets and developing countries after the Lehman bankruptcy.

The results confirm that exposure to liquidity risk of the banking system is a major source of vulnerability to a sudden worsening of external financing conditions. In addition, we show that our indexes reduces substantially the explanatory power of traditional macrofinancial measures of vulnerability, indicating that part of their explanatory power in previous studies is due to their ability to capture liquidity risk, when not properly controlled for.

In an international environment of low growth perspectives and very accommodative monetary policy in developed countries there is room for large capital inflows into the banking system of emerging markets and developing countries. Such a scenario can present challenges if banks do not properly internalize the consequences for the economy of a sudden disruption in external financing. This paper provides two metrics for policymakers to evaluate such exposure.

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Appendix A. Figures and Tables

Table A.1. Core and Extended Samples

Country	Core	Extended	Country	Core	Extended	Country	Core	Extended	Country	Core	Extended
Argentina	✓	✓	Czech Rep.	✓	✓	Latvia	✓	✓	Romania		✓
Belarus		✓	Egypt		✓	Lithuania	✓	✓	Russia	✓	✓
Bolivia		✓	Estonia	✓	✓	Malaysia	✓	✓	Serbia	✓	✓
Brazil	✓	✓	Georgia		✓	Mauritius		✓	Singapore		✓
Bulgaria		✓	Hungary	✓	✓	Mexico	✓	✓	Slovak Rep.	✓	✓
Chile	✓	✓	India	✓	✓	Moldova		✓	Slovenia	✓	✓
China	✓	✓	Indonesia	✓	✓	Morocco		✓	South Africa	✓	✓
Colombia	✓	✓	Israel	✓	✓	Peru	✓	✓	Thailand	✓	✓
Costa Rica		✓	Jordan		✓	Philippines	✓	✓	Turkey	✓	✓
Croatia	✓	✓	Korea	✓	✓	Poland	✓	✓	Ukraine		✓

Figure A.1. Unexpected Output Growth, Extended Sample (Q3.08 to Q.109, saar)

