Monetary policy and its transmission channels in Mexico

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Introduction

This paper first deals generally with monetary policy and the various mechanisms by which policy measures are transmitted to interest rates, the exchange rate, the price level and output. It then uses this framework to present some features of contemporary Mexican monetary policy which has undergone a gradual process of adaptation since 1995, moving from the determination of central bank daily intervention interest rates, to a signalling mechanism based on very small adjustments in the central bank's provision of liquidity.

The paper begins with a description of the frequently misunderstood roundabout process of money creation. These misunderstandings are the origin of considerable confusion about the role of a central bank, the scope of its instruments and the way monetary policy impacts on the economy.

The reference point for the discussion will be the widespread notion that central banks can achieve short-run increases or decreases in the quantity of money.[1] This notion is found in economics textbooks, in academic journals and in many non-specialised writings.[2] Two recent examples, randomly chosen, would be the following: "Tighter monetary policy: by end-December, the central bank began to retire liquidity from

[1] The terms money and currency will be used interchangeably in this paper. Base or high-powered money can also be equated with currency because the payments mechanism in Mexico allows banks to hold practically no settlement balances.

[2] With notable, perhaps not widely known exceptions, such as Goodhart (1987) who writes: "On this thesis, the central bank undertakes open market operations, in order to vary its own liabilities, and, in the process, the reserve base of the banking system[...] In practice, however, the banking system has virtually *never* worked in that manner. Central banks have, indeed, made use of their monopoly control over access to cash and their power to enforce that by open market operations, but for the purpose of making effective a desired level of (short-term) interest rates, not to achieve a pre-determined quantity of monetary base or of some

the economy, trimming the monetary base by 4.9 billion pesos between December 27 and January 3."[3] Another statement, of an opposite nature, that seems to focus correctly on the issues is: "Since there are sound reasons (i.e., Christmas) for output to leap in the fourth quarter, this suggests that output growth causes money supply growth, and not the other way around: as consumers demand more money for their shopping, private and central banks increase the money supply."[4]

The presentation of some general principles of monetary policy in the next section will consider only some essential ingredients, so as to convey in the simplest possible manner the idea that, regardless of the institutional arrangements (whether or not commercial banks are subject to required reserves, or want to hold settlement balances), a central bank has no possibility of immediately altering even the narrowest of the monetary aggregates: the amount of currency in circulation. As Goodhart (1987) puts it, customary textbook presentations misleadingly take the traditional multiplier model as their starting-point. This approach contributes to propagating the erroneous idea that central banks can alter the quantity of money more or less as in the Patinkinesque money-from-a-helicopter parable. Because this thinking is so ingrained, the conceptual discussion will be elaborated in some detail.

The ultimate purpose of the presentation is to provide a framework for understanding the signalling procedures utilised by the Banco de México to ease or tighten monetary conditions. The final part of the paper and the two annexes deal with the Bank's utilisation of its instruments in the past two years. There is also a presentation of their impact on key variables to illustrate how the policy signals are transmitted to interest rates and the exchange rate, and from them to economic activity and prices.

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monetary aggregate[...] Indeed, central banks have historically been at some pains to assure the banking system that the institutional structure is such that the system as a whole can *always* obtain access to whatever cash the system may require in order to meet its needs[...] In short, the behavioural process runs from an initial change in interest rates, whether administered by a central bank or determined by market forces, to a subsequent readjustment in monetary aggregate quantities: the process does *not* run from a change in the monetary base, working via the monetary base multiplier, to a change in monetary aggregates, and thence only at the end of the road to a readjustment of interest rates. In reality, the more exogenous, or policy-determined, variable is the change in (short-term) interest rates while both the monetary base and monetary aggregates are endogenous variables. This reality is, unfortunately, sharply in contrast with the theoretical basis both of many economists' models, and also of their teaching."

[3] JP Morgan, *Data Watch*: Mexico. 10th January 1997, p. 9.
[4] *The Economist*, 14th–20th December 1996, p. 80.

Monetary policy principles

A monetary authority can make its credit dear or cheap and, in principle, it can also issue currency or act upon the monetary base. But the fact that it has the potential to issue currency does not mean it can do so at its discretion. It will be argued that even in the medium term, beyond a quarter or a year, for example, a central bank can increase or decrease the quantity of money only in an indirect fashion and never with the mechanical, immediate kind of result commonly portrayed as the outcome of open market operations.

The central bank will be able to modify the quantity of money only if it is able to influence the demand for money. Furthermore, the actual change in the quantity of money will take place only as the central bank responds passively to accommodate changes in the demand for money. An increase or decrease in the demand for money may have been induced months (or years) before.

One of the indirect channels for altering the quantity of money demanded is to influence interest rates. The latter can change because of modifications in the policy stance of the central bank or because international interest rate movements influence local ones. Interest rate changes induced by the central bank may act upon the exchange rate and upon aggregate demand. As they impinge upon output and/or prices, the demand for money will be affected in turn.

Movements in the demand for money may also be caused by non-monetary shocks such as an increase in the general price level brought about by a devaluation, perhaps provoked by a fall in the terms of trade or a political disturbance. But a terms-of-trade shock is also a supply shock and will cause changes in output that will influence the demand for money as well.

To construct a schematic model useful for analysing these influences a few general concepts are necessary.

The central concepts germane to the discussion are the public's demand for financial assets and the fact that banks operate under a fractional reserve system. Fractional reserve banking means that banks do not have the cash at hand to respond to variations in the public's demand for financial assets, which occurs daily as individuals' preferences shift between cash and deposits issued by commercial banks.

Typically, there are seasonal movements between cash and deposits issued by commercial banks that occur within any given week, within any given month, and also within the year. Because of fractional reserve banking these shifts have to be financed, lubricated as it were, by the central bank. But this continuous and passive accommodation by the central bank of the public's needs for cash does not mean that the central bank can go about injecting or withdrawing cash from the economy beyond what the public is demanding. Fractional reserve banking and the nature of the demand for currency do not allow it.

