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Comments are welcome.

Uncovering Central Bank's Monetary Policy Objectives: Going Beyond Fear of Floating

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Abstract

Peruvian floating exchange rate system could be characterized as a phony floater according to Calvo and Reinhart (2000) and Levy and Sturzenegger (2000). Economies with large liability dollarization ratios have little room to allow highly volatile exchange rates. Therefore, central banks do not follow a unique objective of price stability but its preferences include an implicit exchange rate objective. From a mlogit framework -to account for exchange market intervention probability- and a monetary policy reaction function -built following Clarida, Gali & Gertler (1997)- we found evidence suggesting an implicit defense on the level of the exchange rate. Going beyond the argument of fear of floating as a key explanation of this implicit exchange rate band, we explore the reasons behind the fear and the need of following certain objectives in liability-dollarized economies.

JEL Codes: C52, E52

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1 Introduction

The debate on exchange rate regimes have move toward a new stage in which there is mounting evidence that many floating countries are phony floaters. Emerging countries with officially floating regimes, seem to behave more like a fixed exchange rate regime in which there is an implicit defense on the level of the exchange rate. The basic features of these regimes are (1) a huge amount of forex reserves, (2) an exchange rate with very little variance, and (3) highly volatile domestic interest rates.¹

The motivation of this paper is to explain why countries behave in this way. Hausmann, Panizza & Stein (2000) suggest two explanations. The first one is that these countries have high exchange rate pass through coefficients and therefore any external shock will push inflation up. A second possibility is that these economies face large currency mismatches as a large fraction of firms and households have dollar-denominated obligations and are incapable of generating dollars. Even though the authors find merit in both explanations separately the effect of the first one weakens as both arguments are taken at the same time. One possible explanation is that the risk of a higher inflation due to a shock in the exchange rate is phase dependent and therefore the average might not reflect the proper concern that a central bank might have.

Instead of looking at a panel of countries as Hausmann, Panizza & Stein (2000) we focused on a single case. We are interested in study cases in which the country runs a flexible exchange rate regime but are highly dollarized. In particular, our interest is in those with a high degree of *liability dollarization* as Calvo (1999) puts it. Among these economies Peru is a leading case. Even though one might argue that central bankers would tend to keep an eye on the exchange rate due to the possible effect those sudden depreciations have on inflation and credit conditions, the Peruvian monetary authorities defend their current monetary policy as having a unique and clear objective: price stability (BCRP, 1999).

¹ See for example, Calvo and Reinhart (2000), and Levy-Yeyati and Sturzenegger (2000).

One of the lessons of the exchange rate debate suggests that the middle ground is not precisely the safer ground and economies should move to one of the extremes.² Rather than discussing this we will rather characterize Central Bank's decisions regarding monetary policy in a small, open and dollarized economy as Peru. One of this considerations is the claim that the Central Bank asymmetric behavior (being only a buyer, not a seller) have set the wrong incentives to the banking system to become even more dollarized in a context in which creditors have very few instruments to hedge against exchange rate risk. This weakens the financial system as the payments system is exposed to another set of risks.

Since Krugman (1979) we know that a fixed exchange rate system is an implicit one-sided bet against the Central Bank. If countries do not have enough reserves, they will eventually lose the bet. The second-generation exchange rate crisis literature goes further and concludes that if people think that countries will not have enough reserves in the near future, central banks will lose again.³ If flexible exchange rate systems are not flexible at all due to a hyperactive central bank (Calvo, 1999) they sure face this type of risk at the first signs of a relaxation of the fiscal stance.

In Section 2 we cover some basic ground describing the Peruvian monetary policy in the last decade. In Section 3 we try to draw some results regarding intervention objectives; in particular, the possibility of a level defense versus a volatility mitigation attitude. For this, a multinomial and simple logit framework were used in order to account for the probability of an intervention operation. In Section 4 we follow Clarida, Gali and Gertler (1997) approach to estimate a monetary policy rule to test if the Central Bank is keeping the exchange rate as an implicit target. Finally, section 5 presents the main conclusions of this analysis.

2 Understanding the Peruvian Monetary Policy

Peru has come from a hyperinflation of 7,000% per annum in the late 1980s to an impressive 3% per annum in 1999 (see Table 1). The 1990 stabilization program included a complete

²Of course, others suggest that this claim is not sustained. See for example Frenkel (1999).

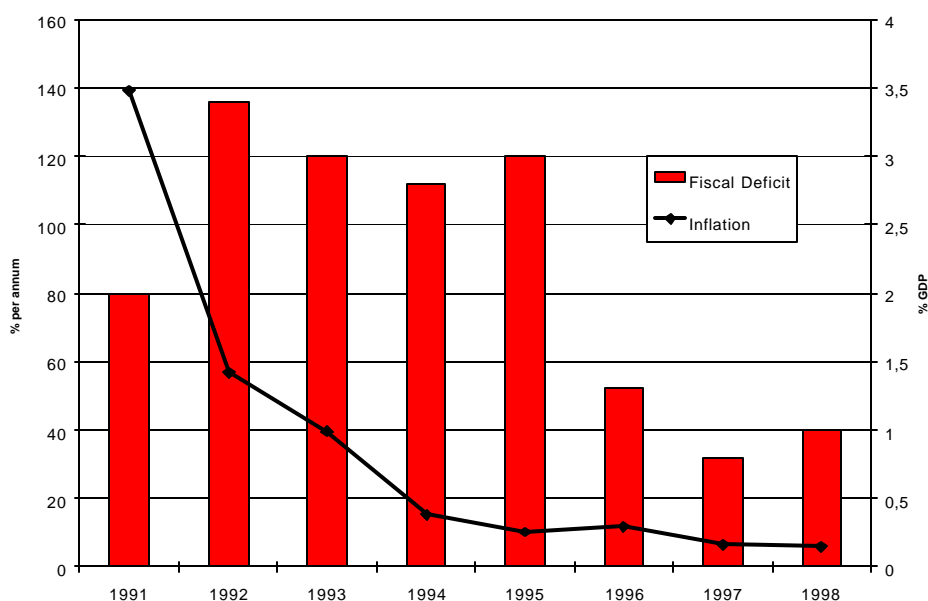
³ See Flood and Marion (1999) for a recent survey of this literature.

liberalization of the exchange rate regime, the financial system, a reduction of tariffs and a new Central Bank charter that cut the possibility of government financing. The choice of the exchange rate regime was quite difficult as the new government needed to build credibility to stop the hyperinflation but the previous administration had already tried almost every possible exchange rate arrangement. Moreover, the decision needed to take into account that by then most of the deposits were in dollar-denominated accounts and the level of intermediation in soles (domestic currency) was at its lowest historic levels.

The economic advisors of President Fujimori even considered the possibility of an official dollarization as a forward escape of the currency substitution. However, the balance leaned toward a flexible exchange rate due to the fact that the international reserves were negative and Peru had no access to international markets after several years of a *de facto* moratorium. There was no room to defend a fixed exchange rate or to consider a currency board.

The flexible exchange rate system worked well in the first years of a significant inflow of foreign capital. The Central Bank policy was very simple: accumulate reserves through sterilized interventions (see Table 1). However, is hard to pinpoint what worked as the nominal anchor of the economy. In our view, the fiscal stance that improved systematically throughout the 1990s was the true nominal anchor of the Peruvian economy (see Graph 1).

