1. INTRODUCTION

The empirical assessment of the effectiveness of exchange rate management has been addressed in the literature. Most papers have studied whether the central banks have achieved smoothness of exchange rates through the use of their two main instruments: interventions in the currency market and the overnight interest rate in the money market. The theoretical support for the empirical analysis is consistently absent. That is not surprising as the theoretical analysis of the optimal exchange rate policy is unable to answer questions like when and how to defend from a speculative attack, and incapable of disentangling autonomous policy action from policy response to market behaviour.

In the current paper, we perform a case study of the Portuguese exchange rate management in the Exchange Rate Mechanism (ERM) period, April 1992 – December 1998. This approach, complementary to existing econometric work, allows a more detailed tracking of the degree of exchange rate pressure and of the instruments used to deal with it. We discuss the behaviour of the Portuguese Escudo (PTE) exchange rate (against the German Mark (DEM)) and the use of instruments by the Banco de Portugal, namely interventions in the foreign exchange market and official interest rates. Our analysis of effectiveness adopts the view that massive sales of foreign reserves, or steep interest rate increases, or both, coupled with observed exchange rate smoothness, meaning absence of large depreciation, should be classified as speculative attacks defended with success. The results suggest that most of the time, even during the ERM crisis, the Banco de Portugal policy was successful. Over the whole period, from April 1992 until December 1998, the central bank did take action in a small percentage of days, most of the time with success. The percentage of days in which the Banco de Portugal did not take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal decided not to take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal did not take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal decided not to take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal decided not to take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal decided not to take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal decided not to take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal decided not to take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal decided not to take action and nevertheless the exchange rate was smooth was above 98 per cent. The vast majority of the days in which the Banco de Portugal decided not to take action and nevertheless the exchange rate was smooth was above 98 per cent.
2. SOME HISTORICAL FACTS ABOUT THE EMS

The European Monetary System (EMS) was created in March of 1979. It was an arrangement established among the members of the 9 European Community countries with the aim of limiting the exchange rate fluctuations of the following currencies: DEM, French Franc (FRF), Dutch Guilder (NLG), Belgian Franc (BEF), Danish Krone (DKK), Irish Pound (IEP) and Italian Lira (ITL). The mechanism in which the currencies were linked was referred to as the ERM. The Luxembourg currency, Luxembourg Franc (LUF), matched the Belgium currency, BEF, since they were already in a currency union. The British Pound (GBP) at the beginning was not in the ERM. All ERM currencies had a symmetric band of fluctuation of 2.25 per cent around the central parity, except for the ITL, which had a band of 6 per cent (narrowed to 2.25 per cent in January 1990). Until 1992 three other currencies joined the ERM: the Spanish Peseta (ESP) in June of 1989, the GBP in October 1990, and the PTE in April 1992, all adopting the 6 per cent band. In September 1992, the ITL and the GBP left the ERM (the ITL would rejoin in November 1996). The currencies of two newcomers to the European Union the Austrian Schilling (ATS) and the Finnish Markka (FIM) joined in January 1996 and October 1996, respectively. The last country to join the ERM was Greek Dracma Greece in March 1998.

The responsibility for maintaining each bilateral exchange rate within the band was formally shared by both countries. Interventions were mandatory on both countries whose currencies hit the respective fluctuation margins. In practice this meant that the strong currency country had to sell its currency and the weak currency country had to buy its currency. Interventions could be carried out in any currency: for example the central bank of the strong currency country could be selling its currency against United States Dollar (USD), DEM (if that central bank was not the Bundesbank), etc. Arrangements for providing credit to weak currency central banks were set. There was a short-term automatic financing facility that provided unlimited credit for 45 days for marginal intervention\(^1\). A central bank could not stop intervening if its parity vis-à-vis another member currency was pressed against one of its limits\(^2\). Other ERM countries could provide help by also intervening in the foreign exchange markets. In special circumstances, i.e. if exchange rates became misaligned, the central rates could be revised with the consent of all concerned. The Single Market Program, which required the removal of capital controls, was implemented since the mid 1980s. Thus, during a certain period in some of the ERM countries there were capital controls that were used to help maintaining the exchange rate inside the band. Since 1990 capital movements including short-term capital and monetary instruments were free\(^3\).