To substantiate this argument, fundamental to the understanding of monetary policy, it will be shown first why the central bank cannot bring about systematic and instant changes in the money supply. Afterwards, the diverse channels of money transmission and their implications for monetary policy will be explored.

To develop the argument it will be useful to start with a simplified accounting representation of the economy.

We shall consider that the central bank's only assets are credit to the commercial banks, A, and international reserves, IR. It has no capital and only one liability, represented by its own notes and coins (M0).

CENTRAL BANK	
A	M0
IR	

The consolidated balance sheet of the commercial banks will be:

COMMERCIAL BANKS	
G	D
	A

The only asset of the commercial banks is government debt, G. They also have no capital and on the liability side they issue deposits, D, held by the general public, in addition to the credit they receive from the central bank, A.

The financial balance sheet of the general public is:

GENERAL PUBLIC	
D	
M0	

This skeleton model is sufficient for the exercise that follows. Any more "realism" would not change the outcome and would add unnecessary complications.

Consider an attempt by the central bank to reduce the supply of currency, M0. In principle it can do so by trying to reduce the size of its credit to the commercial banks, A. In response to the attempt by the central bank to reduce A, commercial banks would have to:

(a) reduce G, or
(b) reduce G and increase D, or
(c) increase D.

G cannot fall automatically as a consequence of monetary policy. Since a central bank cannot determine fiscal policy or synchronise its own monetary policy with it, unfeasible alternatives (a) and (b) will be ignored.

Given the fixity of G, commercial banks have to maintain the level of their funding. Therefore, for the central bank to be able to reduce its credit, A, to the commercial banks, it would have to induce an increase in the amount of deposits held by the public at commercial banks, D. An increase in D involves a very substantial rearrangement of the public's portfolio, away from cash and into bank deposits. If this occurred, the amount of financial assets held by the public would remain the same, the reduction in credit to the commercial banks from the central bank would be compensated by the rise in deposits from the public, and the central bank would be able to contract A and M0 by equal amounts. But since M0 is needed for transaction purposes, the increase in the interest rate necessary to entice the public to instantaneously relinquish the required amount of M0 in order to hold more D would be outlandish. It is not realistic to assume that short-run, or even longer-term monetary policy could rely on such a mechanism.[5]

A strong initial conclusion is that the prevailing idea, held by many economists and lay people, that the central bank can change the amount

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[5] This conclusion holds even in systems where banks are required to hold reserves at the central bank. In those systems commercial banks' settlement balances have to be added to currency in circulation to calculate base money. Under these circumstances the central bank can increase or decrease the amount of base money since its immediate variations will come from the holdings of base money of commercial banks and not from currency.

of currency in circulation in the short run is simply wrong. To achieve this result we have been assuming, paradoxically, that the central bank can control the supply of currency, at least in principle. To be able to increase the supply of currency someone has to be willing to demand the expanded amount.

A change in the quantity of money brought about by the central bank's deliberate actions also requires a flexible exchange rate and an adjustment period. Under a fixed exchange rate regime the central bank can raise interest rates and bring about an increase in its foreign assets. However, in order to preserve the increase in reserves, the central bank has to prevent the credit expansion that would result from the exchange of local for foreign currency, by reducing its credit by the same amount.[6] If it does so, international reserves will increase and their expansionary pressure will have been prevented. This phenomenon should be viewed as a domestic interest rate rise with minimal, if any, short-run consequences on M0. It will, however, be an inducement to holders of foreign assets to shift their worldwide portfolio in favour of the assets of the country which has raised its interest rate. D will rise but not at the expense of a decrease in M0.

Sterilisation does not imply a modified stance of monetary policy, but only the achievement of a different portfolio structure. Sterilisation by the central bank of foreign capital inflows entails a reduction of A in order to accommodate the increase in IR. Commercial banks will experience a reduction in A but also a rise in D held by non-residents by the same amount. The domestic credit provided by the central bank, in this example simply A or (M0−IR), will have shrunk. This reduction in central bank credit to the commercial banks occurs simultaneously with a compensating increase in non-resident bank deposits, so that total credit to the economy is not diminished and no contraction in the amount of currency in circulation has taken place.

The conclusions derived above are arithmetically incontrovertible, as they are accounting identities. But it is useful to spell them out in detail in order to emphasise the relationship between the different variables considered, given that economists' reports, politicians' statements and press articles reveal a serious confusion about them.

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[6] This action is called sterilisation.

An additional discussion of the fixed-exchange-rate special case (known in the literature as the Mundell-Fleming model)[7] would reinforce the original conclusion reached with the simplified accounting model used above: the central bank cannot induce immediate or short-run contractions in the money supply. This conclusion in no way contradicts the possibility for the money supply to increase if, for example, under a fixed exchange rate the demand for money is growing because nominal income is rising. Nominal income may increase as a result of economic growth and perhaps because of some imported world inflation, or as a consequence of the evanescent effects of past exchange rate depreciations. In such situations the central bank will automatically provide the increase in the demand for cash. The Bank will finance these increases from its own credit or from increases in international reserves, depending on the circumstances.

Furthermore, irrespective of the exchange rate regime, it should be emphasised that for money supply reductions to take place in the short run, unrealistic portfolio shifts by the public are required away from its daily cash needed for transactions into non-liquid, interest-bearing deposits. A symmetrical treatment would lead us to similar conclusions when dealing with money supply expansions.

It could be argued that the discussion so far has ignored the price level and that if prices fall when the central bank reduces the nominal supply of money, the real purchasing power of cash balances will be maintained. Large short-run price swings, however, can be ignored because, as will be argued, price movements reflect the delayed outcome of monetary actions in the distant past. Thus, while monetary policy tends to work as predicted in theory, i.e. inflation is a monetary phenomenon caused by excessive central bank credit expansion, contemporary price rises and money movements are the result of shocks, monetary or otherwise, that occurred months and sometimes even years earlier. This means that the monetary expansion witnessed at any moment is the outcome of past decisions taken by the central bank or by the government which have given rise to a delayed increase in the demand for money.

