

The bank liquidity smile across exchange rate regimes

Irina Bunda* and Jean-Baptiste Desquilbet

Laboratoire d'Economie d'Orléans (LEO), France

Combining panel data on bank liquidity at the individual level and data on their macroeconomic environment, for a sample of commercial banks in emerging countries between 1995 and 2004, we show that there exists a 'bank liquidity smile across exchange rate regimes'. In extreme regimes at both ends of the line, i.e. for pure floating exchange rate regimes at one end and currency boards and dollarised economies at the other end, bank assets are more liquid than in intermediate regimes.

Keywords: bank liquidity; exchange rate regimes; currency boards; emerging countries

JEL Codes: F33; G21

1. Introduction

The aim of the paper is to explore how the liquidity of commercial bank assets is affected by the exchange rate regime of the country in which they operate. Many papers have been written on twin crises, and the relationship between exchange rate (or balance of payment) and bank fragility.¹ In particular, Chang and Velasco (2000), using an open economy extension of the famous Diamond and Dybvig (1983) model, study how the 'mixture' of exchange rate regime and presence or lack of a lender of last resort affects the potential for bank (liquidity) crises and balance of payment crises, either simultaneously or in isolation. They show that fixed exchange rate regimes where the central bank does not act as a lender of last resort, in particular currency boards, are more vulnerable to liquidity crises, whereas the combination of flexible exchange rates and a central bank that serves as lender of last resort eliminates self-fulfilling runs. Therefore, according to their model, the potential for a bank run is not independent of the exchange rate regime.

The aim of this paper is to confront with facts the following corollary of that idea: if the potential for a bank liquidity crisis indeed depends on the exchange rate regime,

*Corresponding author. Email: irina.bunda@univ-orleans.fr

banks should behave accordingly. Some kind of self-protection response should induce banks to keep more or less liquid assets, depending, *ceteris paribus*, on the exchange rate regime.

Combining panel data on bank liquidity at the individual level and data on their macroeconomic environment, for a sample of commercial banks in emerging countries between 1995 and 2004, we identify a particular configuration that we label a ‘bank liquidity smile across exchange rate regimes’. In extreme regimes at both ends of the line, i.e. for pure floating exchange rate regimes at one end and currency boards and dollarised economies at the other end, bank assets are more liquid than in intermediate regimes. This result seems to be very robust to changes in the definition of liquidity (we used different liquidity ratios), or the difference between official and *de facto* exchange rate regimes.

After a review of some measurable determinants of bank liquidity (Section two), we set out the data (Section three) and the regression results (Section four).

2. Methodological issues

Several phenomena affect the liquidity of bank assets, such as bank specialisation, ability in risk management, banking regulation and supervision, interest rate margins and their variability, information asymmetries in the credit market, macroeconomic environment. Among these many phenomena, we want to emphasise the role of the exchange rate regime.²

Since the perspective of this paper is basically empirical, and oriented towards emerging economies, we take into account variables for which available data exist and are easily obtained.

Individual bank data was provided by the Bankscope database (see below). Since the behaviour of a bank may depend on its ‘type’, we retained commercial banks only.³

We test the following relationship:

$$\begin{aligned}
 \text{Liquidity ratio} = & \alpha_0 + \sum_{k=1}^4 [\alpha_{1k} \text{ relative size} + \alpha_{2k} \text{ equity to asset ratio} \\
 & + \alpha_{3k} \text{ enforcement of Basel Core Principles (dummy)} \\
 & + \alpha_{4k} \text{ real lending interest rate} \\
 & + \alpha_{5k} \text{ total deposits/GDP} + \alpha_{6k} \text{ public expenditures/GDP} \\
 & + \alpha_{7k} \text{ rate of inflation} + \alpha_{8k} \text{ real rate of growth} \\
 & + \sum_{p=9}^{11} \alpha_{pk} \text{ realisation of a twin/banking} \\
 & \text{/currency crisis (dummy)} + \sum_{s=12}^{15} \alpha_{sk} \text{ country region} \\
 & \text{/type (dummy)} + \beta_k \text{ type of exchange rate regime}_k \\
 & \text{(dummy)](type of exchange rate regime}_k \text{(dummy))}
 \end{aligned}$$

We interpret this relationship as follows.

The higher is the *liquidity ratio*, the more liquid will be the bank assets. It is assumed to depend on the individual behaviour of banks, their market and macroeconomic environment as well as the exchange rate regime.

A first set of variables is representative of individual characteristics of commercial banks.

Relative size is a measure of the weighted size of the bank. It is meant to capture differences in debt management and asset liquidity according to the importance of individual banks for the domestic banking sector. If big banks were seeing themselves as 'too big to fail', we would observe a negative coefficient (the bigger the bank, the less liquid and thus more vulnerable to a bank run). This effect may be reinforced if larger banks have stronger political connections and support than smaller banks, as may be the case in some emerging countries.

The *ratio of equity to assets* may have opposite effects on liquidity, as shown by the debate on minimum capital adequacy requirements in emerging markets. On the one hand, the effect may be negative. The higher the equity ratio, the smaller the amount of liquid assets required for sound banking practice, in order to keep liquid liabilities and liquid assets in balance. Kim and Santomero (1998) show that, in general, the solvency regulation will entail a recomposition of the risky part of the bank's portfolio in such a way that its risk is increased. According to Dewatripont and Tirole (1993), shareholders are much more inclined to involve the bank in risky investment projects than ordinary creditors. Therefore, the bank may reduce its 'unprofitable' liquid assets in order to maintain or to increase the overall return on bank's equity. On the other hand, information asymmetries in the credit market may bring about credit rationing phenomena, reflecting the fact that banks do not necessarily increase profitability by lending more. Thus, a higher ratio of equity to assets may be compatible with higher asset liquidity (see, for example, Thakor 1996). We take these two variables as exogenous to liquidity, and we do not include other variables that are more or less codetermined with asset liquidity and asset portfolio choice, such as the net interest margin, or measures of return (ROAE, ROAA).

A second set of variables relates liquidity to banking activities at a 'market' level.

The *enforcement of Basel Core Principles* may be viewed as a measure of the presence of prudential regulation, which should show through on bank liquidity. In emerging economies, prudential regulations (in particular the capital adequacy requirements) were adopted and progressively enforced through the 1990s, more often in the aftermath of currency and/or financial crises (see Appendix A). At first sight, they can be considered as an obligation for banks to be liquid enough, but also as an incentive mechanism for banks to enforce a more efficient liquidity management. It is also implemented within a general improvement of bank supervision. In an environment such as emerging markets, with poor lending opportunities, the introduction of prudential regulation can explain an increase in liquidity if banks tended to lend too much, but also a decrease in liquidity whenever banks tended to be too cautious in their lending policy.

The *lending interest rate* is taken into account as a measure of lending profitability at market level, so that higher interest rates could be naively interpreted as an explanation for lower bank liquidity. However, it is well known that portfolio choices of banks depend on both interest rates and risk controllability. In a credit market with asymmetric information, i.e. poor risk controllability, adverse selection can lead to credit rationing, as shown, for example, by Stiglitz and Weiss (1981), so that high interest rates may well be associated with high bank liquidity.

The *Total Deposit/M2 ratio* reflects the degree of liberalisation and financial deepening. Financial market reforms and deregulation in the 1990s have often provided a local financial intermediary with greater freedom of manoeuvre in the asset/liability management and the recourse to international capital markets. A negative coefficient for absolute/relative liquidity ratios suggests that the liquid assets rise less than credit/short-term funding as a result of greater financial openness. The banks can collect more deposits, thus increasing liquid liabilities, while, at the same time, but to a greater extent, investing more in illiquid projects. A positive coefficient suggests that liquid assets increase more than the credits/short-term funding thus making the banks less vulnerable to a bank run.

A third set of variables relates liquidity to the macroeconomic environment.

Public expenditures/GDP are included to take into account supply side factors in the market for liquid assets: large public expenditures reflect a substantial supply of government securities, which are usually computed as liquid assets. It also represents the potential for government inference in banking activities: in emerging countries, in which capital market development is in process, the government often relies on banks to finance its expenditures.⁴

The *rate of inflation* measures another incentive for banks to hold liquid assets: when banks give more importance to customer relations and increase long term lending, they make the nominal value of their assets stickier, and thus become more vulnerable to rises in inflation.

The *rate of growth*, on the contrary, is taken as indicating better perspectives for borrowers, and more profitable lending by banks, thus reducing their asset liquidity.

We also take into account the fact that the *realisation of a banking crisis* purges the financial system from unhealthy (illiquid) banks, induces banks to curtail lending, spills over to the real sector and prompts a decrease in the demand for loans, so that the aftermath of the crisis should be associated with higher liquidity. A negative link with bank liquidity indicates that the crisis may be due to poor bank liquidity, which can result from a lending boom (see, for example, Tirole 2002). As far as the occurrence of a currency crisis is concerned, it may affect bank liquidity if the bank has liabilities denominated in foreign currency whereas its assets are denominated in domestic currency (currency mismatch). Should a devaluation/depreciation occurs, the bank may be constrained to use up its liquid assets to meet its obligations, whose value in foreign currency has risen. In the case of twin crises, the effect of the banking crisis may prevail as, in more than half of twin crises episodes affecting the emerging countries over the sample period, banking crises preceded currency crises, whereas the rest of the time they occurred the same year (see Appendix A).

Finally, we took into account the country's region or type, distinguishing among four categories: countries in transition, Asian countries, Latin American countries and other countries from Europe, Middle East and Africa.

The last set of variables are dummy variables that reflect the type of exchange rate regime, which is the *raison d'être* of this paper, as explained in the introduction. Many emerging economies went through noticeable changes in their exchange rate regimes during the second half of the 1990s, after confronting severe financial crises. We have to bear in mind that, for a subset of emerging countries, changes in exchange rate regime, realisation of a financial crisis and changes in prudential regulation were concomitant.

We also took into account the impact of previous variables according to the type of exchange rate regime through cross variables based on the idea that their impact on bank liquidity may also show indirectly through the country's exchange rate arrangement.

3. The data

3.1. Individual bank data

Individual bank data (liquidity ratios, total assets, equity ratio) come from Bankscope. We used data available on a sample of 1308 commercial banks in 36 emerging economies⁵ for years 1995 to 2004.