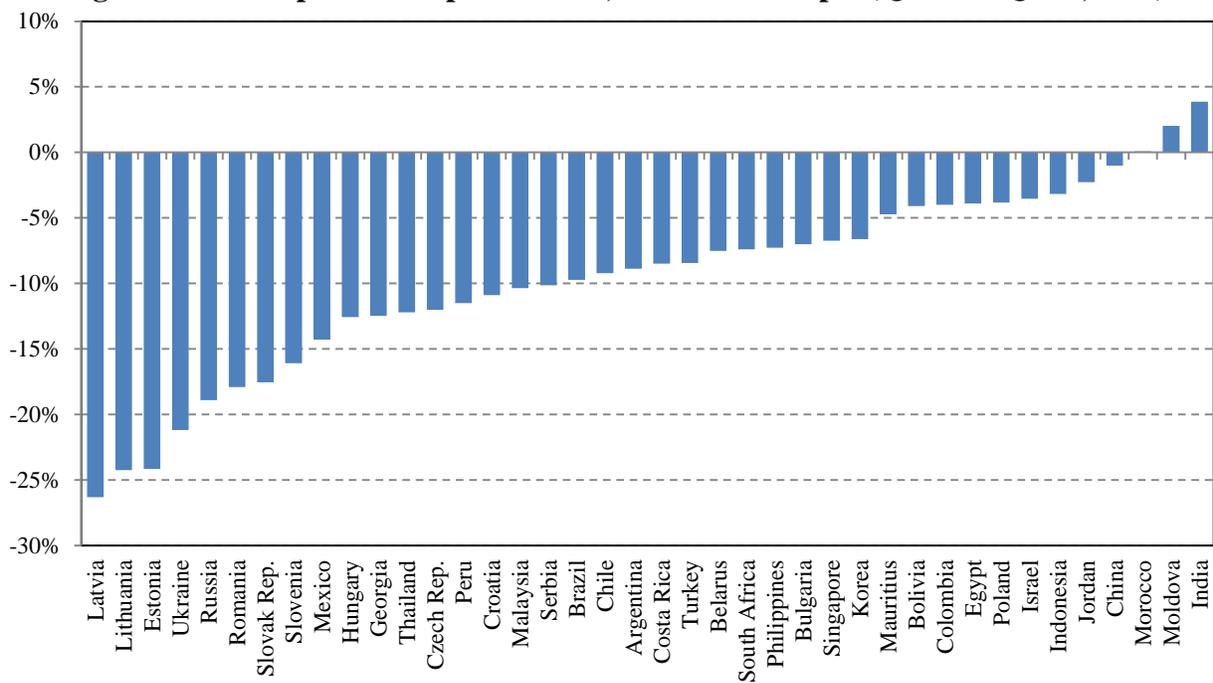


Figure A.2. Unexpected Output Growth and Main Set of Regressors, Extended Sample

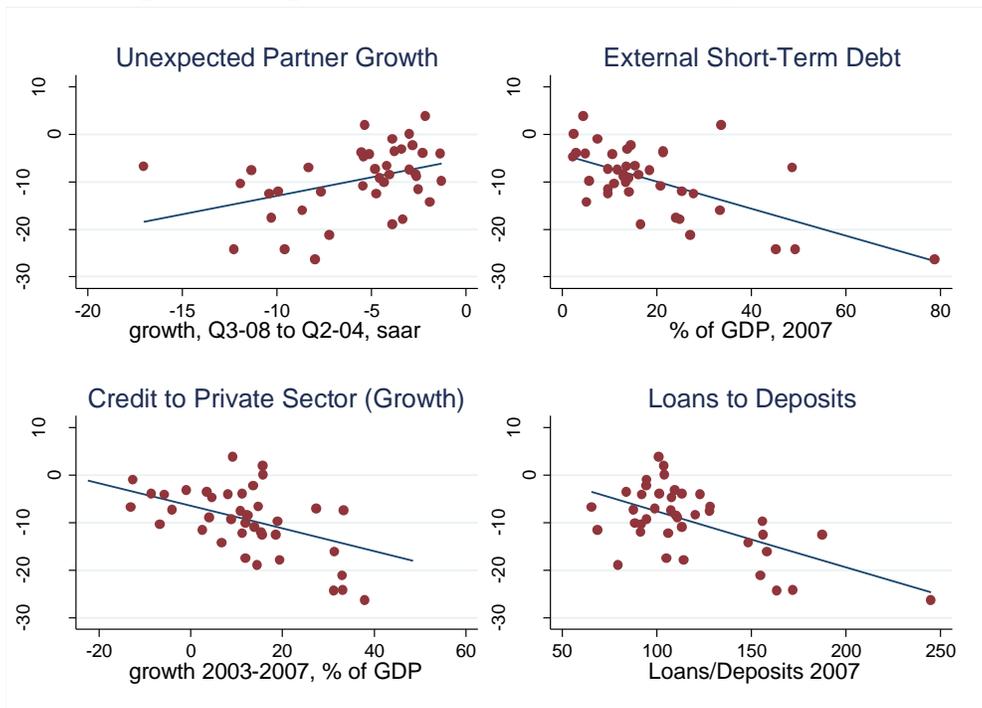


Table A.2. Explaining Unexpected Output Growth (Main Set), Extended Sample
(dependent variable: projected minus actual semester growth Q3.08 to Q2.09, saar)

Regressor			
Unexpected Partner Growth ²	0.26 *	0.71 ***	0.65 ***
Short-Term External Debt ³	-0.26 ***		
Credit to Private Sector (Growth) ⁴		-0.23 ***	
Loans to Deposits ⁵			-0.11 ***
Constant	-3.28 *	-2.49	7.00 **
N	40	40	40
R-sq	0.39	0.43	0.45

¹ Robust standard errors, *** p<0.01, ** p<0.05, * p<0.1

² Forecasted minus actual GDP growth of trade partners (Q3.08 vs Q2.09, saar), weighted by trade and multiplied by home export share of nominal GDP in 2007.

³ Short Term debt with remaining maturity of less than one year, as a percentage of GDP in 2007.

⁴ Credit as a percentage of 2007 GDP minus 2003 GDP.

⁵ Total bank claims over deposits in depositary corporations other than Central Banks.

