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The currency exchange band system in Ecuador

I. INTRODUCTION

Since the exchange rate is a key economic variable, the determination of the exchange system is relevant to and should be linked with microeconomic efficiency and macroeconomic stability in addition to policy objectives and priorities. Policy objectives, for example, could dictate an exchange rate regime conditioned to control inflation, diminish the volatility of the product, or increase competition in exports.

In general, given the importance of the exchange rate in the assignment of resources and the transmission of expectations, an optimum regime should consist of two basic characteristics: i) reduce to the maximum abrupt, unpredictable and transient movements in the exchange rate, and ii) adjust to permanent movements.

Because the more extreme regimes have not fulfilled these requirements, there is a renewed interest on the part of theoretical literature and praxis in "administered" exchange rates based on fundamentals that will contend with the expectations of economic agents and that are flexible enough to weather exogenous shocks. An exchange band policy would fulfill these

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characteristics by attempting to manage the real exchange rate through the establishment of a target zone of exchange parity. The extremes of the band are the limits within which the monetary authority would intervene.

This pattern has been applied recently by some countries. Israel, Chile and Mexico after using fixed exchange rates to break inflation inertia, found that this caused substantial increases in the real exchange rate, and have implemented exchange bands around central adjustable parities to introduce some degree of flexibility in the nominal exchange rate, without abandoning the exchange rate as a nominal anchor.¹

In Ecuador, the monetary authority replaced a discretionary "dirty floating" exchange pattern with a system of preannounced exchange bands in December of 1994. An analysis of its performance, implications and critical aspects is relevant.

This paper will analyze the theoretical and practical characteristics of exchange band patterns, based on simple models from economic literature, and test the hypothesis that, under present circumstances, this is the most appropriate pattern for the Ecuadorian economy.

In the first section we review Krugman's basic exchange model, with its implications and the modifications that have been introduced to better reproduce the empirical behaviour of this exchange pattern. In the second section we broach some aspects that are critical in the successful application of band systems, such as determining a central parity, the band's breadth, and the basic criteria for interventions. Finally, the last section is a review of the Ecuadorian experience, the behaviour of the exchange rate within bands, and its perspectives. We should mention that the Ecuadorian experience in the application of exchange bands is limited, but can be relevant in outlining some preliminary conclusions on its performance and advisability.

II. THEORETICAL MODELS OF EXCHANGE BANDS

1. Krugman's Basic Model

Theoretical literature on exchange bands was greatly advanced by Krugman's model (1991), which is based on a pattern that determines the merely monetary nominal rate. Based on market equilibrium of monetary

¹ See Leiderman, Bufman and Kiguel (1994) for a review of these experiences.
assets and parity buying power, the nominal exchange rate is determined as follows

\[ m - p = \tau y - \delta i - \nu \text{ (real money supply } = Dd \text{ real money)} \]  

(1)

In which \( m \) is the logarithm of the domestic monetary supply, \( y \) is the logarithm of the product, \( i \) the domestic interest rate, \( \tau \) the elasticity of money with respect to earnings, \( p \) is the logarithm of the domestic prices index, and \( \nu \) is a stochastic variable that represents shocks that are exogenous to money velocity. Changes in the behaviour of \( \nu \) can be characterized as a "brownian"\(^2\) trajectory, defined by the following stochastic differential equation:

\[ d\nu = \sigma dz \]  

(2)

in which \( \sigma \) is a constant and \( dz \) is the standard increase of the brownian process.

Now, according to the theory of buying parity power, the exchange rate should be the result of the difference between price indexes:

\[ s = p - p^*, \text{ } p^* \text{ being the logarithm of foreign prices index} \]  

(3)

Based on the parity of uncovered interest, the expected devaluation can be expressed as equivalent to the difference between interest rates:

\[ E(ds)/dt = i - i^* \]  

(4)

Substituting (4) in (1) and in the result of (3) and assuming that \((\delta i^* - \tau y - p^*)\) is constant and can be included in the definition of \( m \), we obtain the basic determining equation of the nominal exchange rate:\(^3\)

\[ s = m + \nu + \delta E(ds)/dt \]  

(5)

To determine the dynamic behaviour of the nominal exchange rate in equation (5) we must add equation (2), which defines the behaviour of

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\(^2\) A brownian process is a stochastic process in continuous time in which increments of the process, which can be defined as \( dz(z_t - z_s) \), are normally distributed with a mean equal to zero and \( t - s \) variance. It equals an aleatory path, but in continuous time.

\(^3\) In this context \( \nu \) can be more conveniently understood as the group of exogenous fundamental factors that affect the exchange rate, such as variations in money demand, changes in interchange terms, the behaviour of fiscal policy, changes in the foreign sector.
the aleatory variable \( \nu \). To simplify the analysis, we assume that \( m \) changes only when the Central Bank buys or sells currency.

In this model, in a free exchange rate regime \( s = m + \nu \), since devaluation expectations are always zero because \( \nu \) follows an undirected aleatory trajectory. With a fixed exchange rate, \( m \) adjusts to defend the parity, and devaluation expectations will be null under perfect credibility.

In a pattern of exchange bands with complete credibility and rational expectations, on the other hand, devaluation expectations will not be zero as a result of expected Central Bank interventions to maintain exchange rate quotations below the "ceiling" and above the "floor". In effect, if the exchange rate is above the central parity, agents will expect the rate to decrease due to monetary intervention \((E (ds)/dt < 0)\), but if \( s \) is below the central parity, devaluation expectations will be positive \((E (ds)/dt > 0)\).

