Comments are still welcome

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

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Abstract

Highly volatile exchange rates don't come cheap in economies with large liability dollarization ratios. Therefore, central banks do not follow a unique objective of price stability but its preferences include an implicit exchange rate objective. This gives us reasons to believe that the Peruvian exchange rate could be characterized as a phony floater. From an mlogit framework and a monetary policy reaction function, 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 for this, we explore the reasons behind the fear and the need of following certain objectives in liability-dollarized economies.

JEL Codes: C52, E52

Keywords: Dollarization, floating exchange rates, central bank preferences, Peru.

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1 Introduction

The debate on exchange rate regimes has moved towards a new stage in which there is mounting evidence that many floating countries are phony floaters or at least a far cry from a textbook definition of a floating exchange rate. 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 this way. Hausmann et. al. (2000) suggest two explanations. The first on is that those 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 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 data of countries as Hausmann et. al. (2000) we focused on a single case. We are interested in studying cases in which the country runs a flexible exchange regime but is highly dollarized. In particular, our interest focuses in those with a high degree of *liability dollarization* as Calvo (1999) puts it. Among these economies Peru is a leading case.[2] Even though one might argue that central bankers would tend to keep an eye on the exchange

[1] See for example, Calvo and Reinhart (2000), and Levy-Yeyati and Sturzenegger (2000).
[2] Uruguay could be another interesting case to look at.

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).

One of the lessons of the exchange rate debate suggests that the middle ground is not precisely the safer and economies should move to one of the extremes. Rather than discussing this, we shall characterize Central Bank's decisions regarding monetary policy in a small, open and dollarized economy as Peru. In particular, we are interested in analyzing if the Peruvian Central Bank follows a "leaning against the wind" behavior when looking at the exchange rate and try to disentangle the reasons behind this attitude. In this context, an "hyperactive" central bank (Calvo, 1999) can set the wrong incentive to the banking system to become even more dollarized in a context in which creditors have very few instruments to hedge against exchange risk. This weakens the financial structure 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 they sure face this type of risk at the first signs of a relaxation of the fiscal stance. One issue that lies behind this discussion is which is the optimal nominal anchor available for an economy that is small, open, but dollarized. The recent trend is to combine a flexible exchange rate regime with an inflation targeting framework as in Brazil or Chile. However, the case for an inflation targeting in a dollarized economy has not been thoroughly discussed.

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

The outline of this paper is as follows. 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 a simple logit framework were used in order to account for the probability of an intervention operation. In Section 4 we follow Clarida et. al. (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 hyperinflation process was basically the result of a major fiscal deficit financed with monetary emission. The 1990 stabilization program included a complete 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 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 towards price stability. However, the balance leaned toward a flexible exchange rate due to the fact that the international reserves were negative and Peru had

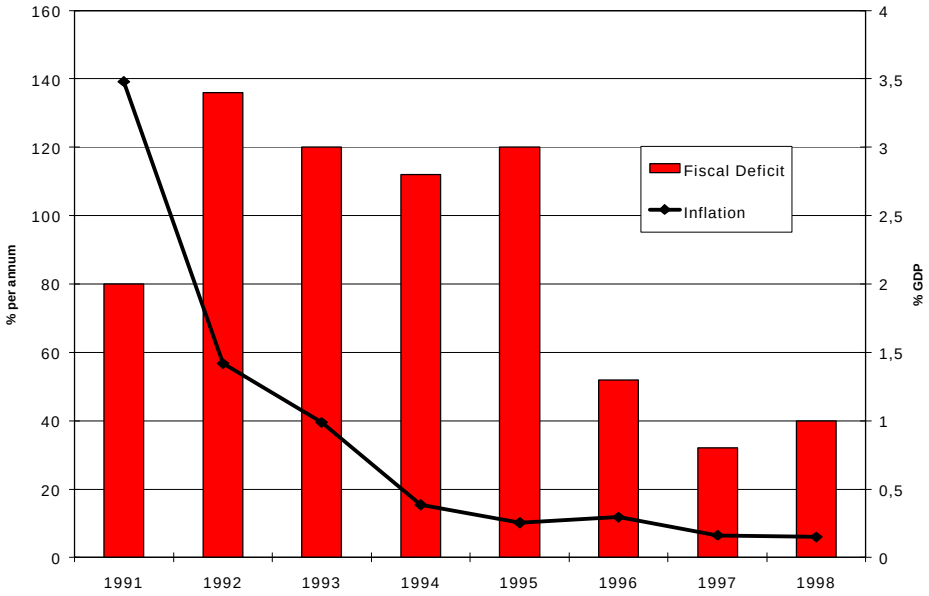
no access to international markets after several years of a *de facto* moratorium. There was no room to defend a fixed exchange rate or to consider a currency board.

The flexible exchange rate system worked well in the first years, which were characterized by 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), in the sense that if the fiscal deficit is under control, the existence of a nominal anchor becomes a less important issue.

Currently, the Central Bank has a clear and declared sole objective of maintaining price stability. In practical terms the Central Bank follows a rule very close to the one followed by Banco de Mexico before adopting the inflation targeting in 1999.[4] The price stability objective is achieved through a quantity rule rather than the more typical interest rate rule (as in Brazil or Chile nowadays). In the Central Bank's monetary policy framework the intermediate objective is the growth rate of the monetary base, which has had, until now, good results in the fight against inflation. The choice for this variable as the intermediate objective relies on the close relation between inflation and the growth rate of the monetary base. Likewise, there is an operational target given by the balances that the banking system maintains at the Central Bank in a daily basis.

[4]See Carstens and Werner (1999).

