**Implicit regimes for the
Spanish peseta/Deutschmark exchange rate***
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Abstract

The objective of this paper is to identify implicit exchange rate regimes for the Spanish peseta/Deutschmark exchange rate. To this end, several statistical approaches, proposed by previous studies, are applied to the period 1965-1998. The results indicate the existence of implicit regimes other than a free-floating one.

JEL classification: F31; F33

Keywords: Exchange rate regimes; implicit fluctuation bands, exchange rates.

1. Introduction

A recent line of research emphasizes that the *de facto* exchange rate policy adopted by many monetary authorities has tended to differ from the proclaimed *de jure* exchange rate regime, thereby explaining why IMF classifications¹ are not always an accurate guide to the true exchange rate policy of those authorities². Recent studies have sought to achieve two objectives, namely to detect divergences between *de jure* and *de facto* regimes and to assess the consequences these differences have on the relevance of exchange rates to macroeconomic performance³. Recognition of these divergences poses a number of key questions regarding the analysis and recommendations of international economic organizations as well as for academic research. For example, which classification is the correct one and which variables and methods should be considered for this purpose? What is more, some historical episodes related to exchange rate regimes could be rewritten and reinterpreted under the light of the facts better than the official words, (i.e., on too many occasions, actions seem to speak louder than the stated commitments of the monetary authorities⁴).

In this paper, the case study of the Spanish peseta/Deutschmark exchange rate provides some evidence about the need to take official regimes with extreme caution. Furthermore, the peseta and the chosen period of the present investigation (1965-1998) offer the opportunity to study an exchange rate that seems to have a variety of mutable regimes.

In 1959 the Spanish government established the convertibility of the peseta within the general Bretton Woods regime of fixed parities⁵. This system finally collapsed in the early 1970s, when it was replaced, at least officially, by a floating regime which practically lasted until the peseta joined the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) on 19 June 1989. Since its entrance into the ERM, the Spanish peseta suffered four devaluations *vis-à-vis* the Deutschmark.

¹ The IMF used to group exchange systems in no more than three categories: pegged, floating and intermediate regimes. After 1998, the IMF revised its annual classification, allowing for different forms of pegged and intermediate regimes (Levy-Yeyati and Sturzenegger, 2001).

² Reinhart and Rogoff (2004) went to the extent of arguing that the IMF taxonomy was only slightly better than random.

³ See Coudert and Dubert (2004) for a survey of studies of implicit exchange rate regimes. Reinhart and Rogoff (2004) examine the importance of exchange rate regime classifications for empirical macroeconomics.

⁴ However some episodes may be undoubtedly classified as free-floating or pure peg. This is, for instance, the case of the US dollar during the so-called greenback period, widely recognized as a free-floating regime (Officer, 1981).

⁵ The 1959 Stabilization Plan put an end to dreams of autarchy and the Spanish government accepted the dismantling of the multiple exchange rate regimes and its substitution by a unified rate for the peseta.

We consider that our results are of interest, not only for the Spanish experience, but also for other European countries, as the new European Union member states will ultimately have to enter the Eurozone and will have to previously connect their currencies to the Euro during a transitional period of at least two years. In addition, the presently reduced daily exchange rate fluctuations suggest that Croatia, Morocco, Norway, Switzerland and Tunisia may have been pegging their currencies fairly tightly to the Euro and, therefore, our results could be also of interest to those countries. Other nations, such as Russia, Belarus, Ukraine, Algeria, Egypt and Turkey may reconsider their present-day exchange rate strategies and agree to eventually link their currencies to the Euro.

In this paper, several statistical procedures are applied to the recent history of the Spanish peseta/Deutschmark exchange rate with the aim of identifying the various *de facto* exchange rate regimes which determined the value of the peseta during the period from 1965 until 1998. To that end, the paper is organized as follows: Section 2 presents the historical background to the research performed; Section 3 describes several statistical measures used to determine whether implicit exchange rate regimes existed; Section 4 applies three procedures to recent developments in the Spanish peseta/Deutschmark exchange rate, comparing the main results; finally, Section 5 offers some concluding remarks.

2. Exchange rate regimes

Even after the definitive unification of the exchange rate of the peseta in 1959, external monetary policy remained in the hands of the Spanish Institute for Foreign Currency (IEME), which was closely dependent on the Ministry of Trade; external policy therefore continued to be separated from internal monetary control, which was dictated by the strict orders issued by the Ministry of Finance. The role of the Bank of Spain remained passive, as the reforms implemented during the 1960s did not include the establishment of a central bank in the true sense of the word (i.e. the political authorities did not create the necessary instruments to exercise adequate control of monetary aggregates). This explains why, when the permanent Spanish inflation differential of the 1950s –an inevitable consequence of, among other things, an overly lax monetary policy– seemed to be cured by the stabilization measures adopted, the continuity of the same loose monetary policy forced an appreciation of the peseta that produced a continuous deterioration of the external sector during the 1960s, something that could only be solved by devaluation; in November 1967, the value of the peseta was reduced from 60 to 70 to the dollar (Aixalá Pastó, 2000).