**Table A.3. Correlation between Selected Variables
(Core Sample)**

Correlations	Unexpected Partner Growth	CNL	INL	Short-Term External Debt	Credit to Private Sector (G)	Loans to Deposits
Unexpected Partner Growth	1					
CNL	0.2014	1				
INL	-0.4897	-0.7683	1			
Short-Term External Debt	-0.6139	-0.6718	0.8191	1		
Credit to Private Sector (Growth)	-0.2952	-0.7353	0.7394	0.6987	1	
Loans to Deposits	-0.3008	-0.7178	0.7641	0.7498	0.6819	1

**Table A.4. Correlation between Selected Variables
(Extended Sample)**

Correlations	Unexpected Partner Growth	CNL	INL	Short-Term External Debt	Credit to Private Sector (G)	Loans to Deposits
Unexpected Partner Growth	1					
CNL	0.034	1				
INL	-0.2934	-0.7591	1			
Short-Term External Debt	-0.475	-0.5016	0.6356	1		
Credit to Private Sector (Growth)	-0.0713	-0.5727	0.5762	0.6469	1	
Loans to Deposits	-0.1234	-0.6526	0.6359	0.5712	0.6441	1

Table A.5. Explaining Unexpected Growth (Alternative Set), Extended Sample
(dependent variable: projected minus actual semester growth Q3.08 to Q2.09, saar)

Regressor						
Unexpected Partner Growth ²	1.06 ***	1.51 ***	1.17 ***	1.04 **	1.18 ***	1.14 ***
Reserves to Short-Term External Debt ³	0.01 **					
Reserves to GDP ⁴		0.20 **				
Bank Capital to Total Assets ⁵			-0.20			
Bank Liquid Assets to Total Assets ⁶				0.07		
Bank Credit to Private Sector to GDP ⁷					0.01	
M2 Growth ⁸						-0.24
Constant	-10.7	-9.95	-5.4	-10.8	-7.85	-6.07
N	40	40	40	33	40	40
R-sq	0.26	0.23	0.17	0.13	0.16	0.17

¹ Robust standard errors, *** p<0.01, ** p<0.05, * p<0.1

² Forecasted minus actual GDP growth of trade partners (Q3.08 vs Q2.09, saar), weighted by trade and multiplied by home export share of nominal GDP in 2007.

³ Reserves over Short-term debt with remaining maturity of less than one year, 2007.

⁴ Reserves to GDP, 2007.

⁵ Aggregate bank capital to aggregate bank assets, 2007.

⁶ Aggregate bank liquid assets to aggregate bank assets, 2007.

⁷ Aggregate bank credit to the private sector over GDP, 2007.

⁸ Growth of M2 as a percentage of GDP from 2004 to 2007.

Table A.6. Analysis of Bankscope Coverage
(Comparison with WDI and IFS)

Country	Measure	2004	2005	2006	2007	2008	2009
Argentina	WDI - Domestic Credit by Banking Sector	45%	38%	31%	29%	24%	28%
	WDI - Credit To Private Sector	10%	12%	13%	14%	14%	14%
	IFS - Credit to Private Sector	10%	11%	13%	14%	13%	13%
	IFS - Domestic Credit	45%	38%	30%	28%	24%	28%
	<i>Bankscope - Gross Loans</i>	17%	17%	15%	16%	15%	14%
Bolivia	WDI - Domestic Credit by Banking Sector	53%	71%	57%	54%	48%	50%
	WDI - Credit To Private Sector	43%	45%	38%	37%	35%	37%
	IFS - Credit to Private Sector	42%	40%	35%	34%	31%	34%
	IFS - Domestic Credit	53%	49%	38%	35%	32%	33%
	<i>Bankscope - Gross Loans</i>	29%	27%	25%	24%	22%	24%
Brazil	WDI - Domestic Credit by Banking Sector	73%	74%	87%	92%	97%	97%
	WDI - Credit To Private Sector	29%	31%	40%	48%	53%	54%
	IFS - Credit to Private Sector	28%	30%	35%	42%	48%	49%
	IFS - Domestic Credit	74%	77%	85%	92%	97%	98%
	<i>Bankscope - Gross Loans</i>	28%	28%	33%	37%	46%	50%
Chile	WDI - Domestic Credit by Banking Sector	87%	84%	83%	90%	98%	99%
	WDI - Credit To Private Sector	79%	80%	82%	88%	97%	97%
	IFS - Credit to Private Sector	65%	67%	66%	73%	83%	80%
	IFS - Domestic Credit	71%	69%	66%	73%	82%	80%
	<i>Bankscope - Gross Loans</i>	62%	64%	64%	74%	82%	76%

Notes: (1) WDI stands for World Development Indicators, IFS stands for International Financial Statistics. (2) "IFS - Credit to Private Sector" corresponds to the figure for Other Depository Corporations when available and for Depository Corporations in other cases. (3) "IFS - Domestic Credit" corresponds to the figure for Depository Corporations. (4) "Bankscope - Gross Loans" correspond to total gross loans to all the financial institutions listed in group 1 and 2 in Section XX.