Graph 1. Fiscal Deficit & Inflation



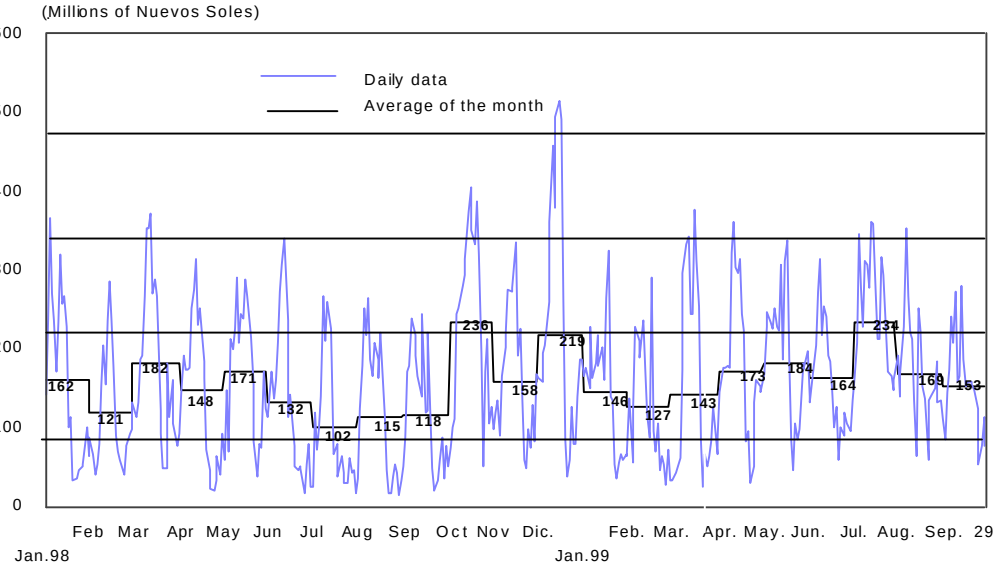
In theory, there are no multiple targets. In particular, the Central Bank does not have an exchange rate or interest rate target. There are no exchange rate bands or anything of the sort. As many other floaters, the Peruvian Central Bank uses an implicit inflation targeting framework as a nominal anchor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

We show the past behavior of the operational target in Graph 2. Clearly, this variable has a very volatile behavior. This is explained in part by the legal framework: firms pay taxes the third week of every month, so there is a substantial increase in the demand for money. But another important point is the problem of looking at the balances kept by the banks at the Central Bank: normal banking business might get mixed with particular problems of liquidity that a bank might face.

The Central Bank has tried to conduct its monetary policy without committing its actions to predetermined rules. In contrast to Banco de Mexico, whose actions are guided by

predetermined rules of intervention if the exchange rate fluctuates too much, the Peruvian central bank 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.

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



2.1 The Fear and the Reasons Behind

Before explaining the methodology applied to estimate the Central Bank's 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.[5]

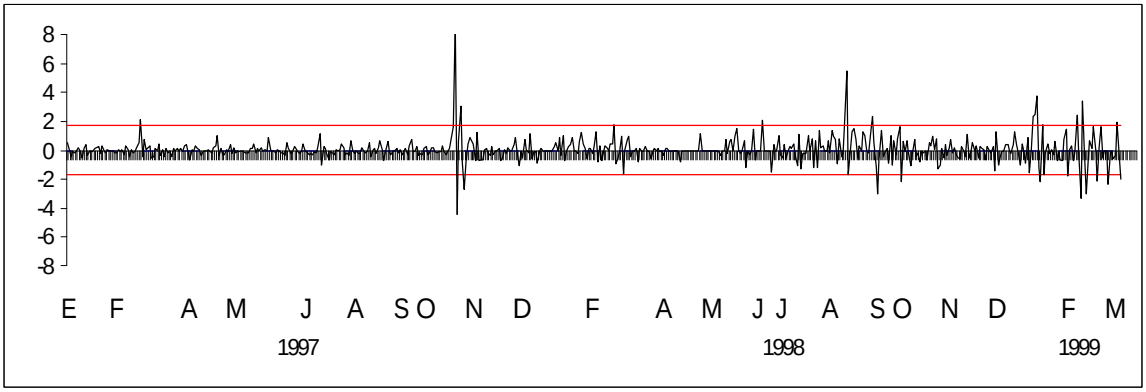
A comparative analysis reveals that the first and most striking feature of the Peruvian flexible exchange rate system is its lack of flexibility. If we analyze how flexible the Latin American floating exchange rate systems have been (Chile, Colombia, Mexico and Peru), we shall be surprised to learn that Peru is the one with less variability even when compared to Chile or Colombia when they had exchange rate bands (see Table 2); or to developed economies with flexible exchange rates (see Graph 3).

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 as those economies do not have exchange rate bands. One can also expect very few days in which the exchange rate does not move. 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 at the height of the Russian crisis, have recently adopted a fully flexible exchange rate regime.

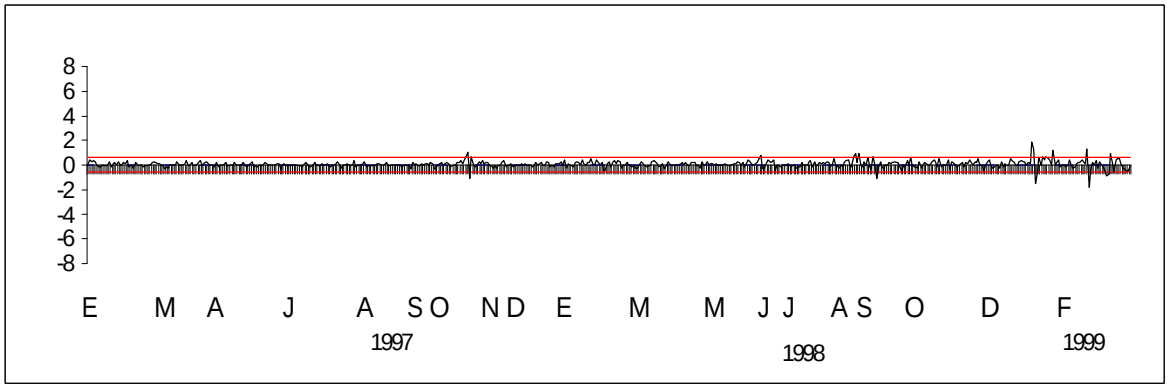
[5]The ratio M2 to forex reserves has been widely used in the literature as an indicator of financial fragility. See for example, Calvo, Leiderman and Reinhart (1994).

Graph 3. Daily Volatility of the Nominal Exchange Rate

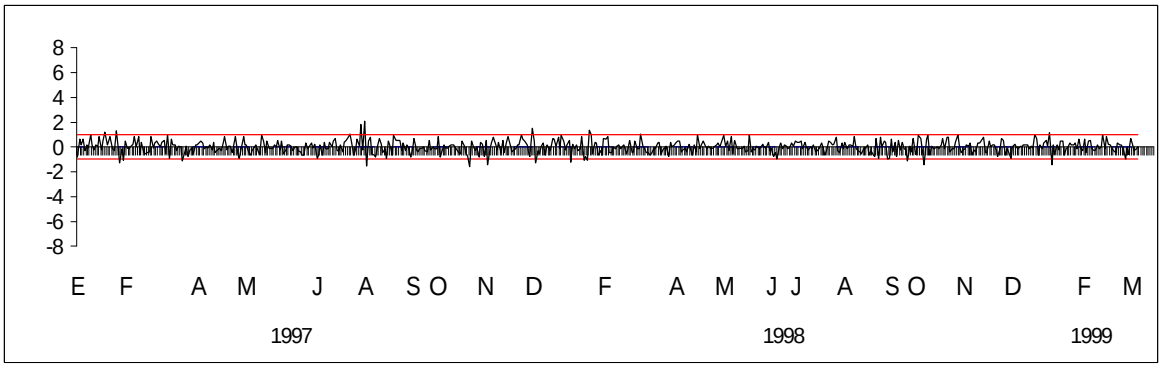
(A) Mexico (1997 - 1999)



(B) Peru (1997 – 1999)



(C) England (1997 – 1999)



After all this *prima facie* evidence a logical question is just: why? Why is the Peruvian central bank so reluctant to allow the exchange to freely float?

