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Introduction

While there is large number of central banks practicing the strategy of "managed floating", this policy regime has so far received relatively little academic interest. Due to this "fear of floating" of many researchers[1], the central terms "floating" and "managed floating" lack a clear and widely shared definition and there is no theoretical framework which lays down the core principles of such a strategy. As a consequence a central bank which intends to adopt managed floating receives almost no academic guidance for the concrete management of monetary and exchange rate policies.[2] This lack of a positive as well as a normative theory of managed floating impairs above all the discussion about the transition to EMU by the countries in Central and Eastern Europe. As most economists are inclined to dismiss all intermediate regimes too easily, the academic discussion is unduly focused on the extreme solution of Euroization.

The paper is organized as follows: In Chapter 2 we present three different definitions of floating: pure floating, independent floating, and managed floating. In order to identify these three different forms of floating, we develop a simple but efficient methodology. Compared with the approach by Calvo and Reinhart [2000], our method has the advantage that it allows for changes in the exchange rate strategy over time and that it provides a clear demarcation between the three variants of floating.

In Chapter 3 we give a short survey of the literature. We show that the Mundell/Fleming model as well as the more refined models for open economy inflation targeting are unable to explain the high intervention activity of many central banks which can be observed empirically. In addition, with their reliance on UIP such models rest on a pillar for which no empirical evidence can be found.

In Chapter 4 we present a simple theoretical framework for managed floating. It is shows that in such a regime monetary policy uses two operating targets simultaneously: the exchange rate *and* the short-term interest rate. We analyze the conditions under which such an exchange rate targeting is possible. Then we show how in an open economy a central bank has to set these two operating targets in order to achieve simultaneously

- an *internal equilibrium* which is defined by an MCI which minimizes a social loss function,
- an *external equilibrium* which is defined by a combined interest and exchange rate policy that is compatible with uncovered interest parity.

We use a simple New-Keynesian model in order to demonstrate how the two operating targets have to be adjusted if the economy is affect by different shocks (demand shock, supply shock, foreign interest rate shock). As the adjustment of the two operating targets is identical under managed floating and under pure floating, the main difference between these two approaches concerns UIP shocks. The main advantage of managed floating is that it allows to avoid such

[1] While there was some discussion of this issue in the 1980s, in the last few years there are almost no publications with a title that is directly related to exchange rate system of floating or managed floating; for instance, in EconLit since 1990 only 17 publications can be found under "managed float" and 21 publications under "managed floating".

[2] See Fischer [2001] about foreign exchange market interventions in system of managed floating: "This is one of the remaining areas in which central bankers place considerable emphasis on the touch and feel of the market, and where systematic policy rules are not yet common" (ibid., p. 7).

shocks as long as the central bank is able to keep the exchange rate on a path determined by the interest rate differential.

We also discuss the shortcomings and implications of managed floating. As managed floating is characterized by an unannounced exchange rate path, a separate anchor for private sector expectations is required in small open economies. A second shortcoming of managed floating is the limited ability of central banks to defend an exchange rate path in a situation of strong speculative outflows. Finally, under an uncoordinated managed floating countries can manipulate the exchange rate in order to improve their international competitiveness.

Chapter 5 discusses the compatibility of the Exchange Rate Mechanism (ERM) II with managed floating. While this framework is flexible enough to allow a combined targeting of the exchange rate and the interest rate, its intervention and credit mechanisms are too much shaped by the requirements of ERM I with its narrow ±2.25 per cent bands and a predominant role of marginal interventions. As a consequence it provides almost no support for and even hinders intra-marginal interventions. In our view, the ERM II could be easily modified above all by providing more generous credit facilities for intramarginal interventions. This would reduce the vulnerability of managed floating in the case of capital outflows and help to transform the ERM II from a not very pleasant waiting room into a business class lounge for EMU aspirants.

The last Chapter summarizes the main results and concludes.

Defining and identifying three forms of floating

"Floating": the predominant exchange rate regime in the New Millennium

In the last decade the international monetary order has undergone a dramatic transformation. Intermediate regimes which had been the prevailing exchange rate arrangement in the early 1990s are now only used by about one third of the IMF's member countries (see Table 1). In the group of developing and emerging market economies the decline has been even more pronounced. For the country groupings of all countries and of emerging market economies floating has been the preferred alternative to intermediate regimes. Table 1 shows that for all three country groupings floating has become the predominant exchange rate arrangement. Hard pegs could also profit from the "vanishing middle", especially in developing countries, but their market share remains much lower than the share of floating.

Table 1: Exchange rate arrangements 1991 and 1999

	Hard Pegs		Intermediate		Floating	
Year	**1991**	**1999**	**1991**	**1999**	**1991**	**1999**
All countries	16%	24%	62%	34%	23%	42%
Emerging market economies	6%	9%	64%	42%	30%	48%
Developing and emerging market economies	5%	25%	65%	27%	29%	47%

Source: Fischer [2001]

In the literature this "hollowing out" has been widely welcomed and is even recommended as an optimum solution for almost all countries (Fischer [2001], Frankel [1999], Summers [2000]). Eichengreen [1999] has become a specially prominent promoter of this approach:

"Hence, the IMF needs to more forcefully encourage its members to move to policies of greater exchange rate flexibility, and the sooner the better. With few exceptions it should pressure its members, in the context of Article IV consultations and program discussions, to abandon simple pegs, crawling pegs, narrow bands and other mechanisms for limiting exchange rate flexibility before they are forced to do so by the markets." (ibid., p. 105)

Three forms of floating

As Table 1 shows, in many policy-related discussions the spectrum for exchange rate arrangements is reduced to the three central options of "hard pegs", "intermediate regimes", and "floating". While this gives some impression on the main choices, an understanding of managed floating requires a more detailed classification. In our view, the IMF's International Financial Statistics classification of exchange regimes is quite useful in this regard. It uses the following eight categories:

a) Exchange rate arrangements with no separate legal tender (dollarization, membership in a currency union)
b) Currency board arrangements
c) Other conventional fixed peg arrangements (formal or de facto peg with a narrow margin of at most ± 1 per cent around a central rate)
d) Pegged rates within horizontal bands (formal or de facto peg with margins that are wider than ± 1 per cent around a central rate)
e) Crawling pegs (the currency is adjusted periodically in small amounts at a fixed, *pre-announced* rate or in response to changes in selective quantitative indicators)
f) Crawling bands (the currency is maintained within certain fluctuation margins around a central rate that is adjusted periodically in small amounts at a fixed, *pre-announced* rate or in response to changes in selective quantitative indicators)
g) Managed floating (no *pre-announced* path for the exchange rate; the monetary authority influences the movement of the exchange rate through active intervention in the foreign exchange market without specifying, or pre-committing to, a pre-announced path for the exchange rate)
h) Independent floating (the exchange rate is market determined, with any foreign exchange market intervention aimed at moderating the rate of change and preventing undue fluctuations in the exchange rate, rather than establishing a level for it)

At least from a theoretical point of view it seems useful to add an additional category:

i) Pure floating (the exchange rate is market determined with no foreign exchange market intervention at all; changes in foreign exchange reserves are due to technical factors only).

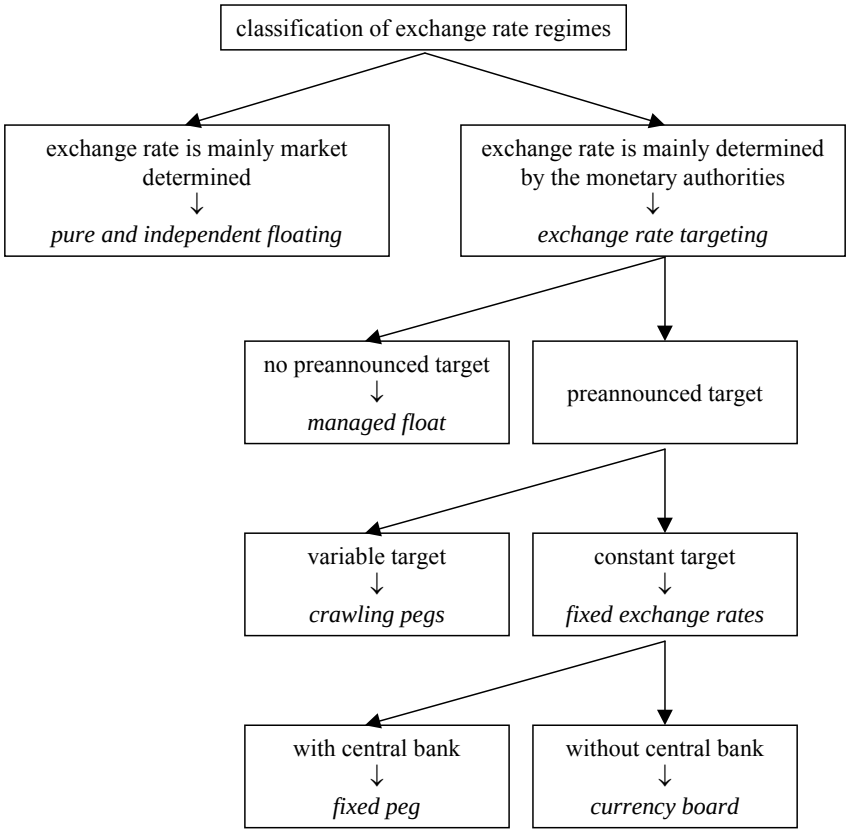
As already mentioned, many authors summarize the arrangements g), h), and i) under the heading of "floating". This can create the impression that the economic rationale of these three arrangements is more or less identical. However, a careful reading of the IMF's description of g) and h) and of our category i) shows a very important difference:

- Managed floating implies that the exchange rate path is determined by the central bank (or the government).

- Pure and independent floating imply that the exchange rate path is mainly market determined.

In other words, what distinguishes managed floating from the intermediate solutions e) and f) is not a different form of exchange rate determination, it is mainly the fact that there is no *preannounced* path for the exchange rate (see Figure 1).

Figure 1: Exchange rate regimes



As a consequence, for a theoretical understanding of managed floating it is not sufficient to treat it simply as a variant of independent or pure floating, for which the elaborate theories of flexible exchange rates are available. The very fact, that under managed floating central banks try to target the exchange rate requires a positive analysis of this policy, as well as a normative theory designing policy rules for managed floating.

Governments do not always tell the truth

The need for a precise definition of floating exchange regimes applies not only to economists. As the research by Calvo and Reinhart [2000] has shown, national governments and/or central banks do not seem to pay too much attention to the exact definitions in the IMF's forms. The starting point for Calvo and Reinhart is the textbook model of flexible exchange rates (or our option "pure floating") which is characterized by a constant level of foreign exchange reserves. Therefore, Calvo and Reinhart identify "***floating***" (in our taxonomy: "pure floating") by a *high* probability that the monthly per cent change in foreign exchange reserves falls within a ± 1 or ± 2.25 per cent band. As there are always technically determined changes in reserves, Calvo and Reinhart use the data of the United States and Japan as a benchmark. In other words, a lower probability for small reserve changes is regarded as an indication that a

country is not following a policy of floating (in or taxonomy; "pure floating"). The polar case of *fixed exchange rates* is characterized by a *low* probability that the monthly per cent change in nominal exchange rate falls within a ± 1 or ± 2.25 per cent band. Again, the United States and Japan are used as a benchmark. Table 2 presents the main results of the study by Calvo and Reinhart

Table 2: Main results of the Calvo and Reinhart (2000) study

	Foreign exchange reserves volatility		**Exchange rate volatility**	
Regime	**+/- 1 per cent band**	**+/- 2.25 per cent band**	**+/- 1 per cent band**	**+/- 2.25 per cent band**
Independent floating[3]	16.2	33.9	51.8	79.4
Managed floating	17.8	39.2	60.1	87.5
Limited flexibility	20.8	45.9	64.6	92.0
Fixed	15.4	36.5	83.1	95.9
USA	*28.6*	*62.1*	*26.8*	*58.7*
Japan	*44.8*	*74.3*	*33.8*	*61.2*

Source: Calvo and Reinhart [2000]

The most striking result of this study is the very small difference between the polar options of independent floating and fixed rates as far as the changes in foreign exchange reserve volatility are concerned. In addition the independent floaters behave completely different than the two benchmark countries. The same applies to the category "managed floating". In other words, most of the countries which classify themselves as independent or managed floaters are actively intervening on the foreign exchange market. The exchange rate volatility of independent and managed floaters is also much lower than in the United States and Japan and if is analyzed within the ± 2.25 per cent band, the difference to fixed rates is not very pronounced, especially for managed floating.

In sum, the results of Calvo and Reinhart as well as of a related study by Levy-Yeyati and Sturzenegger [2002] show that it is important to make a clear distinction between the textbook ideal of "free floating" and the reality of "independent" and "managed floating".

A different approach for identifying three variants of floating

While the study by Calvo and Reinhard has contributed to a much better understanding of "floating", it has the important drawback that it cannot distinguish between the three different forms of floating. Another problem of this study is that it analyses very long periods (up to February 1973 – April 1999). This can have the disadvantage that a singular strong intervention activity or changes in intervention behavior in the more recent past cannot not be identified. Finally the Calvo/Reinhart study normalizes changes in reserves by relating them to reserve levels. This can be misleading if countries start an intervention period with different reserve levels although their overall macroeconomic data are roughly similar or if countries accumulate large reserve levels over time.

A new method for measuring different forms of floating

In order to avoid these short-comings, we present a new methodology for identifying different forms of floating. We start with two different methods to proxy the intervention activity of a country:

[3] Excluding Japan and the United States

1. changes in foreign reserves minus gold (Res) as a ratio of the *external sector's size* measured by a twelve-month moving-average of the arithmetic mean of imports (Im) and exports (Ex);
2. changes in foreign reserves minus gold (Res) as percentage of the *level of reserves* at the beginning of the underlying period.

The first normalization procedure has the advantage that changes in reserves are related to the size of a countries' external sector. To some extend this also takes into account differences in the total economic size. The second method was chosen to produce results that are comparable to those of the Calvo/Reinhart study.

As a first step we want to identify the overall intervention activity of a country. For this purpose we add the absolute values of normalized changes in reserves for a period of n=6 and of n=12 months. Thus, we do not discriminate between the monthly values of net sales and net purchases of foreign exchange reserves. The resulting variable is called *sum of absolute changes* (S^{abs1}, S^{abs2}):

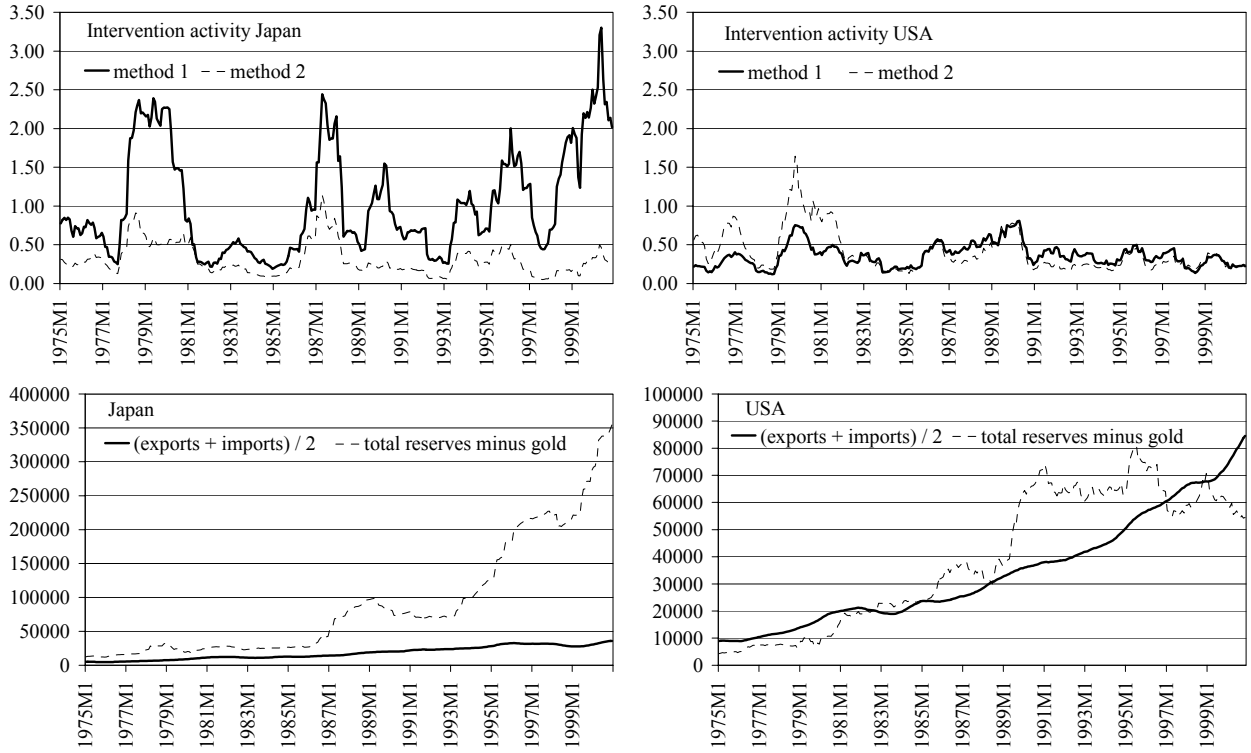
$$(1) \qquad S^{abs1}(n)_t = \sum_{i=0}^{n} \left| \frac{Res_{t-i}}{\frac{Ex_{t-i} + Im_{t-i}}{2}} - \frac{Res_{t-i-1}}{\frac{Ex_{t-i-1} + Im_{t-i-1}}{2}} \right|,$$

$$(2) \qquad S^{abs2}(n)_t = \frac{\sum_{i=0}^{n} \left| Res_{t-i} - Res_{t-i-1} \right|}{Res_{t-n-1}}.$$

The superscripts 1 and 2 refer to the method of normalization. If S^{abs} is low (i.e. approaching zero), a country's overall intervention activity is low. As in Calvo and Reinhart [2000] we chose the U.S. as a benchmark which we assume to be a pure floater.

The difference between the two methods of normalization can be illustrated quite easily with the four charts of Figure 2. In the upper two charts we depicted the proxies for the intervention activity S^{abs1} and S^{abs2} for Japan and the US. While the two lines differ only slightly in the case of the US, the differences in the conclusion that one would draw in the case of Japan are striking. According to the thin line (method 2) the Japanese exchange rate policy would be judged as a non-interventionist one, similar to what results for the US. In the study of Calvo and Reinhart [2000] which uses a similar technique (monthly change in foreign exchange reserves as a percentage of the level of reserves) Japan is classified as even more independently floating than the US (see Table 2). The major problem with this approach is the bias that emerges with an increasing level of reserves. The same sale or purchase of foreign exchange measured in US dollars becomes less important the higher the base in terms of which the percentage change is measured. From the lower two charts we can see that the Japanese authorities accumulated large amounts of foreign reserves during the last two decades (the figures depicted are in millions of US dollars). The average rate of growth amounted to a multiple of the rate of growth of the external sector. In contrast to this, the two variables seem to have a common long-run trend in the US so that the measurement bias described above does not occur. This explains why the two methods approximately yield the same results for the US. In order to eliminate such a bias, in the following we only use the second normalization method.

Figure 2: Different methods of proxying intervention activity



In a second step we calculate the *sum of effective changes* (S^{eff1}, S^{eff2}) of reserves again for a 6 and a 12 month period:

$$(3) \qquad S^{eff1}(n)_t = \sum_{i=0}^{n} \left(\frac{Res_{t-i}}{\frac{Ex_{t-i} + Im_{t-i}}{2}} - \frac{Res_{t-i-1}}{\frac{Ex_{t-i-1} + Im_{t-i-1}}{2}} \right),$$

$$(4) \qquad S^{eff2}(n)_t = \frac{\sum_{i=0}^{n} \left(Res_{t-i} - Res_{t-i-1} \right)}{Res_{t-n-1}}.$$

We then divide the sum of effective changes by the sum of absolute changes of reserves for each normalization method and for each time horizon. The resulting ratio allows us to differentiate between independent floaters and managed floaters. We therefore labeled it *index of floating* (I^{float}):

$$(5) \qquad I^{float1}(n)_t = \frac{S^{eff1}(n)_t}{S^{abs1}(n)_t},$$

$$(6) \qquad I^{float2}(n)_t = \frac{S^{eff2}(n)_t}{S^{abs2}(n)_t}.$$

I^{float} assumes values ranging from minus one to plus one. A value *close to zero* indicates that a central bank has not changed its total level of reserves during an observation period. As this is

compatible with a high value of the denominator, a low value of I^{float} shows that interventions were mainly carried out in order to smooth short-term fluctuations around an exogenously determined trend. This behavior is typical for a strategy of independent floating as it is defined by the IMF.

A value of I^{float} *close to plus or minus one* implies that the intervention activity was associated with a change in reserves during the observation period. This can be regarded as an indication that a central bank has tried to influence the trend of the exchange rate. Thus, such values of I^{float} can be regarded as a marker for managed floating. In addition, the sign of this indicator shows whether the central bank has tried to intervene against an appreciation (a positive sign: net purchases of the central bank) or a depreciation (a negative sign: net sales of the central bank) of its currency.