We use four different measures of bank asset liquidity:

$$\text{Ratio 1} = \text{LiquidAssets}/\text{TotalAssets}$$

(computed from Bankscope data, 57.8% initially available). ‘Liquid assets’ are the sum of ‘Cash and Due from Banks’, ‘Deposits with Banks’, ‘Due from Central Banks’, ‘Due from Other Banks’, ‘Due from Other Credit Institutions’, ‘Treasury Bills’, ‘Other Bills’, ‘Government Securities’, ‘Trading Securities’, ‘CDs’.

$$\text{Ratio 2} = \text{NetLoans}/\text{TotalAssets}$$

(provided by Bankscope, 53.6% initially available). This ratio indicates what percentage of the assets of the bank is tied up in loans. The higher this ratio the less liquid the bank will be.

$$\text{Ratio 3} = \text{Liquid Assets}/\text{Customer \& Short Term Funding}$$

(provided by Bankscope, 38.8% initially available). This is a deposit run off ratio and shows what percentage of customer and short term funds could be met if they were withdrawn suddenly. The higher this percentage, the more liquid the bank and the less vulnerable to a classic run.

$$\text{Ratio 4} = \text{Liquid Assets}/\text{Total Deposits \& Borrowing}$$

(provided by Bankscope, 29.3% initially available). This ratio is similar to the previous one, but indicates the amount of liquid assets available to the borrower as well as depositors.

The first and second ratios assess some kind of ‘absolute’ asset liquidity, since they consider liquid (or illiquid) assets relative to total assets. The third and fourth ratios measure some kind of ‘relative’ asset liquidity, since they relate liquid assets to liquid liabilities.

The bank’s *Relative size* as a measure of the weighted size of the bank is computed as the fraction of individual bank’s total assets (provided by Bankscope, 54.7% initially available) in the total assets of the banking sector.⁶

3.2. Market and macroeconomic data

Most market and macroeconomic data were retrieved from various publications of the International Monetary Fund.

- *Lending interest rate*: line 60p
- *Deposit to M2 ratio*: Total deposits of residents held in resident banks (lines 24 + line 25)/(money(line 34) and quasi money (line 35))
- *Public expenditures/GDP*: line 91f/ line 99b
- *Rate of inflation*: computed from the Consumer Price Index given in line 64

- *Rate of growth*: computed from real GDP given in line 99bvp⁷
- *Enforcement of Basel Core Principles (dummy)* This dummy variable, used in order to catch the regulatory framework, indicates whether the country makes use of a more strict application of the bank minimum capital requirements as recommended by the 1988 Capital Accord proposed by the Basel Committee on Banking Supervision.⁸

In the case of emerging countries, the CAR enforcement year is the only measure of an effective regulatory framework.⁹ It is worth pointing out that for the emerging markets, the year of adoption of the New Basel Capital Requirements does not coincide with the implementation year. As Chiuri et al. (2001) point out, the non G10 countries adopted the Basel 1988 Capital Accord on a voluntary basis and therefore without any predefined time schedule. Moreover, several non-G10 countries have relatively weak regulatory and supervisory structures and therefore the simple introduction of new capital requirements cannot be considered equivalent to their enforcement.

For these reasons, there is an element of judgement in the definition of the exact date when the emerging countries of our sample effectively adopted the minimum capital requirements as well as the proper date where capital requirements were enforced.¹⁰ We employ the assessment made by Chiuri et al. (2001) for nine countries of our sample (Argentina, Brazil, Chile, Hungary, India, South Korea, Malaysia, Poland and Thailand). As for the other 27 countries of our sample, we extended their analysis with a view of being consistent. We identified the years of capital adequacy requirements enforcement by surveying the IMF Reports on the Observance of Standards and Codes (ROSCs) and the World Bank Comparative Database on Microfinance Regulation. We focused on banking supervision as one of the 11 areas¹¹ studied by the Fund and the World Bank. Appendix A presents the years of adoption of prudential regulation, while detailed country data are listed in Appendix B.

- *Realisation of a pure banking/pure currency/twin crisis (dummy)*

We identified the countries and the years where a financial and/or a currency crisis took place through an extensive survey of the IMF *World Economic Outlook* for the specified time span. Detailed results are given in Appendix A. Furthermore, useful information was provided by the IMF Country Reports for the 36 countries of our sample. The dummy variables for the three varieties of crises are also introduced with a one and two-year lag, to capture the expected opposite effects of both the onset and the aftermath of the crisis on bank liquidity. The occurrence of a sovereign crisis that often accompanied that of a currency crisis was taken into account into the currency crisis category.

3.3. Exchange rate regimes

We used the IMF International Financial Statistics Yearbook (2001) definitions for official exchange rate regimes and Bubula and Otker-Robe (2002) for *de facto* regimes. The basic official IMF Exchange Rate Arrangements (i.e. the declared commitments of the Central Banks) are identified by a number from independent floating to dollarisation. Bubula and Otker-Robe (2002) split *de facto* regimes into 13 categories. However, for comparison purposes, we reorganised the latter to use the same taxonomy as for official regimes. Their definition is given in Appendix D. We then group some classes together, and keep five different types of regime (see Table 1).

Appendix E presents the *de facto*/official regime for each country in the sample, according to these five types used in the regressions. The group ‘soft pegs’ consists

Table 1. Exchange rate regime classification*.

Official classification	De facto classification by Bubula and Otker-Robe, 2002	De facto classification in line with the official one	Exchange rate category used in regressions
8 = independently floating	13 = independent floating	8 = independent floating	Independently floating
7 = managed floating with no pre-announced path for exchange rate	12 = other managed float with no pre-announced exchange rate path excluding tightly managed floats	7 = managed floating with no pre-announced path for exchange rate	Managed floating
6 = exchange rates within crawling bands	10 = backward looking crawling bands	6 = exchange rates within crawling bands	Soft pegs
5 = crawling pegs	9 = forward looking crawling bands 8 = backward looking crawling pegs 7 = forward looking crawling pegs	5 = crawling pegs	
4 = pegged exchange rates within horizontal bands	6 = horizontal bands	4 = pegged exchange rates within horizontal bands	Conventional fix
3 = Other conventional fixed peg arrangements against a single currency, against a composite and de facto peg arrangements under managed floating)	11 = tightly managed floats 5 = against a composite 4 = against a single currency	3 = Conventional fixed peg arrangements	
2 = currency boards arrangements	3 = currency boards arrangements exchange	2 = currency boards arrangements	Hard pegs
1 = exchange arrangements with no separate legal tender	arrangements with no separate legal tender 2 = currency union 1 = formal dollarisation.	1 = exchange arrangements with no separate legal tender	

*Note: detailed explanations are given in Appendix D.

of economies with exchange rates within crawling bands, crawling pegs and pegged exchange rates within horizontal bands. The group ‘conventional fix’ consists of economies with other conventional fixed peg arrangements (against a single currency, against composite as well as de facto peg arrangements under managed floating). The extreme solutions consist of either hard pegs (that is currency boards arrangements and formal dollarisation) or independently floating. Therefore, we treat managed float with no specified central rate as an intermediate exchange rate regime rather than an extreme one.

Appendix F shows the evolution of the number of countries in the different exchange rate arrangements. Careful study of sample data on the realisation of a financial crisis, the introduction of prudential regulation and changes in exchange rate regimes shows that there might be a different impact of the explanatory variables according to the country’s exchange rate regime. We therefore build dummies that catch the potential cross effects.

4. The results

We estimate the following type of relationship:

$$R(i, t) = \sum_{k=1}^{22} \alpha_k x_k(i, t) + \sum_{k=1}^{22} \sum_{s=1}^4 \alpha_{ks} x_k(i, t) \delta_s(i, t) + \sum_{s=1}^4 \beta_s \delta_s(i, t) + u(i, t)$$

where:

$R(i, t)$ denotes the liquidity ratio;

$x_k(i, t)$ represent the following explanatory variables: relative size, equity to assets ratio, enforcement of Basel Core Principles (dummy), lag1 of prudential regulation (dummy), lending rate, financial deepening, public expenditure/GDP, rate of inflation, rate of growth, realisation of twin/pure banking/pure currency crises with one and two-year lags (dummies), country's region (dummy);

δ_k are the dummy variables for the exchange rate regime (with 'managed floating' used as reference for official regimes, 'soft peg' or 'conventional fix' for *de facto* regimes);¹²

$u(i, t)$ is the error term;

i denotes an individual bank;

t is the time index.

We use the SAS TSCSREG procedure, which is appropriate for regressions on unbalanced panel data, after deleting all banks in the sample reporting a null equity ratio, a null total assets, and/or less than two years for all the variables. We estimate the relationships as two-way random effect models, applying the 'RanTwo' option of the SAS TSCSREG procedure, i.e. we assume that the error term depends on both the cross section and the time series to which the observation belongs:

$$u(i, t) = v(i) + e(t) + \varepsilon(i, t)$$

where $v(i)$ is the cross-section component of the error term, $e(t)$ its time component, and $\varepsilon(i, t)$ is a classical error term with zero mean and a homoscedastic covariance matrix.

As there are no major differences in results if we use *de facto* or official classifications of exchange rate regimes, we report regression results using *de facto* taxonomy, for each liquidity ratio, in Tables 2 to 5. The coefficients presented in the first column capture the direct impact on bank liquidity of the variable itself and of the reference exchange rate regime. The coefficients reported in the other four columns capture the variation in bank liquidity, compared with the reference level, induced by an exchange rate regime other than the reference one. In this case, the total impact of each variable on bank liquidity is the sum of the two coefficients.

The size effect as captured by the negative coefficient (under the reference regime) of *relative size* is statistically significant, in particular for the absolute measures of bank liquidity. As far as the exchange rate regime is concerned, intermediary regimes seem to reinforce the 'too big to fail' effects, as shown by significant and highest negative coefficients for these regimes. On the contrary, under hard pegs, banks' size and liquidity are positively correlated, which suggests a more prudent liquidity management in the case of large size banks.

Table 2. Bank liquidity, measured as *Liquid Assets/Total Assets*, and *de facto* exchange rate regimes[†].