Graph 1: Fiscal Deficit & Inflation



In the last five years the Central Bank has changed its monetary policy. In particular, there is a clear and declared sole objective of maintaining price stability.⁴ In practical terms the Central Bank follows a rule very close to the one followed by Banco de Mexico before adopting the inflation targeting this year.⁵ The price stability objective is achieved through a quantity rule rather than the more typical interest rate rule (as in Brazil or Chile). In the CB monetary policy framework the intermediate objective is the growth rate of the monetary base. But there is an operational target given by the balances that the banking system maintains at the Central Bank in a daily basis.

In theory, there are no multiple targets. In particular, the CB does not have an exchange rate or interest rate target. There are no exchange rate bands or anything of the sort. As many other floaters, the Peruvian Central Bank uses as a nominal anchor an implicit inflation targeting framework (see Svensson (1999)).

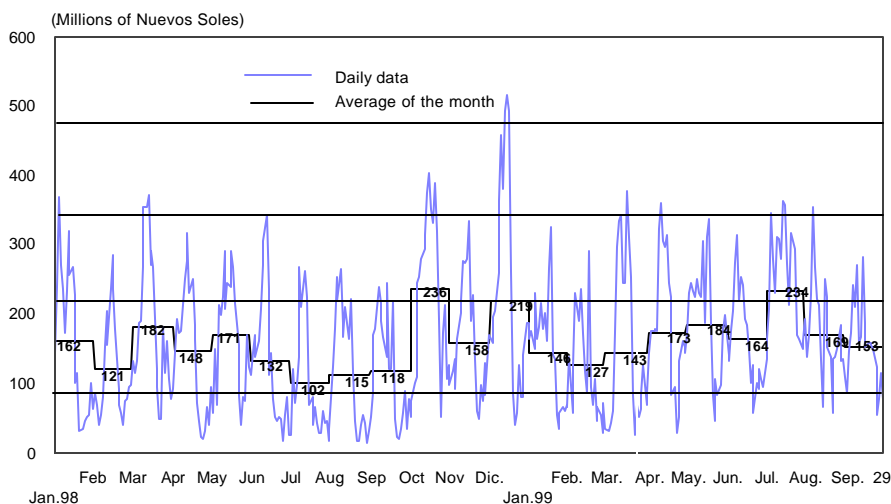
We show the past behavior of this operational target (see Graph 2). Clearly, this variable has a very volatile behavior. This is explained in part by the legal framework. The third week of the month is when firms pay taxes, so there is a substantial increase in the demand for money. But another important point is that the problem of looking at the balances that banks keep at their accounts at the CB is that normal banking business gets mixed with particular problems of liquidity that a bank might face.

The CB has tried to conduct its monetary policy without committing its actions to predetermined rules. In contrast to Banco de Mexico predetermined rules of intervention if the exchange rate fluctuates too much, the Central Bank of Peru has no rules but discretion. The question that we pose is if in effect the market -and in particular the banks- had already learned that behind this discretion there is an implicit rule of intervention.

⁴See Banco Central de Reserva del Peru (1995).

⁵See Carstens and Werner (1999).

Graph 2. Banks' current account balances at the Central Bank



3 The Reasons Behind the Fear of Floating

Before explaining the methodology applied to estimate the Central Bank preferences we illustrate the idea of fear of floating. One should ask why central banks around the region -if not the world- that follow flexible exchange rate regimes maintain a substantial amount of forex reserves. A quick answer to this is the fact that international liquidity is crucial to build effective credibility for central banks.⁶

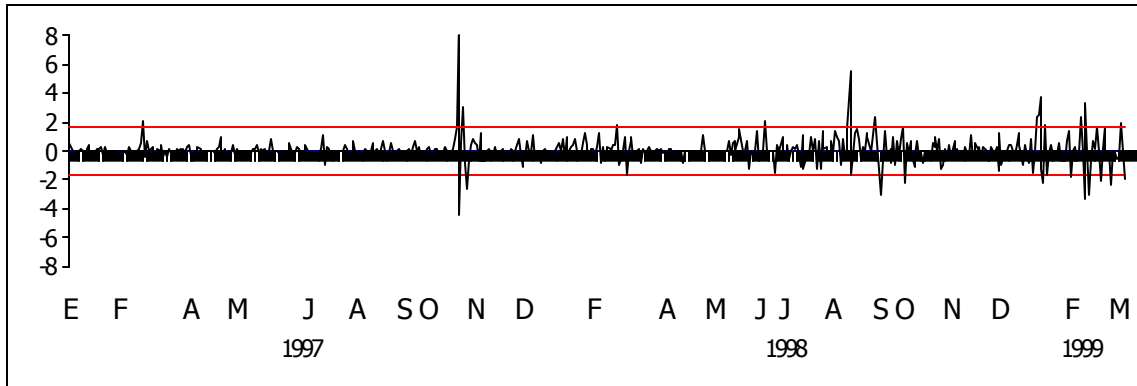
The first and most striking feature of the flexible exchange rate system is the lack of flexibility. If we compare how flexible have been the flexible exchange rate systems of Latin America (Chile, Colombia, Mexico and Peru) we will be surprised by learning that Peru is the one with less variability even compared to Chile or Colombia when they had exchange rate bands (see graph 4); or to other open economies with flexible exchange rates.

⁶See Calvo, Leiderman and Reinhart (1994) using the ratio M2 to forex reserves as one of the best indicators of financial fragility.

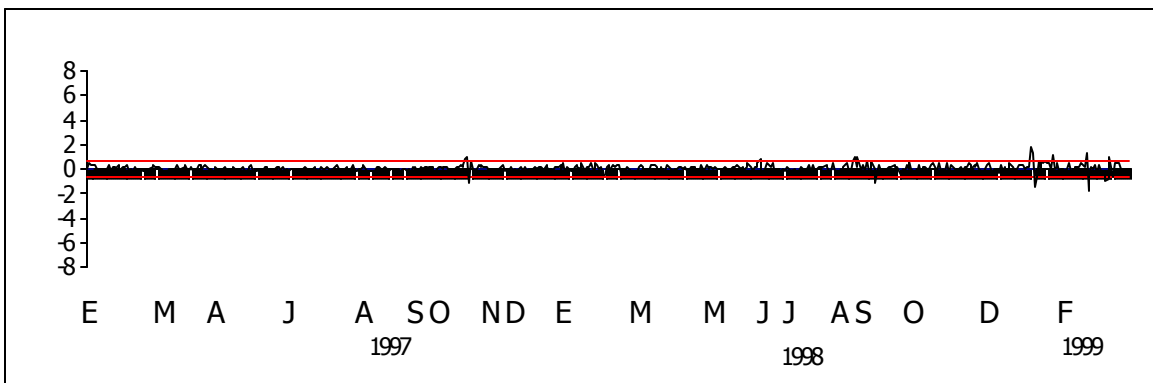
We compare all these economies from January 1997 to March 1999 using daily exchange rate data. We compute several measures of volatility for each case expecting more volatility in Peru and Mexico that do not have exchange rate bands. One can also expect very little days in which the exchange rate does not move. Our findings are in Table 2. Clearly, the Peruvian floating system is not as flexible as one might think. The question is if it should be more flexible or not. For example, the Chilean monetary authorities, after narrowing the exchange rate band, have recently adopted a fully flexible exchange rate regime.