Not only the parity levels within the ERM were adjusted occasionally (see Table 1) but also the width of the bands adopted changed, in 2 August 1993. During the period between 1979 and 1987, realignments were frequent; the central parities changed 11 times. The last realignment in 1987 led to revisions of the EMS arrangements in the Basle-Nyborg agreement of 12 September 1987. The agreement extended the credit facilities to longer periods, and gave weak currency countries up to 75 days of unlimited access to credit from stronger ERM currencies. For the first time it was permitted to draw on credits before a currency reached the limit of its ERM band. Except for Italy, there were no adjustments in the central parity between 1987 and mid-September of 1992. Bands at 2.25 per cent were maintained for those countries that adopted them initially, and the band of fluctuation for the ITL was narrowed to 2.25 per cent in 8 January 1990.

European currency problems of the 1990’s were more profound than all the previous ones. In the literature the period September 1992 – July 1993 is identified with a currency crisis period for the ERM. The ITL and GBP floated. The IEP was devalued once, the PTE twice, and the ESP three times. Finally, on the 2\(^{nd}\) of August of 1993 it was decided to widen the bands to [-15,+15] per cent\(^4\).

---

\(^1\) Eichengreen and Ghironi (1996) refer that the Bundesbank objected to the ERM and “Otmar Emminger, the finance minister, conceded it the right to opt out of its intervention obligation if the Government was unable to secure an agreement with its European partners on the need to realign”.

\(^2\) Another option was to ask for a realignment.

\(^3\) Ireland, Spain, Portugal and Greece had derogations.

\(^4\) The decision to widen the ERM bands was complemented by a bilateral agreement between the Dutch and German authorities to preserve the former band.
After August 1993 the ERM worked well, maybe because the margin was wide, as low inflation countries usually have exchange rate fluctuations below 30 per cent. Most countries had their currencies fluctuating within their earlier bands for sometime, and later smoothly converging to the European Monetary Union conversion rate\(^{(5)}\).

3. THE PTE IN THE ERM

From August 1977 until September 1990 the PTE exchange rate was managed in the context of a crawling peg regime. Since the mid 1980s, the rate of the crawling-peg of the PTE was successively cut down. In October 1990 the exchange rate regime changed. The PTE floated around an unidentified trend for an index that included only the main currencies of the ERM, with particular emphasis in some currencies. This change was made with two objectives, of reducing the degree of predictability surrounding the short-term value of the PTE and of preparing the country for future participation in the ERM. For this reason this regime became known as the shadowing regime\(^{(6)}\). In April 1992, the PTE joined the ERM adopting a fluctuation band of 6 per cent.

The Banco de Portugal was active in the foreign exchange market either as a seller or as a buyer of PTE. There were two types of interventions: “strict sense” interventions (in the spot and in the forward markets\(^{(7)}\)) and the so-called “re-channeling operations”. The “re-channeling operations” were sales of foreign currency that had been bought from the Treasury and had originated from Community transfers or the issuance of foreign currency denominated public debt. In this way, the Banco de Portugal could manage the sale of significant amounts of foreign currency so as to avoid major disturbances to the ongoing exchange rate policy. An index for the interventions including

---

(5) Exceptions were the ESP and the PTE; in March 1995 both realigned.

(6) For an analysis of the period before ERM membership see Banco de Portugal Annual Report (various editions).

(7) Forward interventions, which were minor and mostly concentrated in 1998, were converted into spot interventions according to the formula described in the appendix.