From 1973 onwards, the Bank of Spain managed to achieve greater integration between monetary and exchange rate policies, following its assumption of the functions of the defunct IEME. It was thus able to assimilate the collapse of the Bretton Woods system⁶ and the beginning of the peseta's fluctuation in 1974. According to some researchers, the Bank of Spain attempted to stabilize the peseta by taking as reference an index of the nominal exchange rate against the currencies of the main developed countries (Serrano Sanz, 2000). Furthermore, the unresolved fiscal deficit meant a continuous growth in the amount of money in circulation during the 1970s, a situation which the Bank of Spain was anxious to end. During this period, which coincided with the crumbling of Franco's dictatorial regime and the beginning of the transition to democracy, two important devaluations of the peseta took place, in 1976 (11%) and 1977 (20%).

The demise of the Bretton Woods system in the early 1970s and the resulting volatility of the financial markets did not, however, give rise to a generalized regime of flexible exchange rates. On the contrary, some states tied the external value of their currencies to a hard currency (or a basket of currencies) to which they had close links, in the belief that any greater flexibility would generate an excessive fluctuation in exchange rates. Such fluctuation would, in their view, not only be a source of macroeconomic instability, but also negatively affect productive investment, international trade and, consequently, economic growth. In order to avoid this, many countries tied their currencies to a hard currency.

This same conviction led some Western European countries to establish an area of monetary stability. Firstly, they created the so-called Snake agreement [which included both European Community (EC) and non-EC members], and later, in March 1979, a multilateral parity grid, the EMS, which exemplified their deep commitment to exchange rate stability. From its inception, the EMS grouped together the main Western European countries (by then exclusively EC members), except for the UK, with the intention of reducing exchange rate volatility, and thus established the scenario which would lead to closer economic and financial articulation. Monetary integration was viewed as indispensable for economic integration, since excessive exchange rate volatility disrupted economic policies and threatened to erode political support for the customs union. The move to a Single Market clearly showed that exchange rate fluctuations were impeding true economic integration.

⁶ The oil price hike at the end of 1973 was undoubtedly the main economic problem facing the peseta during the early and mid-1970s. Moreover, the political tensions caused by the demise of Franco's regime made its solution even more difficult (Serrano Sanz, 2000). The energy crisis and political developments caused a serious depreciation of the peseta, which fell to 170 to the dollar in 1985 (Alcaide Inchausti and Alcaide Guindo, 2004).

The second oil price increase in 1979 and the consequent European recession gave rise to an economic crisis in Spain that lasted until the mid-1980s. Monetary policy until 1982 was quite lax, in order to cushion the effects of the democratic transition and facilitate the financing of the growing budget deficit. The period initiated by the Socialist government in December of 1982, devaluing the peseta by 7.6% against the dollar, was one of greater political stability; this in turn permitted a mild reform of the Spanish economy by the implementation of a tighter monetary policy, even though it was always conditioned by the inflationary financing of the budget deficit (Serrano Sanz, 2000).

The choice of the most appropriate national exchange rate regime in the 1980s was determined by the prerequisite that it offer the maximum protection from monetary and real shocks (i.e., that it be an effective stabilization tool). In addition, the widespread monetary instability of that period demanded national policies of disinflation and budgetary consolidation⁷. As could be expected, economists in this period focused on the monetary side of economic affairs (Levy-Yeyati and Sturzenegger, 2001) and many countries adopted a fixed exchange rate, in the hope of controlling their domestic monetary expansion and thereby imposing stricter discipline upon national public finance⁸. The choice between domestic price stability and exchange rate stability was made in a (completely justified) climate of uncertainty regarding the true possibilities of domestic monetary control and, in contrast, ever greater confidence in external stability.

The credibility level of individual countries' monetary and exchange rate commitments depended on the success of their institutions in combating inflation; for most nations (whose record in this regard left much to be desired), this entailed the self-imposed necessity of tying their exchange rate to a hard currency with an excellent reputation. Thus, the economic authorities, given the growing European links of the Spanish economy, accentuated by its accession to the EC in 1986, adopted the decision to include the peseta in the EMS in 1989. Thus, and as had been expected since at least 1985, the Deutschmark became the true anchor of Spanish exchange rate policy.

One of the main arguments in support of the EMS was that it facilitated the necessary process of disinflation, raising the costs of inflation by obliging its

⁷ Following Broadberry (1999), the debate about the optimal exchange rate system requires dealing convincingly with the tensions between a search for universal economic laws and a recognition of the importance of historical contingency.

⁸ Alberola and Molina (2004) have shown that a greater short-term possibility of financing the budget deficit under a regime of fixed or semi-fixed exchange rates tends to reduce the exercise of fiscal control, thus reducing the sustainability of the regime and leading to the abandonment, in the medium term, of the exchange rate anchor.

members to adopt sound financial management. The aim was to impose policies of macroeconomic discipline to ensure that fiscal deficits would not be exacerbated by monetary expansion. On such issues, Germany emerged almost unquestioned as the anchor for exchange rate and anti-inflation policy (Bajo-Rubio *et al.*, 2001). Indeed, the EMS might even be viewed as an institutional arrangement that enabled its members to ‘borrow’ the Bundesbank’s reputation by pegging their exchange rates to the Deutschmark. Weaker currencies achieved greater credibility owing to the effects of this reputation within the ERM. In other words, European Union member states with histories of high inflation used the EMS as a way of “importing” the Bundesbank’s anti-inflationary credibility.

