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Does Monetary Policy Stabilize the Exchange Rate Following a Currency Crisis?¹

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Abstract

This paper provides evidence on the relationship between monetary policy and the exchange rate in the aftermath of currency crises. It analyzes a large data set of currency crises in 80 countries for the period 1980-98. The main question addressed is: Can monetary policy increase the probability of reversing a postcrisis undervaluation through nominal appreciation rather than higher inflation? We find that tight monetary policy facilitates the reversal of currency undervaluation through nominal appreciation. When the economy also faces a banking crisis, the results are not robust: depending on the specification, tight monetary policies may not have the same effect.

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"Tight money in a given financial crisis can serve either to attract funds or to repel them, depending on the expectations that a rise in interest rates generates. With inelastic expectations, no fear of crisis or of currency depreciation, an increase in the discount rate attracts funds from abroad, and helps provide the cash needed to ensure liquidity; with elastic expectations of change – of falling prices, bankruptcies, or exchange depreciation – raising the discount rate may suggest to foreigners the need to take more funds out rather than in."

Kindelberger (1978)

I. INTRODUCTION

In the aftermath of currency crises, several economies have seen their exchange rates depreciate beyond what could be justified by fundamentals. Recent examples of this overshooting include Indonesia, Korea and Thailand during the Asian crisis in 1997 and Brazil in 1999. In this situation, policy makers have to decide whether to tighten policies to stabilize the exchange rate, in particular, whether higher interest rates are the appropriate response. There is a lively debate in the literature whether tighter monetary policy is effective in these situations. Furman and Stiglitz (1998) provide a very comprehensive discussion of the various channels whereby high interest rates may affect the exchange rate.²

This paper attempts to shed light on this debate by analyzing a large set of large depreciations in the aftermath of currency crises in the period 1980 to 1998. The analysis of the effect of tight monetary policy on the exchange rate takes into account three important steps. The first step is to evaluate whether the exchange rate overshot during the crisis, or in other words, whether the real exchange rate (RER) has become undervalued and needs to be brought back to equilibrium. The second step is to identify the mechanisms through which the RER could be corrected in case it is undervalued. There are two ways to reverse an undervaluation through nominal currency appreciation or through higher inflation at home than abroad (or a combination of the two). If avoiding an inflation buildup is an important concern and/or nominal appreciation is desirable for the benefit of domestic corporate and banking balance sheets, the extent to which the reversals occur through nominal appreciations is fundamental. The third step is to identify through which policies and under which circumstances the reversal occurs through nominal appreciation. In particular, it is important to evaluate whether nominal appreciations occur mainly in cases where interest rates are kept high. In addition, it is also important to evaluate whether other economic conditions, for example the state of the banking system, influences the relationship between interest rates and exchange rates.

²See also Krugman (1998), Sachs and Radelet (1998), Stiglitz (1998). Goldfajn and Baig (1998) and Goldfajn and Gupta (1999) summarize this debate and present the main theoretical arguments.

Operationally, the paper selects currency crises that have led to large undervaluations of the real exchange rate and investigates the way the reversals occur. It defines as successful cases reversals that occur primarily through nominal appreciations rather than through higher inflation and calculates the probability of successful cases in the overall sample. The paper calculates the probability that a tight monetary policy, defined to be a case in which real interest rates in the aftermath of the crises are higher than the average real interest rate during the 24 months preceding the crises, is successful and compares with the overall probability of success. The traditional approach would suggest that the probability of being successful is higher in cases where tight monetary policy was implemented. Then, the whole exercise is replicated using only twin crisis cases when currency crises coincide with banking crises and again the probability of success is compared with the conditional probability of success when tight monetary policy is implemented. In principle, one would expect tight monetary policies to be less successful when a country is also experiencing a banking crisis.

The results indicate that tight monetary policy increases substantially the probability of success. For example, for undervaluations greater than 15 percent, the probability of success increases from 26 percent to 37 percent when tight monetary policy is implemented. When both currency and banking crises are present, the results are not robust: under some specifications, tight monetary policies may actually reduce the probability of reversing undervaluation through nominal appreciation.

The exercise in this paper differs from previous studies in a few important aspects. First, it analyzes the relationship between interest rates and exchange rates in crisis episodes, crucial periods for policy makers. This leaves out several interesting issues but allows the paper to concentrate on the role of monetary policy in reestablishing currency stability after a large collapse. Previous studies have looked at the general relationship between interest rates and exchange rates but few studies have concentrated their analysis on crisis episodes.³ Second, the paper studies a large set of currency crises and, therefore, can offer more general results. Previous studies have concentrated on specific currency crisis cases, offering more limited results.⁴ Third, the paper studies the relationship between *real* interest rates and *real* exchange rates using monthly data as opposed to studying the relationship between the respective nominal variables using daily data. The availability of a sufficient number of monthly data from the pooling of countries allows the paper to refrain from extracting the relevant information from more noisy daily data. In addition, the objective of the paper is to evaluate the relationship between tight monetary policy and currency stabilization: both, in our view, are more precisely defined using the real rather than the nominal variables. Finally, the

³ An exception is Kraay (1998).

⁴ For example, the Asian crises and the debate on the role of monetary policy has motivated a few studies on the relationship between exchange rates and interest rates in the five or six most affected countries. See Ghosh and Phillips (1998), Goldfajn and Baig (1998), and Kaminsky and Schmukler (1998).

recent research and availability of data on banking crises allows us to evaluate the relationship between real interest rates and real exchange rates in cases where currency and banking crises occur simultaneously.

The paper does not analyze the role of high interest rates in preventing a currency crisis, as the focus is on the role of interest rates in reversing undervaluation following a currency crisis. The former issue is analyzed in a contemporary paper by Kraay (1998). Quite interestingly Kraay finds no evidence that “(a) interest rates set by the monetary authority systematically increase during speculative attacks that do not culminate in the devaluation of the currency, or (b) increases in these interest rates lower the probability that a speculative attack culminates in the devaluation of the currency.”⁵

This paper is organized as follows. Section II explains the methodology and the data used in the paper. Section III characterizes the undervaluation cases looking at their duration and frequency. Section IV characterizes the reversals and evaluates the effect of monetary policy providing the essential results in the paper. Section V analyzes the behavior of important macroeconomic variables in currency crises, with and without tight monetary policy. Section VI presents the econometric analysis and section VII concludes.

II. METHODOLOGY AND DATA

This paper analyzes all the episodes of currency collapses that resulted in large undervaluations from a sample of 80 countries between January 1980- January 1998 and studies the role of tight monetary policy in reversing the undervaluation through nominal appreciations of the currency rather than through higher inflation. This exercise requires the definition of four different objects. First, one needs to define the term undervaluations and specify the threshold that defines a “large” undervaluation. Second, the exercise requires the definition of what constitutes a successful reversal, i.e., it requires a threshold for the proportion of the reversal to equilibrium that is due to nominal appreciation of the currency (for example, is a reversal that is 50 percent driven by nominal exchange appreciation a successful case?). Third, there is a need to define tight monetary policy and, finally, one needs to specify how to evaluate whether tight monetary policy has helped stabilize the exchange rate.

A. Definition of Undervaluation and Cases

This paper defines undervaluation episodes as departures of the actual real exchange rate from an estimated equilibrium real exchange rate. Specifically undervaluation is defined as

⁵The paper, however, uses central bank discount rates to measure the tightness of monetary policy. It is well known that discount rates tend to remain flat and often do not reflect short run tight policies (e.g. Swedish famous 500 percent interest rate defense in September 1992 was not reflected in the discount rate that remained constant).

deviations of the actual exchange rate from a Hodrick-Prescott filtered series. The filtered series captures stochastic trends in the series and allows us to concentrate on the cyclical behavior of potentially non-stationary RER series. The filtered series represents the predicted equilibrium RER and captures the permanent changes in the relative prices between countries while the estimated undervaluation series represents the cyclical component of the RER movements since, as a misalignment, it must eventually correct itself. This approach will also net out from the undervaluation measure trends in the equilibrium RER, as for example the Balassa-Samuelson effect.⁶

The paper also defines the equilibrium real exchange rate as the predicted value of the cointegrating regression between the actual real exchange rate and a set of fundamentals terms of trade, openness, government size and international interest rate and calculates the undervaluations as deviations from this equilibrium value (see Goldfajn and Valdés (1996)). Since the sample with fundamentals is more restricted, in the paper, we will use these RER series to test for robustness of the results.