Source: Bankscope, International Financial Statistics, World Development Indicators and World Economic Outlook.

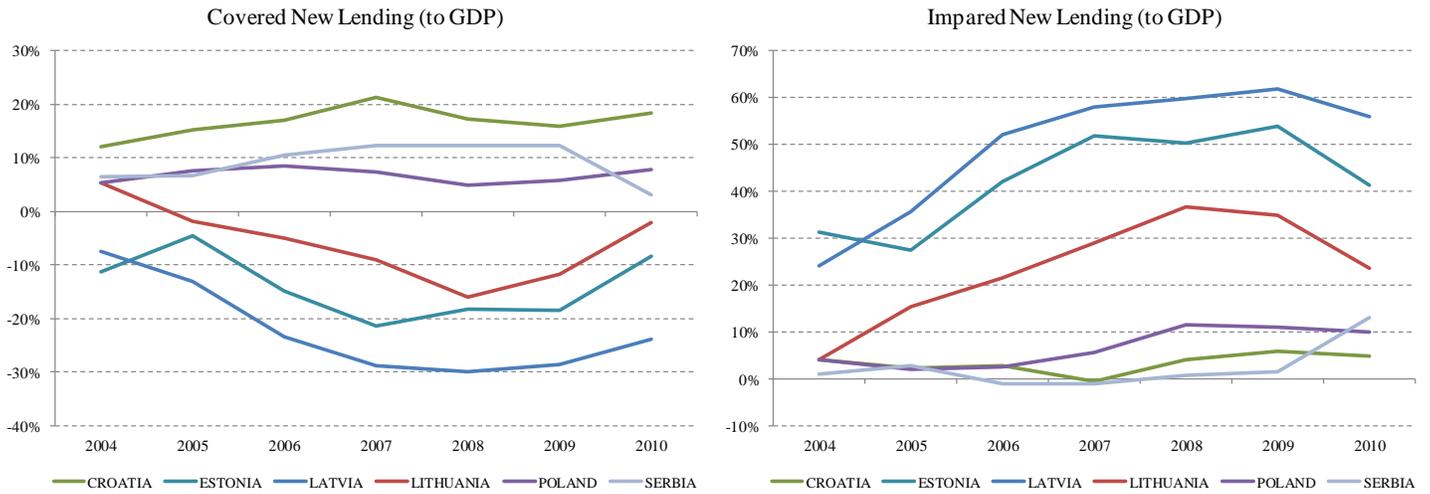
Table A.7. Analysis of Bankscope Coverage
(Comparison with WDI and IFS)

Country	Measure	2004	2005	2006	2007	2008	2009
Colombia	WDI - Domestic Credit by Banking Sector	31%	32%	34%	35%	36%	37%
	WDI - Credit To Private Sector	22%	23%	27%	30%	31%	30%
	IFS - Credit to Private Sector	24%	24%	30%	33%	34%	30%
	IFS - Domestic Credit			34%	35%	36%	37%
	<i>Bankscope - Gross Loans</i>	21%	22%	26%	32%	31%	30%
Costa Rica	WDI - Domestic Credit by Banking Sector	43%	43%	43%	47%	54%	54%
	WDI - Credit To Private Sector	32%	36%	38%	44%	51%	49%
	IFS - Credit to Private Sector	32%	35%	38%	44%	50%	49%
	IFS - Domestic Credit	43%	43%	43%	47%	54%	54%
	<i>Bankscope - Gross Loans</i>	33%	36%	38%	48%	57%	55%
Mexico	WDI - Domestic Credit by Banking Sector	32%	32%	35%	38%	37%	44%
	WDI - Credit To Private Sector	15%	17%	20%	22%	21%	23%
	IFS - Credit to Private Sector	13%	14%	17%	18%	17%	19%
	IFS - Domestic Credit	33%	32%	33%	34%	32%	36%
	<i>Bankscope - Gross Loans</i>	16%	17%	18%	22%	23%	25%
Peru	WDI - Domestic Credit by Banking Sector	17%	18%	15%	16%	18%	18%
	WDI - Credit To Private Sector	18%	19%	18%	21%	25%	24%
	IFS - Credit to Private Sector	18%	19%	18%	21%	25%	25%
	IFS - Domestic Credit	17%	17%	15%	16%	19%	18%
	<i>Bankscope - Gross Loans</i>	17%	18%	18%	20%	25%	25%

Notes: (1) WDI stands for World Development Indicators, IFS stands for International Financial Statistics. (2) "IFS - Credit to Private Sector" corresponds to the figure for Other Depository Corporations when available and for Depository Corporations in other cases. (3) "IFS - Domestic Credit" corresponds to the figure for Depository Corporations. (4) "Bankscope - Gross Loans" correspond to total gross loans to all the financial institutions listed in group 1 and 2 in Section XX.