Since its entrance in 1989, the history of the Spanish peseta in the ERM was undoubtedly conditioned by the crises of the system in the 1990’s. The speculative attacks against the EMS, beginning in the summer of 1992, led to the devaluations with respect to the Deutschmark in September and November of 1992, as well as in May of 1993. The situation only returned to normal with the broadening of the fluctuation bands in August of 1993. A new devaluation of the Spanish peseta took place in March of 1995, which turned out to be the last one in its 130 years-history, going from 1868 up to 1998.

3. Identification of the exchange rate regime

This section presents the principal approximations employed to discover the real exchange rate regime prevailing in a particular country. The first empirical utilization of the difference between *de jure* and *de facto* was made by Ghosh *et al.* (1997), although these researchers only employed the nine possibilities listed in their study of the robustness of the results obtained previously with the official classification by the IMF of three categories: fixed, intermediate and floating. Thus, the “finest” classification contemplated a first group of four types of fixed regimes i.e. fixed in relation to a currency, or in relation to Special Drawing Rights, or with regard to a basket of established currencies or, lastly, with regard to an unknown basket. The second, intermediate, group consisted of cooperative regimes (like the EMS), unclassified floats and rates which floated within established bands. The third and final group comprised both rates floating without established bands and pure floats.

Reinhart (2000) and Calvo and Reinhart (2002) have shown, using monthly data from 39 emerging countries for the period 1970-1999, that the majority of countries which profess to have a pure floating regime in fact regularly intervene in the currency markets in order to stabilize exchange rates. Thus, they affirmed the existence of an epidemic of “floatation fear” and roundly

rejected the idea that fixed exchange rate regimes, whether conventional or not, would tend to disappear. They proposed a classification based on variations in the nominal exchange rate, on the interest rate and on currency reserves, dividing countries into two groups with floating exchange rates (depending on whether or not the central bank pursued an objective with regard to a particular monetary aggregate) and a further four groups with fixed rates (one of which was credible and three which were not).

The principal shortcomings of this method are, on the one hand, the impossibility of differentiating, through some type of statistical comparison, between the variances of the emerging countries analysed and those which truly have a floating regime. On the other hand, the method does not consider the fixed (crawling peg) regime, which was widely used in that period. Furthermore, the interest rate variable is incapable of discriminating between fixed and flexible exchange rates. A final problematic aspect which should be emphasised in the analysis performed by Calvo and Reinhart (2002) arises from their insistence on the simultaneous coexistence of the credibility score in the exchange rate classification. This seems excessive, and therefore exchange rate credibility requires more detailed study, using indicators designed to this end.

The classification of exchange rate regimes performed by Levy-Yeyati and Sturzeneger (2001; 2005) uses three variables: the average absolute monthly variation in the exchange rate, the standard deviation of its monthly variation and the average of the monthly changes in currency reserves. In contrast to Calvo and Reinhart (2002), the elimination of the considerations regarding exchange rate credibility allows a completely statistical approximation to be produced. Moreover, in Levy-Yeyati and Sturzeneger (2001; 2005), the interest rate is discarded, while the detection of fixed (crawling peg) rates, through the consideration of the standard deviation of exchange rate movements, is added. The problem of determining whether the values of the variables are high or low is resolved by using a cluster analysis. The set of observations, once the three variables considered for each year and country studied have been calculated, is divided into five groups: flexible, dirty float, fixed (crawling peg), fixed and inconclusive.

3.1. Index of effective flexibility

In a study of the determinants of the exchange rate regime, Poirson (2001) proposed the use of an exchange rate flexibility index (FLT) to measure the elasticity exhibited by a given exchange rate regime. This FLT index is a variable which compares the movements of currency reserves (as the most appropriate measurement of the degree of state intervention in the currency markets) with the volatility observed in the nominal exchange rate.

Thus, the degree of *de facto* exchange rate flexibility in a country *i* is measured by the quotient between the average absolute value of the monthly depreciation of the nominal exchange rate, ME, and the average absolute value of the monthly variations in currency reserves, normalized by the monetary base of the previous month (which permits the monetary impact of such variations to be approximated), MR:

$$FLT = \frac{ME}{MR} = \frac{\sum_{k=0}^{11} |E_{t-k} - E_{t-k-1}| / E_{t-k-1}}{\sum_{k=0}^{11} |R_{t-k} - R_{t-k-1}| / H_{t-k-1}}$$

where E_t is the exchange rate, R_t are currency reserves excluding monetary gold, and H_t is the monetary base.

The values which FLT may take range from 0, in the case of a monetary union (i.e., no independent currency exists), when $ME = 0$, to infinity, if state intervention is non-existent, since in this case $MR = 0$. The indicator will display lower values when heavy intervention takes place in order to combat undesirable movements in the currency markets, since MR will be relatively greater than ME. By contrast, those countries which have greater confidence in the unhindered activity of such markets will obtain a higher value on the flexibility index.

One important weakness of the exchange rate flexibility index proposed by Poirson (2001), and recognised by the author herself, regards the measurement of the degree of intervention through variations in currency reserves. Such variations are also clearly affected by international current operations and by capital movements in which both the private agents and public authorities of a country participate. Furthermore, intervention using reserves may be aimed at affecting various currencies simultaneously. Whatever the case, these limitations of the FLT index are equally present in all the indicators that take into account the movements in currency reserves. In any case, the FLT index has the advantage of graphically depicting the real position of a particular currency in relation to a totally fixed exchange rate regime.