Chart 1 presents the definition of an undervaluation episode and its phases. We define the start of an undervaluation case as the time when the difference between the actual RER and our estimate of the steady state RER is equal to or higher than a certain threshold (e.g., 15 percent or 25 percent). The undervaluation ends when this difference hits a second threshold associated with the existence of no undervaluation. We define this second threshold as 5 percent. In order to control for data blips, an episode has to be sustained for more than 2 consecutive months to be classified as such.

We define four notable points: (i) *Start*, when the undervaluation hits the threshold, (ii) *End*, when the undervaluation disappears i.e., the RER hits the 5 percent benchmark, (iii) *Peak*, when the undervaluation is the highest, and (iv) *History*, when the undervaluation first reached 5 percent. An undervaluation episode is then defined as the Start-End period.

There are also two phases: History-Peak, representing the build up of the overshooting and Peak-End, representing the reversal to a "normal" level.

B. Definition of Successful Reversals

There are two ways to reverse an undervaluation through nominal currency appreciation or through higher inflation at home than abroad (or a combination of the two). If avoiding an inflation buildup is an important concern and/or nominal appreciation is desirable

⁶ The Balassa-Samuelson effect occurs when a country's tradable sector productivity grows faster than that of its trading partners ones and this differential growth is smaller in the nontradable sector. Then the (cross-country) relative price of nontradables increases and, therefore, the RER appreciates over time. See Rogoff [1992].

for the benefit of domestic corporate balance sheets, the extent to which the reversals occur through nominal appreciations is fundamental.

In order to decompose the real appreciation that occurs during the return to equilibrium we calculate the total appreciation of the actual real exchange rate during the Peak-End phase, and the total nominal appreciation during that same period. Successful reversals can then be defined as episodes that return to equilibrium with higher than a certain threshold of nominal appreciation of the currency.

Letting Δ denote percentage change we have the identity:

$$\Delta RER \equiv \Delta E + \Delta (P-P^*), \quad (1)$$

where E and RER are the nominal and real effective exchange rate indices, and P and P^* the price indices at home and abroad, respectively. We can then calculate

$$S = \Delta E / \Delta RER, \quad (2)$$

as our success index. As a starting point we define that a successful case occurs when the success index S is greater than 50 percent. In the next section, we test the sensitivity of our results to different thresholds for S .

C. Definition of Tight Monetary Policy

Ideally, one would like to have exogenous shocks to monetary policy in all the crisis episodes. Clearly, there are no such data available. This paper identifies that a country is experiencing a tight monetary policy when the average real interest rate during the period of undervaluation, r , exceeds a threshold real interest rate. The latter is calculated as the average real interest rate during the 24 months preceding the crises and is denoted by μ_r , plus x times the standard deviation of the series, σ_r , i.e.

$$r > \mu_r + x\sigma_r \quad (3)$$

As a starting point, we have set x equal to zero in the benchmark case but sensitivity analysis is performed.

There are several possible ways to calculate real interest rates depending on how expected inflation is proxied.⁷ In this paper we calculate expected inflation by taking the following month's inflation. The real interest rate in period t is then calculated by taking the quarterly moving average of real interest rates, centered at t .

⁷ See Goldfajn and Baig (1998).

The paper evaluates the results under different definitions of the real interest rate and tightness definitions.

D. How to Determine Whether Tight Monetary Policy has been Effective?

The paper defines that monetary policy has been effective if we find that the conditional probability of reversing an undervaluation through nominal appreciations using tight policy is higher than the unconditional probability (or higher than the probability conditional on not using tight policy). In other words, we consider that monetary policy has been effective if out of the cases that had tight monetary policies we observe a larger proportion of success than the proportion of success observed in the overall sample.

The main tables of the paper compare the conditional probabilities of success under tight or non tight policies for different thresholds and definitions. In particular, we will evaluate the probability of success of tight monetary policy with and without a banking crisis.

E. Data Description

Our sample consists of monthly data for 80 countries (see the Appendix for a list of the countries in the sample during the period January 1980 to January 1998).⁸ The monthly data on nominal interest rates were obtained from International Financial Statistics (IFS). For nominal interest rates we used the series for money market rate and treasury bill rate. In a few cases where none of the above series was available the series for deposit rate or discount rate was used.

The data on seasonally adjusted CPI, nominal effective exchange rate and the real effective exchange rate were obtained from the Information Notice System (INS).⁹ The use of the INS effective real exchange rate should, in principle, consider the effect of "competitive devaluations" in third markets. The existence of banking crises is summarized by a dummy series.¹⁰ The dates of banking crises have been obtained from Lindgren, Garcia and Saal (1998), Caprio and Klingebiel (1996) and Demirguc-Kunt and Detragiache (1997). Since

⁸ We started with the same set of 93 countries as included in Goldfajn and Valdes (1996), however because of the unavailability of the data some countries had to be dropped and the final sample consisted of 80 countries.

⁹ The nominal and real exchange rates have been defined such that an increase is an appreciation.

¹⁰ The problems in the banking sector may exist in one or both of the following forms. First the banks may be unsound, i.e. they may have a high share of non-performing assets in their portfolio and second there may be a run on banks. We include both types of cases to define a fragile banking sector.

these studies provide only annual data, monthly data was interpolated by assuming that the crisis lasted from the January of the year in which it started till the December of the year in which it ended.

III. CHARACTERIZING UNDERVALUATION (OR CRISES)

In this section we present several characteristics of the undervaluation episodes in our sample. In particular we analyze the number of episodes with different magnitudes of undervaluation, the average duration of the undervaluation episodes, the proportion of cases in which banking problems were also experienced, i.e. the twin crises cases, and the proportion of cases in which the monetary policy was tight.

A. Number of Cases

The number of episodes clearly depends on the cutoff that defines undervaluation. We identified 99 cases of undervaluation using a 10 percent cutoff, i.e. there are 99 cases in our sample where the real exchange rate has overshoot by at least 10 percent. As we make the definition stricter by raising the cutoff, the number of undervaluation cases declines. Thus, while the number of cases with more than 15 percent undervaluation declines to 77, there are just 28 cases in which the real exchange rate is found to be undervalued by more than 30 percent. These results are presented in Table 1.

Table 1 also shows the proportion of banking crises in the sample. We identified about 45-55 percent of the undervaluation cases to be twin crises cases, i.e. we find that about half of the undervaluation cases are accompanied by a fragile banking sector.¹¹ This confirms previous results in the literature that find strong evidence for the simultaneous occurrence of banking and currency crises. The proportion of these cases increases for larger thresholds of undervaluations. This means that once the degree of undervaluation reaches 15 percent, further undervaluation alters the likelihood of having a banking crises.

We find the monetary policy to be tight in nearly one third of the cases with more than 10 percent undervaluation. The percentage of such cases declines when the threshold to define undervaluation is increased.

B. Duration of Undervaluations

We also examine the average duration for which the real exchange rate remained undervalued after a currency crisis. The average duration is found to be about 30 months for the cases with more than 15 percent undervaluation, i.e. on average the undervaluation persisted for about two and a half years. The average build up phase, i.e. the History-Peak

¹¹ See Kaminsky and Reinhart (1998) and Gupta (1997) for evidence on the existence of the twin crises and various explanations of why such crises may arise.

phase, is 9.5 months, which is considerably shorter than the phase of reversal, i.e. the Peak-End phase, which takes about 20.4 months. These results are summarized in Table 2.

We also present a frequency histogram of the duration of the build up phase and the reversal phase in Chart 2. As can be seen from the chart there is a great asymmetry in the duration of these two phases. On one hand, in more than 45 percent of the cases, the build up takes only 1-3 months, and in almost 80 percent of the cases it takes less than 1 year. On the other hand, reversal takes much longer, in only 35 percent of the cases reversal takes less than 1 year.

IV. CHARACTERIZING REVERSALS AND THE EFFECT OF MONETARY POLICY

In this section we address the main questions raised in this paper. What is the probability that a reversal occurs through nominal appreciation rather than through higher inflation? What is the effect of a tight monetary policy on the probability of successful reversals? Does the condition of the banking system alter the effectiveness of monetary policy?

We first analyze the proportion of success cases. Then we identify the proportion of success in cases in which interest rates were kept high. In light of the recent debate on how the state of the banking system may influence the relationship between interest and exchange rates, we analyze the effect of the health of the banking sector on the probability of successful reversal.

A. Unconditional Reversals: Proportion of Nominal Appreciation versus Inflationary Returns

We first analyze the success cases for undervaluations of at least 15 percent. We consider several alternative definitions of success by varying the percentage of reversal that is required to be brought through nominal appreciations. The results are contained in Table 3 and Chart 3. The number of success cases declines when a stricter definition is used.