Data description and proceeding

Our sample consists of 14 developed market economies and 30 emerging market economies[4] that have been classified as independent or managed floaters according to the IMF's quarterly Exchange Rate Arrangements published in the International Financial Statistics (IFS). Our data is monthly from January 1975 to November 2000. The variables used in our calculations are all from the IFS. Reserves (Res) are measured by "Total Reserves minus Gold" (line 1l.d), exports and imports by line 70 and 71. If the latter were denominated in national currency, we converted them into US dollars with the average monthly dollar exchange rate (line rf).

For each month during the period that a country reports its exchange rate regime as an independent or a managed floater we calculated the two variables of interest S^{abs} and I^{float}. The periods and the reported regimes are summarized in Table 8 (see Appendix 1: Country coverage). Since some countries followed different exchange rate strategies in the whole period, we get a total of 65 cases for the 6-month horizon and 62 cases for the 12-month horizon. We then computed the frequency distribution of each variable for each period.

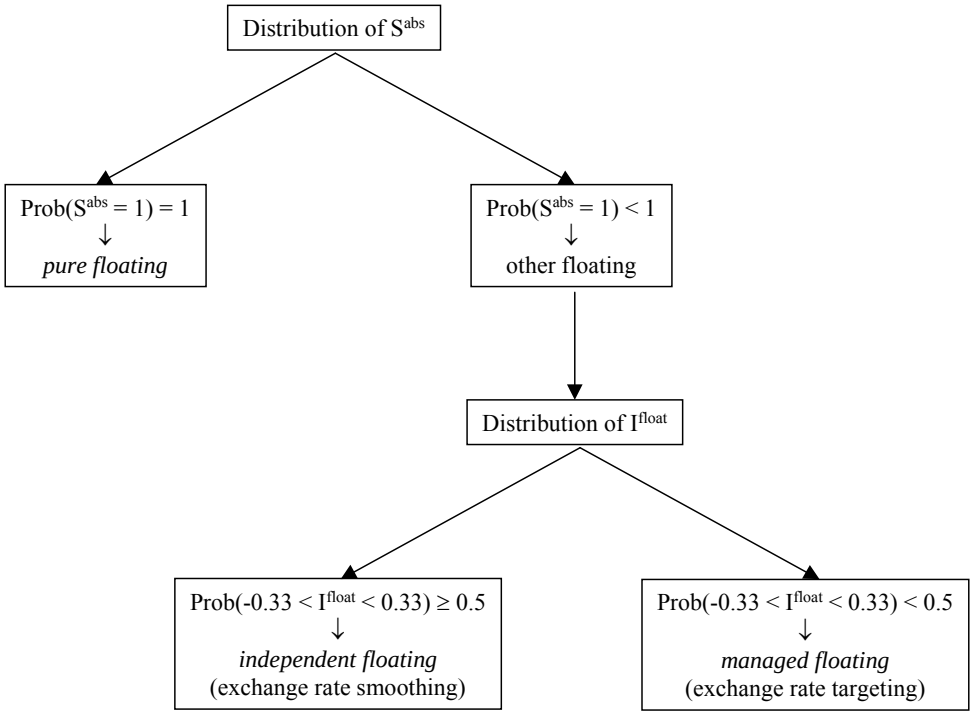
For our classification of exchange rate regimes we proceed as follows. In a first step we try to find out whether a country is a pure floater or not. For this purpose we look at the value of S^{abs} of our benchmark country, the United States. We see that for both time horizons there is a 100 % probability that the sum of absolute reserve changes is less than the average of the sum of monthly imports and exports during the observation periods (i.e. $S^{abs} \leq 1.0$, see Table 11 and Table 12 in Appendix 2: Probability distributions). For the 6-month horizon the United Kingdom (09/92-11/00), Canada and Poland (04/00-11/00) can also be regarded as pure floaters. For the 12-month horizon only the United Kingdom (09/92-11/00) can qualify as a pure floater; for Poland the experience with floating is not long enough.

For those countries which cannot be not classified as pure floaters we try to identify whether their intervention policy can be classified as independent or managed floating. For this purpose we use the index floating. We assume that a range of $-0.33 < I^{float} < 0.33$ describes independent floating; the ranges of $-1 \leq I^{float} \leq -0.33$ and $0.33 \leq I^{float} \leq 1$ are regarded as a policy of managed floating. If the probability of $-0.33 \leq I^{float} < 0.33$ is at least 50 %, we classify a country as an independent floater, if it is lower a country is classified as a managed

[4] We distinguish between developed market economies and emerging market economies as in Fischer [2001]. This restriction allows us to concentrate on the subset of developing countries which are integrated with world capital markets. As we were also interested in the exchange rate policy of the Eastern European accession countries, we additionally included Slovenia in our analysis.

floater. Since we lack a benchmark country, the interventions of the United States are to small to be used for this purpose, we had to chose these critical values somewhat arbitrarily. Figure 3 gives an overview of this classification procedure.

Figure 3: A classification of floating exchange rate systems



Main results

A summary of the results of our classification is presented in Table 3 and Table 4 (for the detailed country results see Table 13 and Table 14 in Appendix 2: Probability distributions). For the 6-month observation period they show that most floating countries can be regarded as managed floaters regardless whether we focus on all regimes that were in existence in the whole period from 1975 until 2000 or on those that are still in existence. Only 23 % of the IMF's independent floaters are pure floaters or independent floaters according to our classification. For the 12-month observation period a more even distribution between independent and managed floating emerges. Again there is no strong correlation with the IMF's classification: only 48 % of the IMF's independent floaters were true independent floaters and only 46 % of the managed floaters were true managed floaters. Thus, depending on the observation period our analysis shows that managed floating is either the most widely used form of floating or a more or less equally important form of floating as independent floating.

Table 3: IMF classification and our classification for floating using 6-month periods

		Our classification			Sum
		Pure float	**Independent float**	**Managed float**	
IMF classification	**Independent float**	4 (4)	3 (2)	24 (15)	31 (21)
	Managed float	-	4 (0)	31 (10)	35 (10)
Sum		4 (4)	7 (2)	55 (25)	66 (31)

Note: The figures in brackets indicate the number of regimes that are still in existence.

Table 4: IMF classification and our classification for floating using 12-month periods

		Our classification			Sum
		Pure float	Independent float	Managed float	
IMF classification	Independent float	2 (2)	11 (8)	14 (10)	27 (20)
	Managed float	-	19 (6)	17 (4)	36 (10)
Sum		2 (2)	30 (14)	31 (14)	63 (30)

Note: The figures in brackets indicate the number of regimes that are still in existence.

The importance of managed floating becomes even more obvious if we use our methodology for the analysis of *time series*. Thus, we can observe for each country how the values of S^{abs} and I^{float} vary over time. Of course this approach has the effect that even with a low overall probability situations with high values of S^{abs} can be reached from time to time. The most interesting case is Japan. According to the cross-section analysis which covers the period from 1975 to 2000 the probability for high interventions in Japan is relatively low so that Japan is not very different from the pure floaters (see Table 11 and Table 12 in Appendix 2: Probability distributions). However, the time series for Japan show a quite different picture (see Figure 2). Especially in the years 1999 and 2000 its intervention activity is very high and it is associated with values of I^{float} that exceed +0.33 for most of the time which clearly indicates that the Japanese authorities targeted an exchange rate path. In other words, there has been a clear regime change which cannot be detected with the approach of Calvo and Reinhart or any other forms of a cross-section analysis. Thus, an analysis of time series of the two intervention indicators has the advantage to filter out episodes of high intervention activity and episodes of low intervention activity within the whole period considered as well as episodes where exchange rate targeting (managed floating) or exchange rate smoothing (independent floating) prevailed. Moreover it allows us to identify changes in the intervention policy of a country.

What can we learn from the literature?

The empirical analysis shows that there three different approaches under the general heading of floating. While pure floating and independent floating are more or less discussed in the extensive literature on flexible exchange rates, there has been astonishingly little theoretical discussion of managed floating. Above all it is unclear

- why countries try to target the exchange rate directly,
- how the exchange rate can be controlled effectively, and
- how the exchange rate paths should be determined that are targeted under managed floating.

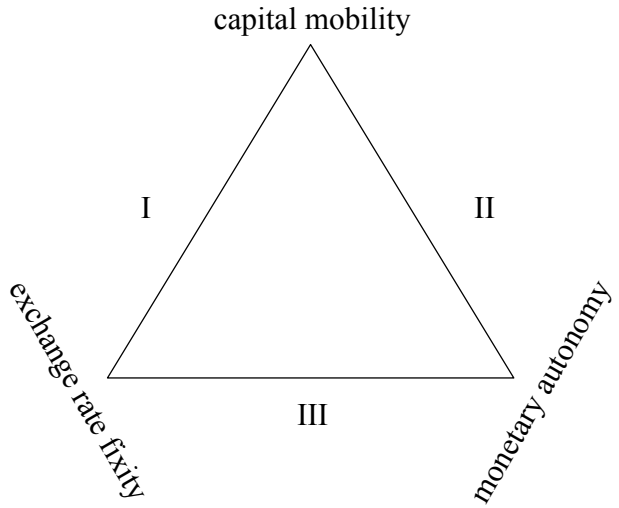
The first question leads to the old debate about fixed versus flexible rates that we do not want to discuss here. In our view an important explanation of the widespread use of managed floating is the very weak statistical relationship between macroeconomic fundamentals and a floating exchange rate. In the words of Frankel and Rose [1995]:

> "To repeat a central fact of life, there is remarkably little evidence that macroeconomic variables have consistent strong effects on floating exchange rates, except during extraordinary circumstances such as hyperinflations." (ibid., p. 1709)

The low interest in the second and third question seems mainly due to the semantic confusion that was already mentioned. Since most economists do not differentiate between the three forms of floating they seem to believe that the so-called *inconsistency triangle* provides already a sufficient framework for a analysis of the relevant arrangements in exchange rate policy. According to this metaphor a country can choose between the following options (see Figure 4):

- a fixed exchange rate with a lack of an autonomous interest rate policy and free capital mobility (I),
- an autonomous interest rate policy with a freely floating exchange rate and free capital mobility (II),
- capital controls and a combination of a fixed exchange rate and an autonomous interest rate policy (III).

Figure 4: Inconsistency triangle



I: fixed exchange rates
II: pure floating
III: capital controls

As the effectiveness of controls for capital inflows and outflows is very limited, at least on a sustained basis (Ariyoshi et al. [2000]), the menu is reduced to the first two options.

The main problem of this presentation is its focus on the polar solutions of either absolutely fixed or absolutely flexible exchange rates (pure or independent floating). In other words it has nothing to say about a policy of managed floating where the exchange is

- neither *fixed*, since it is targeted along an unannounced exchange path,
- nor *flexible* in the sense of a market-determined rate, since the central bank intervenes in order to keep the exchange rate close to the target path.

The Mundell-Fleming legacy

The theoretical framework for the inconsistency triangle is the well-known Mundell-Fleming model which is the workhorse for almost all textbooks on open economy macroeconomics. But in spite of its popularity the model is not very well designed for a world of managed floating. As a comparative-static model it cannot cope with dynamic processes in exchanges rates, i.e. exchange rate paths and exchange rate expectations. In other words, the polar view presented in the inconsistency triangle is not so much a result of sound theoretical reasoning but rather the outcome of an outdated economic model which by its very nature cannot deal with policy options other than absolutely fixed or absolutely flexible exchange rates.

In addition, the standard textbook presentation of the Mundell-Fleming model only focuses on a domestic monetary policy that tries to follow a more expansionary interest policy than in the anchor currency country. Thus, it overlooks the more interesting situation of a central bank that follows a more restrictive policy which leads to capital inflows and an increase in foreign exchange reserves. In this context the scope for sterilized interventions is also not sufficiently analyzed. We will discuss this in more detail below.

Open economy inflation targeting

Managed floating is a major challenge not only to the old fashioned but also to more elaborate models of international macroeconomics. Important models with monetary policy rules for open economies have been presented by Ball [1999] and Svensson [2000]. Both authors base their papers on a textbook view of free floating.

Svensson [2000] assumes that the flexible exchange rate is determined even in the short-run by a variant of the absolute purchasing power parity (PPP) and by the uncovered interest rate parity (UIP). As a result, foreign exchange market interventions are not discussed as an independent monetary policy instrument.

However, both textbook assumptions are not compatible with the empirical evidence. It is well-known that pricing-to-market can lead to strong deviations from PPP in the short-run (see Rogoff [1996]). The systematic deviations of exchange rate changes ("forward discount bias") from UIP have been discussed in many papers (see Froot and Thaler [1990]). In other words, if a central bank follows the policy rule prescribed by Svensson, it has to be aware of the fact that it relies on unrealistic exchange rate theories. This discrepancy between the Svensson model and the reality can be regarded as an explanation of why there is so much foreign exchange market intervention by central banks although the model implicitly assumes that such transactions are not necessary.

The paper by Ball [1999] uses a rather simple structure for the international linkages of an open economy. Instead of the UIP it simply assumes a positive relationship between the real exchange rate q_t and the domestic real interest rate r_t which can be disturbed by shocks ν_t:

(7) $\quad q_t = \theta\, r_t + \nu_t.$

Of course, this description of the reality is even more problematic than the Svensson model since it disregards the foreign interest rate. In addition, for short-term foreign portfolio investments it is not the real but the nominal interest rate that matters. Real interest rate differentials are relevant for international portfolio decisions only if PPP holds all the time.

Nevertheless, the Ball paper provides an important building bloc for a theory of managed floating. It presents a monetary policy rule for an open economy which is based on the Monetary Conditions Index (MCI) as a "policy instrument". In Chapter 0 we will introduce the MCI concept more formally. Ball defines the MCI as a weighted average of the real interest rate and the real exchange rate and derives it from the minimization procedure of a central bank's loss function. He correctly states:

> "The rationale for using an MCI is that it measures the overall stance of policy, including the stimulus through both r and e [the real exchange rate in his notation; the authors]. Policy makers shift the MCI when they want to ease or tighten." (ibid., p. 131)

But subsequently he specifies his policy rule as follows:

> "When there are shifts in the e/r relation - shocks in equation (3) [our equation (7); the authors] - r is adjusted to keep the MCI at the desired level."

In other words, even though he accepts the central role of the exchange rate for monetary policy in an open economy, he grounds his theory on a purely floating exchange rate system where the only instrument of monetary policy is the interest rate.

In sum, the models by Ball and Svensson cannot provide a theory of managed floating since they do not take into account the lack of a stable relationship between macroeconomic fundamentals and the exchange rate which is the very rationale of managed floating. As a consequence, both models disregard the role of foreign exchange market interventions (in the sense of managed floating) as an independent monetary policy instrument. In Chapter 0 we will come back to their understanding of monetary policy in small open economies and we will present the strategy of independently floating exchange rates and its major flaws within the scope of the open economy model that we are going to introduce in Chapter 0.

John Williamson's proposals

John Williamson is the most prominent promoter of intermediate exchange rate systems, above all in the form of crawling peg (Williamson [1996]), and more recently in the BBC-variant (Williamson [2000]) which calls for wide **b**ands, a **b**asket peg and a **c**rawl.

If managed floating is interpreted as a form of a non-announced exchange rate path, Williamson's proposals come relatively close to it. However, there are also some important differences. First, Williamson proposes a very specific form of an exchange rate path: the active crawl, which is characterized by a rule that depreciates the domestic currency vis-à-vis the foreign currency (or a basket of foreign currencies) according to

- the difference between the *targeted* domestic and the foreign inflation rate minus
- a factor which takes into account differences in the domestic and the foreign productivity growth (Ricardo-Balassa-effect).

A second difference between the reality of managed floating and Williamson's proposals concerns the role of interventions. Williamson favors a very cautious attitude towards exchange market interventions which becomes evident in his preference for "soft buffers". As our empirical analysis has shown, many central banks follow a much more offensive approach

since they do not hesitate to intervene for prolonged period of time and with large amounts of money.

A theoretical framework for managed floating

A map of managed floating

Our very short survey of the literature has shown that so far no comprehensive theory of managed floating is available. In the following we develop a simple policy framework for managed floating which is based on the simultaneous use of the exchange rate and the interest rate as operating targets of monetary policy. We will show that these two instruments have to set in order to achieve simultaneously external and internal equilibrium (see Figure 5).

The external equilibrium is by itself not a final target of monetary policy, but under policy of managed floating a central bank has to respect the UIP condition in order to avoid high costs of sterilization. This condition keeps profits for short-term investors close to zero and thus removes the incentive for short-term capital inflows. It is characterized by

(8) $$s_{t+1} - s_t = i_t - i_t^f$$

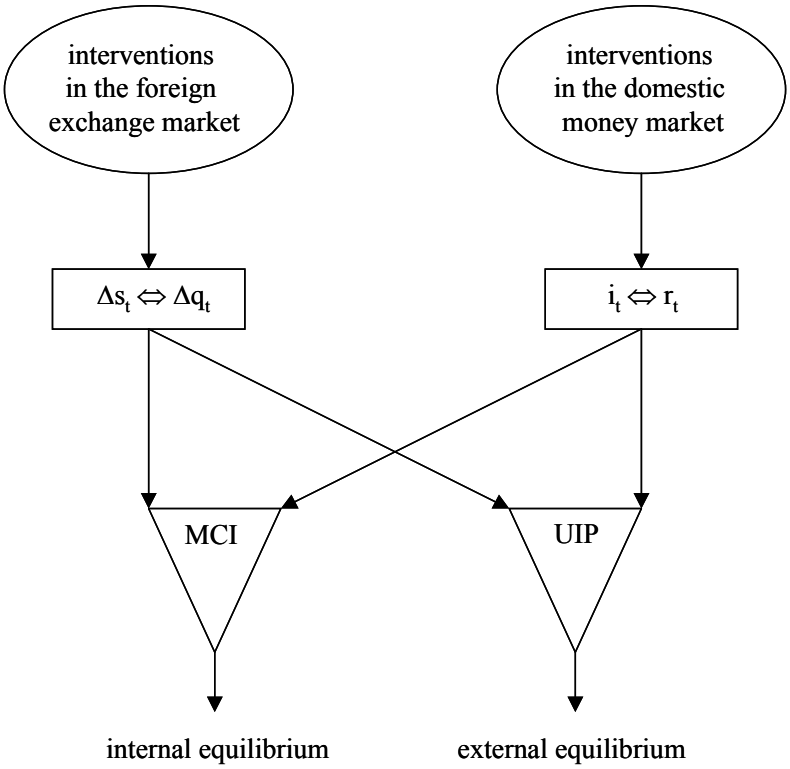
where s_t is the nominal exchange rate (a rise is a depreciation), i_t the domestic nominal interest rate, and i_t^f the foreign nominal interest rate.

The internal equilibrium is characterized by the minimizing the central bank's loss function. In other words, combination of the interest rate and the exchange rate has to generate an optimum monetary condition index.

(9) $$MCI_t^{opt} = r_t - \psi q_t .$$

We will see that the optimum MCI determines the inflation rate so that the instrument variables of monetary policy (i_t and s_t) which are directly controllable by the central bank can also be discussed in the form of their real counterparts r_t and q_t .

Figure 5: Monetary policy in small open economies



Our framework is a typical example for the analysis of economic policy by Tinbergen [1952] who has shown that in order to meet two independent targets two instruments are required that need to be efficient and independent from each other.

Targeting the exchange rate with sterilized interventions

The simultaneous management of the exchange rate and the interest rate implies that the central bank is able to target the exchange rate by means of sterilized interventions. This is possible since the central bank has two independent instruments at its disposal:

- With *open-market* operations (or any other refinancing operation) a central bank exchanges short-term domestic notes (or other short-term domestic liabilities) against domestic central bank reserves in order to target the short-term interest rate. As a result the monetary base changes and the central bank balance sheet is extended.
- With *foreign exchange market interventions* a central bank exchanges foreign sight deposits against domestic central bank reserves in order to target the exchange rate. If the intervention is sterilized, the monetary base remains constant and also the size of central bank balance sheet. However, the structure of the central bank's assets has changed.

In both cases the operating target is controlled directly by interventions in the relevant market (domestic money market, foreign exchange market).

