A comprehensive approach for currency crises theories stressing the role of the anchor country

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Für meine Familie – Gaby, Michael und Florian

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Abbreviations

ARS:	Argentine Peso
BIS:	Bank for International Settlements
Bn:	Billion
BoPS:	Balance of Payments Statistics
BRL:	Brazilian Real
BWS:	Bretton Woods System
CPI:	Consumer price index
CZK:	Czech koruna
DEM:	German mark
DI:	Direct Investment
DOTS:	Direction of Trade Statistics
ECB:	European Central Bank
ed.:	Editor
eds.:	Editors
EMS:	European Monetary System
ERM:	Exchange Rate Mechanism
et al.:	Et alii
Fed:	Board of Governors of the Federal Reserve System
GDP:	Gross domestic product
IIF:	Institute of International Finance
IFS:	International Financial Statistics
IMF:	International Monetary Fund
MCI:	Monetary Conditions Index
Mm-rate:	Money market rate
Mn:	Million
No.:	Number
OECD:	Organisation for Economic Cooperation and Development
p.a.:	Per annum
PPP:	Purchasing power parity
REER:	Real effective exchange rate
RER:	Real exchange rate
RMB:	Renminbi Yuan
UIP:	Uncovered interest parity
yoy:	Year on year
USD:	US dollars

„There is no generally accepted formal definition of a currency crisis, but we know them when we see them“. KRUGMAN (2000, p. 1)

Chapter I: Introduction

I.1 Theme and Proceeding

History shows that fixed exchange rate regimes are prone to currency crises. Concentrating on the most popular crises of fixed exchange rate regimes since 1990, crises affected industrialised as well as emerging economies, countries and whole regions: The European Monetary System broke down in 1992/1993, 1997, the Asian Crisis occurred, the crash of the Czech exchange rate regime in the same year and the Argentine currency crisis at the turn of the year 2002/2003. As the above quotation by KRUGMAN demonstrates, these crises mostly came as a surprise, they were only recognised after having occurred. It is generally subsequent to a currency crisis that the literature rationalizes the episode by a tailor-made theory. Parallel to ex post rationalizing, attempts were encouraged to build early warning systems for the ex ante recognition of potential crises. Up until now, these systems however do not seem to predict crises reliably.

KRUGMAN's above statement points to a further central reason for the shortcomings of currency crises theory and applied science: If there is not even a common consensus on the definition, how can currency crises even begin to be commonly understood or even predicted? According to the different understanding, there exists a vast amount of literature on the subject of currency crises, modelling reasons and consequences or discussing specific phenomena like contagion. The crucial shortcoming of the literature is that it fails to be comprehensive in the sense of covering currency crises across different generations. Linkages between the theoretical fragments are missing and the different approaches neither seem to be consistent nor complementary. They rather provide tailored rationalization "on demand", ex post of currency troubles. That is why, among others, PESENTI/TILLE (2000, p.11) request a synthesis of the models, which would "help to create a comprehensive picture of recent episodes of turmoil in exchange rate markets". For the same reason, FLOOD/MARION (1998) suggest a common cross-generation framework.

Additionally, present currency crisis theory fails to integrate cross-border influences into the analysis and concentrates instead on discussion from the domestic perspective although empirics provide evidence for the important role of anchor country influences. The simple observation of interest rate developments in the anchor country frequently reveals striking modifications in the forefront of currency troubles in the pegged countries. Occasionally, this theoretical shortcoming is brought up in the literature – FRANKEL/ROSE (1996) enumerate several empirical approaches – but up to now there has been a lack of modelling in theory.

The motivation for the present analysis emerges from these considerations. The attempt is to

- establish an integrative cross-generational framework for currency crises, and
- integrate cross-border monetary transmission into the discussion.

Therefore, a macroeconomic approach is chosen. Microeconomic theory used to explain currency crises is mostly not considered so as to establish connections in different currency crises of fixed pegs. It is, however, not the focus to provide a detailed and comprehensive analysis of selected crises episodes. For this purpose, a vast amount of theoretical as well as empirical literature is available.

The analysis proceeds as follows. Chapter II *b*riefly reviews the theory of monetary policy for fixed pegs and the classical theories of currency crises. The discussion illustrates the major shortcomings in attempts to consistently explain currency crises.

These shortcomings provide the motivation to build a framework approach, which is addressed in chapter III. In chapter III.1, the concept of the "Monetary Conditions Index" (MCI) is introduced and implemented in the BMW model for managed floating to show which possibilities of monetary policy a central bank generally has when it is targeting its exchange rates. Subsequently, chapter III.2 extends the concept for monetary policy in fixed exchange rate systems. An MCI required for foreign exchange market stability (MCI^{fix}) and an MCI describing the monetary requirements for the internal balance (MCI^{opt}) are derived in III.2.1.

Chapters III.2.2 and III.2.3 then discuss the parameters, which influence monetary conditions. The most important conclusion is that in fixed pegs, all determinants of the monetary conditions required for holding the peg are exogenous to the monetary authority. Problems arise as soon as the internal and external monetary requirements deviate from each other, since the central bank does not achieve to bring them in line again as it has under managed floating. While discussion has up to then remained bilateral (domestic and anchor country), chapter III.2.5 extends the analysis for third countries.

The MCI concept for fixed exchange rates is subsequently implemented in chapter III.3. Assuming the MCI^{fix} and MCI^{opt} deviate, four stylised situations are discussed theoretically (III.3.1 and III.3.2), all of

them leading to a currency crisis. Each section also points out parallels of the approach to traditional theory, ensuring consistency with them.

In order to evaluate the practical applicability, chapter IV then applies the theoretical framework to the most popular currency crises of fixed peg regimes in previous decades. The case studies proceed in reverse historical order. They start with the most recent currency crisis in Argentina (IV.3.1), continue with the breakdown of the Czech Republic's currency peg (IV.3.2), the Asian currency crisis (IV.3.3) and close with the crisis of the European Monetary System (IV.3.4).

Finally, Chapter V summarizes the key findings of the analytical and empirical sections and concludes the study. Most importantly, it shows that the framework on the whole succeeds in depicting currency crises of fixed pegs in different episodes and proves that monetary influences respectively shocks coming from the anchor country are a central trigger of currency troubles.

I.2 Definitions

(1) Exchange rate arrangements

The definition of exchange rate arrangements basically refers to the former official classification of the IMF, which initially only distinguished between two main groups of exchange rate systems: systems with in some way fixed exchange rates and other systems. Later on, the classification enlarged to three, then four categories. Until 1999, it was composed of *pegs, limited flexibility, more flexibility* and *independent floaters*. The IMF modified this nomenclature in 1999[1] since the former system suffered from some shortcomings: Firstly, *pegged regimes* did not differentiate between *softer* and *harder pegs* and secondly deviations of the *claimed* regime and the *de facto* monetary policy were not taken into account.

For the present analysis, this revised 1999 nomenclature of the IMF is adopted which distinguishes between the following exchange rate regimes[2]:

1) *Exchange rate arrangements with no separate legal tender:*
   The currency of another country circulates as the sole legal tender or the member belongs to a monetary or currency union in which the same legal tender is shared by the members of the union.

[1] See IMF (1999).

[2] See also the World and Area Tables of the IMF's International Financial Statistics.

2) *Currency board arrangements:*
   A monetary regime based on an explicit legislative commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate, combined with restrictions on the issuing authority to ensure the fulfilment of its legal obligation.

3) *Other conventional fixed peg arrangements:*
   The country pegs its currency (formally or de facto) at a fixed rate to a major currency or a basket of currencies where the exchange rate fluctuates within a narrow margin of less than +/- 1 percent around a central rate.

4) *Pegged exchange rates within horizontal bands:*
   The value of the currency is maintained within margins of fluctuation around a formal or de facto fixed peg that are wider than at least +/- 1 percent around a central rate.

5) *Crawling pegs:*
   The currency is adjusted periodically in small amounts at a fixed, preannounced rate or in response to changes in selective quantitative indicators.

6) *Exchange rates within crawling bands:*
   The currency is maintained within certain fluctuation margins around a central rate that is adjusted periodically at a fixed preannounced rate or in response to changes in selective quantitative indicators.

7) *Managed floating with no preannounced path for the exchange rate:*
   The monetary authority influences the movements of the exchange rate through active intervention in the foreign exchange market without specifying, or precommitting to, a preannounced path for the exchange rate.

8) *Independent floating:*
   The exchange rate is market determined, with any foreign exchange intervention aimed at moderating the rate of change and preventing undue fluctuations in the exchange rate, rather than at establishing a level for it.

Thus, pegs were split into further groups from then on. Hard pegs, the most restrictive type of exchange rate regime, consist of pegs with no separate legal tender (e.g. dollarisation), currency unions and currency boards. Other fixed pegs are broken down depending on their flexibility to fixed and crawling pegs, horizontal and crawling bands and managed floating regimes. Finally, independent floaters are defined as regimes leaving the exchange rate market determined – though the IMF does not exclude foreign exchange market intervention in this case. For the purpose of the present approach, the analysis concentrates on fixed pegs. When talking about fixed pegs, the approach refers to *groups one to four* of the IMF's 1999 classification.

The IMF's 1999 system was repeatedly discussed and extended. One major problem evaluating fixed peg regimes is that there exist major differences between the *officially declared* exchange rate strategy and the *de facto* stance. It is the *de facto* policy that is central for research about currency crises. BUBULA/ÖTKER-ROBE (2002) provide a comprehensive database of de facto exchange rate regimes of all IMF members since 1990, using the IMF nomenclature. The authors' assessment of the claimed and de facto regimes results from a quantitative as well as qualitative analysis, an approach referring to that pursued by the IMF. REINHARD/ROGOFF (2002) provide another comprehensive database of exchange rate regimes that goes back to 1946 and is based on the IMF's 1999 classification method as well.

BUBULA/ÖTKER-ROBE (2002, pp. 31-35) extend the classification to 13 groups, mainly to elaborate on the crawling pegs and managed floats:

1) Another currency as a legal tender
2) Currency union
3) Currency board
4) Conventional fixed peg to single currency
5) Conventional fixed peg to basket
6) Pegged within a horizontal band
7) Forward-looking crawling peg
8) Forward-looking crawling band
9) Backward-looking crawling peg
10) Backward-looking crawling band
11) Tightly managed floating
12) Other managed floating
13) Independently floating

Groups one to six of the extended version correspond to classes one to four of the IMF, the present paper's understanding of fixed pegs.

(2) Currency Crises

There is a broad variety of approaches and definitions of when a currency movement is classified as a crisis or crash[3]. AZIZ et al. (2000, p. 5) share the broadest view[4]:

> *"A currency crisis may be said to occur when a speculative attack on the exchange value of a currency results in a devaluation (or a sharp depreciation) of the currency, or forces the authorities to defend the currency by expending large volumes of international reserves or sharply raising interest rates"*.

FRANKEL/ROSE (1996, p. 2) belong to the group of researchers who limit the understanding of a crisis to concrete amplitudes. In the view of FRANKEL/ROSE (1996), a currency crisis is defined by "a depreciation of the nominal exchange rate of at least 25 per cent that is also at least a 10 per cent increase in the rate of nominal deprecation".

For the purpose of the present analysis, which only considers fixed exchange rate regimes, an elementary definition is chosen. Every official abandonment of a fixed peg is considered a crisis, whose continuation would have been impossible for technical (currency reserves) or economic reasons (interest rate and growth rate). Typically, the abandonment of the peg is followed by a major currency devaluation because of loss of confidence in this currency.

[3] See for example Abiad (2003), who reviews 30 empirical studies about currency crises and lists their definitions of currency crises in table A in Appendix I.

[4] See Edison (2000), Deutsche Bundesbank (1999a), IMF (1998a), Kaminsky/Reinhart (1999) and Sachs et al. (1996) as well.

Chapter II:
Fixed exchange rate regimes in macroeconomic theory

II.1 Monetary policy under fixed exchange rates

It is a long-term debate whether fixed or freely floating exchange rates are the superior monetary strategy. Today, especially small, open economies choose the monetary strategy of adopting a nominal anchor to import price stability and credibility from an anchor country. Within this strategy of conducting monetary policy, the exchange rate has the function of an intermediate target.

II.1.1 Strategy of exchange rate targeting

Germany is a good example to demonstrate the relevance of exchange rate targeting in the last decades. Since the Second World War, the country was constantly involved in exchange rate stabilization policies – stabilizing the exchange rate itself as a member of the Bretton Woods System or the European Monetary System or providing the nominal anchor for countries like Austria, Denmark and the Czech Republic:

Table 1: Exchange rate fixing as a monetary policy strategy

Period	Country or System	Arrangement
1946 - 1973	Germany as a member of the Bretton Woods System	US dollar as the official anchor currency
1979 - 1998	Germany as a member of the European Monetary System	German mark as the de facto anchor currency
1979 - 1998	Austria	Unilateral fixing to the German mark (as of 1999 EMU)
1992 - now	Denmark	Fixing to the German mark (as of 1999 Euro) in the ERM II
1993 - 1997	Czech Republic	Fixing to a currency basket consisting of 65% German mark and 35% US dollars

Within the monetary strategy of open economies, the exchange rate generally can serve as an *intermediate target* as well as an *operating target*. As an operating target (in addition to the money market rate), the exchange rate is influenced *directly* by the monetary authority through intervention in

the foreign exchange market by buying and selling foreign currency assets. It is comparable to the operating target short-term interest rate that is directly targeted by the central bank by intervening in the money market via open-market operations.

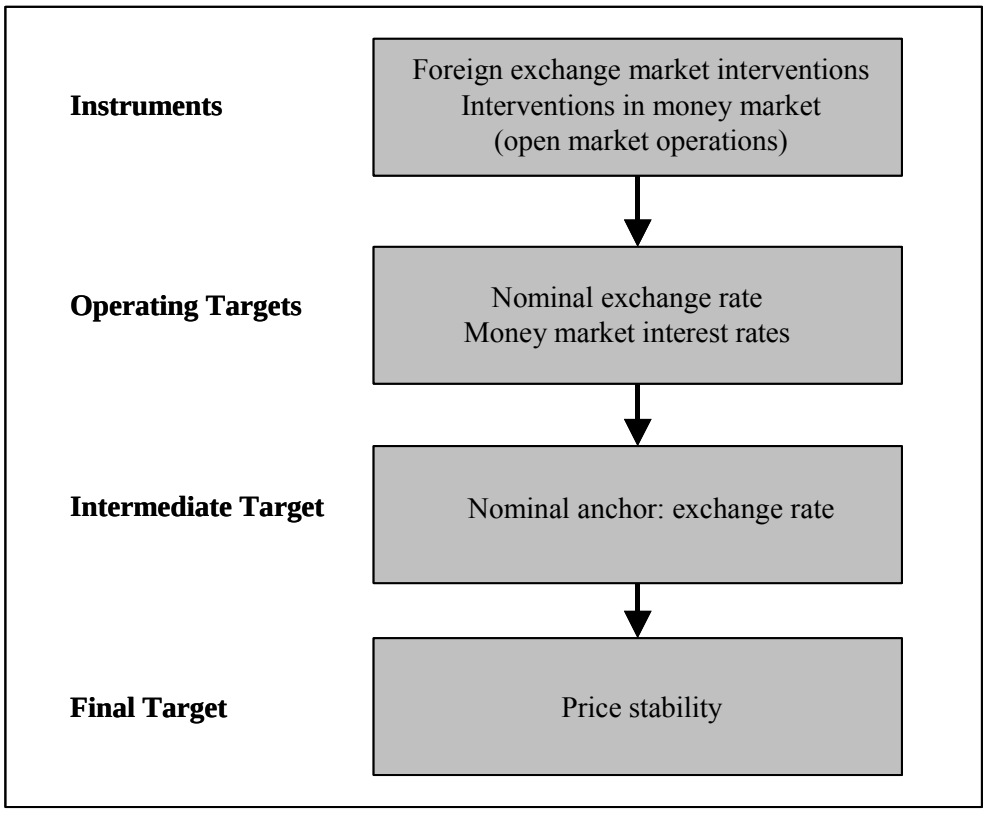
As an *intermediate target*, the exchange rate is targeted *indirectly* by the central bank's interest rate policy. In order to be a suitable intermediate target, the exchange rate has to fulfil two requirements

1) There has to be a strong relationship to the ultimate target (price stability).
2) It has to be controllable by the operating target.

An answer to both conditions is found in the transmission channels of open economies. The theoretical basis for the relationship between the exchange rate and price stability is set by the purchasing power parity and the expectations channel. The interest rate parity gives the theoretical foundation of the relationship of the exchange rate and the domestic interest rate. These underlying transmission processes are discussed in the subsequent chapter.

The *final target* for adopting a nominal anchor like the exchange rate as an *intermediate target* is that this anchor transfers monetary stability of an anchor country to the domestic economy[5].

Figure 1: Strategy of exchange rate targeting



[5] For the different possibilities of the arrangement of an exchange rate system see chapter I.2.

For a central bank that decides to fix its exchange rate, this strategy can by applied as a simple rule: If the exchange rate deviates from the targeted one, the central bank has to react using its instruments, i.e. intervene in the foreign exchange market and/or adjust the short-term interest rate.

II.1.2 Transmission channels in open economies

In addition to the standard textbook transmission channels of closed economies[6], open economies are influenced by changes in the exchange rate. These can be summarised in two transmission channels:

(1) The exchange rate channel, consisting of purchasing power parity and the expectations channel.

(2) The interest rate channel (interest rate parity).

II.1.2.1 The exchange rate channel (Purchasing Power Parity)

The price level of an economy is affected by exchange rate changes in three ways: via import prices, via purchasing power parity theory and finally via expectations of exchange rate changes.

(A) Imported Inflation

The most direct influence of the exchange rate on domestic prices is known as „imported inflation“[7]. Changes in the exchange rate are passed on to the import prices, which then influence domestic inflation in two ways – directly via the consumer prices, if the imported goods are destined for consumption or indirectly via the producer prices, if the imported goods are input for the production process.

(B) Purchasing Power Parity[8]

Purchasing power parity (PPP) is derived from the „law of one price“ assuming that perfect markets equalize the prices for all tradable goods when denominated in the same currency (in the absence of

[6] i.e. the quantity theory, the interest rate structure channel, and the expectations channel. For an overview see Bofinger (2001), European Central Bank (2000) and Mishkin (1996).

[7] See European Central Bank (2000), p. 54 and Svensson (2000).

[8] See Dornbusch (1987) and Rogoff (1996).

transaction costs) because price differences would trigger arbitrage trades. Consequently, the domestic price P_i of a commodity *i* equals its foreign price P_i^* times the exchange rate *S*.

[1] $S \cdot P_i^* = P_i$ *respectively* $S = \frac{P_i}{P_i^*}$ *(the asterisk marks the foreign country)*

Assuming that the domestic and foreign price indices are of the same structure yields the absolute version of PPP, which refers to the price levels *P* and P^*

[2] $S = \frac{P}{P^*}$

For taking reality into account, where transaction costs, tariffs and taxes exist, a constant θ is included

[3] $S = \theta \frac{P}{P^*}$

Thus, the nominal exchange rate expresses the relative national price levels.

The relative version of this theory shows that the percentage change of the exchange rate from period t to period t+1 equals the inflation difference between the domestic (π_{t+1}) and foreign country (π^*_{t+1}).

[4] $(S_{t+1}-S_t)/S_t = (P_{t+1}-P_t)/P_t - (P^*_{t+1}-P_t)/P^*_{t+1} = \pi_{t+1} - \pi^*_{t+1}$

When s_t denotes the logarithm of the S_t, the equation [4] can also be written as

[5] $\Delta s = \pi - \pi^*$.

This is derived by considering the current period t

[6] $S_t = \frac{P_t}{P_t^*}$

and the following period t+1 with

[7] $$S_{t+1} = \frac{P_{t+1}}{P^*_{t+1}}.$$

Written in logarithms, the equation is

[8] $$\ln S_t = \ln P_t - \ln P^*_t$$

When s is the logarithm of the exchange rate and p is the logarithm of the price level, the relation considering the current period t and the following period t+1 is

[9] $$s_t = p_t - p^*_t$$ and

[10] $$s_{t+1} = p_{t+1} - p^*_{t+1}.$$

Deducting equation [9] from [10] gives

[11] $$s_{t+1} - s_t = p_{t+1} - p_t - (p^*_{t+1} - p^*_t)$$

Further, the argument is based on the approach that

[12] $$\ln(1+x) \approx x$$ for very small values of x.