In Chart 4 we present the probability of reversal through nominal appreciation for varying degrees of undervaluation. We define successful cases as the ones in which nominal appreciation of the exchange rate is responsible for at least 50 percent of the reversal in the real exchange rate. We find that in a significant number of cases the reversal comes through a nominal appreciation of the currency, e.g. 35 percent of the undervaluation cases of more than 10 percent have been found to be success cases. The percentage of success cases declines for undervaluations of higher magnitudes but not significantly. Thus, about 29 percent of the undervaluations of greater than 30 percent were reversed through nominal appreciations. This implies that the magnitude of the overshooting does not affect significantly the probability of reversing the undervaluation through nominal appreciations.

B. Conditional Reversals: Proportion of Successful Cases with Tight Monetary Policy

Table 4 and Chart 5 address one of the main questions of the paper, what is the effect of tight monetary policy in bringing the reversal through nominal appreciation. The probability of success, conditional on using tight monetary policy, is substantially higher than the probability of success, conditional on non tight policy. Thus while the probability of success is only 26 percent for undervaluation of at least 15 percent for the non tight sample, the probability increases to 38 percent when tight monetary policy is used. This result is confirmed for all the different degrees of undervaluation.

Thus the results could lend support to the use of tight monetary policy for the purpose of correcting undervaluation of the currency. However, one has to interpret the results with caution. Since there is no true exogenous policy variable in this exercise, the higher incidence of successes under high real rates could be driven by the effect of a third factor.

Notwithstanding this caveat the fact that our results do show a positive correlation between tight policies and nominal appreciations is interesting. A typical "endogeneity" argument advanced is that interest rates and exchange rates are both driven by the deterioration in investor's confidence during the crisis. The latter increases risk premium and, consequently, interest rates and, at the same time, depresses the exchange rate. This would typically generate a negative correlation but not a positive correlation as obtained here.

C. Proportion of Successful Cases also with Banking Problems

A vulnerable banking and corporate sector raises the often mentioned tradeoff between banking sector fragility and exchange rate stability, that a policy maker faces while choosing the monetary policy. The policy maker may be less willing to raise the interest rate to defend the currency when the banking and or corporate sector are exposed to the interest rate increases.¹² This is compounded by the fact that interest increases may affect the expected return of an investor. Interest rates may affect the probability of default by increasing the debt servicing burden of the corporations, by depressing the economy and reducing profits, by altering the net worth of corporations adversely exposed to interest rate changes, or, finally, by affecting the health of the banking system that tends to be naturally exposed to interest rate changes.¹³

¹² Other factors affecting the monetary policy may include the stock of government debt and the increased burden of debt servicing.

¹³ Ideally one would like to analyze the effect of the health of the banking as well as the corporate sector on the reversal process and on the relationship between real interest rate and
(continued...)

In fact, we find that the policy makers choose tight policies less often when they are simultaneously facing a banking crisis. In Table 6, we find that the unconditional probability of choosing a tight monetary policy is higher than the probability of choosing a tight policy conditioned on having a banking crisis. For example, the probability of choosing tight monetary policy declines from 29 percent in the entire sample to 25 percent in the twin crises cases, for undervaluations of at least 15 percent.

Moreover, when tight monetary policy is adopted it diminishes the probability of a successful recovery. Table 5 and Chart 6 shows that the probability of success falls from 45 percent to 29 percent when tight monetary policies are adopted, for undervaluations greater than 15 percent. This means that the relationship between high interest rates and stable currencies hinges crucially on the state of the banking system.¹⁴

V. MACROECONOMIC VARIABLES UNDER TIGHT AND NONTIGHT MONETARY POLICY

Even if one accepts that tight monetary policy helps to stabilize the exchange rate one also needs to take into account the costs involved in raising interest rates and weigh them against the benefits. The natural sequence for this paper is to look at the effect of tight monetary policy on output growth, inflation and debt service.

In this section we analyze the behavior of growth rate of output, inflation, current account (as a percentage of GDP) and debt servicing (as a percentage of GDP) in currency crises, under tight and non tight monetary policy. We follow a methodology developed in Eichengreen et al. (1995), which has also been used by Milesi-Ferretti and Razin (1998). We first calculate the average value of the variable during the tranquil periods, where tranquil periods include all the years in the sample, 1980-1998, excluding the years of undervaluation. Then we take the deviation of the variable during a few years around the time of undervaluation from the average value. A positive value in any of the years indicates that the value of the variable is higher during that year than the average of the tranquil periods. We distinguish between the cases with tight monetary policy (TMP cases) and those with non tight monetary policy (NTP cases) and compare the behavior of the variables.

For this exercise, data on GDP, nominal exchange rate, current account and Inflation were obtained from the IMF's IFS data base. The data on debt servicing were obtained from

¹³(...continued)

real exchange rate. However, because of the data limitations we just analyze the effect of the banking sector.

¹⁴ An important caveat for this result is that there are very few cases in our sample in which tight policy was used in the presence of banking problems.

the World Bank, Global Development Finance. It measures the ratio of interest payments on external debt to GNP.

Charts 7 to 10 depict the behavior of the variables inflation, current account, debt servicing and growth rate of GDP respectively around the crisis period. Each chart shows the behavior of the variable for the whole sample (the broken line) and for the reduced samples of tight monetary policy (the plain line) and non tight monetary policy (the dotted line). In the charts we focus on the year before the undervaluation, C-1, the year when it started, C, and the next four years, C+1,...,C+4.

Chart 7 shows that during the undervaluation periods inflation starts out higher than the average of tranquil period and then declines. Inflation is higher in the tight monetary cases than in the non-tight cases to begin with and then declines more sharply. This is consistent with the result that tight monetary policy are more successful. Chart 8 shows that the current account is lower than the average before the undervaluation but improves and becomes higher afterwards. Moreover, it is more negative in tight cases before and during the year of the undervaluation, but improves and stays above the level of non tight cases afterwards. Chart 9 shows that during the periods of undervaluations, the burden of debt servicing is higher than the average. Moreover, debt servicing is relatively higher for the tight cases. Finally, Chart 10 shows the behavior of the growth rate of output. Here we find that the growth is smaller during the undervaluation periods than the average. Somewhat surprisingly, we find that the recovery of output is sharper in tight cases than in non tight cases. This result may be attributed to the fact that the tight monetary policy is usually associated with more successful reversals, therefore, with an economy recovering with relatively less inflation and more nominal appreciations.

VI. PANEL DATA ESTIMATION AND LIMITATIONS

The analysis so far treated each currency crisis as a single event and did not analyze the time series relationship between interest rates and exchange rates in the aftermath of currency crises. To fill this gap, we further analyze the effectiveness of monetary policy in correcting the undervaluation in RER estimating a fixed effects model using monthly panel data. We consider undervaluations greater than 15 percent and hence consider 77 episodes of undervaluation for this exercise. The panel data consists of time series observations for the cases of undervaluation. Since the duration of undervaluation differed across cases, we estimated the model with an unbalanced panel.

We estimated the model by regressing the deviation of the real exchange rate from the equilibrium exchange rate, RER, (which measures the extent of undervaluation) on real interest rates, controlling for the case-specific fixed effects. The model specification is given as

$$y_{it} = \alpha_i + \beta x_{it} + u_{it} \quad (4)$$

where y is the deviation of real exchange rate from equilibrium, subscript i refers to the i th case and t to the time period. Notice that t is different across cases. α is a constant term which is assumed to differ across cases. x denotes the real interest rate and u is the error term with mean zero and constant variance.

Table 7 contains the main results from this regression exercise. The coefficient on the real interest rate is found to be positive and highly significant (at the one percent level), which implies that high real interest rates help in correcting undervaluation.

In light of the recent debate on the effectiveness of monetary policy in the presence of a fragile banking sector, it would also be interesting to see how the latter affects the relationship between the RER and the interest rate. Hence we divided the sample into two subsamples. One subsample included the observations when along with undervaluation the country is also experiencing a fragile banking sector, i.e. the twin crises cases, and a second subsample included the observations when the banking sector is supposedly healthy, i.e. just the currency crisis cases. We re-estimated the model separately for these subsets of observations. The results are presented in columns two and three of Table 7. The coefficient on the real interest rate is again positive and significant at the one percent level of significance for both the currency crises only and the twin crises only. This result shows that once the time series dimension is taken into account, the relationship between real interest rates and exchange rates is positive, even when including economies facing banking crisis.