While it is uncontested today that central banks are able to perfectly control short-term interest rates, many economists are in doubt that a direct control of the exchange rate is possible at all. They either argue that this due to the sheer size of foreign exchange markets or that a control of the exchange rate can only be achieved with a limited control over the interest rate which is normally not acceptable. For instance, Schwartz [2000] concludes:

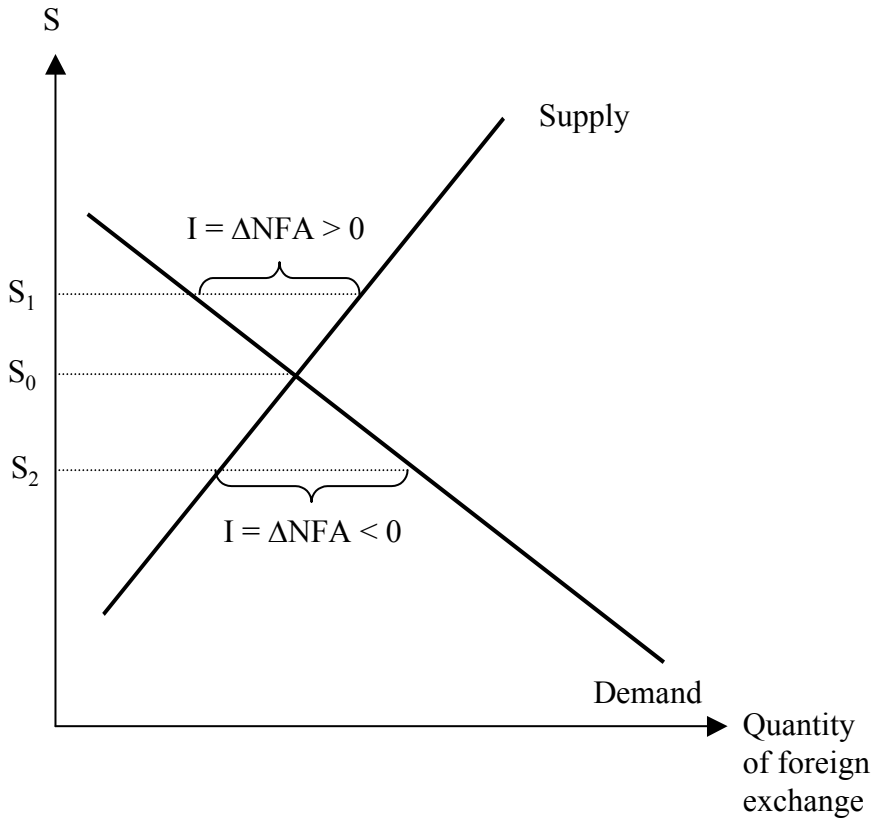
"(...) monetary policy can support either domestic or external objectives. Monetary policy cannot serve both." (ibid., p. 26)

Or, to put it the other way round, if both instruments are assumed to be independent from each other due to complete sterilization of the liquidity effects of foreign exchange market interventions, then interventions are deemed to be ineffective. Finally sterilized intervention can be associated with interest rate costs that a central bank is not willing to accept. In the following we will discuss these points more in detail.

The flow channel of interventions matters

The effectiveness of foreign exchange market interventions has been discussed in many theoretical and empirical studies. The results are mixed especially for the case of sterilized interventions (Sarno and Taylor [2001]). The most serious flaw of this literature is that almost all papers analyze the mark-dollar rate. As we have shown in the empirical part of our paper, interventions in this market have been extremely small so that the lack of a firm empirical evidence for the effectiveness of such interventions can simply be explained with an insufficient dose of intervention. In other words, analyses of the mark-dollar rate cannot be taken as an evidence for the ineffectiveness of managed floating in emerging market economies and other developed countries where the relative amount of interventions is in some case several times higher (see Table 11 and Table 12 in Appendix 2: Probability distributions).

Figure 6: The flow channel of foreign exchange market interventions



The microeconomics of intervention can be described with a simple diagram for the foreign exchange market (see Figure 6). On the y-axis is the price of foreign exchange in terms of the domestic currency. Thus, there is an upward-sloping supply curve and a downward-sloping demand curve for foreign exchange. The equilibrium exchange rate is S_0. Foreign exchange market intervention implies that the central bank targets a higher or a lower exchange rate than the market-clearing rate. If the central bank targets a rate S_1 that is higher than the equilibrium rate, there is an excess supply of foreign exchange which it has to buy in exchange for domestic reserves. As a result its net foreign assets (NFA) will grow. In the case of a targeted rate S_2 below the market-clearing rate, there is an excess demand for foreign exchange which the central bank has to satisfy by selling foreign assets out of its foreign exchange reserves ($\Delta NFA<0$). As a consequence the commercial banks' reserves decline. As far as the effectiveness of interventions is concerned there is no doubt that the central bank can target a different exchange rate than S_0 as long as it is able to fill the gap between the quantity demanded and the quantity supplied in disequilibrium.

Of course the ability to target S_1 is completely different than the ability to target S_2. In the first case which identifies an intervention policy that tries to target a *weaker* exchange rate than the market rate the, central bank's foreign exchange reserve increase. In the second case which characterizes an attempt to keep the exchange rate at a *stronger* level than market-clearing level, the central bank loses foreign exchange reserves. Thus, in the first case there is no limit to the intervention policy since the central bank can always increase the domestic liquidity. In the second case, the central bank operates under a "hard budget constraint" which makes it difficult to pursue such an intervention policy over a prolonged period of time.

Table 5: Size of local foreign exchange markets

	Average *daily turnover of local currency in the local foreign exchange market* in millions of US-$ (April 1998)	**Column 1 as a percentage of *total reserves* minus gold (1998, end of year)**	**Column 1 as a percentage of the *external sector's size* (1998) as defined in Chapter 2.4**	**Column 1 as a percentage of the *GDP* (1998, in US-$)**
	1	**2**	**3**	**4**
Australia	23600	161.20	39.05	6.47
Austria	3014	13.44	4.62	1.43
Belgium	10706	58.59	6.31	4.28
Canada	25869	110.99	12.43	4.25
Denmark	5564	36.45	12.00	3.20
Finland	2566	26.47	6.82	1.99
France	32634	73.65	10.97	2.26
Germany	62145	83.95	12.27	2.89
Hong Kong	18711	20.87	10.44	11.50
Ireland	3569	37.98	6.53	3.99
Italy	22500	75.28	9.71	1.89
Japan	124045	57.57	37.20	3.26
Luxembourg	1637		21.41	8.93
Netherlands	18651	87.08	9.59	4.92
New Zealand	4928	117.23	39.81	9.23
Norway	5350	28.75	14.12	3.67
Portugal	2983	18.85	9.45	2.79
Singapore	17644	23.55	16.43	21.27
Spain	13007	23.54	0.02	2.35
Sweden	6285	44.58	44.58	44.58
Switzerland	31611	76.74	42.44	12.03

United Kingdom	114817	356.45	39.12	8.12
United States	315872	446.68	38.84	3.59
Argentina	2173	8.78	7.51	0.73
Bahrain	21	1.95	0.61	0.34
Brazil	5127	12.04	9.18	0.65
Chile	1212	7.74	7.21	1.66
China	211	0.14	0.13	0.02
Czech Republic	4169	33.24	15.13	7.48
Greece	5361	30.71	31.55	4.42
Hungary	554	5.95	2.28	1.18
India	1389	5.08	3.64	0.33
Indonesia	972	4.28	2.55	1.03
Malaysia	660	2.58	1.00	0.91
Mexico	8543	26.87	11.61	2.03
Philippines	492	5.33	1.61	0.75
Poland	1315	4.97	3.55	0.83
Russia	4728	60.60	6.82	1.70
Saudi Arabia	1422	10.00	4.14	1.11
South Africa	7289	167.30	0.86	0.18
South Korea	2289	4.40	2.03	0.72
Thailand	2574	8.93	5.29	2.30

Source: BIS, IFS, own calculations

As far as the size of the foreign exchange market is concerned, the figures of a daily transactions volume of about 2,000 billion dollar are related to the *market-maker principle* by which the foreign exchange market is organized. Due to this principle which generates a "hot potato effect" (see Bofinger [2000]), an individual transaction can lead to a multiple of foreign exchange market turnover. Thus, central bank interventions at much smaller scales can be successful. For instance, in the period from June 1999 to June 2000 the Bank of Japan managed to stop a further appreciation of the yen with a total intervention volume of about 100 billion dollar, which is only 5 % of the daily global transactions volume.

This is also confirmed by the data for *local* foreign exchange turnover. They show that because of its role of a vehicle currency on the foreign exchange market the dollar turnover is extremely high compared to the stock of total foreign reserves or the size of the external sector of the United States. For many emerging market economies, however, the relative size of the turnover is considerably smaller so that central banks can affect the exchange rate with relatively small intervention volumes (see Table 5, columns 2 and 3). We calculated for example that the turnover measured as a percentage of the external sector's size was on average more than three times higher in developed market economies compared to emerging markets.

Sterilized interventions can be effective

This leads to the second argument which is raised against foreign exchange market interventions. If a central bank intervenes in order to keep its currency from appreciating (depreciating), it increases (reduces) domestic liquidity which ceteris paribus is identical with a more expansionary (restrictive) monetary policy stance. Due to this direct connection it is often argued that any attempt to control the exchange rate is associated with a reduced control over the interest rate.

This argument neglects the fact that most central banks dispose over different instruments with which they can mop up the excess liquidity that is created by foreign exchange market

interventions. As Table 6 shows such a policy of sterilization is very common in those countries that we identified as managed floaters (see Table 14 in Appendix 2: Probability distributions). For each country we estimated the following sterilization equation:

(10) $\Delta NDA_t = \beta_1 \Delta NFA_t + \beta_2 \Delta NDA_{t-1} + u_t$.

Under complete sterilization the coefficient β_1 of the change in net foreign reserves (ΔNFA_t) is expected to be -1, for net domestic credit (ΔNDA_t) is systematically varied to offset the effect of reserve acquisitions and losses on domestic liquidity.[5] Ten of the 27 managed floaters had a sterilization coefficient smaller than –0.90, and for 19 of them it was less than –0.70.

How does sterilization work in practice? For the case of an intervention that increases domestic liquidity the sterilization can be achieved as follows:

- As long as the banking system is a net debtor of the central bank, credits to the banking system can be reduced in parallel with foreign exchange market interventions. An instrument which is especially suitable for that purpose are the ECB's security repurchase agreements with a maturity of up to two weeks that are conducted on a weekly basis.
- For the case of interventions that exceed this form of sterilization a central bank has to issue interest-bearing short-term notes with which the excess liquidity can be neutralized. A similar and even more simple instrument is the *deposit facility* which has been established by the European Central Bank. Such an interest bearing facility has the advantage that it provides a sterilization potential that is unlimited, at least in principle. So far, this instrument is not very common with other central banks, but it is not a major technical problem to establish such a facility which is simply an additional interest-bearing account for each commercial bank with the central bank.

In this context it is important to note that the literature uses two different definitions of sterilization which depend on the domestic operating target of the central bank. If a central bank uses the *monetary base* as its operating target, sterilization means that the amount of monetary base is not affected by interventions. Based on this definition the estimation presented in Table 6 was made. If a *short-term interest rate* (overnight rate, one or three month rate) serves as the domestic operating target, sterilization has to guarantee an unchanged level of this rate. As almost all central banks in the world use the interest rate as their domestic operating target, we will use the second definition of sterilization. At first sight both definitions seem almost identical, but in the situation of shocks to the domestic money market, the two control options lead to very different results (Bofinger [2001]).

Table 6: Sterilization coefficient in managed floating economies

Dependent variable: ΔNDA_t					
	Explanatory variables		**Statistics**		
	ΔNFA_t	**ΔNDA_{t-1}**	**R^2**	**DW**	**n**
Argentina	-1.05 (-17.64)***	0.56 (14.42)***	0.81	2.24	121
Australia 2	-0.66 (-9.89)***	0.13 (2.22)**	0.37	1.89	202
Brazil 1	-0.92 (-19.95)***	-0.12 (-2.50)**	0.89	1.66	53

[5] The lagged values of ΔNDA were included to capture other effects than the sterilization policy of the central banks. The data is monthly and all taken from the IFS (lines 11 to 17).

Brazil 2	-0.88 (-8.21)***	-0.18 (-1.70)*	0.61	2.02	46
Brazil 3	-1.13 (-4.39)***	-0.29 (-2.00)*	0.59	2.32	21
Bulgaria	-0.77 (-29.07)***	-0.27 (-7.25)***	0.98	1.50	21
Chile 1	-0.23 (-3.87)***	-0.21 (-3.06)***	0.06	1.80	200
Colombia 1	-0.76 (-10.20)***	-0.35 (-5.02)***	0.56	2.24	96
Egypt	-1.03 (-18.24)***	-0.04 (-0.87)	0.72	1.94	134
Finland	-0.44 (-5.36)***	-0.14 (-1.28)	0.41	2.01	47
India 1	-0.76 (-3.57)***	-0.19 (-2.53)**	0.03	1.99	167
India 2	-0.26 (-1.65)	-0.13 (-1.26)	0.05	2.02	91
Indonesia 2	-0.91 (-21.81)***	0.00 (0.03)	0.94	2.45	34
Israel 1	-0.77 (-3.85)***	0.18 (1.19)	0.28	1.56	35
Israel 2	-0.67 (-8.88)***	-0.09 (-1.17)	0.43	2.17	106
Japan	-0.94 (-4.91)***	-0.47 (-9.55)***	0.27	2.41	306
Korea 2	-1.09 (-15.75)***	-0.04 (-0.64)	0.85	2.40	34
Malaysia	-0.77 (-4.96)***	0.10 (0.84)	0.37	1.95	56
Mexico 1	-0.95 (-16.11)***	-0.13 (-2.64)***	0.72	1.98	103
Peru	-0.57 (-8.88)***	-0.18 (-2.63)***	0.42	2.18	124
Poland 1	-0.89 (-13.36)***	-0.20 (-3.23)***	0.68	2.17	80
Singapore	-0.83 (-16.88)***	0.02 (0.44)	0.56	2.43	154
Slovenia	-1.01 (-31.40)***	-0.11 (-3.44)***	0.92	2.69	88
Sri Lanka	-0.85 (-18.95)***	-0.20 (-4.78)***	0.59	2.35	262
Thailand 2	-0.29 (-1.20)	0.09 (0.53)	0.06	1.90	31
UK 1	-1.05 (-15.00)***	-0.05 (-0.81)	0.80	2.39	61
Venezuela 1	-0.83 (-6.55)***	-0.04 (-0.40)	0.50	2.09	47

Note: OLS estimation, t-values in parentheses, *** (**) [*] = significant at the 1 (5) [10] per cent level; for Bulgaria, Colombia 1 and UK 1 only quarterly data was available for the whole period;

Many economists are in doubt whether sterilized intervention can have a direct effect on the exchange rate since with such interventions the relative domestic money supplies remain constant. For instance Rosenberg [1996] argues:

> "According to the monetary approach to exchange rate determination, central bank intervention that does not alter the supply of money relative to the demand for money will not have a perceptible impact on exchange rates." (ibid., p. 298)[6]

For an understanding of sterilized intervention it is necessary to describe in more detail the transactions and their impact on the balance sheets of the central bank, commercial banks and non-bank investors. We start with a situation where a euro area commercial bank (CB€) holds 100 € reserves with ECB which it has obtained via a repo credit. At the same time a euro area investor (IN€) holds a 100 $ deposit with a United States commercial bank (CB$). We neglect from minimum reserves and assume that the dollar/euro exchange rate is 1:1.

1st round (intervention):
We now assume that the investor wants to exchange his dollar deposit into a euro deposit. For this purpose he sells the deposit to CB€ which in turn sells it on the foreign exchange market. We assume that the ECB intervenes and purchases the dollar deposit from CB€. The counter-value of the deposit is credited to the CB€'s account with the ECB. Thus, the euro reserves increase.

2nd round (sterilization):
The ECB sterilizes the intervention by reducing its repo credits to CB€.

[6] See also Sarno and Taylor [2001].

As a result, the monetary base in the euro area and in the United States (which we do not need to present) has remained unchanged. The foreign deposits with CB$ have also not changed, but the ECB has become a depositor instead of IN€. Thus, the dollar deposits held by non-central banks have declined. At the same time, the euro deposits held by non-banks with the CB€ have increased. In other words: even with constant monetary base in both areas, the relative amount of deposits held by the public have changed. This has been compensated by the ECB which holds more dollar assets and less euro assets since it has reduced its euro denominated repo credits. Thus, with sterilized interventions a central bank enters an open position the foreign currency – a long position if it purchases foreign exchange, a short position if it sells foreign exchange.

Seen from this perspective sterilized intervention implies a certain commitment by a central bank since in both cases the risk of the open position is at least partially determined by the central bank's own actions. In the case of an appreciating currency, the central bank runs the risk that the domestic value of its foreign exchange reserves is reduced by an appreciation of the domestic currency which the central bank is able to prevent. In the case of a depreciating currency the opposite applies but the budget constraint of foreign exchange reserves makes the commitment less binding.

As these portfolio adjustments are the driving force of sterilized interventions, the literature obviously suffers from an incorrect identification of the relative monetary bases with the relative amount of deposits held by the public in the two currencies.

A very common assumption in this regard is the assumption of a perfect *substitutability between assets* denominated in different currencies. In the words of Sarno and Taylor [2001]:

> "(...) it is tempting to conjecture that the portfolio balance channel will diminish in importance over time – at least among the major industrial countries – as international capital markets become increasingly integrated and the degree of substitutability between financial assets denominated in the major currencies increases." (ibid., p.862)

While this seems plausible for risk-neutral investors, it does not hold if investors are risk-averse. The very fact that investors incur transactions for exchanging a dollar deposit into a euro deposit indicates that the two assets are not regarded as perfect substitutes. With a perfect substitutability of dollar and euro assets it would be also difficult to explain the huge trading volume on foreign exchange markets. Why should banks trade assets of about 2 billion dollar per day if they are complete substitutes? In other words, increasing capital mobility does not mean that the assets traded are substitutes. On contrary, large capital flows are an indication that investors see important qualitative differences in assets that are denominated in different currencies or issued by debtors from different regions.

How can the costs of sterilization be avoided

Thus, we have shown that a central bank is always able to avoid an unwarranted appreciation of its currency without losing control over the domestic interest rate. The remaining problem are the costs of sterilization (C_t^S). These costs that are supposed to occur in period t (defined per unit of domestic currency that is supplied in interventions in period t-1) are made up of two components: the interest rate costs (or earnings) (C_t^i) and the valuation losses (or returns) from foreign exchange reserves (C_t^V):

(11) $C_t^S = C_t^i + C_t^V$.

The interest rate component of sterilization is determined by the difference between the foreign and the domestic interest rate:

(12) $C_t^i = i_{t-1} - i_{t-1}^f$.

This is due to the fact that a sterilized intervention that tries to prevent an appreciation leads to an increase in foreign assets and a decrease in domestic assets; in the case of a deposit facility or the issuance of notes, domestic liabilities increase. Thus, the central bank loses income from domestic assets (or has to pay interest on domestic liabilities) while it receives additional income from an higher amount of foreign assets. It is obvious that sterilized interventions are associated with interest costs (returns) if the domestic interest rate is higher (lower) than the foreign interest rate.

The valuation costs (returns) per unit of sterilization depend on the percentage change of the exchange rate which we express by the difference of the log of the nominal exchange rate:

(13) $C_t^V = -(s_t - s_{t-1}) = -\Delta s_t$.

If the domestic currency depreciates, the value of foreign exchange reserves in terms of the domestic currency increases. The central bank makes a profit from sterilized intervention.

Both cost components can be combined in order to define conditions under which sterilized interventions are free of charge:

(14) $C_t^S = 0 \stackrel{!}{=} i_{t-1} - i_{t-1}^f - (s_t - s_{t-1})$,

which leads to the ex post formulation of the interest parity condition:

(15) $(s_t - s_{t-1}) = i_{t-1} - i_{t-1}^f$.

In other words, the costs of sterilized intervention are zero if a central bank targets the exchange rate in a way that it follows a path that is determined by the interest rate differential. This guarantees at the same time that there are no profit opportunities for short-term oriented investors which invest in the domestic currency. If the domestic interest rate is higher than the foreign interest rate this advantage is fully compensated by a depreciation of the domestic currency. Thus the condition of zero costs for sterilized interventions is the mirror image of the condition that the mix of exchange rate and interest policy should not provide profit opportunities for short-term oriented investors. In fact, the profits of these investors are to a large extent nothing else but the sterilization costs paid by the central bank.[7]

In sum, the exchange rate can targeted by the central bank without a budget constraint, without costs and without negative side effects on interest rate policy, if

[7] As far as domestic commercial banks receive deposits denominated in the domestic currency and grant credits in the foreign currency, they also pay for the profits of short-term oriented investors.

- the domestic currency is appreciating vis-à-vis the foreign currency,
- its sterilization potential is unlimited, which can be arranged by offering a deposit facility,
- the targeted exchange rate path is compatible with the prevailing interest rate differential.

A control over the exchange rate is more difficult, if a central banks tries to counteract a depreciation and/or if it follows exchange rate paths that are associated with high sterilization costs e.g. if the domestic currency is kept stable although the domestic interest exceeds the foreign interest rate.