If we compare the dynamics of the exchange rate on one plane \((m + \nu, s)\), a floating exchange rate would have a lineal trajectory with a slope equal to one because it would adjust proportionately to changes in fundamental factors, and there would be no devaluation expectations. With exchange bands, the rate would follow an \( S \) shaped trajectory that would never reach a slope equal one, due to devaluation expectations.

GRAPH 1. DINAMIC OF THE EXCHANGE RATE

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4 This model rejects the previously sustained idea that within the band the exchange rate behaves in the same way as in floating, and that at its limits if behaves like a fixed exchange rate.

5 This can be observed in equation (5): below central parity devaluation expectations would be positive, while above central parity they would be negative. Krugman calls this behaviour "honeymoon effect".
In the case of exchange bands, the system formed by equations (5) and (2) can be resolved in terms of the dynamics of the exchange rate:

\[ s = g(k) = k + 0.5g''\sigma^2\delta \]  \hspace{1cm} (6)

Equation (6) is a non homogenous differential equation of the second order. Its general solution is given by the particular solution \( g(k) = k \) and the solutions to the characteristic equation of the homogenous part \( (\alpha y - \alpha) \):

\[ s = g(k) = k + Ae^{\alpha k} + Be^{-\alpha k} \]  \hspace{1cm} (7)

as in the homogenous part \( 0.5\sigma^2\delta\alpha^2 - 1 = 0 \), then

\[ \alpha = \sqrt{\frac{2}{\sigma^2\delta}} > 0, -\alpha < 0 \]  \hspace{1cm} (8)

with which we verify the \( S \) form behaviour of the exchange rate. The values of \( A \) and \( B \) are obtained in this case through "smooth pasting" that dictates, under perfect credibility, that the function of the exchange rate on the band borders shall be tangent to the extreme values \( (g' = 0) \), which implies that the exchange rate becomes insensitive to its fundamental determinants.

A simple modification that can be introduced in the basic model is to allow the stochastic variable to have a direction. This permits the representation of mobile bands, such as in the Chilean and Uruguayan cases, where the band takes an ascendant path because it adjusts to the positive gap between domestic and international inflation. Equation (2) is restated as follows for this effect:

\[ dv = \mu dt + \sigma dz, \mu > 0 \]  \hspace{1cm} (2')

The general solution for the dynamics of the exchange rate will therefore be:

\[ s = g(k) = k + \mu dt + Ae^{\alpha k} + Be^{-\alpha k} \]  \hspace{1cm} (6')

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\( s = g(k), g() = \) non lineal function  
\( k = m + v = \) fundamental factors  
\( ds = g'dk + 0.5g''(dk)^2 \) Taylor expansion  
\( dk = \sigma dz \)  
\( \Rightarrow ds = g'\sigma dz + 0.5g''\sigma^2(dz)^2 \)  
Applying the Ito calculus rule that \( (dz)^2 = dt \),  
\( E(ds) = 0.5g''\sigma^2 dt \)  
The symbol ' signifies first derivative, while '' signifies second derivative.
Inclusion of the term $dt$ allows the introduction of predictable movements in the behaviour of the exchange rate.

2. Implications of the basic model

Krugman's model, based on perfect credibility and interventions solely when the exchange rate reaches the limits of the band ("marginal interventions"), implies that in a pattern of exchange bands:

a) The rate is more stable than under a floating regime due to the effect of devaluation expectations ("honeymoon effect"). It should be noted that the greatest exchange stability does not totally depend on the assumption of complete credibility; the simple positive probability of Central Bank intervention can't have repercussions on devaluation expectations.

b) The differential between interest rates shows a reversion to the mean, i.e. it is negatively correlated with the exchange rate. In effect, when the exchange rate is above the central parity, devaluation expectations and interest rate differentials are negative; the greater the distance from the central parity, the more negative the differential.\(^7\)

c) Monetary policy flexibility affects aggregate demand while the exchange rate remains within the band. This is an evident advantage over a fixed exchange regime.\(^8\)

d) There is greater volatility in the exchange rate due to the ups and downs of devaluation expectations. In effect, these expectations will be negative below the central parity, and positive above the central parity, which implies higher movements in the domestic interest rate when there are depreciation expectations, and lower movements when an appreciation is expected.

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\(^7\) This result is obtained when the interventions are made exclusively through the use of the IMR. If the monetary authority intervenes through interest rate policy, this relation ceases to exist.

\(^8\) Delgado and Dumas (1991) demonstrate that even a very narrow band permits substantial flexibility of fundamental determinants. This is because agents anticipate that any deviation of fundamental determinants will be temporary, therefore the exchange rate would not register modifications versus movements of the fundamentals.
3. Extensions of the basic model

Empirical evidence has consistently rejected the implications of the basic model, therefore extensions have been developed to remove the assumptions of perfect credibility and marginal interventions.

3.1. Imperfect credibility and expected realignment

The assumption of perfect credibility is replaced by imperfect credibility in the form of band realigning risks (Bertolo and Caballero, 1992). Realignment of the band has been registered empirically, and its inclusion is a logical extension.

Bertolo and Caballero postulate a structure of probabilities to defend the band and its realignment. The expected devaluation rate equals, in this case, to the expected devaluation rate within the band plus the expected central parity exchange rate, which is the expected realignment of the band. Under this specification there are two fundamental determinants of the exchange rate: variable $k$ and the expected realignment rate, which could depend on other variables such as the international monetary reserves level ($IRM$).