Source: Bankscope, International Financial Statistics, World Development Indicators and World Economic Outlook.

Figure 6. Evolution of INL (to GDP) in LAC8



Source: Author's calculations based on Bankscope, BIS, IFS, QEDS and WEO.

Table A.8. Testing the FPIs, Extended Sample
(dependent variable: projected minus actual semester growth Q3.08 to Q2.09, saar)

Regressor								
Unexpected Partner Growth ²	0.74 ***	0.48 **	0.71 ***	0.68 ***	0.81 *	0.27 *	0.58 **	0.55 **
Aggregate CNL	0.33 ***	0.24 ***	0.22 ***	0.21 **				
Aggregate INL						-0.26 ***	-0.16 *	-0.14 *
Short-Term External Debt ³		-0.13 *				-0.17 *		
Credit to Private Sector (Growth) ⁴			-0.13 **				-0.17 ***	
Loans to Deposits ⁵				-0.06 *				-0.08 **
Constant	-7.33 ***	-5.80 ***	-5.09 **	0.39	-3.48 *	-2.93 *	-2.36	4.68
N	40	40	40	40	40	40	40	40
R-sq	0.47	0.51	0.53	0.52	0.38	0.45	0.47	0.48

¹ Robust standard errors, *** p<0.01, ** p<0.05, * p<0.1

² Forecasted minus actual GDP growth of trade partners (Q3.08 vs Q2.09, saar), weighted by trade and multiplied by home export share of nominal GDP in 2007.

³ Short Term debt with remaining maturity of less than one year, as a percentage of GDP in 2007.

⁴ Credit as a percentage of 2007 GDP minus 2003 GDP.

⁵ Total bank claims over deposits in depository corporations other than Central Banks.

Appendix B. Description of the Net Stable Funding Ratio and How to Adapt it to Bankscope

In December 2009, the BCBS issued a consultative document proposing a regulatory framework for liquidity risk, which is intended to address lessons issues that became relevant in the Crisis.⁴⁰ The proposals impose two measures of liquidity risk exposure. The first, the Liquidity Coverage Ratio, is based on a 30-day time horizon. The second, the Net Stable Funding Ratio (NSFR), addresses longer-term structural liquidity mismatches over a one-year time period.

The NSFR is computed as the ratio between liabilities that are considered stable (ASF, available stable funding) and assets that require stable funding because (RSF, required stable funding) since they are considered to be relatively illiquid. The higher the ratio, the less a bank is exposed to a drying-up of liquidity. The BSBC requires the ratio to be greater than one most of the time, indicating that exposure is at acceptable levels.

Generally described, the ASF and the RSF are calculated applying factors to designated items on the right and left side of the balance sheet. These factors range from 100 percent to 0 percent and indicate the liquidity profile of the liability/asset. Tables B.1 and B.2 adapt the factors to a stylized balance sheet of a bank, for which the information is available in Bankscope.

Although the NSFR is currently the most comprehensive measure of exposure to liquidity risk, it is not perfect. The weights on each component of the balance were designed for a representative economy, and they could be adapted to specific characteristics of countries and conditions of the economic environments.

⁴⁰ See BCBS (2009).