External equilibrium

For the discussion of the external equilibrium in an open economy we *assume free capital mobility*. In order to understand the role of the external equilibrium in the context of managed floating it is important to take a deeper look at the behavior of the two major participants of the foreign exchange market: the private investors and the domestic central bank.[8]

The private investor's external equilibrium

The private sector's equilibrium condition is captured by the well-known uncovered interest parity:

$$(16) \qquad i_t - i_t^f = E_t \Delta s_{t+1} + \varepsilon_t .$$

According to UIP, in equilibrium the return on domestic investment i_t equals the expected return on foreign investment which itself is the sum of the foreign interest rate i_t^f, the expected exchange rate change $E_t \Delta s_{t+1}$ and, depending on the underlying monetary and exchange rate regime, a time-varying risk premium ε_t. If this condition is met, private market participants should be indifferent between the domestic and the risky foreign investment. Hence, short-term[9] capital flows do not occur.

The central bank's external equilibrium

The equivalent of the private investor's arbitrage condition is the central bank's zero-cost-condition. In Chapter 0 we explained the mechanics of sterilized foreign exchange market interventions. One basic result was that if central banks want to make independent and efficient use of the short-term interest rate and the exchange rate as operating target, the costs of sterilization have to be zero. This has led to the ex post interest parity condition which we formulated in equation (15). By augmenting the time subscript by 1 we can now derive the central bank's external equilibrium condition:

$$(17) \qquad i_t - i_t^f = \Delta s_{t+1}^T .$$

[8] We will see later on that the foreign central bank also has an important impact on our equilibrium conditions, mainly by setting the foreign short-term interest rate i_t^f. But as this will be treated as being exogenous to the domestic central bank's policy decision, it is sufficient to concentrate on these two participants.

[9] In our context the short term refers to a period of one or at most three months which corresponds to the maturity of the interest rates that is normally assumed to be under the control of the central bank.

According to equation (17) the central bank targets an exchange rate path (Δs^T_{t+1}) that is equal to the difference of the domestic interest rate i_t (set by the central bank as well) and the exogenous foreign interest rate i^f_t.

The overall external equilibrium and the central bank's intervention response function

The overall equilibrium condition can be obtained by inserting equation (16) into equation (17):

(18) $\Delta s^T_{t+1} = E_t \Delta s_{t+1} + \varepsilon_t$.

That is to say, if the central bank's targeted exchange rate path equals the private sector's expected exchange rate change plus the actual risk premium, there is no need for the central bank to intervene in the foreign exchange market and the balance of payments is in equilibrium.

Otherwise, there is a case for central bank interventions. Two basically different situations have to be distinguished:

In the first case, private investors expect to make a profit from an investment in the domestic currency which leads to *capital inflows*. The sum of the private sector's expectations about the future exchange rate path and the required risk premium are more than compensated by the given actual interest differential and the given actual spot rate:

(19) $i_t - i^f_t = \Delta s^T_{t+1} > E_t \Delta s_{t+1} + \varepsilon_t$.

In a world of managed floating the central bank intervenes in the foreign exchange market in order to absorb the excess supply of foreign exchange. This guarantees that the central bank achieves the desired exchange rate path Δs^T_{t+1}. At the same time, it is able to keep the interest rate at its level i_t because of the immediate sterilization of the accumulated foreign reserves. It is important to underline that in this case the central bank is neither restrained by its stock of foreign reserves (the bank is able to buy unlimited amounts of foreign reserves) nor by any costs of sterilization (by achieving Δs^T_{t+1}, the bank perfectly fulfils the zero-cost-condition).

The second case is characterized by *capital outflows* which can be described as follows:

(20) $i_t - i^f_t = \Delta s^T_{t+1} < E_t \Delta s_{t+1} + \varepsilon_t$.

The actual interest rate differential does not compensate for the expected exchange rate change and the required risk premium, and hence, international investors prefer the foreign investment. As the central bank's objective is to realize Δs^T_{t+1}, it has to sell foreign assets in order to satisfy the excess demand for foreign exchange. Here again, the sterilization issue is not a problem as long as the desired exchange rate path is achieved. But in contrast to the first case (the capital inflow case), now the central bank is restrained by its stock of foreign reserves (see Chapter 0). But this does not mean that the central bank is not able to realize Δs^T_{t+1} at all. As long as its reserves exceed a critical threshold, say NFA^c, the central bank can credibly achieve the desired path through sterilized interventions. But as soon as the current

stock of foreign reserves is perceived as too low by the international investors, capital outflows will accelerate and the central bank looses its intervention instrument.

In sum, sterilized foreign exchange market interventions can be described by the following implicit function:

$$(21) \qquad I_t = \Delta NFA_t = f\left(\Delta s^T_{t+1} - E_t \Delta s_{t+1} - \varepsilon_t\right),$$

where f(0) is equal to zero and where the first derivative f' is always positive. Theoretically, I_t can adopt values ranging from $-NFA^c$ to infinity. Thus, equation (21) completes our flow channel analysis of foreign exchange market interventions in Chapter 0.

In three of the cases described above (the capital inflow case, the case without interventions, and the capital outflow case with sufficient foreign reserves) the central bank is able to realize its target path for the exchange rate:

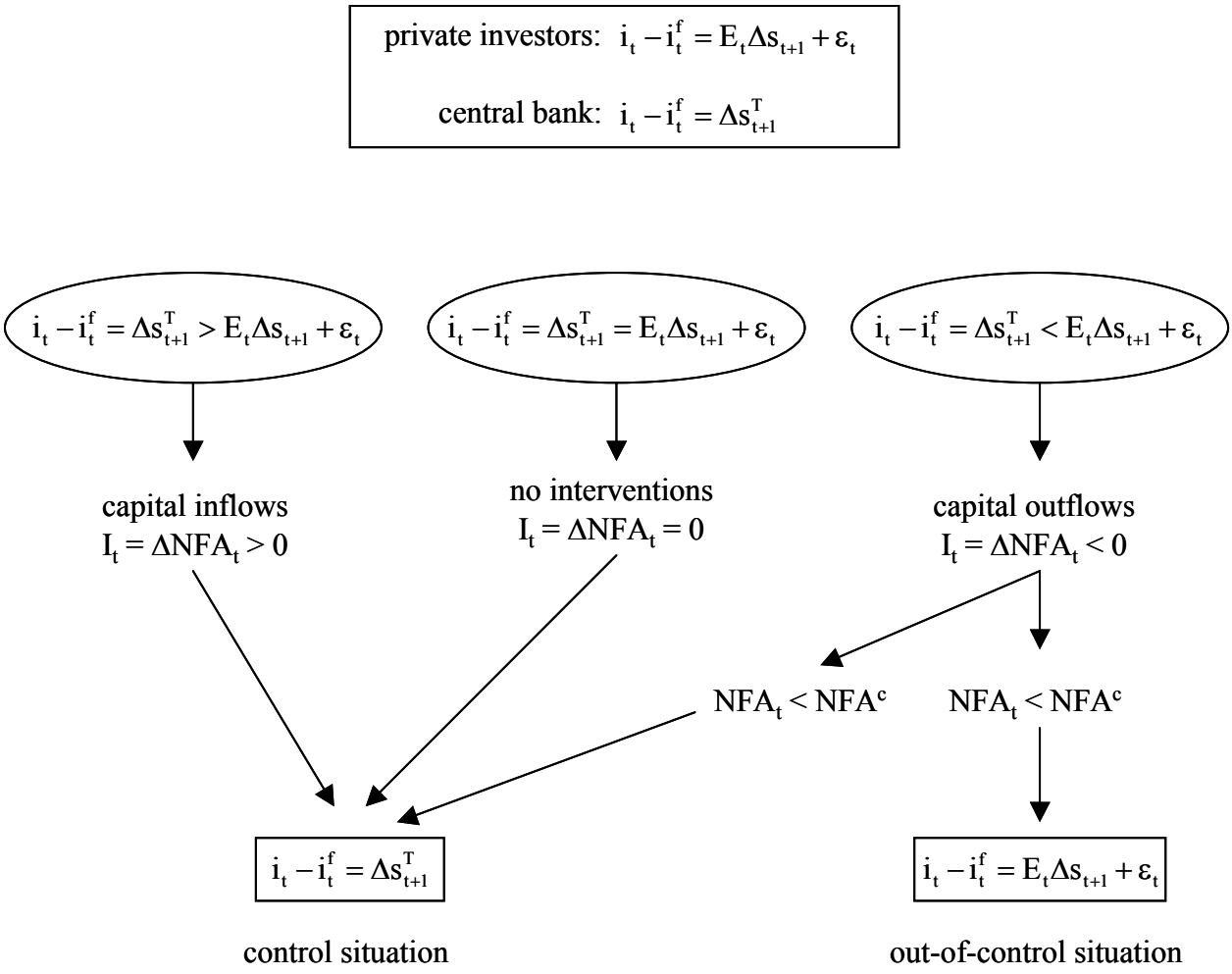
$$(22) \qquad i_t - i^f_t = \Delta s^T_{t+1}.$$

We call this the "control situation". There is only one, but of course very important, case in which the central bank looses the control over its operating target: the capital outflow case with foreign reserves falling below a critical threshold. In this situation which we call "out-of-control situation", the central bank is no longer able to target the exchange rate through sterilized interventions. It rather has to adjust its interest rates in order to stop the capital outflow. This adjustment can be achieved by either reducing the domestic part of the monetary base, or by non-sterilized foreign exchange market interventions which lowers the foreign part of the monetary base. Independently of how domestic interest rates are raised, the external equilibrium condition in the out-of-control situation becomes

$$(23) \qquad i_t = i^f_t + E_t \Delta s_{t+1} + \varepsilon_t.$$

Figure 7 summarizes again the major relationships underlying the external equilibrium of our strategy.

Figure 7: The external equilibrium



Internal equilibrium

In order to derive the internal equilibrium condition, we start with the transmission channels of monetary impulses in a small open economy. For the conduct of monetary policy it is important to differentiate between two channels: the *exchange rate channel* and the *interest rate channel* (see Svensson [2000]).

With the *interest rate channel*, monetary policy affects aggregate demand via its effect on the short-term real interest rate (and possibly on the availability of credit). Subsequently, aggregate demand affects inflation via the supply-side of an economy which is often described by a Phillips-curve relation. In this respect we follow the current mainstream in monetary macroeconomics according to which the money stock only plays a minor role in describing monetary policy effects (see Romer [2000] for an illustrative paper). Monetary policy is thus assumed to follow an interest rate policy rather than a money supply policy.

The *exchange rate channel* can be divided into a direct and an indirect channel. The *direct channel* explains inflation fluctuations via the pass-through of exchange rate fluctuations to import prices, and hence on inflation. *Indirectly*, the real exchange rate affects the relative price between domestic and foreign goods, which in turn has an impact on both, domestic and foreign demand for domestic goods, and hence contributes to the aggregate demand channel for the transmission of monetary policy.

Both channels can be summarized in the following simple model of an open economy:

(24) $\pi_t = \delta E_t \pi_{t+1} + \alpha y_t + \beta q_t + \eta_t$

(25) $y_t = E_t y_{t+1} - \gamma r_t + \mu q_t + \nu_t$.

The two relations incorporate the forward–looking behavior typical of the New Keynesian framework. Equation (24) is a forward-looking open economy Phillips curve. It can be derived from an optimization problem of an individual firm acting in a monopolistically competitive environment. Equation (24) is then a loglinear approximation about the steady state of the aggregation of the individual firm pricing decisions. Accordingly, the inflation rate π_t is positively related to expected inflation, the output gap and the real exchange rate (see Guender [2001] for a derivation of the open economy version and Roberts [1995] for a general paper on New Keynesian Phillips curves). Equation (25) defines an open-economy IS relation. The output gap y_t depends positively on its expected future value, negatively on the real interest rate r_t and positively on the real exchange rate q_t. Note that a rise in q_t represents a real depreciation. Thus, the structural parameters α, β, γ, δ and μ are all positive. The supply shock η_t and the demand shock ν_t are assumed to follow an AR(1) process

(26) $\eta_t = \theta \eta_{t-1} + \hat{\eta}_t$

(27) $\nu_t = \kappa \nu_{t-1} + \hat{\nu}_t$

where θ and κ are the coefficients of autocorrelation. $\hat{\eta}_t$ and $\hat{\nu}_t$ are white noise disturbances.

An additional feature of open economy models is the uncovered interest parity (UIP) condition which describes the behavior of international financial markets participants:

(28) $i_t = i_t^f + E_t s_{t+1} - s_t + \varepsilon_t$.

If this condition is met, private market participants should be indifferent between the domestic and the foreign investment. Using the definition of the real exchange rate (variables for the foreign country are marked with the superscript f)

(29) $E_t q_{t+1} - q_t \equiv E_t s_{t+1} - s_t + E_t \pi_{t+1}^f - E_t \pi_{t+1}$

and the Fisher equation

(30) $i_t = r_t + E_t \pi_{t+1}$ and $i_t^f = r_t^f + E_t \pi_{t+1}^f$

for the domestic and the foreign nominal interest rate we can express the UIP condition in real terms:

(31) $r_t = r_t^f + E_t q_{t+1} - q_t + \varepsilon_t$.

The risk premium shock and the foreign real interest rate are modeled as serially correlated disturbances:

(32) $\varepsilon_t = \rho\varepsilon_{t-1} + \hat{\varepsilon}_t$

(33) $r_t^f = \phi r_{t-1}^f + \hat{r}_t^f$

where ρ and ϕ are the coefficients of autocorrelation. $\hat{\varepsilon}_t$ and $\hat{r}_t^f$ are white noise disturbances. The complete model then exists of the behavioral equations (24), (25) and (31) as well as the AR(1) processes for the shocks (equations (26), (27), (32), and (33)).

If a central bank implements its monetary policy decisions with two operating targets it is useful to introduce a comprehensive measure of the actual policy stance of the central bank's two operating targets. This is provided by the so-called *Monetary Conditions Index* (MCI) which can be defined in a simple form as follows:

(34) $MCI_t = r_t - \psi q_t$.

If the monetary policy stance is about to tighten, the MCI rises, and in the opposite case, the index falls. With a positive elasticity ψ, a tighter MCI can be achieved by raising the interest rate, by a real appreciation, or by a combination of both.[10] The definition of the MCI in equation (34) corresponds to that by Ball [1999] (see also Chapter 0).

For the monetary policy maker it is now crucial to know which MCI he has to realize. Thus, we first have to define the objective of the central bank. In the class of dynamic rational expectation models given by equations (24), (25) and (31) the central bank is typically assumed to follow an intertemporal loss function

(35) $L_t = E_t\left[\sum_{\tau=0}^{\infty}\delta^\tau\left(\lambda_\pi\pi_{t+\tau}^2 + \lambda_y y_{t+\tau}^2\right)\right]$

which consists of the expected sum of discounted current and future period losses. δ denotes the discount factor ($0 < \delta < 1$). The period loss function is assumed to be quadratic where λ_π and λ_y are the preferences of the central bank with respect to the target variables π and y. The monetary policy problem is then to find an instrument path that minimizes the intertemporal loss subject to the structure and the state of the economy at all dates. It is convenient to summarize the model of the economy to the so-called state-space representation which can be written as

(36) $A_0\begin{pmatrix} x_{1,t+1} \\ E_t x_{2,t+1} \end{pmatrix} = A_1\begin{pmatrix} x_{1,t} \\ x_{2,t} \end{pmatrix} + B_0 r_t + \begin{pmatrix} \hat{x}_{1,t+1} \\ 0_{n_2\times 1} \end{pmatrix}$

with $x_{1,t} = \begin{pmatrix} \eta_t & \nu_t & \varepsilon_t & r_t^f \end{pmatrix}^T$ as a $(n_1 \times 1)$ vector of predetermined variables with $n_1 = 4$, $x_{2,t} = \begin{pmatrix} \pi_t & y_t & q_t \end{pmatrix}^T$ as a $(n_2 \times 1)$ vector of forward looking variables with $n_2 = 3$ and the instrument variable r_t. The vector of white-noise disturbances $\hat{x}_{1,t+1}$ to the predetermined

[10] Note that a negative change in the real exchange rate is a real appreciation. Of course central banks are only able to directly control the nominal values of their operating targets i_t and s_t. But under the important assumption of price stickiness, r_t and q_t are perfectly correlated with their nominal counterparts i_t and s_t, the operating targets of the central bank.

variables is composed of $\left(\hat{\eta}_t \quad \hat{\nu}_t \quad \hat{\varepsilon}_t \quad \hat{r}_t^f\right)^T$. A_0, A_1 and B_0 are the matrices containing the structural coefficients. Thus, our model can be rewritten as

$$(37)\quad \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \delta & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \eta_{t+1} \\ \nu_{t+1} \\ \varepsilon_{t+1} \\ r_{t+1}^f \\ \hline E_t\pi_{t+1} \\ E_t y_{t+1} \\ E_t q_{t+1} \end{pmatrix} = \begin{pmatrix} \theta & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \kappa & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \rho & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \phi & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 1 & -\alpha & -\beta \\ 0 & -1 & 0 & 0 & 0 & 1 & -\mu \\ 0 & 0 & -1 & -1 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \eta_t \\ \nu_t \\ \varepsilon_t \\ r_t^f \\ \hline \pi_t \\ y_t \\ q_t \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ \hline 0 \\ \gamma \\ 1 \end{pmatrix} r_t + \begin{pmatrix} \hat{\eta}_t \\ \hat{\nu}_t \\ \hat{\varepsilon}_t \\ \hat{r}_t^f \\ \hline 0 \\ 0 \\ 0 \end{pmatrix}.$$

The solution to the problem of the monetary policy maker, i.e. the minimization of (35) subject to (37), can be found by applying some well-developed numerical algorithms, as described for example in Söderlind [1999]. For this reason, the model has to be calibrated. The parameters of our economy were set as follows: $\delta = 1$, $\alpha = 0.4$ and $\beta = 0.3$ in the Phillips curve, $\gamma = 0.8$ and $\mu = 0.4$ in the IS relation. The autocorrelation coefficients of the shock processes are $\theta = \kappa = \rho = \phi = 0.6$. The central bank is finally assumed to follow a strategy of flexible inflation targeting so that the preferences of the central bank are $\lambda_\pi = \lambda_y = 1$. The specification of the system is completed by setting all the variances of the white-noise shocks to unity, and all the covariance terms to zero. These parameters are well in line with the literature on monetary policy in small open economies (see the calibration in Ball [1999] and Dennis [2000]).

By using standard methods the optimal discretionary policy is calculated as a rule for the interest rate which is a linear function of the predetermined variables:

$$(38)\quad r_t = Fx_{1,t}.$$

Given this interest rate rule the reduced form (i.e. the dynamics) of the model can be written as

$$(39)\quad x_{1,t+1} = Mx_{1,t} + \varepsilon_{1,t+1}$$

$$(40)\quad x_{2,t} = Nx_{1,t}.$$

For the calibrated model the relevant matrices are

$$(41)\quad F = \begin{pmatrix} 0.1880 & 0.4772 & 0.6182 & 0.6182 \end{pmatrix},$$

$$(42)\quad M = \begin{pmatrix} 0.6 & 0 & 0 & 0 \\ 0 & 0.6 & 0 & 0 \\ 0 & 0 & 0.6 & 0 \\ 0 & 0 & 0 & 0.6 \end{pmatrix}, \text{ and}$$

$$(43) \qquad N = \begin{pmatrix} 1.3014 & -0.5422 & 0.4338 & 0.4338 \\ -0.8459 & 0.3524 & -0.2819 & -0.2819 \\ -0.4700 & -1.1930 & 0.9544 & 0.9544 \end{pmatrix}.$$

The optimal interest rate rule under discretion can then be expressed as

$$(44) \qquad r_t = 0.1880\eta_t + 0.4772\nu_t + 0.6182\left(\varepsilon_t + r_t^f\right).$$

From (40) and (43) we can write the endogenous q_t variable as

$$(45) \qquad q_t = -0.4700\eta_t - 1.1930\nu_t + 0.9544\left(\varepsilon_t + r_t^f\right).$$

Note that in this approach q_t is not treated as an instrument. This is due to the fact that once the decision on the real interest rate path is made, the future evolution of q_t is determined by (45). Thus, it cannot be viewed as an independent instrument. However, as we will see below, the crucial difference between independently floating exchange rates and managed floating is that under a managed float this path is only determined by domestic and foreign interest rates while under a independent float this path is subject to stochastic disturbances stemming from the international financial markets. And these are the disturbances which induce the central to intervene in the foreign exchange market (see the previous Chapter, equation (21)).[11]

Solving (45) for $\left(\varepsilon_t + r_t^f\right)$ and inserting it into (44) yields an alternative formulation of the optimal reaction function

$$(46) \qquad r_t = 0.1880\eta_t + 0.4772\nu_t + \frac{0.6182}{0.9544}\left(q_t + 0.4700\eta_t + 1.1930\nu_t\right)$$

which can easily be solved for a linear combination of r_t and q_t, the Monetary Conditions Index (MCI):

$$(47) \qquad MCI_t = r_t - 0.6477q_t = 0.4924\eta_t + 1.2500\nu_t.$$

Equation (47) represents the internal equilibrium rule. It consists of two elements:

- the optimum weighting of the real exchange rate in the MCI: $\psi = 0.6477$;
- the optimum response of the MCI to domestic shocks: $MCI_t = 0.4924\eta_t + 1.2500\nu_t$.