Graph 4: Daily Volatility of the Nominal Exchange Rate

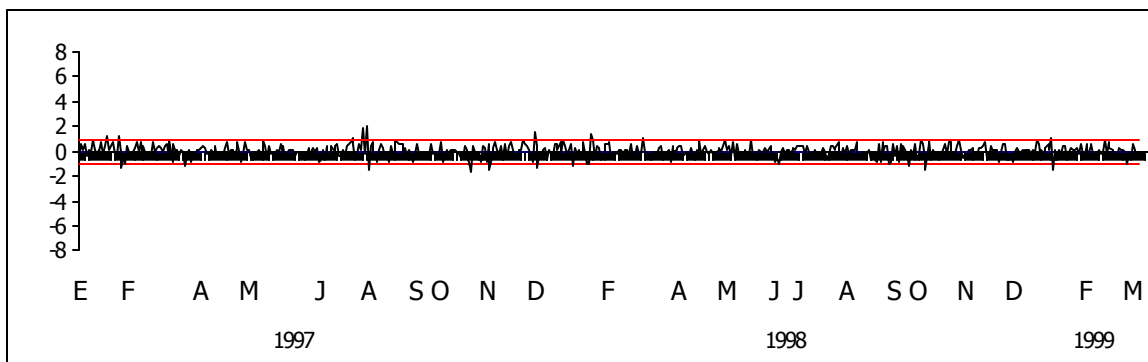
(A) Mexico (1997 - 1999)



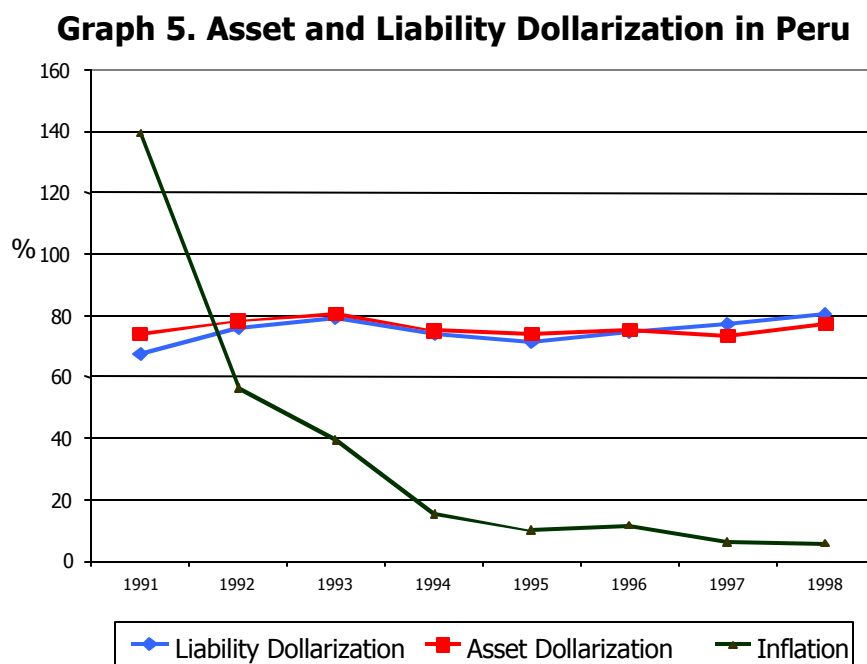
(B) Peru (1997 - 1999)

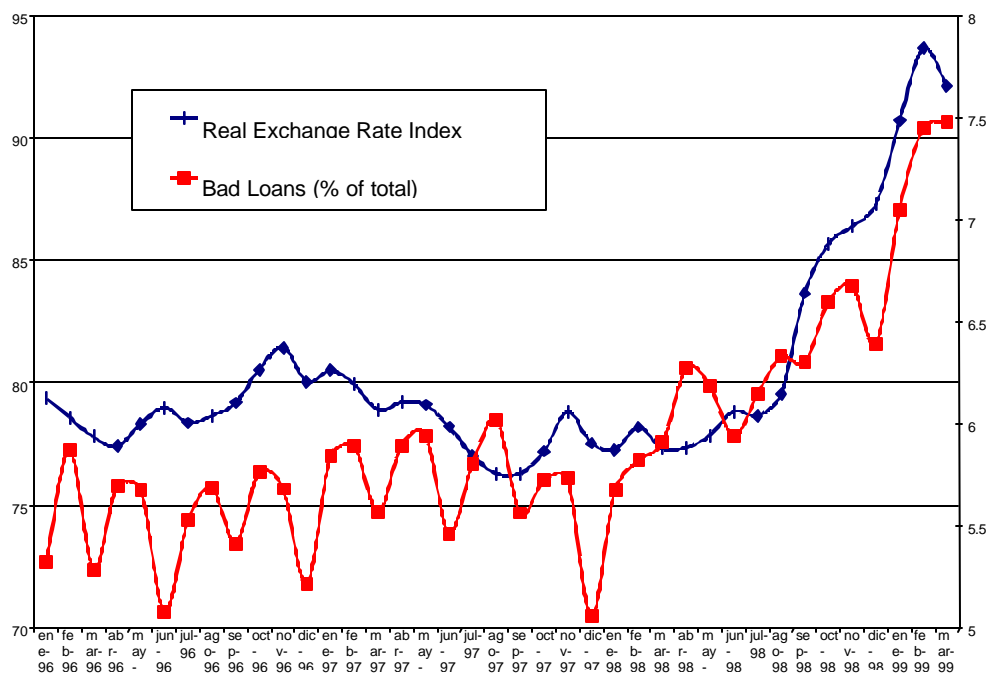


(C) England (1997 - 1999)



After all this evidence a logical question is just: why? Why the Central Bank in Peru is so reluctant to allow the exchange to freely float? The reasons behind this fear of floating lie in the characteristics of the economy. The first one is the degree of dollarization of our economy. Despite the success taming the inflation rate from hyperinflationary levels to the current 3% per annum, the degree of asset and liability dollarization remained more or less hovering around the 70%-80% levels in the last ten years (see Graph 5). The high level of foreign currency denominated liabilities within a country in which there are scant opportunities to hedge against the risk of sudden depreciations of the exchange rate becomes a repayment risk. The twin crisis phenomenon is right there. If we look at the Peruvian case we will see a clear relationship between the real exchange rate behavior and the bad debts ratio of the financial system (see Graph 6).



Graph 6: Real Exchange Rate Index and Bad Loans Ratio

This devastating effect on the financial fragility is exacerbated through the contractionary effect of the devaluation in the context of a highly indebted private sector that is not fully hedged against exchange rate risks. This second round effects have been important in practice as there are no signs of recovery of this temporary shock.

A second characteristic is the possible impact of any depreciation in the rate of inflation. The Peruvian monetary authorities like to show off to international bankers and investors that they have overcome a huge threshold reducing inflation to the current levels. However, much of this was due to the fact that Peru received a substantial flow of funds from abroad that put a lot of downward pressure on the nominal exchange rate. The 12-month pass-through coefficient for Peru is 0.22⁷.

If the main objective is price stability but the pass-through is high enough, any external problem will eventually imply a sudden depreciation and a new round of contractionary effects on domestic activity. However, one element that should be considered is the presence of a

⁷ See Hausmann, Panizza and Stein (2000).

time-varying pass-through coefficient that actually depends on the sign and size of the output gap, exactly as in Israel.⁸

This will work -in a way- in favor for the monetary authorities that will not face inflationary pressures if the depreciation has contractionary effects. The banks, however, will face a double hazard. The exchange rate and the recession both will hit the performance of their loans. Either the Central Bank decides to act after the fact (sudden depreciation) with liquidity provision to those banks in need, or higher interest rates on reserves held at the Central Bank. Remember that in that type of situation banks will recover their liquidity faster than firms and households will recover their likelihood to receive a new loan. The best debtor turns out to be the Central Bank.