As Calvo and Reinhart (2000) put it, fear of floating arises when central bankers face a lack of credibility; this would conduce to a lower exchange rate volatility along with a higher volatility of the interest rate.[6] Their model, however, assumes that the central bank is able to control (or influence) the relevant market interest rate. In our case, the high degree of liability dollarization makes its difficult to defend this argument. Also, the fact that the Peruvian Central Bank operates with a quantitative intermediate target (the growth of the monetary base) favors the inclusion of this variable as the relevant policy instrument. How can the lack-of-credibility argument be used then?

In our case, the analysis focuses on two very distinct periods: one characterized by a massive inflow of foreign capital and another consistent with a reversal of these flows and a slowdown of economic activity. Central Bank's decisions during the first period were mainly characterized by sterilized purchases. This enabled the accumulation of international reserves while the appreciation tendency of the exchange rate helped to keep the inflation level low. In this context, we argue that forex purchases during the first period can be, in fact, associated to a credibility issue: accumulation of foreign reserves were aimed at proving an adequate back-up, as mentioned earlier. In other words, in the event of significant capital inflows, the natural decision of a central bank seeking for credibility is to "lean against the wind" in terms of forex purchases in order to accumulate foreign reserves.

[6] In particular, they show that a monetary accommodation aimed at offsetting the positive effects of a devaluation on interest rates would undermine credibility. The natural consequence is to choose stabilizing the exchange rate rather than the interest rate. Now, and since depreciation leads to higher domestic interest rates, an increase in the policy rate conducted to offset devaluatory pressures (if we consider this increase as equivalent to lowering money supply), would lead to a further increase in interest rates (a *pro-interest-rate-volatility bias* as defined by Calvo and Reinhart).

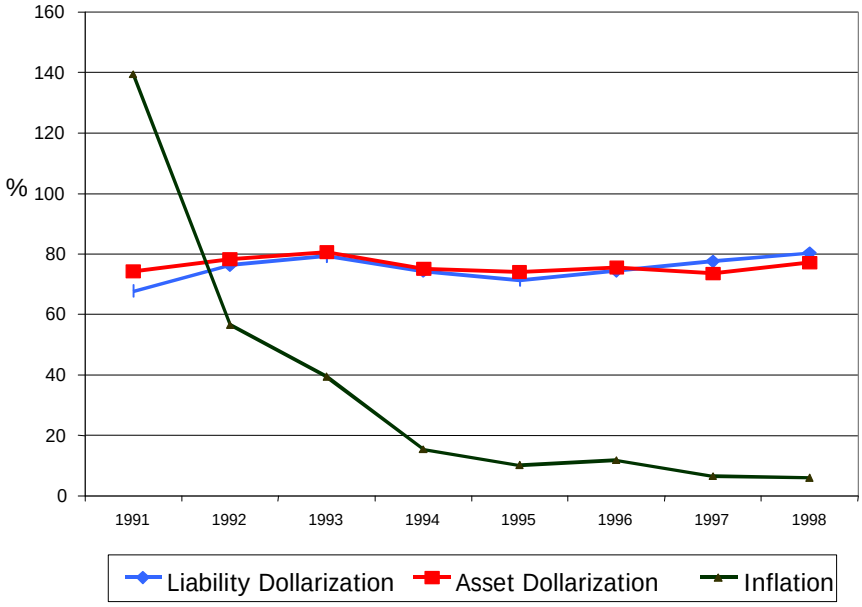
On the other hand, during the capital inflow scenario the regulatory framework favored a credit boom financed by short term external debt. In this context, we find Caballero and Krishnamurthy's (2000) explanation particularly appealing. They claim that the underdevelopment of the domestic financial system (in the sense of a limited availability of domestic collateral) leads to an excessive demand for dollar denominated debt (an undervaluation of the insurance provided by domestic currency denominated liabilities). In this way, excessive dollar-indebtedness is not only motivated by the existence of a hyperactive central bank, but reinforced by this distortion.[7] These characteristics favor liability dollarization which, in turn, provides strong reasons for being afraid of a floating exchange rate on the event of a capital flow reversal.

In Peru, and 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 4).[8] The high level of foreign currency denominated liabilities, in 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 shall see a clear relationship between the real exchange rate behavior and the bad debts ratio of the financial system (see Graph 5).

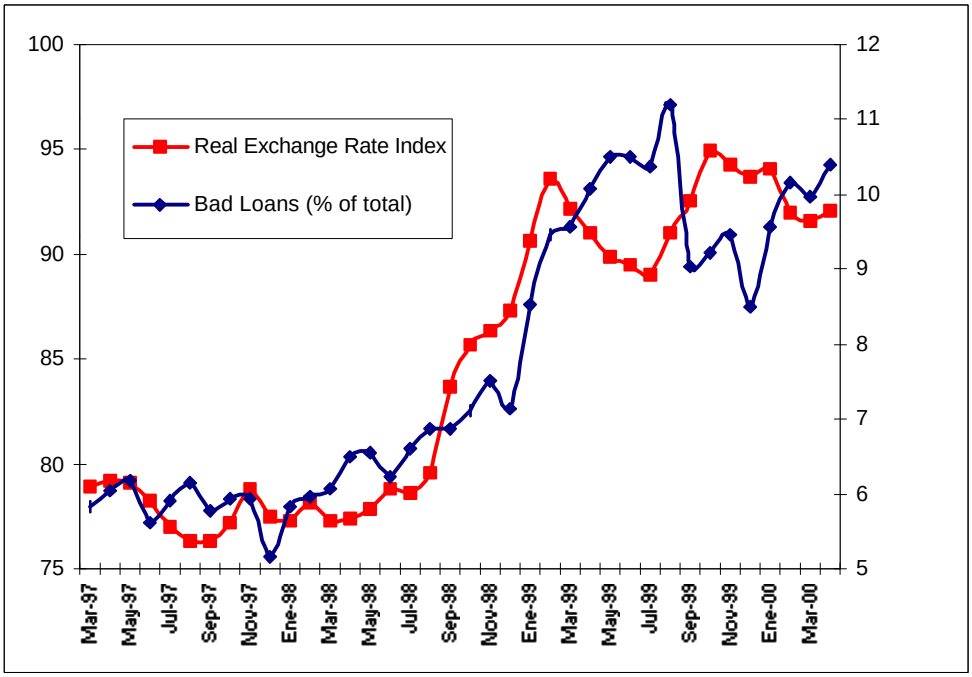
[7] In particular, Caballero and Krishnamurthy show that the existence of limited domestic collateral leads to a restricted competition for international liquidity. This, in turn, provokes a private overvaluation of domestic collateral and an undervaluation of international liquidity. This distortion sets the wrong incentives to the private sector which contracts excessive dollar liabilities.