<table>
<thead>
<tr>
<th>Date</th>
<th>DEM</th>
<th>FRF</th>
<th>NGL</th>
<th>BEF</th>
<th>PTE</th>
<th>ESP</th>
<th>IEP</th>
<th>DKK</th>
<th>ITL</th>
<th>GBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 Sep. 79</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-2.9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>30 Nov. 79</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-4.8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>23 Mar. 81</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>05 Oct. 81</td>
<td>5.5</td>
<td>-3</td>
<td>5.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>22 Feb. 82</td>
<td>-8.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>14 Jun. 82</td>
<td>4.25</td>
<td>-5.75</td>
<td>4.25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-2.75</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>21 Mar. 83</td>
<td>5.5</td>
<td>-2.5</td>
<td>3.5</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>-3.5</td>
<td>2.5</td>
<td>-2.5</td>
<td>-</td>
</tr>
<tr>
<td>22 Jul. 83</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-6</td>
<td>-</td>
</tr>
<tr>
<td>07 Apr. 86</td>
<td>3</td>
<td>-3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>04 Aug. 86</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-8</td>
</tr>
<tr>
<td>12 Jan. 87</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>08 Jan. 90</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-3.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>14 Sep. 92</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>17 Sep. 92</td>
<td>-5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>23 Nov. 92</td>
<td>-6</td>
<td>-6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>01 Feb. 93</td>
<td>-10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13 May 93</td>
<td>-6.5</td>
<td>-8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>06 Mar. 95</td>
<td>-3.5</td>
<td>-7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>16 Mar. 98</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Sources: Gros and Thygesen (1992) and Banco de Portugal Annual Report (various editions).

Note: “—” means out of the ERM.
the “re-channelling operations”, was built, as well as its cumulative. A negative value for the index corresponds to a purchase of PTE, and a positive value to a sale of PTE. The intervention index is the ratio between the daily intervention and the highest absolute value of the daily intervention in the period of ERM membership times 100. In this paper we concentrate our attention in the total interventions index, which includes all types of interventions. Chart 1A shows the cumulative foreign total interventions index.

Since the late 1980s until August 1992, the Banco de Portugal intervened in the foreign exchange market mainly as a seller of PTE. As Chart 1A shows the cumulative foreign total interventions index achieved its highest value in mid-August. In Chart 1B we observe that the descending behaviour of the cumulative interventions index was not accompanied by an equivalent reduction of net foreign reserves, which showed a fairly stable path from 1993 onwards. This reflects the fact that interventions in this period were to a large extent “re-channeling operations”.

The ERM crisis of 1992-93 affected the PTE. The PTE was under continued pressure from 20 of August 1992 till 23 of November 1992, and the cumulative foreign interventions index went from 1583 in August to 987 in November. In September 1992, when the central rate of the ESP was devalued by 5 per cent and the ITL and GBP left the ERM, the PTE was under a speculative attack (see Chart 2). The Banco de Portugal intervened buying a massive amount of PTE (the intervention index achieved its lowest value on the 16th, the day before the ESP was devalued), the overnight interest rate increased to 68 per cent (see Chart 3) and the tomorrow/next interest rate on the euro-escudo market was above 1000 per cent. This action had a momentary effect on the exchange rate as a few days after the PTE appreciated by about 4 per cent. Although the PTE exchange rate was relatively stable, the foreign reserves decreased at a fast pace until the 23rd of November, when the central rate of the PTE and of the ESP were devalued by 6 per cent. On this day the tomorrow/next interest rate exceeded 250 per cent and the Banco de Portugal...
sold a massive amount of foreign reserves, the foreign intervention index achieved its third lowest value.

The following 3 months were calm; neither the cumulative foreign interventions index nor the exchange rate changed much. But in mid-February 1993, the PTE currency was again under pressure; the Banco de Portugal made sizable purchases of PTE, until the 23rd of April 1993. Between those two dates the cumulative foreign interventions index went from 1024 to 604. The overnight rate was kept for about 3 months, at a very high level; during March the weekly average overnight rate climbed 11 percentage points, which had marked effects on the longer maturity interest rates. On 13th of May 1993, the PTE realigned by 6.5 per cent, while the ESP realigned by 8 per cent. The interest rate had two peaks in April 1994 and June 1994, the more pronounced was on the 7th of April, when the overnight interest rate achieved 36.5 per cent and the PTE appreciated by 3 per cent.

After the May realignment until the 30th of July of 1993, interventions were negligible, and the overnight interest rate was relatively low. During the month of July 1993 most currencies of the ERM were again under tension. The PTE exchange rate depreciated considerably during this month, by about 8 per cent. Just from the 19th of July to the 1st of August of 1993 it depreciated by 6.3 per cent. In the 2nd of August 1993 the ERM fluctuation bands were enlarged and the PTE depreciated 2.3 per cent in just one day(8). This change was temporary as two days after the PTE appreciated 4.2 per cent.