3 Defending the level or taming the volatility

In this section we explore the importance of level changes and exchange rate volatility in explaining the decision of a Central Bank intervention. Results obtained from this analysis can provide some evidence concerning the level versus volatility issue when judging Central Bank's intervention policy.

The adequacy and effects of official intervention in the exchange market have been extensively discussed. This paper builds on some previously developed methodologies⁹ to account for the objectives (the level vs. volatility issue) of Central Bank's intervention operations in the period 1995-1999. In this particular context, we can distinguish two different economic scenarios: a period of relative stability accompanied by significant capital inflows (1995-1997) and a much more turbulent environment related to the outburst of the Russian and Brazilian crisis and the subsequent capital flow reversal. This shift in the economic conditions allows a more comprehensive characterization of the Central Bank's stance with respect to movements in the exchange rate, and to account for the occurrence of forex purchases and sales in the

⁸ See Leiderman and Badas-Or (1999).

⁹ Dominguez and Frankel (1993) present an extensive survey.

challenging scenario imposed by the international crisis on emerging economies in the last two years of the preceding decade.

Since the application of the economic stabilization program in 1990, the exchange rate regime was defined as a managed float, where the market freely determines forex price and Central Bank's intervention should only occur in the event of abrupt fluctuations. In other words, the main objective of the Bank's intervention policy is not to foster a greater dollar demand or supply (exchange rate level defense), but to mitigate sharp fluctuations. In this context, previous analysis based on a similar methodological approach (Arena and Tuesta, 1999), apparently allowed the authors to conclude that, in fact, Central Bank's interventions were not consistent with a "leaning against the wind" behavior; in other words, there was no evidence in favor of a "level defense" attitude. Explanatory variables included in that analysis, however, failed to directly reflect the competing objectives.

In our case, and in order to directly account for the importance of level changes and volatility, variables reflecting these were included. In particular, daily data from the period 2-jan-1995 to 14-jan-2000¹⁰ on Central Bank's net forex purchases and exchange rate depreciation and volatility¹¹ were considered.

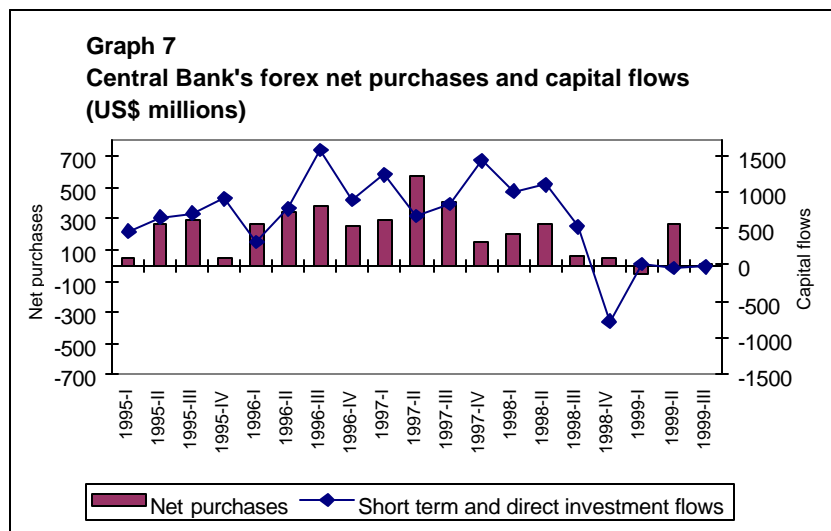
3.1. A quick look at the facts

A rapid exploration of the data reveals some important issues that will help us understand the analysis presented in the next section. During the period 1995–1998, no selling operations took place, so all interventions were associated with net forex purchases. This tendency is fully consistent with the significant capital flows registered between the consolidation of Peruvian economic stability and the outburst of the Russian and Brazilian crisis, events that implied a reversal in foreign investor's perception towards emergent economies. Obviously, short-term

¹⁰ A larger dataset would have been preferred, but daily information concerning intervention operations is not publicly available for periods before 1995.

¹¹ The variable used to account for level changes (LEVEL) was a five-day rolling average of daily depreciation. Series for volatility (VOL) was estimated using a five-day rolling standard deviation of the exchange rate.

capital flows were the most affected by the increased risk associated to these economies, and the reversal in these flows had a significant impact on the possibility of financing an already large current account imbalance.

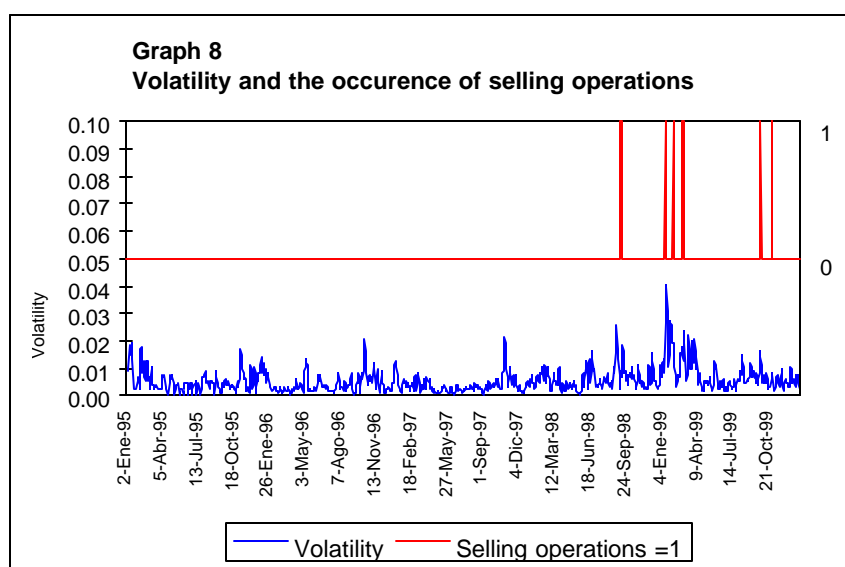


Graph 7 depicts the quarterly path of capital flows (short term plus direct investment) and Central Bank's forex net purchases. There is no intention of showing a tight correlation between these variables, but only to demonstrate that most of Central Bank's purchasing operations occurred during a period of considerable capital inflows. Consistent with this, foreign capital slowdown coincides with a decrease in net purchasing operations. Evidence from Graph 1 is rather rough in this sense because of daily data aggregation. In fact, the first selling operations in the sample period occurred in September 1998, about 10 days after the abrupt ruble devaluation (which exacerbated the anxiety of investors towards emergent economies) and when most of the external credit lines to domestic commercial banks were already cut (this cut in short term foreign loans was the main reason explaining the credit crunch experienced between the last quarter of 1998 and most of 1999).