Considering the parameter in two periods x_t and x_{t+1} and applying this approach gives that

[13] $$x_{t+1} - x_t = \ln(\frac{X_{t+1}}{X_t}) = \ln(\frac{X_{t+1} - X_t}{X_t} + 1) \approx \frac{X_{t+1} - X_t}{X_t}$$

the difference of the logarithms is approximately the same as the rate of change of the parameter.

Applying this logic to the parameters s, p and p^*

[14] $$s_{t+1} - s_t = \Delta s_{t+1} \approx \frac{(S_{t+1} - S_t)}{S_t}$$ and

[15] $$p_{t+1} - p_t = \Delta p_{t+1} \approx \pi_{t+1} = \frac{(P_{t+1} - P_t)}{P_t}$$ and

[16] $$p^*_{t+1} - p^*_t = \Delta p^*_{t+1} \approx \pi^*_{t+1} = \frac{(P^*_{t+1} - P^*_t)}{P^*_t}$$.

finally gives equation [5]

[5] $$\Delta s = \pi - \pi^* .$$

The rate of change of the exchange rate Δs is equal to the difference of the domestic (π) and foreign inflation rate (π^*).

This relative version of the theory was for years thought to give the theoretical legitimatisation for freedom in choosing the economically desirable inflation rate, as it would be compensated by exchange rate changes. Empirical application has shown, however, that countries with flexible exchange rates experienced strong deviations of the exchange rate course from relative PPP in the short and medium term[9].

Such potential deviations from PPP are expressed in the real exchange rate Q, conventionally defined as the division of the nominal exchange rate S by the relation of the price levels $\frac{P}{P^*}$:

[17] $$Q = S \cdot \frac{P^*}{P}$$

When the absolute PPP is valid, the real exchange rate Q equals 1 since the nominal exchange rate S compensates differences in the price levels. On the basis of equation [5] and [13], the rate of change of the real exchange rate Δq then is defined by:

[9] See for example Dornbusch et al. (2003), pp. 624.

[18] $\Delta q = \pi^* + \Delta s - \pi$

This implies that the real exchange rate remains constant when relative PPP holds. If it does not, changes in the real exchange rate affect domestic as well as foreign demand for domestic goods. In the standard textbook definition, exports *X* depend on the real income abroad Y^f (f indicating foreign) and the real exchange rate Q while imports IM depend on the domestic real income Y^d (d indicating domestic) and *Q*.

[19] $X = X(Y^f; Q)$ *with* $\delta X/\delta Q > 0$

[20] $IM = IM(Y^d; Q)$ *with* $\delta IM/\delta Q < 0$

Consequently, if a change of the relative prices of goods or a foreign market intervention triggers a real appreciation, this results in a decline of net exports *(X-IM)*. Since net exports are a component of aggregate demand, this finally results in a decline in the national income Y^d consisting of private consumption *C*, government consumption *G*, gross fixed investment I and net exports *NX*.

[21] $Y^d = Y^d(Q) = C(Y^d) + I(Y^d, r) + G + NX(Y^d, Y^f, Q)$ *with* $NX(Y^f, Y^d, Q) = X - IM$

In standard textbook theory, aggregate demand in open economies is mostly reduced to its most important determinants, changes in the real exchange rate *Q* and the real interest rate r. Assuming a linear relation between both channels, writing in real terms and logarithms (except for the real interest rate) yields the common formal depiction of aggregate demand in open economies:

[22] $y = a - br + cq + \varepsilon_1$ *with a, b, c >0*

The log of the output, *y,* is determined by the real interest rate *r* with an interest rate elasticity b, by the real exchange rate q with an elasticity of c and finally by ε_1 which reflects demand shocks. *a* summarizes all autonomous components.

This paper follows the approach of BOFINGER/WOLLMERSHÄUSER (2001) to extend this aggregate demand equation for changes of the real exchange rate as they consider not only the level of the real exchange rate but also its changes a further important determinant of aggregate demand. Integrating these real exchange rate changes into the IS equation [22] is central for modelling monetary policy under exchange rate targeting in chapter III.

Extending equation [22] for the percentage change of the real exchange rate Δq gives

[23] $y = a - br + c\Delta q + dq + \varepsilon_1$ *with a, b, c, d >0*

Deducting the natural rate of output $\hat{y}$ on both sides of equation [23] gives an expression for the output gap $\tilde{y}$

[24] $\tilde{y} = y - \hat{y} = a - br + c\Delta q + dq + \varepsilon_1 - \hat{y}$

If the neutral components of aggregate demand, the neutral real interest rate $\hat{r}$, the logarithm of the neutral real exchange rate $\hat{q}$

[25] $\hat{y} = a - b\hat{r} + d\hat{q}$

are eliminated from equation [24], this expresses the output gap $\tilde{y}$ as follows:

[26] $\tilde{y} = -b(r - \hat{r}) + c\Delta q + d(q - \hat{q}) + \varepsilon_1$

We follow the proceeding of BOFINGER/WOLLMERSHÄUSER (2001, p. 24) who simplify and

> *"normalize $\hat{r}$ to zero. $\hat{q}$ is assumed to adopt the value of q_t so that we arrive at the final definition of the output gap:"*[10]

[27] $\tilde{y} = -br + c\Delta q + \varepsilon_1$

Output gap changes again affect domestic inflation via a simple Phillips curve relation with the inflation target π_o that is influenced by supply shocks ε_2.

[28] $\pi = \pi_0 + dy + \varepsilon_2$ *with* d[11] *>0*

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[10] For more details on the proceeding, see the source Bofinger/Wollmershäuser (2001).

[11] Since the structural parameter d drops out in equation [27], this variable is from equation [28] onwards used in the Phillips curve as the weight for y, as common in the literature.

(C) Expectations channel

Finally, exchange rate changes indirectly affect domestic inflation through the expectations channel[12]. Since, due to PPP, market participants are aware of the fact that the exchange rate is an important determinant of the domestic inflation rate, it is reasonable to derive inflation expectations by observing considering their future exchange rate expectations. This is a central reason why countries rely on a nominal anchor when stabilising their economy. By imposing a fixed exchange rate, they aim to stabilise exchange rate expectations and thus inflation. Hereby, it is of special importance that the peg is credible because otherwise inflation expectations arise that could initiate a real appreciation.

II.1.2.2 The interest rate channel (Interest Parity)

The uncovered interest parity (UIP) is the theoretical basis for the connection between short-term interest rates and exchange rate changes. UIP ensures that within a strategy of exchange rate targeting, the intermediate target can be controlled by the operating target. Because the exchange rate, again, is an important determinant of the domestic inflation rate, this transmission channel completes the transmission via interest rates known for closed economies – that is, affecting aggregate demand via its reaction to the interest rate.

The interest parity logic[13] is also based on arbitrage opportunities, but contrary to PPP, it focuses on capital flows instead of trade flows. Assuming perfect markets with free capital mobility, domestic and foreign assets being perfect substitutes and risk-neutral investors, the approach is that arbitrage of investors eliminates differences in the rate of return between domestic and foreign investment.

The rate of return E of an amount of investment X invested in the domestic country consists of an interest rate income i .

[29] Return of domestic investment: $E = (1+i)X$.

For foreign investment, the return consists of an interest rate i^* plus exchange rate changes ΔS. For investing abroad, the money is converted with the exchange rate, which gives X/S. Thus, foreign

[12] This section draws on Bofinger (2001), pp. 388.

[13] See for example Gandolfo (2004), Burda/Wyplosz (2001), Dornbusch et al. (2003) or Barro/Grilli (1996).

investment yields $(1+i^*)\frac{X}{S}$, and this is transformed back into domestic currency. In order to depict the investment's return at the beginning of the investment period, only expectations about the future exchange rate are available (S^e). Alternatively, the exchange rate risk can be hedged by a forward transaction F (forward sale of the foreign currency).

[30] Return of foreign investment: $E = (1+i^*)\frac{X}{S}S^e$ *or* $E = (1+i^*)\frac{X}{S}F$

Consequently, capital will be invested domestically as long as

[31] $(1+i)X \succ (1+i^*)\frac{X}{S}S^e$

and when both sides are equal, the investor will be indifferent.

Conversion of this equation gives

[32] $\frac{1+i}{1+i^*} - \frac{1+i^*}{1+i^*} \succ \frac{S^e}{S} - \frac{S}{S} \rightarrow \frac{i-i^*}{1+i^*} \succ \frac{S^e - S}{S}$

To simplify, the term $(1+i^*)$ is set to one. The resulting equation indicates

[33] $i - i^* \succ \frac{S^e - S}{S}.$

that capital will flow into the country as long as the profit from the interest rate spread exceeds the loss of an expected depreciation of the domestic currency. Capital flows that make use of this logic will eliminate the inequality in equation [33].

[34] Uncovered interest parity (UIP): $i - i^* = \frac{S^e - S}{S}.$

Accordingly, in analogy to PPP logic, which equates changes in the exchange rate to the difference of the price levels in the domestic and foreign country, interest rate parity equates changes in the exchange rate to the difference in interest rates. Eliminating the exchange rate risk through a forward transaction leads to the

[35] Covered interest parity (CIP): $i - i^* = \frac{F - S}{S}$.

Regarding covered and uncovered interest parity, the expected exchange rate should equal the forward exchange rate if markets are efficient. Empirical tests, however, discover shortcomings of UIP in explaining exchange rate changes[14]. However, it is important to notice that the rationale of UIP depends on the exchange rate regime in which it is applied. While numerous tests show that UIP does not hold for flexible exchange rates, the results change in the case of a fixed exchange rate regime. Within fixed pegs that require (more or less) constant spot rates and endogenous interest rate setting by the anchor country's central bank, tests of UIP come to the conclusion that "for fixed rate systems UIP seems to be a very important relationship since it clearly shows the constraints under which the 'satellite central banks' are operating" BOFINGER (2001, p. 397)[15].

In a world with uncertainty and risk-averse investors, a difference between the forward and the expected exchange rate is considered by adding a risk premium α.

[36] $i - i^* = \frac{S^e - S}{S} + \alpha$

This implies that interest rate deviations between the foreign and domestic country can coexist with a stable exchange rate.

II.1.3 Conducting monetary policy within fixed peg regimes

With knowledge of these relations between domestic monetary conditions and foreign markets as well as the monetary strategies built upon them, monetary policy conduction can be discussed for fixed exchange rate regimes. This will discover inconsistencies of the fixed exchange rate strategy and an

[14] This discussion uses the term "forward premium puzzle" to mean testing the suitability of the forward premium (difference of forward and spot exchange rate) as a predictor for future exchange rate changes. For a comprehensive overview of the logic and prognostic value of financial market prices see Deutsche Bundesbank (1998a). Mostly, studies testing the predictive value of the forward premium are getting negative results. The problem was already recognized in the eighties, see Fama (1984), and Froot/Thaler (1990).

[15] See Flood/Rose (1996) and Bofinger/Wollmershäuser (2002a) as well.

autonomous monetary policy under the condition of free capital mobility in the case of shocks. The destabilising effects of such a macro-economically oriented monetary policy under fixed exchange rates will be discussed with the Mundell-Fleming Model and the more comprehensive BMW Model.

It will become obvious that these inconsistencies are in fact the root of fixed peg crises because central banks try to escape it by pursuing an autonomous monetary policy that is not compatible with the exchange rate commitment.

II.1.3.1 Two-dimensional character of monetary policy

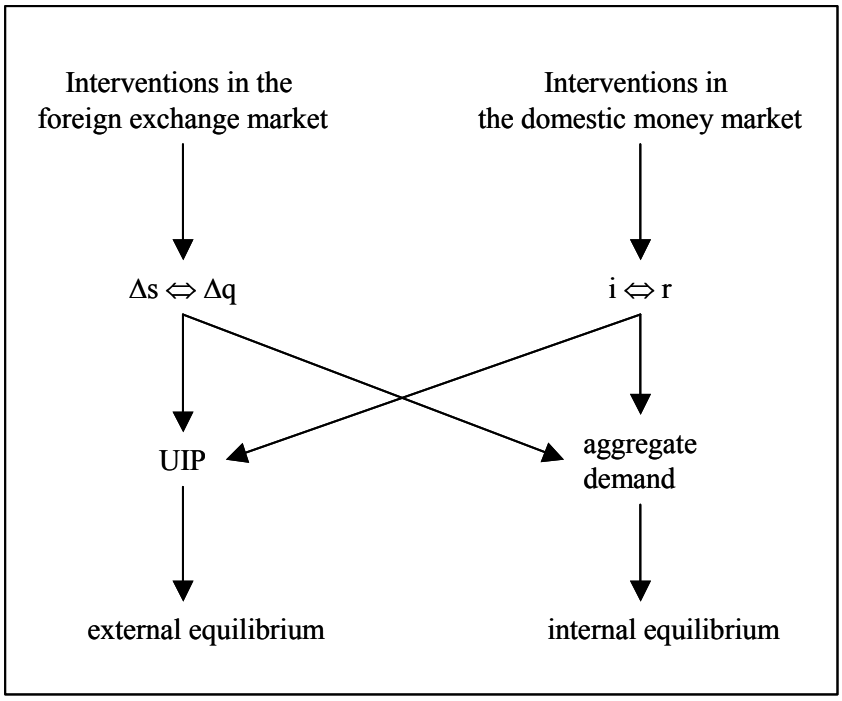
In an open economy, a central bank that uses the exchange rate as a nominal anchor operates via two instruments, interventions on the money market and interventions on the foreign exchange market. The challenge is the simultaneous achievement of an *internal* and *external balance*. The internal balance is characterised by an output gap of zero (full employment). The external balance is defined by an equilibrium in the balance of payments with respect to a balanced foreign exchange market.

Whereas a flexible exchange rate regime per definition is not concerned with the *external balance*, since this is established automatically on the foreign exchange market, within a fixed exchange rate system the external balance is endangered by imbalances on the foreign exchange market. Hence, the challenge is to avoid such pressure stemming from cross-border short-term capital flows by means of an adequate monetary policy. UIP is the theoretical basis for this monetary policy challenge. In order to achieve a foreign exchange market balance, monetary policy in a world of free capital mobility has to set its instruments in a way to maintain UIP since this ensures that no speculative capital flows arise. Consequently, the nominal money market rate is not available as an operating target any more, it is determined exogenously. In order to successfully maintain a fixed peg policy, the domestic central bank has to concentrate on the nominal exchange rate by intervening when necessary. This condition is formally derived in chapter III.2.1.2.

On the other hand, a central bank is also required to take care of the *internal economic balance*. For this purpose, aggregate demand is usually influenced via the interest rate channel and the exchange rate channel. If one aims to apply a simple rule for setting instruments to achieve an internal balance and if one concentrates on demand-side effects, the Monetary Conditions Index is a suitable concept. This index is based on the central determinants of the open-economy IS function, that is r and q. Chapter III.2.1.1 will introduce this concept and derive the formal conditions for the internal balance as well.

Altogether, monetary policy in an open economy has a complex, two-dimensional character. Moreover, adjustment of instruments in favour of one of the balances affects the other. This interdependence seriously complicates monetary policy.

Figure 2: Two-dimensional aspect of monetary policy



Source: BOFINGER/WOLLMERSHÄUSER (2001), p. 30[16]

If the domestic monetary authority varies the interest rate to affect domestic demand, it simultaneously influences the investment decision of foreign exchange market participants since the interest rate is a parameter of UIP. Should the central bank, on the other hand, decide to intervene in the foreign exchange market, this also has effects on the economy. Selling domestic currency to intervene against an appreciation pressure expands the monetary base, and defending the exchange rate against a devaluation (buying domestic currency) tightens the monetary base. This is where sterilisation, discussed in the next chapter, comes into play.

This depiction again visualises the requirements of a successful monetary policy within fixed pegs that was stated before: In fixed pegs, UIP has to be maintained, which requires that determination of the domestic interest rates should be completely left to the market. There is no longer a domestic lever for macroeconomic stabilisation available. This incompatibility of an active monetary policy and an exchange rate peg is discussed widely in the literature and referred to as the "inconsistency triangle".

[16] The figure from Bofinger/Wollmershäuser (2001) has been slightly modified for this approach.

II.1.3.2 Sterilisation as a solution?

It is well known that a central bank can use a method to offset unwelcome effects of intervention on the monetary base, called sterilisation, which is common in practice. An intervention with buying foreign currency reserves – that would increase the monetary base and respectively reduce the domestic short-term interest rate – is counteracted by reducing the credit volume for domestic central banks or by enlarging their deposits and vice versa. A simplified central bank balance visualises this neutralisation of monetary base variations:

Table 2: Sterilisation

Simplified central bank balance sheet	
Credits to the banking system ↓	Deposits of the banking system ↑ (among those minimum reserves)
Currency reserves ↑	Currency in circulation

The simplified central bank balance also demonstrates the limitations of intervention policy. When a central bank tries to defend a currency against depreciation pressure, this is not infinitely possible. The restraint is set by the amount of foreign currency reserves (intervention potential). However, defending a currency against appreciation is possible without such a restraint.

Moreover, sterilising excessive or reduced liquidity has its limitations as well[17]. If there is no deposit facility, the central bank is faced with a limited sterilisation potential for absorbing excess liquidity in the case of intervening against appreciation. As soon as the credits to the banking system have decreased to zero, sterilisation is no longer possible. Furthermore, the costs of sterilisation set an important restriction. These stem from a difference in domestic and foreign interest rates. Currency reserves, on the one hand, yield the foreign interest rate i^*[18] whereas the central bank has to pay the domestic interest rate i for the deposits of the banking system (it receives the domestic rate for the credits of the banking system). Consequently, even an intervention intended to avoid appreciation is subject to limitations. While the central bank in this case is not limited by its intervention potential, restrictions arise if the domestic interest rate exceeds the foreign one[19]. Under these conditions, sterilising causes permanent losses induced by the spread of the money market rates $(i\text{-}i^*)$ because the

[17] See Bofinger (2001), pp. 390.

[18] as the funds are generally invested in short-term money market instruments.

[19] what in general is the case in pegged countries.

central bank has to pay the higher rate for the deposits and only earns the lower rate for its exchange reserves.

To summarize, because of a limited intervention potential, a central bank is not able to persistently defend a fixed exchange rate against a depreciation. And as soon as the domestic interest rate exceeds the foreign rate, a central bank is also unable to constantly defend its peg against appreciation because of escalating sterilisation costs for the capital inflows. Therefore, sterilisation is not a practicable solution to the inconsistency problem arising from an active monetary policy within a fixed exchange rate regime. The general problem cannot be swept away: Fixed exchange rates do not leave scope for a domestically oriented monetary policy. This problem is taken up in several models, the most simple one being the inconsistency triangle.

In what follows, chapter II.1.3.3 will introduce two more comprehensive models discussing this dilemma, the popular standard macro model of Mundell and Fleming and a more recent and comprehensive approach, the BMW model.

II.1.3.3 Destabilising effects of fixed pegs

Probably the most popular model discussing the inconsistency problem of fixed exchange rates is the Mundell-Fleming-Model. This model clearly shows the destabilising effects of a fixed exchange rate in the case of shocks. The analysis refers to the standard model in a world of free capital mobility, considering the usual assumptions (constant wages and prices, no expectations of exchange rate changes, supply is determined by demand, monetary base equals money supply). The model is based on three main relations[20]:

Equilibrium of aggregate demand and supply, expressed by a standard open economy IS equation:

[37] IS-relation: $Y = Y(Q) = C + I + G + NX$ *with* $NX\,(Y^f, Y^d, Q) = X - IM$

As in chapter II.1.2.1, Q stands for the real exchange rate, Y^f for the foreign real income and Y^d for the domestic real income.

Equilibrium on the money market (real money supply M/P equals the real demand for money L, as in the case of closed economies):

[20] See for example Burda/Wyplosz (2001).