Until July 1994, with the exception of two periods, from the second half of December 1993 until the first week of March of 1994 and during April of 1994 and the first 3 weeks of May of 1994, Banco de Portugal kept buying PTE. The cumulative foreign interventions index was -37 on July 1994. The interest rate had two peaks in April 1994 and June 1994, the more pronounced was on the 7th of April, when the overnight interest rate achieved 36.5 per cent and the PTE appreciated by 3 per cent.

From July 1994 until March 1995, when the PTE experienced its third and last realignment, there were no significant developments in the PTE exchange market. As in the previous realignment, once again the PTE was not under strong pressure until the realignment took place. This was even clearer this time, as during this relatively large period there were almost no changes in the interest rate or in the interventions, and the PTE exchange rate had a smooth behaviour with a depreciation of 0.6 per cent. On the 6th of March 1995 the central parity of the escudo was adjusted by 3.5 per cent and the central rate of the ESP was devalued by 7 per cent. On that day and two days after, the Banco de Portugal was in the market selling foreign currency and the intervention index achieved quite low values, -31 and -43, respectively.

After March 1995 until the second week of January of 1997 interventions were of smaller size. Since March 1995 the PTE appreciated significantly and the Banco de Portugal decided to make a large purchase of foreign currency to avoid a too large appreciation of the currency. During the second week of January the intervention index achieved in 3 nonconsecutive days the values of 29, 65 and 39. Until the end of 1998 there would be a few more sales of foreign currency by the Banco de Portugal. The last intervention was in the third

---

(8) The Banco de Portugal did not make much use of the larger fluctuation band, as the PTE did not fluctuate outside the “outdated” narrower band.
week of October 1998 and at that date the cumulative foreign interventions index was -1564.

As we saw, the various episodes of exchange rate pressure were addressed in different manners. In some of these episodes the Banco de Portugal decided to defend the currency strongly, in others it decided, following other central banks, not to defend the currency and instead realign, or widen the band. The first period of tension (see Charts 4A and 4B), around September 1992, was overcome with heavy interventions and interest rate management, without resorting to realignment, as Spain did while GBP and ITL floated. The next period of tension (see Charts 4A and 4B), November 1992, was resolved with interventions and realignment. In this second attack, the Portuguese Authorities decided to follow the Spanish realignment. As the currencies of some of our main trading partners depreciated substantially, the realignment can be seen as a measure to curb competitiveness losses. In the third period of pressure for PTE (see Charts 5A and 5B), February-April of 1993, the attack was defended with interventions and interest rates – actually kept high for a relatively long period– with success as the exchange rate was close to the central parity. The realignment of May 1993 was not closely preceded by pressure on the PTE. It appears as a response to
the ESP realignment. The PTE July-August 1993 tension was partially resolved by the widening of the band. In July the Portuguese Authorities decided to follow the majority of the ERM members by widening the PTE band. The period before the last realignment of the PTE in March 1995 (see Charts 6A and 6B), done together with the ESP once more, was a peaceful period without active policy.

4. **EFFECTIVENESS OF EXCHANGE RATE MANAGEMENT**

In simple economic monetary models only unsterilized interventions, as they change the relative supply of domestic and foreign money, have effects on the exchange rate. The monetary model needs to be more complex for sterilized intervention to have effects. Namely, the model should allow for a portfolio balance channel and/or a signalling channel. However, in the conduct of exchange rate policy, central banks also use sterilized interventions, and most of the empirical literature considers sterilized interventions.