Thus, the MCI serves as combined measure of the monetary policy stance which has to be controlled and adjusted in response to changing macroeconomic conditions. As a simple rule the monetary policy stance has to become more restrictive if the domestic economy is affected by positive supply or demand shocks (the optimal MCI rises); in the opposite case, when the domestic economy is hit by negative shocks (the optimal MCI declines), the monetary policy

[11] Of course equation (45) still contains ε_t as determinant of the real exchange rate path. This is because the internal equilibrium condition derived here equally applies to managed floating regimes and independently floating regimes. As we will show below, the extent to which managed floating is practiced is reflected in the degree of validity of UIP.

stance has to become more expansionary. The domestic constraint to monetary policy therefore is the strict observation of this rule, independently of the exchange rate regime chosen. A deviation from this rule leads to either an overheating or a recession of the domestic economy.

Managed floating in action – similarities and differences to independently floating exchange rates

The setting of the two operating targets within this framework can be demonstrated if we analyze four different shocks: a positive demand and an inflationary supply shock, a shock in the form of an increase of the foreign real interest rate and a UIP shock. The following Figures depict the impulse-response of the variables of interest over 12 periods. The shocks are assumed to hit the economy in period 1. To demonstrate the necessity of a policy reaction the left panel of Figure 8, Figure 10 and Figure 12 shows the development of inflation and output under the assumption of a constant real interest rate. The size of the shocks is one standard deviation.

Figure 8 shows that a positive *demand shock* calls for a restrictive MCI. In an open economy framework this is mainly achieved by an increase of the domestic real interest rate. Since the foreign real interest rate has remained unchanged, UIP requires that the domestic currency is on a depreciation path (see Figure 9). This is realized by an immediate real appreciation of the domestic currency which exerts an additional degree of monetary restriction.

Figure 8: Demand shock

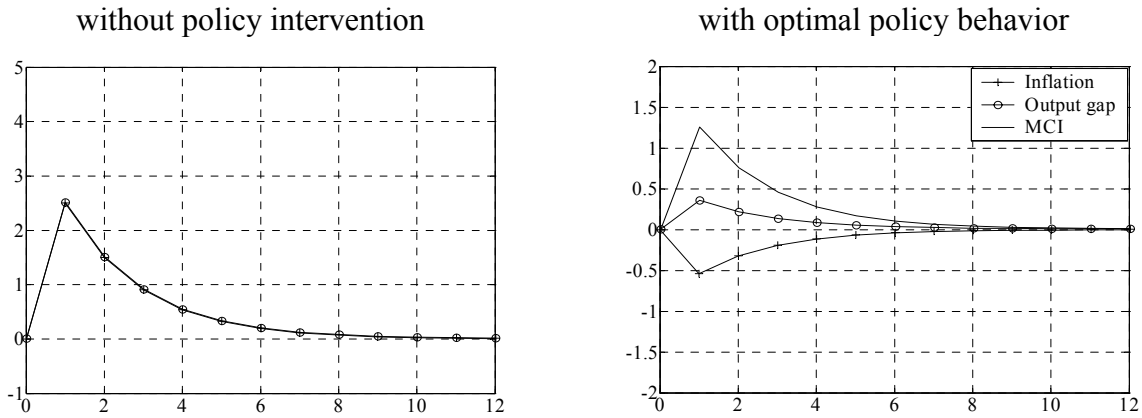
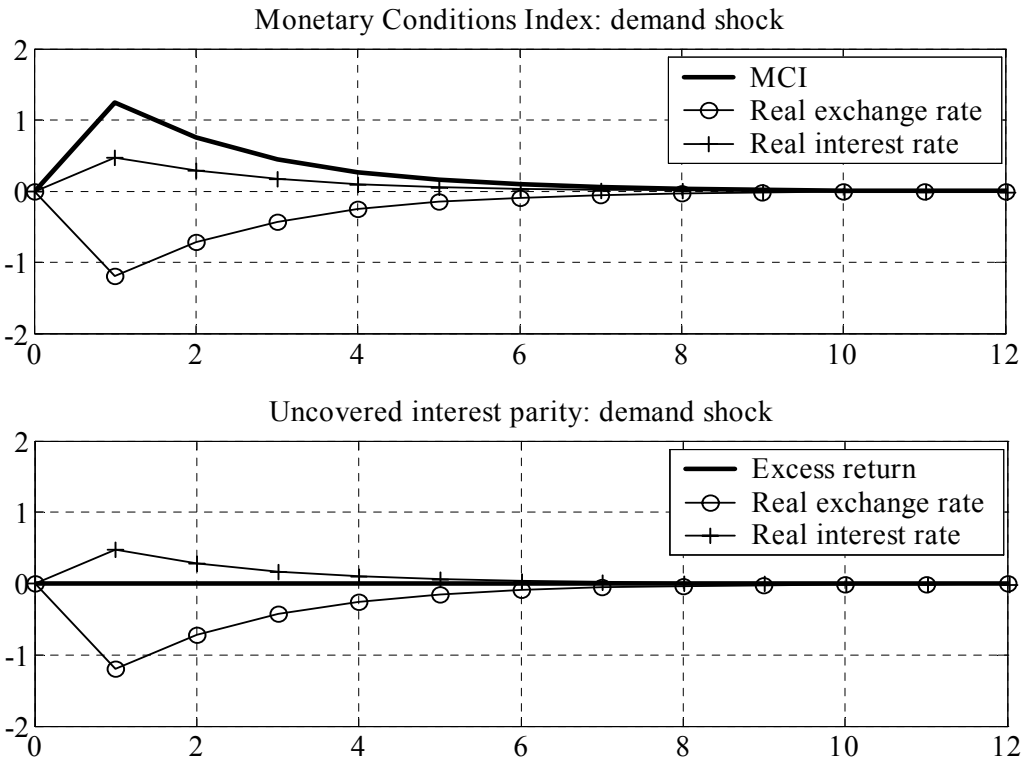


Figure 9: MCI and UIP with a demand shock



In the situation of an *inflationary supply* shock the model shows that also a (slight) tightening of monetary conditions is required (see Figure 10). Again, as the foreign interest rate has remained constant, an instantaneous appreciation is needed after which the domestic currency will depreciate in order to meet the UIP condition (see Figure 11).

Figure 10: Supply shock

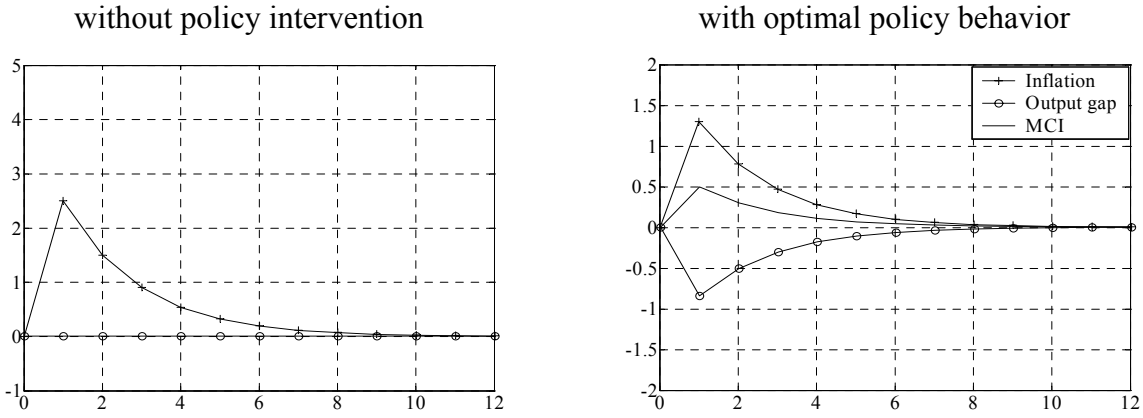
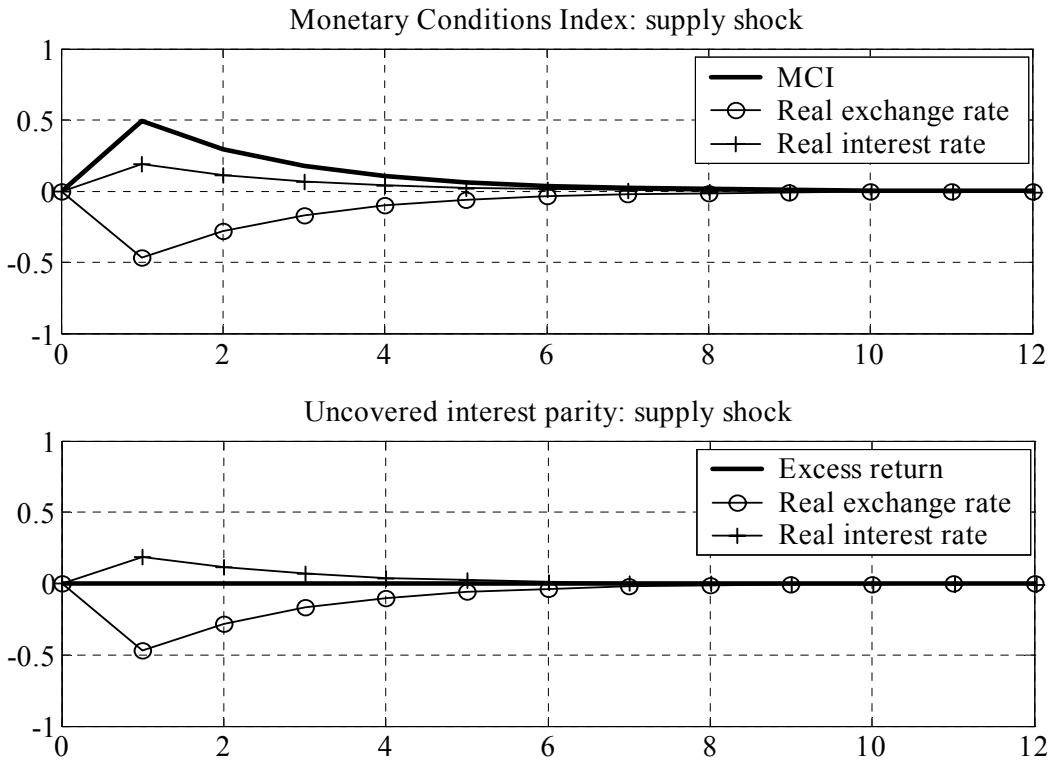


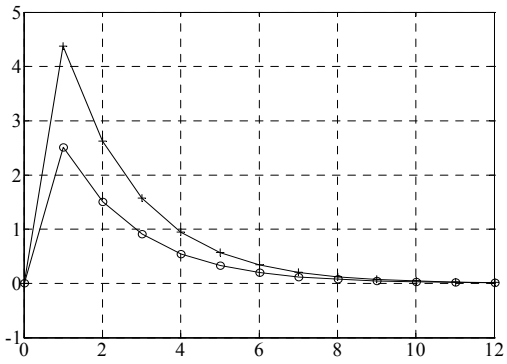
Figure 11: MCI and UIP with supply shocks



In an open economy changes in the *foreign interest rate* can be also treated as a shock. Here we assume that the foreign interest rate is increased by one standard deviation. In order to insulate the domestic economy from this disturbance, monetary policy has to keep monetary conditions unchanged (see Figure 12). This can be reconciled with UIP if the domestic real interest rate is increased, but less than the foreign rate and if at the same time the exchange rate is depreciated instantaneously which compensates the restrictive demand effect of the higher interest rate. From its depreciated level the exchange rate can appreciate over time so that the interest differential in favor of the foreign currency is compensated (see Figure 13).

Figure 12: Foreign interest rate shocks

without policy intervention



with optimal policy behavior

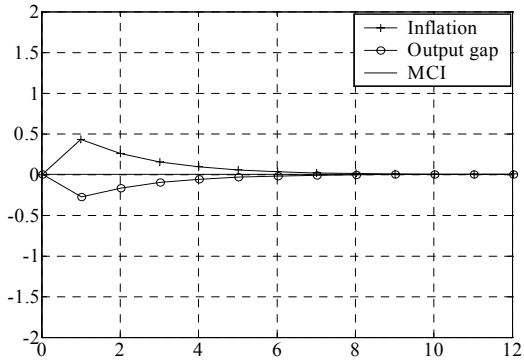
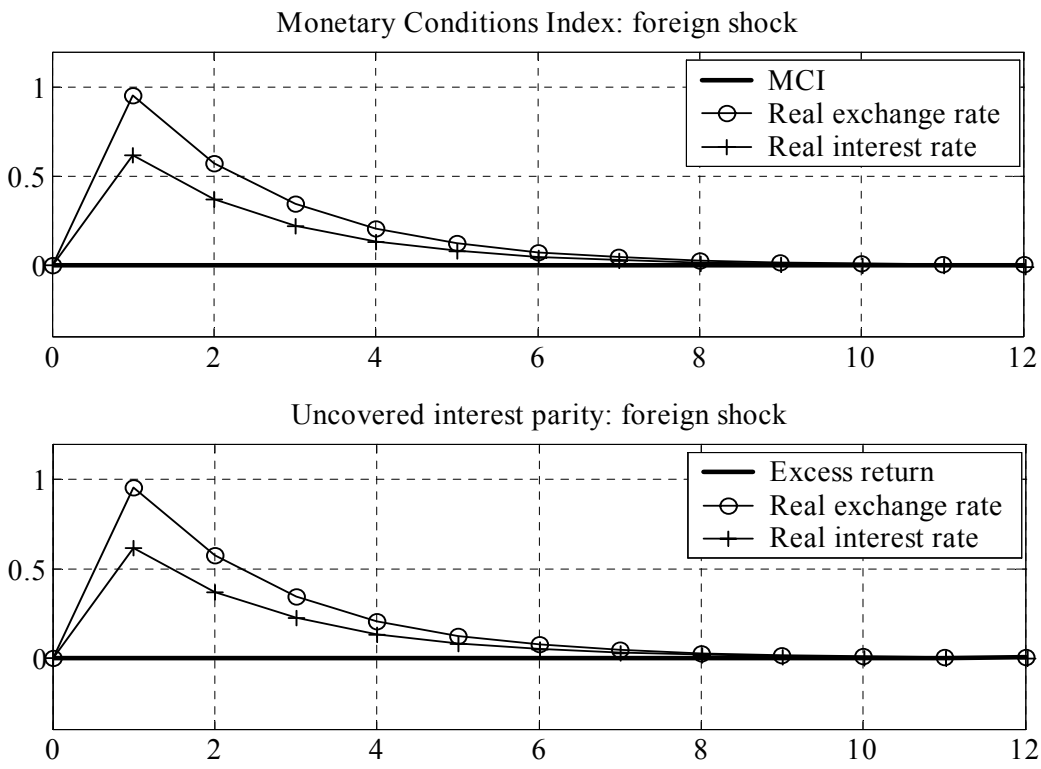


Figure 13: MCI and UIP with foreign interest rate shocks



It is important to note that the interest rate and exchange rate response to these three shocks would also take place under a system of free floating as long as the UIP condition is perfectly met. UIP would keep the exchange rate automatically on the target paths delineated here. However, as already mentioned, the empirical evidence for UIP is extremely poor. Thus, the main attraction of managed floating is that it uses foreign exchange market intervention in order to keep the exchange rate on the UIP path. In other words, managed floating prevents or least reduces UIP shocks. This is demonstrated by Table 7, Figure 14 and Figure 15 which compare the UIP for two independently floating countries (United Kingdom, New Zealand) and for two "managed floaters" (Peru and Slovenia). The results for the United Kingdom and New Zealand are taken from Hüfner [2002]. For the UIP estimations the following standard regression was carried out:

$$(48) \qquad \Delta s_{t,t+3M} = \alpha + \beta\left(i_{t,3M} - i^{f}_{t,3M}\right) + \varepsilon_{t,t+3M} .$$

For UIP to be valid, the parameter α has to equal zero, and the parameter β has to equal one. The 3-month ahead exchange rate changes refer to changes of the bilateral nominal exchange rate of the country under consideration against the US dollar, except for Slovenia which manages its parity against the German mark/the euro. The Peruvian nominal interest rate is the average rate offered by commercial banks on 31- to 179-day time deposits in national currency taken from the International Financial Statistics of the IMF. The Slovenian interest rates are average commercial banks' deposit rates with a maturity of 31 to 90 days taken from Bank of Slovenia's monthly bulletin. The remaining nominal interest rates are treasury bill rates taken from the International Financial Statistics of the IMF. The residuals of the estimations were all found to be stationary.

Again, one can see very clearly that UIP does not hold under independently floating rates. For the United Kingdom and New Zealand the "typical anomaly" of a negative β value can be detected. Moreover, in both cases, the βs become insignificant. In contrast to this, the estimated coefficients show that under managed floating a relatively solid evidence for UIP can be observed. In other words, the exchange rate policy in these cases has indeed contributed to exchange rate paths that were to some degree in line with UIP.

Table 7: Empirical evidence for UIP

	period	α	β	R^2
United Kingdom	1993:1 – 2001:1	-0.003 (0.420)	-0.775 (-0.417)	0.003
New Zealand	1993:1 – 2001:1	0.021 (1.550)	-2.345 (1.283)	0.031
Slovenia	1993:1 – 2001:12	0.005 (1.616)	0.461*** (4.976)	0.189
Peru	1995:1 – 2001:12	-0.016 (-1.636)	1.473*** (3.317)	0.118

Notes: t-values are in parentheses; *** denotes significance at the 1 per cent level; estimation method: OLS.

Figure 14: UIP under independently floating exchange rates

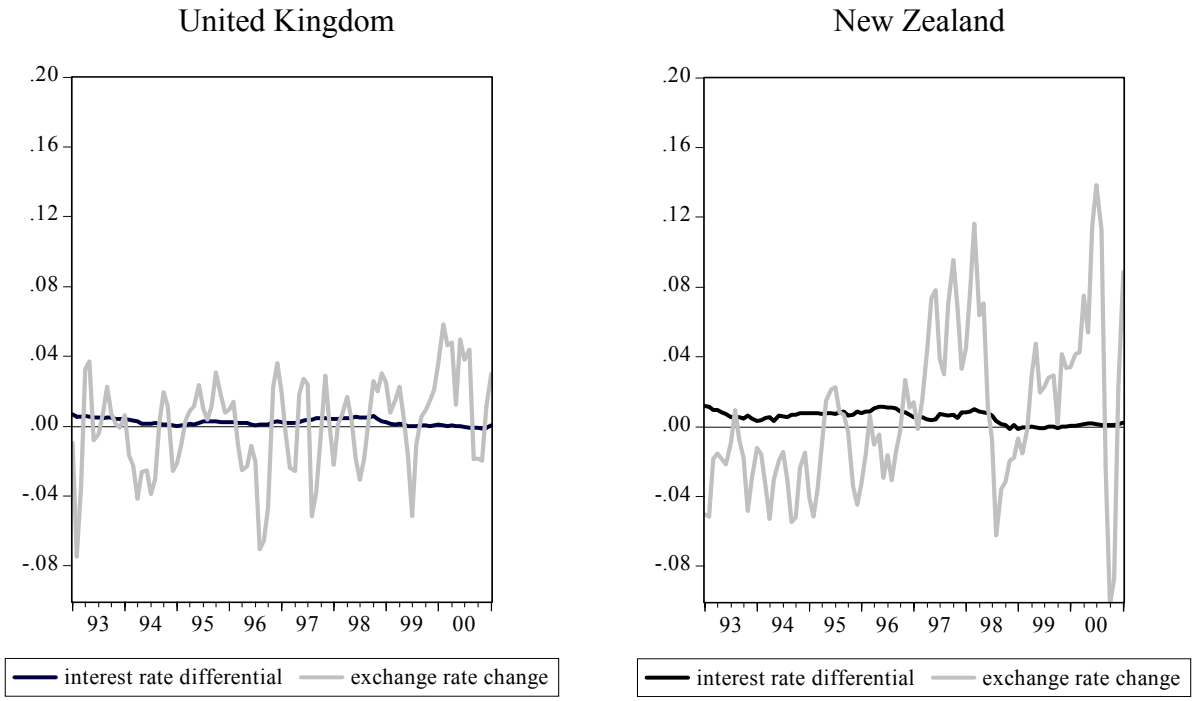
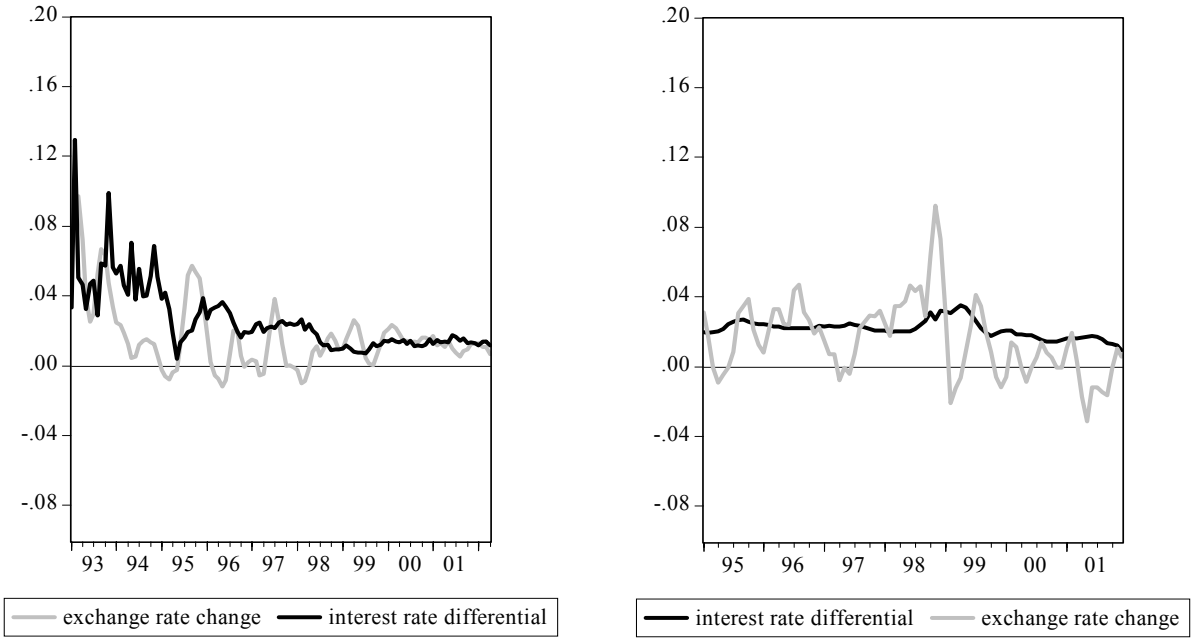


Figure 15: UIP under managed floating exchange rates

Slovenia Peru



Thus, the advantage of managed floating over independent floating can be demonstrated if we assume that a central bank is able to maintain perfect UIP by foreign exchange market intervention. As mentioned in Chapter 0 the budget constraint of foreign exchange reserves can prevent such a control if a currency is under the pressure of a depreciation. As a consequence the costs of independent floating consist in the social loss that is caused by UIP shocks. Figure 16 depicts the impact of UIP shocks on the goal variables π and y. It shows that even with optimum policy behavior (i.e. an increase in the real interest rate) deviations from the target values can be important.