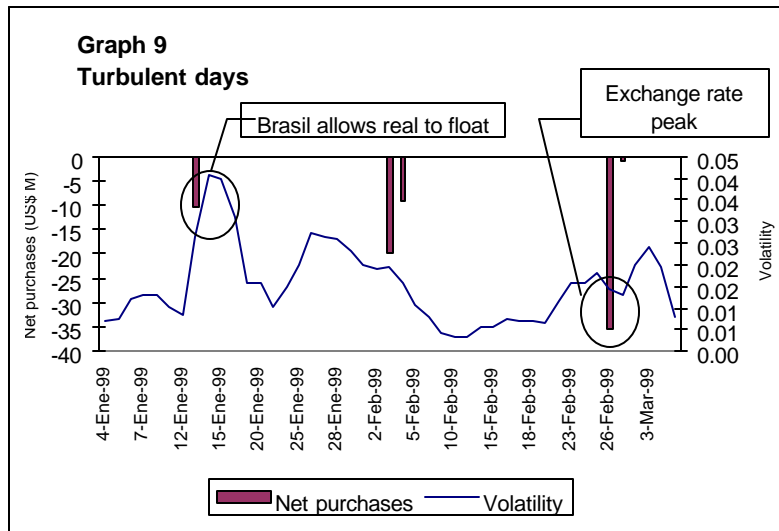
Although purchasing operations appear fully consistent with an excess dollar supply, direct association of selling operations with an excess forex demand (in a causality sense) can be, at this point, misleading. We must recall that the capital flow reversal episode coincides with a period of high volatility and considerable uncertainty concerning the future path of the

exchange rate. If we take a closer look to the occurrence of selling operations and volatility, we can observe a high degree of correlation towards the end of the sample period (Graph 8).

In fact, the volatility peak (which was accompanied by a US\$ 10.5 million sell) coincides with the adoption of a free float in Brazil. In particular, this selling operation and the volatility hike occurred between the days in which Brazilian authorities decided to increase the exchange rate band and finally allowed the real to float (12-15 January 1999). By these days, Central Bank officials argued that the Bank was not willing to increase forex supply to satisfy speculative demand. Consistent with this, domestic currency supply was tightened by the means of CDBCRP auctions (an instrument vastly used after the Russian crisis and aimed at mitigating forex speculative demand).



On the other hand, the most important single selling operation (US\$ 35.3 millions) took place on February 27th, one day after the occurrence of an abrupt peak in the exchange rate which took place after economic authorities revealed to local bankers that their main concern was not forex price but interest rate reduction.



The previous analysis reveals that most of purchasing operations took place in a period of relative stability and significant capital inflows, while forex sells are more consistent with high volatility episodes towards the end of the sample period (due to external shocks as the Brazilian crisis and uncertainty concerning the future path of the exchange rate). However, a more formal analysis is needed to fully understand and distinguish the importance of level changes and volatility in explaining intervention operations.

3.2 Actions speak louder than words: A multinomial analysis

Central Bank's decisions fall into three different categories: purchase, sell or no intervention. In this manner, and because of the existence of three categories or outcomes for the variable to be explained, we rely on a multinomial logit (mlogit) framework to account for the probability of these outcomes. In particular, the intervention variable considered three values: INTERVEN = 1,2,0 in the case of a forex purchase, sell, and no intervention, respectively. Explanatory variables in the model were LEVEL (accounting for level changes) and VOL (accounting for exchange rate volatility). After a base category is chosen (in our case INTERVEN=0), the mlogit approach permits the estimation of two different sets of coefficients, each belonging to the remaining two categories and measuring relative changes

with respect to the no intervention scenario. After setting $\mathbf{b}_0 = 0$, the probabilities for each category are given by:

$$\begin{aligned}\Pr(\text{Interven}=0) &= \frac{1}{1 + \exp(\mathbf{b}_{10} + \mathbf{b}_{11}\text{Level} + \mathbf{b}_{12}\text{Vol}) + \exp(\mathbf{b}_{20} + \mathbf{b}_{21}\text{Level} + \mathbf{b}_{22}\text{Vol})} \\ \Pr(\text{Interven}=1) &= \frac{\exp(\mathbf{b}_{10} + \mathbf{b}_{11}\text{Level} + \mathbf{b}_{12}\text{Vol})}{1 + \exp(\mathbf{b}_{10} + \mathbf{b}_{11}\text{Level} + \mathbf{b}_{12}\text{Vol}) + \exp(\mathbf{b}_{20} + \mathbf{b}_{21}\text{Level} + \mathbf{b}_{22}\text{Vol})} \\ \Pr(\text{Interven}=2) &= \frac{\exp(\mathbf{b}_{20} + \mathbf{b}_{21}\text{Level} + \mathbf{b}_{22}\text{Vol})}{1 + \exp(\mathbf{b}_{10} + \mathbf{b}_{11}\text{Level} + \mathbf{b}_{12}\text{Vol}) + \exp(\mathbf{b}_{20} + \mathbf{b}_{21}\text{Level} + \mathbf{b}_{22}\text{Vol})}\end{aligned}\quad (1.)$$

The above expressions are useful for computing average probabilities and forecast exercises, so we can rely on odd ratios for a better understanding of the coefficient signs and magnitudes. For example, the relative probability of a selling operation with respect to a no intervention stance would be given by:

$$\frac{\Pr(\text{Interven}=2)}{\Pr(\text{Interven}=0)} = \exp(\mathbf{b}_{20} + \mathbf{b}_{21}\text{Level} + \mathbf{b}_{22}\text{Vol}) \quad (2.)$$

So, the signs for \mathbf{b}_{21} and \mathbf{b}_{22} provide useful information about the importance of level changes and exchange rate volatility in explaining the probability of an official forex sell versus a non intervention stance. At this point we must recall that coefficient interpretation in a mlogit model is more difficult than in a traditional logit framework. The marginal effect of a variable on a particular category probability is calculated differentiating expressions in (1), thus obtaining:

$$\frac{\partial \Pr_j}{\partial x_i} = \Pr_j \left[\mathbf{b}_j - \sum_{k=0}^2 \Pr_k \mathbf{b}_k \right] \text{ for } j = 1, 2. \quad (3.)$$

So, the direct association of b_j with the j th category can be misleading. In other words, if we obtain a positive coefficient for variable x_i in the j th category, this does not necessarily mean that an increase in that variable will conduce to a higher probability for category j . However, and although estimation of pure marginal effects over each category probability should involve some extra calculations, we can rely on direct sign interpretation if we keep in mind that we are comparing probabilities with respect to a no intervention decision. In a more traditional mlogit framework, an analysis solely based on this relative probability approach would not yield much information; however, in our case, direct comparison with a no intervention decision has a more meaningful understanding. Yet, we will also perform some forecasting exercises and construct several simple logit models in order to facilitate result interpretation.

The mlogit model was first run using full sample data (we then considered two sub periods to account for the shift in the economic scenario). Coefficients were estimated in STATA and reported in Table 1 (standard errors and z-statistics in parenthesis).

Table 1
(Full sample)

	Interven = 1 (Purchase)	Interven = 2 (Sell)
Constant	1.747364 * (0.13270) (13.168)	-4.90199 * (0.5057) (-9.694)
Level	-5.934968 * (0.79177) (-7.496)	3.3518 (2.8147) (1.191)
Vol	-305.9177 * (25.1438) (-12.167)	58.281 (55.6099) (1.048)
* Denotes rejection of null hypothesis at 5% sig. Pseudo R-squared = 0.211 Interven = 0 is the comparison group.		

If we consider the results obtained for the first category (purchase) these appear consistent with the preliminary data analysis. The negative sign for LEVEL responds to the capital inflow period influence: a systematic domestic currency appreciation (which implies a negative sign

for LEVEL) increases the probability of a forex purchase with respect to a no intervention stand. On the other hand, the negative sign for VOL is consistent with the decline in purchasing operations towards the end of the sample period, in which we can observe a higher volatility. In the case of the second category (sell), and although both variables have the expected sign, their statistical significance is considerably small.