[38] *LM-relation:* $\frac{M}{P} = L(Y, i)$

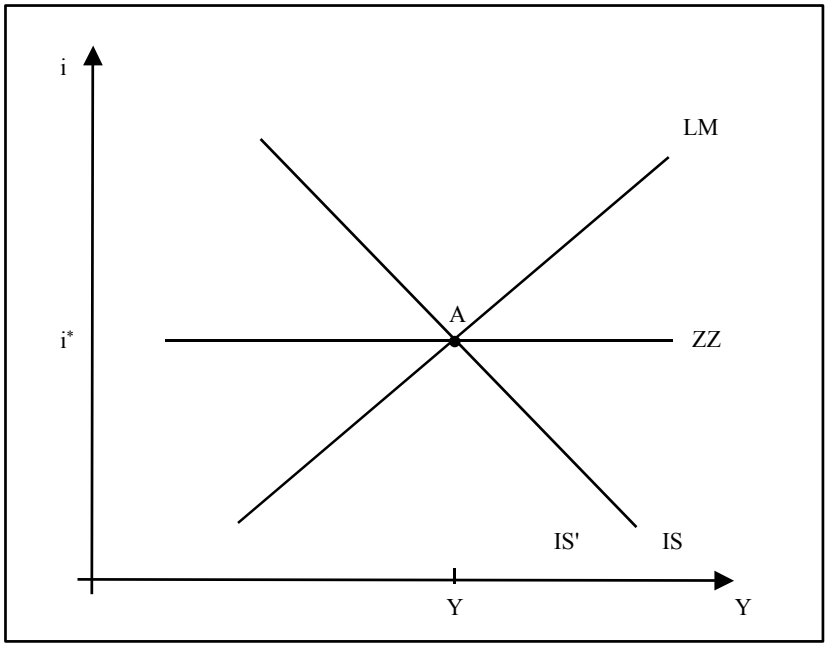
Equilibrium of the balance of payments (per definition, through combining the trade surplus *NX* and the capital balance *CF*):

[39] *ZZ-relation:* $ZZ = NX(Y^f, Y^d, Q) + CF(i - i^*)$

In order to maintain the external equilibrium, the central bank has to ensure that UIP holds. Expected exchange rate changes are not taken into account.

The classical Mundell-Fleming Model for an open economy, based on the above relations, demonstrates the effects of monetary policy measures[21].

Figure 3: Mundell-Fleming Model for a fixed exchange rate regime

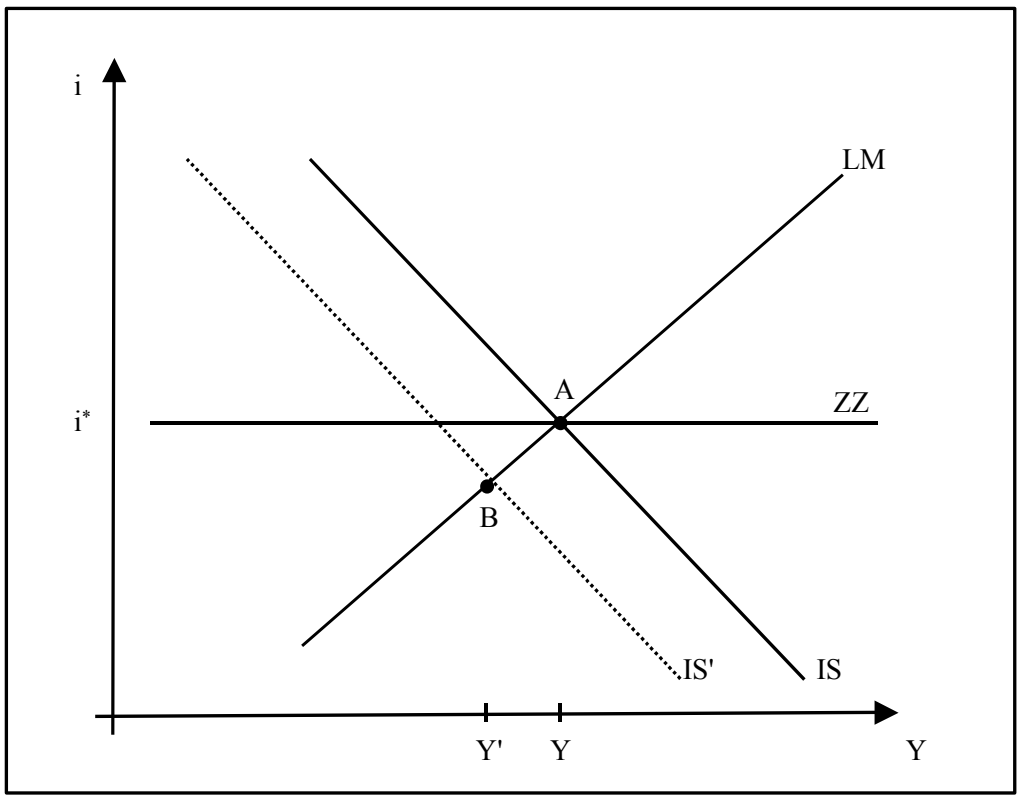


Standard textbook didactic approaches are somewhat modified by applying a demand shock as the starting point for the system. This is much more realistic than starting from a central bank that actively changes its monetary stance without any simultaneous change of the macroeconomic situation.

[21] For reasons of simplicity, discussion is limited to the classical form of the Mundell-Fleming Model, which considers small open economies. A pegged country is regarded as the small open economy.

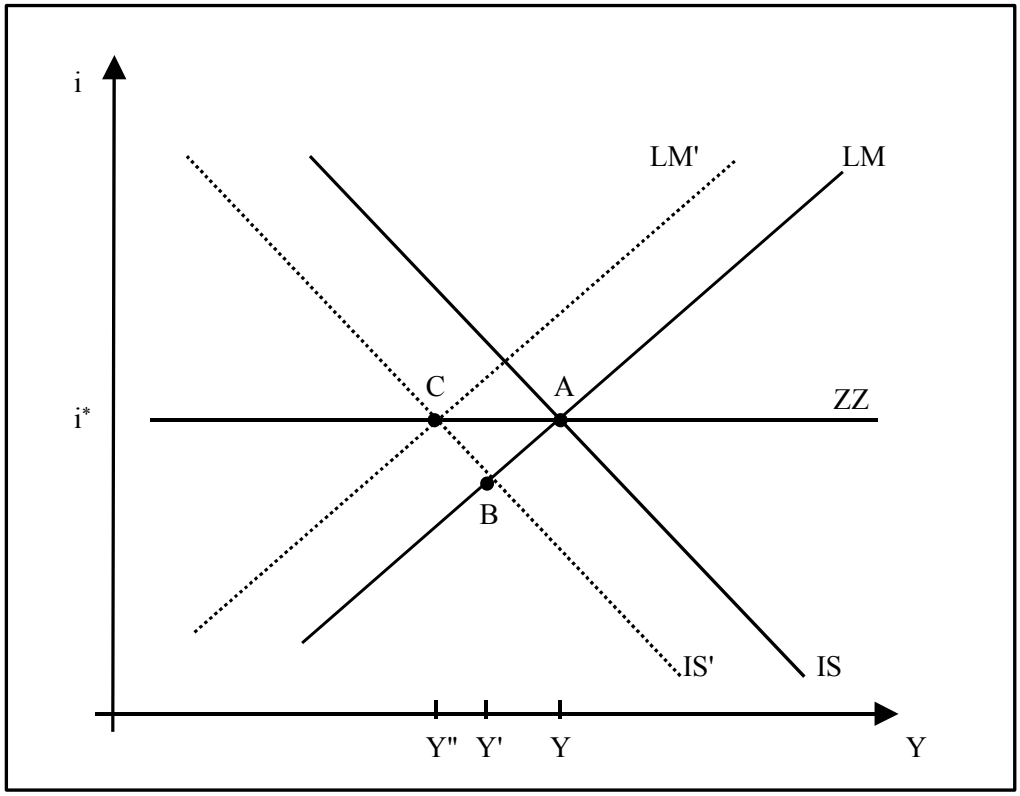
Starting from an internal and external balance *A*, that is characterised as the intersection of IS, LM and ZZ, we assume a negative demand shock that shifts the IS balance to the left. Moving from A to B, output Y declines and the demand for money L declines accordingly, since less transactions have to be financed. That lowers the interest rate i. An external disequilibrium *B* is the outcome, because IS and LM do not intersect ZZ.

Figure 4: Mundell-Fleming Model: Negative demand shock on fixed exchange rate regime I



In a closed economy, the shock would lead to this downward movement along the LM-curve, which corresponds with a lower domestic interest rate. The new balance would establish at *B*. In the open economy, however, a lower interest rate than that of the anchor country triggers capital outflows, which in turn urges the monetary authority to intervene. It has to sell foreign currency reserves and to buy domestic liquidity. Thus, the intervention activity contracts the money supply, resulting in a domestic interest rate increase. In the figure, point *C* is reached, as the LM curve shifts upwards and to the left because of monetary contraction.

Figure 5: Mundell-Fleming Model: Negative demand shock on fixed exchange rate regime II



The result is disappointing: The final output effect is *Y''*. Hence, subsequent to a negative demand shock, monetary policy according to the fixed exchange rate's requirements leads to an even bigger decline in output. While the Mundell-Fleming Model concludes that monetary policy in fixed pegs is ineffective, the example provides even further insight. It shows that monetary policy, which tries to react to changes in the macroeconomic situation without violating the external balance destabilises the economy even more. The same logic applies for the opposite case, that of an expansionary demand shock.

Another model, which more comprehensively demonstrates the destabilising effect of fixed pegs in the case of shocks, is the BMW Model by BOFINGER et al. (2002b). Discussion is restricted to the graphical analysis. For the algebraic discussion see BOFINGER et al. (2002b), from which the following introduction heavily draws.

The model is founded on four main pillars:

- An aggregate demand function with an output gap *y* depending on autonomous demand components *a*, the real interest rate *r* and a demand shock ε_1

  [40] $y^D = a - br + \varepsilon_1$ *with a>0, 0<b<1 ,*

- an aggregate supply that is determined by aggregate demand

  [41] $y^s = y^D = y$,

- a central bank that is able to determinate the real interest rate. In the simplest form, it is assumed that the monetary authority sets the interest rate discretionarily

  [42] $r = \bar{r}$,

  In the following figure, this assumption is illustrated as a horizontal monetary policy line (MP).

- and a Phillips curve relation, in which inflation is determined by inflation expectations π^e, the output gap and a supply shock ε_2

  [43] $\pi = \pi^e + dy + \varepsilon_2$. *with 0<d<1* .

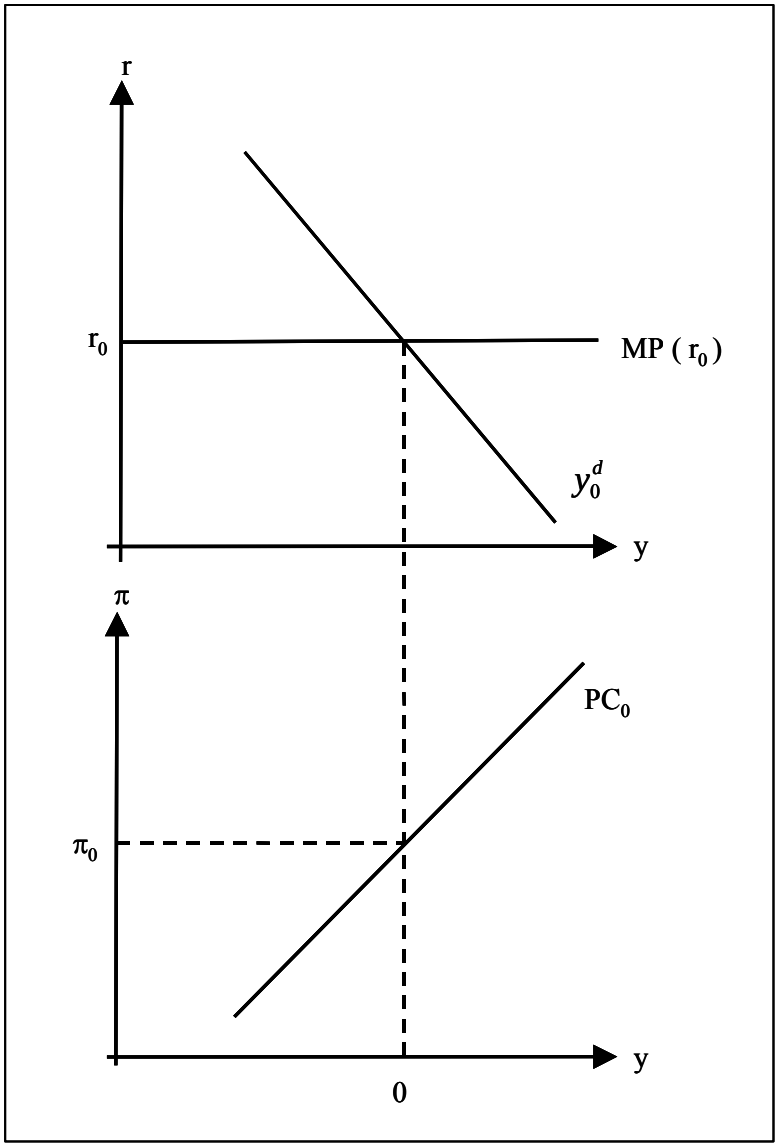
- If monetary policy is credible, inflation expectations equal the central bank's inflation target π_0.

  [44] $\pi = \pi_0 + dy + \varepsilon_2$.

  This condition is depicted as the PC line in the following chart.

Altogether, the graphical standard model for the closed economy is

Figure 6: Standard BMW Model for closed economies[22]



Assuming that monetary policy follows an interest rate targeting strategy in order to support welfare modifies the position of the MP-line[23]. Applying a simple interest rate rule, the central bank generally concentrates on stabilizing the inflation rate around its target value and achieving an output gap close

[22] MP symbolizes the Monetary Policy, PC represents the Phillips Curve relation.

[23] For a discussion and algebraic deviation of an unregulated system – where the central bank concentrates on leaving r unchanged at its long-term equilibrium value – or a central bank that conducts an optimal monetary policy that minimises a welfare loss function see Bofinger et al. (2002b).

to output potential. A popular simple rule that models this monetary policy strategy is the Taylor rule, where the real interest rate stance depends on output gap and inflation.

[45] $$r = r_0 + e(\pi - \pi_0) + fy$$

This equation changes the MP line into an upward sloping line (depicted in figure 7).

Inserting the Taylor rule into the aggregate demand equation [40] yields the aggregate demand curve depending on inflation $y^d(\pi)$.

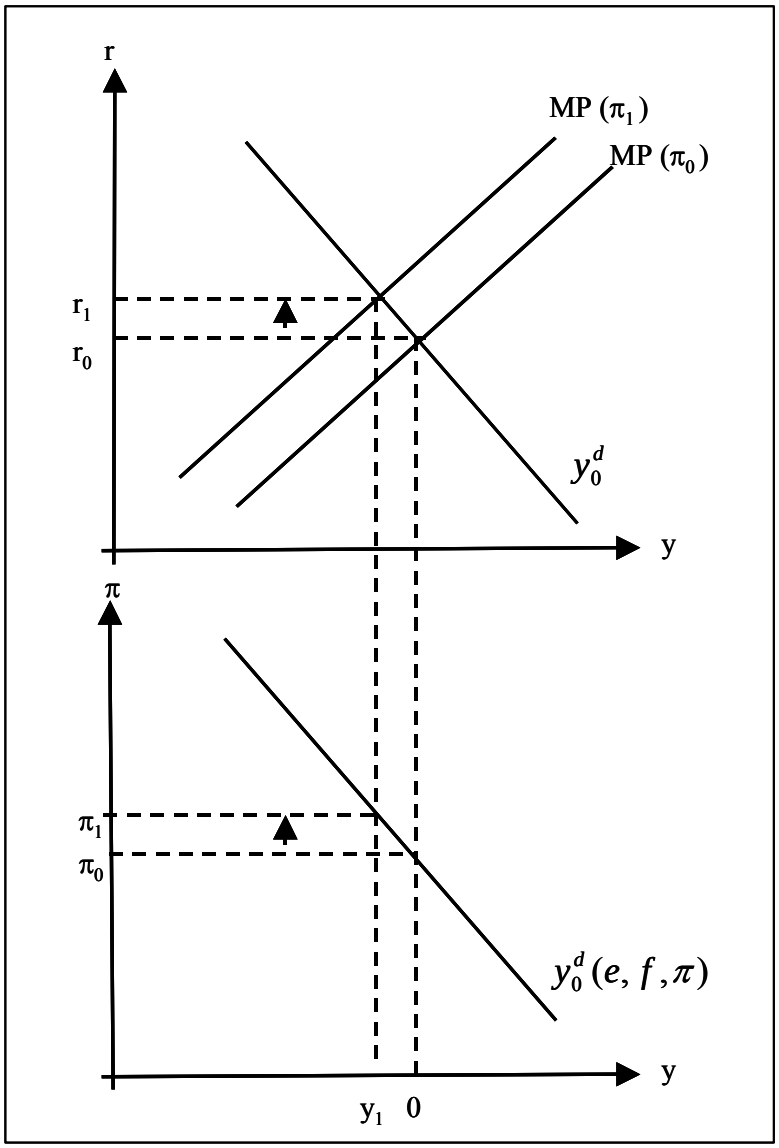
[46] $$y^d(\pi) = \frac{(a - br_0) + be\pi_0}{1 + bf} - \frac{be\pi}{1 + bf} + \frac{\varepsilon_1}{1 + bf}$$

Since *e*, *f*, and *b* are positive, the above equation implies that aggregate demand is negatively related to inflation.

Graphically, this can be derived by assuming a rise in inflation $(\pi_0$ *to* $\pi_1)$. This leads to an increase in the real interest rate, shifting the MP (π_0) line to MP (π_1), and produces a negative output gap y_1. In the y/π diagram, this gives the two combinations $0/\pi_0$ and y_1/π_1, implying a downward sloping $y(\pi)$ line.

Together, the graphical illustration changes to

Figure 7: BMW Model: Simple interest rule (closed economy)



For the analysis of the open economy,

- aggregate demand is extended for changes in the real exchange rate Δq in open economies[24]

  [47] $y^D = a - br + c\Delta q + \varepsilon_1$ *with a, b, c >0; b,c<1 ,*

- the inflation rate in the long run is completely determined by the PPP logic

  [48] $\pi = \pi^* + \Delta s$

[24] For the integration of Δq in aggregate demand, see pp. 13 and 14. An increasing q reflects a real depreciation.

whereas in the short run the Phillips curve is assumed to be identical to that of the closed economy[25]

[49] $\pi = \pi_0 + dy + \varepsilon_2$,

- UIP is taken into account to include foreign exchange market behaviour.

[50] $\Delta s + \alpha = i - i^*$.

As stated before and depicted by the above equation, monetary policy in fixed exchange rate regimes *(Δs=0)* requires an interest rate that is aimed at following the sum of the anchor country's interest rate and a risk premium in order to avoid short-term capital inflows and outflows

[51] $i = i^* + \alpha$.

Inserting the Fisher equation leads to

[52] $r = i^* + \alpha - \pi$.

The above equation expresses the MP-line in the case of fixed exchange rates, i.e. a horizontal line in the *(y,r)*-diagram that implies an abandonment of an autonomous real interest rate policy. Thus, the fixed peg strategy can be understood as a simple rule for monetary policy. Modifying it slightly shows the analogy to the logic of the Taylor rule:

[53] $r = (i^* + \alpha - \pi_0) + (-1)(\pi - \pi_0) + 0 \cdot y$

That is, this case represents a Taylor rule with the parameters *e = -1* and *f = 0*.

Equation [52] already gives an indication of the destabilising character of the strategy of fixed exchange rates. It implies that the real interest rate has to rise if domestic inflation declines.

---

[25] because of companies pursuing a pricing-to-market strategy that leaves prices unchanged in local markets despite of exchange rate changes.

Bofinger/Wollmershäuser (2002a) extend the Phillips curve for influences over the exchange rate channel in a direct way – see Appendix I of their paper – since domestic inflation is also affected by imported inflation. This gives $\pi = \pi_0 + dy + e\Delta q + \varepsilon_2$. They show however, that the more realistic – and more complex – argumentation fits with the basic logic presented here.

What is changing as well in the case of fixed pegs is the slope of the aggregate demand curve in the *(y,r)*-space. While it has a negative slope in closed economies and in the case of independently floating exchange rates, in the case of a fixed peg the curve can have a positive slope.

This is derived by first modifying the UIP equation into a related version, inserting [50] and the Fisher relations for the domestic and foreign country into the real exchange rate equation

[54] $\Delta q = \Delta s + \pi^* - \pi$ ➔ *[54']* $\Delta q + \alpha = r - r^*$.

Inserting [54'] into the aggregate demand equation [47] then gives $y^d(r)$ for the open economy under fixed exchange rates

[55] $y^d(r) = a - (b-c)r - c(r^* + \alpha) + \varepsilon_1$.