3.2. Coudert and Dubert's statistical test

Coudert and Dubert (2004) propose a statistical test to identify exchange rate regimes. To this end, they divide the regimes into five categories: float, managed float, crawling peg, peg, and devaluation; their aim is to construct a quarterly classification using weekly data for exchange rates and monthly figures for currency reserves. The application is performed for a sample of the ten principal countries of South West Asia in the period 1990-2002. The currency used as reference is the US dollar and the variance comparisons are made with regard to the float group (US dollar/Deutschmark, or euro after 1999, US dollar/Japanese yen and US dollar/Pound sterling).

The technique used by Coudert and Dubert (2004) has five stages. In the first place, the annual trends of the weekly exchange rates series are calculated. If the trend is positive (devaluation), the series which display no trend are calculated, in order to distinguish between fixed and flexible regimes. Next, for those periods in which the trend is positive, this is eliminated from the exchange rate series used. If, on the contrary, the trend is negative (appreciation), its significance must first be established, to which end Coudert and Dubert propose that it must exceed a threshold of 2% annually. If this proves to be the case, the corresponding exchange rate regime cannot be fixed, and direct passage is made to the fourth stage, in which an examination is made of whether the float is clean or dirty. When the value is lesser than the abovementioned 2%, it is necessary to proceed to the second stage, since in such cases the regime is said to be either fixed or flexible.

The second stage compares the quarterly variances of the exchange rate series to be studied (which may be “detrended”, depending on the result of stage 1) with those of the reference currencies (floating, by definition). Thus, the authors propose a statistical test which allows them to distinguish between fixed and floating exchange rates.

In the third stage, a study is made of the annual deterministic trend, obtained in the first stage, with the aim of distinguishing between fixed and semi-fixed (crawling peg) rates. The observations in which the annual exchange rate trend is below 2% are categorised as fixed rates, while in cases to the contrary they are classified as belonging to a semi-fixed (crawling peg) regime.

The fourth stage is concerned with calculating the variance of the growth rate of the official reserves of the currencies classified as flexible in the first stage, with the aim of distinguishing between periods of free flotation and dirty flotation. In order to obtain the quarterly variances of the reserves, the monthly variances for a rolling period of 15 months (the six previous months, the quarter

under study and the following six months) are calculated. In addition, the authors propose a statistical test in order to compare the variance in the variation of the monetary authorities' reserves of those currencies being examined with the average quarterly variances in the variation rates for the reserves of the free-floating reference currencies.

Lastly, in the fifth stage, the deterministic quarterly trends are calculated, with the aim of detecting possible abrupt currency devaluations. When analysing the nations of South West Asia, with a history of moderate (except in times of crisis) depreciations, the authors established a relatively low significance threshold (6%), stating that they would have increased it if their study had included Latin American countries.

The results obtained by Coudert and Dubert (2004) show a considerable “fear of floating”, since only 7% of the observations may be classified as free flotation. In fact, almost 50% of the regimes are fixed or semi-fixed (crawling peg) and account for up to 9.5% of total devaluations.

3.3. *Implicit bands*

The classification of the exchange regimes made by Reinhart and Rogoff (2004) is defined by them as “natural”, in comparison with the “artificial” one officially employed by the IMF. Their extensive research details the historical evolution of the monthly data for the exchange rates of 153 countries between 1946 and 2001, and stresses the existence of dual, multiple or even parallel (whether legal or not) currency markets; this leads them to distinguish up to 15 possible exchange rate categories.

The proposed algorithm employs, firstly, the exchange rate determined by market forces, which proves to invariably be (for over 80% of countries having dual or multiple rates⁹) the best indicator of monetary policy and of the future evolution of the official exchange rate. In cases where there is no dual market, then in order to correctly classify the *de facto* exchange rate situation, this approximation is based on the analysis of the percentage variation in the absolute value of the exchange rate and on the probability of it being maintained within a specific fluctuation band (of 1%, 2% and 5%) over 2 or 5 rolling years¹⁰.

⁹ In 1950, 45% of countries had dual exchange rates and many more had black markets. In the industrialized nations the existence of dual or multiple markets was normal in the 1940s and 1950s. This situation was even more widespread in the underdeveloped countries, where, even in 1980, 32% of such nations had dual rates (and almost 20% in the 1990s).

¹⁰ The classification made by Reinhart and Rogoff (2004) focused solely on the study of exchange rates and it does not consider the variations in official currency reserves.

To test the veracity of the announcements by the relevant authorities regarding the establishment of a fixed exchange rate, an analysis is undertaken of the variation in the monthly average of the rate in the period following such declarations. However, if there exists a dual or parallel market the dual rate is analysed, and the announcement is taken to be one emanating from a mere *de jure* regime. If the exchange rate declared is tied to an unknown basket, where the relative importance of its components is not declared, Reinhart and Rogoff (2002, 2004) check it to see if, *de facto*, the regime is fixed with regard to one of the dominant currencies.

With respect to the detection of *de facto* fixed exchange rates, this situation is taken to exist if for at least four consecutive months there has been no variation in the exchange rate. Subsequently, the probability that the monthly variation is maintained within a band of $\pm 1\%$ during a mobile period of five years is calculated. If this probability is at least 80%, the regime is classified as fixed or semi-fixed (crawling peg) for those years. In the case that no drift is observed, the regime is classified as one of fixed parity, while if a positive fluctuation exists, it is taken to be crawling peg. When the exchange rate undergoes periods of appreciation and depreciation, it is a flexible rate.