[8] These facts should not be wrongly used as evidence of hysteresis as in Guidotti and Rodriguez (1992) or Uribe (1997). The previous literature on dollarization just thought about it as currency substitution. The evidence of Morón (1997) and Alarcón and Lladó (1999) suggests that a more accurate measure of currency substitution (not asset substitution or liability substitution) is below 30%. It would not make sense to think about a Central Bank that is able to control inflation without having any control over nominal aggregates.

Graph 4. Asset and Liability Dollarization in Peru



Graph 5. 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. These second round effects have been important in practice, as there are no signs of recovery of this temporary shock even though the government implemented several restructuring programs during 1999.

Another consideration behind fear of floating 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 around US$ 10,000 million in foreign investment between 1990 up to 1998, capital flows that put a lot of downward pressure on the nominal exchange rate. The possible conflict of having a high pass-through did not show up because this appreciating trend. On the other hand, after the external crisis the possibility of a phase-dependent pass-through became an issue.[9]

In highly liability dollarized economies depreciation caused by a sudden capital outflow will have contractionary effects that will reduce the possible inflationary pressures. The banks, however, will face a double hazard. The exchange rate and the recession both will hit the performance of their loans. The Central Bank will be forced to provide liquidity to those banks in need at the beginning of the crisis and then allow higher interest rates on reserves held by commercial banks. These banks will recover their liquidity faster than firms or households, which will slowly recover their likelihood to receive a new loan. In this way, the Central Bank becomes a debtor of first resort.[10]

[9] One example of this is the case of Israel, see Leiderman and Hadas Bar-Or (1999).
[10] During the crisis, the banks' regulatory agency closed three banks (Banco República, BANEX, Banco Orión), another (Banco Latino) was absorbed by a state second-tier bank (COFIDE).

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 methodologies[11] to account for the objectives (the level vs. volatility issue) of Central Bank's intervention operations in the period 1995-1999. [12] 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 for 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 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,

[11] Dominguez and Frankel (1993) present an extensive survey of this literature.
[12] A larger dataset would have been preferred, but daily information concerning intervention operations is not publicly available for periods before 1995. Although part of the analysis will be done considering a sample beginning in 1995, the inclusion of interbank rates would imply the use of a smaller sample (beginning in 1997) for most regressions.

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.

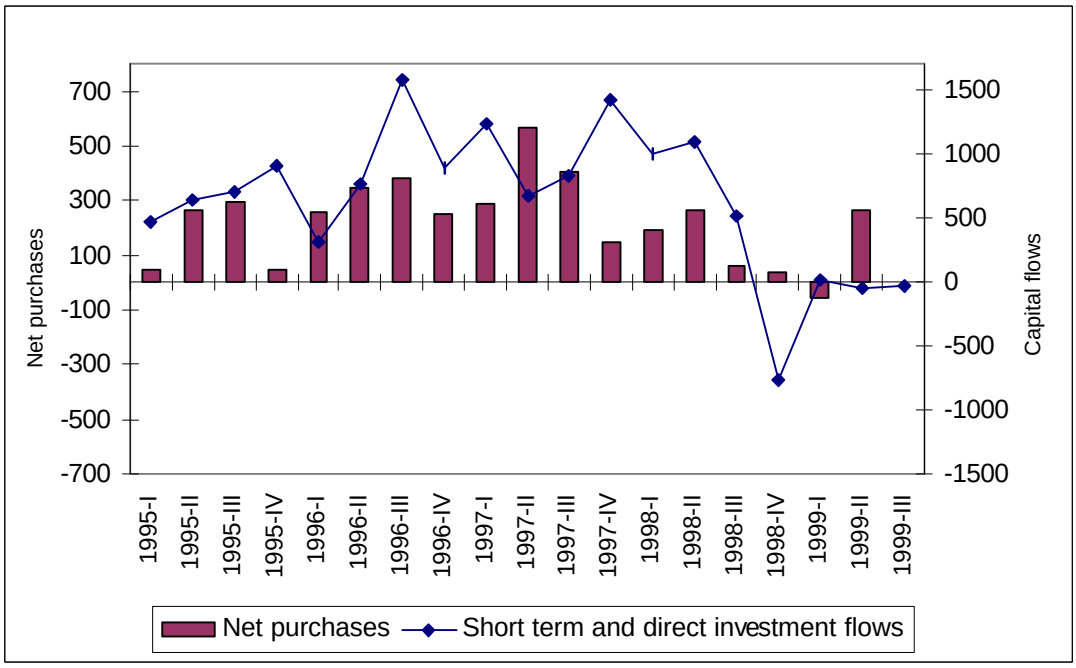
In our case, and in order to directly account for the importance of level changes and volatility, variables reflecting these were included. In particular, daily data from the period 2-jan-1995 to 14-jan-2000 on Central Bank's net forex purchases and exchange rate depreciation and volatility[13] were considered. In addition, and in order to control for the level of forex liquidity in the system, the level and volatility of the interbank rate for dollar operations were also included.

3.1. A quick look at the facts

A quick 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 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.

[13] 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.