The reasoning and conclusions above can also be applied to a system in which banks hold settlement balances at the central bank either voluntarily or because of reserve requirements. If banks have cash

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[7] See Mundell (1963) and Fleming (1962).

balances at the central bank, they will be able to reduce them if the central bank contracts M0. They will actually be forced to do so in order to fulfil their payment obligations. This withdrawal is equivalent to central bank credit or to rediscounting of government paper.

The transmission channels of monetary policy

If the nominal money supply is neither a lever available to induce immediate changes in the stock of currency nor a trigger for short-run movements in the general price level, how does monetary policy work?

It was shown above how fixed exchange rate allows the central bank to vary the level of international reserves but not the monetary base. The reason is that under a fixed exchange rate the supply of money is demand determined even in the medium or long term. To induce changes in the demand for money, a flexible exchange rate is required. Under such an arrangement a monetary expansion can be brought about through the various channels that influence the nominal exchange rate. One is for the central bank to engage in non-sterilised purchases of foreign currency. In the central bank's balance sheet this will be reflected by parallel and equal movements in IR and in M0: as it purchases foreign currency, the central bank will induce an increase in the assets held by commercial banks on their central bank accounts. In our simplified accounts, commercial banks will hold a greater amount of M0 (non-interest-bearing deposits) at the central bank. As they withdraw these non-interest-bearing assets and try to place them among borrowers, lending rates will fall and banks will also be compelled to lower the interest rates paid to depositors. However, since in the simplified balance-sheet presentation the government is the only borrower from the banks, the excess non-interest-bearing cash in the hands of the banks will induce them to reduce the interest rate paid to depositors as well.

As interest rates fall people will either spend more on goods and services, thus putting pressure on the current account of the balance of payments, or purchase foreign assets. These outflows will tend to depreciate the exchange rate, since one cannot presume that a home-made credit expansion will automatically bring in compensatory foreign flows to match the additional aggregate demand and to finance the resulting balance-of-payments deficit.

The depreciated exchange rate will filter through to the price level via various channels. One is direct: the local currency cost of imports goes up, as do the prices of exportable goods sold domestically. These rises will encourage increases in the prices of local goods which are a substitute for or complementary to foreign ones. When imported inputs and capital goods become more expensive, firms will be induced to raise prices to maintain profit levels and to generate a flow of income sufficient to replace their capital goods. All these price rises will, in turn, increase the nominal demand for cash. Since depreciation shocks in Mexico have invariably been associated with a fall in internal demand, protracted price adjustments may also reflect the restoration of profit margins made possible by the gradual recovery of internal demand to its former levels.

How the increased demand for cash produced by higher inflation manifests itself and is then met is key to the transmission mechanism. Some of the additional currency is supplied as the demand for it rises in response to the immediate price increases. But the price adjustments triggered by a depreciation of the exchange rate are spread over time, partly because expectations take time to adjust, and partly because non-traded services contracts are frequently staggered so that prices may take several years to catch up (Gil Díaz and Carstens (1996a and b)). As price rises spread, the demand for nominal currency undergoes futher increases. This demand shows up as currency is withdrawn from the banks through the exchange of D for M0.

As noted above, the daily lubrication of the payments system traditionally performed by central banks ensures that the additional demand for money is properly taken care of. As banks lose deposits while providing currency to the public, they will turn to the central bank to replenish their shrinking liabilities with central bank credit for an equivalent amount. The central bank injects or withdraws credit every day in response to such fluctuations: it accommodates the demand for currency. In its endeavour to ensure that the payments system clears every day, the central bank automatically supplies the cash which the public demands. Thus, credit expansion fuels inflation through its effect on the exchange rate and the ensuing inflation, in turn, induces currency expansion.

The two-way mechanism described above is helpful to illustrate the linkage between policy actions and subsequent events, but is not likely to occur since it is uncharacteristic for central banks to cynically purchase

foreign currency in order to inflate. More realistic scenarios must be looked for.

One is to have the central bank determine interest rates.[8] Most central banks implement daily liquidity expansions or contractions by charging or paying an overnight or very short-run interest rate. This rate will influence the whole structure of interest rates in a variety of ways. Since the overnight rate is viewed by the market as a benchmark, arbitrage possibilities will ensure that market interest rates on some 28-day instruments will tend to equal $(1+d)^{28}$, where d is the daily expected central bank interest rate. In turn, other term deposits will react to changes in the one-month rate so that the one-day rate will end up influencing the overall term structure of interest rates.

Another powerful transmission mechanism will be the implicit announcement effects of an interest rate change. An adjustment of the daily interest rate by the central bank may signal to the market that the central bank aims for a tighter or looser stance. Such a change could have an amplified effect on the level of interest rates beyond the impact via the arbitrage mechanism described above, if the markets believe that the change portends a trend, the continuation of a trend and even, if necessary, a future sharpening of the stance.

If, as argued above, the very short-run interest elasticity of the demand for currency is zero, what purpose can be served by trying to raise or lower interest rates? If a rise in the interest rate will have insignificant effects on the public's preferences between currency and deposits, the central bank would appear to be severely constrained in trying to influence the amount of currency in circulation. But we shall see that it can do so, albeit with a significant delay, through its power to influence the determinants of the demand for currency.

In the short run the central bank has virtually no possibility of altering the demand for currency and, consequently, its supply, but its ability to change interest rates has powerful, if delayed, effects on both variables. A rise in interest rates, for instance, will depress consumption and investment, resulting in a dampening of aggregate demand. As this happens, the general price level will fall or rise less than it would otherwise have done. The drop in inflation will make the nominal demand for currency lower

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[8] The central bank can do this through various mechanisms: it can use keynote tender operations at fixed rates (fixed rate tenders), or it can target short-run or overnight interest rates through variations in its provision of liquidity.

than it would have been without the change in the policy position of the central bank.[9] Thus, the eventual fall in the supply of money, or its smaller increase, is brought about not by directly reducing its nominal supply but by influencing the economic determinants of its demand.