Figure 16: Consequences of UIP shocks under independently floating exchange rates

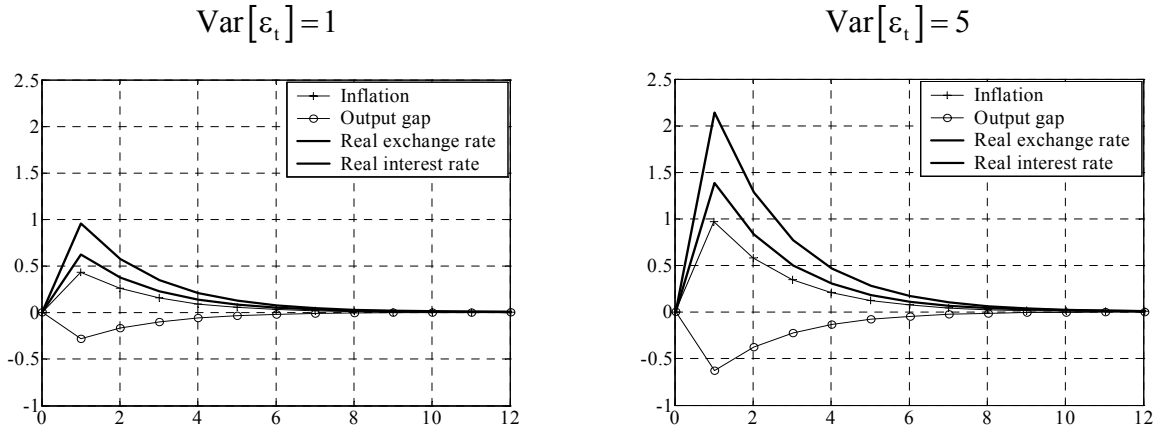
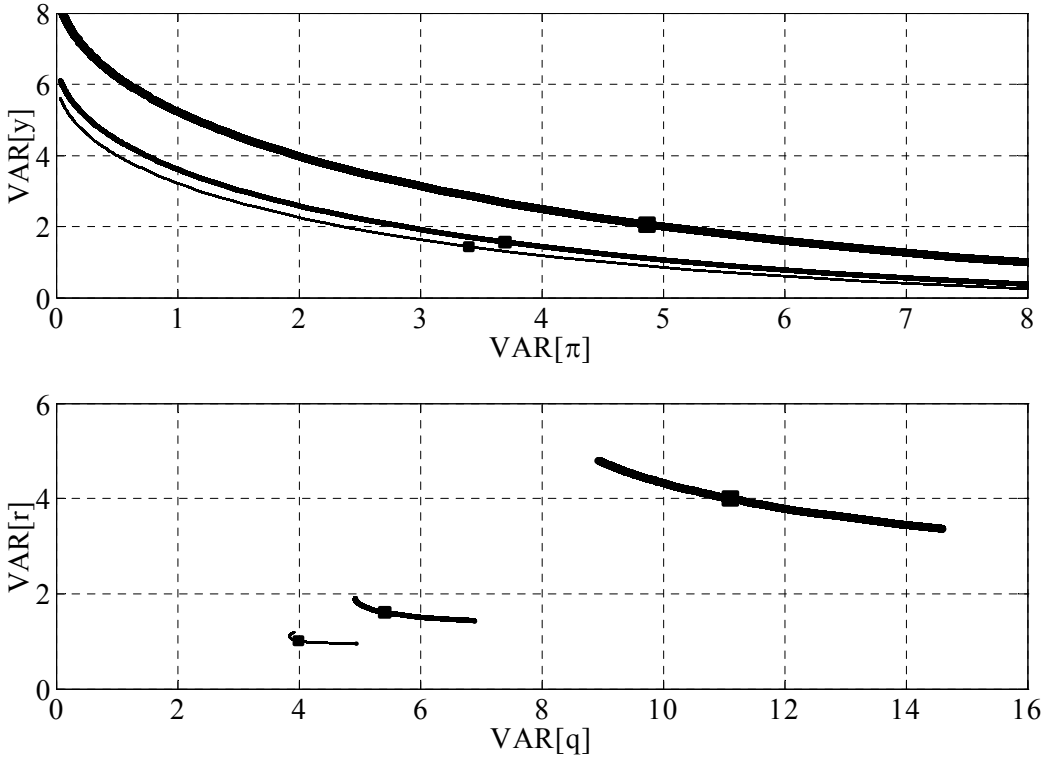


Figure 17 shows the policy frontiers for three variances of the UIP shock: $\mathrm{Var}[\varepsilon_t] = 0$ (the thin line), $\mathrm{Var}[\varepsilon_t] = 1$ (the medium line), and $\mathrm{Var}[\varepsilon_t] = 5$ (the thick line). The black squares indicate a central bank that equally weights the inflation rate and the output gap in its loss function. Thus, a perfect managed floating provides less output and inflation instability than pure float with UIP shocks. The lower panel of Figure 17 also shows that UIP shocks require

a high variance of the domestic interest rate which can conflict either with the stability of the domestic financial sector or with a zero-bound of nominal interest rates.

Figure 17: Policy frontiers in the case of UIP shocks



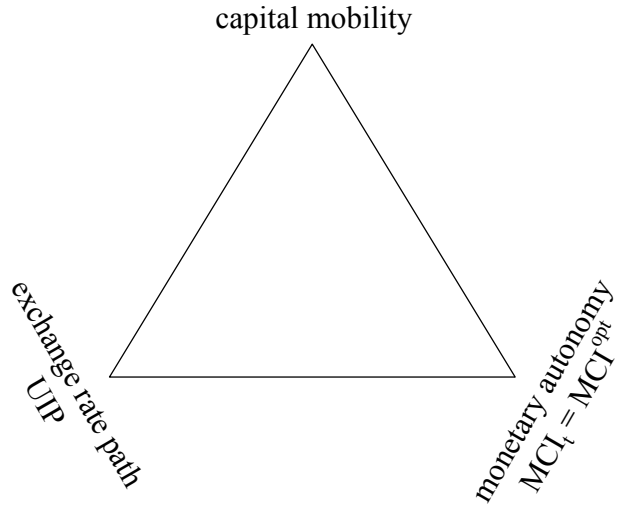
Overcoming the inconsistency triangle through managed floating

As already mentioned, the inconsistency triangle postulates that a country can only attain one side (i.e. one pair of attributes) of the triangle: capital controls, fixed exchange rates or pure floating. But it says nothing about the possibility of adopting some sort of intermediate regime. Frankel [1999] has mentioned this flaw of the current debate:

> "There is nothing in existing theory, for example, that prevents a country from pursuing a managed float in which half of every fluctuation in demand for its currency is accommodated by intervention and half is allowed to be reflected in the exchange rate." (ibid., p. 7)

Our discussion has shown that the solution to the inconsistency triangle is not a halfway house between half-stability and half-independence. Instead an integrated approach is required where the optimum interest rate level and the optimum exchange rate path are determined simultaneously. Thus, managed floating allows to convert the inconsistency triangle into a *consistency triangle* with the following three corners: capital mobility, an autonomously determined monetary conditions index and an exchange rate path which follows the interest rate differential and which can be controlled as long as the reserves are above a critical level (see Chapter 0). Above all, managed floating provides a comprehensive solution to the problem of capital inflows which many economists regard as an inherent flaw of intermediate regimes.

Figure 18: Consistency triangle



Unresolved issues of managed floating

While managed floating offers several important advantages compared with traditional exchange rate strategies, it is certainly not a panacea which could solve all problems of the international monetary order. The main weaknesses of this framework are the following:

- As the central bank does not announce an exchange rate path, the exchange rate can no longer be used as an anchor for private sector expectations which is especially useful in the situation of a disinflation.
- As a the control over the exchange rate is asymmetric, a central bank can lose the control over the macroeconomic situation if it is confronted with very strong capital outflows.
- As each central bank or government decides autonomously over the exchange rate, there is a serious risk that managed floating is misused for a beggar-my-neighbor policy which can undermine the aims of the WTO.

We will shortly discuss these three topics.

In search of a new anchor for private sector expectations

In the 1980s monetary targeting and exchange rate targeting were regarded as ideal devices for establishing a transparent and credible monetary framework in larger and smaller currency areas respectively. As far as monetary targeting is concerned, many central banks decided to substitute it by inflation targeting as a more comprehensive strategic approach (Bernanke et al. [1999], Bofinger [2001]). In same way, the EMS crises and the Asian crises have demonstrated that the conditions under which fixed nominal exchange rate pegs can be applied are very rare. In Bofinger and Wollmershäuser [2000] we have shown that the reason for the instability of such regimes is due to the difficulty to reconcile the dual requirement of internal and external equilibrium especially if the foreign interest rate is exceptionally low (US rates in the years 1971-73 and 1992-94) or high (German rates in 1992).

While managed floating allows an insulation from such disturbance, by its very nature it cannot provide an anchor for private sector expectations. Thus, if managed floating is

regarded as an optimum solution in terms of achieving internal and external equilibrium, an additional institutional device is required. The most obvious solution is inflation targeting which provides an anchor for expectations by a public announcement of the inflation target that the central bank intends to achieve.

There is nothing that prevents a combination of managed floating and inflation targeting. As demonstrated Ball [1999], inflation targeting in an open economy requires that the central bank sets monetary conditions in way that a given inflation target can be achieved. Managed floating provides a framework that allows to generate such monetary conditions in way that is compatible with external equilibrium. Schaechter et al. [2000] have shown there are already several emerging market countries that have adopted this approach: Brazil, Chile, the Czech Republic, Israel, Poland, and South Africa. All of them are now independent or managed floaters according to the IMF's classification.

The control over the exchange rate is asymmetric

The most serious flaw of managed floating as we have described it here is the asymmetric control over the exchange rate: a central bank's ability to avoid an unwanted depreciation is limited by the stock of its exchange reserves (and the availability of balance of payments credits). Thus, a central bank could always be confronted with a situation of a major crisis of confidence which forces it to accept a depreciation that exceeds its exchange rate target path by far. An example for such a crisis is the depreciation of the rupiah in 1997/98 from 2,500 rupiah per US-dollar in July 1997 to over 15,000 rupiah per US-dollar in mid-July 1998. In the more recent past, Uruguay had to give its managed float because of very strong capital outflows.

If a country loses control over the exchange rate it has to cope with a UIP shock. In order to maintain a given MCI, this would require a very strong increase of the interest rate. As the MCI is constructed under the assumption of a perfect substitutability of the interest rate and the exchange rate lever, such a policy switch would not be problematic. In reality, this substitutability is questionable, above all if the required degree of substitution is very high. While the exchange rate mainly affects the international sector of the economy (exporters and import substitution), the interest rate affects the whole economy. A policy shift leading to a strong real depreciation and a very high real interest rates implies an extremely restrictive impulse for the domestic sectors of the economy (the banking system because of its maturity transformation, the services and the construction sector, and the government which is often heavily indebted and often also in a foreign currency). As the Asian crisis has shown, such an overly restrictive effect on the domestic sectors of the economy can transform a currency crisis into a financial sector crisis.

Thus, under managed floating countries remain vulnerable to crises of confidence which can be generated simply by contagion effects. Some IMF credit facilities (the Supplemental Reserve Facility and as a precautionary device the Contingent Credit Line) provide countries with financial resources that are not subject to the usual limits but are based on the actual financing needs. However, a surcharge of 300 up to 500 basis points is applied for such funds and the member country has to repay these credits within 2 ½ years at the very latest. Given the rather strict eligibility criteria for the CCL[12] one could ask whether countries that are

[12] See IMF [2000], p. 67: "(...) the eligibility criteria confine potential candidates for a CCL to those members implementing policies considered unlikely to give rise to a need to use IMF resources; whose economic performance— and progress in adhering to relevant internationally accepted standards—has been assessed

qualified for CCL could be completely or partially dispensed from the repayment of such credits if a clear contagion effect can be diagnosed.

Managed floating and beggar-my-neighbor policies

With the widespread practice of managed floating by IMF member countries the international monetary order has experienced a profound change. By its very nature managed floating implies unilaterally decided exchange rate policies that are not discussed in the public domain. This gives governments ample scope for exchange rate policies that are not only designed by macroeconomic considerations but also by trade-related aspects. Since exchange rate changes have similar effects as tariffs, managed floating makes it possible to circumvent the regulations of the WTO.

The very fact that the foreign exchange reserves of developing countries have increased from 330 billions of US-dollar in 1990 to 1,170 billions of US-dollar in 2000[13] shows that in the longer run exchange rate policies were dominated by the desire to keep the national currencies on an undervalued basis. The alarmingly high United States current account deficits reflects the risks for those countries which follow a unilateral policy of benign neglect in a world where most other countries have clear targets for their exchange rate vis-à-vis the dollar.

Thus, managed floating would require a comprehensive surveillance of national exchange rate policies by the International Monetary Fund or even by the WTO. Without a clear theoretical framework for managed floating and a "neutral" exchange rate policy it will be not easy to detect strategic exchange rate policies. We hope that the empirical methods and the theoretical considerations presented in this paper can provide a basis for such an approach.

Managed floating and the Exchange Rate Mechanism II

Our analysis of managed floating has important implications for the exchange rate strategies of EU accession countries. It shows that the negative assessment of intermediate regimes which can be found in the papers by Buiter and Grafe [2002] and by Begg et al. [2001] is mainly due to a lack of a clear theoretical treatment. Above all, it becomes obvious that the capital inflow problem which plays an important role in the second paper is mainly attributable to a neglect of the UIP condition.

As a consequence, it is no longer compelling to ask for Euroization as the only sensible strategy for EMU entry. If managed floating is regarded as a realistic alternative, one has whether such a regime is compatible with the Exchange Rate Mechanism II which is the prescribed institutional framework for all EMU entrants. From our analysis of managed floating it is of special interest in which the ERM II deals with the main flaws of this regime: the asymmetric control over the exchange rate and the potential for beggar-my-neighbor-policies.

Institutional set-up

The Exchange Rate Mechanism II is a modified version of the Exchange Rate Mechanism of the original European Monetary System which started in March 1979. For the accession countries the ERM II plays an important role in their process to European monetary

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positively by the IMF in the latest Article IV consultation and thereafter; and which have constructive relations with private sector creditors with a view to facilitating appropriate private sector involvement."

[13] These figures are taken from the IFS (line 1l s, country code 200). As they were listed in SDRs, we multiplied them by the average annual US-dollar/SDR exchange rate.

integration. According to Article 121 of the Treaty one of the four *criteria* of convergence required for EMU entry is

> "the observance of the normal fluctuation margins provided for by the exchange rate mechanism of the European Monetary System, for at least two years, without devaluing against the currency of any other Member State."

In addition, the European Council in its resolution "on the establishment of an exchange-rate mechanism in the third stage of economic and monetary union" has declared:[14]

> "Participation in the exchange-rate mechanism will be voluntary for the Member States outside the euro area. Nevertheless, Member States with a derogation can be expected to join the mechanism. A Member State which does not participate from the outset in the exchange-rate mechanism may participate at a later date."

Thus, under present rules an accession country

- cannot join the ERM II before EU membership,
- may and is expected to join the ERM II after it has become an EU member,
- must join the ERM II two years prior to its scheduled EMU entry.

For an assessment of the status quo it seems useful to analyze in more detail the institutional framework provided by the ERM II and its contribution to the exchange rate policies of accession countries in relation to the euro. The most important elements of the ERM II are

- the definition of central rates and fluctuation bands,
- the rules for marginal and intramarginal interventions,
- the provision of short-term financing facilities for interventions,
- an exit option, especially for the ECB.

Central rates and fluctuations bands

According to the resolution of the Council an ERM II member country must define a *central rate* against the euro for its currency. Thus, the system is *asymmetric* by nature, since the ECB is not required to do the same for the euro vis-à-vis the currencies of ERM II members. This is one of the main differences between ERM II and ERM I where a formal symmetry prevailed. The parities were defined by a "*parity grid*", i.e. a matrix of mutual parities.

In line with the regulations for the ERM I since August 1993 the *fluctuation band* of the ERM II is ± 15 %. In the ERM I until July 1993 the "normal" fluctuation margin was ± 2.25 %; a wide band of ± 6 % was also possible, but it was only used by Italy.

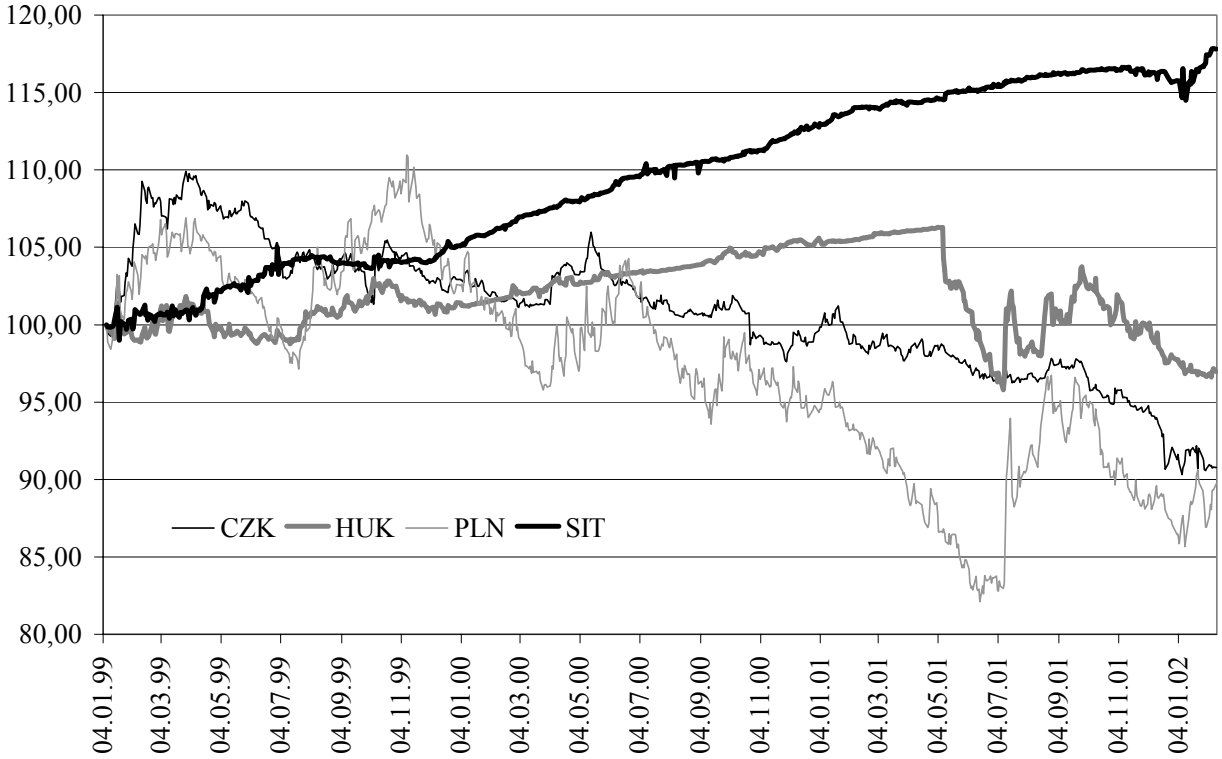
Because of the fixed parity one could argue that managed floating and ERM II are incompatible. However, as the Ecofin has stated this only applies to managed floating without a mutually agreed central rate.[15] As Figure 19 shows, the exchange rate paths of all lead

[14] Resolution from 16 June 1997 (97/C 236/03).

