

Prudential regulation of foreign exchange: the Mexican experience

Pascual O'Dogherty and Moisés J Schwartz¹

1. Introduction

The recent crises in Asia, Russia and Latin America have highlighted the challenges that the globalisation of financial markets and capital mobility pose for domestic financial systems. Countries are affected nowadays not only by their own economic mischief but also by contagion effects from events taking place in economies with which they do not have any real or financial links.

International investors in general tend to react negatively to markets that are related or share similar economic features. This type of behaviour can sometimes be explained by investors' desire to liquidate financial assets across markets. Frequently, investors attempt to offset positions in one market by taking the other side in another. Whatever the reason, the collective response of international investors makes the financial authorities' task more difficult and calls for immediate action on their part to upgrade regulatory frameworks and improve the management of foreign indebtedness and liquidity. Emerging open economies are particularly vulnerable to volatile capital flows given the size and depth of their capital markets. Consequently, their financial systems have to be better equipped to deal with highly mobile capital flows and their regulations should be aimed at preventing excessive build-ups during economic upswings.

Financial system vulnerability derives from, among other things, banks and other financial intermediaries having short-term obligations greater than the assets they can access at short notice. This balance sheet maturity mismatch is one of the main characteristics of banks. As financial intermediaries, banks engage in the business of transforming maturities.² However, when short-term obligations are denominated in foreign currency, financial vulnerability can easily turn into a balance of payments crisis.

Central banks throughout the world have slight differences in their mandates and objectives. However, monetary stability and sound domestic financial markets are nearly universal goals of monetary authorities. Crisis management by central banks has traditionally relied on the possibility of resorting to their role as lender of last resort for sound institutions that face transitory liquidity difficulties. Central banks represent the ultimate source of domestic liquidity, thus their role as lender of last resort has historically been one of the most important features of central banking. Nevertheless, if a central bank overuses this feature, the most likely result will be that monetary stability will be notably weakened in the short term. Hence, central banks have recognised that this facility should always be exercised with caution.

The strongest argument in favour of central banks maintaining their discretionary right to act as lender of last resort lies in their capacity to reduce the likelihood of systemic crises and to ease conditions in those crises that inevitability materialise. This is so because central banks are capable of providing the market with enough domestic liquidity to deal with crises of systemic proportions. However, a different situation occurs when central banks are required to play the role of lender of last resort in foreign currency. Unlike the unlimited liquidity that central banks can quickly mobilise during a crisis period, foreign currency resources are in limited supply. Under certain circumstances, central banks might need to utilise some of their international reserves in order to alleviate pressures on the banking sector as credit institutions are unable to refinance their debt in foreign markets.

This paper deals with the challenges that a volatile international environment poses to domestic financial systems and to the sustainability of sound macroeconomic performance. The article

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² Chang (1999).

addresses the relevance of proper foreign exchange regulations for the banking system. It is argued that appropriate regulations will result, on a microprudential level, in individual institutions with an improved ability to successfully face adverse shocks and, on a macroprudential level, in financial systems more capable of handling the volatile capital flows that characterise open and global economies. Thus, the aim of prudential regulation is to ease the adjustment costs of financial distress. The Mexican experience since the onset of the 1994-95 crisis serves as an interesting example of how a microeconomic prudential regulation that cushions banks' balance sheets from exchange rate movements reduces the likelihood that turbulence in international capital markets will cause severe macroeconomic adjustments in the domestic economy.

The paper is organised as follows: Section 2 describes the challenges that financial authorities in Mexico faced once the 1994-95 crisis erupted. Special emphasis is placed on the Bank of Mexico's involvement as a lender of last resort in foreign currency and on the loopholes that existed in the prevailing regulations. Section 3 reviews current central bank regulations on foreign exchange. Particular attention is given to the liquidity coefficient and its impact on banks' behaviour in terms of foreign exchange risk exposure. Information requirements on banks' foreign exchange exposures are also summarised. Section 4 provides evidence that supports the fact that the banking system of a small open economy, such as Mexico, that is totally integrated into global financial markets requires appropriate regulations on foreign exchange risk exposures.

There is no doubt that the speed at which investors now tend to react to changes in expectations leaves financial and monetary authorities far less room for crisis management and resolution than in the past. Even countries with solid fundamentals can now be subject to speculative attacks. In this environment, prudential regulation of foreign exchange exposures designed to prevent the build-up of imbalances takes a more prominent role. As a result of improved regulation, Mexican banks are now better equipped to deal with sudden and unanticipated capital flows.

2. The Mexican crisis of 1994-95

2.1 The 1994-95 crisis

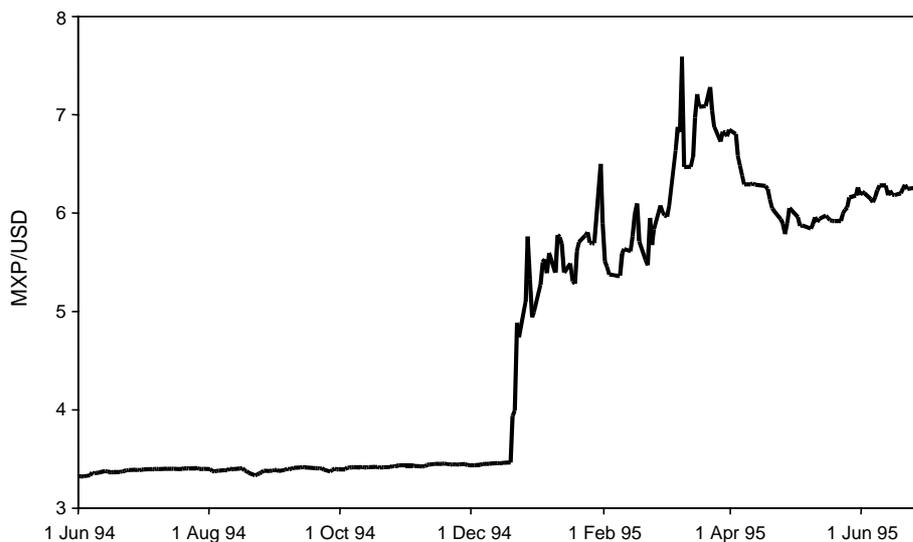
The collapse of the Mexican peso in December 1994 unleashed a number of unprecedented challenges for the Mexican authorities. The exchange rate depreciated more than 100% (see Figure 1), inflation skyrocketed and the real economy plunged downwards at an alarming rate. At the same time, nominal and real interest rates increased substantially, real wages collapsed, unemployment increased, the financial system was severely strained and countless corporations and households were overwhelmed by the burden of their own debts and the concurrent decline of their real incomes. As net foreign capital inflows ceased and international reserves reached dangerously low levels, domestic investment could no longer exceed national saving, and thus the current account deficit virtually vanished.