As mentioned above, it's not difficult to associate the results obtained for purchasing operations (and specially those that account for the impact of volatility) with the change in the economic scenario. So, and in order to control for this structural break, the same exercise was done for a reduced sample: 1-set-98 to 14-jan-00¹². Results where as follows:

Table 2
(Reduced sample)

	Interven = 1 (Purchase)	Interven = 2 (Sell)
Constant	-1.3596 * (0.32161) (-4.228)	-3.7432 * (0.51957) (-7.204)
Level	-11.2371 * (2.31575) (-4.852)	7.2970 ** (3.92992) (1.857)
Vol	-114.504 * (49.6444) (-2.306)	-31.9538 (76.5742) (-0.417)
* Denotes rejection of null hypothesis at 5% sig. ** Denotes rejection of null hypothesis at 10% sig. Pseudo R-squared = 0.1435 Interven = 0 is the comparison group.		

Signs for both variables in the first category are as in full sample results. For the second category, however, volatility reverses its sign (though remains not significant) while the variable accounting for level changes gains statistical significance. Also, the impact of each variable on the analyzed category's probability has changed. In order to account for these impacts, pure marginal effects and elasticities were computed for each sample using equation

¹² The break point date was chosen to account for the increase in exchange rate volatility and the reversal in capital flows; the abrupt ruble devaluation occurred the 26th of August of 1998.

(3) and average probabilities for each category (Pr_j and Pr_k). As was mentioned earlier, signs can aid in the interpretation of the variables effects when comparing the probability of each category versus a no intervention stance. However, and in order to compare the relative impact of each variable, some further calculation based on forecasting exercises is needed.

Table 3
Elasticities /1

Full sample	Outcome	Variable	
		Level	Volatility
	Purchase	-0.227	-1.704
	Sell	0.230	1.094

Reduced sample	Outcome	Variable	
		Level	Volatility
	Purchase	-0.525	-0.901
	Sell	0.365	-0.202

/1 Response of $Pr(\text{purchase})$ and $Pr(\text{sell})$ to a 1% increase in DEVAL and VOL.

When we control for the structural break in economic conditions, the negative impact of volatility on the probability of purchasing operations declines. In other words, the high impact shown by this variable in full sample results can be attributed to the misleading influence of two different scenarios (where the more turbulent one is associated to a decline in selling operations). It is worth noticing, however, that this variable maintains its sign and statistical significance (and has a higher impact if compared to level changes) for the more turbulent scenario. In other words, purchasing operations can be directly associated to relatively stable episodes in the exchange rate behavior, even if the average scenario is more turbulent. It must also be noticed that level changes (understood as an average appreciation tendency) also exerts an important positive influence on the probability of a purchasing operation.

On the other hand, and if we consider the impact of each variable on the probability of selling operations, reduced sample results provides important evidence about Central Bank's concern when deciding to carry out this type of operations. When evaluating the importance of volatility we must take into account not only its sign reversal but also its lack of statistical significance (as reported in Table 2). On the other hand, level changes not only evidence an increase in its marginal impact but also gains statistical significance. In other words, and if we only consider the more turbulent scenario, the main variable explaining the occurrence of a selling operation is a systematic depreciation of the exchange rate (as accounted by the five-day rolling average of the exchange rate depreciation used to reflect level changes).

3.3 *Signaling the Central Bank Intervention Stance*

In order to provide further evidence about the role of volatility and level changes in explaining intervention operations (and confirm some of the conclusions obtained in the previous analysis), a simple logit framework was proposed for the two sub periods. In this auxiliary regression an additional variable was included to account for the evolution of net forex reserves (as a proxy for the capital flow tendency). This variable (DUMNIR) is 1 if in the corresponding month an increase in forex reserves is observed. For the first part of the sample (2-jan-1995 to 31-aug-1998) a dummy variable was generated to account for the occurrence of purchasing operations (we must recall that in this period there were no selling operations). Results are reported in Table 4.

The sign and significance of variables accounting for level changes and volatility is maintained as in the mlogit regressions (Tables 1 and 2) for the first category (purchase). Its worth noticing that volatility still has a negative impact on the probability of purchasing operations; in other words, its sign is not only due to the presence of two different economic scenarios, as mentioned earlier. These results finally confirm that purchasing operations are associated to stable episodes in the exchange rate, even if we consider stable and turbulent scenarios separately.

On the other hand, and if we consider the sign and construction of the variable reflecting level changes, results reported in Table 4 confirm that purchasing operations took place in the context of a systematic exchange rate revaluation (as accounted by the negative impact of the five day rolling average of depreciation). The sign and significance of the variable accounting for forex reserves evolution confirm this argument: in the event of positive capital flows (an increase in forex reserves), the probability of a purchasing operation increases (consistent with the subsequent exchange rate appreciation).

As in the mlogit results for the second sub period, volatility has a higher (and negative) impact on the probability of a purchasing operation. In this scenario, we must consider that volatility peaks in the first part of the sample where associated to exchange rate depreciations so, and in a context of significant capital inflows, a no intervention stand is fully reasonable.

So, and if we consider the results reported above, we can conclude that purchasing operations which took place in the first part of the sample respond to systematic exchange rate appreciations, while the significant negative impact associated to volatility responds to the no intervention decision consistent with an exchange rate depreciation (if volatility is exacerbated by an increase in the exchange rate as it actually occurs in this period- the most reasonable decision would be to stay away from the market since we are in the middle of a capital inflow scenario). In the second part of the sample, exchange rate appreciations also exert a significant influence on the probability of purchasing operations (as reported in Tables 2 and 3), while the negative sign associated to volatility is fully consistent with a no intervention (or selling) decision, which becomes the most reasonable attitude if volatility has been exacerbated by an increase in the exchange rate and the economy faces a capital outflow.

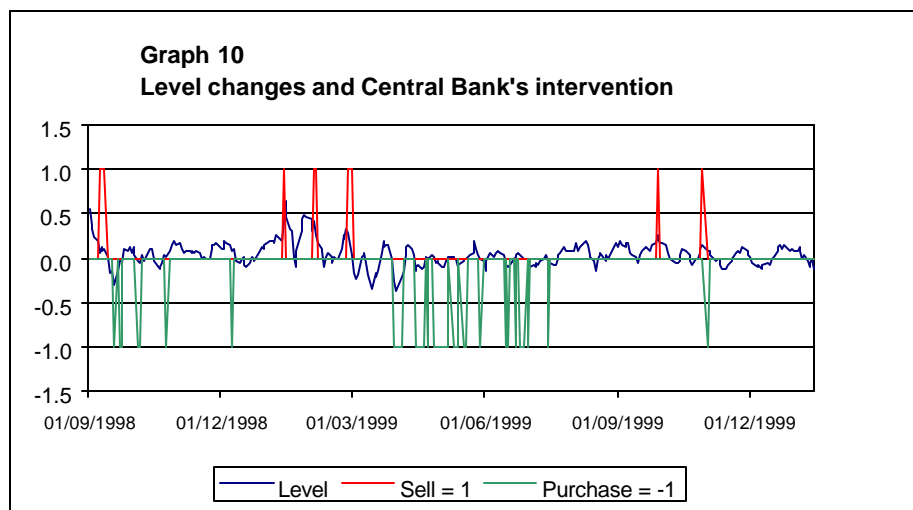
Table 4

	First sub period Dependent variable (Purchase = 1)	Second sub period Dependent variable (Sell = 1)
Constant	1.8663* (0.1921) (9.7155)	-3.8760* (0.5497) (-7.0514)
Level	-6.8088* (0.9826) (-6.9292)	7.3056* (3.7271) (1.9601)
Vol	-300.6220* (32.7360) (-9.1832)	-0.1523 (79.3839) (-0.0019)
Dumnir	0.8197* (0.1700) (4.8213)	-1.3056 (0.9660) (-1.3515)
	Mc Fadden = 0.2580	Mc Fadden = 0.1424
* Denotes rejection of null hypothesis at 5% sig.		