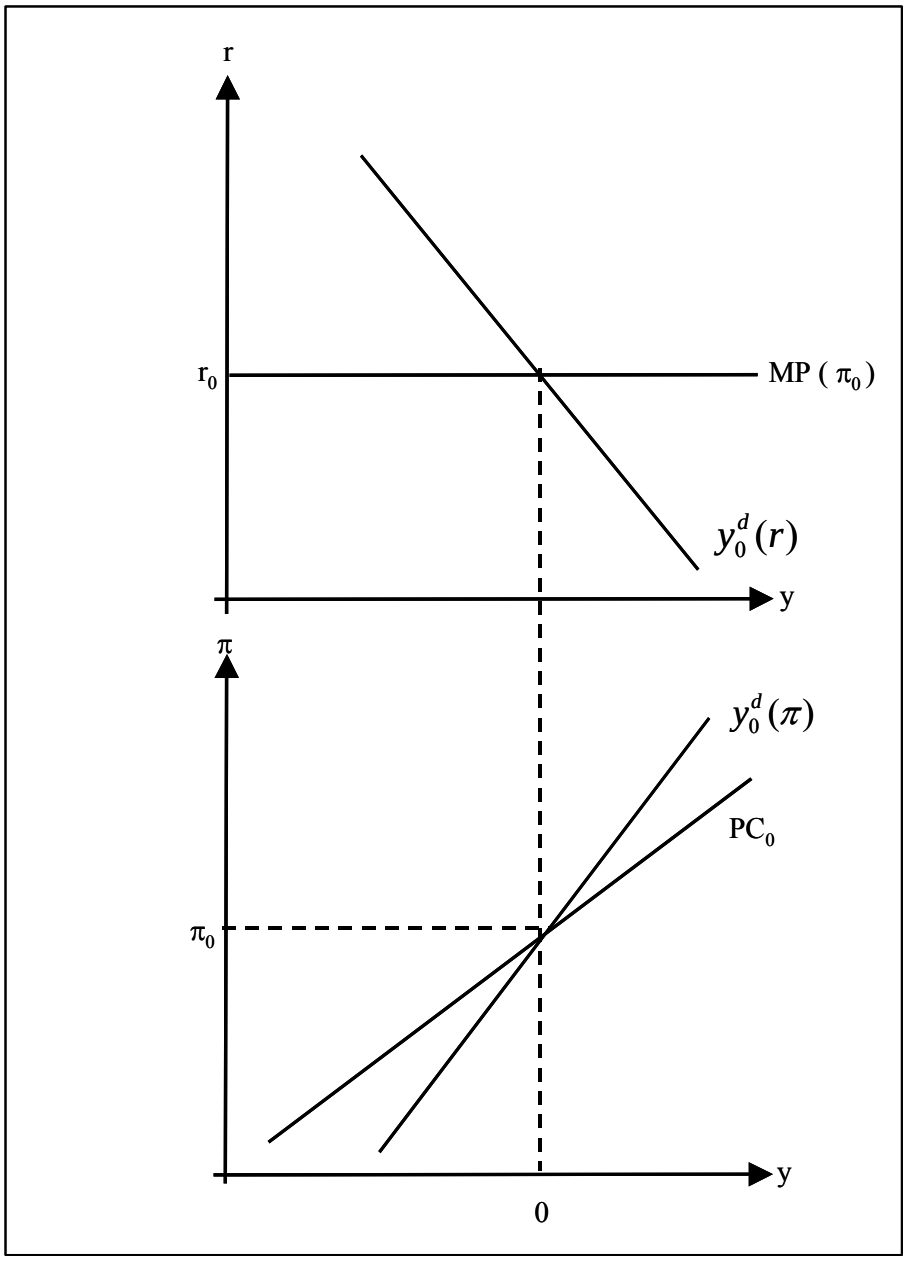
Inserting the "simple fixed peg interest rate rule" [52] into the above equation then gives $y^d(\pi)$

[56] $y^d(\pi) = a - b(r^* + \alpha) - (b-c)\pi^* + (b-c)\pi + \varepsilon_1$

Thus, with the assumption of *(b-c)* being positive, the curve now has a positive slope of *1/(b-c)*. This already indicates the destabilising effect of the interest rate rule with fixed exchange rates.

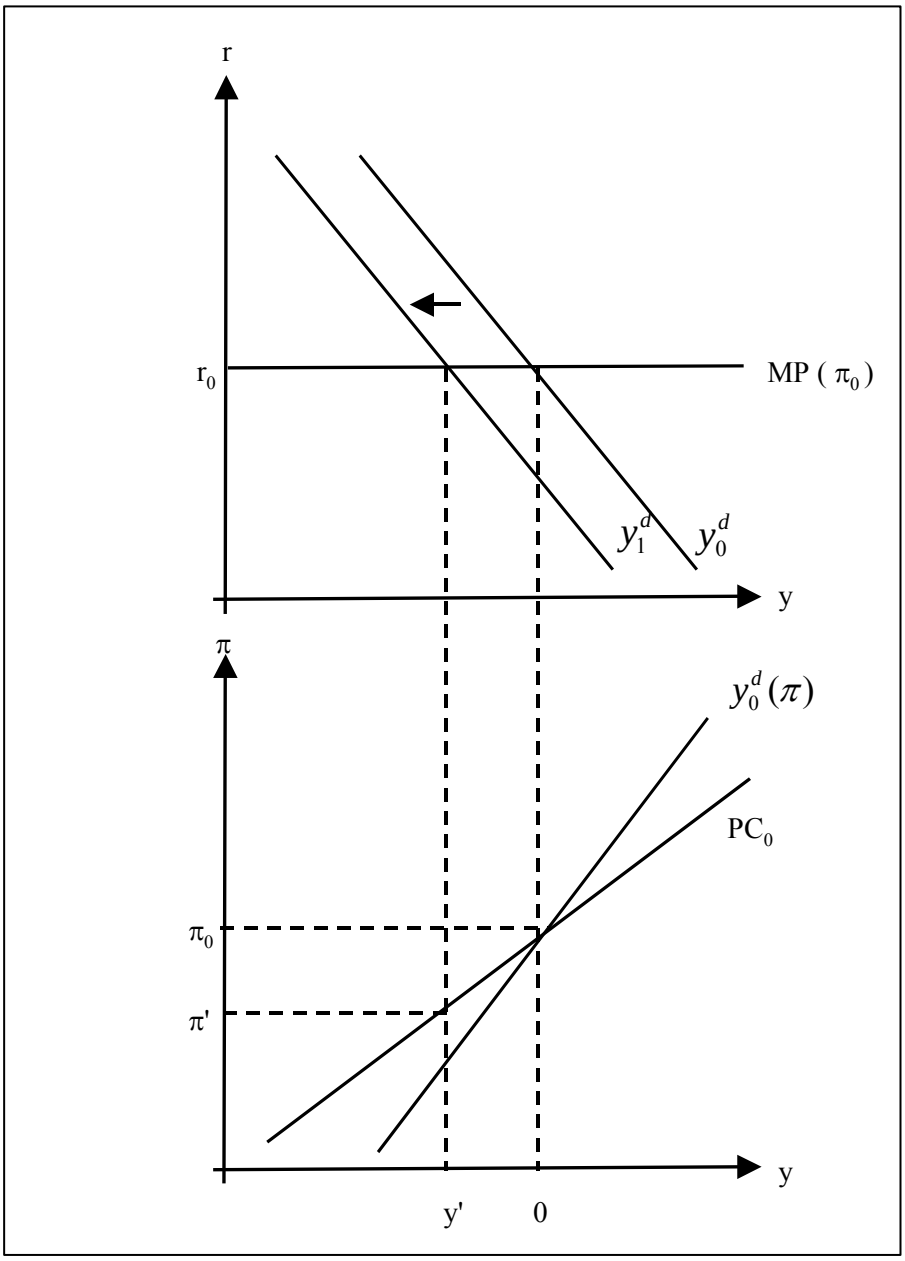
Because *b* and *c* are less than one, the slope is greater than one. Consequently, it is steeper than the Phillips curve with a slope of *d*.

Figure 8: Standard BMW Model for open economies with fixed pegs



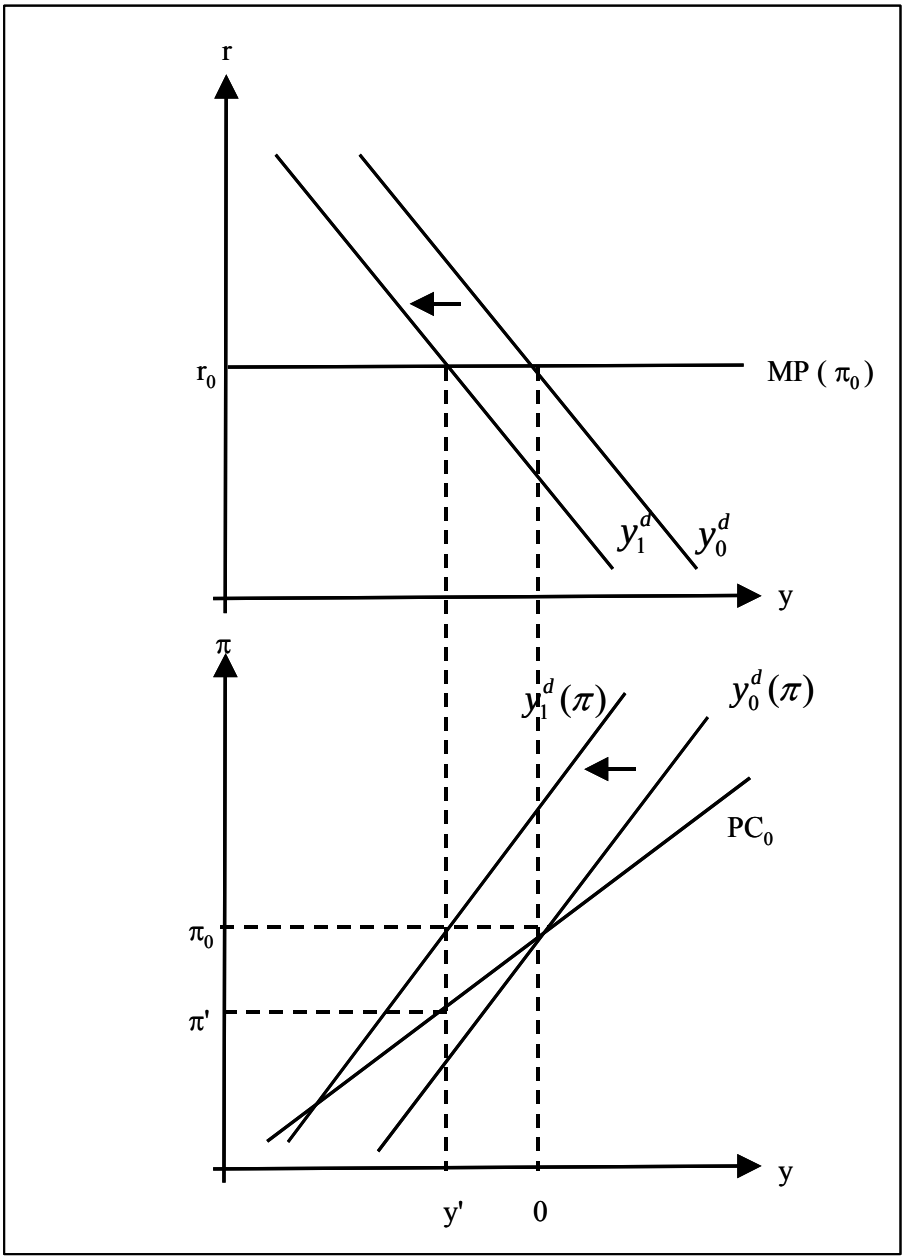
Within this environment, a negative demand shock and a negative supply shock are analysed graphically. If a contraction of domestic demand hits an economy with fixed exchange rates, figure 9 shows that the shock shifts the $y^d(r)$-curve to the left. Without effects on the domestic real interest rate *r*, the situation *y'/π'* would emerge.

Figure 9: BMW Model: Demand shock in fixed pegs I



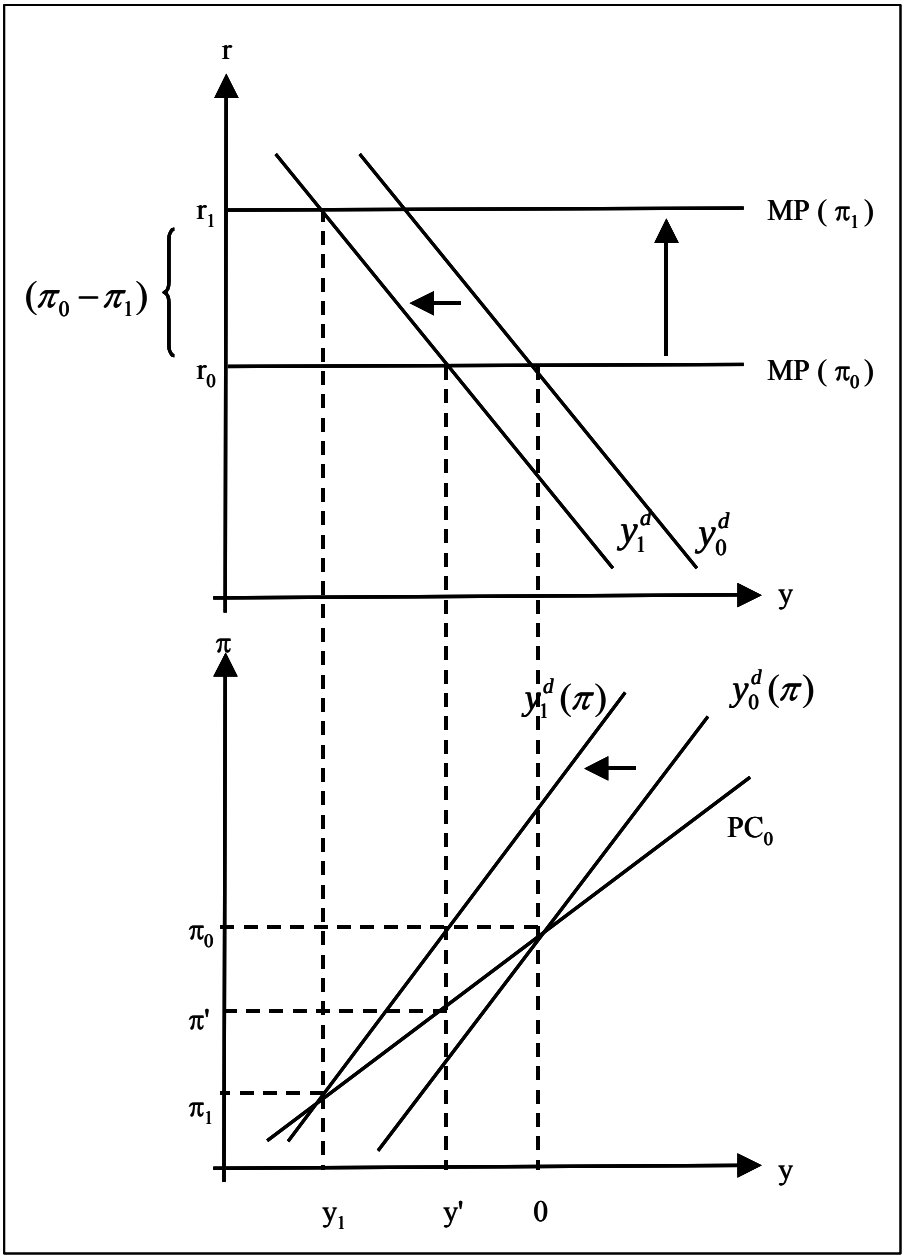
But since the central bank is committed to keeping *i* unchanged at the level of i^* due to its fixed exchange rate policy, the real interest rate goes up when domestic inflation declines. This repercussion graphically is reflected in the $y^d_0(\pi)$ curve shifting to the left to $y^d_1(\pi)$

Figure 10: BMW Model: Demand shock in fixed pegs II



finally resulting in the new equilibrium y_1/π_1, where inflation has eventually receded from π_0 to π_1 and the real interest rate has increased from r_0 to r_1.

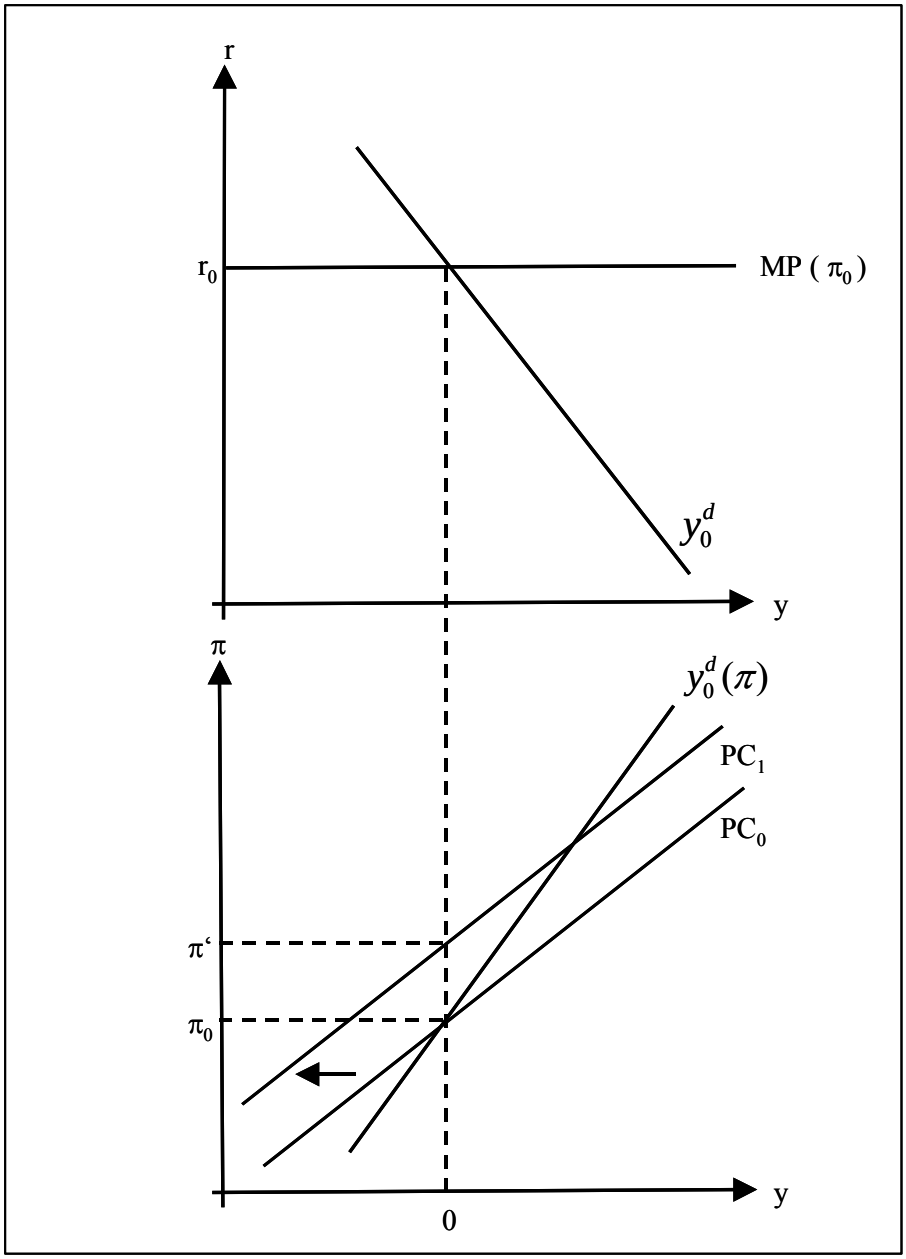
Figure 11: BMW Model: Demand shock in fixed pegs III



In the outcome, this monetary policy reaction conforming to the fixed peg requirements is clearly destabilising: The output gap deteriorated from y' to y_1 and inflation decreased from π' to π_1.