With regard to the declared or *de facto* bands a two-stage process is also followed. If the band has been specifically declared by a country's authorities and there exists no parallel market, it is accepted, unless the previous process revealed that a *de facto* fixed exchange rate existed. Subsequently, the probability of it being maintained within a specific band (of 1%, 2% and 5%) of fluctuation throughout over a rolling period of 2 or 5 years is calculated; if that probability is equal to or greater than 80%, the exchange rate regime is classified as narrow band, crawling peg or moving band for the period in which probability is maintained continually at 80%. When the declared band is broader, verification is performed using a probability of being situated within a band of $\pm 5\%$.

An important aspect of the classification elaborated by Reinhart and Rogoff (2004) is the inclusion of a new category of "free fall", in order to group together those currencies whose annual rate of inflation exceeds 40%, since 12.5% of the total observations meet this criterion; for the subgroup in which the monthly inflation in a country exceeds 50%, the observations (4.5% of the total) are termed "hyperfloating". The remaining observations are classified as float (either clean/pure or dirty/managed), in accordance with a statistical index which relates the various absolute averages of the monthly exchange rate to the probability that these variations are high (clean float) or low (dirty float).

Among the most interesting results for the period 1970-2001 should be emphasised the fact that 33% of the observations concern fixed exchange rate

regimes¹¹, while fixed (crawling peg) exchange rates and narrow crawling bands account for 26%. Furthermore, it must be stressed that approximately 45% of the fixed regimes, declared to be such by the IMF, should be classified instead as pure float, dirty float or limited flexibility regimes.

4. An application to the Spanish peseta/Deutschmark exchange rate

This study applies some of the approximations described in the previous section to the Spanish peseta/Deutschmark exchange rate for the period 1965-1998, with the aim of detecting the existence of implicit fluctuation bands “agreed” upon by the monetary authorities. The starting and finishing date of our sample are conditioned, respectively, by the availability of reliable historical data and the fact that on 31 December 1998 both currencies disappeared, as Germany and Spain joined the Economic and Monetary Union (EMU). It should also be emphasised that the Spanish peseta was incorporated into the ERM of the EMS on 19 June 1989, with explicit fluctuation bands of $\pm 6\%$ (later broadened to $\pm 15\%$ on August 1993); however, we have also included the period 1989-1998 in our analysis in order to gain a different perspective about the behaviour of the Spanish peseta during its participation in the ERM, as well as to examine the capacity of the various indicators in order to detect significant episodes registered during this period.

In the empirical analysis we use monthly data for the following variables: the Spanish peseta/Deutschmark exchange rate; the monetary base of Spain; the monetary reserves (except monetary gold) of Spain and the monetary reserves (except gold) of Germany. The source of data used is the IMF *International Financial Statistics*.

The following graphs present the properties of the variables used in the study of the *de facto* exchange rate regimes for the Spanish peseta/Deutschmark. Figure 1 shows the modification of the daily Spanish peseta/Deutschmark exchange rate; an overall tendency (strongly marked, on occasions) toward the depreciation of the Spanish peseta throughout almost the entire period under study can be observed. In turn, Figure 2 presents the monthly evolution of Spanish currency reserves (in the right-hand panel) and German reserves (in the left-hand panel). The monthly variation of the monetary base in Spain is depicted in Figure 3.

¹¹ It should be remembered that Reinhart and Rogoff (2004) include in the category of fixed exchange rates all those in which parity fluctuates within a band of $\pm 1\%$.

Graph 1
SPANISH PESETA/DEUTSCHMARK EXCHANGE RATE

Graph 2
CURRENCY RESERVES OF THE BANK OF SPAIN AND THE BUNDESBANK
(in billions of Spanish pesetas and billions of Deutschmarks)

Graph 3
MONETARY BASE OF SPAIN
(in billions of Spanish pesetas)

The results of the application of three of the procedures which may be employed to classify the implicit exchange rates for the Spanish peseta/deutschmark are presented below. In the first case we use a measurement which takes into account both the volatility of the exchange rate and the intensity of the interventions by the central bank, approximating them to

variations in their reserves. Secondly, the results of the approximation which incorporates a sequence of tests for the identification of exchange rate regimes are presented. The third procedure, as we have seen, only employs the exchange rate in order to detect the various exchange rate regimes which are not free float, although it focuses its interest on the search for implicit fluctuation bands.

4.1. The effective flexibility index

The results obtained using the exchange rate flexibility index proposed by Poirson (2001) are shown in Figure 4. Proximity to the value of zero indicates closeness to a fixed exchange rate regime, as, according to the graph, apparently was the case in the years 1964, 1965, 1968 and 1972, as well as the middle and late 1980s (1984-1985 and 1987-1989) and the early and late 1990s (1991-1992 and 1996-1998).