The econometric analysis presented above gives rise to some endogeneity and sample selection issues. It may be argued that if the choice of monetary policy is endogenous to inflation and real exchange rate, then our results on the effectiveness of monetary policy would be biased, for example, the government may have a reaction function whereby it increases the interest rates if inflation picks up. However, this kind of behavior would only give a downward bias to our results as it implies that there would be more cases of high inflation (i.e. more unsuccessful cases) associated with high interest rates.

Second it may be argued that the analysis suffers from the omitted variables problem. It is possible that a third factor, as for example loss of confidence of foreign investors, may increase both interest rates and exchange rates. Thus we may see high interest rates associated with more unsuccessful cases, but it need not imply causality between the two variables. Truly we cannot say anything about causality here, but as far as the direction of bias goes, if anything the presence of such common factors would provide a downward bias to our results.

Third, our analysis may also suffer from the sample selection problem, i.e. we tend to exclude the cases where tough governments (and hence tight monetary policy) are able to prevent crises and, therefore, are not included in our sample. In this case we should observe fewer cases of tight policy and less success out of our sample. This again will bias the result

encountered in the paper. However, we do find that about 30 percent of our cases have tight monetary policy and these cases are relatively more successful.

Finally tight monetary policy may be accompanied by a whole package of reforms. It would be difficult to attribute the reversal of exchange rate wholly, or even partly to tight monetary policy.¹⁵

VI. CONCLUSION

This paper provides empirical evidence on the debate about the effectiveness of tight monetary policy in stabilizing exchange rates in the aftermath of currency crises. Although exogenous monetary policy variables are not available, at least not for a large set of countries, and true causality claims cannot be offered, the relationships encountered in this paper provide food for thought.

The paper finds that in a large set of undervaluations in the aftermath of currency crises, tight monetary policy increases substantially the probability of reversing undervaluation through nominal appreciation rather than through higher inflation. When the country is also experiencing a banking crisis however, the results are not robust: depending on the specification, tight monetary policy may reduce the probability of a reversal of currency undervaluation through currency appreciation.

The paper also looks at the effect of tight monetary policy on inflation, the current account, and growth. It finds that inflation declines more sharply in the cases with tight monetary policy. The current account improves after the implementation of tight monetary policy and remains stronger than in the non-tight monetary policy cases. Somewhat paradoxically, the paper also finds that the recovery of output is steeper in the tight monetary policy cases than in non-tight monetary policy cases. This result may be attributed to the fact that the tight monetary policy is usually associated with more successful reversals of the initial undervaluation and, therefore, with an economy recovering with relatively less inflation and relatively more nominal appreciation.

¹⁵ Some, but not all of these issues, are addressed in a forthcoming paper entitled "Overshootings and Reversals: The Role of Monetary Policy." To address the endogeneity issues we estimate a model using only cross section data, with 77 episodes of undervaluation, and use central bank independence index as an instrument. We thank Aart Kraay for the data and suggestions.

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Table 1: Number of Undervaluation Episodes

Undervaluation 1/	Number of crises	Proportion of cases with tight policy 2/	Proportion of cases with banking crises 3/
10	99	32.3	41.4
15	77	29.2	45.4
20	49	22.5	46.9
25	36	17.2	50.0
30	28	13.6	57.1

Source: Authors' calculations.

1/ Percentage misalignment with respect to constructed real exchange rate equilibrium.

2/ Tight Policy defined as real interest larger than average in previous 24months.

3/ Banking Crises dummy as in Lindgren, Garcia and Saal (1998) and others.

Table 2: Average Duration - in Months 1/

Phase	Months
Build Up	9.5
Reversal	20.4
Total	29.9

Source: Authors' calculations.

1/ Total episode defined from History to End. Build Up from History to Peak and Reversal from Peak to End (See Chart 1).

Table 3: Unconditional Probabilities as a function of Success Definition

At least X percent of reversal through nominal appreciation 1/	Success probability
50	0.32
65	0.22
75	0.19
85	0.14
95	0.13

Source: Authors' calculations.

1/ Cases with undervaluations greater than 15 percent considered.

Table 4: Unconditional Probabilities versus Conditional Probabilities of Success

Undervaluation 1/	Unconditional probability	Probability conditional on tight policy	Probability conditional on nontight policy	Significance test 2/
10	0.35	0.38	0.28	*
15	0.32	0.37	0.26	*
20	0.29	0.33	0.19	
25	0.31	0.40	0.21	
30	0.29	0.33	0.26	

Source: Authors' calculations.

1/ Success defined as 50 percent of reversal through nominal appreciation.

2/ *Indicates that the probabilities are different at a significance level greater than 85 percent.

Table 5: Unconditional Probabilities versus Conditional Probabilities of Success in Twin Crises 1/

Undervaluation	Unconditional probability	Probability conditional on tight policy	Probability conditional on nontight policy	Significance test 2/
10	0.33	0.38	0.43	
15	0.34	0.29	0.45	*
20	0.30	0.25	0.36	*

Source: Authors' calculations.

1/ Success defined as 50 percent of reversal through nominal appreciation.

2/ *Indicates that the probabilities are different at a significance level greater than 85 percent.

Table 6: Unconditional versus Conditional Probabilities of Choosing Tight Policy 1/

Undervaluation	Unconditional Probability	Probability Conditional on Banking
10	0.32	0.34
15	0.29	0.25
20	0.23	0.21

Source: Authors' calculations.

1/ Success defined as 50 percent of reversal through nominal appreciation.

Table 7: Panel Data Regressions of RER 1/

Sample	Coefficient 2/	t-stat
Entire sample	.1467 *	13.6
Only twin crises cases	.1484 *	9.01
Only currency crises cases (no banking crises)	.1513 *	10.7

1/ Dependent variable is deviation of RER from the equilibrium value and the independent variable is real interest rate.

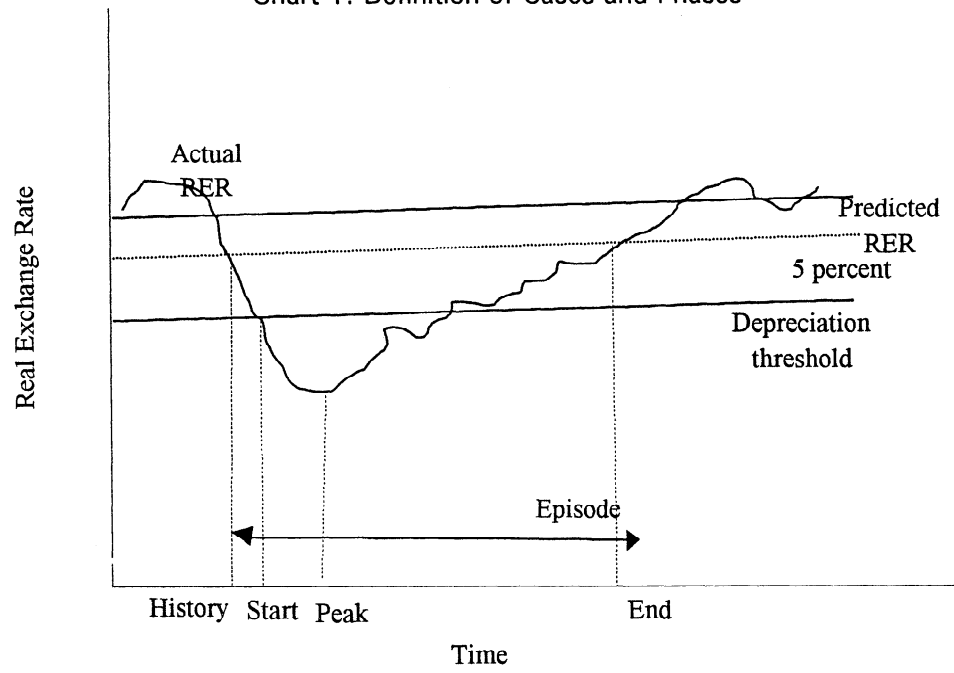
2/ * denotes statistically significant t ratios at 1 percent and 5 percent levels respectively.