Following the abandonment of the exchange rate peg in December 1994, the exchange rate and interest rates experienced marked volatility. Both the peso and interest rates came under heavy pressure as foreign investors liquidated their peso positions and creditors stopped rolling over their loans. The turbulence experienced by financial markets was exacerbated by the actions of speculators and several Mexican banks, who met margin calls and covered short dollar positions held through the use of exchange rate linked structured notes and off-balance sheet derivative instruments.

Before the abrupt devaluation of the peso, Mexican banks actively engaged in a variety of operations to take advantage of interest rate differentials between instruments denominated in pesos and dollars. These operations were structured in a way that enabled banks to circumvent Mexican regulations that forbid credit institutions to take long or short positions in foreign exchange in amounts exceeding 15% of their capital. Regulations also forbid banks holding securities on margin. In order to maintain short dollar positions, banks purchased notes denominated in pesos but with payoffs linked to the behaviour of the exchange rate. Many of these notes were also structured to allow banks to leverage their short

dollar positions several times.³ Some banks also took short forward dollar positions through offshore subsidiaries. Moreover, to take advantage of interest rate differentials Mexican banks borrowed foreign currency excessively in the short term in order to be able to invest in long-term higher risk securities that in turn were pledged as collateral for the loans.⁴ To circumvent prohibitions on holding securities on margin, banks recorded these operations as swaps or repurchase agreements instead of loans secured by collateral.

Figure 1
Exchange rate



After the initial fall of the peso in December 1994, attempts by banks and other participants to cover short dollar positions and margin calls on swaps, repurchase agreements and structured notes exerted enormous pressure on an already battered peso, further exacerbating its volatility. Many participants not only covered short dollar positions but also took bets against the peso, adding to pressure in an already thin market.

Mexican banks, in particular, were hurt by the crisis. As foreign lenders began refusing to roll over their loans, balance sheet mismatches hampered the ability of banks to pay for their foreign liabilities. Although Mexican banks could have obtained enough funding in pesos to purchase dollars (the Bank of Mexico sterilised its interventions in foreign exchange markets), domestic interest rates increased rapidly, thus making peso funding very expensive (Figure 2). Additionally, liquidity in foreign exchange markets decreased substantially and bid/ask spreads skyrocketed (Figure 3). As a result, banks found it almost impossible to purchase dollars without substantially affecting the exchange rate.

To prevent the dangerous consequences of a systemic contagion in the event that some banks failed to honour their dollar liabilities, the central bank stepped in as lender of last resort. At that time it was considered that the failure of a single bank to meet its foreign exchange obligations could have triggered a run in the rest of the system. Between January and April 1995, financial authorities in Mexico provided liquidity support in foreign exchange to 17 Mexican banks in the amount of \$3.9 billion.⁵ The support was formally provided through the Deposit Insurance Fund. Additionally, the federal government guaranteed all of the credits given by the Bank of Mexico to the Deposit Insurance

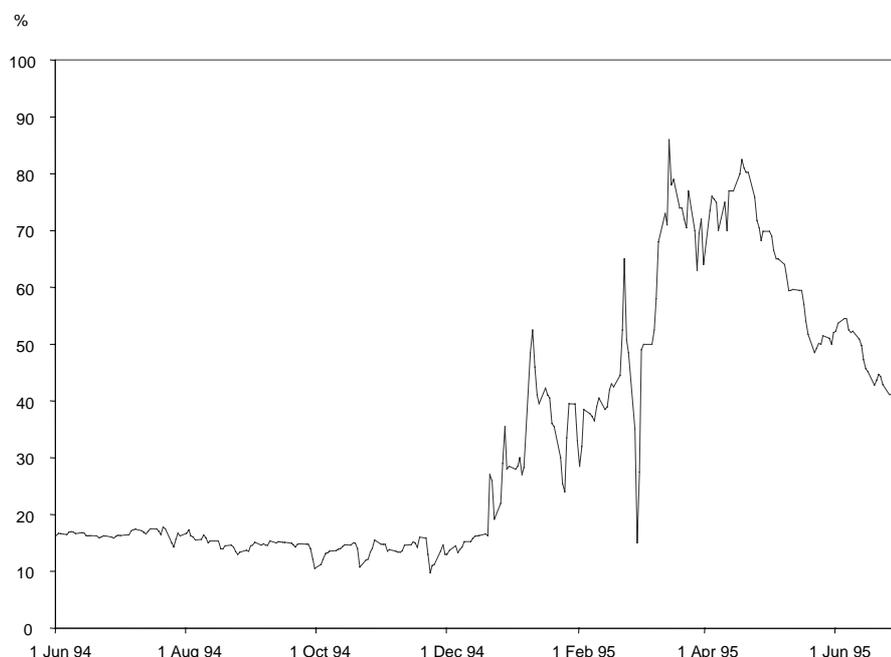
³ These notes usually carried high coupons, but the principal repayment was linked to the behaviour of the exchange rate. A sharp depreciation of the currency could result in a negative repayment.

⁴ For more details on these operations, see Garber (1996).

⁵ Banco de México (1995).

Fund in order to ensure that the central bank would not assume any of the credit risk of the banks who were receiving the support.⁶