Graph 4
POIRSON'S EXCHANGE RATE FLEXIBILITY INDEX

With regard to the episodes detected in the 1980s, it should be emphasised that, in January 1984, a significant modification of monetary control strategy in Spain occurred, as the Bank of Spain became concerned about the evolution of the index of the nominal monetary base. Thus, in June 1985, Spain signed the Treaty of Admission to the EC, thereby transforming the scenario for the Spanish peseta and raising the possibility of returning to fixed exchange rates within the EMS. Furthermore, and even before eventual monetary integration, adherence to the EC in itself gave added weight to exchange rate stability as an informative element for economic agents. When Spain joined the EC in 1986, the Bank of Spain began to employ a nominal exchange rate index for the Spanish peseta *vis-à-vis* the EC countries, excluding Greece and Portugal. The behaviour of this index became increasingly important for the monetary policy decision-making process and in currency market interventions. Furthermore, several factors related to the activity of the Bank of Spain in this market and the role of the Deutschmark as the key currency in the EMS were responsible for

linking the Spanish peseta to the Deutschmark [see, for example, Escrivá and Santos (1991) and Escrivá and Malo de Molina (1991)].

Turning our attention to the episodes detected in the 1990s, it should be emphasized that, following the intervention of the Bank of Spain to support the Spanish peseta in June 1991, a period of exchange rate stability which lasted until May 1992 started; confidence in the maintenance of the grid was strengthened by the positive effects of the increased credibility gained from the EMU project, following the signing of the Treaty of Maastricht in December 1991. Elsewhere, the establishment of direct objectives regarding inflation, an ambitious budgetary consolidation and the introduction of reforms which would increase the flexibility of the economy gave rise to significant advances with respect to convergence. This improvement progressively stabilized the exchange rate (from 1996 onwards) within the upper limits of the central parity fixed in 1995, a parity which would ultimately become the conversion rate to the euro (Malo de Molina, 2003).

4.2. The statistical test proposed by Coudert and Dubert

Table 1 presents the results obtained by employing the statistical tests designed by Coudert and Dubert (2004).

Formally, in order to test if the variance in the Spanish peseta/Deutschmark exchange rate is greater than in a free float system, the following hypothesis is employed:

$$\begin{aligned} H_0 : \sigma^2 &\geq \sigma_0^2 \\ H_1 : \sigma^2 &< \sigma_0^2 \end{aligned}, \text{ where } \sigma_0^2 \text{ is the variance of the series in a free float regime.}$$

The acceptance region for the null hypothesis is: $(n-1)\frac{s^2}{\sigma_0^2} \geq \varepsilon$, where n is the sample size, s^2 is the sample quasi-variance for the Spanish peseta/Deutschmark exchange rate series and $\varepsilon = \chi_{n-1, 1-\alpha}^2$ is the critical value of the chi-square distribution for $n-1$ degrees of freedom at a confidence level of $1-\alpha$. The sample duration for the calculation of the variances is 60 days (equivalent to three months, taking five-day working weeks into consideration).

Table 1
CLASSIFICATION OF DE FACTO EXCHANGE RATE SYSTEMS
(tests at the 95% significance level)

Quarter Year	I	II	III	IV
1965	Peg	Free float	Peg	Dirty float
1966	Peg	Free float	Peg	Dirty float
1967	Peg	Peg	Peg	Peg (*)
1968	Peg	Peg	Dirty float	Peg
1969	Peg	Dirty float	Dirty float	Peg
1970	Dirty float	Peg	Peg	Dirty float
1971	Peg	Dirty float	Peg	Dirty float
1972	Peg	Peg	Peg	Peg
1973	Dirty float(*)	Dirty float(*)	Peg	Dirty float
1974	Dirty float	Dirty float	Peg	Dirty float
1975	Peg	Peg	Peg	Peg
1976	Dirty float	Peg	Peg	Peg
1977	Crawling peg	Free float	Free float	Free float
1978	Peg	Peg	Peg	Peg
1979	Peg	Peg	Dirty float	Peg
1980	Peg	Peg	Peg	Peg
1981	Peg	Peg	Dirty float	Peg
1982	Peg	Peg	Peg	Free float (*)
1983	Peg	Peg	Peg	Peg
1984	Peg	Peg	Peg	Peg
1985	Crawling peg	Crawling peg	Free float	Crawling peg
1986	Peg	Peg	Peg	Peg
1987	Peg	Peg	Peg	Peg
1988	Peg	Peg	Peg	Peg
1989	Peg	Peg	Peg	Dirty float
1990	Peg	Peg	Peg	Dirty float
1991	Peg	Peg	Peg	Peg
1992	Peg	Peg	Peg	Peg
1993	Peg	Free float	Peg	Dirty float
1994	Dirty float	Peg	Peg	Peg
1995	Free float	Free float	Peg	Peg
1996	Peg	Peg	Peg	Peg
1997	Peg	Peg	Peg	Peg
1998	Peg	Peg	Peg	Peg

As can be seen in Table 1, the results show the predominance of the peg exchange rate system in many quarters of the sample period between 1965 and 1998. In fact, 76% of the cases fall into this category, mainly in the following periods:

a) First, between 1965 and 1972, as can also be seen using Poirson's exchange rate flexibility index (Figure 4) and the direct test of average monthly variations based on the proposal made by Reinhart and Rogoff (Figures 7 and 8).

b) Secondly, in the period 1978-1984, similarly perceptible when using the direct test (even with fluctuation bands of $\pm 1\%$) based on Reinhart and Rogoff.

c) Thirdly, during the years 1986-1992, as observations indicating the existence of implicit bands predominated until 1989. After the Spanish peseta joined the ERM on 19 June 1989 a $\pm 6\%$ band was explicitly set. Such fluctuation bands could have played a stabilising role in the Spanish peseta/Deutschmark exchange rate owing to the absence of expectations of a future variation in the central parity and as suggested by the behaviour of the volatility of the Spanish peseta/Deutschmark exchange rate in this period (Bajo-Rubio *et al.*, 1995).

d) Lastly, during the period 1996-1998, in which a progressive effort was made to achieve nominal convergence with the other EU countries and where the objective was forming part of the group of countries which founded the EMU. This effort was backed by the increasing credibility of the instruments employed, both monetary (starting from the autonomy of the Bank of Spain and the establishment of a set of direct objectives regarding inflation) and fiscal (through the application of efficient mechanisms for the reduction of public expenditure and the improvement of its management and control). Once more, the stabilising effect of the EMS was reinforced by further economic integration among its members as a result of the Treaty of Maastricht.