The dynamics of the resulting exchange rate can be very different from that of the basic model, and depends on the probability of realignment. In effect, if agents assign a high value to the probability of realignment, the behaviour of the exchange rate as it approaches the band limits will be completely different from the original model: the tangency of the exchange rate as a function of the fundamental factors when confronting its limits ("smooth pasting") will be replaced by an approximation with a high slope, because a realignment of the band, not a defense, will be expected. As a result, high probabilities of realignment would involve an exchange rate function in the form of an inverted $S$, an even more volatile exchange rate than under floating, and a positive ratio between the exchange rate and the interest rate differential. The higher the exchange rate, the greater the expectations of band realignment, the higher devaluation expectations and, as a result, a higher interest rate differential.\(^9\)

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\(^9\) It is implicitly assumed that devaluation expectations within the band are not very strong versus realignment expectations.
3.2. Expected realignment and the bands breadth

The higher volatility of interest rate differential in this pattern is questioned by Werner (1994), who proposes a model in which realignment expectation is the only exogenous variable, and the monetary authority can use monetary policy to counter act shocks from the expected realignment. The application of monetary policy determines the breadth of the exchange band: the bigger the intervention, the smaller will be the breadth of the band.\textsuperscript{10}

Interest rate differentials are determined by the sum of the expected realignment plus the expected modification of the exchange rate within the band, factors which are negatively correlated.\textsuperscript{11} The rate differential is less sensitive to realignment expectations within exchange bands, this effect growing stronger as the band broadens.

The exchange rate, in turn, will be more volatile when the band broadens, precisely because of the expected realignment and the tendency to reverse when approaching the exchange rate mean.

There would be opposite effects in the presence of realignment expectations on exchange rate variability and interest rate differentials. Selecting the optimum breadth could therefore be influenced by minimizing the average between exchange rate variations and interest rate differentials. The most important determinant of the optimum band breadth would be the variation of the expected realignment: the larger the variation, the wider the optimum breadth and the least monetary intervention.\textsuperscript{12}

3.3. Credibility

In any case, besides resulting in different implications about the behaviour of the exchange rate and interest rate differentials, modeling realignment expectations emphasizes the importance of credibility when sustaining the bands.

\textsuperscript{10} If monetary policy adapts completely to changes in the expected realignment, the breadth would be zero, and the exchange rate would therefore be fixed.

\textsuperscript{11} In addition, the higher the volatility of the expected realignment, the higher the probability of a stabilizing intervention in the exchange rate.

\textsuperscript{12} This results from a stronger reversion to the mean within the band, which achieves a greater reduction in the differential variance of interest rates.
A key element in credibility (although not the only one) is the amount of IMR at the monetary authority's disposal to defend the band. Rotemberg and Krugman (1991) create a model to determine the minimum IMR needed to face a speculative attack (exchange run) that might provoke the collapse of the exchange band system.\textsuperscript{13}

They start with the expression of the monetary supply in relation to its emission source, IMR and net domestic credit (NDC):

\[ m = \ln(IMR + NDC) \]

(9)

After a speculative attack that depletes the IMR, the amount of money will be given by:

\[ m' = \ln(NDC) \]

(10)

The size of the speculative attack that can be supported by the Central Bank is therefore:

\[ m - m' = \ln(IMR + NDC) - \ln(NDC) = \ln(1 + IMR/NDC) \]

(11)

From this equation we can see that the greater the IMR and, especially, the greater the proportion of IMR against NDC, the greater the probability of sustaining the exchange band pattern. To reach a more explicit solution, using the theory of a speculative attack signifying that the exchange rate will be the same before and after the attack (i.e., that it should be continuous), we proceed to equate the exchange rate below the outer band with the floating exchange rate:

\[ m' + v' = s^u = m + v' + Ae^{\alpha(m + v')} \]

(12)

Replacing and substituting (8) in (12) and equating with (11), we obtain:

\[ m - m' = \sqrt{\frac{\sigma^2 \delta}{2}} = \ln(1 + \{IMR/NDC\}) \]

(13)

Resolving for the IMR/NDC relation:

\[ IMR/NDC = e^{\sqrt{\frac{\sigma^2 \delta}{2}}} - 1 \]

(14)

From which we can infer that the greater the volatility of the fundamental factors ($\sigma^2$), the greater the proportion of IMR that will be needed to preserve the exchange band system.

\textsuperscript{13} This model abstracts other factors such as opportunity cost, country risk and balance of payments.
3.4. Intra-marginal interventions

Apart from the basic model, we can assume intra-marginal interventions, i.e. interventions by the monetary authority within the band in order to nudge the exchange rate towards a predetermined level. A simple way to model such interventions is through a reversion of the fundamental factors to the mean; to do this, we direct them toward a level that is compatible with the exchange rate's central parity, proportionate to its distance from that level. The result is a stabilizing behaviour similar to an “administered” exchange rate, rather than the impact of “smooth pasting” within the limits of the band. The exchange rate is then less volatile than when floating. However, the S form is less pronounced than in Krugman's original model since, in this case, the stabilizing effect of marginal intervention expectations to prevent the rate from going outside the band is smaller. In effect, two reasons would make the exchange rate tend toward the central parity: intra-marginal and marginal expected interventions; the latter are not as strong as in the original model because the probability of the exchange rate reaching band limits is smaller.

In general, the basic model and its extensions establish the existence of critical points for the design and implementation of exchange bands. In the next section, we will review some of these aspects based on theoretical and empirical evidence.

III. CRITICAL ASPECTS IN THE APPLICATION OF EXCHANGE BANDS

Among critical aspects in applying and sustaining exchange bands, we can mention the determination of the central parity, the breadth of the band, intervention criteria, complementary policies, and credibility levels.