Figure 2
**Interest rate
on one-day peso repurchase agreements**



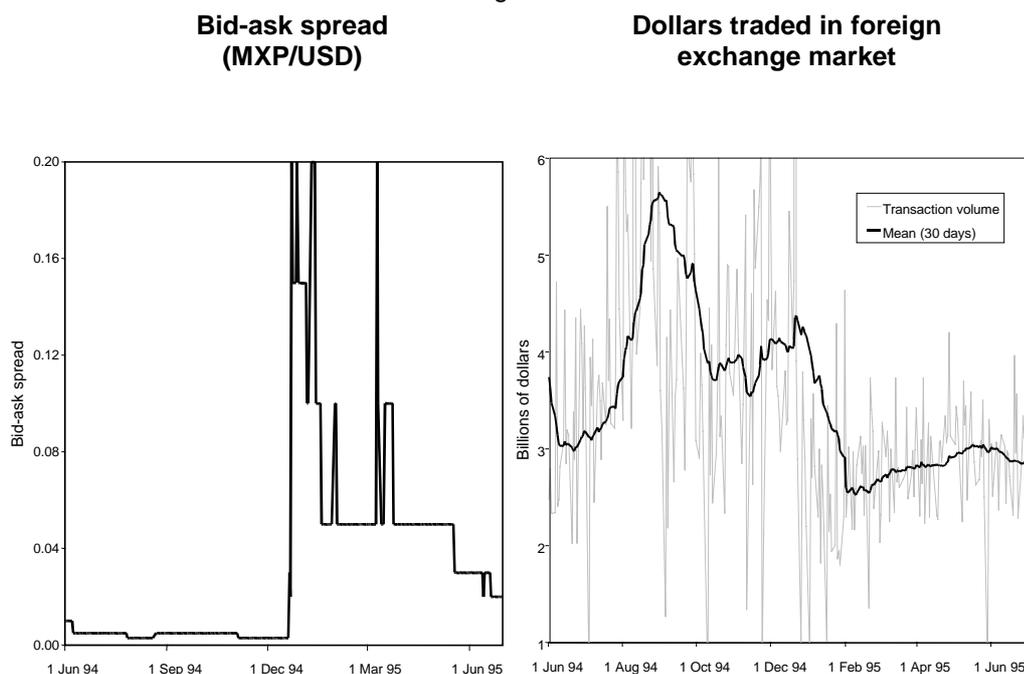
2.2 The aftermath of the 1994-95 crisis

The 1994-95 crisis forced the authorities to acknowledge the importance of having timely access to information on the private sector's foreign exchange positions. This is especially true for financial intermediaries implicitly covered by the safety net. At the time, the Mexican authorities were not fully aware of the size of banks' foreign exchange imbalances, or of the amounts of their short-term liabilities.

The widespread financial distress that followed the depreciation of the peso also made evident the shortcomings and loopholes of regulations regarding foreign exchange and derivative instruments. The ample use of structured notes and other derivative products, whose value depends on the behaviour of other assets, renders regulations based on traditional accounting principles inefficient in identifying risk allocations. Therefore, the financial authorities in Mexico decided to strengthen regulations on foreign exchange by modifying the traditional definition of foreign exchange positions, establishing a liquidity coefficient in foreign currency and setting prudential limits on banks' foreign currency liabilities and on their holdings of foreign currency denominated securities. In addition, the authorities took great care in improving the process for monitoring banks' risk positions, particularly those in foreign exchange and derivatives, and established a regulatory framework for the prudent use of derivative instruments.

⁶ Foreign exchange assistance was granted in dollars at penalty rates that ranged from 17.5% to 25%, with the lower rate applicable to outstanding balances below a certain threshold. By September 1995, all banks had repaid their loans in full.

Figure 3



Another important consequence of the 1994-95 crisis was Mexico's abandonment of its pegged exchange rate regime. The Mexican experience of 1994 and the previous European episode of 1992 suggest that in today's global financial capital markets even apparently high levels of international reserves might turn out not to be enough to effectively confront a speculative attack under a fixed or pegged exchange rate regime. As an alternative, a flexible exchange rate regime can result in adequate incentives for economic agents when engaging in foreign exchange transactions. Without the implicit guarantee to currency risk-takers provided by a semi-fixed exchange rate regime, banks and other economic agents are expected to be more cautious when incurring such risks. The Mexican experience of the last five years seems to corroborate this argument.

3. The Bank of Mexico's regulations on foreign exchange

This section provides a description of the main elements of Mexico's upgraded regulations on foreign exchange. Specifically, regulation encompasses: foreign exchange positions, limits on liabilities denominated in or linked to foreign exchange, liquidity coefficients in foreign exchange, limits on holdings of sovereign debt and information requirements.

3.1 Foreign exchange positions

Banks can hold long or short positions in foreign exchange for up to 15% of their capital. The aim of these regulations is to prevent substantial losses in banks' balance sheets when the peso experiences drastic adjustments. Since credit institutions enjoy a greater capacity to leverage than other participants in foreign exchange markets, the aforementioned regulations also aim to prevent banks from engaging in significant purchases of dollars when the peso is expected to depreciate.

To leverage an attack against a weak currency, speculators have to gain access to credit either from the banking system or from the central bank. Commercial banks can always refuse to extend credit to some economic agents. However, central banks often find themselves in a difficult situation. Under a fixed or pegged exchange rate regime, central banks have to sterilise the monetary impact of their foreign exchange interventions in the domestic market. If this were not the case, the sudden shrinkage

of “high-powered money”,⁷ resulting from the central bank’s selling of international reserves, could impede banks from settling their customers’ accounts as well as their own transactions, thus leading to payment system failures.

When banks expect a depreciation of the domestic currency, they can either leverage themselves in that currency through the interbank market in order to acquire dollars or sell forward the domestic currency. In this situation, the central bank could easily end up doing both: buying its own weak currency (to maintain the peg) and supplying the credit needed to attack its reserves.

Central banks can always raise domestic interest rates to fend off an attack. However, these rate increases are rarely sufficient to entice speculators from not reaping the potential gains of a depreciation. Therefore, the Bank of Mexico imposed, several years ago, a limit on banks’ foreign exchange positions in order to impede banks in betting against the domestic currency or taking excessive foreign exchange rate risk to profit from interest rate differentials. Nevertheless, the 1994-95 crisis evidenced the shortcomings of the prevailing accounting practices, which focused on static valuations instead of risk exposures. As a result, some Mexican banks were able to circumvent the regulatory limits on foreign exchange positions by holding structured notes denominated in pesos but linked to the behaviour of the exchange rate.

To prevent banks from getting around the regulatory limits, the Bank of Mexico changed its definition for long and short foreign exchange positions. Thus, a *foreign exchange position should be considered to be long or short if it generates potential gains or losses from the depreciation of the exchange rate*. A “long position in foreign exchange” is defined as any position in an asset or liability (cash or derivative) that increases its value measured in domestic currency when the peso depreciates. Conversely, a “short position in foreign exchange” refers to any asset or liability that increases its value in domestic currency when the peso appreciates.

3.2 Limits on liabilities denominated in or linked to foreign exchange

The Mexican crisis of 1994-95 and the more recent events in Asia proved that banks have a tendency to overestimate the ability of their domestic borrowers to access foreign currency. Prudent behaviour by banks suggests that the currency denomination of a loan should be related to the borrower’s cash flows. However, domestic debtors frequently disregard the denomination of their flows, and attempt to take advantage of interest rate differentials by borrowing in dollars instead of domestic currency. This is especially true when domestic debtors believe that the monetary authorities are committed to maintaining an exchange rate peg. Under these circumstances, a depreciation of the exchange rate will sharply deteriorate those foreign currency loans, which is exactly what happened in both Mexico and Asia during their respective banking crises.