[15] See also ECOFIN [2001]: "The only clear incompatibilities with the ERM II that can be identified already at this stage are the cases of free floating (or managed floats without a mutually agreed central rate), crawling pegs, and pegs against anchors other than the euro."

accession countries since 1999 could have been relatively easily surrounded by a ± 15 % band around a constant central rate.

Figure 19: Exchange rates of the lead accession countries vis-à-vis the euro



Source: European Central Bank

Thus, ERM II is very well suited for a policy of managed floating. First, the *broad fluctuation margins* provide a sufficient breathing space for exchange rate paths that are determined by interest rate differentials. Even if one assumes that a currency exhibits a interest differential of 10 percentage points in relation the euro, it could be kept within the band at a constant central rate for three years: It would start in the first year at the ceiling of the band and gradually move towards to floor by the end of the third year. Additional flexibility is provided by the possibility of discretionary realignments.

As far as parity adjustments are concerned, the resolution calls for a coordinated procedure:

> "Decisions on central rates and the standard fluctuation band shall be taken by mutual agreement of the ministers of the euro-area Member States, the ECB and the ministers and central bank governors of the non-euro area Member States participating in the new mechanism, following a common procedure involving the European Commission, and after consultation of the Economic and Financial Committee. The ministers and governors of the central banks of the Member States not participating in the exchange-rate mechanism will take part but will not have the right to vote in the procedure."

This constitutes another positive feature of the ERM II since it removes one of the risk of an unilateral floating where an individual country could be always tempted to pursue a beggar-my-neighbor-policy. This advantage of a coordinated exchange rate management increases

with the number of countries in Central and Eastern Europe participating in the ERM II. It is important to note that such an arrangement is mainly in the interest of the present EMU countries since it helps to prevent an exchange rate dumping by CEE countries.

Rules for interventions

In line with our assessment of foreign exchange markets the resolution explicitly addresses the problems of purely market-determined exchange rates:

> "the mechanism will also help to protect them (ERM II members; PB and TW) and the Member States adopting the euro from unwarranted pressures in the foreign-exchange markets. In such cases, it may assist Member States outside the euro area participating in it, when their currencies come under pressure, to combine appropriate policy responses, including interest-rate measures, with coordinated intervention."

The agreement which will be made between the ECB and possible ERM II members differentiates between *marginal* interventions, i.e. interventions which are required for preventing a breaching of the margins, and *intramarginal* interventions, i.e. interventions within the margins. The agreement stipulates:

- "Intervention at the margins shall in principle be automatic and unlimited. However, the ECB and a ERM II central bank can suspend these interventions if they conflict with the objective of price stability".
- "The ECB and participating non-euro area NCBs (national central banks; PB and TW) may agree to co-ordinated intramarginal intervention."

It is obvious that the agreement is still very much shaped by the arrangements of the original ERM I with its narrow ± 2.25 % margins. In this system shocks very rapidly forced a currency to the limits of the band so that marginal intervention took place rather often and had to be a very effective tool. Nevertheless, intramarginal interventions also played an important role in the original ERM but they were never given an equal treatment with marginal interventions.[16]

This subordinate role of intramarginal interventions makes is a clear disadvantage for countries that want to pursue managed floating within the ERM II. In this case intramarginal interventions are certainly more important than marginal interventions which only come into play if intramarginal interventions were insufficient in stopping a speculative attack. Thus, under managed floating

- intramarginal interventions are required for the management of the exchange rate from day to day, while
- marginal interventions provide a safety net which under an effective exchange rate management will not be used.

In other words, the importance of the different forms of interventions is completely different under managed floating within the ERM II than under the narrow bands of the original ERM.

[16] A limited access for such interventions was made possible with the Basle-Nyborg agreement of 1987.

Financing of interventions ("Very short-term financing facility")

Compared with a unilateral managed floating, ERM II membership would provide the CEE countries access to the "very short-term financing facility" (VSTF) of the ERM II. The ECB's preferential treatment of marginal interventions is also mirrored in the regulations for the financing of interventions:

- In the case of *marginal* interventions the VSTF is "in principle automatically available and unlimited in amount".
- For *intramarginal* interventions, the VSTF can also be used but it requires an agreement of the ECB and the cumulative amount made available for such interventions is limited to a ceiling which is laid down for each ERM II member country. In addition it is expected that the debtor central bank makes "appropriate use" of its own reserves.

As the asymmetry of the reserve constraint is one of the main difficulties of a strategy of managed floating, the provision of additional funds is certainly very helpful. However, in the case of intramarginal interventions the *ceilings* laid down by the agreement are relatively strict. E.g. Denmark could obtain a maximum of 520 million euro. If one relates the ceilings to a country's GDP, e.g. Poland would qualify for about 450 million euro. Compared with Poland's foreign exchange reserves totaling about 25 billion dollar, the additional leeway provided by the VSTF is extremely limited.

In both cases the *maturity* of the credits is indeed very short-term. The unlimited facilities for marginal interventions have to be repaid after three months. They can be automatically renewed once, but this is also limited to the narrow ceilings of the agreement. Thus, for defending a currency a against a strong speculative attack, the whole financing mechanism is not very effective. This became obvious in the ERM crises of 1992/93 when France had to give up the ± 2.25 % margin in August 1993 although its macroeconomic fundamentals were not worse than those of Germany.

The exit option

In the view of the Bundesbank, one of the main flaws of the ERM I was the lack of a clearly defined exit option for the central bank with a strong currency.[17] This concern was taken up by the authors of the Council resolution:

> "However, the ECB and the central banks of the other participants could suspend intervention if this were to conflict with their primary objective. In their decision they would take due account of all relevant factors and in particular of the need to maintain price stability and the credible functioning of the exchange-rate mechanism."

Such a regulation would certainly have been helpful for the Bundesbank in the ERM I where it was confronted with up to nine central banks, some of them of almost similar size. In the case of the ECB and its relations with CEE countries such a safeguard clause seems no longer appropriate. It is difficult to image that even strong *interventions* for Poland, as the largest CEE economy, but with a GDP and a monetary base of only 3½ % of the present euro area, could directly threaten the ECB's attempts to maintain price stability.

[17] Otmar Emminger (the Bundesbank's president in the period from 1977-79) in November 1978 wrote a letter to the German Government in which he declared that the Bundesbank would make use of an opting-out in the case of interventions threatening monetary stability in Germany (see Emminger [1986]).

In the relationship between a hegemonic ECB and its satellites in the CEE the main risk is that a certain ERM II country is pursuing a non-stability oriented fiscal and monetary policy which causes a strong depreciation of its currency, but which only in the longer run, if at all, could impair price stability of the whole currency area. As in this case interventions by itself would not be the right therapy, it would be helpful if the ECB could suspend interventions from the very outset. A simple framework for a modified exit option could be based on the "*broad guidelines*" laid down in Article 99 of the Treaty which were not available when the original ERM was established. In the context of an ERM II exit option the following two paragraphs would be especially important:

> Paragraph 3: "In order to ensure closer coordination of economic policies and sustained convergence of the economic performances of the Member States, the Council shall (...) regularly carry out an overall assessment."
>
> Paragraph 4: "Where it is established (...) that the economic policies of a Member State are not consistent with the broad guidelines (...) or that they risk jeopardising the proper functioning of economic and monetary union, the Council may (...) make the necessary recommendations to the Member State concerned."

Thus, an exit option could be designed in a way that a country automatically looses the access to the VSTF if the Council decides according to paragraph 4 that its policies are no longer compatible with the broad guidelines.

Overall assessment

While the rules for central rates and the fluctuations band are well designed for a policy of managed floating, the rules for interventions, the VSTF and the exit option are still very much shaped by the situation of the old ERM with its narrow bands and a Bundesbank which had to safeguard its dominance vis-à-vis relatively large member countries. As a result, the additional funds made available under the VSTF are very limited so that under the status quo ERM II membership provides relatively small advantages for an accession country.

Therefore, it seems useful to reconsider the whole ERM II framework. In our view, it would be possible to modify the Council resolution as well as the ECB agreement in a way that

- it really supports the stability-oriented accession countries on their way to EMU
- without jeopardizing price stability in the euro area.

This requires above all, that a much stronger role is assigned to intramarginal interventions. First, it would be necessary to stipulate in article 4 of the agreement that an ERM II member country has a general permission to undertake intramarginal interventions at its own discretion. This would reflect the fact that under managed floating the exchange rate and the interest rate policy are integral elements of autonomous national monetary policy. If an ECB agreement is always required for intramarginal interventions, this could interfere with an effective national monetary policy and it could blur monetary policy responsibilities.

Second, in order to support a smooth exchange rate policy of accession countries, the ceilings of the VSTF would have to be increased considerably. The example of Denmark shows that the amounts have been kept constant in nominal terms since 1979 which explains their very

small size compared to present levels of foreign exchange reserves. For Table 8 we assume that the ceilings would be about 20 times the size of the present agreement so that Poland would be entitled to an amount of 10 billion euro. The ceilings for the other countries were calculated according to the nominal GDP. For all accession countries in Central and Eastern Europe this would lead to an aggregate ceiling of about 23 billion euro.

Table 8: Ceilings in an enhanced VSTF (=20 times the ceilings under the current VSTF)

Country	GDP (€ billion)	Ceiling (€ billion)
Bulgaria	13.0	0.8
Czech Republic	55.0	3.2
Estonia	5.5	0.3
Hungary	49.5	2.9
Latvia	7.7	0.5
Lithuania	12.2	0.7
Poland	171.0	10.0
Romania	40.0	2.3
Slovak Republic	20.9	1.2
Slovenia	19.5	1.1
Sum		23.1

Source: Deutsche Bundesbank, own calculations

A comparison of the aggregate ceiling with the amount of refinance credits provided by ECB which total about 200 billion demonstrates that such an extended VSTF would not constitute a problem for the ECB's monetary policy management. In any case, the situation would be much less difficult than for the Bundesbank in 1979, when it was confronted with an aggregate ceiling (of the other EU members) of 16.5 billion ECU compared with a monetary base of 57 billion ECU.

Such a modification of VSTF would not only be in the interest of the accession countries it could also be helpful for the present EMU members. By transforming ERM II from a waiting room into a business class lounge, accession countries would join sooner than under present conditions. As already mentioned this has the advantage that a mutual agreement on parities and realignments is required which prevents the old members against an exchange rate dumping by the newcomers. In addition, if the access to a much more generous VSTF is made dependent on the observance of the "broad policy guidelines", it additionally creates a very strong incentive for national policy makers to adhere to these guidelines which fosters macroeconomic stability in the whole European Union.

A pre-accession ERM II

Given these advantages of a modified ERM II the question arises whether it would be adequate to open it also to countries which are in the accession stage. Under legal aspects such an opening would be not too difficult since in the tradition of the original EMS and ERM the whole ERM II has be designed outside the EU Treaty. As already mentioned it simply rests on a resolution by the Council and on an agreement between the ECB and national central banks. Both legal documents could be easily amended and modified permitting an ERM II membership already to accession countries.

Of course, such an opening of the ERM II would require an enhanced surveillance of national economic policies by the EU. Along the lines already mentioned, one could envisage that "broad policy guidelines" are formulated already for accession countries. If the access to

ERM II is made contingent upon meeting the guidelines, national governments would have a very strong inventive to pursue stability-oriented economic policies at the macroeconomic and the microeconomic level.

Conclusion

After the experience with the currency crises of the 1990s, a broad consensus has emerged among economists that such shocks can only be avoided and capital mobility be maintained if countries adopt either purely floating exchange rates or very hard pegs (currency boards, dollarization). As a consequence of this view which has been enshrined in the so-inconsistency triangle (or "unholy trinity") all intermediate currency regimes are now regarded as inherently unstable. As far as economic theory is concerned, this view has the attractive feature that it not only fits nicely with the logic of the traditional Mundell-Fleming model but also that for both corner solutions (flexible exchange rates with a domestically oriented interest rate policy; hard pegs with a completely exchange rate oriented monetary policy) solid theoretical frameworks have been developed. Finally the IMF's statistics seem to confirm that indeed intermediate regimes are less and less in fashion by both industrial countries and emerging market economies.

However, in the last few years an anomaly has been detected which seriously challenges this new paradigm on exchange rate regimes. In their influential cross-country studies, Calvo and Reinhart [2000] and Levy-Yeyati and Sturzenegger [2002] have shown that many of those countries which had declared themselves as "independent floaters" in the IMF statistics were indeed heavily intervening on foreign exchange markets. Thus, in most cases "floating" means "managed floating".

This insight and the lack of literature about "managed floating" was the starting point for our study. We first developed a set of indicators that allows us to differentiate further between three forms of floating:

- *Pure floaters* completely refrain from foreign exchange market intervention.
- *Independent floaters* intervene in order to smoothen short-term swings in exchange rates but they allow the market to determine the path of the external value of their currency.
- *Managed floaters* are characterized by the fact that the central bank tries to control the exchange rate path by sterilized intervention.

Our empirical analysis which extends and refines the Calvo/Reinhart approach comes to the result that many developed and emerging market economies can be regarded as managed floaters. In other words, the international monetary order is currently dominated by managed floating. This has important implications for economic theory and economic policy. As far as theory is concerned, managed floating is different from the textbook versions of both fixed and flexible exchange rates.

- Compared with *flexible exchange rates* (or pure floating) the central intervenes sometimes very often and also with high quantities on the foreign exchange market in order to target a path for the exchange rate.
- Compared with *fixed exchange rates* (or also crawling pegs) the central bank does not announce its target path. In other words, there is no pre-commitment in the exchange

rate policy. Instead of such a rule-based approach, a completely discretionary exchange rate management is adopted.

Thus, managed floating can no longer be explained with the Mundell-Flemig model (above all because it is a comparative static model) nor with standard theories of fixed exchange rates or flexible exchange rates (including the more refined models of open economy inflation targeting). Therefore, we have tried to develop a simple theoretical framework for managed floating. At the level of a central bank's *operating targets* it is based on the assumption that to some extent a simultaneous targeting of the nominal short-term interest rate and the nominal exchange rate is possible. Since the latter is rather controversial, above all because of the literature on sterilized interventions, we have shown in detail under which conditions a targeting of the exchange rate is possible. This is the case above all, if

- the currency is under a pressure of strong inflows, i.e. it is appreciating by more than a target rate set by the central bank;
- the central bank disposes over a large sterilization potential;
- the costs of intervention are low; this is the case if the target path for the exchange rate is compatible with the interest rate differential.

In the next step we develop a monetary and exchange rate policy framework which is grounded on the general logic of the Mundell-Fleming, but which neglects fiscal policy. It is based on the assumption that the two levers of a central bank (exchange rate, interest rate) have to be so as to fulfill internal and external equilibrium simultaneously:

- As for the *internal equilibrium*, both operating targets have to be set in a way that minimizes a typical loss function of a central bank. We use an MCI as a combined measure of the actual monetary policy stance that results from both, the real interest rate and the real exchange rate.[18] More precisely, we define the internal equilibrium condition as an MCI rule which we derive in accordance with a real interest rate rule for a closed economy. In other words, internal equilibrium requires that the short-interest rate and the exchange rate path are set in way that an optimum MCI is realized.
- As for the *external equilibrium*, the exchange rate path and the interest rate have to be set in a way that they correspond with the interest rate differential vis-à-vis the anchor currency. This avoids short-term profit opportunities of international investors and thus helps to prevent speculative inflows (which can often turn into outflows). At same time this rule keeps the cost of sterilization as low as possible.

With a simple New-Keynesian model we show how the two operating targets have to be adjusted if the economy is affect by different shocks (demand shock, supply shock, foreign interest rate shock). It becomes obvious that the adjustment of the two operating targets is identical under managed floating and under pure floating. Thus, the main difference between these two approaches are UIP shocks. Due to the dismal empirical performance of UIP it is obvious that such shocks can be very large. Under a regime of pure floating a UIP shock has a negative effect on the central bank's target variables and thus causes a social loss. This can be avoided under managed floating as long as the central bank is able to keep the exchange rate on a path determined by the interest rate differential. As a consequence, the efficiency line

[18] As we assume sticky prices in the short-run, we assume that the real exchange rate and the real interest rate can be perfectly controlled by the nominal interest rate and the nominal exchange rate

under managed floating is superior to the efficiency line under pure floating. Thus, managed floating offers a free lunch by using the additional degree of freedom that is provided by sterilized interventions.

We also discuss several unresolved issues of managed floating. First, as the central bank does not announce an exchange rate path, the exchange rate can no longer be used as an anchor for private sector expectations. Thus, in the same way as the abandonment of rules for the money supply has paved the way for inflation targeting, a discretionary approach towards exchange rate targeting could also be accompanied with a switch to inflation targeting. In fact, same of the countries which manage their exchange rate have already introduced inflation targeting. Second, as a the control over the exchange rate is asymmetric, a central bank can lose the control over the macroeconomic situation if it is confronted with very strong capital outflows. This shows that managed floating is not a complete substitute for international co-operation in exchange rate policy. The contingent credit line of the IMF can be regarded as an important step into this direction. Third, as each central bank or government decides autonomously over the exchange rate, there is a serious risk that managed floating is misused for a beggar-my-neighbor policy which can undermine the aims of the WTO. The very strong increase in the foreign exchange reserves of developing countries in the 1990s is a strong indication that such incentives are rather strong. At the same time the growing current account surplus of the United States shows the negative consequences for those countries that follow a completely passive exchange rate policy in an environment that is dominated by managed floating. Thus, managed floating is also not a prefect substitute for international coordination of exchange rate polices. On contrary, it makes this even more urgent than fixed rates or purely flexible rates.

Finally, we discuss managed floating as a strategy for the EMU entry of countries in Central and Eastern Europe. For that purpose we analyze the main rules of the ERM II which provides the institutional framework for this transition. We show that in its present form ERM II would allow enough flexibility to pursue a policy of managed floating. However, the intervention and credit facilities of ERM II which originally were designed for ERM I with its narrow ± 2.25 % band are of little help for a central bank that tries to follow a policy of managed floating. There is very limited financial support for such interventions. In addition, they also require the ECB's approval. In order to make this intermediate regime more attractive, the ECB should consider a significant increase of the individual credit facilities in general and above all for intramarginal interventions. While this would not impair the ECB's internal monetary management, such a reform could have the advantage that Euroization is no longer regarded as the only viable option.