Variables	Soft pegs (Reference)	Indep. floating	Managed floating	Conv. fix	Hard pegs
Relative size	-0,463*** (0,144)	0,374* (0,205)	0,454** (0,178)	0,431** (0,180)	0,485** (0,205)
Equity to assets ratio	0,061*** (0,023)	0,070** (0,030)	0,006 (0,037)	0,022 (0,038)	-0,067*** (0,025)
Prudential regulation	6,029*** (1,530)	-3,404 (2,455)	5,525** (2,432)	1,634 (2,207)	-17,633*** (6,189)
Lag1 prudential regulation	-3,671** (1,444)	9,094*** (2,353)	0,214 (2,342)	5,572*** (1,894)	2,280 (3,599)
Real lending rate	0,118*** (0,032)	0,074 (0,057)	-0,316*** (0,113)	-0,364*** (0,114)	-1,337* (0,740)
Deposits to M2 ratio	0,136 (0,093)	-0,651*** (0,121)	-0,331*** (0,120)	-0,130 (0,098)	-0,548* (0,289)
Public expenditure/GDP	0,319*** (0,075)	-0,103 (0,197)	-0,585*** (0,146)	-0,353*** (0,133)	-1,432** (0,718)
Rate of inflation	0,042*** (0,015)	0,133** (0,054)	-0,034 (0,041)	-0,098*** (0,022)	-0,841** (0,400)
Rate of growth	0,111 (0,129)	0,171 (0,144)	-0,218 (0,215)	-0,818*** (0,195)	-0,220 (0,287)
Twin crisis	2,534 (2,562)	-12,137*** (3,812)	-2,202 (3,447)	-2,427 (4,112)	11,730 (11,982)
Lag1 twin crisis	4,157 (3,443)	4,159 (4,451)	-10,756** (4,397)	-3,047 (5,395)	738,350** (355,800)
Lag2 twin crisis	17,229*** (2,182)	-15,386*** (4,924)	-17,108*** (2,705)	5,932 (4,870)	-19,922*** (5,352)
Pure banking crisis	-0,437 (2,755)			-13,979*** (4,179)	-7,332 (8,778)
Lag1 banking crisis	2,695 (1,746)			-12,704*** (3,601)	-10,353*** (3,947)
Lag2 banking crisis	2,648* (1,401)			-10,679*** (3,265)	-7,529*** (2,411)
Pure currency crisis	0,642 (1,500)	0,804 (2,063)	2,014 (3,120)	-20,831*** (5,768)	3,172* (1,754)
Lag1 currency crisis	-1,976 (2,173)	-2,274 (2,173)	-30,343*** (3,754)	(4,665)	
Lag2 currency crisis	2,037 (2,007)	-1,457 (2,338)	9,647*** (3,189)	-4,499 (3,496)	
Transition	13,953*** (2,787)	-0,724 (4,093)	6,827** (2,849)	-11,206*** (4,017)	2,939 (15,898)
Other European, African, Middle East	10,519*** (2,182)	7,101 (4,646)		-12,619*** (3,055)	
Asian	-5,152** (2,564)	11,062*** (2,783)	14,109*** (2,680)		
Latin American			5,167* (2,936)	1,504 (4,140)	
De facto exchange rate regime		52,202*** (11,032)	41,874*** (11,491)	37,967*** (8,589)	111,381*** (31,504)
Intercept	4,493 (7,843)				

Number of cross sections: 10; Series Length: 1269; R-Square: 0.105

Hausman test for random effects m value. (Pr > m): 170.810. (<.0001)

[†]Note: *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level. Standard errors are given in brackets.

Table 3. Bank liquidity, measured as *Net Loans/Total Assets*, and *de facto* exchange rate regimes[†].

Variables	<i>Soft pegs</i> (<i>Reference</i>)	Indep. floating	Managed floating	Conv. fix	Hard pegs
Relative size	0,450*** (0,139)	-0,401** (0,192)	-0,422** (0,171)	-0,294* (0,171)	-0,590*** (0,194)
Equity to assets ratio	-0,209*** (0,023)	0,037 (0,029)	0,157*** (0,036)	0,046 (0,038)	0,267*** (0,023)
Prudential regulation	-9,260*** (1,404)	7,900*** (2,249)	1,915 (2,228)	2,170 (2,042)	13,378** (5,746)
Lag1 prudential regulation	4,895*** (1,326)	-7,498*** (2,154)	-1,427 (2,141)	-6,444*** (1,734)	5,013 (3,321)
Real lending rate	-0,053* (0,029)	-0,160*** (0,052)	0,324*** (0,104)	0,315*** (0,104)	0,427 (0,692)
Deposits to M2 ratio	0,111 (0,085)	0,529*** (0,112)	0,220** (0,110)	0,045 (0,090)	-0,094 (0,264)
Public expenditures/GDP	-0,445*** (0,069)	0,279 (0,177)	0,667*** (0,135)	0,566*** (0,122)	1,619** (0,648)
Rate of inflation	-0,040*** (0,014)	-0,201*** (0,049)	0,028 (0,038)	0,086*** (0,021)	0,344 (0,372)
Rate of growth	0,506*** (0,120)	-0,574*** (0,133)	0,001 (0,199)	0,271 (0,180)	-0,042 (0,266)
Twin crisis	-4,774** (2,299)	19,616*** (3,460)	2,551 (3,150)	3,628 (3,783)	6,116 (11,206)
Lag1 twin crisis	-7,282** (3,135)	4,996 (4,054)	10,223** (4,030)	1,137 (4,929)	-287,061 (330,400)
Lag2 twin crisis	-15,652*** (1,988)	11,272** (4,466)	11,258*** (2,473)	-0,181 (4,542)	11,132** (4,970)
Pure banking crisis	-2,697 (2,526)			7,957** (3,816)	9,689 (7,960)
Lag1 banking crisis	-0,922 (1,615)			1,191 (3,290)	17,101*** (3,632)
Lag2 banking crisis	-4,828*** (1,284)			-0,778 (2,971)	11,162*** (2,204)
Pure currency crisis	-1,941 (1,389)	2,761 (1,913)	-4,072 (2,944)	22,891*** (5,395)	
Lag1 currency crisis	-2,880* (1,602)	3,420* (2,003)	1,775 (3,444)	14,123*** (4,309)	
Lag2 currency crisis	-1,832 (1,847)	-0,204 (2,166)	-9,458*** (2,956)	-0,469 (3,302)	
Transition	-1,016 (2,552)	-6,954* (3,716)	-7,739*** (2,605)	-3,305 (3,686)	-15,604 (14,375)
Other European, African, Middle East	-2,649 (1,998)	-7,145* (4,323)		3,763 (2,794)	
Asian	7,376*** (2,335)	-13,216*** (2,547)	-7,177*** (2,445)		
Latin American			-6,981** (2,691)	-8,772** (3,849)	
De facto exchange rate regime		-46,678*** (10,129)	-38,287*** (10,572)	-28,192*** (7,862)	-49,172*** (29,170)
Intercept	55,583*** (7,172)				

Number of cross sections: 10; Series Length: 1239; R-Square: 0.170

Hausman test for random effects m value. (Pr > m): 226.090 (<.0001)

[†]Note: *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level. Standard errors are given in brackets.

Table 4. Bank liquidity, measured as *Liquid Assets/Cust& ST Funding*, and *de facto* exchange rate regimes[†].

Variables	<i>Soft pegs</i> (<i>Reference</i>)	Indep. floating	Managed floating	Conv. fix	Hard pegs
Relative size	0,101 (0,210)	-0,417 (0,283)	-0,330 (0,254)	-0,848*** (0,269)	0,644 (0,407)
Equity to assets ratio	0,784** (0,064)	-0,177** (0,080)	-0,073 (0,093)	-0,386*** (0,082)	-0,168* (0,099)
Prudential regulation	9,321*** (2,460)	-6,573* (3,944)	-1,684 (3,936)	-5,572 (4,018)	-27,112** (11,208)
Lag1 prudential regulation	-3,509* (1,888)	10,606*** (3,642)	3,056 (3,796)	4,314 (3,363)	1,362 (6,111)
Real lending rate	0,121 (0,204)	-0,436* (0,253)	-0,410 (0,287)	-0,249 (0,229)	-2,757** (1,291)
Deposits to M2 ratio	0,157 (0,115)	-0,884*** (0,171)	-0,353* (0,186)	0,004 (0,163)	-1,500* (0,789)
Public expenditures/GDP	0,303 (0,207)	0,198 (0,423)	0,452 (0,353)	-0,063 (0,233)	-0,169 (1,233)
Rate of inflation	-0,003 (0,030)	0,170* (0,096)	0,511** (0,259)	0,026 (0,040)	-1,682** (0,692)
Rate of growth	-0,300 (0,266)	0,681** (0,287)	0,424 (0,463)	-0,100 (0,355)	-0,318 (0,863)
Twin crisis	-12,208* (6,958)	23,616*** (8,146)	4,125 (8,255)	15,821* (8,239)	
Lag1 twin crisis	12,304 (22,827)	-6,194 (23,285)	-20,753 (23,294)		1540,860** (616,900)
Lag2 twin crisis	-3,826 (14,788)	5,347 (16,528)	2,371 (15,157)	16,179 (15,396)	12,417 (17,022)
Pure banking crisis	-10,122** (4,707)			8,948 (6,691)	23,728 (17,082)
Lag1 banking crisis	-13,686*** (4,703)			20,227*** (6,272)	47,608*** (15,324)
Lag2 banking crisis	-13,875*** (4,323)			11,417* (6,923)	21,706* (13,006)
Pure currency crisis	-32,461 (24,212)	37,453 (24,592)	45,173* (24,723)	35,461 (24,397)	
Lag1 currency crisis	-1,358 (13,495)	3,126 (14,017)	-21,268 (21,474)	-1,750 (13,824)	
Lag2 currency crisis	-1,631 (7,222)	-1,928 (8,019)	22,668*** (8,189)	-1,525 (8,054)	
Transition	-15,925*** (4,778)	15,757 (14,408)	8,933** (4,492)		
Other European, African, Middle East	5,100 (3,656)	44,635*** (14,297)		15,545*** (4,422)	
Asian		18,203 (13,035)	8,501** (4,124)	4,239 (6,653)	
Latin American	12,752 (12,591)		-8,736 (13,760)	-9,340 (12,621)	17,037 (29,047)
De facto exchange rate regime		52,052** (20,627)	13,557 (19,359)	2,790 (14,299)	163,281* (83,652)
Intercept	7,396 (9,758)				

Number of cross sections: 10; Series Length: 927; R-Square: 0.168

Hausman test for random effects m value. (Pr > m): 194.120 (<.0001)

[†]Note: *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level. Standard errors are given in brackets.

Table 5. Bank liquidity, measured as *Liquid Assets/Dep & Borrowing*, and *de facto* exchange rate regimes[†].