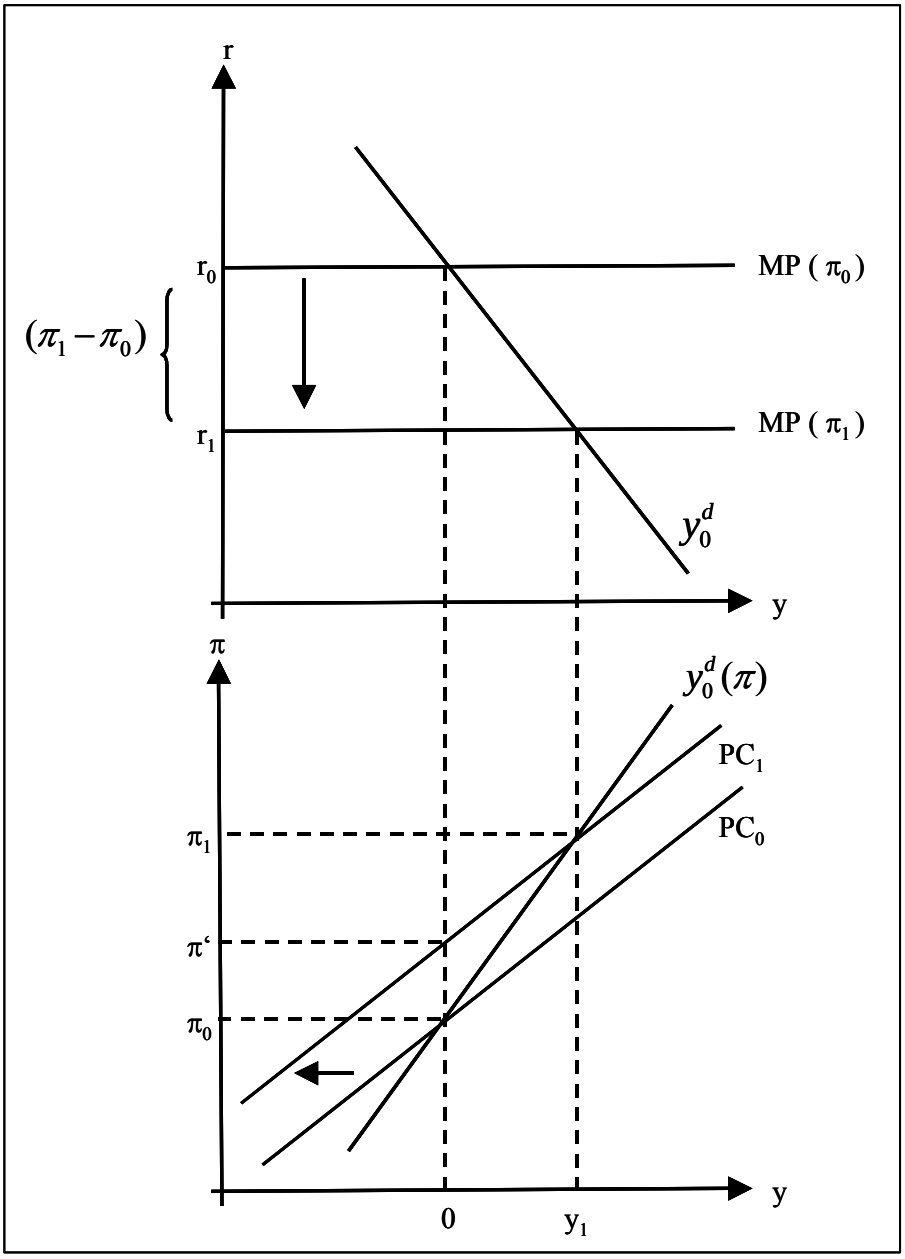
To show that the destabilising effects do not depend on the kind of shocks, the next step is to discuss a negative supply shock which shifts the Phillips curve in figure 12 from PC_0 to the left to PC_1. This increases inflation to π' and at first has no effect on output.

Figure 12: BMW Model: Supply shock in fixed peg I



The increase in inflation leads to a decline of the real interest rate, since the nominal interest rate i has to remain unchanged on the level of the foreign interest rate. Thus, the domestic real interest rate falls, expressed in a MP-line moving downwards, what again produces a positive output gap that fuels inflation even more.

Figure 13: BMW Model: Supply shock in fixed peg II



A new equilibrium is reached in y_1/π_1. Consequently, here again, monetary policy reaction based on the interest rate rule destabilises the economy, because it increases inflation $(\pi_1 > \pi')$ and produces a positive output gap.

Altogether, these stylised cases show that a fixed exchange rate manifests itself as a destabilizing Taylor rule since it obliges the domestic central bank to conduct a monetary policy that destabilises the domestic economy in the case of shocks[26].

Of course, the level of destabilisation depends on the size of the country because of the relevance of the interest rate channel in relation to the exchange rate channel. In small open economies, the influence of the exchange rate channel generally is higher than in bigger countries. This implies that bigger countries are more affected by the destabilising effects discussed above in the case of domestic shocks.

Empirical studies confirm that relatively closed economies are subject to less influence of the exchange rate channel. However, it is important that these studies also show that the interest rate channel on the whole dominates the exchange rate channel in open economies, in smaller as well as bigger countries. Based on these insights, our further analysis refrains from dividing into smaller and bigger countries[27].

The implications of the fixed exchange rate on domestic monetary policy explain why in reality, central banks of countries with fixed exchange rates do not mechanically adopt the passive attitude that nominal anchor theory requires but frequently try to escape from this corset to avoid the destabilising effects. The attempt is to conduct some autonomous interest rate policy that on the other hand does not fit with the fixed peg requirements. Consequently, UIP is not valid any more and the central bank has to intervene on the foreign exchange market to keep the exchange rate stable while the negative effects on the domestic economy are reduced. More stability on the one side (internal

[26] It has to be noticed, however, that the fixed peg does not ever perform worse than a strategy of free floating. Only in the case of shocks that affect the domestic country asymmetrically to the anchor country does the monetary policy response to these shocks have destabilising effects. In the case of shocks affecting the pegged country and its anchor country in the same way, the fixed exchange rate strategy triggers a monetary policy response that is more effective than under a free floating. This is what the theory of optimum currency areas argues with, see Mundell (1961).

[27] Mayes/Virén (1998), p. 8, provide a general overview of estimations of ratios of exchange rate impacts versus interest rate impacts and compare them to their own estimations. The table on page 8 in this paper includes estimates for countries of all sizes. The authors define the ratio as follows (p.7): "A ratio of X to 1 implies that a change in the exchange rate by X per cent has the equivalent impact to a 100 basis points change in the interest rate". In their table on page 8, the estimates with very few exceptions show a ratio bigger than one, that is, the interest rate channel generally dominates the exchange rate channel for smaller as well as bigger countries. Furthermore, the authors state that "large relatively closed economies such as the US or Japan are thought to have ratios around 10 to 1 and very open economies around 2 or 3 to 1" (p. 7) what the table of estimates confirms.

equilibrium) is at the expense of less stability on the other side (foreign exchange market equilibrium). This dilemma is the root of currency instabilities that potentially end in currency crises. To explain currency crises theoretically, several currency crises models have emerged in the last 25 years. As none of the models was really successful in predicting upcoming currency troubles, the models were extended and extensively rebuilt.

II.2 Currency crises theory

The traditional literature about currency crises models is basically classified by EICHENGREEN et al. (1996b), who separate the models into generations – at that point into *First and Second Generation models.* The following introduction of currency crises models refers to these categories. However, the focus is to provide an introduction and overview to the theoretical literature with the objective to show that the theories are relatively disparate in their arguments.

II.2.1 First Generation model

The concept of the initial models of currency crises, subsumed under *First Generation model*, principally goes back to KRUGMAN (1979) and was extended several times, a popular approach being FLOOD/GARBER (1984). The models of this group explain crises with unsound fundamentals that require a monetary policy that is incompatible with a fixed exchange rate. The crisis is the unavoidable result of an unsustainable policy.

KRUGMAN's model was motivated by Latin America's currency crises in the seventies. It is based on the work of SALANT/HENDERSON (1978), who analysed the stabilisation of commodity prices (explicitly the gold price). The theoretical basis for modelling the capital outflows that precede the crash is a model of exhaustible resources. An exhaustible resource is characterised by a price rising with increasing demand in the resource and the resource is just exhausted, when the price has reached a certain point – called “choke point” by KRUGMAN – where there is no demand any more. In the model of SALANT/HENDERSON (1978), there further exists an official institution that aims at stabilising the price of the resource by selling and buying it at a fixed price. As soon as the price for the resource that is officially targeted by the board exceeds the price that would find its level on an unregulated market, investors would sell the commodity while the board would acquire stock in it. This price that balances the foreign exchange market is called “shadow price” in the model. If, on the other hand, this shadow price is higher than the price targeted by the official institution, it is attractive to buy the commodity. If the board is willing to continue stabilising the price, it has to sell and thus

exhaust its stocks. This logic explains the closing of the open gold market after speculative buying in 1969.

KRUGMAN (1979), who constructed the model[28] for a small open economy, uses this logic and applies it to speculative attacks on central banks that aim at stabilising the exchange rate at a fixed rate and therefore use their stock of currency reserves to sell or buy foreign currency at the fixed rate.

In his model, KRUGMAN assumes purchasing power parity (PPP) to hold

$$[2] \qquad S = \frac{P}{P^*}$$

with a constant foreign price level P^* (P^* is assumed to equal 1).

Furthermore, investors should only have the choice between two assets, foreign and domestic money that are both not bearing interest. That way, real private wealth W is composed of the real value of their holdings of domestic money (M) and foreign money (F)

$$[57] \qquad W = \frac{M}{P} + F$$

The author further assumes that the foreign investors do not hold domestic money.

In equilibrium, the domestic money supply M must equal its demand, which KRUGMAN assumes to be proportional to wealth

$$[58] \qquad M / P = L(\pi) \cdot W$$

π here stands for the expected rate of inflation.

In the author's model, the government of the pegged country monetizes its budget deficit by issuing domestic money and thereby increases the supply of domestic currency. By doing so, under a fixed peg the domestic central bank has no control over its foreign exchange reserves any more, since if

> *"the government issues more domestic money than the private sector is willing to hold, private investors can always withdraw the excess money from circulation by trading it for foreign*

[28] For a formal introduction see Krugman (1979) and Flood/Marion (1998).

> *money at the exchange window. As a result, the extent to which the government finances its deficit by running down its foreign currency reserves is determined by the private sector's willingness to acquire additional domestic money"* KRUGMAN (1979), p. 318.

The consequences are comparable with the logic of a speculative attack on a commodity stock described above. If investors knew that with the depletion of foreign currency reserves – which entails floating the currency – the price for foreign currency was beginning to rise (the domestic currency was depreciating), the "shadow price" would exceed the official exchange rate target. Accordingly, anticipating investors would sell domestic currency in advance of a currency reserves exhaustion. It is a key insight of the KRUGMAN model that the speculative attack would take place as soon as the reserves would have fallen to a critical level since the end of the exchange rate stabilisation would be foreseeable and it would not be attractive to hold domestic currency when its price is no longer stabilised. Thus, according to the author, as soon as the critical threshold is reached, the currency stock depletes suddenly and not gradually. KRUGMAN emphasises that the speculative attack is rational.

In brief, the KRUGMAN model describes the crisis as a result of a fundamental inconsistency between the pursued economic policy and the exchange rate target, which inevitably triggers a speculative attack. In terms of the distinction between an external and internal equilibrium, this theory on the one hand focuses on the violation of the external equilibrium, and on the other on the internal equilibrium faced with the excessive money supply.

The same effect of speculative pressure can also occur for countries that do not show the traditional indicator, a massive fiscal deficit, in the beginning.[29]. When for instance corporate or financial institutions suffer from some sort of shock that endangers their profitability, bailout by the government may be needed. While the process of bailing such institutions out can be different, the costs for this intervention activity need to be financed. This requires an expansionary monetary stance in the future[30]. This policy stance again is incompatible with a fixed exchange rate regime and speculators come up that speculate on the end of the currency peg.

This logic of the Krugman model is in line with the argument of purchasing power theory (PPP). When PPP holds and an excessive money supply increases inflation, the theory implies a devaluing domestic currency.

One could also argue that the excess domestic money supply leads to a decreasing domestic interest rate,

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[29] See Pesenti/Tille (2000).

[30] Deficits are financed by the creation of money. Dooley (1997) argues the same way.

[59] $i = i^{opt} \Rightarrow i \prec i^{*} + \alpha$

which according to uncovered interest parity raises devaluation pressure for the domestic currency.

This violation of the fixed peg rules requires intervention by the central bank to stabilise the currency price through selling foreign and buying domestic currency.

To sum up, the key pillars of First Generation models are

1) unsound fundamentals i.e. an economic policy that is incompatible with the peg.
2) rational behaviour of market participants seeking to maximise benefits.
3) a sudden speculative attack at a time when the currency reserve stock is not yet depleted, because of the perfect foresight of the involved actors. At this time the central bank has lost any leeway in acting.

Consequently, this model implies that a potential currency crisis can be identified before it breaks out by observing the fundamentals. Typical symptoms are declining currency reserves, an increasing credit volume, a high budget deficit and public debt, a real exchange rate appreciation due to inflationary pressure, a deterioration of the trade balance and finally, increasing domestic interest rates[31].

The basic model of KRUGMAN (1979) and FLOOD/GARBER (1984) was the inspiration for numerous papers, providing further modifications. AGÉNOR et al. (1991) and FLOOD/MARION (1998) provide a survey of the variations of the First Generation model. However, after some time, it became clear that First Generation models face some serious shortcomings. One central point of criticism is that it is left out of consideration that the monetary policy line of the domestic central bank is not always time consistent. The central bank has the possibility of monetary policy changes, e.g. abandoning a fixed peg, which are not discussed in this model. Furthermore, analyses are based on purely monetary fundamentals like money supply, credit growth or the budget deficit. Other economic parameters like unemployment and the business cycle are not taken into consideration. Moreover, psychological phenomena that are not directly observable like credibility, confidence and potential irrationality of market participants are not covered[32].

[31] See Kaminsky et al. (1998) and Frenkel (2000).

[32] See Resinek (2001), p. 18.

Due to these shortcomings, as soon as the next substantial currency crisis arose – the European Monetary System currency troubles – models of First Generation failed in predicting and depicting the process. Typical indicators of First Generation models like vast budget deficits could not be observed in advance of pressure on the foreign exchange rate.

II.2.2 Second Generation models

Contrary to the approaches discussed above, Second Generation models focus on the behaviour of market participants by suspending an essential assumption of the First Generation models: In the more advanced model generation, established by OBSTFELD (1994), the central bank operates less mechanically and instead is allowed to modify its strategy when necessary[33]. Finally, in the models of Second Generation, currency crises are triggered by shifts of expectations of the market participants.

Whereas in the First Generation models the central bank's behaviour is reduced to printing money and intervening with the reserve stock, Second Generation models consider that "the defence of an exchange rate is a matter of tradeoffs rather than a simple matter of selling foreign exchange until the money is gone" KRUGMAN (2001, p. 3).

Rather, Second Generation models[34] argue based on

1. the *social costs* of pegging the exchange rate,
2. the *economic benefits* of pegging the exchange rate and
3. on the *market expectations* of the central bank behaviour that directly influence monetary policy decisions.

The monetary authority generally aims at minimising a loss function of social welfare. Therefore, the central bank always has to evaluate the economic benefits of a fixed exchange rate as the reason for defending the peg against the social costs of pursuing the peg that on the other side can become a reason for abandoning this strategy.

The *social costs* of the peg arise from poor economic performance with high unemployment that cannot be supported by a suitable, domestically oriented interest rate policy (i^{opt}) since the peg requires holding UIP. In terms of the BMW model, the dilemma is:

[60] $$i \succ i^{opt} \; but \; i = i^* + \alpha$$

[33] See Aschinger (2001), chapter 5, pp. 165.

[34] See Obstfeld (1994), Flood/Marion (1998) and Ozkan and Sutherland (1995).

Minimizing the loss of social welfare requires the central bank to conduct a more expansionary interest rate policy to support the domestic economy (i^{opt}). Under fixed peg conditions however, we have discussed in chapter II.1.3 that a valid UIP ($i = i^* + \alpha$) is crucial for a foreign exchange market balance. Thus, there isn't the flexibility to pursue an autonomous interest rate policy meeting the domestic requirements and the domestic interest rate is to restrictive ($i \succ i^{opt}$) causing loss of social welfare.

Under a freely floating exchange rate, an economic downturn could be counteracted by an expansionary monetary policy. So, if the social costs arising from the economic imbalances accelerate, this would provide an incentive to leave the currency peg. Another approach of Second Generation models is to explain social costs from the assumption that the pegged country is highly indebted and that this debt is denominated in domestic currency. This situation would also create an incentive for the domestic central bank to reduce the debt burden by depreciating the currency.

In contrary to the costs, the *benefits of a currency peg* stem for instance from importing stability and credibility from the anchor country and in this way reducing the refinancing costs of a country. So, the *balance* of costs and benefits counts: If the costs exceed the benefits, the central bank is supposed to rethink its monetary strategy. This argumentation shows that strategy shifts from a peg to a free float can be reasonable and have to be considered in the models.

It is in fact the *market participants' expectations* that are crucial for the continuation of a fixed exchange rate regime. As soon as investors consider a monetary policy shift towards a free float to be sufficiently likely, this initiates a speculative attack onto the peg. In formal terms, the risk premium increases, distorting the monetary equilibrium.

[61] $\alpha \uparrow\uparrow \Rightarrow i \prec i^* + \alpha$

Consequently, the central bank is required to defend the currency peg, i.e. increasing the domestic interest rates which again burdens the debt service and the economic performance. It is in fact the change in investors' expectations itself that triggers the breakdown of the peg since this shift ultimately alters the balance between the peg's costs and merits by making its defence extremely expensive. That is why the Second Generation models argue with *self-fulfilling* speculative attacks or panics.

It is important to notice that the other way round investors could refrain from taking a policy shift into account. They would not charge any risk premium and the central bank could maintain the peg. In this case as well, the expectations would be self-fulfilling, as the expectation of "no policy switch" would be confirmed. In this context, it is important to state that a balanced situation is no guarantee against

currency crises any more as it has been in the First Generation. It is rather crucial that the central bank's monetary policy remains credible to the markets. Since the outcome depends on the market's expectations, Second Generation models consider *multiple equilibria* possible[35].

To sum up, in the Second Generation models, the central bank faces a trade off between macroeconomic flexibility and credibility and investors always observe the behaviour of the central bank accurately to build expectations of it. At last, the central bank does not exogenously decide about the time of a potential strategy shift but the monetary authority is forced to float the currency by the respective market expectations.

In this respect, the First Generation models are added for financial market influences with a special emphasis on the interaction of the market and monetary policy. Thus, the discussion that concentrated on the external equilibrium in the First Generation models is now extended to include the internal balance.

To list typical symptoms that precede a crisis according to the Second Generation logic is not as unproblematic as in the First Generation. KAMINSKY et al. (1998, p. 5) state that the Second Generation "approach suggests a variety of factors [...] could be used as leading indicators". They refer to the stock of public debt as well as to a weakening of the banking system since both are negatively affected by an increase in domestic interest rates for UIP reasons. Anyhow, because of the possibility of multiple equilibria under the same fundamental scenario, a strong relationship between fundamentals and a crisis is difficult to establish.

Finally, in the Second Generation of currency crises models, there again remain considerable shortcomings. These models neglect to consider what causes the expectation shifts concerning the loss of confidence among investors. Furthermore, they give no indication about the timing of such switches. In this way, the model explanations again proved to be insufficient for predicting the subsequent major currency crises. In the aftermath of the Asian currency crises it became obvious that important elements and developments of the currency turmoil were not covered by the theory available at that time, motivating researchers to develop Third Generation approaches.

II.2.3 Third Generation approaches

Models of the Third Generation cannot be applied homogenously for a specific theoretical approach like the First Generation and Second Generation models can be. Rather, the label Third Generation serves as a generic term for a variety of advanced, but relatively different currency crises approaches.

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[35] See Flood/Marion (1998) and Frenkel (2000).

II.2.3.1 Spill-over effects

Striking new phenomena that needed theoretical explanation were contagion effects. Through the Tequila Crisis, which arose in Mexico in 1994, several Latin American and East Asian economies were affected. In the course of the Asian crisis of 1997, Thailand's currency turmoil spilled over to Malaysia, Indonesia, South Korea and Singapore. The most recent example is the Argentina crisis, infecting Brazil and other Latin American countries.

As a definition for the spreading of financial troubles, the description of EICHENGREEN et al. (1996a, p. 2)[36] is applied who understand contagion as "a systematic effect on the probability of a speculative attack which stems from attacks in *other* currencies, and is therefore an additional effect above and beyond those of domestic 'fundamentals'". In the literature, this occurrence is also referred to as "spill-over effects". Both terms – "contagion" and "spill-over effects" – are mostly used interchangeably. MASSON (1998), however, proposes to distinguish the two definitions. According to him[37], spill-over effects are fundamentally based and explain the spill-over by economic linkages between countries, be it in bilateral trade or in financial markets. Contagion is characteristically a change in market sentiment without fundamental reasons[38].