A higher interest rate will produce other effects that reinforce those already described. It will attract capital inflows and, through its negative impact on aggregate demand, will tend to reduce the demand for foreign currency or increase its supply through its effect on some current account transactions of the balance of payments. Both outcomes will tend to appreciate the exchange rate and, thereby, contribute to reducing inflation. In some countries the direct link between the exchange rate and prices will be immediate and strong. In others, the relationship between interest rates and aggregate demand may dominate.

It may also be of interest to consider the opposite case of a rise in inflation. If the central bank lowers its interest rate, the end-result may be to stimulate aggregate demand and depress the exchange rate. Both developments will tend to raise inflation. Higher inflation will increase the nominal demand for currency, and the daily lubrication of the payments mechanism by the central bank will translate this higher demand into a correspondingly higher degree of monetary accommodation.

An expansionary stance of the central bank therefore will gradually filter through to the price level and with it to the nominal demand for currency because of the time required to go through the different steps in the transmission mechanism and, as argued before, because of the fact that contracts are typically staggered over time. Inflationary expectations play an important part in determining the duration of contracts governing wages, rents, tuition, etc. To the extent that contracts are not revised every day and overlap over time, price adjustments may take years to work through, whether they originate in shifts in aggregate demand or changes in the exchange rate.

In this fashion, the observed contemporary price rises are the outcome of past modifications in the central bank's policy stance, or of previous supply shocks or political disturbances. It is in this sense that,

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[9] The total effect of the policy change on the demand for money is somewhat more complicated. Sooner or later lower inflation will bring about a decrease in nominal interest rates. Therefore, the decrease in the demand for money due to lower inflation will be compensated, to some degree, by an increase in its quantity demanded. But from experience, it can be safely concluded that the first effect will eventually dominate and lower inflation will generally mean a lower nominal demand for currency than would otherwise have occurred.

following Friedman (1968), monetary policy has delayed and changing effects on prices.

Mexico's monetary policy

While the transmission channels examined above differ in intensity across countries because a vast variety of institutional arrangements and historical experiences exist, they represent the range of options available to central bankers and policy-makers around the world. Depending on preferences, on the degree of central bank independence and credibility, on the level of present and past inflation, on the size and openness of the economy, among other variables, the central bank will choose a set of objectives and operational variables to carry out its task.

Some countries, such as Canada, have chosen a floating exchange rate, with foreign exchange interventions implemented in such a mechanical and predictable fashion that their regime can be likened to a free float. The central bank modifies its stance if it feels that circumstances call for such a change. Others, such as New Zealand, have also maintained a free float, albeit without lubricating interventions in the foreign exchange market. In the case of New Zealand, the central bank favours issuing statements that send a signal to the market and exert a subtle and sophisticated influence on freely determined market interest rates (see Reserve Bank of New Zealand (1992), p. 73).[10]

The reference to New Zealand seems appropriate because recently the course of monetary policy in Mexico has shown some parallels with that country's experience, although Mexico's evolved independently.

From the onset of the 1994 peso devaluation and the ensuing financial crisis, to the present day, the Banco de México has continued its practice of setting its settlement cash target daily to accommodate the demand for currency, but it has radically modified its mode of intervention. Before the crisis fixed rate tenders were often used to set each day the interest rates at which it would conduct its intervention to withdraw or inject liquidity.

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[10] Signalling is a technique widely used by central banks (Borio (1997)). Regarding the supply of bank reserves by the Bank of Canada, Borio reports (p. 26): "Supplying, say, a somewhat larger amount than that targeted by banks is expected to put downward pressure on the overnight rate. It is still an open question, however, how much of the downward pressure occurs through a mechanical liquidity effect or, more fundamentally, through the signal conveyed regarding monetary intentions."

The crisis, however, brought about a nominal depreciation of the exchange rate of more than 100%, high and variable inflation and, initially, a severe slump in the real economy. The situation was further complicated by highly volatile perceptions abroad of Mexico's prospects.

In such a context it would have been highly inadvisable to attempt to set an interest rate for central bank transactions. Too low a rate, perhaps causing real interest rates to turn negative, would have encouraged lending and higher inflation. Too high a level would have aggravated the problems faced by borrowers and the portfolio difficulties experienced by commercial banks. Thus, it was decided that the accommodating stance of the central bank as regards the demand for currency would be complemented with a freely-floating, market-determined interest rate on the central bank's daily operations with commercial banks.[11]

Given this arrangement, the question arises as to the type of procedure the central bank could use if it considers that intervention is appropriate. A variety of circumstances could call for intervention: for example, the central bank might believe that inflation is rising too quickly; it could fear that rapid exchange rate movements might provoke a bandwagon effect; or it could view the rate of growth in total credit as excessive.

To influence monetary conditions, the Reserve Bank of New Zealand has relied on carefully prepared statements of its Governor or senior officials. The Bank for its part uses a daily announcement of its target for the cumulative or average amount of settlement balances for signalling purposes. Movements in the target for the cumulative balance are translated into changes in the amount of settlement balances that the Bank injects or withdraws at auction-determined interest rates in its daily operations with commercial banks. Movements in the cumulative target have been so minuscule that they amount to something akin to the moral suasion that many central banks have sought to impose through policy statements.[12]

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[11] This strategy is not unique. Again quoting Borio ((1997, p. 50): "The initial move towards more market-oriented means of policy implementation away from standing facilities and, in some countries, the greater focus on quantitative objectives for operating and/or intermediate aggregates went naturally hand in hand with implementation strategies where central banks gave less guidance about desired interest rates. At a time when reducing inflation was paramount, these policies were also seen as a way of shielding central banks from social and political resistance to unpalatable increases in interest rates".