Table B.1. Approximation of the NSFR

ASSETS	RSF	LIABILITIES AND EQUITY	ASF
1. Total Earning Assets		1. Interest-bearing Liabilities	
1.a. Net Loans		1.a. Total Deposits, Money Market and Short-term Funding	
1.a.i. Gross Loans		1.a.i. Total Customer Deposits	
Residential Mortgage Loans	1.00	Customer Deposits - Current	0.85
Other Mortgage Loans	1.00	Customer Deposits - Savings	0.70
Other Consumer/ Retail Loans	0.70	Customer Deposits - Term	0.70
Corporate & Commercial Loans	0.85	1.a.ii. Deposits from Banks	0.00
Other Loans	1.00	1.a.iii. Repos and Cash Collateral	0.00
1.a.i. (Reserve for impaired loans)	-1.00	1.a.iv. Other Deposits and Short-term Borrowings	0.00
1.b. Other Earning Assets		1.b. Total Long Term Funding	
1.b.i. Loans and Advances to Banks	0.00	1.b.ii. Senior Debt Maturing after 1 Year	0.75
1.b.ii. Total Securities		1.b.iii. Subordinated Borrowing	1.00
Reverse Repos and Cash Collateral	0.00	1.b.iv. Other Funding	0.75
Trading Securities and at FV through Income	0.15	1.c. Derivatives (NETTED IN ASSET SIDE)	
Derivatives (NETTED IN ASSET SIDE)	0.90	1.d. Trading Liabilities	0.00
Available for Sale Securities	0.15	2. Non-interest Bearing Liabilities	
Held to Maturity Securities	1.00	Fair Value Portion of Debt	0.00
At-equity Investments in Associates	1.00	Credit impairment reserves	0.00
Other Securities	1.00	Reserves for Pensions and Other	0.00
1.b.iii. Investment in Property	1.00	Current Tax Liabilities	0.00
1.b.iv. Insurance Assets	1.00	Deferred Tax Liabilities	0.00
1.b.v. Other Earning Assets	1.00	Other Deferred Liabilities	0.00
2. Non Earning Assets		Discontinued Operations	0.00
Cash and Due From Banks	0.00	Insurance Liabilities	0.00
Foreclosed Real Estate	1.00	Other Liabilities	0.00
Fixed Assets	1.00	3. Hybrid Capital	
Goodwill	1.00	Pref. Shares and Hybrid Capital accounted for as Debt	1.00
Other Intangibles	1.00	Pref. Shares and Hybrid Capital accounted for as Equity	1.00
Current Tax Assets	1.00	4. Total Equity	
Deferred Tax Assets	1.00	Common Equity	1.00
Discontinued Operations	1.00	Non-controlling Interest	1.00
Other Assets	1.00	Securities Revaluation Reserves	1.00
		Foreign Exchange Revaluation Reserves	1.00
		Fixed Asset Revaluations	1.00

Source: Author's calculations based on BCBS (2009) and Bankscope.

Appendix C. Description of Samples

Table C.1. Selected Macro Aggregates for Countries in Sample

Country	UOG	UPG	ESTD	LD	CG	Credit	NPL
Argentina	-8.9%	-2.6%	13.0%	111.0%	3.7%	14.5%	0.3%
Belarus	-7.5%	-11.3%	18.5%	127.8%	13.1%	24.8%	2.5%
Bolivia	-4.1%	-5.1%	10.6%	92.1%	-10.9%	37.0%	-0.8%
Brazil	-9.7%	-1.3%	5.7%	155.8%	19.2%	47.9%	1.1%
Bulgaria	-7.0%	-8.3%	48.7%	98.9%	36.3%	62.8%	3.9%
Chile	-9.2%	-4.5%	14.0%	94.7%	9.9%	88.3%	2.0%
China	-1.0%	-3.9%	7.4%	94.7%	-19.7%	107.5%	-0.8%
Colombia	-4.0%	-1.4%	4.9%	122.8%	9.4%	30.4%	0.1%
Costa Rica	-8.5%	-4.0%	16.1%	110.0%	13.1%	44.4%	0.5%
Croatia	-10.9%	-5.4%	20.7%	113.2%	16.5%	62.3%	2.9%
Czech Rep.	-12.0%	-10.0%	25.3%	91.5%	16.2%	47.9%	1.8%
Egypt	-3.9%	-2.3%	2.9%	101.1%	-8.4%	45.5%	-1.4%
Estonia	-24.1%	-12.3%	49.3%	172.1%	43.3%	93.9%	3.3%
Georgia	-12.5%	-4.8%	9.7%	187.4%	19.6%	28.3%	2.2%
Hungary	-12.6%	-10.4%	27.8%	156.1%	19.1%	61.4%	3.7%
India	3.9%	-2.1%	4.4%	101.0%	12.8%	44.8%	
Indonesia	-3.2%	-3.4%	13.7%	109.3%	2.5%	25.5%	0.1%
Israel	-3.5%	-3.8%	21.4%	83.9%	3.0%	88.5%	
Jordan	-2.3%	-2.9%	14.4%	94.4%	17.5%	88.3%	2.5%
Korea	-6.6%	-4.2%	15.3%	128.4%	9.3%	99.6%	0.1%

UOG refers to unexpected output growth, UPG to unexpected partner growth, ESTD to the external short-term debt to GDP ratio, LD to the loans to deposits ratio, CG to the growth of bank credit to the private sector, Credit to the amount of bank credit to the private sector over GDP, and NPL to the change in non-performing loans over assets. UOG, UPG, ESTD, LD and Credit are measured at the end of 2007. CG corresponds to growth between 2003 and 2007 and is normalized by GDP. NPL refers to change between 2008 and 2009.