• Determining the central parity. Because the exchange rate is a variable key in the assignment of resources, one reason for favoring an exchange rate regime based on target zones is the empirical observation that fixed and flexible rates tend to diverge persistently from the values that are indicated by their fundamental determinants. In this sense, determining

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14 We assume that the direction of $k$ obeys $E(k)/dt = -\beta k$, in which $\beta$ is positive and reflects the reverse rate toward the mean.
the central parity of a target zone must respond to the level and evolution of the fundamental determinants of the exchange rate.

This is the reason why countries like Chile and Israel were motivated to replace fixed exchange rate patterns, initially designed to break inflation inertia, by exchange bands with movable central parities that try to capture or anticipate changes in fundamental determinants. In the case of Chile, daily adjustments in the central parity are announced at the beginning of each month, based on the estimated difference between the annual inflation goal and a prediction of foreign inflation. In Mexico, although a fixed exchange rate regime was replaced by one of exchange bands, there was little central parity readjustment for a long time, bringing on the collapse of the exchange regime at the end of 1994.

The Mexican experience clearly shows the advisability of imposing a movable central parity that will gradually adjust to a "fundamental equilibrium" exchange rate. Given that there can be a series of real shocks whose duration and intensity are hard to predict, one way to implement this policy is to adapt its evolution to the real exchange rate’s tendency to achieve balance (focussing real goals). In this way, economic agents can receive signals to guide their expectations so that they can efficiently assign their resources and maintain their confidence in the permanence of the exchange regime.

To realign the central parity without discarding the exchange bands pattern, there are three options: change the level of the central parity, change the slope of dynamic readjustment of the central parity, or a combination of both. Changing the central parity involves incorporating variations in the fundamental equilibrium of the exchange rate, while altering the slope of the band involves readjusting inflation expectations and devaluing to new levels. If the first option implies a change in the gradient of the exchange rate’s dynamic readjustment, leaving the original gradient unaltered involves reaffirming controls on inflation expectations.

In general, determining the slope is relevant to exchange and monetary consideration, and varies in different countries. In most cases, it has been fixed according to past or anticipated inflation. Nonetheless, apart from inflation differentials, which could make competition important, capital accounts and arbitrage of interest rates are also relevant. Given that the exchange rate influences the commercial balance

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15 This could basically result from changes in the domestic inflation goal.
and capital inflow, determining the band's slope should also take into account the objectives of the balance of payments.

In this sense, there is a policy schism if the exchange rate is used as a nominal anchor between inflation control and the foreign balance. The exchange stability needed to reduce inflation can lead to increased unprogrammed current account deficits.

**Breadth of the band.** In contrast with the fixed exchange rate pattern, exchange bands give monetary policy the flexibility to affect aggregate demand, reach inflation goals, and even cushion domestic and foreign shocks. In this sense, the band's breadth should be based on the desired degree of monetary flexibility.

There are, however, several elements to be considered when defining the band's breadth. In the first place, a very broad band, while reducing the danger of traumatic realignments, affects the credibility of the system as well as its potential stabilizing effect on the exchange rate. Under very broad bands with marginal interventions, the behaviour of the exchange rate would be similar to a floating rate (except in the areas close to the limits of the band), which implies a more volatile exchange rate.

On the other hand, in countries where the exchange rate functions as a nominal anchor, it is not advisable to have a very broad band; it would require more interventions by the monetary authority, but the basic objective of exchange policy is to control inflation expectations.

As for the volatility of interest rates, it is difficult to define the impact of the band's breadth. In the absence of realignment expectations, a broader band would increase the volatility of interest rates, due to the ups and downs of devaluation expectations. In the presence of weighty realignment expectations, on the other hand, broader bands would result in less volatile interest rates because of the opposite effects of an expected realignment and an expected modification of the exchange rate within the band.

Finally, the band's breadth can be used as a facility to discourage the flow of short term foreign capital (speculative).

In effect, the broader the band, the greater the "exchange risk" for such capital.
To summarize, conflicts exist in determining the breadth of the band, which should be resolved for the best operational performance of the exchange pattern.

- *Criteria for interventions in the exchange market.* The monetary authority can opt to intervene in defense of the band whenever the exchange rate approaches its limits, or to reverse the rate toward the central parity.

  Management and defense of the band is basically accomplished by direct intervention (use of international reserves), modification of the exchange rate, and changes in interest rates. It is therefore necessary to define when and how changes in reserves and interest rates are permitted in defense of the band. In addition, for any intervention to be sustained, it is indispensable that fiscal discipline prevent amplifying the effects of the intervention. If the intervention is through interest rates, for example, it is important for authorities not to exert pressure on tax levels.

  The behaviour of the exchange rate under marginal interventions (only at the limits of the band) and intra-marginal interventions (within the band) in theoretical models is similar although intra-marginal interventions would attenuate transient fluctuations of the exchange rate. On the other hand, the existence of intra-marginal interventions reduces the stabilizing effect of "smooth pasting", and *de facto* reduces the flexibility of monetary policy.

  Intra-marginal interventions would seem to have the advantage if the exchange pattern's reliability were greater when the rate fluctuated closer to the central parity. Nonetheless, if it is completely credible that marginal interventions will maintain the exchange rate within the band, reduction of the flexibility of monetary policy is not justified.

  The previous discussion seems to affirm that under high credibility conditions marginal interventions are preferable; this becomes relative as the levels of credibility diminish and intra-marginal interventions become more relevant.

  The *IMR* should be the basic intervention instrument. When the exchange rate is very high within the band, the Central Bank sells currency in the market, diminishing the monetary system's liquidity, which can bring on an increase in domestic interest rates which, in turn, encourages the ownership of assets in domestic currency. In this sense, the use of reserves generates an automatic adjustment to defend the exchange band.