[12] See Tait and Reddell (1992, pp. 72–73). As to the question "How can mere announcements have such a critical effect?" Borio (1997, p. 57) notes: "The answer perhaps lies in the fact that as a monopolist supplier of settlement balances, the central bank *could*, if it so wanted, set the overnight rate."

With regard to current monetary management in Mexico, the daily operations of liquidity injection or withdrawal are effected in the context of a zero reserve requirement for the accounts of commercial banks at the central bank. Given the characteristics of the Mexican payments system,[13] banks are confident that they will be able to overdraw or add to their central bank accounts if on any given day there is insufficient or excess settlement cash. In practice, imbalances are relatively small because of the daily targeting procedures and the close co-ordination between the Treasury and the Bank. The Treasury will not issue a payment on t of which it did not give notice on t-1, and commercial banks, through which all tax revenues (including customs duties) are channelled, give notice on t–1 of Treasury income to be deposited on the Treasury's account at the central bank on t. With daily settlement cash targets always including compensation for t–1 errors, the amount of net settlement balances demanded by commercial banks on any given day is virtually nil. Complementing these procedures is a central bank policy of aiming for a zero, or near-zero, excess supply of settlement cash on any given day.

A crucial element of the zero average reserve requirement scheme is the daily announcement by the Bank of its target for the cumulative balance of commercial banks' accounts at the central bank for the next day's market opening. Thus, for example, announcing a zero objective for the cumulative balance implies a neutral monetary policy, while a movement to a negative target would signal a tightening of monetary conditions.

Overdrafts can be easily induced. The Bank injects or withdraws credit, as the case may be, in its daily operations in order to accommodate the fluctuations in the demand for currency. If less credit than

[13] Daily government operations are known with certainty one day prior to their taking place. Up to mid-1995 all the daily movements in the government and bank accounts at the central bank were offset daily through a second auction of settlement cash known as the "milkman's market", as it was conducted before banks open for business, at the previous closing-day value date. This system was transformed into the present one, which allows banks to draw settlement balances within the 28-day zero reserve requirement period. Within this period the market knows that the central bank will offset completely all movements on its accounts by means of a second daily auction of settlement balances which is conducted at least each closing 28th day of the cycle. The rule of fully offsetting account balances is altered only when the central bank deliberately modifies its stance, thereby forcing the banks to overdraw their current accounts at the central bank. But as noted in the text, these overdrawings are so small, that they can only be interpreted as signals: in 1995 the largest overdrawing amounted to 40 million pesos, or barely $5 million out of $200 billion of bank liabilities.

needed is injected, the banking sector as a whole will incur an overdraft on its central bank accounts.

Above conclusions do not hinge on a system of zero reserve requirements, nor on a banking system that holds practically no settlement balances, nor on the resulting identification of currency with the monetary base. If banks were required to hold a fraction of their liabilities deposited at the central bank, an error in targeting the daily cash needs (e.g. a shortfall) by the central bank would be cushioned by withdrawals from their accounts. This mechanism does not differ in any essential way from the workings of a system based on zero reserve requirements. The same applies to the process, favoured in some countries, of rediscounting of government paper by the commercial banks at the central bank. Under a system of zero reserve requirements the central bank can also set a daily cash target different from zero, or alter it if it wishes to influence monetary conditions, with effects that are indistinguishable, analytically and quantitatively, from what would occur under a system in which banks need to hold settlement balances or are required to maintain reserves at the central bank.

Graphs 1 and 2 illustrate the development of key monetary variables and their relationship with policy changes. The graphs show the behaviour of the spot exchange rate, of a leading market interest rate and of the changes in the Bank's target for settlement cash throughout 1995 and 1996. The interpretation of the latter is as follows: from 2nd to 23rd January 1996, the central bank merely accommodated the daily demand for currency, that is, it left at zero the amount of commercial banks' settlement balances at the central bank. On the latter date it changed its stance from neutral to -5 million pesos and on 25th January to -20 million, where it was held until 7th June, when it was changed to -30 million.

A 10 million peso shortage induced by the central bank until the closing 28th day of the cycle, meant that some commercial banks ended up paying twice the Treasury bill rate on the amount of their overdrafts at the end of the 28-day averaging period used to calculate their compliance with the reserve requirement. The reserve requirement, or the amount that banks have to hold on average in their accounts at the central bank, is at least zero.

The amounts involved mean nothing quantitatively: 10 million pesos amount to 0.0000063 of the average liabilities of the banking system in

Graph 1

Banks' funding rate, the spot exchange rate and the objective for accumulated balances, 1995*
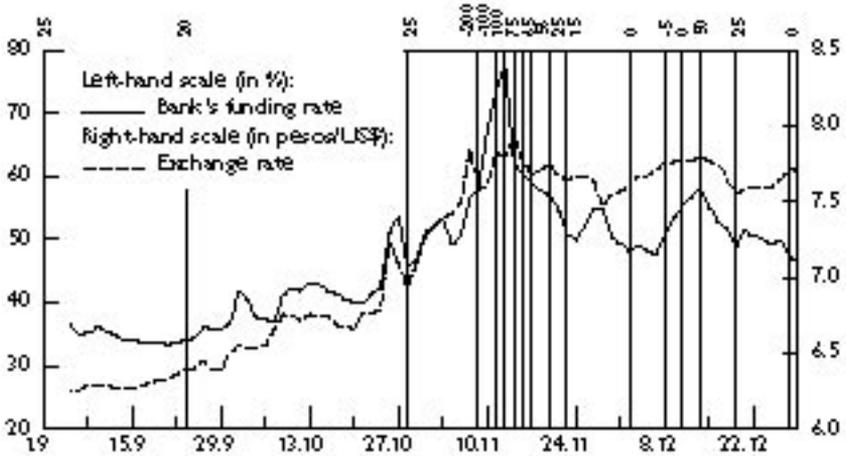
* Accumulated settlement balances in millions of pesos are shown on the top scale.