Variables	<i>Soft pegs</i> (<i>Reference</i>)	Indep. floating	Managed floating	Conv. fix	Hard pegs
Relative size	0,281 (0,222)	-0,432 (0,329)	-0,414 (0,270)	-1,048*** (0,281)	1,057*** (0,398)
Equity to assets ratio	0,919*** (0,074)	-0,398*** (0,089)	-0,449*** (0,101)	-0,639*** (0,092)	0,205 (0,133)
Prudential regulation	7,905*** (2,686)	-4,664 (4,133)	-3,246 (4,177)	-3,383 (4,686)	-33,802*** (10,598)
Lag1 prudential regulation	-2,693 (1,986)	4,072 (3,700)	3,961 (3,863)	-1,885 (3,840)	2,400 (5,622)
Real lending rate	0,201 (0,211)	-0,367 (0,271)	-0,658** (0,294)	-0,271 (0,235)	-3,750*** (1,175)
Deposits to M2 ratio	0,365*** (0,133)	-1,176*** (0,201)	-0,319 (0,206)	-0,143 (0,169)	-1,949** (0,763)
Public expenditures/GDP	0,049 (0,243)	0,884* (0,477)	0,879** (0,372)	0,104 (0,270)	0,495 (1,269)
Rate of inflation	0,026 (0,033)	0,153 (0,110)	0,494* (0,255)	-0,012 (0,043)	-2,180*** (0,632)
Rate of growth	-0,400 (0,335)	0,839** (0,354)	0,849 (0,559)	0,177 (0,413)	-0,011 (1,007)
Twin crisis	3,243 (4,797)		-8,402 (6,630)	33,277*** (12,356)	
Lag1 twin crisis	-22,731** (9,391)	25,356** (10,565)	17,662 (11,175)		1990,223*** (563,900)
Lag2 twin crisis	-8,090 (16,153)	11,077 (17,753)	9,778 (16,491)	25,431 (16,750)	8,693 (17,905)
Pure banking crisis	-8,295 (5,794)			9,170 (7,401)	
Lag1 banking crisis	-10,013 (6,093)			18,200** (7,403)	
Lag2 banking crisis	-9,402* (5,633)			10,244 (6,667)	
Pure currency crisis	-1,446 (2,905)	3,106 (5,191)	12,643* (7,305)		
Lag1 currency crisis	5,557 (14,469)	-6,253 (15,230)	-39,626* (22,227)	-12,598 (14,794)	
Lag2 currency crisis	-0,188 (7,638)	-10,487 (8,652)	21,548** (8,688)	-4,473 (8,362)	
Transition	-14,793*** (5,480)	-9,470 (14,907)	6,532 (4,505)		
Other European, African, Middle East	5,325 (3,923)	0,859 (15,923)		11,044** (4,649)	
Asian		-0,576 (13,578)	8,788** (4,220)	-5,028 (7,494)	
Latin American	-5,796 (13,062)		18,014 (14,563)	4,457 (12,877)	45,225 (29,348)
De facto exchange rate regime	86,855***	3,211 (23,409)	16,971 (21,205)	177,847** (14,803)	(83,099)
Intercept	-4,628 (10,899)				

Number of cross sections: 10; Series Length: 735; R-Square: 0.201
Hausman test for random effects m value. Pr > m): 176.040 (<.0001)

[†]Note: *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level. Standard errors are given in brackets.

The coefficient on the *equity to asset ratio* is significant and positive in regressions for all liquidity ratios under all regimes, from independent float to conventional fix pegs. These results support the view that a higher ratio of equity to assets (as a result, for instance, of regulatory tightening) is concomitant with higher asset liquidity. As far as extremely fixed exchange rate regimes are concerned, the coefficient is significant negative for absolute liquidity measures (ratio 1 and 2) and positive for relative measures (ratio 3) suggesting that the credit variation overpasses the reserves variation following a rise in the equity to assets ratio.

The dummy for the *presence of prudential regulation* enters with a positive sign under the reference regime for all ratios, suggesting that the enforcement of the Basle Core Principles increases confidence in the banking sector and leads to an improvement of bank liquidity. The coefficients for cross-variables show that, although present under all regimes from independent float to conventional fix, the impact is more marked under intermediate ones. On the contrary, the impact of prudential regulation on bank liquidity is negative whenever the country adopted a hard peg regime, which may suggest that banks under hard peg regimes were over-liquid prior to the introduction of the Basle Core Principles.

The *lending rate* parameter estimate is significant and positive under the reference regime (soft peg) and most marked under independent float, for the two measures of absolute liquidity. This is consistent with the 'credit rationing' phenomenon: higher lending rates do not encourage banks to lend more. However, the impact is significant and negative under managed floating,¹³ conventional fix¹⁴ and hard pegs¹⁵ indicating that, under these regimes, higher interest rates lead to lower bank liquidity.

The *deposit to M2 ratio* as a measure of the country financial deepening enters with a positive sign for all reference regimes, but, significantly, only for ratio 4, under the conventional fixed regime. The impact is significantly negative under independent floating, managed (with the exception of ratio 4) and hard pegs (with the exception of ratio 2), which indicates that, under these regimes, a deeper financial system led to increased bank lending to the detriment of bank liquidity. The most marked impact is noticed under independent floating regimes (for absolute liquidity measures) and hard pegs (for relative liquidity measures).

The *Public expenditures to GDP ratio* is significant and enters with expected positive sign in all the regressions under independent and managed floating (significant only for ratio 4) and most marked under soft pegs (significant for ratio 1 and 2). We interpret this result as evidence of a liquid asset supply effect. Conversely, the impact on bank liquidity is negative under conventional fixed pegs (significant for ratio 1 and 2) and hard pegs (significant for all ratios except for ratio 4) suggesting that more often than not, the adoption of a conventional or extremely fixed exchange rate regime was accompanied by fiscal discipline. In this context, banks anticipate that the government may not be disposed in the future to deal with a liquidity crisis and respond accordingly by holding more liquidity.

The *rate of inflation* has a positive expected impact on bank liquidity under independent float (significant for all ratios except for ratio 4), managed floating (significant for relative liquidity measures) and soft pegs (significant for absolute liquidity measures) regimes. Moreover, the more flexible the exchange rate, the higher the coefficient: this indicates that banks limit their credit activity and build up reserves in response to heightened uncertainty as to government behaviour. A negative coefficient under conventional fixed pegs (significant for absolute liquidity measures) and hard pegs (significant for all ratios except for ratio 2) indicate that the monetary tightening that

often accompanied the adoption of fixed pegs, led to an increase in bank liquidity on precautionary grounds.

The *rate of growth* enters with the expected negative sign under soft pegs (significant only for ratio 2) and conventional fixed pegs (significant only for ratio 1) but is not different from zero under hard pegs and managed floating. However, moving toward more flexibility, the rate of growth seems to have the opposite impact on bank liquidity as illustrated by the positive coefficient under the independent floating regime (significant for all ratios except for ratio 1).

The occurrence of a financial crisis has a different impact on bank liquidity according to the exchange rate regime. The *realisation of a twin crisis* has an immediate negative impact on bank liquidity under conventional fixed regimes (significant only for ratio 3) and a positive impact under soft peg regimes (significant for all ratios with the exception of ratio 2). It is worth noting that under conventional fixed regimes the negative impact is more persistent than under the other exchange rate regimes, as shown by the negative coefficients for the current and the previous year of occurrence of a twin crisis. As for the lagged impact of a twin crisis, it has the expected positive impact on bank liquidity under independent floating,¹⁶ soft pegs¹⁷ and hard pegs¹⁸ indicating that the aftermath of the crisis is characterised by a surge in liquidity.

The *occurrence of a pure banking crisis* has a significant negative and lasting impact on bank liquidity under the conventional fixed regimes.¹⁹ The aftermath of a pure banking crisis is associated with increased bank liquidity under soft peg regimes (significant for relative measures of bank liquidity) indicating that the banking crisis induced a decrease in the demand for loans and greater bank liquidity.

The occurrence of a *pure currency crisis* has a negative significant and persistent impact on bank liquidity under conventional fixed regimes (significant for absolute liquidity measures) but positive under managed floating (significant for relative liquidity measures) and hard peg (significant only for ratio 1). The aftermath of a currency crisis is associated with greater bank liquidity under soft peg regimes.²⁰

The nature of the exchange rate regime has an interesting effect on bank liquidity. In extreme regimes at both ends of the line, 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. We call this phenomenon a 'bank liquidity smile across exchange rate regimes', as suggested by Figure 1, hereafter for de facto regimes. The results for the official classification are given in Appendix H.

Under 'hard pegs', observed high bank liquidity complies with the theoretical model put forward by Chang and Velasco (2000):²¹ 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'. Nevertheless, they point out that deposit dollarisation, i.e. the fact that bank accounts may be denominated in foreign currency, impedes dramatically the potential role of the central bank as a lender of last resort: 'the central bank can print pesos, but not dollars needed to honour the dollar claims of impatient depositors. . . flexible exchange rates cannot help prevent bank runs' (Chang and Velasco 2000, 27). We could not check this potential explanation since Bankscope does not provide data on deposit dollarisation. Instead, we could check the relationship between the exchange rate regime and the degree of liability dollarisation of the banking sector at a macroeconomic level, using the country panel. We use two common dollarisation ratios provided by the IFS (see also the Levy-Yeyati