  Although using the interest rate policy in this context defends the exchange regime, it can provoke higher increases in the levels and
volatility of interest rates. Another argument against using the interest rate is its role as an indicator of devaluation expectations; an interest rate increase could be interpreted as an increase in devaluation expectations or of band realignment, possibly producing an even greater demand for foreign currency.\textsuperscript{16}

If the country's monetary reserves are at an adequate level, its use in defense of the band should be preferred. The use of interest rates, however, should be restricted to situations involving substantial reserve variations and foreign shocks that require maintaining the reserves or that predict their eventual depletion. There is a disjunction as to the best instrument or combination of instruments, which must be resolved by the disposable level of IMR and its potential use, and the effects that interest rate variations will have on the economy.

- \textit{Complementary policies}. Given the relative inflexibility of monetary policy, fiscal policy is crucial when responding to real shocks, controlling inflation, and maintaining the real exchange rate. Fiscal policy should try to absorb transient shocks on income in order to cushion adverse expectations and reduce the need for Central Bank intervention. In practice, it is difficult to adjust short term fiscal policy; however, it can be designed to counteract tendencies of real exchange rate increases by means of higher aggregate savings and a less structured demand for non transferable goods.

Monetary policy is not very flexible because it is dedicated to maintaining the band. For example, in order to avoid a possible speculative attack, monetary policy must be contractionary in order to attenuate an exchange run, by diminishing the amount of domestic currency that could be substituted by foreign currency. This, however, could rebound with an increase in the level and volatility of domestic interest rates.

Monetary policy can have adverse effects on the exchange band if it also pursues interest rate objectives. In the case of Chile, for example, real interest rate goals have rebounded negatively on the target zone by stimulating the inflow of international capital, with a resultant appreciation of the peso. We should note that the less capital mobility, the less the potential impact of high interest rates on the exchange band,
and the greater the impact of monetary policy. In any case, it is advisable to avoid pursuing objectives that are mutually inconsistent.

• *Credibility.* As seen in the previous section, one of the key variables for credibility of the target zone is the amount of IMR at the monetary authority's disposal to defend the band. In Krugman and Rotemberg's model (1992), the larger the IMR and, especially, the larger the proportion of IMR to NDC, the greater the probability of sustaining the exchange band pattern. In addition, the greater the volatility of exchange rate determinants, i.e. when an economy is more susceptible to foreign and domestic shocks, the larger IMR-NDC ratio that will be needed to preserve the exchange band system. The Central Bank should manage the IMR very carefully as a key variable of policy and of expectations for other sensitive economic agents.

Nonetheless, the IMR is not the sole relevant variable in determining the band's credibility. Specific variables such as the real exchange rate, the inflation rate, the current account of the balance of payments and, in general, the government's macroeconomic framework, transmit information to the economy about perspectives of maintaining the objective zone. This implies that an adequate, stable framework of economic policy is a basic complementary ingredient that contributes to the credibility of the exchange band regime.

• *Inflation and the real exchange rate.* We have two options when determining the objectives of exchange band policy: using the exchange rate as a nominal anchor or, conversely, applying a pattern to maintain the real exchange rate.

Using the objective zone as a nominal anchor will, in practice, involve an appreciation of the exchange rate by fixing increases at lower levels than those of present and estimated inflation, in order to exert deflationary pressures on expectations. On the other hand, a pattern of real goals for the exchange rate ignores potential inflationary pressures and limits itself to avoiding imbalances caused by non-alignment of the exchange rate.

This discussion suggests that the inflation situation and the sensitivity of the inflation process to devaluations are factors that should be taken into account when determining the objective of exchange band policy. Weighing these factors will help to define the disjunction between inflation and the exchange rate.
IV. EXCHANGE BANDS: THE ECUADORIAN CASE

1. Antecedents

The exchange system in Ecuador evolves from a multiple and fixed exchange rate typical of the seventies; the eighties see rates with periodic adjustments (mini devaluations) and even floating exchange rates. The exchange regime of the nineties, in the context of foreign liberalization, however, is based on complete convertibility with a unified exchange rate, and free access for economic agents.

Since August, 1992, exchange policy has been an important part of the Macroeconomic Stabilization Plan, whose primary objectives have been assisting inflation control, restoring foreign viability, and establishing conditions for sustained long term growth. At the same time there has been an attempt to control devaluation expectations, increase international monetary reserves to adequate levels, and maintain conditions for export competitiveness.

Reform of the exchange system began on September 3, 1992, with a devaluation of 35% in the Central Bank's intervention exchange rate and the gradual transfer of private sector operations from the Central Bank's intervention market to the free exchange market. To this end, the Central Bank's facility of advance buying of foreign currency was eliminated, and would later be transferred to authorized private sector financial institutions. The Monetary Board also authorized the Central Bank to participate in the free exchange market, fixing amounts and quotations in accordance with the market's situation and the requirements of the monetary program. This new facility, called the Currency Exchange Board, became an important regulating instrument of foreign currency availability and the behaviour of the exchange rate.

Toward the end of 1992 another adjustment was made, establishing the quotation of S/1.700 sucres to buy and S/2.000 to sell. At that time, the average dollar quotation in the free exchange market (1.938 sucres per dollar) began to fall, maintaining a lower value until July, 1993, when it returned to a moderate bullish tendency.