To prevent banks from overextending foreign currency lending in order to satisfy their customers’ demand for credit, it seems prudent to impose some limits on domestic banks’ lending in foreign currency. Since banks are subject to limits on their foreign exchange exposure, limits on lending could also be enforced through the establishment of ceilings that limit the amount of foreign currency liabilities that a bank is allowed to maintain. The ceilings also have the advantage of reducing the use of foreign borrowing by banks to finance domestic credit expansions. Finally, ceilings prevent domestic banks’ balance sheets from becoming fully *dollarised*. Thus, the Bank of Mexico has imposed limits on the amount of foreign currency liabilities (measured as a percentage of their capital) that Mexican banks are allowed to hold.

According to the Bank of Mexico’s regulations, banks are not allowed to hold liabilities denominated in or linked to foreign currency in excess of a certain amount of their capital. The limits are imposed after netting out foreign currency assets weighted according to their credit risk. Liabilities are also weighted according to their remaining maturity.

⁷ “High-powered money” is composed of currency and banks’ reserves at the central bank.

3.3 Liquidity coefficients in foreign currency

3.3.1 Liquidity

Liquidity can be defined as the ability of an institution to successfully face reductions in its financial liabilities, or in its income stream. The greater the ability to roll over liabilities or obtain funds at reasonable rates and/or liquidate assets at reasonable prices, the better the liquidity position of that particular institution. When liabilities are rolled over at high rates or with great frequency, as is the case with short-term liabilities, a liquidity problem can easily become one of solvency. Hence, the concept of liquidity is closely related to that of solvency.

One can also distinguish between individual liquidity difficulties and systemic crises. The former take place when institutions face temporary difficulties in renewing their liabilities. Unless these institutions are already facing some sort of solvency problem, they can generally access the interbank market and obtain funds to cover their short-term liabilities. Nevertheless, a bank's liquidity conditions also depend on the currency denomination of its assets and liabilities, the exchange rate regime and the procedures used by the central bank to conduct its monetary policy and settle operations in the payment systems. On the other hand, systemic liquidity problems occur when a significant number of institutions are having trouble renewing their liabilities or face exorbitant increases in their funds' costs. Under these circumstances, many financial institutions tend to look to the central bank as a possible source of credit.

From the monetary authorities' perspective, banks' liquidity concerns take on a completely different dimension when a foreign currency is involved. Central banks have an unlimited capacity to provide credit in their own domestic currency. However, a central bank's capability to extend credit in foreign currency is drastically limited by the availability of foreign reserves and its ability to access other sources of funding. Compulsory bank reserve requirements in domestic currency are generally imposed for monetary policy purposes rather than to address liquidity risk considerations.⁸ However, there is an increasing consensus among central bankers from emerging economies on the need to establish some type of foreign exchange liquidity cushion for domestic banks.

The next sections convey the hypothesis that compulsory domestic currency reserves are not essential to protect the banking system from liquidity crises when the central bank does not intervene in the foreign exchange market or when it sterilises the monetary impact of its interventions. Conversely, liquidity coefficients in foreign currency are an important element of an overall framework of prudent risk management for an emerging economy.

3.3.2 Liquidity in domestic currency

Under a flexible exchange rate regime, in which the central bank's intervention in the foreign exchange market is limited or virtually non-existent, banks may never face a liquidity problem in their domestic currency balance sheet, unless they face an insolvency situation. This is due to the fact that, under a free float, the central bank does not purchase nor sell foreign currency in the foreign exchange market. Thus, the monetary base remains constant. Under normal market conditions, a bank could obtain enough funds to cover its deposit losses from the very banks that gain the resources.

The situation is the same even if the loss of deposits is caused by a substitution of domestic currency for foreign-denominated assets. When the central bank does not intervene in the foreign exchange market (ie the monetary base remains unaltered), increases in the demand for foreign currency assets have to be compensated for by an equivalent increase in the quantity supplied, at a new equilibrium exchange rate. Therefore, the amount of "high-powered money" remains constant, and banks are able to balance their domestic currency denominated liabilities' gains and losses through the interbank market.

Under a fixed exchange rate regime, banks could face liquidity problems in their domestic currency balance sheets only when the central bank does not fully sterilise its interventions in the foreign exchange market, as may be the case under a currency board scheme. With a currency peg, increases in the demand for foreign assets force the central bank to sell foreign currency in exchange

⁸ Currency boards may be an exception.

for its own to maintain the exchange rate peg. These interventions destroy the monetary base and decrease domestic currency denominated deposits. In order to offset the reduction in deposits, banks must use reserves held at the central bank. Under these circumstances, banks may not be able to compensate for the loss of domestic currency deposits unless they obtain funds in foreign currency to sell to the central bank or, as was previously mentioned, the central bank sterilises its interventions in the foreign exchange market through open market operations.

Therefore, it can be concluded that, *ceteris paribus*, there is no reason for a solvent bank to face a liquidity crisis in domestic currency if the monetary base remains unaltered. The monetary base will remain constant as long as the central bank does not intervene in the foreign exchange market or if it sterilises its interventions through open market operations.⁹

3.3.3 Liquidity in foreign currency

The above situation fails to hold when banks' liabilities are denominated in foreign currency. Liquidity problems immediately arise when a bank faces a run on its foreign currency denominated deposits or experiences difficulties in rolling over its foreign-denominated liabilities. This may be particularly the case when liability holders are foreign residents who can not assess the situation of banks. Rumours can also precipitate a run against an otherwise healthy bank, or lead to difficulties in rolling over external credit lines.

It is important to mention that runs on foreign currency denominated deposits or difficulties in rolling over foreign currency denominated liabilities do not necessarily result in liquidity crises. Banks can always resort to borrowing funds in domestic currency, which they can then use to purchase enough foreign exchange to pay for their upcoming liabilities. In this sense, banks will be substituting domestic currency liabilities for liabilities denominated in foreign currency. To compensate for the increased asset/liability mismatch in foreign currency, banks can simultaneously sell foreign currency forward.¹⁰ However, during a severe systemic crisis, liquidity in foreign exchange markets could diminish substantially. In those circumstances, the central bank might be forced to step in as lender of last resort to prevent excessive depreciation of the exchange rate as a result of banks' purchases of foreign currency (to meet liabilities falling due). Further depreciation of the exchange rate under those extreme events will only cause non-performing foreign currency denominated assets and the liquidity situation of domestic banks to deteriorate.

3.3.4 Different approaches to the management of liquidity in foreign currency

The most common approach to dealing with banks' foreign currency liquidity in emerging markets is to establish minimum liquidity requirements related to the size and term structure of foreign liabilities. Setting minimum requirements has certain advantages for both supervisors and credit institutions. For authorities, it is relatively easy to set minimum ratios and supervise the compliance of individual institutions. For banks, with little experience in modern risk management systems, it might also be more convenient to comply with fixed parameters. However, a regulatory framework based on fixed ratios attached to balance sheet items could bear little relation to real liquidity risks.