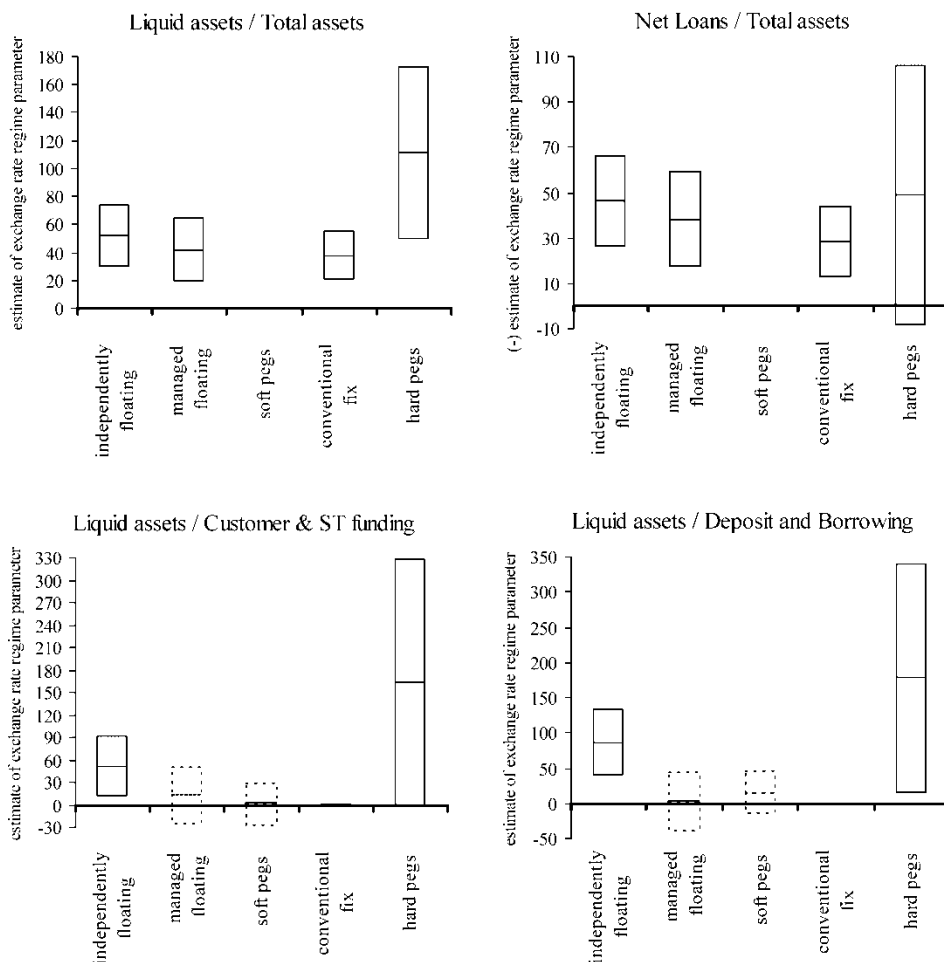


Figure 1. The bank liquidity smile across de facto exchange rate arrangements. Note: Exchange rate arrangements are de facto; ‘soft pegs’ is the reference class for Ratio 1 and 2 whereas ‘conventional fix’ is the reference class for Ratio 3 and 4. Boxes represent confidence intervals around the estimated parameter of the exchange rate regime dummy variable, β_k , calculated as $\beta_k \pm 1.96 \times$ standard error). Dotted line boxes recall estimated parameters that are not significantly different from 0.

2006 database on deposit dollarisation) and took into account, among the explanatory variables, the macroeconomic variables previously used in the liquidity model as well as the quality of institutions, as documented by Kaufmann et al. (2005). The results are given in Appendix I. Hard peg as well independent floating regimes are well associated with greater liability dollarisation, which could then explain banks precautionary behaviour.

Another way to consider the ‘liquidity smile’ is to emphasise the relative lack of bank liquidity in intermediary regimes. This phenomenon has been underlined by studies on the Asian crisis (see for example Tirole 2002 and Feldstein 2003). Intermediary regimes in the mid-1990s created an illusion of stability and lowered the cost of borrowing in international markets by blurring currency and country risk: banks could borrow underpriced liquidity if need be, and kept a relatively low amount of liquid assets.

5. Conclusion

Using panel data on bank liquidity in emerging countries between 1995 and 2004, we find that, in hard pegs and in pure floats, commercial banks are more liquid than in intermediary regimes. We call it a ‘bank liquidity smile’.

We accounted for the fact that many emerging countries were hit by financial and/or currency crises during that period, as well as the changes of prudential regulation they operated.

We take the ‘bank liquidity smile’ as a stylised fact to be reinforced or dispelled by further empirical research. Empirical developments of our analysis should include banks in more advanced countries, in order to check whether the liquidity smile is specific to emerging markets or a more general phenomenon. It should also take into account liability dollarisation and the currency mismatch of individual banks’ balance sheets and also the magnitude and the currency composition of public debt.

Acknowledgements

The authors are grateful to Jean-Bernard Chatelain, Christophe Hurlin and participants at the GDR workshop ‘Currency Boards and Dollarisation’, Clermont-Ferrand, France, 7 March 2003; the 20th GDR ‘Banking and Monetary Economics’ Symposium, Birmingham, UK, 5–6 June 2003; the 82nd Applied Econometrics Association Conference ‘Econometrics of Emerging Markets’, 6–7 November 2003, Toledo, Spain; and at the LEO Seminar for useful comments and discussion. The authors also thank an anonymous referee of the *International Economic Journal* for helpful comments and suggestions. Any errors are the authors’ own.

Notes

1. See Feldstein (2003), among others, in addition to Chang and Velasco (2000).
2. From a theoretical point of view, the relationship between banking crises and exchange rate collapses (leading to a change in the exchange rate regime) goes both ways according to the literature on twin crises. However, from an empirical point of view, measuring liquidity at the bank level helps evacuate this endogeneity bias (since it is unlikely that the liquidity level of a single bank can affect the exchange rate regime). While it is well established that this endogeneity problem exists at a macroeconomic level (see Collins 1996; Edwards 1996; Rizzo 1998), however, the lack of any fixed effects in our microeconomic panel avoids instrumenting the exchange rate regime for countries’ GDP or openness (as in Domaç and Martinez-Peria 2003).
3. We used the general, worldwide, classification provided by Bankscope, which divides banks into 12 categories (assigned to each bank based on the annual report): Commercial Banks, Savings Banks, Cooperative Banks, Real Estate/Mortgage Banks, Medium & Long Term Credit Banks, Investment Banks/Securities Houses, Islamic Banks, Non Banking Credit Institutions, Specialised Governmental Credit Institutions, Bank Holdings & Holding Companies, Central Banks and Multi-lateral Governmental Banks.
4. The level of public expenditure is a key factor in explaining Government intervention in financial markets of emerging countries when dealing with individual bank data because of time lags between payments on expenditures and tax receipts. Moreover, data on the level of the outstanding public debt or Government’s deficit’ although they might reflect the Government’s desire to issue securities’ were not available for all emerging countries in our sample.
5. Countries in the sample were selected according to the IMF classification of emerging countries (see the IMF World Economic Outlook) and taking into account data availability in the Bankscope database. They are in Africa (Morocco, Tunisia, South Africa), in Asia (China, India, Indonesia, Malaysia, Philippines, South Korea, Thailand, Vietnam), in the Middle East (Egypt, Israel, Lebanon), in the Western Hemisphere (Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Venezuela), in the Commonwealth of Independent States (Belarus, Kazakhstan, Russia, Ukraine) and EU accession candidates (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Turkey).
6. For Bulgaria, Chile, China, Czech Republic, Estonia, Hungary, Latvia, Mexico, Ecuador, Lithuania, Slovak Republic, South Africa, Ukraine and Vietnam. For the rest of the countries in the sample, the ratio is computed as the Bank’s total assets/Total Assets of Deposit money banks, as provided by the IFS of the IMF.

7. Except for Lebanon: data provided by EIU and the national bank (Banque du Liban).
8. The links between the enforcement of CARs and bank credit is well established (see for example the Report of the Basle Committee on Banking Supervision, 1999, for the G10 countries, and the literature on the credit crunch during the Asian crises (Ferri and Kang 1991; Ito and Pereira da Silva 1999) and Chiuri et al. 2001 for emerging countries). According to these authors, the enforcement of capital adequacy requirements negatively affects the supply of bank loans irrespective of whether the enforcement takes place in the aftermath of a crisis or in normal times.
9. The other fields of regulation as liquidity and diversification requirements, internal management and organisational requirements, the change in the depositors or savings protection schemes, provisioning, ownership or reserve requirements were not available for all emerging countries of our sample.
10. The enforcement implies that the country took important steps towards a more rigorous banking supervision (e.g. improvements in the dissemination policies and bankruptcy regulations, implementation of bank restructuring programmes, adoption of more restrictive criteria in the definition of non-performing loans or provisioning practices, a more severe control of risks the banks take with depositors funds, etc).
11. The other areas are monetary and financial policy transparency; fiscal transparency; securities; insurance; payments systems; corporate governance; accounting; auditing and insolvency and creditor rights.
12. The references were chosen according to the size of the underlying samples. Since the sample used for each regression changes, due to missing and/or deleted data, the reference are different across the four liquidity measures. See Appendix G.
13. Not significantly different from zero for ratio 3
14. Only for absolute measures of bank liquidity
15. Not significantly different from zero for ratio 2
16. Significant for ratio 4 (lag1) and ratio 1 and 2 (lag2)
17. Significant for ratio 2 (lag1) and ratio 1 and 2 (lag2)
18. The lag1 coefficient is significant for all ratios with the exception of ratio 2.
19. The coefficient for the current year is significant for all ratios except for ratio 4 whereas the lag1 coefficient is significant for ratio 1 and 3.
20. Significant for relative liquidity measures
21. For example their corollary 3.4, page 12, states that 'equilibrium bank runs may occur in a currency board regime'.

References

- Basle Committee on Banking Supervision. 1999. *Capital requirements and bank behaviour: The impact of the Basle accord*, April.
- Bubula, Andrea, and Inci Otker-Robe. 2002. The evolution of exchange rate regimes since 1990: Evidence from de facto policies. *International Monetary Fund Working Paper* no. 02/155.
- Chang, Roberto, and Andres Velasco. 2000. Financial fragility and the exchange rate regime. *Journal of Economic Theory* 92: 1–34.
- Chiuri, M. Concetta, Giovanni Ferri, and Giovanni Majnoni. 2001. The macroeconomic impact of bank capital requirements in emerging economies: Past evidence to assess the future. *Journal of Banking and Finance* 26, no. 5: 881–904.
- Collins, Susan. 1996. On becoming more flexible: Exchange rate regimes in Latin America and the Caribbean. *Journal of Development Economics* 51, no.1: 117–38.
- Dewatripont, Matthias, and Jean Tirole. 1993. *La réglementation prudentielle des banques*, Editions Payot, Lausanne. *The prudential regulation of banks*. MIT Press, 1994.
- Diamond, Douglas W., and Philip H. Dybvig. 1983. Bank runs, deposit insurance, and liquidity. *Journal of Political Economy* 91: 401–19.
- Domaç, Ilker, and Maria S. Martinez-Peria. 2003. Banking crises and the exchange rate regime: Is there a link? *Journal of International Economics* 61: 41–72.
- Edwards, Sebastian. 1996. The determinants of the choice between fixed and flexible exchange-rate regimes. NBER Working Paper no. 5756, September.
- Feldstein, Martin, ed. 2003. *Economic and financial crises in emerging market economies*. The University of Chicago Press.
- Ferri, Giovanni, and Tae Soo Kang. 1999. The credit channel at work: Lessons from the Republic of Korea's financial crisis. *The World Bank Policy Research Working Papers* no. 2190.
- Ito, Takatoshi and Luiz A. Pereira da Silva. 1999. New evidence of credit crunch in Thailand and Indonesia and its policy implications. Paper presented to the workshop on The Credit Crunch in East Asia: What Do We Know? What Do We Need to Know?, 30 November–1 December. Washington DC: World Bank.

- Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi. 2005. Governance matters IV: Governance indicators for 1996–2004. *World Bank Policy Research Working Paper* no. 3630; Governance Database available at <http://www.worldbank.org/wbi/governance/data.html>
- Kim, Daesik, and Anthony M. Santomero. 1998. Risk in banking and capital regulation. *Journal of Finance* 43, no. 5: 1219–33.
- Levy-Yeyati, Eduardo. 2006. Financial dollarization: Evaluating the consequences. *Economic Policy*, January, pp. 61–118, database available at <http://200.32.4.58/~ely/papers/html>
- Rizzo, Jean-Marc. 1998. The economic determinants of the choice of an exchange rate regime: A probit analysis. *Economic Letters* 59: 283–87.
- Stiglitz, Joseph E., and Andrew Weiss. 1981. Credit rationing with imperfect information. *American Economic Review* 71: 393–410.
- Thakor, Anjan V. 1996. The design of financial systems: An overview. *Journal of Banking and Finance* 20, no. 5: 917–48.
- Tirole, Jean. 2002. *Financial crises, liquidity, and the international monetary system*. Princeton, NJ: Princeton University Press.

Appendix A. Prudential regulation and financial crises

This table presents the year of adoption of Basel Capital Requirements and the years of occurrence of a banking, currency and twin crises.

Country	Prudential regulation adopted	Pure banking crisis	Pure currency crisis, BOP	Twin crises	
				Banking crisis	Currency Crisis, BOP
Argentina	1994	1994	–	2001	2002*
Belarus	2001	–	–	–	–
Brazil	1997	1994	1998, 2002*	–	–
Bulgaria	2000	–	–	1996	1997
Chile	1997	–	–	–	–
China	–	–	–	–	–
Colombia	2001	–	1995, 1997, 1998, 1999	–	–
Czech Republic	1998	–	–	1997	1997
Ecuador	2001	1995	–	1998	1999
Egypt	2003	–	–	–	–
Estonia	1999	1994, 1997, 1999	–	–	–
Hungary	1995	–	1994	–	–
India	1996	–	–	–	–
Indonesia	2005	–	1998	1997	1997
Israel	2000	–	–	–	–
Kazakhstan	2001	–	–	–	–
Korea	1998	–	–	1997	1997
Latvia	1995	1995, 1999	–	–	–
Lebanon	1998	–	–	–	–
Lithuania	2002	1995	–	–	–
Malaysia	1998	–	1993, 1998	1997	1997
Mexico	1994	–	–	1992	1994
Morocco	1997	–	–	–	–
Peru	2002	1993	–	–	–
Philippines	2001	–	–	1997	1997
Poland	1993	–	–	–	–
Romania	1998	1999	–	–	–
Russia	–	1995	1998*	–	–
Slovak Republic	2002	–	–	–	–
South Africa	2000	–	1996	–	–
Thailand	1998	–	–	1996	1997
Tunisia	2000	–	–	–	–
Turkey	1999	–	–	1994, 2000	1994, 2001
Ukraine	2004	–	–	1997	1998
Venezuela	1996	–	1995, 2002	1993	1994
Vietnam	1998	–	–	–	–

*Closely followed by a sovereign crisis.

Appendix B. Sources of regulatory environment indicators

Belarus 2001	ROSC Republic of Belarus: Financial System Stability Assessment, Country Report No. 05/216, June 28, 2005
Bulgaria 2000	ROSC Bulgaria- V. Banking Supervision, updated in March 2001; IMF Country Report No. 02/188-August 2002; Law on Banks- Regulation No. 8 of the Bulgarian National Bank
Colombia	Financial Reform Law 795 of 2003, Art. 16 and Decree 1720 of 2001, Art. 2.
Czech Republic 1998	ROSC Czech Republic VI. Banking Supervision Compliance with Basel Core Principles for Banking Supervision, reissued in July 2000; Country Report No. 01/113, July 25, 2001; Czech Republic ROSC, IMF Country Report No. 02/169-August 2002; Czech Republic: ROSC-Banking Supervision, IMF Country Report No. 04/4-January 2004.
Ecuador	General Law of the Financial System's Institutions, 2000, Art. 47.
Egypt 2003	Central Bank of Egypt Annual Report 2002/2003; Law No. 88 of the Year 2003 Promulgating The Law of The Central Bank, The Banking Sector and Money, amended by Law No. 162 of the Year 2004 and Law No. 93 of the Year 2005.
Estonia 1999	ROSC Estonia-Banking Supervision Compliance with the Basel Core Principles for Effective Banking Supervision, June 2000; Credit Institutions Act. CI Act, 1999; EU Capital Adequacy Directive through Decree No. 19 of the President of the BoE in June 1999
Indonesia 2005	Bank Indonesia Regulation No. 8/7/PBI/2006 concerning the amendment to the Bank of Indonesia Regulation No. 7/13/PBI/2005 on the Capital Adequacy Ratio for Commercial Banks.
Kazakhstan 2001	Republic of Kazakhstan: Financial System Stability Assessment, IMF Country Report No. 04/268, August 2004; Republic of Kazakhstan: Financial Sector Assessment Program Update, IMF Country Report No. 04/338, October 2004
Latvia 1995	The Republic of Latvia: Financial System ROSC, IMF Country Report No. 02/67, March 2002; Credit Institutions Law. 1995.
Lithuania 2002	Republic of Lithuania: Financial System Stability ROSC, IMF Country Report No. 02/19, February 2002; Banking Crises and Bank Resolution: Experiences in Some Transition Economies Enoch, Ch. A et al, IMF WP No. 02/56; March, 2002; Law on Financial Institutions 2002
Morocco 1997	ROSC Morocco: Financial System Stability Assessment, Country Report No. 03/212, July 17, 2003
Mexico	Law on Credit Institutions, 2004
Peru 2002	Peru: Selected Issues Country Report No. 01/51, March 29, 2001
Philippines 2001	Circular no. 282, April 2001; Philippines: Financial System Stability ROSC, IMF Country Report No. 02/222, October 2002; Philippines: ROSC- Banking Supervision, IMF Country Report No. 04/106, April 2004
Romania 1998	Romania: Selected Issues and Statistical Appendix Country Report No. 01/16, January 16, 2001; Romania: Financial System Stability Assessment, IMF Country Report No. 03/389, December 2003; 1998 Banking Act, Minimum Capital circular No. 40/23-October 2002.
Russia	Russian Federation: Financial Sector Stability Assessment, IMF Country Report No. 03/147, May 2003.
Slovak Republic 2002	Slovak Republic: Financial System Stability Assessment, IMF Country Report No. 02/198, September 2002; Slovak Republic: Selected Issues and Statistical Appendix, Country Report No. 01/129; August 6, 2001 Banking Law. Effective January 2002 Banks Amendment, 2000
South Africa	Experimental IMF ROSC: Tunisia September 1999, updated on January 29, 2001
Tunisia	Regulation on Measurement and Assessment of Capital Adequacy of Banks, issued by the Banking Regulation and Supervision Board, January 31, 2002
Turkey 1999	Ukraine: Financial System Stability Assessment, IMF Country Report No. 03/340, November 2003; New Regulation on capital adequacy, March 2004
Ukraine 2004	Ukraine: Financial System Stability Assessment, IMF Country Report No. 03/340, November 2003; New Regulation on capital adequacy, March 2004
Vietnam	Law on Credit Institutions, 1997, Art. 81 and Decision 1035, August 2001

Appendix C. Sample composition

This table presents available data by country provided by Bankscope and used for the estimation of the liquidity ratios, the weight of each country in the sample as well as the number of non-missing data used in the regressions.

Country	<i>(Liquid Assets/ Total Assets)</i>			<i>(Net Loans/ Total Assets)</i>			<i>(Liquid Assets/ Cust & ST Funding)</i>			<i>(Liquid Assets/ Dep & Borrowing)</i>		
	Data avail.	%	Non Miss.	Data avail.	%	Non Miss.	Data avail.	%	Non Miss.	Data avail.	%	Non Miss.
Argentina	1050	8.27	630	1040	8.39	612	n.a.			n.a.		
Belarus	170	1.34	73	170	1.37	73	170	1.83	71	160	2.18	60
Brazil	1240	9.77	672	1150	9.28	613	n.a.			n.a.		
Bulgaria	280	2.21	174	280	2.26	173	270	2.91	169	250	3.40	162
Chile	190	1.50	128	180	1.45	120	190	2.05	123	110	1.50	61
China	400	3.15	205	400	3.23	207	400	4.31	200	360	4.90	161
Colombia	380	2.99	249	370	2.99	244	380	4.10	245	370	5.03	200
Czech Republic	280	2.21	144	280	2.26	140	270	2.91	140	260	3.54	126
Ecuador	340	2.68	196	340	2.74	203	340	3.67	185	210	2.86	83
Egypt	300	2.36	261	300	2.42	261	210	2.27	100	210	2.86	86
Estonia	20	0.16	6	20	0.16	6	20	0.22	6	10	0.14	3
Hungary	180	1.42	100	170	1.37	96	180	1.94	92	170	2.31	81
India	650	5.12	487	640	5.17	482	650	7.01	483	610	8.30	439
Indonesia	920	7.25	441	920	7.43	443	900	9.71	433	750	10.20	375
Israel	30	0.24	16	30	0.24	15	10	0.11	7	10	0.14	7
Kazakhstan	200	1.58	71	200	1.61	70	180	1.94	63	170	2.31	61
Korea	70	0.55	40	70	0.56	41	70	0.76	41	40	0.54	24
Latvia	260	2.05	153	260	2.10	152	260	2.80	152	130	1.77	66
Lebanon	510	4.02	331	520	4.20	337	510	5.50	332	430	5.85	234
Lithuania	50	0.39	27	50	0.40	26	50	0.54	25	20	0.27	12
Malaysia	170	1.34	107	160	1.29	95	90	0.97	48	70	0.95	35
Mexico	310	2.44	174	280	2.26	163	280	3.02	151	200	2.72	91
Morocco	90	0.71	51	90	0.73	51	90	0.97	51	50	0.68	23
Peru	220	1.73	139	220	1.78	139	220	2.37	137	120	1.63	67
Philippines	300	2.36	153	280	2.26	147	280	3.02	146	220	2.99	107
Poland	500	3.94	272	480	3.87	260	500	5.39	270	420	5.71	231
Romania	250	1.97	135	250	2.02	134	250	2.70	133	230	3.13	113
Russia	1340	10.56	460	1310	10.57	451	1330	14.35	455	940	12.79	318
Slovak Republic	210	1.65	117	210	1.69	117	210	2.27	116	180	2.45	93
South Africa	200	1.58	130	180	1.45	120	190	2.05	118	110	1.50	60
Thailand	80	0.63	48	70	0.56	47	90	0.97	54	40	0.54	19
Tunisia	160	1.26	125	150	1.21	90	150	1.62	121	130	1.77	74
Turkey	300	2.36	112	300	2.42	117	50	0.54	10	40	0.54	8
Ukraine	360	2.84	161	360	2.91	161	80	0.86	26	70	0.95	24
Venezuela	480	3.78	229	460	3.71	231	280	3.02	103	180	2.45	77
Vietnam	200	1.58	141	200	1.61	141	120	1.29	56	80	1.09	34
Total	12690	100.0	6958	12390	100.0	6778	9270	100.0	4862	7350	100.0	3615