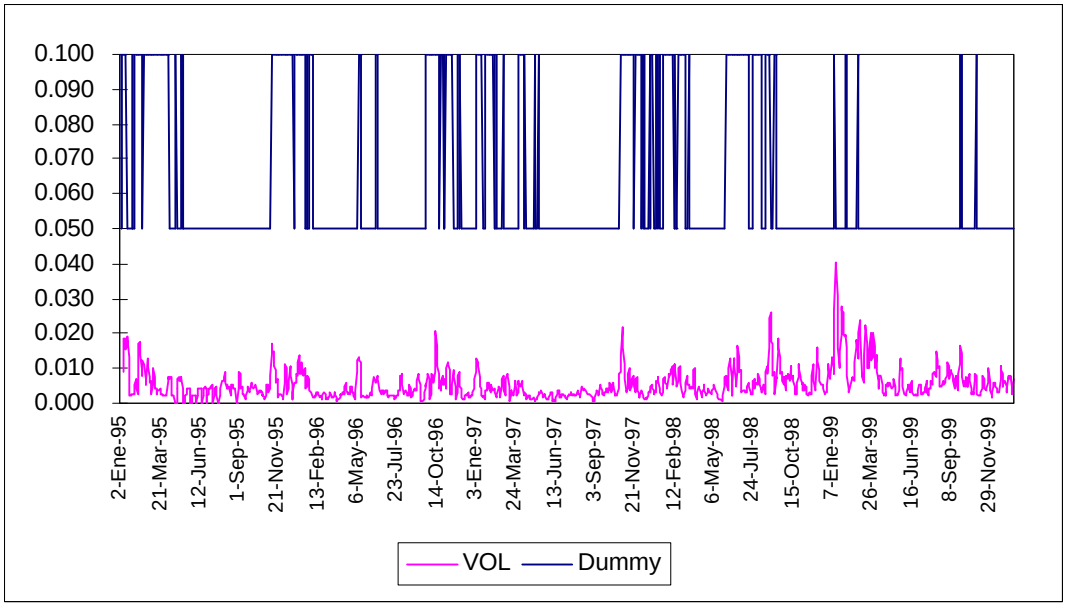
Graph 6. Central Bank's forex net purchases and capital flows (US$ millions)



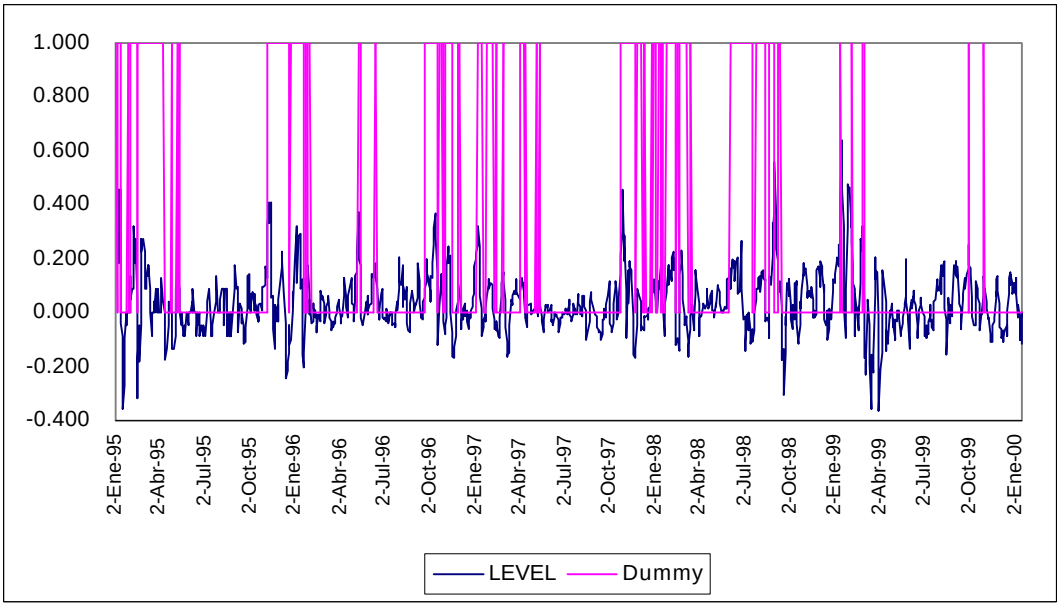
Graph 6 depicts the quarterly path of capital flows (short term plus direct investment) and Central Bank's forex net purchases. There is no intention of showing a tight correlation between these variables, but only to demonstrate that most of Central Bank's purchasing operations occurred during a period of considerable capital inflows. Consistent with this, foreign capital slowdown coincides with a decrease in net purchasing operations. Evidence from Graph 6 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 that explained the credit crunch experienced between the last quarter of 1998 and most of 1999).

Although purchasing operations occurred until the Russian crisis appeared fully consistent with an excess dollar supply (provoked by the capital inflow), such a direct association becomes much more difficult when considering intervention operations after the outburst of this crisis. In fact, the capital flow reversal implied a new scenario with a "natural" tendency towards depreciation, as opposed to the appreciation tendency observed during the years of capital inflows. Therefore, the result of a no intervention decision on the exchange rate market differs between both periods: in a context of capital inflows, the absence of intervention would favor an appreciation; while after the Russian crisis, you will need a selling operation to induce an appreciation trend. Following this intuition, Graphs 7a and 7b depict the behavior of exchange rate volatility and level together with a dummy that adopts the value of 1 if no intervention operations take place before the 1-set-98 or a selling operation takes place after that date[14]; both consistent with an "appreciation attitude" from the Central Bank.

Graphs 7a and 7b: Different responses to exchange rate volatility and level



[14] The intuition behind this dummy variable will be further exploited in a simple logit framework to be presented in the following section.