The following approaches fall under the fundamental explanations for spill-overs, whereas e.g. herding behaviour is an example for the contagion category.

(1) *Trade linkages*

The most obvious explanation of economic interdependencies between two countries is that these are linked through international trade. Among others, EICHENGREEN et al. (1996a), EICHENGREEN/ROSE (1999), GLICK/ROSE (1998) and KAMINSKY/REINHART (2000) conclude from empirical studies that trade linkages are very significant for spill-over effects. One of the first theoretical analyses of this subject was GERLACH/SMETS (1995). For a more recent analysis see CORSETTI et al. (2000) who rethink the traditional models of competitive devaluation. The logic is that an exchange rate regime's breakdown leads to a devaluation of the currency of country *A*, which weakens the competitiveness of its trade partner *B*. Thus, a devaluation of country *A*

[36] Kaminsky/Reinhard (2000) base their comprehensive analysis on the same definition.

[37] See Pesenti/Tille (2000) as well.

[38] Apart from the categorisation into spill-overs and contagion, that is common in other papers as well, Masson (1998) even introduces a third category, called "monsoonal effects". According to Masson, this class describes the simultaneous occurring of crises because of a common cause – the author gives the example of a policy stance of industrial countries that affect emerging markets in the same way.

tends to deteriorate the fundamental situation of the trading partner *B*. In country *B*, this triggers the circle of intervention to defend devaluation pressure, therefore declining foreign currency reserves and rising interest rates that burden the economic balance. The situation comes full circle with a speculative attack on the currency of country *B*, since credibility in the currency regime is undermined by the growing incentives for abandoning the peg[39].

Generally speaking: Currency devaluation in one country forces monetary authorities in other countries to abandon their fixed peg and also devalue their currency to restore their competitiveness. However, this mechanism does not only depend on the volume of bilateral trade, since additionally, a depreciation in country *A* reduces the trading partner's (*B*'s) export perspectives on third markets, where both countries' export sectors compete for other trading partners[40].

(2) *Financial linkage* ➔ *Credit Crunch*

Another transmission channel of currency troubles that did not gain broad attention in theory until now but comes into play in the Asian as well as the Latin American crisis is the problem of *common lenders*. KAMINSKY/REINHART (2000) and FRATZSCHER (2002) discuss the issue that the lenders, especially commercial banks fuel further crises somewhere else subsequent to an initial currency crisis. When a currency crisis leads to difficulties for domestic borrowers to redeem loans to foreign banks, the foreign lender is faced with losses of its loans and consequently restructures his portfolio in order to limit losses elsewhere or simply recalls some of his loans to restore his capital. The result is that the currency crisis in the one country leads to a credit crunch in other countries because of common lenders[41].

[62] $\quad i \succ i^{opt}\,,\; i \succ i^{*} + \alpha$

Refinancing gets more expensive for the affected countries. The decreased money supply manifests in an increase in the domestic interest rate, which that way gets more restrictive than the internally optimal interest rate. Furthermore, this interest rate increase endangers UIP validity what produces pressure on the foreign exchange market.

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[39] Up to now, this situation can not be depicted formally, since the monetary rule for holding the peg is based on UIP which does not consider effects of real exchange rate changes. This problem will be solved in chapter III, when the MCI concept is introduced.

[40] See Pesenti/Tille (2000), who present a numerical example in box 1.

[41] See Pesenti/Tille (2000), who also set up a numerical example for credit crunches in box 2.

(3) *Generalisation due to macroeconomic similarities*

Especially in the case of information asymmetries due to the costs of gathering country-specific information, investors tend to neglect national specificities. According to CALVO/MENDOZA (1999), investors tend to view several countries of a region being more or less alike. As soon as new information about one of the countries comes to light, this can be applied to all other countries. So, symptoms of vulnerability in one country of a region raise doubts about the soundness of its neighbours and finally trigger a speculative attack[42].

[63] $\alpha \uparrow\uparrow \Rightarrow i \prec i^* + \alpha$

The logical conclusion is that countries with liquid financial markets that trade their assets internationally and show a high correlation of asset returns with the crisis country are more vulnerable to speculative attacks[43]. This occurrence is seen as a rational herding behaviour among investors.

II.2.3.2 Self-fulfilling crises due to herding

Apart from the argument provided above, optimistic or pessimistic attitudes are observed to be self-confirming without being related to macroeconomic conditions at all. Potential reasons for these *self fulfilling crises* are discussed in theoretical approaches under the heading *"herding behaviour"*. SHILLER's (1989)[44] analysis of the stock market crash of 1987 gives a good impression of the origin of such processes. He states that the only reason for investors to sell stocks was the fact that prices were going down. Theory provides two main explanations for herding: The *bandwagon effect* and *asymmetric incentives*[45].

Bandwagon effects arise because of incomplete information. Due to information costs, one market participant follows the other's behaviour because he thinks the other possesses some private

[42] See as well Bank of International Settlements (1998, p. 132) and Kodres/Pritsker (2002) who call the phenomenon "cross-market rebalancing".

[43] See Kaminsky /Reinhart (2000).

[44] See especially chapter 23.

[45] These are psychological rather than fundamental scenarios that from the monetary perspective fall in the category "rising risk premium": $\alpha \uparrow\uparrow \Rightarrow i \prec i^* + \alpha$.

information[46]. This chain makes one investor sell if he becomes aware that another, whom he expects to be well informed, has sold. As soon as this information reaches a third person, this person needs to sell too even if he has neutral or even slightly positive information; the fact that the other two have sold implies that they have some negative information he is not conscious of and so on. The bandwagon effect increases and the foreign exchange market tends to overreact to news. The problem is that this imitative behaviour leads to a self-fulfilling speculative attack when the market adopts pessimistic expectations of credible investors (mostly big ones) even if there is no fundamental reason[47].

Moreover, especially when principals instruct financial intermediaries to manage their capital, *asymmetric incentives* come into play that distort investment propositions[48]. An investment manager is compensated relative to other investment managers or relative to a benchmark. Therefore, it is superior for the individual agent to generate a loss together with all agents than to under-perform individually. That is, an adaptation of the community's behaviour protects the single agent from negative consequences in the form of salary cuts. The consequence is that not the expected foreign exchange market development is crucial but the expected behaviour of the other market participants, even if there is information indicating that the community's assessment is wrong. This explains self-fulfilling speculative attacks since the pure supposition of a future change in behaviour triggers this change.

There is an important difference to the assessment of the models of the First and Second Generation. Contrary to traditional theory, which relies on an efficient market, the herding behaviour approaches presented above imply that the relation between information and market behaviour is distorted, and consequently the market is inefficient[49].

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[46] See Krugman (1998a), Aschinger (2001) and Resinek (2001). In this respect, Pesenti/Tille (2000) point to the emerging of clusters of specialists, as an investor tends to concentrate his interest onto a small region to save information costs.

[47] Pesenti/Tille (2000) give the example that the initial investor could have sold simply because of an individual need for liquidity.

[48] See Wade (1998), pp. 698.

[49] Krugman (1998a) however points out that it sometimes is unjustified blaming speculators for a crisis. In his view, even a „self fulfilling crisis" can be attributed to unsound fundamentals in most cases. He states that an economy influences its vulnerability for self fulfilling tendencies by the degree of independence of its central bank policy. An institution that enjoys public confidence and credibility and demonstrates its commitment to the exchange rate peg will be less vulnerable to a speculative attack. According to Krugman, often speculators are blaimed for triggering a crises that would have emerged anyway but with a much bigger time lag then with speculative behaviour. So watchers do not assign the development to fundamentals, but to speculators since at this early point of time no aberration in fundamentals is obvious yet.

It is imaginable that the herding system is exploited by market manipulators[50]. The way to gain profit by the currency crisis is that a large investor quietly takes a short position in the currency that he intends to devalue. Then he initiates a self-fulfilling herding process that ends in the currency crisis e.g. by publishing certain negative statements about the currency and seeming to sell positions. A famous example is George Soros' attack on the British pound in 1992 – even if it is likely that this attack was a one-time event. It also is not evident whether the crisis would not have occurred without Mr. Soros as well.

II.2.3.3 Illiquidity in financial markets (bank runs)

Another approach concerning contagion effects is based on herding theory and argues with illiquidity in financial markets[51]. In these approaches, the function of financial intermediaries is crucial to investor panics that trigger banking as well as currency crises. A bank run model was primarily set up by DIAMOND/DYBVIG (1983) and extended for an open economy by CHANG/VELASCO (1998). What is central in the context of currency crises is the channel of banking crises potentially leading to foreign exchange market troubles.

The core of these models is the transformation function of financial intermediaries – transforming maturities of assets and liabilities for consumers and investors. A problematic situation occurs as soon as the behaviour of creditors mismatches the maturity plans of the financial institution, e.g. when more investors aim to withdraw more money than expected in the short run for whatever reason[52]. The bank, having invested a certain volume of the liquidity long-term only can liquidate this long-term investment at a significantly discounted price and thus probably is not able to serve all of the clients' needs, provoking a reaction of panic among investors. Illiquidity of the financial institution is the ultimate result. Thus, the bank run theory gives another rational explanation for herding behaviour among investors[53].

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[50] See Krugman (1998a).

[51] This again is rather a psychological than fundamental explanation that can be expressed with $\alpha \uparrow\uparrow \Rightarrow i \prec i^* + \alpha$.

[52] For example because of a crisis in a neighbour country that leads to doubts about the credit worthiness of the domestic banks. Diamond/Dybvig (1983, p. 417) formulate it more general: A "bank run can occur in response to changes in depositor expectations about the bank's credit worthiness."

[53] For a comprehensive discussion of the logic of a bank run see Diamond/Dybvig (1983) and Chang/Velasco (1998). For a survey of banking institutions getting into the crisis see Eichengreen/Rose (1998). They also discuss supervision and regulation problems as one important factor contributing to banking crises.

Applying this logic to an international environment, financial intermediaries supply liquidity to foreign investors and offer deposits. If these offers are attractive, they lead to capital inflows. As soon as foreign investors withdraw their money, this firstly can provoke a self-fulfilling liquidity crisis for the financial institution again the way it is discussed above. Secondly, the capital outflows affect the currency regime since the investors convert the withdrawal into foreign currency. Subsequently, the central bank is asked to defend the exchange rate parity by intervening. But the intervention direction erodes the foreign exchange reserves since the central bank has to sell foreign currency while buying domestic liquidity. That way, the bank run additionally could set off a self-fulfilling currency crisis[54].

Apart from this argument, there is an even more simple and obvious channel through which a banking crisis can fuel a currency crisis[55]. If the public sector has to bail out illiquid banks, the fiscal position of a country deteriorates rapidly. Accordingly, doubts rise about a possible monetization of the public deficit and therefore about the sustainability of the exchange rate peg. This argumentation is strongly related to the First Generation approach[56], since the change of the fundamental situation potentially provokes a speculative attack on the currency.

In light of that theoretical background coupled with empirical observations, several studies have examined the relation between banking crises and currency crises. KAMINSKY/REINHART (1999) came to the conclusion that banking and currency crises are closely linked and banking crises can be the origin of currency turmoil[57]. That is why KAMINSKY et al. (1998) and KAMINSKY/REINHART (1999) refer to banking crises as a leading indicator for currency crises. Along with models of bank runs, the literature stresses underdevelopment of financial markets as a major cause of vulnerability against speculative attacks. These theories refer to the liberalisation of financial markets in connection with insufficient regulation and supervision. GLICK/HUTCHISON (2001), for example, put a special focus on financial liberalisation in their empirical study when confirming the occurrence of twin crises[58].

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[54] See Eichengreen et al. (1996a).

[55] See Pesenti/Tille (2000).

[56] See chapter II.2.1.

[57] More in detail, the results have to be differentiated: For the period of the seventies, no such relation could be stated, while the relation got much more apparent during the eighties and nineties. This is intuitive since while financial markets were still regulated during the seventies, in the following decades the liberalisation and deregulation had advanced.

[58] See Zhu (2003) as well.

II.2.3.4 Moral hazard

A phenomenon that was of particular importance during the Asian currency crisis is moral hazard. The respective approach derives over-investment or price bubbles from moral hazard that ultimately gives speculators a reason to trigger a self-fulfilling crisis. A simple and popular model explaining the outcome of moral hazard comes from KRUGMAN (1998b). Another early model describing the emergence of over-borrowing through moral hazard comes from MCKINNON/PILL (1996 and 1998). CORSETTI et al. (1999) relate their theory of moral hazard explicitly to the Asian crisis while DOOLEY (1997) provides another early and clear discussion, though not a formal model. On the basis of DOOLEY's (1997) argumentation, FRENKEL (2000) developed a formal model of moral hazard through implicit government guarantees.

It is common that explicit or implicit *government guarantees* for the case of substantial financial troubles are considered the major trigger of moral hazard[59]. The general consequence of such guarantees is that on the one hand, financial institutions engage in risky borrowing and investing and, on the other hand, investors – domestic as well as foreign ones – lend without adequately weighing an investment's risk versus its return[60].

Additionally, creditors have few incentives to survey a financial intermediary's investment policy because they believe their deposits are guaranteed. Similar to the argumentation for the financial sector, this logic is valid for the foreign exchange market in the case of fixed pegs[61]. The fixed exchange rate works as a guarantee against unexpected losses in the value of the currency and thus encourages investors to neglect currency risks in their investment decision.

The following analysis will introduce the KRUGMAN (1998b) model, which is widespread in the literature. This model demonstrates the incentive for financial intermediaries to proceed with risky investments due to government guarantees for their liabilities: In the event of a positive outcome, high yields are realised, whereas in the event of a negative outcome, losses are covered[62]. Consequently,

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[59] Such guarantees generally can consist of a deposit insurance for financial institutions as well as the lender-of-last-resort function of a central bank or expected aid from foreign governments or institutional organisations such as the IMF.

[60] When expressing these monetary effects of guarantees in UIP terms, the effects have to be separated for creditors and debtors. From the debtors' perspective, the guarantees produce lower (than economically adequate) financing costs $i \prec i^{opt}$; $i \prec i^* + \alpha$ whereas for the creditors, the guarantees increase the return $i \succ i^{opt}$; $i \succ i^* + \alpha$.

[61] See Obstfeld (1998).

[62] It is assumed for simplicity, that the financial intermediary does not invest any capital of his own so that there are no personal losses in the bad state of nature.

investment projects are preferred that could yield high returns at a high risk which leads to *over-investment*. This can be demonstrated in a two-period-model:

In the first period, KRUGMAN (1998b) assumes firms raising capital. In the second period, they should start production using that capital. A quadratic production function with an output (revenue) Q, capital *K* and the stochastic term *u*, which expresses uncertainty,

[64] $$Q = (A + u)K - BK^2$$

has a marginal revenue per unit of capital of

[65] $$R = \frac{\delta Q}{\delta K} = A + u - 2BK\,.$$

u can have values of 0 to 1 and signals the uncertainty of the investment return; *A* and *B* are positive. For the decision of the optimal volume of capital investment, the expected return is set equal to the costs of capital. KRUGMAN assumes a small open economy allowing the producer to borrow capital at a fixed world interest rate here assumed to be zero. Accordingly, the costs of capital should equal one. Solving for the optimal capital investment yields

[66] $$K = \frac{A + Eu}{2B}\,.$$

E indicates the expected value of the variable.

To give a numeric example, inserting *A=2* and *B=0.5* shows that a risk neutral investor will choose to invest *K=2.5*[63], when the positive and negative outcome (1 and 0) are distributed with an equal probability of *p = 0.5*. With moral hazard, however, the investment decision changes. A financial intermediary of that sort will only focus on the positive outcome and increase the capital investment to 3, even though the expected return of this investment is lower. More generally speaking: Under moral hazard due to (implicit) guarantees, the investment is considered lucrative as long as it yields a return higher than the capital costs. KRUGMAN (1998b) calls this an orientation to the "*Pangloss value*" instead of the expected return. The simple numerical example demonstrates over-investment in the

[63] The optimal volume of capital is calculated as follows: $K = 0.5\frac{2+1}{2 \cdot 0.5} + 0.5\frac{2+0}{2 \cdot 0.5} = 2.5$

case of moral hazard, since the focus of the investors on the positive state increases the investment volume. KRUGMAN (1998b, p. 6) concludes that moral-hazard investment produces losses of social welfare since "the increased return in the favourable state will not offset the increased losses in the unfavourable state".

As soon as the supply of capital goods is not elastic any more but inelastic, moral hazard initiates *asset price inflation* rather than over-investment. In an example of KRUGMAN (1998b), supply is completely inelastic since the only asset available is land that can neither be produced or destroyed[64]. In reality, the developed model is particularly observed for asset prices. Again, the author uses a two-period-model: In the first period, land is bought that returns rent in the second period. Again, the return depends on two states of nature. In the negative state with a probability of two-thirds, a unit of land yields 25 monetary units, and in the positive case with one-third, it yields 100 monetary units. Without guarantees against losses, risk-neutral investors will buy land until a price of 50, equalling the expected return in period two[65]. Under guarantees, however, losses are covered. Thus, the investment decision is only orientated to the best case of a return of 100 (Pangloss value). Consequently, in this case land will be bought until a price of 100. Competition among investors will thus increase the price for land to 100.

This mechanism is highly susceptible to a price collapse. When the guarantee is honoured in the case of a negative outcome, this will sooner or later become very expensive for the guarantor, e.g. the public sector. In this respect, security against losses can only be provided until a certain limit. DOOLEY (1998, p. 11) explains that a crisis arises as soon as the implicit liabilities of the government equal its assets. As soon as the government is no longer able or willing to cover all losses, a run on government guarantees takes place since it is known that the guarantee sum is limited and not all liabilities can be covered. KRUGMAN (1998b) even simplifies the explanation of an upcoming crisis to the fact that guarantees are credible only as long as they are honoured the first time. When the guarantee has to be honoured, future investors doubt being secured against losses in the future. That is why the investment decision again turns to being orientated towards the expected return of the investment and, accordingly, prices of the investment again fall to its expected return. This development is also known as the "*bursting bubble*"[66].

However, even in the case where guarantees are not honoured, the price bubble can potentially burst. In fact, several outcomes are achievable. As soon as investors start to believe, for whatever reason,

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[64] The same numerical example is discussed in Krugman (1998c).

[65] Expected return: $E = \frac{2}{3} \cdot 25 + \frac{1}{3} \cdot 100 = 50$

[66] Krugman furthermore extends his two-period model to a three-period-model and shows that there is a magnification effect on the losses.

that there will be no guarantees anymore on new liabilities, prices fall back to the expected return. This implies that investors realise losses since their calculation was based on the expected Pangloss values. Because of these losses, investors need to honour their guarantees, and as a consequence, the guaranteeing institution's readiness to provide further guarantees is again exhausted. The end is an "implosion of the unsound financial system [...], producing a self-reinforcing collapse of asset values" KRUGMAN (1998c, p. 3). Investors started a self-fulfilling crisis through a shift in their expectations about future guarantees. Generally, moral hazard behaviour of the financial intermediaries provokes an unstable situation arising from the possibility of *multiple equilibria*. A financial crisis of that style again increases the vulnerability of a currency crisis, as argued in the previous chapter on illiquidity in financial markets.

Implicit and explicit guarantees, e.g. of the public sector, are present in emerging economies as well as in more highly developed economies[67]. However, as soon as any sort of capital insurance distorts investment decisions in open financial markets, strong legal requirements of financial institutions are necessary[68]. The problem of some emerging markets is that financial market liberalisation often was accompanied by an insufficient development of supervisory and regulatory institutions.

On the whole, comparing this line of argument to the previously discussed theory (illiquidity in financial markets) clearly shows the heterogeneity of Third Generation approaches: While the bank run models assume a fundamentally stable environment preceding the crisis outbreak, moral hazard provokes a situation of fundamental instability through over-investment resulting in a crisis.

II.2.3.5 Balance-sheet approach

Contrary to a microeconomic point of view of most of the preceding approaches, another argument of KRUGMAN (1999) explicitly discusses a macroeconomic factor, the real exchange rate, when modelling balance sheet effects of international capital flows. The main line of KRUGMAN's (1999) approach explains crises as a result of a panic of investors. The key focus lies on corporate borrowing in foreign currency[69]. Under these conditions, entrepreneurs are vulnerable against a (real) depreciation of the currency that increases their foreign debt burden. In his argumentation, KRUGMAN especially stresses the role of the structure of corporate balance sheets.