List of Countries

ARGENTINA
BOLIVIA
BRAZIL
CANADA
CHILE
COLOMBIA
COSTA RICA
ECUADOR
EL SLV
GUATEMALA
HATTI
HONDURAS
JAMAICA
MEXICO
PARAGUAY
PERU
TRINIDAD & TOBAGO
UNITED STATES
URUGUAY
VENEZUELA
BURKINA FASO
BURUNDI
CAMEROON
CENTRAL AFR. REP.
EGYPT
ETHIOPIA
GABON
GHANA
KENYA
MADAGASCAR
MALAWI
MOROCCO
NIGERIA
RWANDA
SENEGAL
SIERRA LEONE
SOUTH AFRICA
TOGO
TUNISIA
ZAMBIA
ZIMBABWE

AUSTRIA
BELGIUM
DENMARK
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
IRELAND
ITALY
NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
UNITED KINGDOM
BAHRAIN
BANGLADESH
CHINA,P.R.:HONG KONG
INDIA
ISRAEL
JAPAN
JORDAN
KOREA
MALAYSIA
NEPAL
PAKISTAN
PHILIPPINES
SINGAPORE
SRI LANKA
THAILAND
AUSTRALIA
INDONESIA
NEW ZEALAND
PAPUA NEW GUINEA

Chart 1: Definition of Cases and Phases



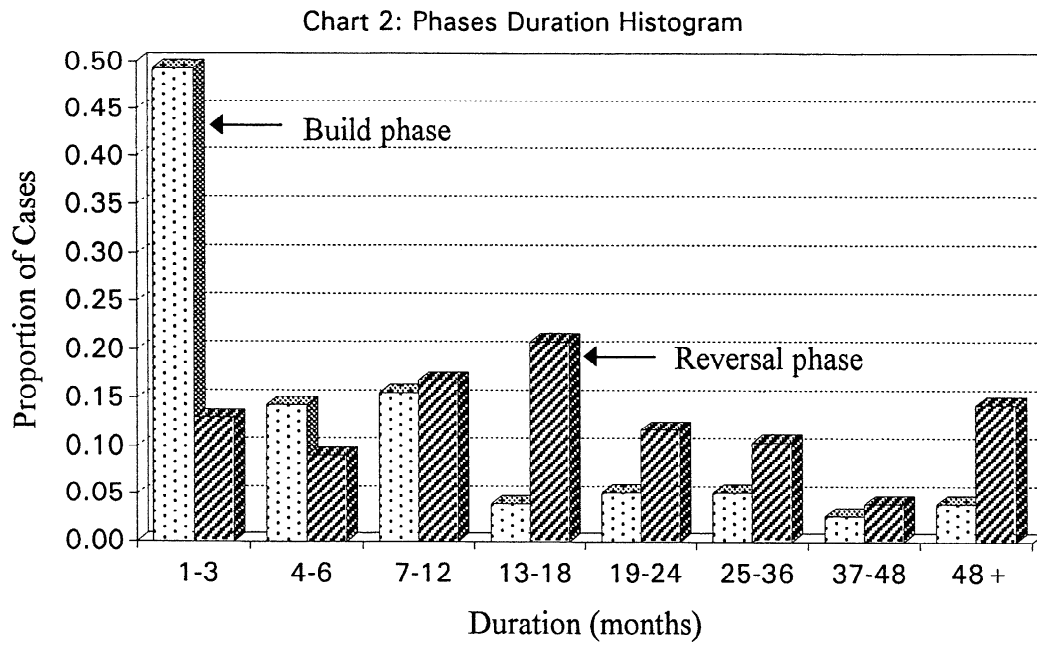


Chart 3: Probability of Reversing Undervaluations as a Function of Success Definition