In June of 1993 the financial sector's operations were enlarged by term buying and selling of foreign currency (forward), rebuying deals (swaps) and options (put and call) to try to reduce uncertainty about the exchange rate's behaviour and to encourage investment decisions by the economic agents that manage future foreign currency flows.
Pursuing the process of exchange flexibility, September of 1993 saw the establishment of a weekly fixed exchange rate for buy and sell transactions through the Central Bank. The sell rate was equal to the interbank sell quotation of the previous week and the buy rate was 250 sucres less, a difference which is at present only 2%. The exchange rate system was thus simplified even more, assimilating the sell rate applicable to transactions from the public sector to the free market's quotations. As a result, the exchange market became united for all capital and current transactions of the public and private sectors.

We should point out that at the end of 1993 a new official exchange rate, equal to the Bank's sell quotation, was fixed for Central Bank accounting purposes. The purpose of this modification is for foreign currency balances and the Bank's financial situation to reflect their real value, thus concluding the process of exchange unification.

A substantial simplification of exchange rate regulations took place in November, 1994; it eliminated certain processes and requisites for foreign currency buy and sell operations through the Central Bank of Ecuador related to the exploration, exploitation, transportation and commercialization of hydrocarbons by foreign companies that have contracts with Petroecuador, and that have the option—not the obligation—of going through the Central Bank of Ecuador. This liberalized the exchange rate market even more.

In December 1994, the monetary authority initiated a pattern of preannounced exchange bands, replacing a "dirty floating" discretionary exchange rate pattern. The monetary authority announced its implementation in the 1995 Economic Program in the following terms:

"An important anti-inflation instrument of the Program, a key point in guiding expectations, is the pre-announcement of a floating band of exchange. This band will have a breadth between ceiling and floor of 100 sucres and a slope of 12%, coherent with the Program's inflation objective and the assumed international inflation. By reducing uncertainty about the evolution of the exchange rate, pre-announcing this band will contribute to a reduction in interest rates to levels more compatible with expected inflation, and to expand planning horizons, thus stimulating longer term investments and savings."

The preceding paragraph clearly shows that the government does not intend to abandon the exchange rate as a key nominal anchor for inflationary expectations. In fact, to determine the rate of annual
variation of the central parity, assumed foreign inflation (about 3%) was subtracted from the domestic inflation goal (15-17%), a pattern similar to that used by Israel.

The band's limits change daily according to values predetermined by the monetary authority, which commits itself in principle (although intraband interventions are not explicitly discarded) to intervene in defense of the band when the exchange rate reaches its ceiling (the Central Bank sells foreign currency) or its floor (the Central Bank buys foreign currency).

Initially, as uncertainty decreased, the pattern was received optimistically. This was reflected by a fall in the exchange rate to levels nearing the band's floor, caused by economic agents' holding the larger portion of their portfolios in domestic currency. This, despite a simultaneous crisis in the Mexican exchange system.

Nevertheless, a few weeks after its application, the band system underwent a foreign shock that had significant consequences on the economy and on the expectations of agents: the armed conflict with Peru. This situation exerted pressures on the exchange rate that forced the intervention of the Central Bank, with a substantial increase in domestic interest rates.

After the inflation goal was revised because of economic measures taken to finance the conflict, on February 16 the central parity was realigned by 2.8%, compatible with an annual 17% devaluation for 1995. However, the slope and breadth of the band were not affected, and were consistent with an inflation goal of 15-17% until July, 1996.

In general, the monetary authority's strategy in the exchange market since 1993 can be summed up in the following terms, according to the Department of Investments and the Free Market of the CBE:

a) Daily announcement of only one of the points in the band at which it will buy or sell dollars; the floor when foreign currency tends to appreciate, and the ceiling when the dollar inclines toward an unwanted depreciation. From January, 1993 to August, 1994, the Central Bank intervened to defend only the extremes (floor or ceiling), selling or buying foreign currency within ranges that it deemed to be coherent with the economy's needs.

b) Definition of a band of implicit intervention. On August 29, 1993, the Issuing Institution changed its strategy and established, daily, the two
points of intervention. The band, which in this case was not explicitly announced, had a breadth of five sucres.

c) Amplifying the breadth of the intervention band. From October 4, 1994 to December 20 of the same year, the policy was to progressively widen the breadth of the intervention band to 10, 25, 30 and 40 sucres.

d) Preannouncement of the intervention band, with a slope coherent with expected inflation. Beginning on December 22, 1994 an exchange floating band was preannounced, that would We sustained by the Central Bank until the end of 1995. It had to be realigned on February 16, 1996.

2. Recent evolution of the exchange rate

Graph No. 2 shows the evolution of the exchange rate within the exchange band between December 21, 1994 to the middle of September, 1995. It can be observed that, at first, the exchange rate tended to fall below the central parity, even reaching the band's floor. However, after the second week of January, a bullish tendency was registered within the band, which coincided with increased military tension with Peru. On the 27 and 30 of January, the CBE had to sell foreign currency on the exchange market to defend the band, for a total of US$ 54 million (3.5% of the IMR). At the same time, the monetary authority substantially increased short term interest rates to over 200% to discourage a run against the sucre; the exchange rate remained within the band, although relatively near the highest level.

On the 16 of February, in answer to a slight change in the exchange rate's fundamental factors, the central parity was readjusted. Afterwards, the rate's position within the band dropped, staying close to its lowest limits until the middle of June.

After the third week of June, the exchange rate tends to stay close to the highest level; later a tendency to drop can be observed, which suggests a certain attenuation of uncertainty in the exchange market. Interest rates (except for interbank rates), however, have been slow in returning to pre-armed conflict levels. In September, a similar situation can be observed: the exchange rate is at levels close to the highest limits of the band, as a result of domestic political uncertainty which affects the expectations of economic agents about future maintenance of the exchange band.
GRAPH 2. EXCHANGE BAND AND OBSERVED RATE

Rate per dollar

Rate

Exchange band

3. Credibility of the exchange band

The preannounced exchange band has been marked by the conflict with Peru and recent political instability, which have been shocks that have substantially affected the behaviour and expectations of economic agents. Next, we will review the evolution of a series of variables and indicators that try to measure the credibility of the target zone.