In turn, evidence refuting the existence of pegs is to be found during the following subperiods:

a) 1973-1974, in which dirty float episodes predominated, suggesting that the collapse of the Bretton Woods system did not produce, at least for the Spanish peseta/Deutschmark exchange rate, an immediate move to a completely flexible exchange rate regime.

b) 1976-1977. In each of these years devaluations aimed at reducing the imbalances registered as a result of the 1973 oil crisis occurred, especially in relation to the inflation rate.

c) 1985, when there was an episode of free flotation that may have been associated with speculative attacks against the Spanish peseta, which were in turn related to expectations of the Spanish peseta's depreciation prior to Spain's accession to the EEC. These attacks were finally counteracted by the Bank of Spain selling large amounts of dollars.

d) 1993-1995, a period which corresponded to a phase of slow depreciation registered by the Spanish peseta due to the widening of the exchange rate bands in August 1993; this was due to both internal factors (the existence of an unfavourable inflation differential, a high rate of unemployment, a sizeable public deficit and the difficulty in achieving a certain equilibrium in

the balance of payments) and external ones (the weakness of the dollar and the subsequent restructuring of portfolios).

Finally, it should be stressed that the results obtained with regard to episodes with an absence of bands after 1989 are consistent with the loss of credibility of the Spanish peseta's exchange rate within the EMS, as detected by Fernández-Rodríguez *et al.* (2003) and Ledesma-Rodríguez *et al.* (2005).

4.3. Implicit bands

The implicit fluctuation bands for the Spanish peseta/Deutschmark exchange rate have been obtained by, first of all, employing the procedure designed by Reinhart and Rogoff (2004) and, subsequently, by subjecting that procedure to a statistical contrast. Finally, an alternative approximation is presented with the aim of studying the sensitivity of the proposal made by these authors.

Figure 5 shows the results obtained by the application of the above procedure, which calculates the proportion of months of the 24 “rolling” ones, including the current month, in which the monthly percentage variation in the exchange rate is below 1%. Employing the threshold of 80%, as suggested by the authors themselves, the presence of bands was only detected in the initial stage (January 1965-January 1970). Nevertheless, a certain movement towards such bands since 1996 can be observed.

Graph 5
PROPORTIONAL MONTHLY VARIATIONS WITHIN BANDS OF 1%

Figure 6 depicts a similar exercise, but uses a fluctuation band of 2%. Using once more the threshold of 80%, the procedure confirms the presence of bands at the beginning of the sample period, although it broadens the number of observations contemplated within that time span (January 1965-August 1971). Similarly, it detects another period of implicit bands between July and

September 1996, while obtaining clearer evidence of a certain movement towards such bands at the beginning of the 1990s and since the middle of 1995.

Graph 6
PROPORTIONAL MONTHLY VARIATIONS WITHIN BANDS OF 2%

Thus, both cases produce additional evidence to support the previously obtained results regarding the influence of the advances in exchange rate stability convergence since 1996.

One weakness of the approximation performed by Reinhart and Rogoff (2004) is that the results are not filtered by their statistical significance. To overcome this, the current study performs a test in which the null hypothesis is that the probability of the variation in the exchange rate being maintained within a band of ± 1 or $\pm 2\%$, throughout a rolling period of 2 years, will be lesser than or equal to the above mentioned threshold of 0.8.

Formally, and assuming normality and independence, the test of whether the population proportion is lesser than or equal to a given frequency p_0 and, therefore, that no bands exist, is posed as follows:

$$H_0 : p \leq p_0, \text{ where } p_0 \text{ is the determined probability.}$$

$$H_1 : p > p_0$$

The acceptance region for the null hypothesis is: $\hat{p} \leq \varepsilon$, where $\hat{p}$ is the estimated sample proportion and $\varepsilon = p_0 + z_{1-\alpha} \frac{\sqrt{p_0 q_0}}{\sqrt{n}}$, where $z_{1-\alpha}$ is the critical value for the Student-t distribution at a confidence level of $1-\alpha$, $\frac{\sqrt{p_0 q_0}}{\sqrt{n}}$ is the population deviation and n is the sample size.

An alternative way of improving the approximation of these authors consists of directly testing whether the average of the proportional absolute monthly variations for each rolling 24-month period is significantly lower than $\pm 1\%$ or $\pm 2\%$.