Table C.1. Selected Macro Aggregates for Countries in the Sample (continued)

Country	UOG	UPG	ESTD	LD	CG	Credit	NPL
Latvia	-26.3%	-8.0%	78.7%	244.7%	48.4%	88.7%	12.8%
Lithuania	-24.2%	-9.6%	45.1%	163.5%	37.2%	60.0%	14.7%
Malaysia	-10.3%	-11.9%	10.9%	91.8%	-13.7%	105.3%	-1.1%
Mauritius	-4.7%	-5.4%	2.3%	107.9%	4.5%	77.7%	
Mexico	-14.3%	-1.9%	5.1%	148.5%	6.0%	22.0%	-0.1%
Moldova	2.0%	-5.3%	33.6%	103.8%	16.5%	36.9%	11.1%
Morocco	0.1%	-3.0%	2.4%	104.0%	16.0%	58.4%	-0.5%
Peru	-11.5%	-2.5%	9.7%	68.6%	0.5%	21.0%	0.5%
Philippines	-7.3%	-4.8%	9.7%	87.7%	-5.0%	29.9%	-0.4%
Poland	-3.8%	-5.5%	21.4%	113.0%	11.4%	39.4%	3.1%
Romania	-17.9%	-3.3%	24.9%	114.1%	21.3%	35.1%	8.8%
Russia	-18.9%	-3.9%	16.6%	79.6%	17.6%	38.7%	5.9%
Serbia	-10.1%	-4.3%	13.4%	88.5%	15.7%	34.9%	4.2%
Singapore	-6.7%	-17.0%	13.6%	65.3%	-22.4%	87.4%	0.6%
Slovak Rep.	-17.6%	-10.3%	24.0%	105.0%	10.5%	42.4%	2.8%
Slovenia	-16.1%	-8.6%	33.3%	158.1%	38.1%	79.5%	0.5%
South Africa	-7.4%	-3.0%	11.7%	107.6%	43.0%	161.9%	2.0%
Thailand	-12.2%	-7.7%	14.1%	106.0%	12.7%	113.2%	-0.4%
Turkey	-8.4%	-2.7%	12.9%	120.3%	14.9%	29.5%	1.8%
Ukraine	-21.2%	-7.2%	27.0%	154.6%	33.6%	58.2%	22.8%

UOG refers to unexpected output growth, UPG to unexpected partner growth, ESTD to the external short-term debt to GDP ratio, LD to the loans to deposits ratio, CG to the growth of bank credit to the private sector, Credit to the amount of bank credit to the private sector over GDP, and NPL to the change in non-performing loans over assets. UOG, UPG, ESTD, LD and Credit are measured at the end of 2007. CG corresponds to growth between 2003 and 2007 and is normalized by GDP. NPL refers to change between 2008 and 2009.