The assessment of the effectiveness of exchange rate policy instruments considered in the empirical literature is linked to their short run effects on the exchange rate\(^{(9)}\). There is no consensual definition of efficacy in the literature. Fatum (2000) takes, essentially, two criteria, that of Frankel (1994) and that of Humpage (1996). The former considers that the central bank is effective if the national currency appreciates when it sells foreign currency. The latter defines a successful intervention as one where the purchase of the national currency is associated with a smaller depreciation of it relative to the situation before the intervention. Dominguez (2002) also follows the criterion of Frankel (1994). In Braga de Macedo et al (2002) and in Brandner et al (2001) the sale of foreign currency is effective if the national currency appreciates or/and the volatility of the exchange rate decreases. Stix (2002) defines that an intervention is successful if it is able to decrease the probability of a high volatility state for the exchange rate. Kraay (2003) identifies a failed speculative attack with an event where sharp reserve losses and sharp increases in the nominal interest rates are not followed by a large devaluation.

The evidence on the effectiveness of the exchange rate policy instruments is mixed. Differences in results across studies about that effectiveness depend, among other things, on the definition of efficacy used. Fatum (2000) examines the DEM/USD exchange rate and finds that in the short run interventions affect the probability of success, especially if coordinated and infrequent.

\(^{(9)}\) The majority of the studies consider only one of the policy instruments, either interventions or interest rates.
Dominguez (2002) does a case study for the JPY, USD and DEM and finds that interventions are most of the times successful. Braga de Macedo et al (2002) study the PTE currency, obtaining mixed results. They consider the time horizon from September 1989 until December 1998 and divide it into three periods. Each period is divided into a low and a high volatility subperiod. Interventions are effective only in some of these subperiods. Brandner et al (2001) study several ERM currencies including the PTE and find no evidence of foreign exchange intervention effects either on the exchange rate, or on its volatility. Stix (2002) finds that, for France and Spain, interventions seem to have increased both the probability of realignment and of a speculative attack. Kraay (2003) finds no evidence that high interest rates help in defending the currency for a large sample of developed and developing countries. Finally, Neely (2001) conducts a survey, where several monetary authorities are asked about their intervention practices, obtaining that foreign exchange intervention does affect exchange rates\(^{(10)}\). All the respondents believed interventions have effects on the exchange rate. Most said the effects are over the short-run. About 60 per cent of the respondents believed the effects on the exchange rate take less than a day and 28 per cent of the respondents that it they take a few days.

There are relevant difficulties in interpreting the results of the existing empirical work on the effectiveness of the policy instruments. The data analyzed are “treated” data, as they are already the result of market behaviour and intended policy actions, i.e., it is impossible to know how the exchange rate would have behaved if the central bank had not intervened in the market. If the objective of the central bank is to smooth the exchange rate time path, the coefficients of the intervention levels or of the interest rate variations on a regression of the exchange rate variation will be biased towards zero. In this type of analysis there is an endogeneity problem, as the interventions, the interest rate and the exchange rate are determined jointly. Therefore, the analysis of the currency market would require a specification of a more structural model to disentangle the effects of policy from the effects from variations in the net demand of private agents. But this alternative, a multi-equation structural empirical model, is difficult to formalize. Before that can be achieved further progress is necessary in understanding the determinants of the supply and of the demand for currency, especially during periods of high volatility in the exchange rate.

The difficulties just referred in reaching a reasonable definition of effectiveness should be seen as cautionary for the analysis undertaken in this section. It will be assumed that the objective of the central bank is for its currency to have a smooth exchange rate behaviour, and namely to defend it from large fluctuations. A successful exchange rate policy is defined as one for which that objective is accomplished. We define the central bank as being active when either interventions in defence of the PTE are large (that is, large purchases of PTE), or the overnight interest rate increases substantially. The central bank can be successful being either active or passive.

The specific taxonomy of our analysis is the following. We consider the time frame between 6 April 1992 (the PTE ERM entry date) and 31 December 1998 (just before the adoption of the euro). Each trading day \(t\) in this period is considered as an event. We select episodes where there were jointly or not: (E1) a cumulative depreciation of the PTE against the DEM from the beginning of day \(t\) to the end of day \(t+k\), larger than the mean plus \(x\) standard deviations; (E2) a cumulative increase in the PTE overnight interest rate from the beginning of day \(t\) to the end of day \(t+k\), larger than the mean plus \(y\) standard deviations; and (E3) cumulative foreign exchange interventions that are purchases of PTE, from the beginning of day \(t\) to the end of day \(t+k\), larger than the mean plus \(z\) standard deviations\(^{(11)}\). The number of events is equal to the number of trading days in our time frame (i.e., 1686) minus \(k\).