This traditional approach does not appropriately consider the differences in behaviour of certain liabilities, as well as alternative sources of liquidity not recorded on balance sheets (ie credit lines or greater access to markets). Hence, fixed liquidity ratios could be set either at levels below the "appropriate" level, which in turn will have implications for banks' liquidity risk exposure, or above the "appropriate" level, which will then jeopardise banks' ability to compete against other financial intermediaries. Furthermore, fixed liquidity coefficients may not consider changes in underlying sources of liquidity risk, making them unnecessarily high during upswings (abundance of liquidity sources) and too low in downturns (liquidity scarcity). On the other hand, when liquidity risk

⁹ The argument assumes that the treasury maintains its resources outside the central bank or that any movement in the treasury's account at the central bank is fully sterilised.

¹⁰ During the Mexican crisis of 1994-95, prevailing regulations prevented banks from engaging in forward transactions in foreign exchange. However, following the Asian and Russian crises some Mexican banks sold dollars forward to compensate for the substitution of peso liabilities for dollar ones. Foreign banks are generally more willing to disregard country risk in forwards because their exposure is smaller when they provide credit through the use of forwards than when they resort to direct loans.

materialises, banks may find it difficult to comply with regulatory liquidity ratios. At this time, enforcement of regulations will exert excessive pressure on the whole system, and thus authorities may be inclined to ease liquidity requirements. Additionally, rapid financial innovation will make it difficult for authorities to keep track of the development of new financial instruments, and as the distinction between financial intermediaries becomes blurred, the requirements imposed on certain types of institutions may become ineffective.

A modern approach being implemented in many developed countries follows the Basel Committee on Banking Supervision's guidelines, which give banks full autonomy and responsibility to measure, monitor and control their liquidity positions in foreign currency. The role of the supervisor under this framework is to verify that banks have appropriate liquidity systems in place, and that liquidity risks bear relation to their capital. Nevertheless, the Basel Committee also considers the possibility of imposing minimum required liquidity coefficients under extreme situations.

As explained above, after the crisis of 1994-95 Mexico introduced liquidity coefficients for foreign exchange, along with other reforms to strengthen the liquidity position of banks. This regulation is explained in the next section. It is important to note, however, that regulation in Mexico is moving towards a framework in which banks will establish their own risk management systems. The final goal is to move from compliance-oriented supervision to self-regulation of institutions that meet stringent standards on risk management and capitalisation. This is a commitment to advance towards the deregulation of financial markets by letting the better equipped institutions have more room to handle their risk and to introduce innovations. The fixed coefficient approach implemented in Mexico is by no means the best way to address liquidity risk management. However, this regulation was considered as a necessary first step towards the implementation of an up-to-date regulatory framework for risk management, and the development and dissemination of modern risk practices in banks.

3.3.5 *The minimum required foreign currency liquidity coefficient*

The goal of this regulation is to encourage banks to show prudent behaviour in their foreign currency balance sheet, to compel them to maintain adequate liquid assets in foreign currency and to promote long-term financing in foreign currency.

According to this regulation, foreign currency liabilities with less than 60 days left to mature that have no corresponding assets of the same or shorter maturity must be matched entirely by high-quality liquid foreign currency denominated assets. Liabilities with less than 60 days left to mature that are matched by non-liquid assets of the same or shorter maturity must be offset by such high-quality liquid assets in a percentage linked to their maturity. That percentage ranges from zero for those liabilities that have a maturity of 60 days to 50 for liabilities that have one day left to mature.

3.4 Limits on banks' holdings of foreign currency denominated securities

Prior to the 1994-95 crisis, some Mexican banks took out short-term loans in order to invest in Brady and other sovereign bonds denominated in foreign currency and thus take advantage of interest rate differentials between the short and long ends of the curve. These bonds were often pledged as collateral for the loans. Each transaction was recorded as either a swap or a repurchase agreement in order to circumvent Mexican regulations that prohibited banks from holding securities on margin. The price of sovereign debt is extremely vulnerable to investors' perceptions of country risk and thus tends to fall sharply during financial crises. The decline in the value of the Brady bonds forced banks to increase their long dollar positions so that they would be able to meet their counterparties' margin calls compensating for the loss of the bonds' value pledged as collateral, and also to keep unaltered their foreign exchange position. As a result of these considerations, the Bank of Mexico decided to place a limit on Mexican banks' holdings of foreign currency denominated sovereign debt.

3.5 Information requirements

To comply with Bank of Mexico regulations on ceilings for foreign exchange liquidity coefficients and liabilities, banks had to make major efforts to improve their information technology resources in order to concentrate, process and send to the central bank information about their daily operations and positions in foreign exchange. As a result, the monetary authority has gained timely access to a wide range of data from banks, including details of high-quality liquid assets in foreign currency (overnight deposits in A-1 or P-1 banks, US Treasuries and credit lines), high-quality assets (time deposits with

remaining maturity of 60 days or less and high-rated commercial paper) and the credit portfolio weighted by rating, as well as information on foreign exchange liabilities classified according to remaining maturity.

The development of a debt monitoring system for Mexican commercial interbank external credit lines represents an important element in an overall strategy to preclude resident banks from engaging in risky positions in foreign exchange. The system includes a daily early warning indicator that detects changes in the condition of banks accessing this type of credit. The Bank of Mexico has utilised this system since July 1999 to continuously monitor information from banks and their non-resident branches and agencies. The information that banks are required to provide to the Bank of Mexico is classified by creditor (NAFTA countries, European Union, other European countries, Latin America, Asia and multilateral institutions), and by the type of operation it tracks (call money, trade-related credit, officially guaranteed credits, etc). With regard to the term structure of debt, the central bank also has access to data regarding the amount due from commercial banks as of the next day, the next week and/or the next months. The interest rates at which credit is contracted are also available on a daily basis, as is the spread between the original agreed rate and US Libor.

The ongoing monitoring of this information represents an important step towards a better understanding of the risks that financial institutions face when conditions in international capital markets deteriorate. Moreover, the high-frequency monitoring of borrowing by domestic commercial banks should allow the financial authorities to rapidly identify changes in market sentiment towards Mexican banks. This, in turn, enables the authorities to be better prepared to confront periods of uncertainty. Consequently, the appropriate mix of regulation and information requirements should allow Mexican banks to successfully deal with sudden and unanticipated swings of capital flows and with the corresponding volatility in domestic markets.