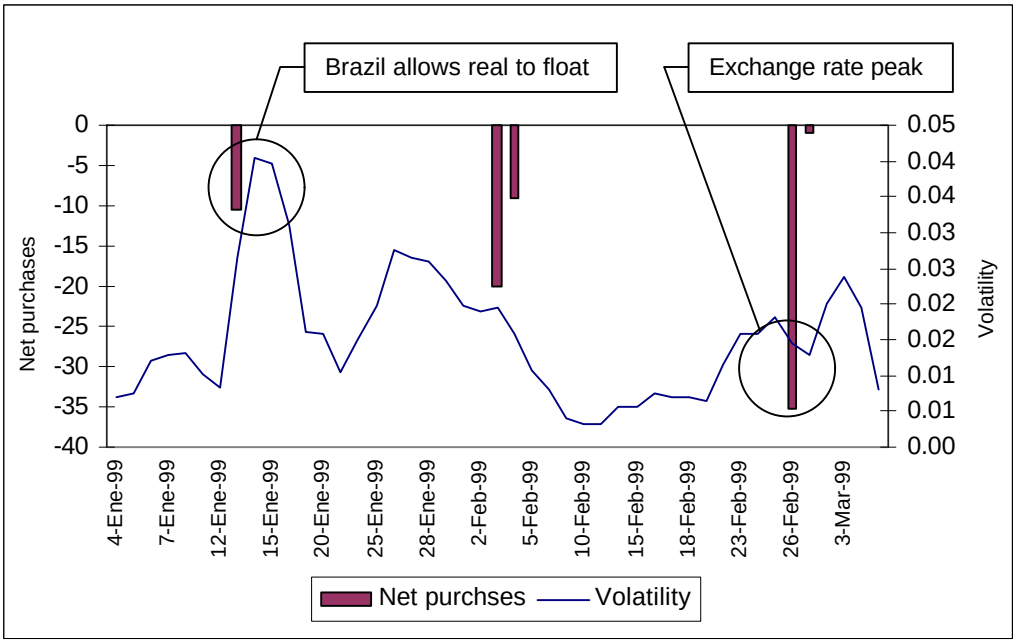


Although evidence from the previous graphs is quite rough, we can observe that the absence of purchasing operations before the Russian crisis and the occurrence of selling operations after this crisis are both consistent with a higher volatility and exchange rate level.

Before presenting a more formal approach, lets take a closer look to the more turbulent days and those where the most significant selling operations took place. 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's 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[15] auctions (an instrument vastly used after the Russian crisis and aimed at mitigating forex speculative demand).

[15] Central Bank certificates, instruments used to control the monetary base.

Graph 8. Turbulent days



On the other hand, the most important single selling operation (US$ 35.3 millions) took place on February 27th, one day 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 consistent with an appreciation tendency in the exchange rate. On the other hand, forex sells, and the absence of purchasing operations until the Russian crisis, are associated to episodes where a high level and volatility can be observed. 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), VOL (accounting for exchange rate volatility), and RATE and RATEVOL (accounting for interbank's rate level and 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 $\beta_0 = 0$, the probabilities for each category are given by:

$$\Pr(\text{Interven} = 0) = \frac{1}{1 + \exp(\beta_{10} + \beta_{11}\text{Level} + \beta_{12}\text{Vol} + \beta_{13}\text{Rate} + \beta_{14}\text{Ratevol}) + \exp(\beta_{20} + \beta_{21}\text{Level} + \beta_{22}\text{Vol}\beta_{23}\text{Rate} + \beta_{24}\text{Ratevol})}$$

$$\Pr(\text{Interven} = 1) = \frac{\exp(\beta_{10} + \beta_{11}\text{Level} + \beta_{12}\text{Vol} + \beta_{13}\text{Rate} + \beta_{14}\text{Ratevol})}{1 + \exp(\beta_{10} + \beta_{11}\text{Level} + \beta_{12}\text{Vol} + \beta_{13}\text{Rate} + \beta_{14}\text{Ratevol}) + \exp(\beta_{20} + \beta_{21}\text{Level} + \beta_{22}\text{Vol} + \beta_{23}\text{Rate} + \beta_{24}\text{Ratevol})}$$

$$\Pr(\text{Interven} = 2) = \frac{\exp(\beta_{20} + \beta_{21}\text{Level} + \beta_{22}\text{Vol} + \beta_{23}\text{Rate} + \beta_{24}\text{Ratevol})}{1 + \exp(\beta_{10} + \beta_{11}\text{Level} + \beta_{12}\text{Vol} + \beta_{13}\text{Rate} + \beta_{14}\text{Ratevol}) + \exp(\beta_{20} + \beta_{21}\text{Level} + \beta_{22}\text{Vol} + \beta_{23}\text{Rate} + \beta_{24}\text{Ratevol})}$$

(1.)

The above expressions are useful for computing average probabilities and forecast exercises, so we can rely on odds 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:

$$\frac{\Pr(\text{Interven} = 2)}{\Pr(\text{Interven} = 0)} = \exp(\beta_{20} + \beta_{21}\text{Level} + \beta_{22}\text{Vol} + \beta_{23}\text{Rate} + \beta_{24}\text{Ratevol}) \qquad (2.)$$

So, the signs for β_{21} and β_{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. We must recall, however, that the possibility of using the estimates in this manner relies on the validity of the independence of irrelevant alternatives (IIA) assumption: the inclusion or exclusion of categories does not affect the odds ratios associated to the remaining categories; in other words, the estimated coefficients associated to a particular category are not sensible to the exclusion/inclusion of any other category. To contrast the IIA assumption, a Hausman test was applied; the null states the difference between the coefficients (comparing a complete vs. an incomplete model) is not systematic.

At this point we must also recall that coefficient interpretation in an 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:

$$\frac{\partial \Pr_j}{\partial x_i} = \Pr_j\left[\beta_j - \sum_{k=0}^{2} \Pr_k \beta_k\right] \text{ for } j = 1,2. \qquad (3.)$$

So, the direct association of β_j with the jth category can be misleading. In other words, if we obtain a positive coefficient for variable x_i in the jth 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 a simple logit model in order to facilitate result interpretation.

In order to avoid the presence of endogenous explanatory variables (since current and future exchange rate are a function of Central Bank's intervention operations) all variables were included in lags (at least to guarantee that they are weakly exogenous). Coefficients were estimated in STATA and are reported in Table 1 (standard errors and z-statistics in parenthesis)[16].

[16] The null of Hausman's test was accepted with a 5% significance.

Table 1
Full sample
(2-jan-97 to 14-jan-00)

	Interven = 1 (Purchase)	Interven = 2 (Sell)
Constant	**3.8593 ***	**-5.5561 ***
	(0.4921)	(1.2367)
	(7.842)	(-4.493)
Level_l	**-6.3535 ***	**11.6137 ***
	(1.2349)	(4.94)
	(-5.145)	(2.351)
Vol_l	**-300.4286 ***	**-120.2767**
	(37.9976)	(93.723)
	(-7.907)	(-1.283)
Rate_l	**-0.3392 ***	**0.2148**
	(0.0689)	(0.1486)
	(-4.925)	(1.446)
Ratevol_l	**-0.6903 ***	**-0.9954**
	(0.3474)	(1.0530)
	(-1.987)	(-0.945)
* Denotes rejection of null hypothesis at 5% sig.		
Pseudo R-squared = 0.2589		
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 evidence shown in Graph 8: volatility peaks are associated to a no intervention decision. In the case of the second category (sell), volatility lacks statistical significance and its sign is not as expected; in fact, the only significant variable is LEVEL and its sign agrees with the intuition: a systematic depreciation (increase in LEVEL) would conduce to a higher probability for a selling operation with respect to a no intervention decision.