Appendix D. Classification of exchange rate arrangements

Independently floating. The exchange rate is market determined, with any foreign exchange intervention aimed at moderating the rate of change and preventing undue fluctuations in the exchange rate, rather than at establishing a level for it.

Managed floating with no pre-announced path for exchange rate. The monetary authority influences the movements of the exchange rate through active intervention in the foreign exchange market without specifying, or pre-committing to, a pre-announced path for the exchange rate. Managed floats in this category are different from tightly managed floats that are ranked as an intermediate exchange rate regime. The distinction lies in the authority intervention on the exchange rate. Under a tightly managed floating, intervention takes the form of very tight monitoring that generally results in a stable exchange rate without having a clear exchange rate path, so as to permit the authorities an extra degree of flexibility in deciding the tactics to achieve a desired path. Conversely, under other managed floating, the exchange rate is influenced in a more *ad hoc* way.

Exchange rates within crawling bands. The currency is maintained within certain fluctuation margins around a central rate that is adjusted periodically at a fixed pre-announced rate or in response to changes in selective

quantitative indicators. The degree of exchange rate flexibility is a function of the bandwidth; bands can be chosen to be either symmetric or fixed around a crawling parity or to widen gradually with an asymmetric choice of the crawl of upper and lower bands. The commitment to maintain the exchange rate within the band continues to impose constraints on monetary policy, with the degree of policy independence a function of the bandwidth.

Crawling pegs. The currency is adjusted periodically in small amounts, against a single currency or a composite, at a fixed pre-announced rate or in response to changes in selective quantitative indicators: past inflation differentials with major trading partners, differential between the targeted or projected inflation with major trading partners, differentials between official and parallel market rates.

Pegged exchange rates within horizontal bands. The value of the currency is maintained within margins of fluctuation around a formal or de facto fixed peg that are wider than at least $\pm 1\%$ around a central rate. Some limited degree of monetary policy discretion can be afforded, with the degree of discretion depending on the bandwidth.

Conventional fixed peg arrangements against a single currency (a composite and de facto peg arrangements under managed floating). The country pegs its currency at a fixed rate to a major currency or a basket of currencies where the exchange rate fluctuates within a narrow margin of less than $\pm 1\%$ around a central rate. The authorities stand ready to keep the fixed parity through direct, e.g. via sale/purchase of foreign exchange in the market, or indirect intervention, e.g. via aggressive use of interest rate policy. Flexibility of monetary policy, though limited, is greater than in hard pegs, as traditional central banking functions are still possible and the authorities can adjust the level of the exchange rate, though relatively infrequently.

Currency boards arrangements. A monetary regime based on an explicit legislative commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate, combined with restrictions on the issuing authority to ensure the fulfilment of its legal obligations. This implies that domestic currency remain fully backed by foreign assets, eliminating traditional central bank functions such as monetary control and lender of last resort. While leaving little scope for discretionary monetary policy, some flexibility may be afforded depending on the strictness of the board's rules.

Exchange arrangements with no separate legal tender (dollarisation). The currency of another country circulates as the sole legal tender. Dollarisation is a complete surrender of the authorities' independent control over domestic monetary policy, and as such, can be viewed as the hardest form of a pegged regime.

Appendix E. Official/de facto classification of exchange rate arrangements

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Argentina	1/1	1/1	1/1	1/1	1/1	1/1	1/1	4/4	4/4	4/4
Belarus	4/2	4/3	4/3	4/3	4/3	4/3	4/3	3/3	3/3	3/3
Brazil	4/3	4/3	4/3	4/3	5/5	5/5	5/5	5/5	5/5	5/5
Bulgaria	5/2	5/5	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Chile	3/3	3/3	4/3	4/3	3/3	5/5	5/5	4/5	5/5	5/5
China	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/2
Colombia	4/3	4/3	4/3	4/3	3/5	5/5	5/5	5/5	5/5	5/5
Czech Republic	2/2	2/2	4/4	4/4	4/4	4/4	4/5	5/5	4/4	4/4
Ecuador	3/3	4/3	4/3	4/3	5/5	1/1	1/1	1/1	1/1	1/1
Egypt	4/2	4/2	4/2	4/2	4/4	4/4	2/2	4/2	4/4	4/4
Estonia	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Hungary	4/3	4/3	4/3	4/3	3/3	3/3	3/2	2/2	2/2	2/2
India	5/4	5/2	5/2	5/2	5/2	5/2	4/2	4/4	4/4	4/4
Indonesia	4/3	4/3	4/5	4/5	5/3	5/5	5/4	4/4	4/4	4/4
Israel	4/3	4/3	4/3	3/3	3/3	3/3	3/3	3/3	3/3	3/5
Kazakhstan	5/4	5/4	5/2	4/3	5/2	5/2	4/2	4/4	4/4	4/4
Korea	4/2	4/2	4/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5
Latvia	4/2	4/2	4/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Lebanon	5/3	5/3	5/3	5/2	5/2	5/2	5/2	5/2	5/2	5/2
Lithuania	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Malaysia	4/2	4/2	4/4	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Mexico	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5
Morocco	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2

(Continued)

Appendix E. Continued.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Peru	5/4	5/4	5/4	5/4	5/5	5/5	5/5	5/5	5/5	4/4
Philippines	5/2	5/2	5/4	5/5	5/4	5/5	5/5	5/5	5/5	5/5
Poland	4/3	4/3	4/3	4/3	3/3	3/5	5/5	5/5	5/5	5/5
Romania	5/2	5/2	5/3	4/3	4/3	4/3	4/3	3/3	4/3	4/4
Russia	4/3	4/3	4/3	4/4	4/4	5/4	4/4	4/4	4/4	4/4
Slovak Republic	2/2	2/2	2/2	4/4	4/4	4/4	4/4	4/4	4/4	4/4
South Africa	5/2	5/4	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5
Thailand	2/2	2/2	4/4	5/4	5/4	5/4	5/4	4/4	4/4	4/4
Tunisia	4/3	4/3	4/3	4/3	3/3	3/4	4/4	4/4	3/3	3/3
Turkey	4/3	4/3	4/3	4/3	3/3	3/3	5/5	5/5	5/5	5/5
Ukraine	5/4	4/2	4/2	4/2	2/4	4/2	4/2	4/2	4/2	4/2
Venezuela	2/2	4/3	4/3	4/3	3/3	3/3	3/3	3/3	2/2	2/2
Vietnam	4/2	4/2	4/2	4/2	4/2	4/2	4/2	4/4	4/4	4/4

5 = independently floating

4 = managed floating with no pre-announced path for exchange rate

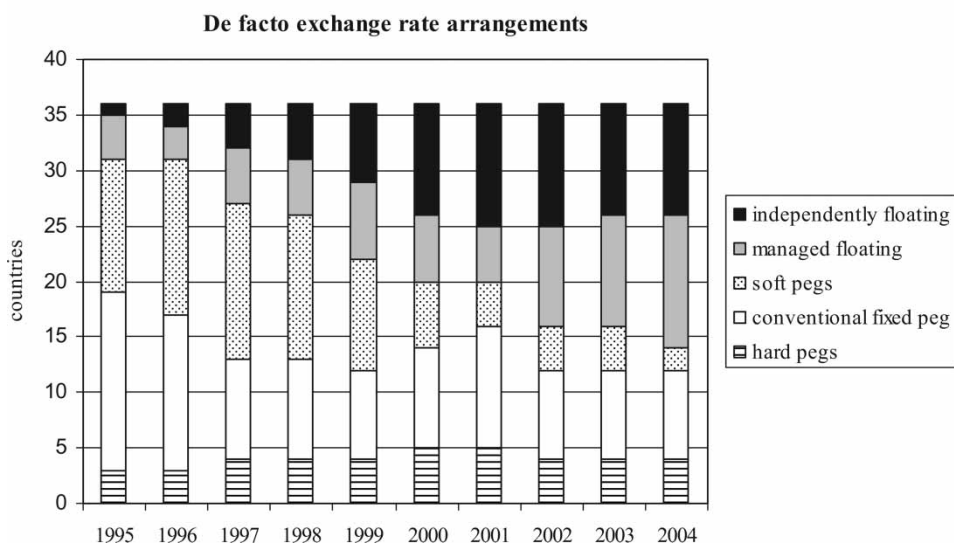
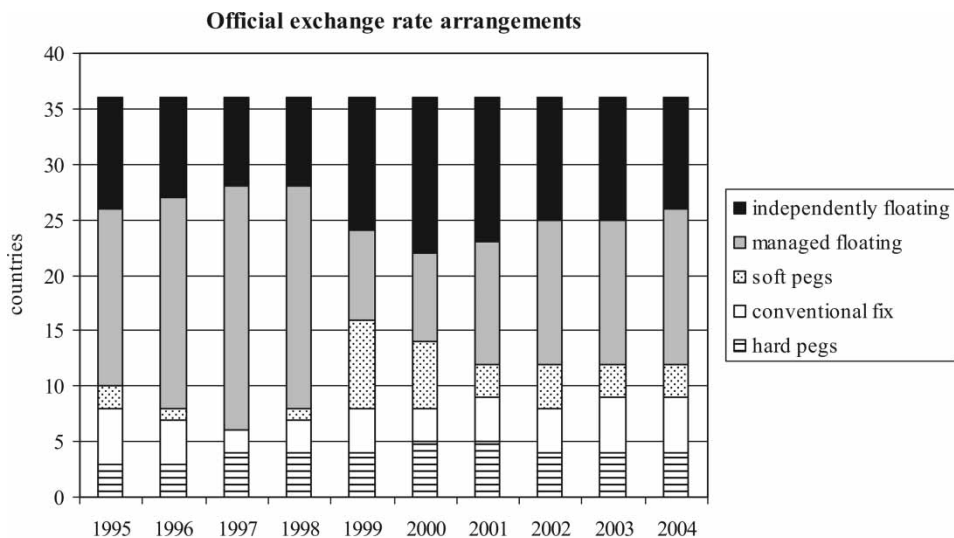
3 = exchange rates within crawling bands and crawling pegs