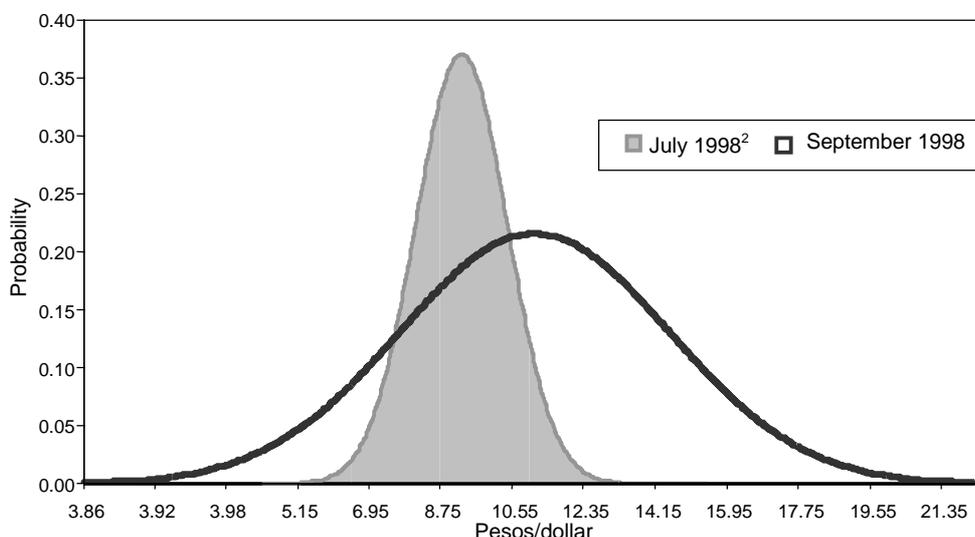
4. Mexico's close linkage with external developments: an example of the importance of foreign exchange prudential regulation

Recent crises in emerging markets have clearly shown the challenges that capital mobility poses to domestic financial markets and have thus reinforced the need to build solid systems capable of handling sudden and unanticipated swings of capital flows. This section provides evidence that supports the fact that the banking system of a small open economy, such as Mexico, which is totally integrated into global financial markets, requires appropriate regulation for overseeing foreign exchange risk exposure. To this end, it is useful to illustrate the magnitude of the shocks that Mexico's exchange rate is subject to as well as the origins of the turbulence. Once this is understood, the importance of establishing prudent foreign exchange risk exposure regulations that would enable banks to handle volatile capital flows and swings in the exchange rate is evident.

Derivatives markets allow for the construction of risk neutral probability distributions of the corresponding underlying assets. In this case, it is of particular interest to show how market expectations regarding the future course of the Mexican peso/dollar exchange rate are affected once an external shock, such as the Russian sovereign debt default, occurs. Figure 4 shows the monthly average of the three-month-ahead probability distribution for the implied peso/dollar exchange rate in derivatives markets for two different periods, July and September 1998. In other words, the figure shows different levels of uncertainty in domestic markets, both before and in the midst of the Russian crisis. This procedure assumes that the exchange rate follows a normal distribution¹¹ and uses the average three-month forward peso exchange rate and the average implied volatility in option prices as the mean and standard deviation of the probability distribution.

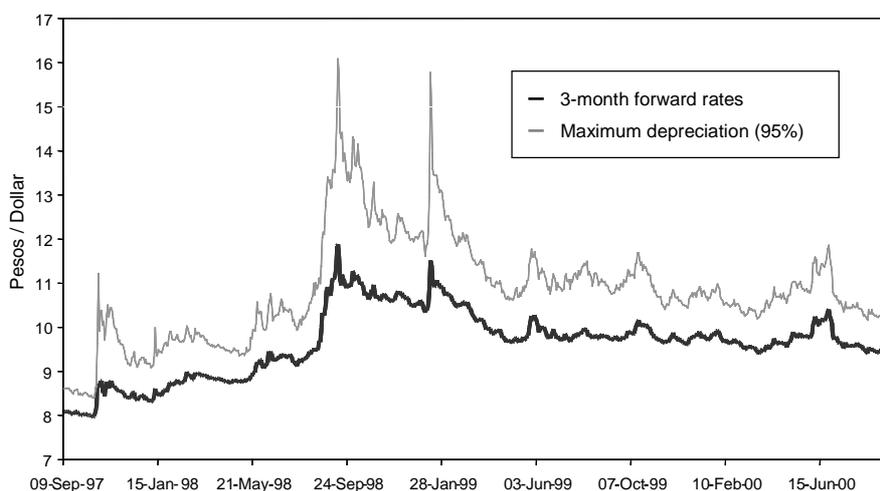
¹¹ Although there is evidence to suggest that exchange rates do not follow a normal distribution, the purpose of this exercise is just to highlight the difference in market expectations before and after the occurrence of an external shock.

Figure 4
**Three-month-ahead exchange rate probability distribution¹
before and after the Russian crisis**



¹ Assuming the forward exchange rate follows a normal distribution. ² Constructed using the average three-month forward price and implicit volatility for at-the-money forward options.

Figure 5
**Three-month forward exchange rate and maximum depreciation
implicit in forward and option markets at 95% confidence level¹**

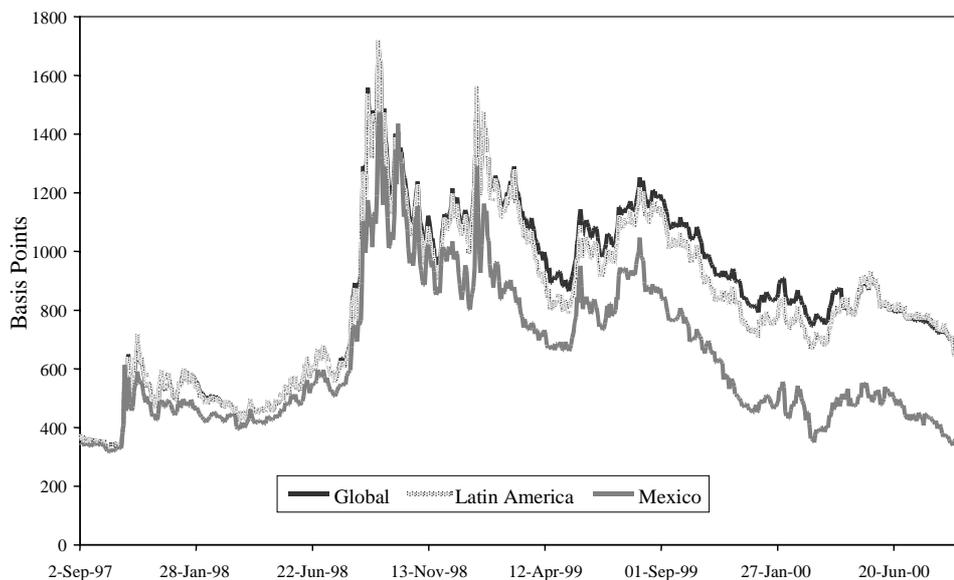


¹ Assuming the forward exchange rate follows a normal distribution.