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Appendix 1: Country coverage

Table 9: IMF exchange rate classification of developed and emerging market economies

Country	Period	IMF	data availability	Country	Period	IMF	data availability
Argentina	10/78 - 12/90	if		**Mexico 3**	12/94 - 11/00	if	12/94 - 09/00
Australia 1	07/82 - 11/83	mf		**Morocco**	09/80 - 03/90	mf	
Australia 2	12/83 - 11/00	if		**New Zealand**	04/85 - 11/00	if	04/85 - 10/00
Brazil 1	03/90 - 09/94	if		**Nigeria 1**	07/82 - 08/86	mf	
Brazil 2	10/94 - 09/98	mf		**Nigeria 2**	09/86 - 12/93	if	
Brazil 3	01/99 - 11/00	if		**Nigeria 3**	03/98 - 11/00	mf	not available
Bulgaria	02/91 - 06/97	if	06/94 - 06/97	**Norway 1**	12/92 - 06/95	if	
Canada	01/75 - 11/00	if		**Norway 2**	09/95 - 11/00	mf	
Chile 1	09/82 - 06/99	mf		**Pakistan**	02/82 - 09/99	mf	02/82 - 04/99
Chile 2	09/99 - 11/00	if		**Peru**	06/90 - 11/00	if	
Colombia 1	01/75 - 06/99	mf		**Philippines 1**	10/78 - 12/84	mf	
Colombia 2	09/99 - 11/00	if		**Philippines 2**	12/84 - 11/00	if	12/84 - 10/00
Czech Republic	06/97 - 11/00	mf	06/97 - 10/00	**Poland 1**	12/91 - 09/98	mf	
Ecuador 1	03/89 - 11/95	mf		**Poland 2**	04/00 - 11/00	if	
Ecuador 2	12/95 - 01/99	mf		**Portugal**	01/75 - 03/92	mf	
Ecuador 3	04/99 - 01/00	if		**Russia 1**	07/92 - 06/95	if	not available
Egypt	06/87 - 09/98	mf		**Russia 2**	07/95 - 12/97	mf	
Finland	09/92 - 09/96	if		**Russia 3**	09/99 - 11/00	if	
Greece 1	12/82 - 12/95	mf		**Singapore**	12/87 - 11/00	mf	
Greece 2	01/96 - 12/97	mf		**Slovenia**	06/93 - 11/00	mf	
Hungary	06/95 - 08/00	mf	06/95 - 08/00	**South Africa**	01/83 - 11/00	if	
India 1	02/79 - 02/93	mf		**Spain**	07/82 - 12/87	mf	
India 2	03/93 - 11/00	if		**Sri Lanka**	10/78 - 11/00	mf	10/78 - 10/00
Indonesia 1	05/83 - 06/97	mf		**Sweden**	12/92 - 11/00	if	
Indonesia 2	09/97 - 11/00	if	09/97 - 04/00	**Switzerland**	04/79 - 11/00	if	04/79 - 10/00
Israel 1	03/84 - 03/87	mf		**Thailand 1**	06/97 - 03/98	mf	
Israel 2	12/91 - 11/00	mf	12/91 - 09/00	**Thailand 2**	03/98 - 11/00	if	
Italy	09/92 - 09/96	if		**Turkey**	01/80 - 11/00	mf	01/80 - 09/00
Japan	01/75 - 11/00	if		**United Kingdom 1**	01/75 - 09/90	if	
Korea 1	03/80 - 10/97	mf		**United Kingdom 2**	09/92 - 11/00	if	09/92 - 09/00
Korea 2	12/97 - 11/00	if		**United States**	01/75 - 11/00	if	
Malaysia	06/93 - 03/98	mf		**Venezuela 1**	03/89 - 03/93	if	
Mexico 1	02/83 - 10/91	mf		**Venezuela 2**	06/93 - 06/94	mf	
Mexico 2	11/91 - 11/94	mf		**Venezuela 3**	06/96 - 11/00	mf	06/96 - 08/00

Table 10: Number of observations

	n = 6		n = 12			n = 6		n = 12	
normalization method	**1**	**2**	**1**	**2**	**normalization method**	**1**	**2**	**1**	**2**
Argentina	142	142	136	136	**Mexico 2**	37	37	37	37
Australia 1	12	12	6	6	**Mexico 3**	65	67	59	61
Australia 2	199	199	193	193	**Morocco**	109	109	103	103
Brazil 1	50	50	44	44	**New Zealand**	182	182	176	176
Brazil 2	46	46	40	40	**Nigeria 2**	82	82	76	76
Brazil 3	18	18	11	11	**Nigeria 3**	46	46	40	40
Bulgaria	13	32	7	26	**Norway 1**	26	26	20	20
Canada	311	311	311	311	**Norway 2**	58	58	52	52
Chile 1	197	197	191	191	**Pakistan**	202	202	196	196
Chile 2	10	10	4	4	**Peru**	121	121	115	115
Colombia 1	294	294	294	294	**Philippines 1**	70	70	64	64
Colombia 2	10	10	4	4	**Philippines 2**	186	187	180	181
Czech Republic	36	36	30	30	**Poland 1**	89	89	83	83
Ecuador 1	76	76	70	70	**Poland 2**	3	3	0	0
Ecuador 2	38	38	38	38	**Portugal**	207	207	207	207
Ecuador 3	5	5	0	0	**Russia 2**	25	25	19	19
Egypt	131	131	125	125	**Russia 3**	10	10	4	4
Finland	44	44	38	38	**Singapore**	151	151	145	145
Greece 1	152	152	146	146	**Slovenia**	85	85	79	79
Greece 2	24	24	24	24	**South Africa**	210	210	204	204
Hungary	58	58	52	52	**Spain**	60	60	54	54
India 1	164	164	158	158	**Sri Lanka**	260	260	254	254
India 2	88	88	82	82	**Sweden**	91	91	85	85
Indonesia 1	165	165	159	159	**Switzerland**	254	254	248	248
Indonesia 2	27	34	21	28	**Thailand 1**	6	6	0	0
Israel 1	32	32	26	26	**Thailand 2**	28	28	22	22
Israel 2	101	101	95	95	**Turkey**	244	244	238	238
Italy	44	44	38	38	**United Kingdom 1**	189	189	189	189
Japan	311	311	311	311	**United Kingdom 2**	92	92	86	86
Korea 1	207	207	201	201	**United States**	311	311	311	311
Korea 2	31	31	25	25	**Venezuela 1**	44	44	38	38
Malaysia	53	53	47	47	**Venezuela 2**	8	8	2	2
Mexico 1	100	100	94	94	**Venezuela 3**		46	40	40

Appendix 2: Probability distributions

Table 11: Probability distribution of $S^{abs1}(6)$

	S≤0.5	S≤1.0	S≤1.5	S≤2.0		S≤0.5	S≤1.0	S≤1.5	S≤2.0
United States	99.04	100.00	100.00	100.00	**India 1**	3.05	17.07	57.32	85.98
United Kingdom 2	89.13	100.00	100.00	100.00	**Ecuador 2**	2.63	26.32	57.89	84.21
Canada	73.63	100.00	100.00	100.00	**Colombia 1**	2.38	23.47	42.52	62.93
Poland 2	33.33	100.00	100.00	100.00	**Switzerland**	1.97	17.32	39.37	62.99
United Kingdom 1	64.02	84.66	95.24	98.94	**Spain**	1.67	33.33	75.00	91.67
Japan	60.45	86.50	96.78	100.00	**New Zealand**	1.65	32.97	56.04	71.43
Colombia 2	60.00	60.00	100.00	100.00	**Chile 1**	1.52	15.23	40.10	70.05
South Africa	50.00	93.81	100.00	100.00	**Philippines 1**	1.43	40.00	74.29	94.29
Korea 1	49.76	93.72	100.00	100.00	**Philippines 2**	0.54	29.57	63.44	80.65
Singapore	40.40	88.08	100.00	100.00	**Pakistan**	0.50	26.73	51.98	79.70
Mexico 3	32.31	86.15	89.23	93.85	**Portugal**	0.48	30.43	71.50	90.82
Malaysia	28.30	54.72	64.15	79.25	**Chile 2**	0.00	30.00	100.00	100.00
Australia 2	28.14	71.36	87.94	94.47	**Hungary**	0.00	29.31	56.90	77.59
Indonesia 1	26.06	73.94	86.06	95.76	**Venezuela 2**	0.00	25.00	37.50	62.50
Slovenia	22.35	76.47	94.12	100.00	**Russia 2**	0.00	24.00	56.00	96.00
Czech Republic	16.67	80.56	100.00	100.00	**Mexico 1**	0.00	24.00	49.00	69.00
Egypt	16.03	25.19	33.59	41.98	**Finland**	0.00	22.73	50.00	72.73
Bulgaria	15.38	53.85	69.23	76.92	**Israel 2**	0.00	18.81	43.56	83.17
Indonesia 2	14.81	29.63	40.74	62.96	**India 2**	0.00	18.18	56.82	84.09
Thailand 2	14.29	53.57	96.43	100.00	**Australia 1**	0.00	16.67	50.00	91.67
Italy	13.64	79.55	100.00	100.00	**Peru**	0.00	13.22	38.84	61.98
Israel 1	12.50	25.00	37.50	62.50	**Nigeria 2**	0.00	12.20	30.49	57.32
Norway 1	11.54	30.77	46.15	65.38	**Venezuela 1**	0.00	11.36	34.09	45.45
Greece 1	11.18	24.34	39.47	59.21	**Norway 2**	0.00	6.90	46.55	63.79
Sri Lanka	10.77	58.46	80.77	93.85	**Ecuador 1**	0.00	6.58	21.05	44.74
Russia 3	10.00	30.00	80.00	100.00	**Venezuela 3**	0.00	6.52	13.04	32.61
Mexico 2	8.11	32.43	54.05	64.86	**Argentina**	0.00	2.11	6.34	12.68
Poland 1	6.74	40.45	87.64	97.75	**Brazil 1**	0.00	0.00	14.00	44.00
Sweden	6.59	48.35	78.02	94.51	**Brazil 3**	0.00	0.00	11.11	11.11
Nigeria 3	6.52	50.00	80.43	93.48	**Brazil 2**	0.00	0.00	10.87	23.91
Turkey	3.69	25.82	60.25	80.33	**Ecuador 3**	0.00	0.00	0.00	80.00
Morocco	3.67	58.72	75.23	88.07	**Greece 2**	0.00	0.00	0.00	0.00
Korea 2	3.23	54.84	70.97	83.87	**Thailand 1**	0.00	0.00	0.00	0.00

Table 12: Probability distribution of $S^{abs1}(12)$

	S≤0.5	S≤1.0	S≤1.5	S≤2.0		S≤0.5	S≤1.0	S≤1.5	S≤2.0
United States	85.53	100.00	100.00	100.00	**Colombia 1**	0.00	0.00	4.76	15.65
United Kingdom 2	62.79	100.00	100.00	100.00	**Pakistan**	0.00	0.00	4.59	22.45
Japan	27.65	60.13	73.95	85.53	**Israel 2**	0.00	0.00	3.16	10.53
United Kingdom 1	20.63	59.79	76.72	87.30	**Philippines 1**	0.00	0.00	3.13	21.88
Canada	18.33	74.92	98.71	100.00	**Portugal**	0.00	0.00	2.90	20.77
South Africa	4.41	41.18	86.27	99.02	**India 1**	0.00	0.00	1.90	10.76
Korea 1	2.99	48.76	82.59	96.52	**Chile 1**	0.00	0.00	0.52	8.38
Egypt	2.40	15.20	21.60	22.40	**Hungary**	0.00	0.00	0.00	25.00
Indonesia 1	1.89	22.64	51.57	68.55	**Spain**	0.00	0.00	0.00	20.37
Mexico 3	1.69	28.81	84.75	86.44	**Philippines 2**	0.00	0.00	0.00	18.89
Australia 2	1.04	18.13	56.48	76.68	**Mexico 1**	0.00	0.00	0.00	10.64
Singapore	0.00	37.24	66.90	88.97	**Finland**	0.00	0.00	0.00	10.53
Malaysia	0.00	17.02	46.81	59.57	**Switzerland**	0.00	0.00	0.00	5.65
Slovenia	0.00	7.59	45.56	77.21	**Nigeria 2**	0.00	0.00	0.00	5.26
Greece 1	0.00	7.53	17.81	18.49	**Russia 2**	0.00	0.00	0.00	5.26
Sri Lanka	0.00	3.54	25.59	50.79	**India 2**	0.00	0.00	0.00	4.88
Sweden	0.00	2.35	21.18	34.12	**Peru**	0.00	0.00	0.00	3.48
Morocco	0.00	0.97	34.95	55.34	**Venezuela 1**	0.00	0.00	0.00	2.63
Korea 2	0.00	0.00	32.00	56.00	**Australia 1**	0.00	0.00	0.00	0.00
Czech Republic	0.00	0.00	30.00	100.00	**Norway 2**	0.00	0.00	0.00	0.00
Colombia 2	0.00	0.00	25.00	100.00	**Argentina**	0.00	0.00	0.00	0.00
Italy	0.00	0.00	23.68	89.47	**Brazil 1**	0.00	0.00	0.00	0.00
Nigeria 3	0.00	0.00	20.00	37.50	**Brazil 3**	0.00	0.00	0.00	0.00
Ecuador 2	0.00	0.00	18.42	23.68	**Chile 2**	0.00	0.00	0.00	0.00
Poland 1	0.00	0.00	15.66	40.96	**Russia 3**	0.00	0.00	0.00	0.00
Bulgaria	0.00	0.00	14.29	42.86	**Brazil 2**	0.00	0.00	0.00	0.00
Thailand 2	0.00	0.00	13.64	77.27	**Ecuador 1**	0.00	0.00	0.00	0.00
Indonesia 2	0.00	0.00	9.52	19.05	**Greece 2**	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	7.14	24.37	**Israel 1**	0.00	0.00	0.00	0.00
Mexico 2	0.00	0.00	5.41	21.62	**Venezuela 2**	0.00	0.00	0.00	0.00
New Zealand	0.00	0.00	5.11	23.86	**Venezuela 3**	0.00	0.00	0.00	0.00
Norway 1	0.00	0.00	5.00	30.00					

Table 13: Probability distribution of $I^{float1}(6)$

	I^-	I^0	I^+	rank	result	IMF		I^-	I^0	I^+	rank	result	IMF
Thailand 1 (*)	16.67	83.33	0.00	1	if	mf	**Chile 1**	25.89	35.03	39.09	32	mf	mf
Switzerland	15.35	71.26	13.39	2	if	if	**Philippines 2**	28.49	34.95	36.56	33	mf	if
Morocco	16.51	65.14	18.35	3	if	mf	**Greece 1**	27.63	34.21	38.16	34	mf	mf
Ecuador 1	18.42	59.21	22.37	4	if	mf	**Israel 2**	34.65	33.66	31.68	35	mf	mf
Mexico 3	21.54	50.77	27.69	5	if	if	**Australia 2**	41.21	33.17	25.63	36	mf	if
Italy	20.45	50.00	29.55	6	if	if	**Argentina**	38.03	33.10	28.87	37	mf	if
Philippines 1	45.71	50.00	4.29	7	if	mf	**Sri Lanka**	43.46	32.69	23.85	38	mf	mf
Turkey	22.54	48.77	28.69	8	mf	mf	**Bulgaria**	38.46	30.77	30.77	39	mf	if
Sweden	39.56	48.35	12.09	9	mf	if	**Peru**	20.66	30.58	48.76	40	mf	if
Nigeria 3	26.09	47.83	26.09	10	mf	mf	**Spain**	20.00	30.00	50.00	41	mf	mf
Slovenia	18.82	47.06	34.12	11	mf	mf	**Poland 1**	25.84	29.21	44.94	42	mf	mf
New Zealand	29.12	46.70	24.18	12	mf	if	**UK 1**	46.03	28.04	25.93	43	mf	if
Norway 2	34.48	46.55	18.97	13	mf	mf	**India 2**	25.00	27.27	47.73	44	mf	if
Nigeria 2	24.39	45.12	30.49	14	mf	if	**Finland**	50.00	27.27	22.73	45	mf	if
Ecuador 2	44.74	44.74	10.53	15	mf	mf	**Colombia 1**	38.44	26.19	35.37	46	mf	mf
Brazil 3	33.33	44.44	22.22	16	mf	if	**Egypt**	29.01	25.95	45.04	47	mf	mf
Russia 2	20.00	44.00	36.00	17	mf	mf	**Singapore**	34.44	25.17	40.40	48	mf	mf
Greece 2	33.33	41.67	25.00	18	mf	mf	**Venezuela 2 (*)**	50.00	25.00	25.00	49	mf	mf
South Africa	24.29	41.43	34.29	19	mf	if	**Mexico 1**	29.00	24.00	47.00	50	mf	mf
Pakistan	32.18	40.59	27.23	20	mf	mf	**Brazil 2**	39.13	23.91	36.96	51	mf	mf
Mexico 2	35.14	40.54	24.32	21	mf	mf	**Israel 1**	37.50	21.88	40.63	52	mf	mf
Korea 1	28.02	40.10	31.88	22	mf	mf	**Japan**	29.26	21.86	48.87	53	mf	if
Colombia 2 (*)	50.00	40.00	10.00	23	mf	if	**Venezuela 1**	25.00	20.45	54.55	54	mf	if
Hungary	43.10	39.66	17.24	24	mf	mf	**Australia 1 (*)**	0.00	16.67	83.33	55	mf	mf
Czech Republic	38.89	38.89	22.22	25	mf	mf	**Korea 2**	9.68	16.13	74.19	56	mf	if
Norway 1	15.38	38.46	46.15	26	mf	if	**Indonesia 2**	22.22	14.81	62.96	57	mf	if
Indonesia 1	21.82	38.18	40.00	27	mf	mf	**Malaysia**	60.38	11.32	28.30	58	mf	mf
Portugal	28.99	37.20	33.82	28	mf	mf	**Thailand 2**	39.29	10.71	50.00	59	mf	if
Venezuela 3	32.61	36.96	30.43	29	mf	mf	**Russia 3 (*)**	0.00	0.00	100.00	60	mf	if
India 1	46.95	36.59	16.46	30	mf	mf	**Ecuador 3 (*)**	20.00	0.00	80.00	61	mf	if
Brazil 1	10.00	36.00	54.00	31	mf	if	**Chile 2 (*)**	100.00	0.00	0.00	62	mf	if

Note:

- An asterisk (*) behind the country's name indicates a limited number of observation (see Table 9).
- I^-, I^0 and I^+ stand for $Prob(I^{float1} \leq -0.33)$, $Prob(0.33 < I^{float1} < 0.33)$ and $Prob(I^{float1} \geq 0.33)$ respectively.
- The ranking was made according to I^0.

Table 14: Probability distribution of $I^{float1}(12)$

	I^-	I^0	I^+	rank	result	IMF		I^-	I^0	I^+	rank	result	IMF
Morocco	3.88	93.20	2.91	1	if	mf	**Brazil 1**	0.00	47.73	52.27	32	mf	if
Czech Republic	3.33	90.00	6.67	2	if	mf	**Brazil 2**	25.00	47.50	27.50	33	mf	mf
Nigeria 3	5.00	90.00	5.00	3	if	mf	**Israel 2**	20.00	47.37	32.63	34	mf	mf
Switzerland	7.26	87.50	5.24	4	if	if	**Singapore**	18.62	46.90	34.48	35	mf	mf
Ecuador 1	0.00	84.29	15.71	5	if	mf	**Sri Lanka**	33.07	46.46	20.47	36	mf	mf
Norway 2	17.31	78.85	3.85	6	if	mf	**Australia 2**	36.79	45.08	18.13	37	mf	if
Mexico 2	2.70	78.38	18.92	7	if	mf	**India 1**	43.67	44.94	11.39	38	mf	mf
Greece 2	12.50	75.00	12.50	8	if	mf	**Argentina**	33.09	43.38	23.53	39	mf	if
Turkey	7.56	72.27	20.17	9	if	mf	**Poland 1**	15.66	40.96	43.37	40	mf	mf
Italy	10.53	71.05	18.42	10	if	if	**Mexico 1**	26.60	37.23	36.17	41	mf	mf
South Africa	9.31	68.63	22.06	11	if	if	**Slovenia**	15.19	36.71	48.10	42	mf	mf
Russia 2	5.26	68.42	26.32	12	if	mf	**Peru**	13.91	35.65	50.43	43	mf	if
New Zealand	19.89	66.48	13.64	13	if	if	**Israel 1**	19.23	34.62	46.15	44	mf	mf
Portugal	12.56	65.22	22.22	14	if	mf	**Finland**	42.11	34.21	23.68	45	mf	if
Korea 1	14.93	65.17	19.90	15	if	mf	**Colombia 1**	33.33	30.61	36.05	46	mf	mf
Venezuela 3	15.00	65.00	20.00	16	if	mf	**India 2**	20.73	30.49	48.78	47	mf	if
Canada	18.65	63.99	17.36	17	if	if	**Egypt**	23.20	30.40	46.40	48	mf	mf
Pakistan	19.90	63.78	16.33	18	if	mf	**Venezuela 1**	10.53	28.95	60.53	49	mf	if
Greece 1	10.27	63.70	26.03	19	if	mf	**UK 1**	46.03	28.04	25.93	50	mf	if
Sweden	35.29	63.53	1.18	20	if	if	**Japan**	26.37	27.33	46.30	51	mf	if
Hungary	36.54	61.54	1.92	21	if	mf	**Brazil 3**	72.73	27.27	0.00	52	mf	if
Ecuador 2	31.58	60.53	7.89	22	if	mf	**Malaysia**	59.57	25.53	14.89	53	mf	mf
Norway 1	5.00	60.00	35.00	23	if	if	**Thailand 2**	40.91	18.18	40.91	54	mf	if
Mexico 3	13.56	59.32	27.12	24	if	if	**Indonesia 2**	0.00	14.29	85.71	55	mf	if
Philippines 2	18.33	56.67	25.00	25	if	if	**Bulgaria**	42.86	14.29	42.86	56	mf	if
Philippines 1	43.75	56.25	0.00	26	if	mf	**Korea 2**	0.00	12.00	88.00	57	mf	if
Indonesia 1	13.21	55.97	30.82	27	if	mf	**Australia 1 (*)**	0.00	0.00	100.00	58	mf	mf
Nigeria 2	22.37	53.95	23.68	28	if	if	**Russia 3 (*)**	0.00	0.00	100.00	59	mf	if
Spain	5.56	53.70	40.74	29	if	mf	**Chile 2 (*)**	100.00	0.00	0.00	60	mf	if
Colombia 2	50.00	50.00	0.00	30	if	if	**Venezuela 2 (*)**	100.00	0.00	0.00	61	mf	mf
Chile 1	16.75	49.74	33.51	31	mf	mf							

Note:

- An asterisk (*) behind the country's name indicates a limited number of observation (see Table 9).
- I^-, I^0 and I^+ stand for Prob($I^{float1} \leq -0.33$), Prob($0.33 < I^{float1} < 0.33$) and Prob($I^{float1} \geq 0.33$) respectively.
- The ranking was made according to I^0.