For the second sub period (1-set-1998 to 14-jan-2000) and due to the existence of both purchase and selling operations, the dummy variable adopted the value of 1 in the presence of a selling operation and 0 if the Central Bank decision was to purchase or not intervene. In the context of a capital outflow and the subsequent natural tendency for a exchange rate depreciation, its reasonable to group both purchasing and no intervention decision under the same category (both are consistent with a depreciation preference). Results are reported in the second column of Table 4.

In this case, and as in the mlogit reduced sample results, volatility has a negative sign and lacks statistical significance. Again, level changes appear as the most important variable (both in terms of significance and marginal impact). Although DUMNIR is not significant, its sing provides some useful information: in the event of an increase in forex reserves, the probability of a selling operation (against a purchase or a no intervention decision) declines.

As final evidence, Graph 10 depicts the evolution of variable LEVEL and the occurrence of selling and purchasing operations in the second part of the sample.



Evidence from Graph 10 and all the results reported above favor the following conclusions:

- ❑ Purchasing operations are associated to periods of relative stability. Since volatility is mainly exacerbated by exchange rate hikes, VOL's negative impact is fully consistent with a no intervention decision in the first part of the sample (allowing for capital inflow to correct the depreciation tendency) and with a no intervention or selling attitude in the second sub period (since the economy is facing a capital outflow a purchasing operation would have contributed to the depreciation tendency).
- ❑ Purchasing operations respond to systematic exchange rate appreciations (as accounted by the negative sign and statistical significance of variable LEVEL; see Tables 2 and 4).
- ❑ Volatility fails to explain selling operations, while level changes remain statistically significant and with the expected sign: systematic exchange rate depreciation increases the probability of a selling operation (as reported in Tables 2 and 4).

- In both auxiliary regressions, the sign associated to the variable accounting for the evolution of forex reserves (to serve as a proxy for capital flow direction) reinforces the above results. The event of a forex reserve raise (which will exert an influence towards appreciation) increases the probability of a purchasing operation if the first sub period and reduces the probability of a selling operation in the more turbulent scenario.

4. What is the Central Bank Looking At?

In this section we intend to specify a monetary policy reaction function and verify if the exchange rate level is a significant argument when explaining movements in the policy instrument.

Our specification -following the basic model proposed by Taylor (1993) and the extensions provided by Clarida, Galí and Gertler (1997)- assumes that the Central Bank targets the policy instrument (the monetary base) accordingly to expected inflation and output. Also, and to account for the significance of the exchange rate level, the model is extended in order to directly include the expected price of the dollar in the Central Bank's reaction function.

As in most of the empirical literature, our specification assumes that the relevant arguments that explain movements in the policy instrument are the deviations of the included variables with respect to a long term equilibrium value. In our case, however, and due to the existence of integrated processes in some of the variables¹³, the reaction function was specified considering these variables' first differences. Formally, the proposed function takes the form:

$$\Delta M0_t^* = \Delta \bar{M0} + \beta \{E_t(\pi_{t+n}) - \pi^*\} + \gamma_1 E_t(\Delta X_{1t}) + \gamma_2 E_t(\Delta X_{2t}) \quad (4.)$$

where:

¹³ ADF and Zivot & Andrews tests performed to both M0 and the exchange rate gap failed to reject the null hypothesis at a 5% significance level.

$$\begin{aligned}\Delta X_{1t} &= (y_t - y_t^*) - (y_{t-1} - y_{t-1}^*) \\ \Delta X_{2t} &= (e_t - e_t^*) - (e_{t-1} - e_{t-1}^*)\end{aligned}$$

In the above equation, $\overline{\Delta M0}$ is the long run nominal monetary base growth, π_{t+n} is the inflation between periods t and $(t + n)$, y_t is real output, e_t is the exchange rate level (soles per dollar), and π^* , y_t^* , e_t^* are the long run equilibrium values of inflation, output and the exchange rate. Finally, the E_t operator stands for the expected value of the variable given all the relevant and available information for the Central Bank at time t . Following Clarida, Galí and Gertler (1997), this baseline model assumes that the Central Bank responds to expected inflation (*forward looking*), however, this specification can be easily extended to also account for a *backward looking* behavior (i.e. the monetary authority sets the policy instrument to account for expected and lagged inflation).

In order to relate the actual and target monetary base growth, a simple partial adjustment mechanism is assumed:

$$\Delta M0_t = (1 - \rho)\Delta M0_t^* + \rho\Delta M0_{t-1} + \mu_t \quad (5.)$$

Notice that this adjustment mechanism refers to monetary base expansion and its inclusion accounts for Central Bank's desire to accelerate or slow down the rate of money growth accordingly to its reaction function but in a smooth fashion. A sudden increase or decrease in the monetary base in the event of a change on the explanatory variables included in (4) (i.e. setting $\rho=0$) could not only affect inflationary expectations but also weaken Central Bank's credibility; on the other hand, it's also reasonable to assume that the monetary authorities try to accommodate to the new target smoothly in order to have time to observe and evaluate the effects of the adopted measures.

Finally, and in order to obtain an estimable equation, constants are grouped into an intercept ($\alpha = \overline{\Delta M0} - \beta\pi^*$), the partial adjustment specification is included and (4) is rewritten only in terms of realized variables:

$$\Delta M0_t = (1 - r)\{\mathbf{a} + \mathbf{b}E_t(\mathbf{p}_{t+n}) + \mathbf{g}_1 E_t(\Delta X_{1t}) + \mathbf{g}_2 E_t(\Delta X_{2t})\} + r\Delta M0_{t-1} + \mathbf{m} \quad (6.)$$

$$\Delta M0_t = (1 - \rho)\{\alpha + \beta\pi_{t+n} + \gamma_1(\Delta X_{1t}) + \gamma_2(\Delta X_{2t})\} + \rho\Delta M0_{t-1} + \varepsilon_t \quad (7.)$$

Now, our composite error term has the form:

$$\varepsilon_t = -(1 - \rho)\{\beta[\pi_{t+n} - E_t(\pi_{t+n})] + \gamma_1\{\Delta X_{1t} - E_t(\Delta X_{1t})\} + \gamma_2\{\Delta X_{2t} - E_t(\Delta X_{2t})\}\} + \mu_t \quad (8.)$$

Considering the assumption that the Central Bank takes into account all the relevant information to form its expectations about future inflation, output and the exchange rate, this linear combination of forecast errors must be orthogonal to this information set at time t . In other words, and if we let I_t be a vector including the variables within the Bank's information set, the condition $E[\varepsilon_t | I_t] = 0$ implies that (6) holds in the sense that the Central Bank adjusts the monetary base growth accordingly to the expected value of inflation and the expected change in the deviation of output and the exchange rate from its long term equilibrium values.

The orthogonality conditions implied in the estimation of the parameters $(\alpha, \beta, \gamma_1, \gamma_2, \rho)$ and the validation of the model, perfectly suit the use of the GMM estimation procedure. Due to the existence of a potentially large instrument set (I_t), the model would be over identified. In this sense, a test for the over identifying restrictions would be a test for the validity of (6): to the extent in which all the pertinent information for forecasting inflation, output and the exchange rate is orthogonal to the forecast errors associated to these variables, movements in the growth of the monetary base would be explained accordingly to the specified reaction function.