Graph 2

Banks' funding rate, the spot exchange rate and the objective for accumulated balances, 1996*
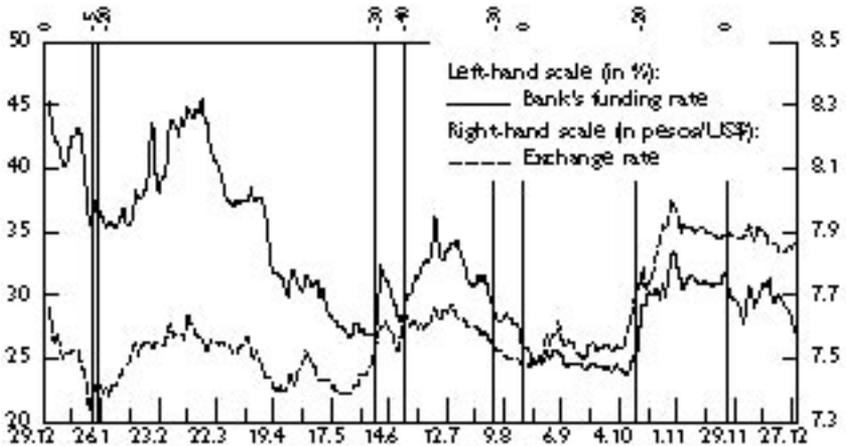
* Accumulated settlement balances in millions of pesos are shown on the top scale.

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1996. The interest cost involved is also insignificant. Yet, as the graphs show, these small movements in the central bank's daily accommodation were signals that the market took into account and to which they reacted accordingly.

A few of the several instances in which the central bank felt it appropriate to act could be analysed. On 7th June 1996 the exchange rate started to depreciate too quickly. This led the Bank to withdraw 30 million pesos from the market instead of the previous 20 million. Shortly afterwards the exchange rate again showed some nervousness and the amount was raised to −40 million. Graph 2 illustrates how interest rates reacted immediately. It also shows that periods of exchange rate appreciation were associated with falling interest rates, as in the period from 22nd February to 14th May 1996. An example of the opposite movement is the period from 3rd to 29th July 1996. In both periods shifts in the exchange rate and in interest rates occurred in the absence of policy changes, simply as the result of natural market forces reflecting how, when the exchange rate depreciates, the demand for funds to purchase foreign exchange leads to higher interest rates, given that the neutrality of the central bank's stance implies that it will not inject excess funds into the system.

Another interesting feature of the variables depicted in the graphs, is that the announcement effect of shifts in the central bank's stance seems to fade rapidly. A negative (restrictive) stance maintained long enough can be found to be associated with falling interest rates and vice versa. Possibly because of the very small amounts involved, the changes in the stance more than its sign or absolute value therefore seem to be what matters.

The transmission channels of the Mexican economy have been well documented in several research papers, some of which are quoted in the list of references below. These channels are closely related to the degree of openness of the economy. Prices in Mexico have a long history of sensivity to the exchange rate. This relationship and its speed have been reinforced by the broad opening-up to trade of the Mexican economy since 1985: current account transactions, excluding interest flows, accounted for 34% of GDP in 1993, 38% in 1994, 58% in 1995 and 60% in 1996 (national accounts figures).

A recent study (Pérez-López (1996)) has shown that in Mexico the behaviour of the exchange rate and that of wages maintain a close

relationship with the evolution of prices. Moreover, this study suggests that a 10% rise in wages causes a 6% increase in the price level over a seven-month period, while a 10% depreciation of the exchange rate generates a 4.5% increase in the price level during the subsequent eight months.

The cause-and-effect relationships are more complex than what statistical correlations appear to corroborate. If the nominal exchange rate had remained fixed from 1994 until the present, for instance, most analysts would agree that nominal wages would have exhibited far smaller increases, so that, even though salary increases bear on prices, wages are also influenced by exchange rate depreciations. Nominal wages inevitably adjust upwards after a devaluation in response to the price increases provoked by the depreciated exchange rate, and wage hikes will be reflected in price jumps that, in turn, will feed into wages again until, if the nominal exchange rate remains at its new, depreciated level, these ever-smaller adjustments peter out. Causation thus appears to be from devaluation to prices, with wages playing catch-up and nudging along price increases with another ultimate cause.

Economic causality appears to be from interest rates to the nominal exchange rate and then to output, and from exchange rate movements to prices, from prices to wages and again from wages to prices. The output relationship has been left until the end because in recent years the impact of exchange rate movements on variations in real output in Mexico has been rather modest under conditions of high inflation. With fast inflation nominal exchange rate variations swamp real ones. Of course, from a welfare point of view, the output link is more important. Again, it has been the Mexican experience (documented in Pérez-López, (1995)) that deviations of the real exchange rate from its stationary level create fluctuations in output. A depreciation of the real exchange rate is associated with a fall in output and vice versa for an appreciation. Since shifts in monetary policy will have effects on the nominal exchange rate, the real exchange rate will be transitorily affected by modifications in the stance of the central bank. The effect of the real exchange rate on output will of course also feed into changes in the demand for money.

The graphs contain another lesson. A neutral accommodating stance is not equivalent to inaction on the part of the central bank. Free floating of interest rates and the exchange rate implies that both variables fluctuate in a sychronised way to absorb shocks. If capital flows out of the country

the adjustment will be spread between both variables, credit will become scarcer and the exchange rate more depreciated. An invariant supply of liquidity by the central bank, understood as modifying its credit solely to accommodate the daily fluctuations in the demand for cash, implies that speculators cannot count on the provision of central bank liquidity to finance their outflows. Therefore, interest rates rise as capital flows out, making speculation more expensive and helping to stem or halt the outflow. In a Canadian context, this would be equivalent to monetary conditions showing compensating movements with no intervention by the central bank. Therefore, a stance of merely accommodating the demand for currency is indeed a policy, viz. a policy consisting of not allowing conditions to loosen when there is a run. A symmetrical reasoning applies to ex ante capital inflows.