Assuming once more normality and absence of serial correlation, then in order to confirm if the population average (of the monthly variations in 24-month periods) is lesser than or equal to a given mean μ_0 ($\pm 1\%$ or $\pm 2\%$), the test takes the following form¹²:

$$H_0 : \mu \leq \mu_0, \text{ where } \mu_0 \text{ is the given mean.}$$

$$H_1 : \mu > \mu_0$$

The acceptance region for the null hypothesis is $\bar{x} \leq \varepsilon$, where $\bar{x}$ is the sample mean of the Spanish peseta/Deutschmark exchange rate and $\varepsilon = \mu_0 + t_{1-\alpha} \frac{S}{\sqrt{n}}$, $t_{1-\alpha}$ being the critical value of the standard normal distribution at a confidence level of $1-\alpha$, S the quasivariance and n the sample size. At the significance level of 5% the critical value of 1.7109 is selected.

The results of the application of this statistical procedure, without previously resorting to the counting of periods as Reinhart and Rogoff do, are presented in Figures 7 and 8.

Graph 7
COMPARISON OF AVERAGE ABSOLUTE MONTHLY VARIATIONS.
BANDS OF $\pm 1\%$

Figure 7 depicts the results obtained when fluctuation bands of $\pm 1\%$ are considered. Blue is used to trace the average value (for 24 rolling months) of the

¹² Given the temporary nature of the series and the limited sample size of the rolling windows comprised of 24 monthly observations, von Neumann's ratio has been used, while the null hypothesis of the absence of serial correlation in the greater part of the period studied has not been rejected.

proportional absolute monthly variations in the exchange rate for each month *vis-à-vis* the previous month, while the series for the critical region at 5% is shown in red. When the critical region is located above the average of the proportional variations, this means that the null hypothesis is not rejected and suggests the acceptance of the existence of bands lesser than or equal to $\pm 1\%$; this apparently occurred in the initial (January 1965-August 1971) and final (January 1996-December 1998) stages of the sample period examined.

Graph 8
COMPARISON OF AVERAGE ABSOLUTE MONTHLY VARIATIONS.
BANDS OF $\pm 2\%$

As Figure 8 shows, the average of the absolute monthly variations in the exchange rate is generally found below the critical region (at 5%) when a band of $\pm 2\%$ is used, thereby suggesting (given the rolling nature of the 24 test months) that during almost the entire study period, monthly limits of $\pm 2\%$ existed. The only exceptions are to be found in November 1972-April 1974, May 1977-November 1978, February and March 1979, February 1985, January-May 1986, August-December 1991 and March-May 1992. If this result is combined with the one obtained for bands of $\pm 1\%$, the results indicate the existence of fluctuation bands ranging from ± 1 to $\pm 2\%$ throughout the sample period, except for the two periods detected when using a band contrast of $\pm 1\%$, in which the fluctuation bands would have been even narrower (i.e. lower than $\pm 1\%$). Thus, the results obtained once again reinforce the hypothesis of the existence of implicit bands for the Spanish peseta/Deutschmark exchange rate, not only during the Bretton Woods period (1965-1971), but also during the period of convergence with the European Union, with a view to membership of the EMU from its inception in 1999.

5. Concluding remarks

This study has explored the possible existence of fixed or semi-fixed exchange rates for the Spanish peseta/Deutschmark exchange rate, examining data from the period 1965-1998 (i.e. including both the period prior to the entry of the Spanish currency in the EMS and the EMS experience).

To this end, we have used three alternative approximations proposed in the most recent studies: the exchange rate flexibility index proposed by Poirson (2001), the algorithm created by Reinhart and Rogoff (2004) and the statistical test established by Coudert and Dubert (2003) for the identification of exchange rate systems.

Poirson's exchange rate flexibility index shows the proximity to a fixed exchange rate regime in the years 1964, 1965, 1968 and 1972, under the Bretton Woods system, repeated in the mid- and late 1980s (1984-1985 and 1989) and the early and late 1990s (1991-1992 and 1996-1998).

The results obtained in using the statistical test devised by Coudert and Dubert (2003) to identify the various exchange rate regimes, show a certain predominance of a fixed or semi-fixed exchange rate system for the Spanish peseta/Deutschmark in 76% of the quarters in the sample period examined.

Lastly, the results obtained using the algorithm proposed by Reinhart and Rogoff (2004) indicate that the presence of bands can only be detected in the initial stage (January 1965-January 1970), although a certain movement towards such bands can be observed from 1996 on. Alternatively, if a direct test of the hypothesis that the average absolute variations for periods of 24 rolling months are maintained within a specific band is carried out, the results seem to indicate the existence of general fluctuation bands, of between $\pm 1\%$ and $\pm 2\%$, both in the initial stages (January 1965-August 1971) and final stages (January 1996-December 1998) of the sample period being study.

At first sight, the results obtained could suggest that the taxonomy of *de facto* exchange rates is sensitive to the approximation employed, clearly demonstrating the need to establish more robust classification procedures. Nevertheless, agreement can apparently be observed among the three indicators with regard to the possible existence of fluctuation bands in the 1980s and 1990s, before and after the entry of the Spanish peseta into the EMS. This is especially significant, as it demonstrates the importance which the Bank of Spain placed upon exchange rate movements regarding monetary policy decision-making, and it imposed increasing limitations upon the autonomous

exercise of Spanish monetary policy, as well as fostered the necessary adjustments for a progressive advance to macroeconomic stability.

Given that the macroeconomic characteristics of the new EU members are similar to those of the Spanish economy when it was incorporated into the EMS, the experience of the Spanish peseta is, logically, interesting for the current and potential members of the new ERM, which, as it is well known, will have to link their currencies to the euro.

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