In order to directly account for these impacts, pure marginal effects and elasticities were computed for each sample using equation (3) and average probabilities for each category (Pr_j and Pr_k). As was mentioned earlier, signs can aid in the interpretation of the variable's 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 2
Elasticities /1

Full sample

Outcome	Variable	
	Level	Volatility
Purchase	**-0.195**	**-1.354**
Sell	**0.531**	**-0.257**

/1 Response of Pr(purchase) and Pr(sell) to a 1% increase in LEVEL and VOL.

Volatility exerts a greater impact on the probability of a purchasing operation that level changes (both negative). Recall, however, that the latter is also a significant variable when explaining this type of operations (see Table 1). On the other hand, level changes have a greater impact on the probability of a selling operation; also recall that it's the only significant variable.

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 to avoid the misleading influence of low frequency selling

operations), a simple logit framework was also proposed. In particular, the dependent variable was the dummy presented in Graph 7; explanatory variables included a multiplicative dummy associated to every variable, which adopts the value of 1 since the outburst of the Russian crisis (D = 1 since 1-set-98).

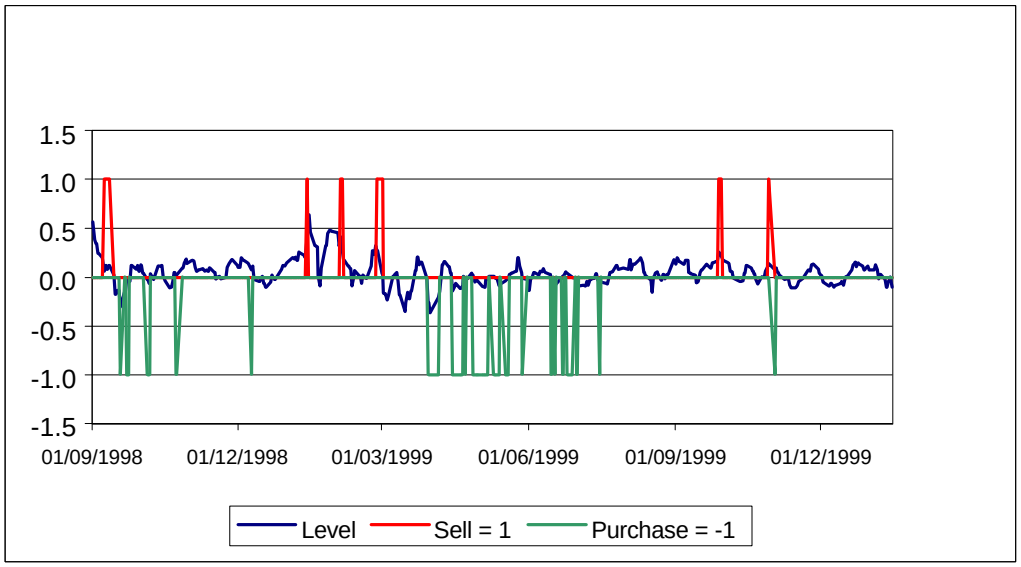
Table 3
Full sample
(2-jan-97 to 14-jan-00)

Dependent variable: DUMMY = 1 if no intervention until Russian crisis or selling operation after the crisis	
Constant	**-5.1511 *** (-7.1192)
Level_l	**8.1923 *** (4.3864)
Vol_l	**390.9463 *** (5.6797)
Rate_l	**0.3453 *** (3.3164)
Ratevol_l	**0.9853 *** (2.3302)
Level_l*D	**6.8506** (1.1757)
Vol_l*D	**-567.8859 *** (-4.6642)
Rate_l*D	**-0.1085** (-1.2371)
Ratevol_l*D	**-2.7591 *** (-2.0388)
	Mc Fadden = 0.43
* Denotes rejection of null hypothesis at 5% sig.	

Results appear consistent with the previous analysis: systematic exchange rate depreciation will increase the probability of a no intervention decision until the Russian crisis and a selling operation after this event. The positive sign associated with volatility (and the significance and sign associated with its multiplicative dummy) confirms that both purchasing and selling operations took place in a context of relative stability.

As final evidence, Graph 9 depicts the evolution of variable LEVEL and the occurrence of selling and purchasing operations since the outburst of the Russian crisis.

Graph 9. Level changes and Central Bank's intervention



Evidence from Graph 9 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 until the outburst of the Russian crisis (allowing for capital inflow to correct the depreciation tendency). The positive impact of volatility in the auxiliary regression confirms this intuition (see Table 3).
- Purchasing operations respond to systematic exchange rate appreciations (as accounted by the negative sign and statistical significance of variable LEVEL; see Table 1). Exchange rate depreciation would conduce to a higher probability for a no intervention until the Russian crisis (see Table 3).

- Volatility fails to explain selling operations in the mlogit regression, while level changes prove statistically significant and with the expected sign: systematic exchange rate depreciation increases the probability of a selling operation (as reported in Tables 1 and 3).

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, et. al. (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 variables[17], the reaction function was specified considering these variables' first differences. Formally, the proposed function takes the form:

$$\Delta M0_t^* = \Delta\overline{M}0 + \beta\{E_t(\pi_{t+n}) - \pi^*\} + \gamma_1 E_t(\Delta X_{1t}) + \gamma_2 E_t(\Delta X_{2t}) \qquad (4.)$$

where:

[17] 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.

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

In the above equation, $\Delta\overline{M0}$ 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, et. al. (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:

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

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 $(\alpha = \Delta\overline{M}0 - \beta\pi^*)$, the partial adjustment specification is included and (4) is rewritten only in terms of realized variables:

$$\Delta M0_t = (1-\rho)\{\alpha + \beta E_t(\pi_{t+n}) + \gamma_1 E_t(\Delta X_{1t}) + \gamma_2 E_t(\Delta X_{2t})\} + \rho\Delta M0_{t-1} + \mu_t \quad (6.)$$

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

Now, our composite error term has the form:

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

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 $E\left[e_t \,|\, I_t\right] = 0$ 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 4. 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)-. It's worth noticing that our final empirical model included both a forward and backward looking specification and that core inflation[18] was used instead of CPI inflation. In fact, it's reasonable to assume that the relevant measure of inflation considered when targeting monetary base growth should exclude transitory shocks from prices' evolution.