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[67] There, deposit insurances guarantee deposits up to a certain amount.

[68] See Dooley (1997).

[69] This is attractive in a situation of $i \succ i^* + \alpha$.

It is argued that a loss of confidence of foreign investors induces capital outflows[70]. In order to compensate the resulting deficit of the capital account via the current account, the domestic country will be forced to devalue its currency. The devaluation again deteriorates the foreign debt position in the corporate balance sheets, which undermines the confidence of the investors even more. Consequently, the overall corporate net worth is reduced. Since the net wealth of a domestic entrepreneur provides a kind of security for a (foreign) creditor, further foreign credit supply reductions lead to an increase in capital outflows. This is the beginning of a vicious circle for the banking sector and the currency peg.

A further important determinant comes into play when regarding the relation between international capital flows and the real exchange rate. Foreign creditors orientated towards the net capital of domestic companies – since these provide securities for their outstanding credit – convert this at the real exchange rate. The real exchange rate again depends on cross-border capital movements. The more investment financed with foreign capital that is realised, the more positive the effect on corporate net wealth. The reason is that a (real) appreciation of the foreign exchange rate induced by capital inflows revalorises the net wealth from the foreign investor's perspective. Similarly, a decrease of investment financed by foreign capital over-proportionally reduces the foreign investors' willingness to provide further credit and leads to accelerated capital outflows. Ultimately, the initial loss of investors' confidence triggers a financial crisis in a self-fulfilling way. That is, this theory again is characterised by the possibility of multiple equilibria, in which a change in sentiment tilts the situation, validates itself and triggers turmoil.

It is important to recognise major disparities with the other approaches of Third Generation. KRUGMAN (1999, p. 18) himself states that although in this theory entrepreneurs go bankrupt due to the financial crisis, the "collapse does not indicate that the previous investments were unsound; the problem is instead one of financial fragility". This statement differs rigorously from the moral hazard argumentation, where over-investment was not at all sound from a fundamental perspective. Rather, the investment decisions were distorted. There are major disparities with the illiquidity theory as well. The balance sheet model does not count on currency mismatches in companies' balance sheets but rather attributes potential sentiment changes to a high foreign debt level, a low import propensity and a high foreign-currency debt-to-exports ratio. A more specific explanation of the motives of a loss of confidence is not provided.

[70] For a formal version see Krugman (1999).

II.3 Summary: Shortcomings of currency crises theories as the motivation for a comprehensive approach

The preceding review of nominal anchor theory illustrates the general problem of fixed exchange rates, that is the inconsistency between a domestically oriented monetary policy and the maintenance of the fixed exchange rate regime. The popular and simple Mundell-Fleming model as well as the more comprehensive BMW model demonstrate that monetary policy that is consistent with the nominal anchor requirements even tends to destabilise the economy in the case of shocks.

This is why, in reality, central banks committed to fixed pegs often try to carry out an active monetary policy to avoid negative consequences for the economy – that is, trying to pursue a compromise course between the internal and external target. As a logical consequence, behaviour that is not consistent with the nominal anchor rule provokes disruptions on both sides, the foreign exchange market and the domestic economy. This is the root of currency and economic troubles potentially ending in a currency crisis, modelled in several approaches that can be classified into three generations. By discussing the traditional and the recent currency crises models and comparing the logic of each generation, it can be concluded that the models are not consistent.

It is apparent that each successive generation of models is mostly not an extension of or supplement to its predecessor but is a noticeably disparate approach, since the theories stress different elements and parameters or attach different importance to them. For example, First Generation Models emphasize chronic budget deficits together with an expansionary monetary policy, which they consider to trigger a currency crisis and thus to be an important ex ante indicator as well. Second Generation approaches, however, do not pay particular attention to the fiscal position but consider it as one fundamental among others like the unemployment rate and the banking system that would provide a potential incentive for a central bank to refrain from a nominal anchor policy. Furthermore, Second Generation models allow for a voluntary switch in the exchange rate regime, while in First Generation models the monetary authority has no such leeway. And while the First Generation considers a speculative attack inevitable, as determined by fundamental distortions, the Second Generation believes in various potential outcomes ("multiple equilibria"). In the Second Generation, not the fundamental situation is decisive, but a shift of market participants' expectations that can occur but could be prevented as well, for instance through a credible central bank. Third Generation model approaches are even more disparate because they integrate the microeconomic perspective and have another understanding of financial markets – traditional models rely on efficient markets whereas herding, for example, entails an inefficiency of financial markets. Furthermore, there are inconsistencies in argumentation even *within* a generation of theories: Third Generation approaches differ considerably in their argumentation, the category "Third Generation" is just the sum of different approaches with different concerns – one primarily considering the contagion of neighbour countries, one discussing the psychology of market participants (herding), another analysing illiquidity in financial markets through

bank runs, a fourth emphasising the problem of guarantees distorting investment decisions (moral hazard) and lastly one pointing to the role of the balance sheets of enterprises. Within the contagion approach, the argument again differs between approaches based on fundamental explanations and theories stressing psychological issues. Herding theory focuses on information costs as a reason for distorting investors' behaviour while moral hazard relies on (deposit) guarantees being the reason for distorted incentives. And whereas moral hazard approaches argue with a fundamentally unbalanced situation preceding the speculative attack and consequently consider the crisis justified and healthy, bank run theory has the opposite point of view. It argues that in the forefront of a currency crisis is a fundamentally sound economy and the bank run only provokes the inefficient and costly liquidation of long-term investment. Therefore, the crisis is economically harmful according to bank run theory.

Regardless, the character of the model generations has changed considerably over time. In First Generation models, a crisis is the outcome of fundamental imbalances. This determination of currency troubles gets somewhat more abstract in models of the Second Generation. While shifts in market sentiment still are based on the assessment of the central bank policy, the timing of a crisis outbreak is not predictable any more. In the Third Generation of models however, the triggers of currency crises are not even closely linked to monetary policy decisions any more. In the words of KRUGMAN (2001, p. 8):

> *"In the original crisis models a currency crisis was something that was deserved, predictable, and harmless. That is, it was caused by the government's pursuit of contradictory and unsustainable policies; given this, it had to happen, and indeed had to happen at a particular time; and since it only made the economic fundamentals visible, the crisis did not actually damage the economy. With the second generation models it becomes much less clear that the crisis is deserved, and it becomes unpredictable though it is still mostly harmless. With the third-generation models, crises become a clearly bad thing – largely because they are no longer mainly about monetary policy. Indeed, [...] the depreciation of the nominal exchange rate becomes more a symptom than a fundamental aspect of these crises."*

In conclusion, a new characteristic of currency crises that has been observed seems to motivate a theory ex post explaining the phenomenon. Regarding the rapid course of rebuilding models, KRUGMAN (1998b, p. 1) reflects upon his own theoretical work when he considers modellers of currency crises theories

> *"playing theoretical catchup – trying, after the fact, to develop a framework for thinking about events that have already happened".*

Linkages between the theoretical fragments, however, seem to fall short. The consequence is a reservoir of model fragments of currency crises that obviously are not able to predict currency troubles consistently ex ante, since otherwise new currency crises would not come along with such surprises, discussions and financial losses. In the words of DORNBUSCH (1998, p. 5):

> *"Of six crises predicted by experts, five never happened. The sixth, however, does happen is far bigger than expected."*

That is why a common cross-generation framework is urgently needed that provides the basis for discussing different crises episodes[71].

Moreover, an important shortcoming of the currency crisis literature is that there is no concretisation of parameters influencing domestic monetary policy committed to a fixed peg. Especially the aspect of foreign monetary influences, even more concrete those of the anchor country, is mostly neglected in currency crisis theory. While KRUGMAN's First Generation model is based on the inconsistency of an active, economically oriented monetary policy, with the exchange rate peg, explicitly the behaviour of the domestic central bank itself (monetization of public debt) is called to account for the breakout of a currency crisis. No attention is paid to international monetary influences. Similarly, models of the Second Generation focus on the behaviour of the domestic central bank. And recent models of Third Generation analyse further aspects of the microeconomic and psychological dimension but also do not consider cross-border monetary transmission.

The intention of the present analysis starts from these findings. The objective is to set up a *framework for currency crises* that is able to integrate the argument of First, Second and Third Generation theories. Hereby, the aim is to contribute to the analysis of concrete *parameters influencing domestic monetary policy*, and particularly to stress *the role of cross-border monetary influences*. The concept of the Monetary Conditions Index is applied that allows to evaluate the theoretical findings in case studies later on. The following model is a purely monetary approach in order to keep the line of argument clear and to put special emphasis on monetary influences coming from the anchor country and the rest of the world.

[71] See among others Pesenti/Tille (2000) and Flood/Marion (1998) who request a cross generation model to enable comprehensive research.

Chapter III:
An integrative theoretical approach for currency crises

A substantial conclusion of the last chapter was that central banks committed to fixed pegs often try to conduct some autonomous interest rate policy to dampen negative economic consequences, what might lead to a currency crisis.

While textbook models for fixed exchange rate regimes only consider one operating target, i.e. interventions in the foreign exchange rate, and leave the interest rate market determined, the following approach is extended by the nominal money market rate as another operating target in order to discuss the consequences for the peg theoretically and empirically.

By proceeding this way, a positive theory of exchange rate targeting is adopted. The analysis leaves the area of a completely passive monetary policy and enters the territory of monetary policy strategies discussed for managed floating or free floating regimes while keeping the restrictions of a strictly fixed exchange rate in mind. For discussing monetary policy within open economies, a considerable amount of literature is available that introduces concrete policy rules, such as the popular models of BALL (1999) and SVENSSON (2000). BALL (1999) bases his monetary policy rule on a Monetary Conditions Index (MCI)[72]. SVENSSON (2000) also backs the concept of the MCI, although with limitations. Both authors however discuss their rules for freely floating exchange rates and therefore use assumptions that are not functional for the present approach – like SVENSSON (2000) leaving interventions in the foreign exchange market out of consideration and BALL (1999) refraining from taking UIP as an exchange rate theory but modelling a more simple relation of the exchange rate and the real interest rate that does not take the foreign interest rate into account[73].

For the objective of this paper, a simple rule based on the concept of the Monetary Conditions Index (MCI)[74] is set up that develops into a policy rule corresponding to the logic of the Taylor Rule. This concept is then extended for monetary policy in economies targeting their exchange rates, in a first step for managed floating systems to introduce a theory of possibilities a central bank has for monetary

[72] See chapter 3.3 of his paper.

[73] Ball establishes a positive relation between the exchange rate q and the real interest rate r, disturbed by shocks v: $q = \theta r + v$. For further approaches deriving an optimal monetary policy for open economies see for example Corsetti/Pesenti (2001), Smets/Wouters (2002) and Benigno/Benigno (2001).

[74] For the role of the MCI as a monetary policy rule for open economies also see Guender (2001).

policy conduction when targeting its exchange rates. In a second step, this theory is further adjusted to discuss the more rigid system of fixed exchange rates.

III.1 Monetary conditions in managed floats: a theory of possibilities

III.1.1 The Monetary Conditions Index (MCI)

The *Monetary Conditions Index (MCI),* which was constructed by the BANK OF CANADA[75], has its main purpose in analysing the monetary policy stance and its effects on aggregate demand in open economies. The MCI is constructed as a linear combination of the two operating targets of a central bank of an open economy, the short-term real interest rate r and the change of the real exchange rate q[76].

[67] $$MCI = \delta_1 r - \delta_2 \Delta q$$

In the literature, the following formulation of the MCI is popular as well:

[68] $$MCI = (r - r_0) - \delta(q - q_0)$$

The subscripts 0 usually refer to base years or neutral values. Thus, subtracting r_0 only shifts the index level by a constant so that r_0 can be left out of the equation. However, the present analysis applies the *change* of the real exchange rate $(q\text{-}q_0)$ to obtain a coherent definition in terms of its dimension[77].

Altogether, a suitable presentation of the MCI is

[69] $$MCI = r - \delta \Delta q \ \ with \ \ \delta = \frac{\delta_2}{\delta_1}.$$

---

[75] See Freedman (1994, 1995).

[76] See for example Freedman (1994, 1995), Stevens (1998), Deutsche Bundesbank (1999b) and European Central Bank (2002). Note that presentations defining a rising Δq as a real appreciation have to add both components.

[77] See Bofinger/Wollmershäuser (2001), p. 24. See also the equations [23] to [27] for our extension of the aggregate demand function for real exchange rate changes.

This combined operating target models the determination of aggregate demand by monetary policy. This can be shown by reformulating the output gap function for open economies

[70] $y = a - br + c\Delta q + \varepsilon_1$

to

[71] $y = a - bMCI + \varepsilon_1 \quad with\ a, b, c > 0;\ b, c < 1$

if b equals δ_1 and c equals δ_2 respectively δ equals c/b.

As argued before, monetary theory requires market-determined money market rates for fixed pegs, but reality and currency crisis theory shows that external and internal disruptions are obviously associated with a monetary policy attempting to pursue some autonomous interest rate stance, i.e. using two operating targets instead of one. Accordingly, for modelling crises in fixed pegs, the MCI is a suitable model, as it combines the real equivalents of the two operating targets i and s, representing the interest rate and the exchange rate channel.

The relative weights δ_1 and δ_2 represent the structural parameters of the domestic economy and correspond to the impact of a change of the variables r and q on aggregate demand. For the MCI ratio δ, STEVENS (1998, p. 35) for example assumes 1/3 for Australia's MCI "so that a 3% move in the exchange rate has the same effect on the index as a 1% move in the interest rate". As the parameters are not empirically observable, they are usually estimated econometrically. Furthermore, since the MCI is constructed as an index, the absolute level has no special significance. Only relative changes give evidence about the stance of monetary policy.

According to this concept, deviations in the short-term real interest rate as well as deviations in the real exchange rate result in contractive or expansionary demand effects. If monetary conditions become more restrictive – r rises or Δq falls – the MCI rises. Accordingly, the MCI falls with expansionary impulses.

Inserting the definition of the real exchange rate (the asterisks mark foreign variables)[78]

[72] $\Delta q = \Delta s + \pi^* - \pi$

[78] see p. 13.

and the Fisher equations

[73] $r = i - \pi$ *respectively* $r^* = i^* - \pi^*$

yields a relation that shows the possible combinations of the nominal operating targets formally:

[74] $MCI = (i - \pi) - \delta(\Delta s + \pi^* - \pi)$

The equation suggests, as stated before, that a rise in the real interest rate and an appreciation of the real exchange rate increase the MCI. Interpreted as a monetary policy rule, an expansionary demand shock requires a restrictive monetary policy reaction that increases the MCI. If, on the other hand, the economy signalises deflationary tendencies, the MCI has to decline. This is reached by an expansionary monetary policy of lowering the nominal interest rate and/or intervening with the purpose of depreciating the nominal exchange rate.

Practical applications of the MCI as a strict rule can be found in the strategy of the Bank of Canada and the Reserve Bank of New Zealand[79].

III.1.2 The BMW model for managed floating

Against this background, the question is how this monetary concept can be used by an open economy central bank for a strategy of foreign exchange rate targeting. Therefore, we introduce the model of managed floating of BOFINGER et al. (2002b) that is based on this MCI concept as a reference model. The discussion is intended to provide a theory of possibilities that a central bank of an open economy has to control its real interest rate *and* its real exchange rate. This is necessary to understand what the possibilities of monetary policy are in the case of shocks and what the consequences are for the internal and external balance of an economy.

According to the IMF (1999), a strategy of managed floating is characterized by a monetary authority that

[79] The concept of the MCI and its applicability to monetary policy, however, is still quite controversial; see for example European Central Bank (2002). However, apart from applying the MCI as a monetary rule or operating target, its use as a monetary indicator receives broad agreement.

"influences the movements of the exchange rate through active intervention in the foreign exchange market without specifying, or precommitting to, a preannounced path for the exchange rate."

In the same way as for the BMW model for monetary policy within completely fixed exchange rates, the following introduction of the managed floating policy is mainly restricted to the graphical discussion and heavily draws on the approach of BOFINGER et al (2002b).

The authors understand the MCI as an operating target with the two constituents real interest rate and real exchange rate $MCI = r - \delta \Delta q$ (see equation [69]).

The model is further based on the Phillips curve, see equation [28] [80]

[28] $\pi = \pi_0 + dy + \varepsilon_2$.

and a loss function of social welfare. Optimal monetary policy is required to minimize this function by adjusting its operating targets.

[75] $L = (\pi - \pi_0)^2 + \gamma y^2$ *with* $\gamma \geq 0$ [81].

A typical loss function is modelled as a linear combination of the weighted targets *inflation gap* and *output gap*. γ is an exogenous preference parameter that expresses the relative weights of the two targets.

The model is solved for an optimal monetary policy by inserting the Phillips curve condition into the loss function and minimising it subject to y. This yields

[76] $$y = -\frac{d}{d^2 + \gamma}\varepsilon_2$$

[80] see also footnote 25 and Appendix I of the paper of Bofinger/Wollmershäuser (2002a), where the Phillips curve is extended for influences over the exchange rate channel in a direct way.

[81] The logic of modelling a quadratic function is that positive and negative deviations of the target values entail identical losses for the social community. Furthermore, large deviations weigh over-proportionally negative.

Inserting [76] into aggregated demand, equation [71], and solving for the optimal MCI yields

$$MCI^{opt} = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b(d^2+\gamma)}\varepsilon_2 \qquad [77]$$

That is, a central bank that intends to provide optimal monetary conditions for its economy is required to adjust its operating targets according to

$$MCI = r - \frac{c}{b}\Delta q = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b(d^2+\gamma)}\varepsilon_2 = MCI^{opt} \qquad [78]$$

Besides this condition, the authors consider a second condition, UIP, to maintain the external equilibrium in the open economy[82]:

$$\Delta s = i - i^{*} \text{ [83]}. \qquad [79]$$

As soon as UIP is violated, either by an arising risk premium or by market expectations about an exchange rate change that differs from the targeted one, destabilising capital inflows or outflows occur that have to be met by sterilized intervention[84] by the central bank.

Transforming UIP into real terms, as already solved in equation [54'][85]

$$\Delta q = r - r^{*} \qquad [54']$$

and inserting this equation into the MCI definition [69] finally produces

$$MCI = (1 - \frac{c}{b})r + \frac{c}{b}r^{*} \qquad [80]$$

---

[82] here without taking a risk premium α into account.

[83] see equation [50], here leaving α out of consideration.

[84] Sterilization is necessary to hold the intended interest rate path.

[85] here again, in the absence of a risk premium α.

the monetary policy stance emerging from the assumption of a valid UIP condition. The equation illustrates that an interest rate policy, which fulfils the UIP condition, allows the monetary authority to control the MCI[86] as long as the targeted exchange rate path is in line with UIP.