Table C.2. Sample of Banks in Emerging Markets

Country	# of Banks	Loans	OEA	NEA	STF	LTF	NIBL	Capital
Argentina	82	41.4%	48.3%	10.3%	82.2%	3.1%	2.5%	12.3%
Belarus	21	65.5%	20.5%	14.0%	84.9%	2.6%	1.2%	11.3%
Bolivia	13	55.7%	35.2%	9.1%	85.9%	1.0%	3.0%	10.2%
Brazil	124	35.6%	50.4%	13.0%	60.2%	11.2%	18.1%	9.9%
Bulgaria	27	62.6%	21.5%	15.9%	78.4%	9.5%	1.1%	11.0%
Chile	25	71.1%	16.9%	12.0%	73.2%	12.6%	4.8%	9.4%
China	130	49.3%	46.4%	4.2%	86.9%	4.0%	3.8%	5.4%
Colombia	26	62.4%	25.2%	12.3%	77.9%	4.6%	5.0%	12.5%
Costa Rica	63	64.7%	20.7%	14.6%	83.2%	0.0%	4.0%	12.8%
Croatia	36	59.2%	26.5%	14.3%	68.1%	16.3%	2.1%	13.5%
Czech Rep.	38	48.8%	43.8%	7.0%	74.9%	14.1%	4.3%	6.5%
Egypt	30	37.5%	52.5%	10.0%	87.2%	2.4%	4.3%	6.1%
Estonia	7	78.7%	11.4%	9.9%	81.5%	6.4%	3.7%	8.4%
Georgia	11	61.4%	13.9%	24.8%	54.9%	22.7%	3.0%	19.3%
Hungary	33	58.7%	33.4%	7.3%	72.4%	14.2%	3.4%	9.6%
India	85	59.0%	30.9%	10.1%	83.9%	4.6%	5.3%	6.3%
Indonesia	52	48.6%	36.4%	15.0%	79.6%	4.8%	4.7%	11.0%
Israel	10	65.4%	28.9%	5.5%	83.1%	4.8%	5.4%	6.7%
Jordan	14	48.2%	41.5%	10.2%	77.9%	2.0%	3.5%	16.6%
Korea	36	66.6%	24.9%	8.0%	62.7%	21.6%	6.2%	8.9%

The definitions follow from the balance sheet specified in Table B.1. Assets are summarized in columns three to five, which refer to net loans - Loans (1.a.), other earning assets - OEA (1.b), and non-earning assets -NEA (2). Liabilities are summarized in columns six to nine, which refer to short-term funding - STF (1.a +1.d), long-term funding - LTF (1.b), non-interest liabilities - NIBL (2), and hybrid capital and total equity - Capital (3+4). Financial statements were obtained from Bankscope. All variables are measured at the end of 2007.

Table C.2. Sample of Banks in Emerging Markets (continued)

Country	# of Banks	Loans	OEA	NEA	STF	LTF	NIBL	Capital
Latvia	21	67.0%	27.0%	6.0%	87.8%	2.4%	1.2%	8.5%
Lithuania	12	71.2%	20.2%	8.4%	85.0%	5.5%	1.5%	7.8%
Malaysia	53	51.6%	23.3%	24.9%	81.4%	5.8%	4.4%	8.4%
Mauritius	17	53.3%	24.5%	22.2%	83.7%	4.6%	3.3%	8.5%
Mexico	54	60.4%	23.2%	15.6%	58.8%	14.4%	11.8%	14.3%
Moldova	14	61.6%	18.7%	19.6%	74.0%	5.9%	1.6%	18.4%
Morocco	15	50.1%	35.8%	14.2%	86.1%	1.3%	4.4%	8.3%
Peru	22	50.9%	31.1%	18.0%	80.9%	3.5%	5.6%	10.0%
Philippines	38	39.3%	45.7%	14.7%	77.4%	3.7%	7.5%	11.4%
Poland	51	60.2%	32.5%	6.8%	84.1%	2.5%	2.7%	10.6%
Romania	31	58.5%	16.1%	25.3%	82.4%	4.8%	3.4%	9.3%
Russia	227	61.5%	28.4%	10.1%	49.3%	29.2%	7.8%	13.7%
Serbia	34	51.6%	16.2%	32.2%	70.9%	4.4%	4.0%	20.7%
Singapore	22	46.1%	40.7%	11.1%	77.1%	8.0%	3.4%	10.5%
Slovak Rep.	19	49.8%	39.5%	10.1%	81.0%	7.0%	3.1%	8.8%
Slovenia	22	67.1%	28.1%	4.7%	80.8%	8.9%	2.2%	8.1%
South Africa	37	73.4%	19.9%	5.4%	78.9%	11.1%	2.5%	6.4%
Thailand	34	67.7%	23.9%	8.3%	82.9%	3.4%	3.7%	9.9%
Turkey	56	52.3%	39.1%	8.5%	71.2%	10.0%	6.1%	12.6%
Ukraine	47	73.0%	12.1%	15.0%	77.0%	10.3%	2.1%	10.7%

The definitions follow from the balance sheet specified in Table B.1. Assets are summarized in columns three to five, which refer to net loans - Loans (1.a), other earning assets - OEA (1.b), and non-earning assets -NEA (2). Liabilities are summarized in columns six to nine, which refer to short-term funding - STF (1.a +1.d), long-term funding - LTF (1.b), non-interest liabilities - NIBL (2), and hybrid capital and total equity - Capital (3+4). Financial statements were obtained from Bankscope. All variables are measured at the end of 2007.