3.1. Evolution of the international monetary reserve

As was stated in the second section, a key variable when determining the credibility of the exchange rate system is the IMR level. Graph No. 3 shows its recent evolution.

The Central Bank of Ecuador has maintained the level of the IMR during the analyzed period between US$ 1,500 and US$ 1,700 million, equal to approximately 4 months of imports of goods and services. During the weeks immediately following the conflict, the IMRs' level rose because the CBE bought currency when the exchange rate reached the band's floor. At the end of May, reserves fluctuated around levels similar to those registered at the beginning of the year, which served to reinforce the band's credibility. Later, during the month of June, the IMR showed a tendency to increase, which attenuated in July and returned in August. During September, the IMR stabilized around US$ 1,650 million.

3.2. The IMR monetary aggregates ratio

Based on Krugman and Rotemberg's model for determining the minimum IMR to face a speculative attack, we can opt to verify the monetary supply proportion represented by the IMR. Monetary supply can be interpreted as the quantity in domestic currency that could be potentially converted to foreign currency during an exchange run. In this sense, the relation of IMR versus a

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17 The original IMR/NDC relation proposed by Krugman and Rotemberg is difficult to apply due the negative values these variables have registered in certain periods. However, in the case of negative net reserves, gross reserves or net international assets could be used, although, conceptually, it is better to apply net reserves.
GRAPH 4. INTERNATIONAL MONETARY RESERVE/MONETARY AGGREGATES RATIO, 1992-95
monetary aggregate is a proxy of the monetary authority's capacity to defend the band. Graph No. 4 shows these ratios with respect to M1 and M2.\(^\text{18}\)

These ratios can be follow-up indicators, and even policy goals, for maintaining the credibility of the exchange band regime.

Other monetary indicators that could be used by the CBE to this end are the levels of sight deposits in the domestic financial system. In the case of a potential speculative attack, these levels would register a bearish tendency due to substitution of domestic currency by foreign currency.

\subsection*{3.3. The real exchange rate}

An important variable for economic agents to determine credibility in controlled exchange rate regimes is the level of the real exchange rate. Faced with a substantial appreciation of domestic currency, for example, agents will develop devaluation expectations, thus questioning the permanence of the exchange regime. In the Ecuadorian case, the Stabilization Plan of September, 1992 used the exchange rate as a nominal anchor, which involved, after an initial depreciation, a constant appreciation of the sucre. Since 1994, under a more flexible exchange regime, this tendency has been partly reversed. The current regime aspires to continue along these lines. Had the depreciation of the dollar in international markets provoked an increase in the effective real exchange rate (which would support medium term credibility of the exchange band), domestic inflation control is vitally important to avoid exchange appreciations that set back the credibility of the band regime.

\subsection*{3.4. Credibility tests}

\textit{IMR} and real exchange levels are not the only key variables in determining the band's credibility. Other factors, such as political transition or uncertainty and exogenous shocks are key factors in the formation of expectations. During January and February, the armed conflict with Peru was a crucial element in the formation of expectations and the exchange regime's credibility.

\footnote{It can be observed that in the mid-1992 exchange run that resulted from expectations for a macrodevaluation by the recently elected government, these relations decreased substantially, while they are now at relatively high levels.}
Graph 5. Real Effective Exchange Rate, 1982-95

Index: August 1992 = 100.
One way to evaluate the band pattern's credibility is by means of Svensson's test.\(^{19}\) It measures the degree of adjustment to devaluation expectations implicit (supposedly incorporated in the foreign and domestic interest rate differential) in maximum and minimum devaluations that could be expected in response to the position of the spot exchange rate within band limits. A band of expected devaluations with complete credibility is constructed, and is compared with "implicit devaluation":\(^{20}\) if the latter falls outside the band, it can be said that agents lack credibility in the band's maintenance.

Implicit devaluation is calculated by taking the differential between the passive domestic referential interest rate and the 30 day Libor interest rate. The band of expected devaluations is calculated by comparing the spot exchange rate with the upper and lower limits of the band at 30 days. We should note that the assumed uncovered interest parity that is applied has not been validated empirically because of the existence of a country risk subsidy, and that the results are very volatile because they are based on daily calculations.

If the test takes realignment of the band into account, implicit devaluation would be within limits, although near the ceiling, until the middle of February. After that date, the interest rate differential exceeds the limits of the test. After the armed conflict, implicit devaluation once again relocated within the devaluation band, suggesting credibility in the exchange rate's target zone until the last week of June. Later, the implicit devaluation tends to locate outside the band, suggesting that the objective zone is no longer credible.

An additional exercise calculates implicit devaluation based on the differential between the foreign referential interest rate and the domestic rate for dollar operations. By incorporating country risk subsidies, this should be a better indicator than the Libor rate at 30 days. In the following graph we can see that we get better credibility ranges by using the domestic interest rate in dollars. The Svensson test should be evaluated as an indicator that should be reconciled within a general macroeconomic context.

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\(^{19}\) Svensson (1991).

\(^{20}\) In reality, implicit appreciations could be registered, depending on the location of the exchange rate in the band and its slope.
GRAPH 6. CREDIBILITY TEST 1

Test limits

Implicit deval.