Table 4

Generalized Method of Moments Dependent variable: DM0 Instrument list: CORE(-1 to -12) DEXRATEGAP(-1 to -12) DOUTPUTGAP(-1 to -12)	
Constant	**0.01403*** (10.58)
CORE(12)	**-0.00222*** (-2.92)
CORE(-1)	**-0.00154*** (-3.08)
DEXRATEGAP	**-0.11059*** (-2.32)
DEXRATEGAP*DUM	**-0.84465*** (-2.17)
DOUTPUTGAP	**-0.00068*** (-4.65)
DM0(-1)	**0.10211*** (2.10)
J-statistic = 0.211799 J*n, $\chi^2(29)$, p-value=0.9847	
* Denotes rejection of null hypothesis at 5% sig.	

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

As mentioned earlier, it's 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 expected[19]: both anticipated and lagged core inflation have a negative impact on the monetary base growth, just like the expected change in the output and exchange rate gap. In other words, 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 $\alpha = \Delta\overline{M}0 - \beta\pi^*$ and notice that the first and second coefficients {c(1) 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:

$$\alpha = \pi^* - \beta\pi^*$$
$$\pi^* = \frac{\alpha}{1-\beta}$$
$$= \frac{c(1)}{1-c(7)} \Big/ 1 - \frac{c(2)}{1-c(7)} = 0.0156$$

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

It's 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 4 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, we finally decided to include a multiplicative dummy variable associated to the exchange rate gap (DUM = 1 for t = set-1998 to dec-1999). As reported in Table 4, 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 it's 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".

Our analysis focuses on tow very distinct economic scenarios and empirical evidence (as shown both in the multinomial and the reaction function results) suggests that the Central Bank's willingness to control both the level and volatility of the exchange rate is present in both regimes. However, the reasons behind Central Bank's fear of floating during the whole period under analysis respond to two different motivations.

The fear-of-floating-type results associated to the capital inflow episode are consistent with forex purchases needed to build up credibility through foreign reserve accumulation. As a matter of fact, the credibility issue is also present but in a different manner than that described

by Calvo and Reinhart: liability dollarization prevents the Central Bank from having to choose between stabilizing the relevant market interest rate or the exchange rate.

One can also argue that the possibility of a monetary expansion (or a less than offsetting sterilization) in the event of an appreciation tendency, as accounted by the reaction function results, can be consistent with an attitude against a "larger" appreciation: with low inflation levels (inflationary expectations can be considered under control in the event of capital inflows) Central Bank's sterilization operations needed not to completely offset the effects of forex purchases on the growth of the monetary base.

On the other hand, trying the disentangle the reasons behind fear of floating during the second part of the sample is a much easier task. We can summarize these reasons with two words: liability dollarization, a phenomenon that can have devastating effects on the financial sector when combined with the lack of hedging mechanisms and a majority of agents generating soles. In this scenario, our results have a clear cut interpretation: defending the level of the exchange rate to prevent an *additional* depreciation by the means of forex sales and the contraction on the supply of domestic currency, was aimed at preventing a further deterioration of the banking sector.[20] Its worth including the term *additional* since (and as revealed by Graph 5) the exchange rate indeed depreciated, consistent with the deterioration of our terms of trade; however, our claim is that it was not allowed to fully depreciate.[21]

[20] In fact, when included in the reaction function, bad loans ratio was statistically significant and with the same sign as the exchange rate gap. This evidence, however, must not lead to conclude that the Central Bank's concern regarding the performance of the financial system is the only reason explaining fear of floating. It can be, however, regarded as the main reason during the second part of the sample.

[21] As accounted by Calvo and Reinhart, if the exchange rate is allowed to adjust this type of shocks, commodity prices in the local currency should be relatively stable (if commodity prices decrease, for example, the exchange rate should go up offsetting variability in local currency prices). Evidence for Peru reveals that commodity prices in local currency are more volatile than the exchange rate: the probability of a monthly fluctuation in excess of a 5% band is about 28% for commodity prices while the probability for a change of the same magnitude is 13% for the exchange rate.

In this context, we can also identify a procyclical bias in monetary policy: a negative correlation between the growth of the monetary base and the exchange rate (in line with the description given by Calvo and Reinhart concerning the interest rate).

Finally, and concerning the relationship between the exchange rate and inflation, 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 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. In this sense, further research is needed to disentangle the relationship between the exchange rate, inflation and the level of economic activity, and to evaluate the existence of a procyclical bias 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.

Table 2
Flexibility of the Exchange Rate Systems

	Peru	Australia	New Zealand	Canada	Mexico	Chile	Colombia
1997							
Max. absolute change	1.10%	3.38%	2.25%	1.43%	8.90%	2.35%	3.26%
# of obs. with no change	33	41	33	31	9	12	57
Standard Deviation	0.18%	0.60%	0.54%	0.30%	0.77%	0.31%	0.49%
Average	0.02%	0.08%	0.08%	0.02%	0.01%	0.01%	0.10%
Coef. of Variability	963.29	771.85	709.69	1,701.11	5,808.19	2,277.32	496.68
Number of observations	260	260	260	260	260	260	260
1998							
Max. absolute change	1.08%	4.68%	3.90%	3.09%	5.49%	2.50%	8.06%
# of obs. with no change	24	23	21	17	70	5	28
Standard Deviation	0.24%	0.88%	0.97%	0.47%	0.76%	0.37%	0.93%
Average	0.06%	0.03%	0.04%	0.03%	0.09%	0.03%	0.07%
Coef. of Variability	429.27	3,128.66	2,235.75	1,532.82	893.84	1,278.02	1,272.05
Number of observations	261	261	261	261	261	261	261
1999							
Max. absolute change	1.88%	1.93%	1.61%	1.66%	3.73%	1.05%	2.06%
# of obs. with no change	4%	6	2	5	7	1	3
Standard Deviation	0.61%	0.66%	0.67%	0.52%	1.44%	0.41%	0.58%
Average	0.11%	-0.06%	-0.01%	-0.03%	-0.04%	0.06%	0.00%
Coef. of Variability	538.42	1,185.10	4,530.54	1,544.58	3,339.38	681.38	574,915.52
Number of observations	56	56	56	56	56	56	56
1997-1999							
Max. absolute change	1.88%	4.68%	3.90%	3.09%	8.90%	2.50%	8.06%
# of obs. with no change	61	70	56	53	86	18	88
Standard Deviation	0.28%	0.75%	0.77%	0.41%	0.86%	0.35%	0.73%
Average	0.04%	0.04%	0.05%	0.02%	0.04%	0.03%	0.08%
Coef. of Variability	619.91	1,752.36	1,478.59	2,194.84	2,114.40	1,390.27	941.49
Number of observations	577	577	577	577	577	577	577