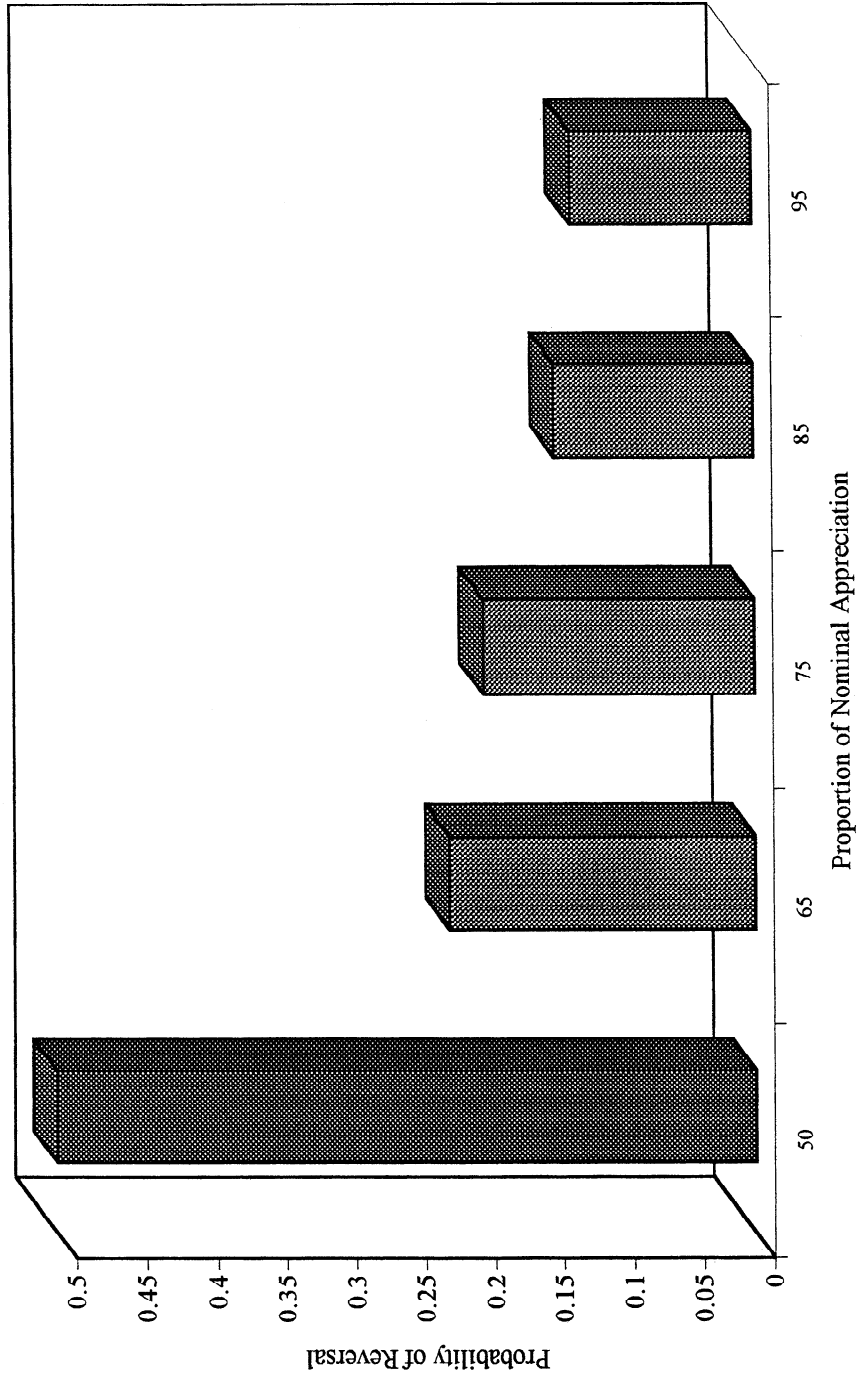


Chart 4: Probability of Reversing Undervaluations through Nominal Appreciations

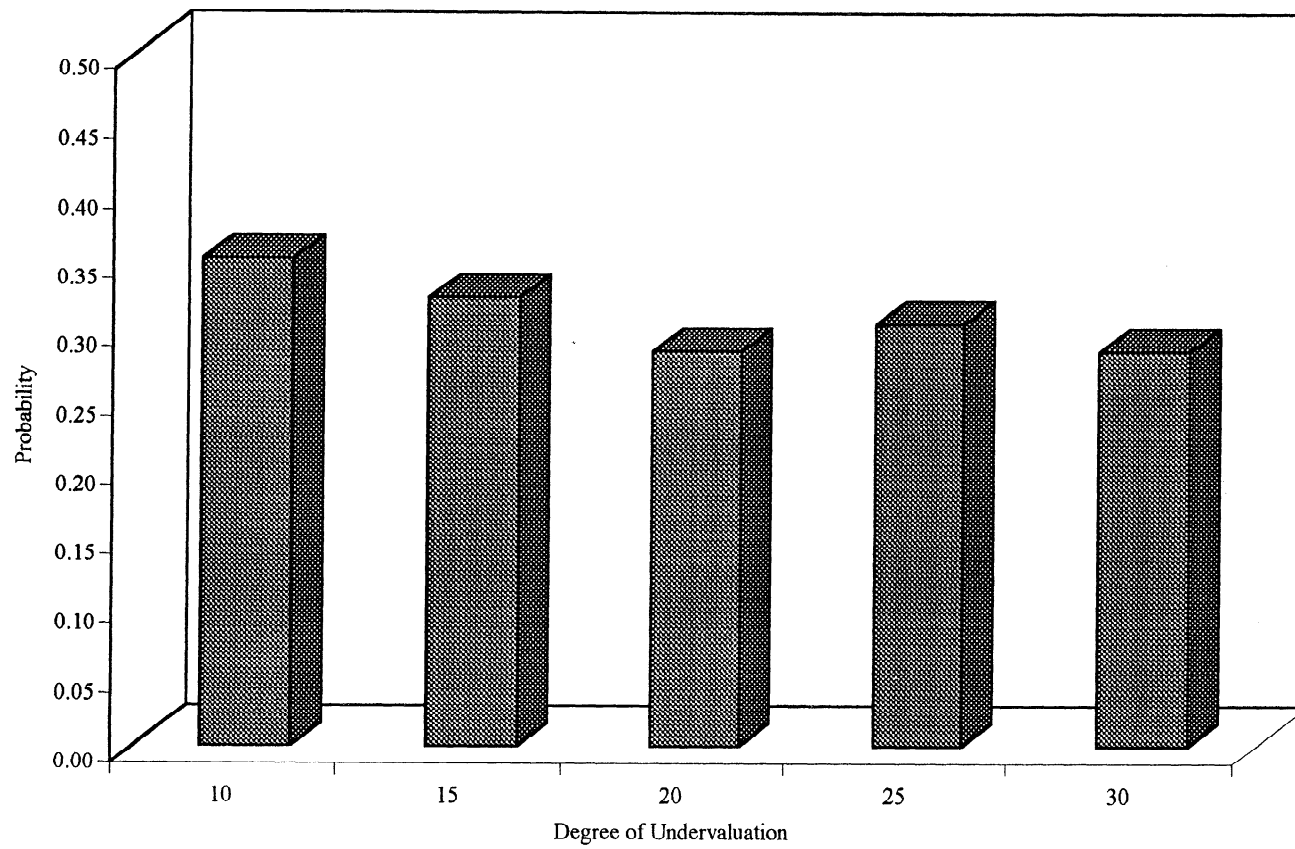


Chart 5: Probability of Success with Tight and Nontight Monetary Policy

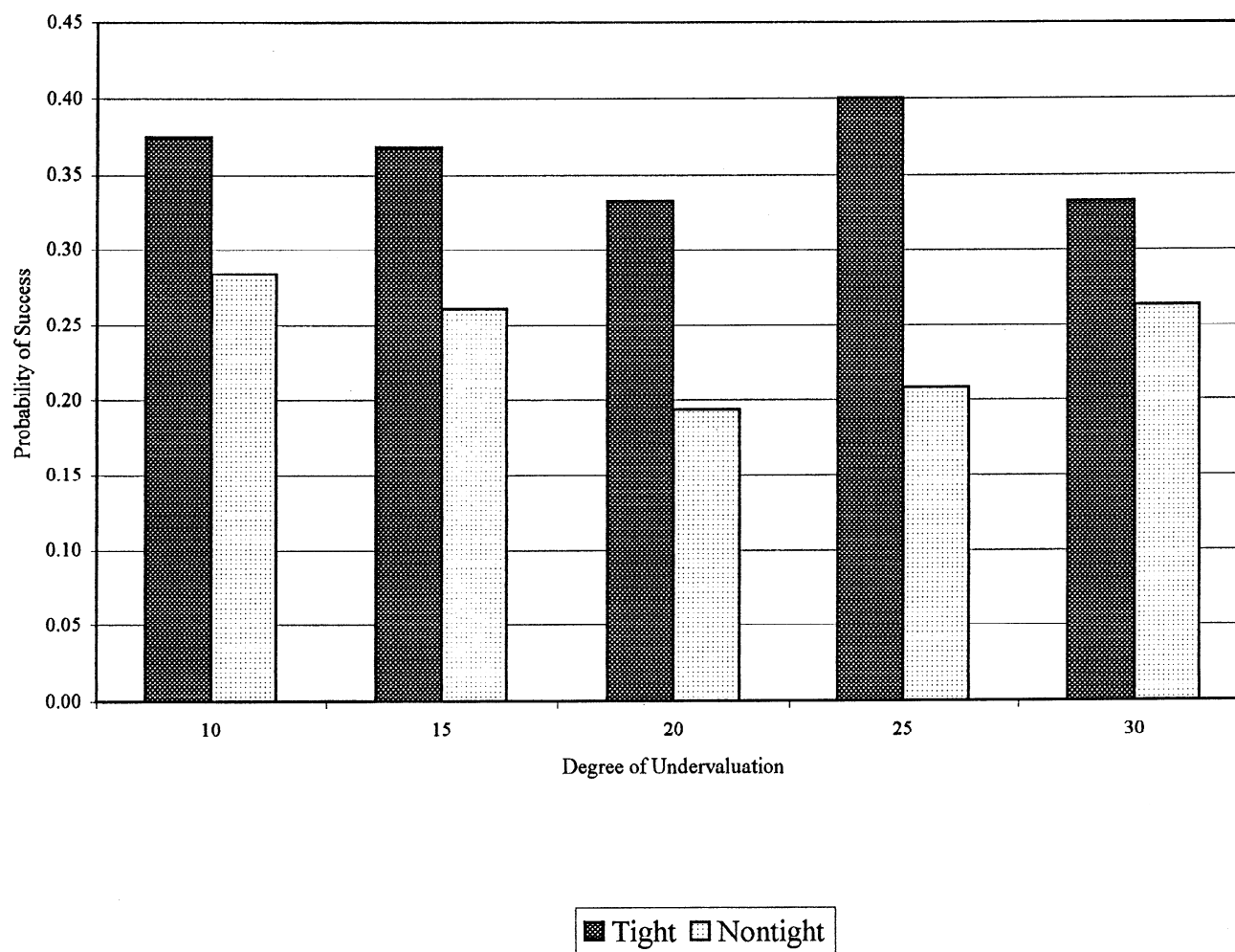


Chart 6: Probability of Success under Twin Crises with Tight and Nontight Monetary Policy