We did not use the interest rate series in levels because it is not stationary over the sample period. The criterion we used takes into account the change in the interest rate, which is stationary. This approach has a caveat as it implies that many sequential days with high overnight interest rate

\(^{(10)}\) This set of countries includes all G7 countries, except for the UK.

\(^{(11)}\)The three time series, rate of depreciation, change in the overnight interest rate and interventions, are stationary.
are considered as events during which the central bank was not active with that instrument.

Given this taxonomy, we consider a situation where either (E2), (E3), or both, were verified as an event in which the central bank was active. Otherwise the central bank was passive. A successful event is one for which (E1) is not verified\(^\text{(12)}\). As usually conditional probabilities can be defined. We compute the distribution of success given the central bank’s stance. Table 2 presents the conditional and the unconditional probabilities for \(k = 1\) and for \(x = y = z\) and \(x = 2.5, 3, 3.5\). Our results are robust to changes in the definitions of the episodes, i.e. the conclusions were not altered in a meaningful way when we considered cases where \(x \neq y \neq z\) or \(k \neq 1\). The assumption taken for \(k\) is in

\(\begin{array}{cccc}
\text{Case 1} & x = y = z \text{ and } x = 2.5 \\
\hline
\text{Unconditional} & \text{Successful} & \text{Unsuccessful} \\
\hline
\text{Active} & 4.4 & 90.5 & 9.5 \\
\text{Passive} & 95.6 & 98.2 & 1.8 \\
\hline
\text{Case 2} & x = y = z \text{ and } x = 3.0 \\
\hline
\text{Unconditional} & \text{Successful} & \text{Unsuccessful} \\
\hline
\text{Active} & 3.3 & 90.9 & 9.1 \\
\text{Passive} & 96.7 & 98.6 & 1.4 \\
\hline
\text{Case 3} & x = y = z \text{ and } x = 3.5 \\
\hline
\text{Unconditional} & \text{Successful} & \text{Unsuccessful} \\
\hline
\text{Active} & 2.1 & 91.4 & 8.6 \\
\text{Passive} & 97.9 & 98.8 & 1.2 \\
\end{array}\)

\(\text{(12)}\) Our definition is closely related with that of Kraay (2003) for a failed speculative attack for the speculator.
line with the results reported in Neely (2001), about 90 per cent of the responses were that the full effect of the interventions was felt within a few days.

As Table 2 shows, the share of days in which the Banco de Portugal was active ranges from 2.1 per cent to 4.4 per cent (as expected the number of active days increases as the selected bands shrink). The success of the central bank when it was active was large, varying from 90.5 per cent to 91.4 per cent of the events, (the number of successes declines as the allowed fluctuation band for the exchange rate diminishes). The intervention alone was used about 80 per cent of the time, constituting the main instrument used, being successful more than 70 per cent of time (see Chart 7). The instrument interest rate alone or combined with interventions was less frequently used; less than 20 per cent of the times the central bank was active.

This result should be seen in the context of the caveat mentioned before. The period during which this limitation was more severe was the one between 17 March 1993 and 16 May 1993. In this period the interest rate was always above 16.4 per cent, and nevertheless according to our indicator the instrument interest rate was used only once when $y=2.5$.

Most of the time, between 95.6 per cent and 97.9 per cent, the Banco de Portugal did not change significantly its policy instruments. This decision of not acting in the markets proved to be successful, as more than 98 per cent of the time the PTE exchange rate did not depreciate substantially. The small fraction of days (less than 2 per cent) in which the Banco de Portugal was passive but, nevertheless, the exchange rate depreciated substantially, can be largely explained by the use of other instruments. About 2/3 of these events correspond to days close to the three realignments of the PTE and to days in July 1993 until the widening of the ERM bands. This behaviour on the part of the Banco de Portugal was deliberate. It was recognized that the best strategy was to let the PTE follow the behaviour of the other ERM currencies under attack. The realignments followed the ESP depreciations, and in July 1993 there was a generalized attack against almost all of the ERM currencies that culminated in the widening of the bands.