Annex 1

The operational framework of the Banco de México

The operational framework adopted by the Banco de México to implement its monetary policy comprises a reserve requirement with averaging around a level of zero reserves over a 28-calendar-day maintenance period. The regime was introduced in March 1995 to allow the Bank to send quantitative signals to the money market without determining interest rate levels.

Under the scheme, the Bank does not remunerate positive settlement balances nor does it charge for overdrafts posted at the end of each day in the commercial banks' current accounts at the central bank. However, it charges a penalty rate at the end of the maintenance period, if the cumulative (average) balance is negative. The cumulative balance is defined as the sum of the daily positive and negative (overdraft) settlement balances. The penalty is meant to give banks an incentive to end the maintenance period with a zero cumulative balance and is equal to twice a market-determined rate. The magnitude of the penalty is set at such a high level in order to make the net cost of end-of-period negative cumulative balances similar to the net cost of holding end-of-period positive cumulative balances.[14]

In order to prevent large fluctuations in commercial banks' account balances and to reduce the capacity of banks to take leveraged positions to influence interest rates, limits were established for the overdraft facility and for the amount of positive balances that count towards the cumulative balance (Graph 3). The limits were set on an individual basis related to each bank's capital.

The Bank intervenes every day in the money market injecting or withdrawing liquidity. The Bank determines the amount of its intervention so that the sum of all banks' cumulative balances at the end of the day adds up to a predetermined amount. The Bank announces every day the predetermined amount and uses it to signal its monetary policy intentions

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[14] The net cost of an end-of-period negative cumulative balance is equal to twice a market-determined rate minus the return from investing at market rates the funds obtained through the overdraft. The net cost of an end-of-period positive cumulative balance is equal to the return forgone by not investing the funds in the market.

Graph 3
Positive and negative balances in banks' accounts
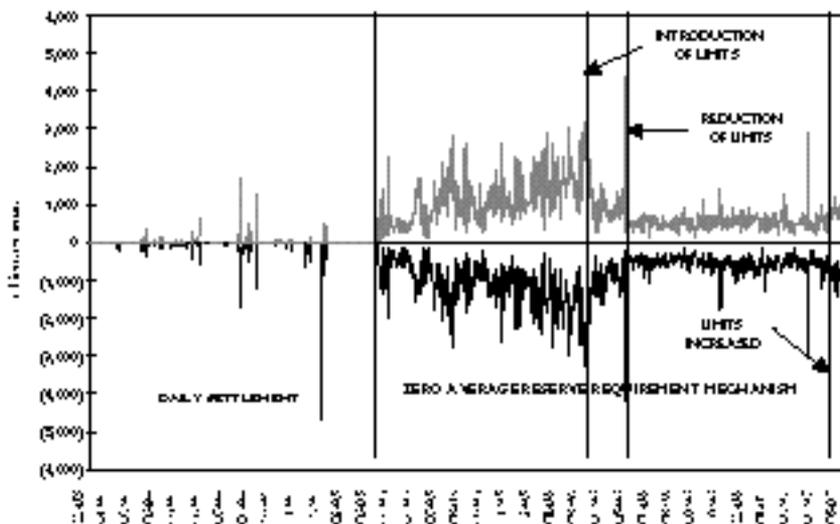
(Table 1). Thus, a reduction in the Bank's target for the cumulative balance would indicate its intention to tighten its monetary stance, whereas an increase would signal its intention to ease policy.

Table 1
Daily information to the market
In millions of pesos

Notes and coins in circulation at the close of the previous day	84,809
Net balance of banks' accounts at the close of the previous day	0
Aggregate cumulative balance	− 1
Projected pre-intervention cash position of the system	−3,981
Central bank intervention in the money market	−3,982
Target for the cumulative balance	0

The Bank does not use an official interest rate nor does it set maximum or minimum levels for interest rates during its interventions in the money market. All interventions are carried out through auctions (Table 2) in which the Bank determines the quantities and the market freely sets the interest rates.

Table 2
Instruments

Instrument	Provide liquidity	Withdraw liquidity	Maturity
Repos	*	*	1 to 56 days
Credits	*		1 to 56 days
Deposits		*	1 to 56 days
Purchases or sales of securities . .	*	*	91 to 364 days

The Bank intervenes every business day to bring the cumulative balance to the announced target. In doing so, it takes into account all transactions that have an impact on the balance in the banks' settlement accounts at the central bank, such as changes in currency demand, government receipts and disbursements, foreign exchange interventions and the falling-due of previous open market operations. The Bank has complete prior information on all these operations, except for cash deposits or withdrawals made by credit institutions to meet changes in the demand for currency. The Bank credits (or debits) banks' current accounts on the same day as banks deposit the notes taken from the public or withdraw them. Therefore, each day the Bank includes its own daily forecast of changes in the demand for notes and coins[15] in its estimate of the intervention in the money market (Graph 4 and Table 3).

Graph 4
Demand for notes and coins
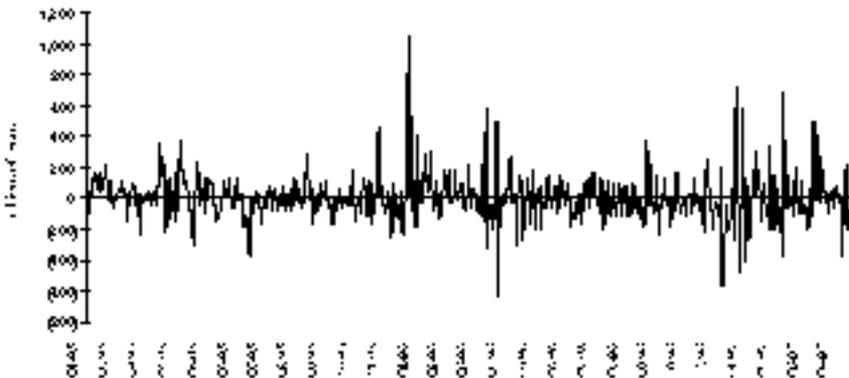
Table 3
Daily demand for notes and coins: forecast errors
In millions of pesos

Year	Mean	Standard deviation	Mean of absolute deviation	Volatility
1995	8.7	128.5	85.7	147.1
1996	−4.1	160.9	107.7	208.4
1997	3.6	183.5	130.4	161.7

Average monetary base in 1997 = 76.2 billion pesos.