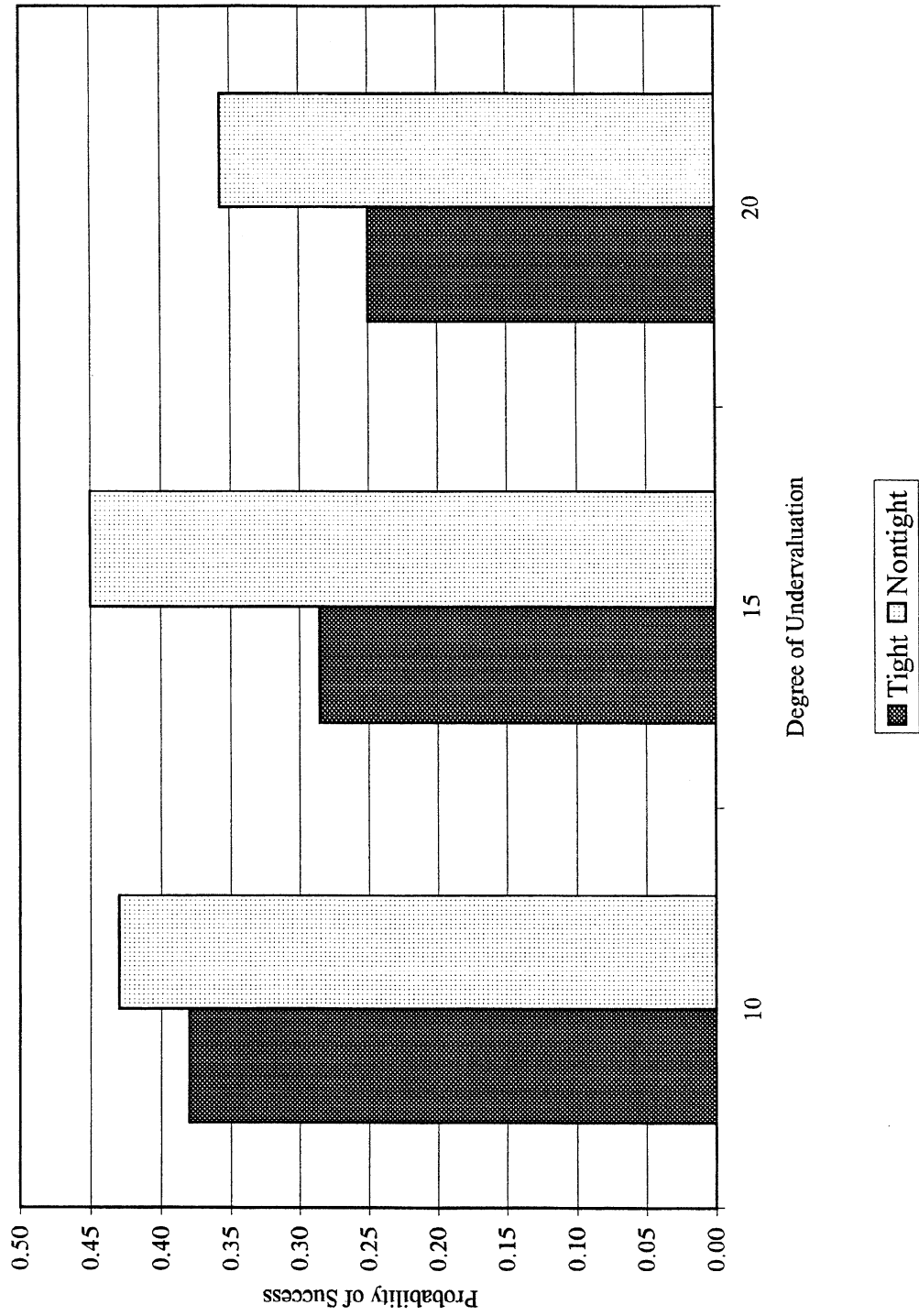
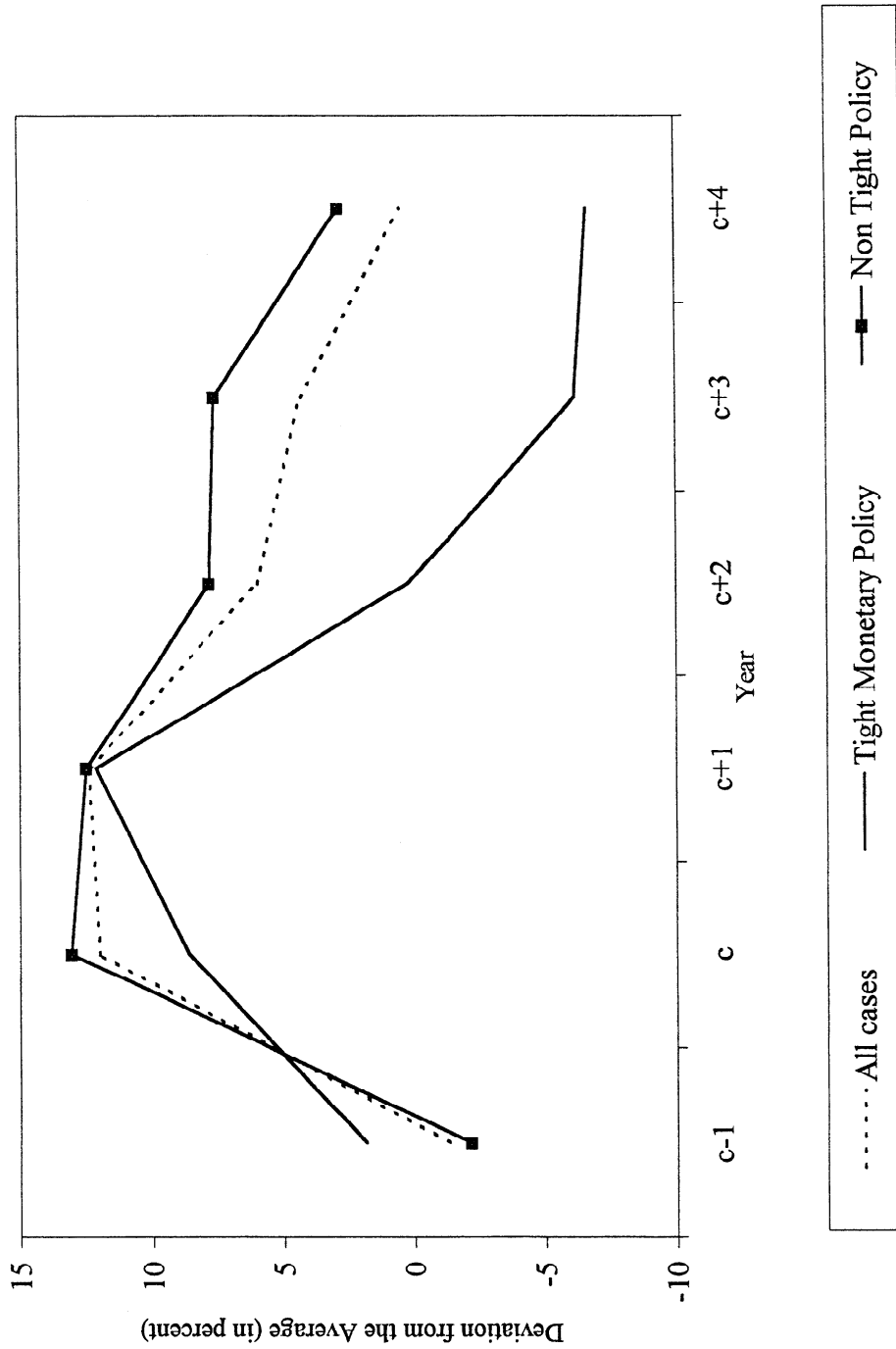
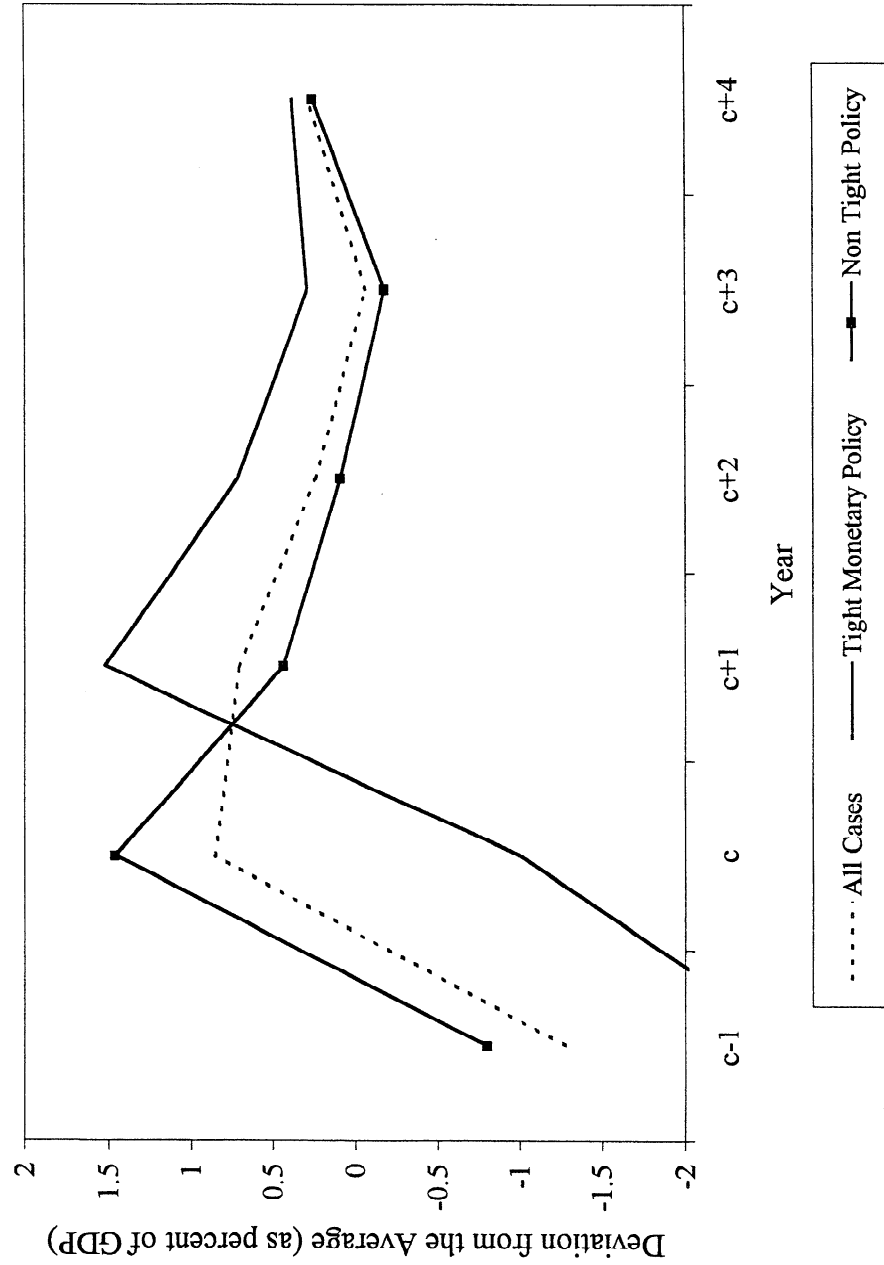