Results obtained from a GMM estimation of (7) are reported in Table 5. We used monthly data from the period jan-1992 to dec-1999. Due to the chosen frequency, the instrument list included 12 lagged values (-1 to -12) of the variables considered in the reaction function, and n was set to 12 -i.e. expected inflation refers to the expected change in prices from time t to time

($t + 12$)-. Its worth noticing that our final empirical model included both a forward and backward looking specification and that core inflation¹⁴ was used instead of CPI inflation. In fact, its reasonable to assume that the relevant measure of inflation considered when targeting monetary base growth should exclude transitory shocks from prices evolution.

Table 5

Generalized Method of Moments	
Dependent variable: DM0 Instrument list: CORE(-1 to -12) DEXRATEGAP(-1 to -12) DOOUTPUTGAP(-1 to -12)	
Constant	0.01403* (0.0013)
CORE(12)	-0.00222* (0.0007)
CORE(-1)	-0.00154* (25.5355)
DEXRATEGAP	-0.11059* (0.0005)
DEXRATEGAP*DUM	-0.84465* (0.0477)
DOOUTPUTGAP	-0.00068* (0.0001)
DM0(-1)	0.10211* (0.0486)
J-statistic = 0.211799 J*n_χ ² (29), p-value=0.9847	
* Denotes rejection of null hypothesis at 5% sig.	

As mentioned earlier, its useful to test over identifying restrictions in order to evaluate if all the available information concerning the forecasted variables is used when forming their expected values. Under the null hypothesis that the over identifying restrictions are satisfied, the reported J-statistic (the minimized value of the objective function) times the number of observations is distributed chi-square with degrees of freedom equal to the number of instruments minus the number of estimated coefficients; in our case we fail to reject this null hypothesis, i.e. the over identifying restrictions hold.

All included variables are statistically significant and reported signs are as expected¹⁵: both anticipated and lagged core inflation have a negative impact on the monetary base growth, just

¹⁴ Trimmed mean 15%. Core inflation series was detrended to account for the disinflationary process.

¹⁵ Since $\rho < 1$, the direction of the impact can be directly deduced observing compound coefficients' signs.

like the expected change in the output and exchange rate gap. In other words, an acceleration in the evolution of either the output or the exchange rate gap would conduce to a slow down in the monetary base growth.

Some additional information can be drawn by disentangling the estimated coefficients according to our specification in (7). Recall that $\alpha = \Delta \bar{M0} - \beta \pi^*$ and notice that the first and second coefficients $\{c(1) \text{ and } c(2)\}$ are $(1 - \rho)\alpha$ and $(1 - \rho)\beta$, respectively. In this sense, and if we assume that the long run nominal monetary base growth equals long run core inflation, an estimated value for latter can be directly deduced:

$$\begin{aligned} \alpha &= \pi^* - \beta \pi^* \\ \pi^* &= \frac{\alpha}{1 - \beta} \\ &= \frac{c(1)}{1 - c(7)} \bigg/ 1 - \frac{c(2)}{1 - c(7)} = 0.0156 \end{aligned}$$

Its worth mentioning that this value is very close to the monthly core inflation sample mean (0.0181).

Besides the specification of an adequate reaction function (in the sense of including all relevant arguments), our special interest rests on the validation of the exchange rate as a relevant variable explaining the policy instrument targeting. In this sense, results reported in Table 5 provide strong evidence in favor of this hypothesis: the Central Bank targets the monetary base growth taking into consideration the exchange rate behavior; in other words, the Bank would react so as to offset accelerations or slow downs in the expected evolution of the exchange rate (with respect to a long run value). In fewer words, our results don't favor the existence of a free float.

Consistent with the analysis presented in the previous section (where the sample was divided to account for the change in the economic scenario), we finally decided to include a multiplicative dummy variable associated to the exchange rate gap ($DUM = 1$ for $t = \text{set-1998}$ to dec-1999). As reported in Table 5, this variable is statistically significant and its sign

reinforces the negative impact that an acceleration in the exchange rate gap would have on the monetary base growth. In other words, since the outburst of the Russian crisis and for the rest of the sample considered, the Central Bank places a closer look to the path of the exchange rate when targeting the policy instrument.

Finally, it must be noticed that the failure to reject the null when testing the over identifying restrictions allows to conclude that lagged values are relevant for the Central Bank only to extent in which these provide useful information for forecasting inflation, output and the exchange rate. In this sense, it could be argued that the Bank considers the path of the exchange rate because its related to inflation (being the latter its final concern and objective); in fact the presence of the exchange rate in the instrument (or information) set and the results of the J-statistic test confirm this. However, the exchange rate's role in the model does not limit to the instrument set: the expected value of the exchange rate gap growth is a relevant (significant) explanatory variable in the specified reaction function. In other words, the results obtained in this analysis allow to conclude that the Central Bank looks at the exchange rate not only on the basis of its relationship with inflation but also as a relevant variable *per se*; as mentioned earlier, we find strong evidence supporting the fact that the Bank sets the target growth of the monetary base accordingly to the expected path of the dollar's price.

5. Final Remarks

Our analysis reveals that the exchange rate level is a relevant variable when explaining both the probability of an intervention operation in the exchange market and the targeting of the policy instrument in a monetary policy reaction function. This evidence doesn't favor the existence of a free float but instead allow us to characterize the Peruvian exchange rate regime as a phony floater.

The desire of the Central Bank to place a close look to the exchange rate level (and react so as to offset systematic appreciations or depreciations, and specially the latter) can be easily understood if we consider the high degree of liability dollarization that characterizes our economy. In particular, the connection between the economic cycle phase and the degree of

exchange rate pass-through doesn't permit an average characterization of Central Bank's preferences in this respect. In other words, we cannot assume that Central Bank's concern about the exchange rate level can only be expressed in terms of its connection with inflation. In periods of relative instability and capital outflows (as the one which characterized our economy during the second half of 1998 and most of 1999), the monetary authority was (and must be) worried about the path of the dollar's price because of its connection with the real sector (an abrupt exchange rate depreciation would conduce to financial instability and to a slowdown in the flow of credit to the private sector). In fact, the slowdown in economic activity during 1999 prevented the existence of high pass-through but the Central Bank still placed a close (and even closer) look to the exchange rate path.

To the extent in which firms and households lack adequate hedging instruments, the relation between the exchange rate and the real sector's performance will still be strong, and the stronger this relationship, the more difficult it would be to talk about the existence of a stable pass-through relationship. In this sense, research devoted to disentangle the relationship between the exchange rate, inflation and the level of economic activity (in connection with the evidence presented in this paper) would clarify the reasons behind the fear to allow for a free float and provide an adequate framework for credible and sustainable commitments in monetary policy.

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Table 1
Peru: Selected Indicators

	Inflation	International Reserves	GDP Growth Rate	Asset Dollarization	Liability Dollarization
Year	(%)	MM US\$	(%)	(%)	(%)
1990	7,649.6	531	-3.7	46.9	53.0
1991	139.2	1,304	2.9	59.9	60.9
1992	56.7	2,001	-1.7	64.5	70.3
1993	39.5	2,742	6.4	69.1	76.3
1994	15.4	5,718	13.1	64.1	73.7
1995	10.2	6,641	7.3	62.7	71.1
1996	11.8	8,540	2.4	67.1	74.2
1997	6.5	10,169	6.9	65.1	77.3
1998	6.0	9,183	0.3	69.1	80.0
1999	4.5	8,600	3.0	69.8	80.0

Source: Central Bank of Peru, Memoria
The 1999 figures are forecasts.