Test limits

Given the questions that might arise from Svensson's test, Licandro (1993) suggests the calculation of a credibility indicator called "discrepancy", which is measured as the difference between the devaluation implicit in interest rates and a computation of expected devaluation with exchange band credibility, based on the spot exchange rate and the central parity after one month. With credibility, it should be expected that this variable will fluctuate around zero, while positive values would represent realignment expectations. The following graph shows the results obtained by calculating this variable, based on the foreign referential rate (Libor) and the domestic rate that remunerates deposits in dollars, respectively.

Since the beginning of March, after the armed conflict provoked a substantial increase in the variable, there was a bearish tendency that placed the discrepancy variable around zero. This tendency was first determined by the exchange rate being close to the band's floor, and was reinforced by a fall in domestic interest rates. However, after the second week of June, the discrepancy is considerably higher, stabilizing at levels close to 20% in response to political instability.

3.5. The forward exchange rate

An additional indicator of agents' exchange expectations is exchange rate quotations on the "forward" market. The next graph shows the position of these quotations at 30 days (from a local bank with a dominant position in this market) versus band limits at due dates. According to this graph, agents maintained credibility during this period, at least at short term.

3.6. Evaluation and perspectives

The 1995 Economic Plan decided to implement exchange bands in order to use the exchange rate as a nominal anchor for inflation expectations, and to diminish the exchange rate's volatility and the level and volatility of domestic interest rates.

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21 Part of the interest rate differential cannot be attributed to devaluation expectations: this would reflect a certain premium of country risk, variations due to movements in the money market (for example, foreign capital inflow), etc.

22 We should note that operations were suspended during the conflict.
GRAPH 10. 30 DAYS FORWARD EXCHANGE RATE

Forward exchange rate

Band
Use of the exchange rate as a nominal anchor is based on observations, documented by Rojas, Samaniego and Lafuente (1995), that exchange policy has been the basic support of successful fights against inflation, and that variations in the exchange rate are currently the most important determinants of inflation variations. However, although the band regime is important in the control of inflation, its credibility and permanence are associated to a great extent with the consistency and stability of monetary and fiscal policies.

Under the exchange system that was in force until December, 1994, domestic interest rate volatility was partly due to changing devaluation expectations resulting from discretionary management of the exchange rate. Establishing the pre-announced exchange band, therefore, was meant to reduce the volatility of interest rates by modulating devaluation expectations within band limits.

The band's existence should help economic agents to expand their planning horizons, stimulating longer term investments and savings. At the same time, earnings from speculative capital are discouraged by high short term exchange risk, shown by the distance between the spot exchange rate and the band's ceiling.

In effect, the earning power of very short term domestic currency investments in local currency is very sensitive to the devaluation rate that was registered during that same period.

The period during which the pre-announced band was in force was marked by the conflict with Peru. This was an unexpected exogenous shock that changed fundamental conditions and, therefore, inflation goals. Realignment of the central parity last February was a response to these changes.

The use of international reserves should be the basic strategy in defense of the exchange band. This defense strategy is reinforced by its impact on interest rates because of changes in the monetary system's liquidity. The use of interest rates to defend the band, however, should be restricted to situations of substantial reserve variations and foreign shocks that require maintaining reserves or that forecast their eventual depletion. This is precisely what happened during the conflict with Peru, when the CBE substantially increased the interbank rate to avoid exchange pressures. In addition, the 1995 Economic Program established

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23 For this, it will be necessary to review the evolution of the money and exchange markets based on indicators presented in previous sections.
the objective of reducing the level and volatility of interest rates, which is impossible if interest rates are used as an instrument to defend the band.

As for the kind of interventions, we previously pointed out that under high credibility conditions it is preferable to intervene marginally (only at band limits) to allow more maneuvering space for monetary policy, and that this becomes relative as the credibility level decreases. Under present conditions, with a relatively narrow band and an economic policy that is relatively consistent in its objectives, it would seem more advisable to intervene marginally. Besides, this strategy allows a certain flexibility for monetary policy, and maintains an exchange risk that discourages short term speculative capital inflow.

We should note that the monetary authority has also established a policy of positive real interest rates. The existence of this objective suggests the advisability of establishing marginal interventions in defense of the exchange band, and allowing monetary policy some degree of independence. We must, however, take into account that the two objectives can be inconsistent under some circumstances, specifically when the floor of the band needs defending. In effect, the increase in required reserves injects liquidity into the system, forcing interest rates down; but this, in turn, can result in capital flight and a consequent bullish pressure on the exchange rate.

To maintain the exchange pattern's credibility in the future, it will be necessary to keep a close watch on the IMR and real exchange rate levels. The CBE should achieve high and stable IMR monetary aggregate ratios and avoid substantial appreciations of the real exchange rate that could cause higher inflation levels than were forecasted in the Economic Program. Besides their potential recessive effects, substantial appreciations could feed devaluation expectations and endanger the exchange regime's stability. In this sense, governmental policy should be consistent with proposed inflation goals.

Another variable that should be watched to anticipate potential speculative attacks against the sucre is sight deposit levels in the private financial system.

Fiscal policy, on its part, should help to sustain the real exchange rate, especially in a context of foreign capital inflow. Achieving superavits in

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24 The Central Bank fixes the basic rate for Monetary Stabilization Bands at short term above the inflation rate.
the domestic fiscal position is a strategy that has been applied in recent years and that should be continued. It involves reducing the demand pressures on non-transferable goods and, therefore, appreciation of the real exchange rate.

To conclude, it is worth noting that, given that the government has pre-announced bank levels until August, 1996 in order to control the short and medium term expectations of economic agents, it will prove indispensable that we avoid the political cycle of economic management that has characterized recent administrations.

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