Chart 7: Inflation During and After Undervaluation



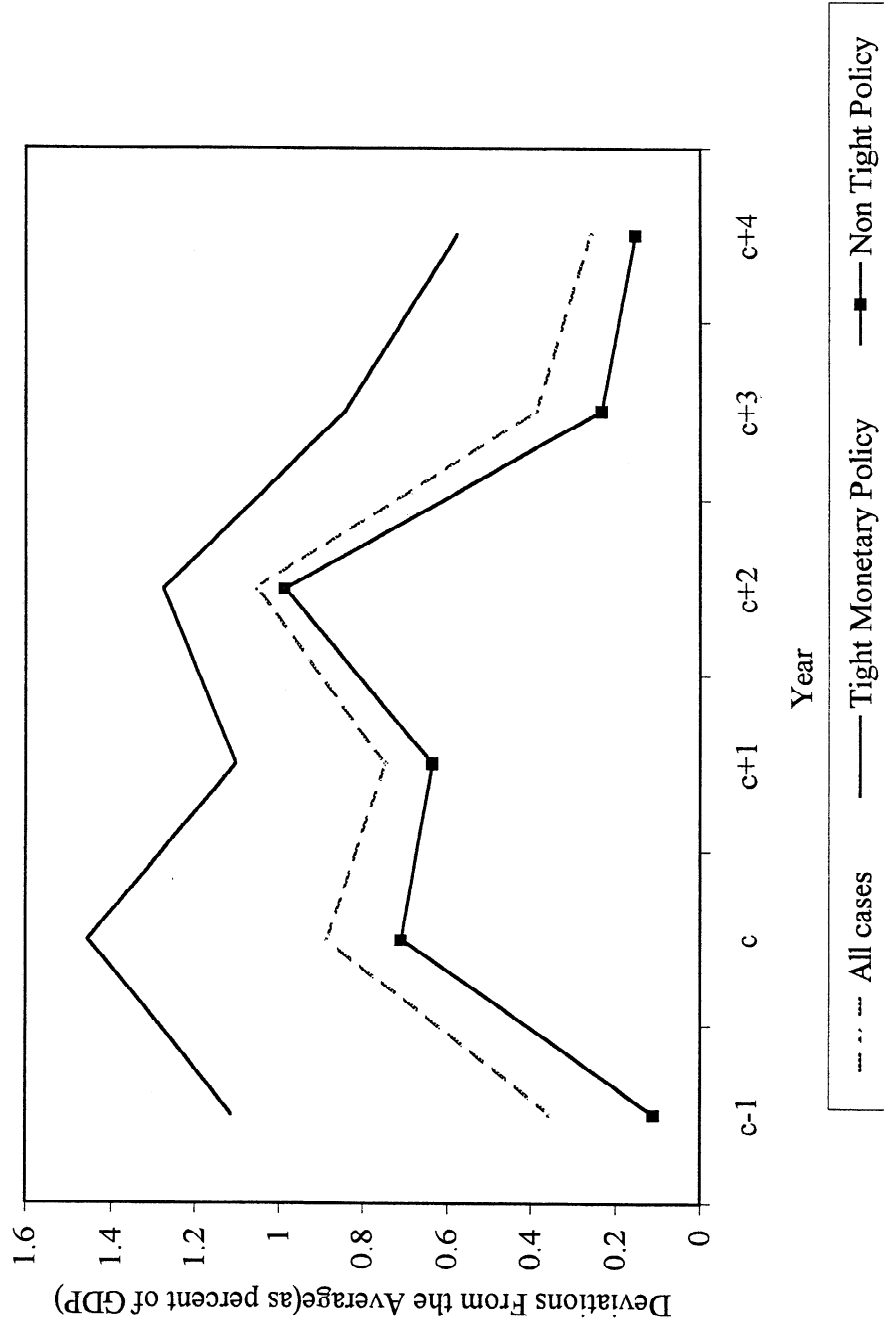
Source: IMF's IFS data base and Authors' own Calculations

Chart 8: Current Account during and after Undervaluation



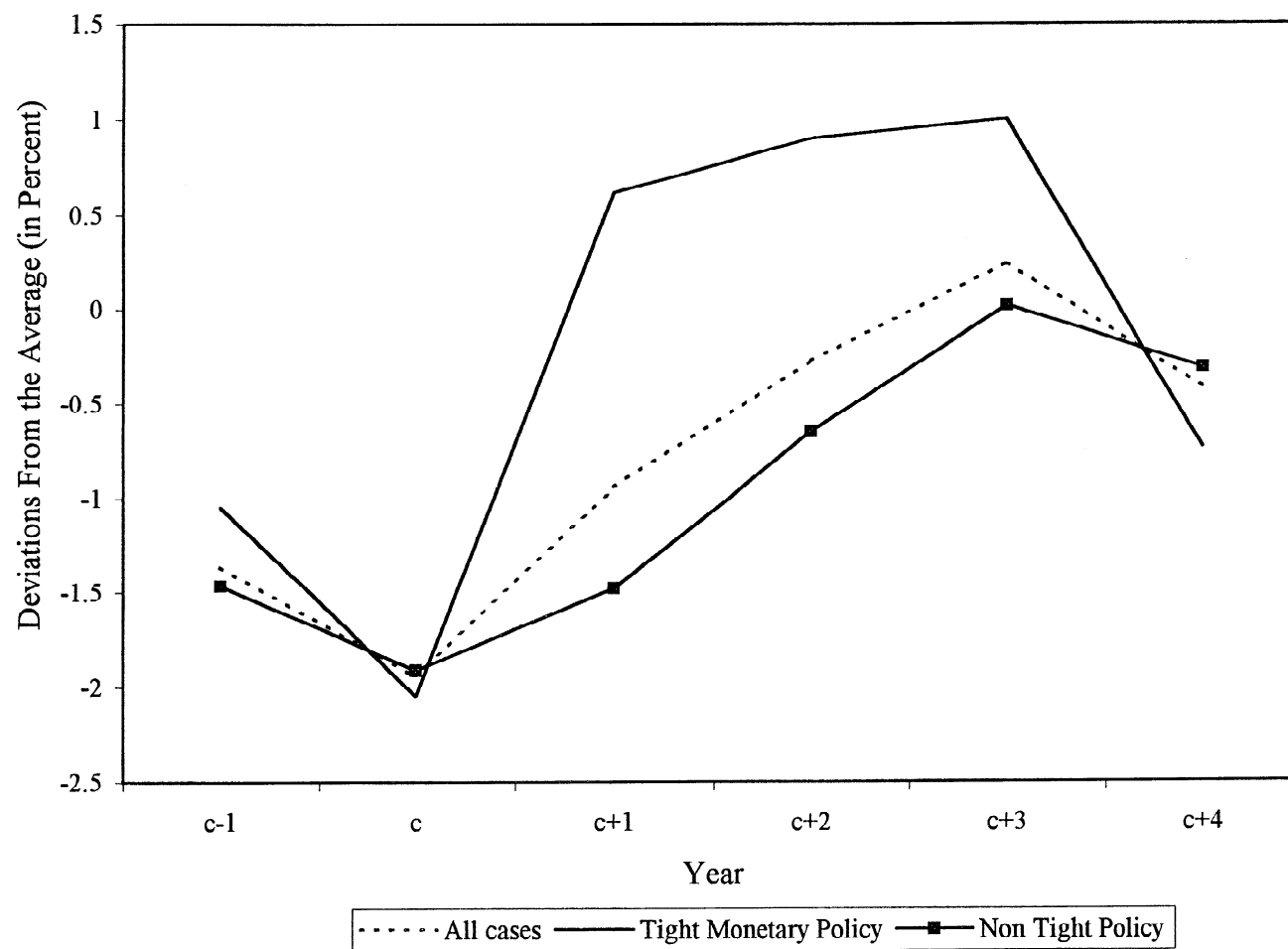
Source: IMF's IFS Data Base and Authors' Own Calculations

Chart 9: Debt Servicing During and After Undervaluation



Source: World Bank, Global Development Finance and authors' Own calculations

Chart 10: Output Growth During and After undervaluation



Source: IMF's IFS and Authors' Own Calculations