When active the Banco de Portugal was not successful 8.6 per cent, 9.1 per cent and 9.5 per cent of the times, which corresponds to just a few events: 3, 5 and 7.

The main conclusion is that the Banco de Portugal exchange rate management, during the ERM period, was successful either when it was active in the market, or when it was not active in the market, as the PTE exchange rate had almost always a smooth behaviour, that is without strong depreciation episodes.

5. FINAL REMARKS

This paper studies whether the Portuguese exchange rate management was successful during the period of ERM membership. Existing empirical studies have focused mostly on assessing the effectiveness of a single exchange rate policy instrument — typically interventions — and have used various kinds of criteria. In this paper, we take into account the possibility of the central bank combining both interventions and interest rate for managing the exchange rate. The criterion used for assessing the effectiveness of the exchange rate management was the absence of large depreciations and an event with central bank action was defined by either massive purchases of PTE by the Banco de Portugal, or large increases of the overnight interest rate.

The results indicate that the Banco de Portugal used massive purchases of PTE or large increases in the interest rates seldom, during the period of the ERM membership, and mostly with success. The most frequent policy choice was interventions alone, and that was also the most successful policy. This result should be seen in the context of the analysis, which considers the change in the interest rate instead of its level. During the period between 17 March 1993 and 16 May 1993 this limitation is particularly strong.
REFERENCES

Dominguez, K., 2002, “Foreign exchange intervention: did it work in the 1990s?”, University of Michigan, manuscript.

This section provides a brief exposition on the behaviour of speculators and currency markets, with special reference to the choices of the central bank on defending an attack. Suppose the currency under attack was the PTE and that the PTE exchange rate in period $t$ is $S_t$, i.e. each PTE was worth $S_t$ DEM. Speculators could attack the PTE in the spot market or in the forward market. The strategy of using the spot market is the following. The speculator borrows amount $Y$ of PTE at the local interest rate $R_t^*$, converts the PTE in DEM at the spot exchange rate, $S_t$, and deposits the DEM at the German money markets at the interest rate $R_t$. At the end of the period the DEM are converted in PTE. The profit in DEM of such action is: $Y \left[ S_t (1+R_t) - S_t (1+R_t^*) \right]$. The profit is positive if $S_t (1+R_t) > S_t (1+R_t^*)$. When $R_t^* > R_t$ the speculator only gains if the PTE depreciates.

If $F_t > S_t$, where $F_t$ is the forward exchange rate, then the speculator by selling forward amount $X$ of PTE has a profit in DEM of $X[F_t - S_t]$. Since the arbitrage condition $S_t (1+R_t) = F_t (1+R_t^*)$, always holds, speculators make profits in the forward market if and only if profits can be made in the spot market. If $X=(1+R_t^*)Y$, the attack in the spot market is equivalent to the attack in the forward market in terms of the PTE that are sold for DEM in the spot market. The bank that buys the PTE forward from the speculators hedges its currency risk. In the spot market trades amount $X/(1+R_t^*)$ of PTE for DEM and deposits amount $S_t X/(1+R_t^*)$ of DEM in the German money market. The return on the deposit is $(1+R_t)S_t X/(1+R_t^*)$. Thus, the amount the bank is willing to pay for the X PTE sold forward, $F_t X = (1+R_t)S_t X/(1+R_t^*)$. Whether the attack is in the spot market or in the forward market the result is the same, $Y$ PTE are sold in the spot market.

What can a central bank do to defend its currency? It can use moral suasion, selective capital controls and regulation to prevent domestic banks from lending domestic currency to speculators, interventions (sale of foreign reserves) or raise the domestic overnight money market interest rate. Generally, in developed financial markets, instruments like moral suasion do not have important effects and the use of instruments like legislation on capital controls is avoided.

By far, the most commonly used instruments to defend a currency are interventions in the foreign exchange market and the overnight interest rate. The mechanics at work are simple. Speculators sell the domestic currency in the spot market expecting to put downward pressure on the exchange rate and the central bank counters that expectation by buying the domestic currency, through interventions. The central bank increases the overnight interest rate to make unprofitable for the speculators the action of borrowing domestic currency to sell in the spot market.