After the Russian debt default, the level of uncertainty surrounding emerging markets and the peso/dollar exchange rate increased significantly. As the figure indicates, the mean and standard deviation of the probability distribution of the three-month-ahead peso/dollar exchange rate went from 9.3 pesos to the dollar and 12% respectively in July to 11.1 and 30% in September of the same year. To help us understand the impact of increased foreign exchange uncertainty over a longer period of

time, Figure 5 shows the three-month peso/dollar forward exchange rate and the maximum exchange rate depreciation implied in derivatives markets (at a 95% confidence level and assuming a normal distribution). As is evident, both the behaviour of the expected exchange rate and the uncertainty surrounding the exchange rate¹² reacted vigorously to external developments. This was the case for the Asian crisis in late 1997, the Russian debt default in September 1998 and the Brazilian devaluation in January 1999.

Figure 6
Emerging Markets Bond Index sovereign spread (EMBI)



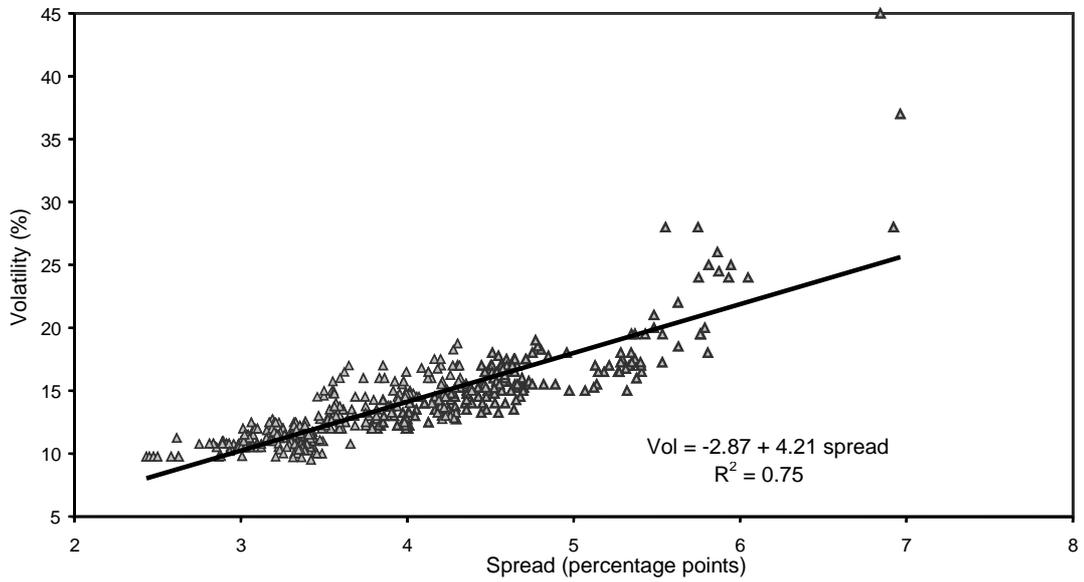
External developments are closely related to Mexico's country risk. Figure 6 shows the evolution of global emerging markets' country risk, as well as that of Latin America and Mexico, depicted by the Emerging Markets Bond Index spread (EMBI spread).¹³ From the figure it can be inferred that, in times of international financial distress, Mexico's country risk, and that of the rest of the emerging markets, tends to increase. Events surrounding the Asian, Russian and Brazilian episodes confirm this claim. Thus, it seems that the risk perception of a particular emerging market such as Mexico is affected not only by domestic events but also by developments taking place in other emerging economies.

The relationship between Mexico's country risk and the implied exchange rate volatility is depicted in Figure 7. The scatter plot shows a linear relationship between these variables. Thus, it is clear that an increase in Mexico's risk perception results in higher levels of uncertainty in the peso/dollar foreign exchange market. Moreover, not only is the expected peso/dollar exchange rate affected when unfavourable external developments take place, but the prevailing exchange rate is also significantly altered. Figure 8 indicates that, in addition to the performance of oil prices, Mexico's country risk perception plays a crucial role in explaining the behaviour of the peso/dollar exchange rate.

¹² Captured by the maximum depreciation implicit in the forward and option markets for foreign exchange.

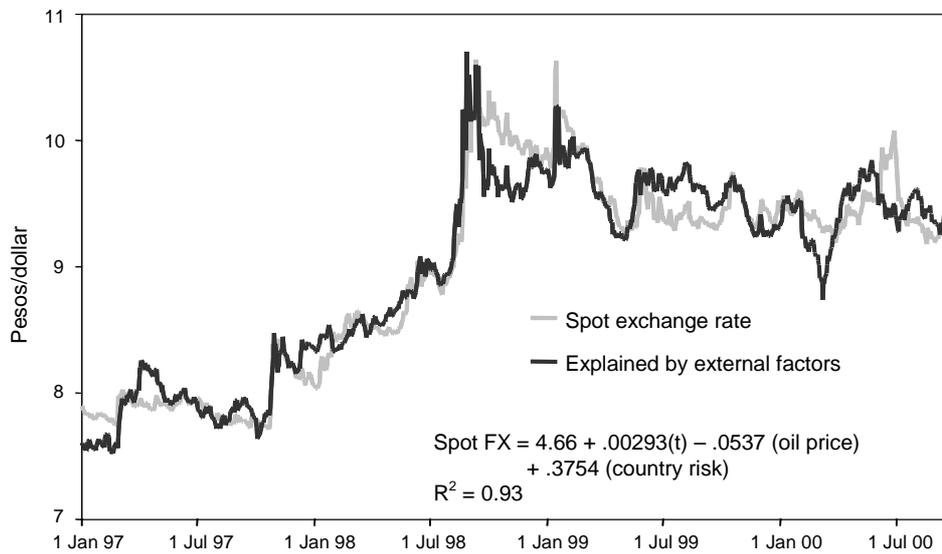
¹³ Computed by JP Morgan.

Figure 7
Exchange rate volatility implicit in three-month options¹ and country risk
 (spread between UMS 2026 and 30-year treasury bond)



¹ Implicit volatility for at-the-money three-month forward options.