Table 4
Interbank market (May 1997)
In millions of dollars

	Average number of daily transactions	Average daily transacted value	Average daily value per transaction
Government securities . .	1,699	19,339.5	11.38
Commercial and development banks' notes .	1,010	30,638.3	30.33
Pre-settlement market . .	43	500.4	11.64

Average exchange rate: 7.9031 pesos/$.

[15] In Mexico, commercial banks' demand for settlement balances is relatively small, making the monetary base almost equal to the demand for notes and coins. This is due to the following reasons: (a) the Bank offsets all changes in the settlement balances of the commercial banks' accounts; (b) it provides daylight credit; (c) commercial banks can overdraw their accounts at the end of the day during the maintenance period; and (d) there is a pre-settlement market (see Table 4) in which commercial banks are allowed to borrow and lend among themselves after their settlement positions are known and third parties are no longer permitted to transact.

Interest rate impact of selected shocks: econometric evidence

To assess the effect on short-term interest rates of changes in the Banco de México´s target for the cumulative balance, a regression was run using the interbank overnight interest rate as the dependent variable and the 30-year US bond yield, the peso/dollar exchange rate, liquidity shocks[16] and the Bank's target for the cumulative balance (CB) as explanatory variables. The results obtained show that short-term interest rates react to the signals sent by the Bank but not to transitory (unintended) liquidity shocks.[17]

The sample period runs from early September 1995, when the Bank established the system of zero average reserve requirements with synchronised maintenance periods for all banks,[18] to end-December 1996, one month after it changed its monetary stance for the last time.[19] Daily data were used.

To provide a test of the stability of the coefficients obtained, the sample was divided in two. The first sub-period runs from 7th September 1995 to 14th March 1996, when the Bank imposed limits on the settlement balances counting towards the cumulative balance. The second sub-period runs from 15th March 1996 to 31st December 1996. The results for the whole period and for the two sub-periods are shown in Table 5.

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[16] The source of the liquidity shock is a central bank error in its daily forecast for notes and coins in circulation. A negative shock occurs when the actual demand for notes and coins exceeds the demand forecast by the Bank and thus commercial banks end up overdrawing their accounts at the central bank to satisfy the public's demand for notes and coins.

[17] Juan-Ramón (1996) and Thorne (1997) found similar results.

[18] From March to August 1995 the maintenance period for reserve requirements of the various banks was overlapping in time.

[19] The last modification of the policy stance was on 8th November 1996 (this paper was completed in August 1997).

Table 5
Interest rate impact of selected shocks

	Interest rate effect in basis points			Days to complete the effect		
	Whole period	First sub-period	Second sub-period	Whole period	First sub-period	Second sub-period
Transitory liquidity shock of 100 million pesos . . .	+ 5	+ 14	–	..*	1	–
Increase of 10 million pesos in the Bank's target for the CB	– 70	– 70	– 90	4	4	3
Depreciation of 10 cents in the peso/dollar exchange rate	+222	+231	+217	3	3	3
Increase of 1 basis point in the 30-year US bond yield	+ 5	+ 10	–	4	4	–

* The effect is purely transitory.

References

Borio, Claudio E.V. (1997): "Monetary policy operating procedures in industrial countries". *BIS Working Papers*, No. 40, March.

Copelman, M. and A.M. Werner (1996): "Exchange rate policy and the bank lending channel: Sectoral evidence from Mexico". *Working Paper Series*, Federal Reserve Board, Washington, D.C.

Fleming, J. Marcus (1962): "Domestic financial policies under fixed and under floating exchange rates". *IMF Staff Papers*, 9(3), pp. 369–80.

Friedman, Milton (1968): "The role of monetary policy". *American Economic Review*, 58(1), pp. 1–17.

Gíl Díaz, Francisco and Agustín Carstens (1996a): "One year of solitude: some pilgrim tales about Mexico's 1994–1995 crisis". *American Economic Review,* 86(2), pp. 164–69.

Gíl Díaz, Francisco and Agustín Carstens (1996b): "Pride and prejudice: the economics profession and Mexico's financial crisis, 1994–95". Document prepared by the Dirección General de Investigación Económica, Banco de México.

Goodhart, Charles (1987): "The monetary base", in John Eatwell, Murray Milgate and Peter Newman (eds.): *The New Palgrave dictionary of economics.* London: Macmillan.

Juan-Ramón Hugo (1996): "The daily conduct of monetary policy in Mexico". International Monetary Fund.

Mundell, Robert, (1963): "Capital mobility and stabilization policy under fixed and flexible exchange rates". *Canadian Journal of Economics and Political Science*, 29(4), pp. 475–85.

Pérez-López, Alejandro (1995): "Un modelo de cointegración para pronosticar el PIB de México". Banco de México, *Documentos de Investigación*, No. 9504.

Pérez-López, Alejandro (1996): "Un estudio econométrico sobre la inflación en México". Banco de México, *Documentos de Investigación*, No. 9604.

Tait John and Michael Reddell (1992): "The operation of monetary policy", in Reserve Bank of New Zealand: *Monetary policy and the New Zealand financial system*. Third edition.

Thorne Alfredo (1997): "Assessing the effectiveness of monetary policy", in JP Morgan: "México's monetary policy". Economics Research Note, México, 24th January.