2 = pegged exchange rates within horizontal bands and conventional fixed peg arrangements, against a single currency, against a composite and de facto peg arrangements under managed floating)

1 = currency boards arrangements and exchange arrangements with no separate legal tender

Appendix F. Number of countries in the different exchange rate regimes

The evolution of both official and de facto exchange rate arrangements for the emerging countries in our sample is illustrated below, according the 5-class taxonomy we used in regressions.

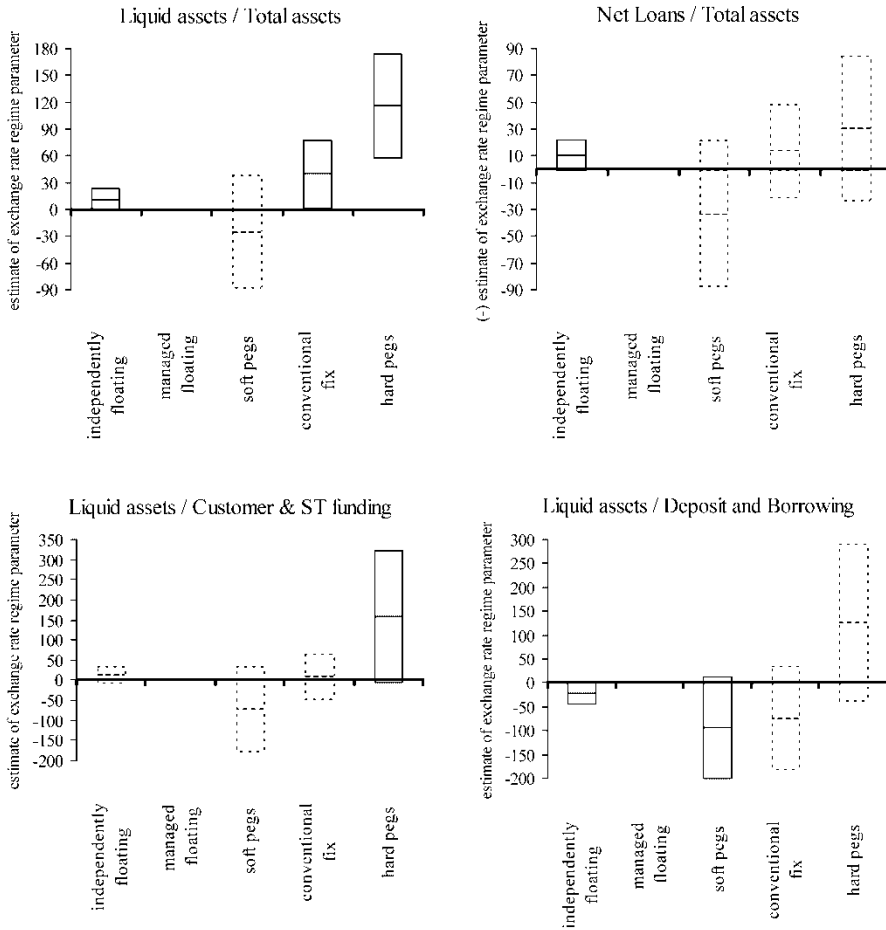


Appendix G. Choice of the reference for de facto exchange rate regime dummies

The tables indicate, for every regression characterised by the liquidity ratio used as dependent variable, the number of banks, corresponding to non-missing data, in every exchange rate arrangement. The last column indicates the reference for the exchange rate regime dummy. De facto exchange rate arrangements.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total	
<i>Liquid Assets/Total Assets</i>												
<i>hard pegs</i>	76	86	94	108	98	118	90	43	42	35	790	
<i>conventional fix</i>	177	223	184	223	189	197	191	131	121	67	1703	
<i>soft pegs</i>	328	359	350	296	217	93	55	56	34	12	1800	reference
<i>managed floats</i>	83	36	81	98	156	146	125	248	246	124	1343	
<i>independently floating</i>	18	33	89	116	185	271	179	183	151	97	1322	
Total	682	737	798	841	845	825	640	661	594	335	6958	
<i>Net Loans/Total Assets</i>												
<i>hard pegs</i>	74	84	93	108	96	119	85	44	41	40	784	
<i>conventional fix</i>	170	218	184	221	187	196	187	131	124	66	1684	
<i>soft pegs</i>	311	344	333	284	216	92	56	54	34	12	1736	reference
<i>managed floats</i>	82	32	75	96	155	145	124	245	245	123	1322	
<i>independently floating</i>	17	33	86	113	180	256	165	171	142	89	1252	
Total	654	711	771	822	834	808	617	645	586	330	6778	
<i>Liquid Assets/Cust & ST Funding</i>												
<i>hard pegs</i>	3	4	19	25	23	48	38	42	40	33	275	
<i>conventional fix</i>	124	169	144	184	178	162	144	104	102	40	1351	reference
<i>soft pegs</i>	230	249	231	170	184	69	44	46	34	12	1269	
<i>managed floats</i>	75	33	65	97	123	136	126	178	167	71	1071	
<i>independently floating</i>	18	33	85	111	103	185	110	116	102	64	927	
Total	450	488	544	587	611	600	462	486	445	220	4893	
<i>Liquid Assets/Dep & Borrowing</i>												
<i>hard pegs</i>	0	0	13	22	21	42	38	40	32	28	236	
<i>conventional fix</i>	47	109	90	156	145	138	129	92	85	34	1025	reference
<i>soft pegs</i>	120	158	128	125	161	53	38	41	33	10	867	
<i>managed floats</i>	46	1	32	73	101	103	99	147	137	68	807	
<i>independently floating</i>	8	20	47	94	62	157	103	97	74	42	704	
Total	221	288	310	470	490	493	407	417	361	182	3639	

Appendix H. The bank liquidity smile across official exchange rate arrangements*



*Note: Exchange rate arrangements are de jure; 'managed floating' is the reference class. Boxes represent confidence intervals around the estimated parameter of the exchange rate regime dummy variable, β_k , calculated as $\beta_k \pm 1.96 \times \text{standard error}$. Dotted line boxes recall estimated parameters that are not significantly different from zero.

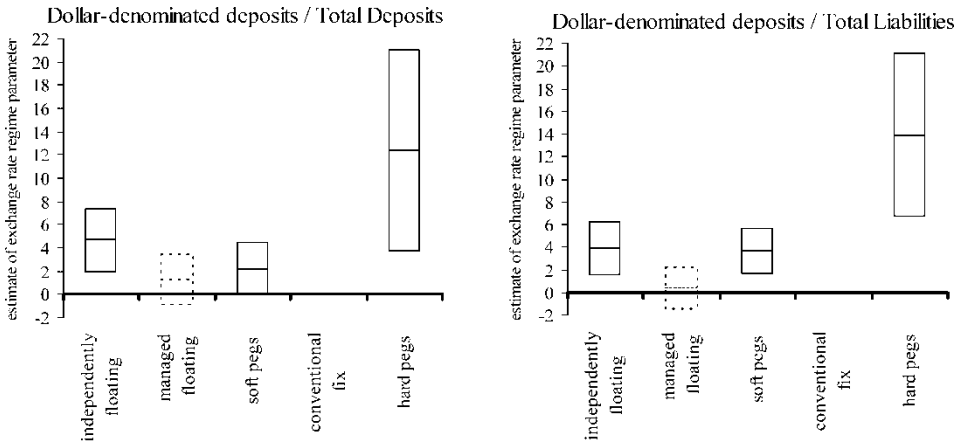
Appendix I. Deposit dollarisation across exchange rate regimes

Dollarization Ratio 1 is computed as dollar-denominated over total deposits. Dollarization Ratio 2 is computed as dollar-denominated deposits over total liabilities.

Variable	Dollariz. Ratio 1	Dollariz. Ratio 2
Intercept	-18,372** (8,070)	-12,295* (6,791)
Restrictions	-50,367*** (5,661)	-32,347*** (4,739)
Independently floating	4,675*** (1,384)	3,919*** (1,177)
Managed floating	1,363 (1,087)	0,485 (0,931)
Soft Pegs	2,194* (1,168)	3,652*** (1,005)
Hard pegs	12,389*** (4,393)	13,925*** (3,680)
R-square	0,9656	0,9589
Number of cross sections: 10;		
Series Length: 34; F test for no fixed effects: <.0001		

*** indicates significance at 1% level.
 ** indicates significance at 5% level.
 * indicates significance at 10% level.
 Standard errors are given in brackets.

Panel regression with fixed effects including as endogenous variables: real lending rate, rate of growth, rate of inflation, public expenditure/GDP ratio, Deposit to M2 ratio, realization of a financial crisis, prudential regulation, presence of restrictions on foreign currency deposits, low, intermediate and high level of the six governance indicators (voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption) and the de facto exchange rate regimes. Restrictions on foreign currency deposits are provided by Eduardo Levy-Yeyati (2006) (Index of restrictions on holdings of FCD by residents)



Exchange rate arrangements are de facto; 'conventional fix' is the reference class. Boxes represent confidence intervals around the estimated parameter of the exchange rate regime dummy variable, β_k (calculated as $\beta_k \pm 1.96 \times$ standard error). Dotted line boxes recall estimated parameters that are not significantly different from zero.

Copyright of International Economic Journal is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.