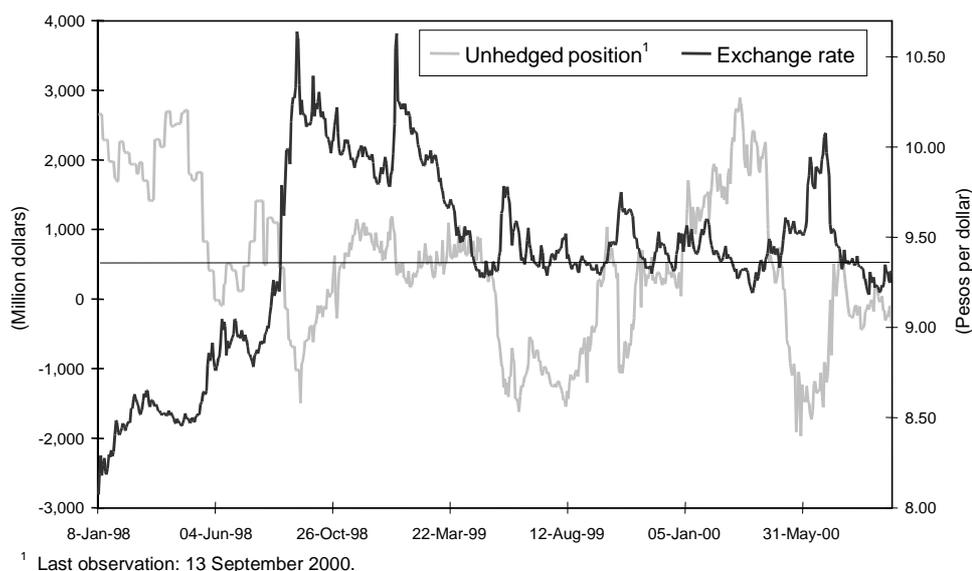
Figure 8
Exchange rate behaviour explained by external factors



Mexico's increased country risk perception and the resulting peso depreciation suggest a diminished appetite for peso-denominated debt. Figure 9 shows the behaviour of international investors' unhedged positions in fixed income peso-denominated securities and the peso/dollar exchange rate. As expected, during turbulent episodes in emerging markets, the unhedged peso position has been reduced and, on several occasions, foreign investors have more than covered their peso holdings with foreign exchange.¹⁴ Moreover, the unhedged position seems to be negatively correlated with the exchange rate.

Financial distress in emerging markets has not only been reflected in reduced foreign holdings of peso-denominated fixed income securities or equities, but also in a far more difficult environment for the private and public sectors to access international capital markets. Figure 10 illustrates how episodes of market turmoil, such as the Russian crisis and the Brazilian devaluation, resulted in a diminished placement of debt in global capital markets by the Mexican non-banking private sector, in terms both of amount and of the number of placements.¹⁵ Furthermore, in some instances capital markets were completely shut off.

Figure 9
Foreign residents' unhedged positions in fixed income peso-denominated securities and exchange rate

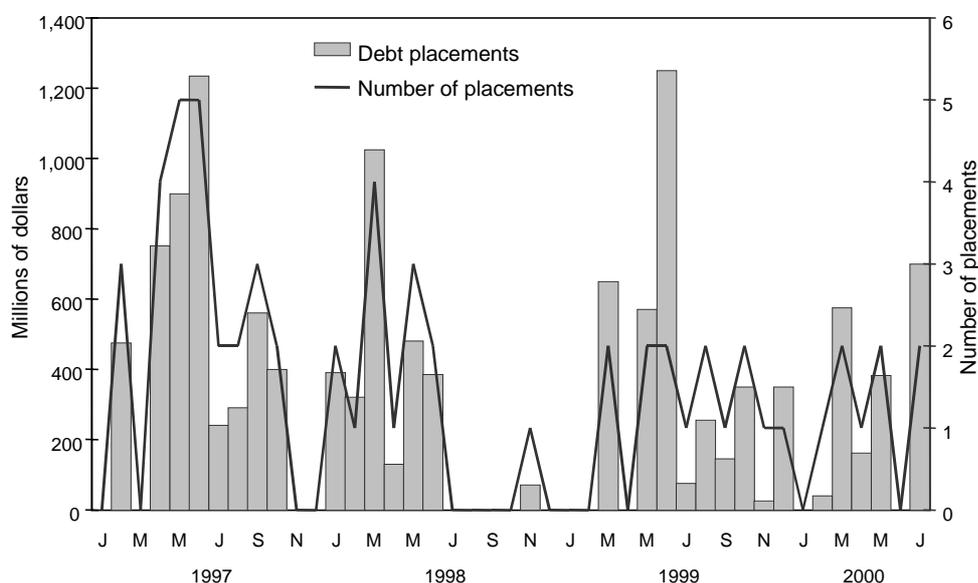


Thus, the analysis supports the claim that, during the last few years, the major shocks experienced by the peso/dollar exchange rate and peso-denominated holdings of foreign investors can be attributed in large part to the shocks experienced by other emerging markets. With this in mind, the Mexican authorities have developed proper prudential regulations on the foreign exchange exposure of banks. These regulations should allow Mexican banks to successfully confront a volatile international scenario characterised by massive portfolio shifts.

¹⁴ The unhedged position in pesos becomes negative.

¹⁵ Banking and public sector debt placements show similar behaviour.

Figure 10
**Non-banking private sector debt placements
in international capital markets**



5. Final remarks

The Mexican experience in late 1994 and 1995 was one of the first economic and financial crises to occur within the new context of integrated global financial markets. Furthermore, in recent years other emerging markets and economic regions have also been subject to severe disruptions in their financial systems. Global financial markets characterised by volatile flows of capital and abrupt movements in exchange rates can be the source of unprecedented negative externalities in domestic financial systems. These externalities can easily be magnified if financial systems are feeble and macroeconomic disequilibria are present.

This article claims that the regulation of foreign exchange risk exposures serves to soften the impact of abrupt movements in the exchange rate on commercial banks' balance sheets. This hypothesis is supported by the results derived from the significant regulatory changes that have taken place in Mexico over the past few years. Moreover, the improved regulatory approach to monitoring banks' foreign exchange risk exposure abates the pressures that financial authorities might face when market conditions deteriorate. The paper presents empirical evidence that supports the fact that the banking system of a small open economy, such as Mexico, that is integrated into global financial markets would benefit from appropriate regulation of banks' foreign exchange risk exposure. This is so because most of the major shocks traditionally experienced by the peso/dollar exchange rate have been, in large part, caused by external factors. Therefore, regulations that allow commercial banks to cushion the impact of exchange rate movements on their balance sheets provide some guarantees that domestic financial systems will not be drastically affected by the turbulence taking place in international capital markets.

In today's globalised financial markets, investors tend to react swiftly to changes in expectations. As a result, financial authorities have witnessed a drastic restriction in their ability to manoeuvre in times of market distress. Even countries with solid fundamentals can now be subject to speculative attacks. In an environment such as this, prudential regulations on foreign exchange designed to prevent the build up of imbalances take on a more prominent role. Thus, this article claims that, as a result of improved regulations, Mexican banks are better equipped to deal with sudden and unanticipated capital flows.

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