In sum, monetary policy in managed floating regimes has to meet the conditions simultaneously

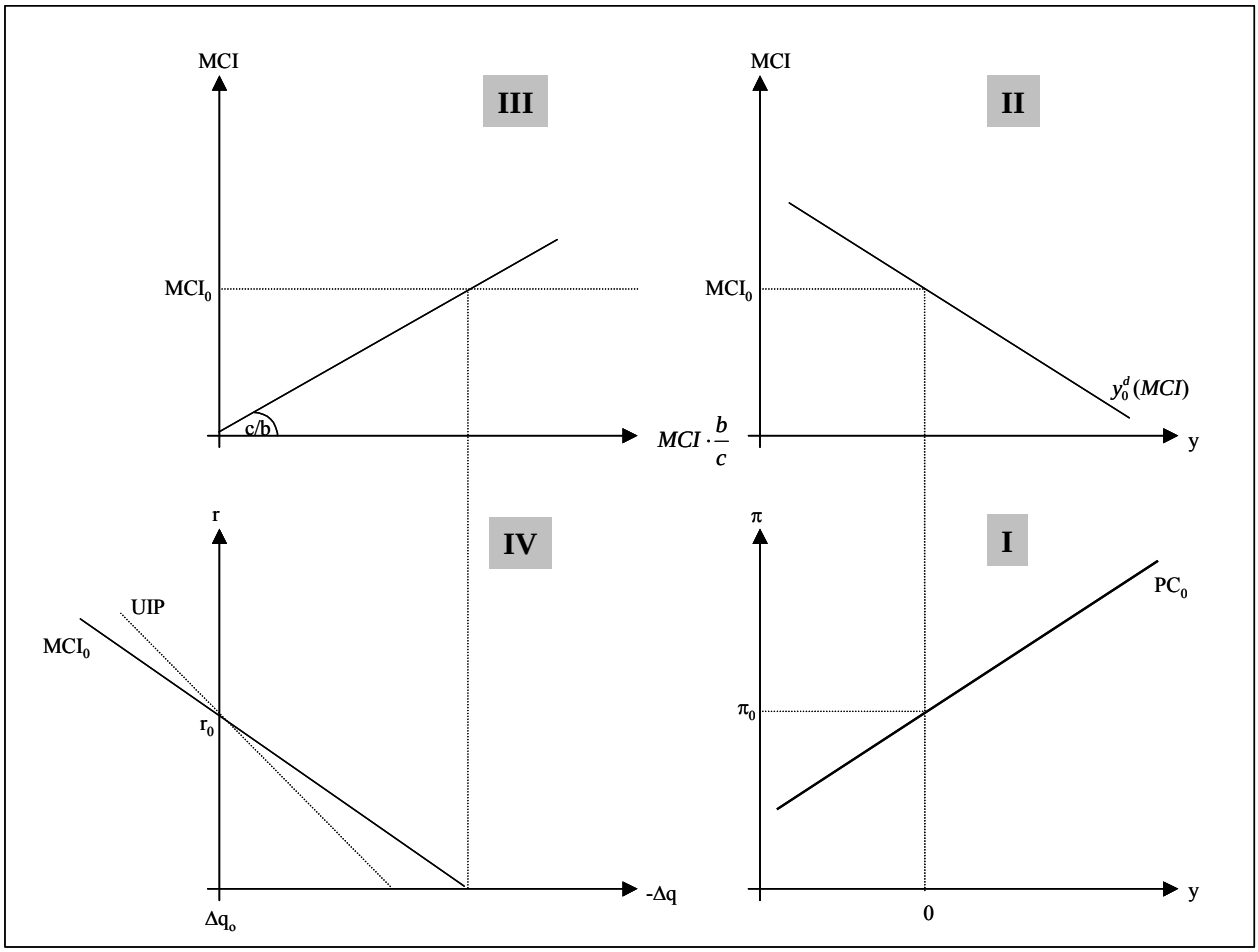
- minimizing the loss function of social welfare
- maintaining a foreign exchange market balance

Thus, the central bank has to set the interest rate r in a way that the actual monetary policy stance (depicted in equation [80]) equals the optimal monetary policy stance (depicted in equation [78]). And it has to secure by sterilized foreign exchange market interventions that the exchange rate path always meets the UIP condition, considering the interest rate policy condition described above.

[86] the only exception being $\delta = 1$, where $MCI = r^{*}$..

For discussing this policy graphically, the initial BMW model is extended to four quadrants.

Figure 14: Standard BMW Model for managed floating



Quadrant I depicts the Phillips Curve, unchanged to the BMW models discussed in chapter II (see equation [44]).

Quadrant II shows the aggregate demand curve (see equation [71]), now depending on the MCI instead only on r.

Quadrants III and IV decompose the MCI into its components r and Δq to illustrate the instrument setting that is not visible when only showing the composite index. In quadrant III, the MCI values are transformed in MCI · b/c values and projected in the quadrant at the bottom. The MCI line is based on the known definition: $MCI = r - \frac{c}{b}\Delta q$.

The transformation into b/c values yields

[81] $$MCI \cdot \frac{b}{c} = \frac{b}{c} r - \Delta q$$

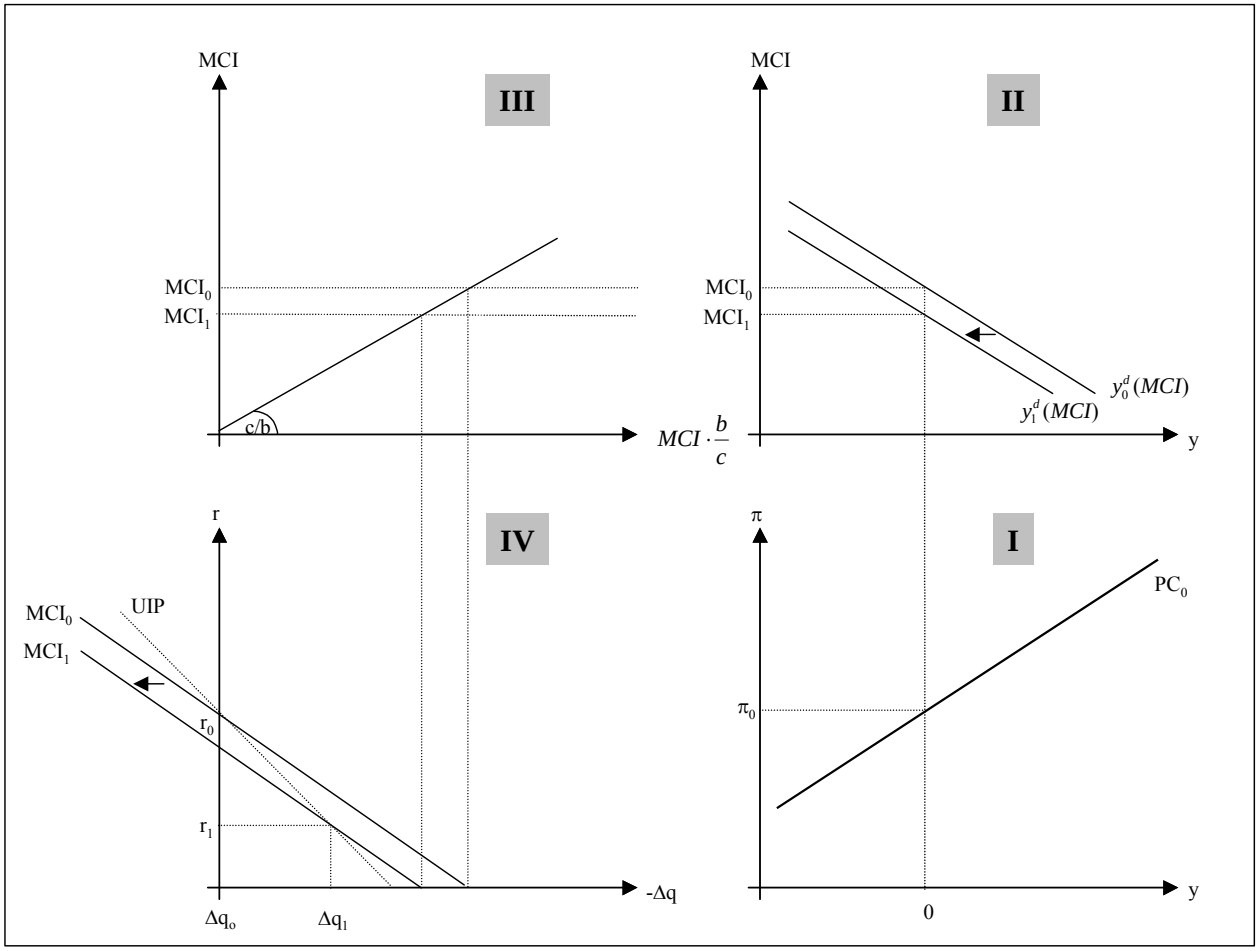
what gives the intersection of the MCI line with the -Δq line at r = 0. Quadrant IV also depicts the UIP curve, defined by equation [54']

[54'] $$\Delta q = r - r^*$$

Thus, the slope is –1 and the intersection with the r axis is given at $r = r^*$.

Within this model framework, BOFINGER et al. (2002b) discuss a demand and a supply shock to demonstrate monetary policy under a managed floating strategy graphically. Aggregate demand shifts to the left due to a negative demand shock ($\varepsilon_1<0$). The authors conclude that the optimal monetary policy reaction is a decrease of the monetary conditions in line with equation [77] from MCI_0 to MCI_1. This policy reaction achieves compensating the shock effect so that there is no negative effect on output nor inflation but both remain at their target levels.

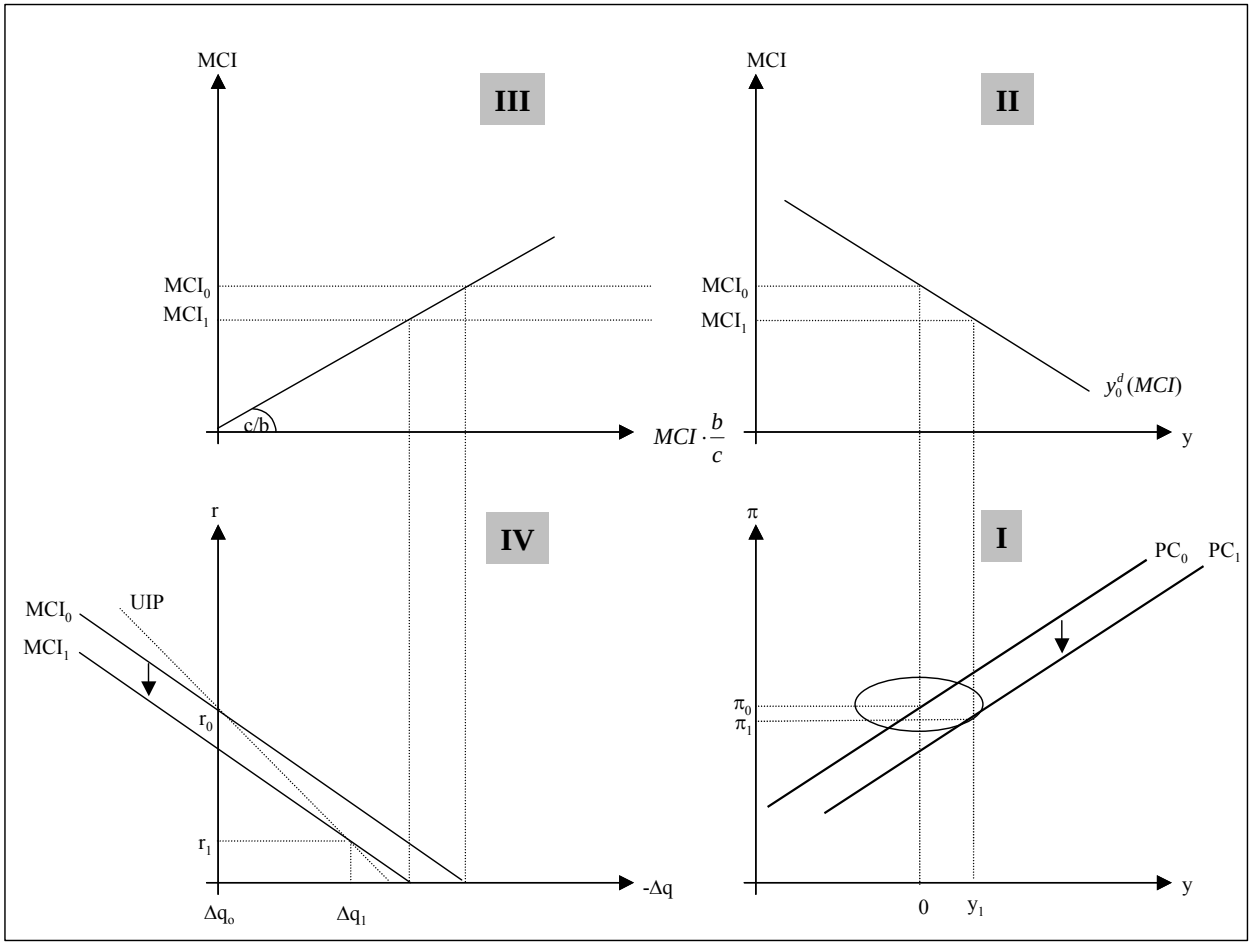
Figure 15: BMW Model: Demand shock under managed floating



Quadrant IV shows that UIP does not react on the negative demand shock (unchanged UIP line). The new constellation emerging in quadrant IV is (Δq_1 / r_1). This means, monetary policy is adjusted to a lower real interest rate and a real appreciation - that together produce the lower MCI[87] - to meet the UIP requirements and at the same time provide an optimal monetary policy stance.

On the other hand, if the economy is hit by a negative supply shock, the Phillips curve shifts down (PC_0 ➔ PC_1).

Figure 16: BMW Model: Supply shock under managed floating

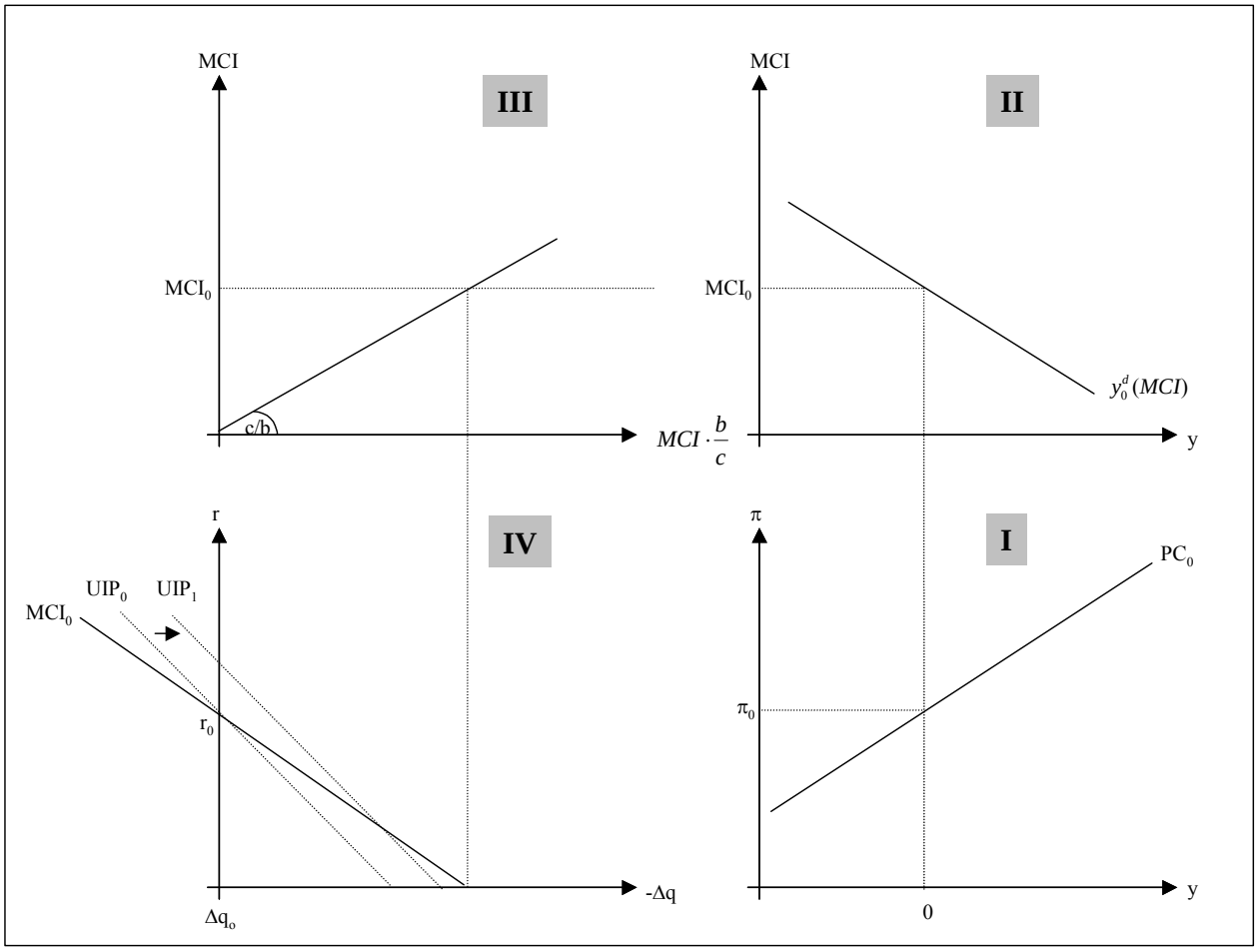


Regarding equation [77], the optimal monetary policy adjustment depends on the preference parameter γ. The different possible outcomes are illustrated by the elipse in quadrant I. Consequently, the MCI has to decrease to MCI_1 in quadrant II. Regarding quadrant IV, this means a fall in the real interest rate from r_0 to r_1 and a real appreciation from Δq_0 to Δq_1.

[87] The authors argue on p. 61 that in „most cases one can assume that the interest rate channel is dominating the exchange rate channel“.

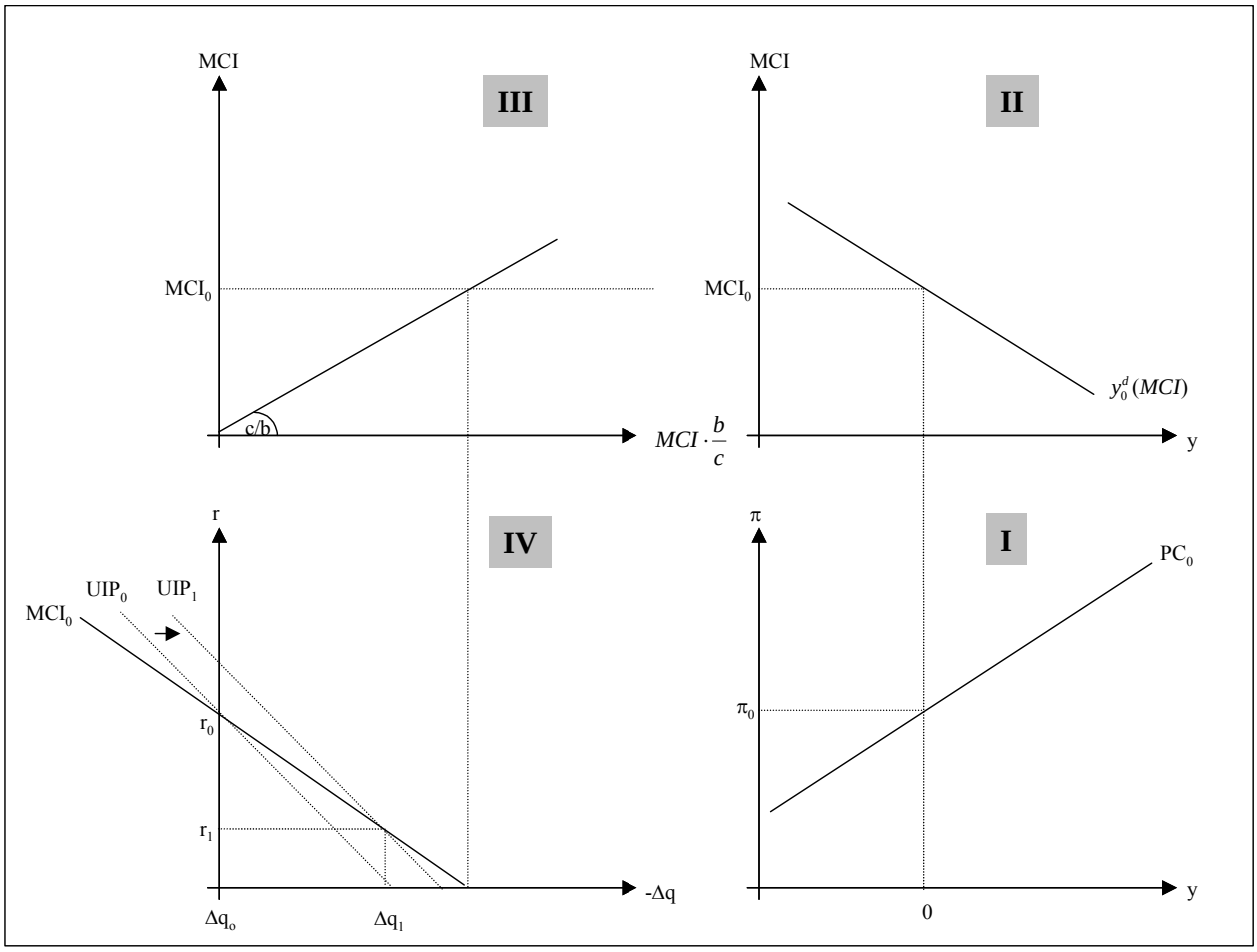
Apart from shocks in the domestic economy, the BMW model serves for discussing a further interesting case: A foreign interest rate shock affecting the economy. This shifts the UIP curve to the left.

Figure 17: BMW Model: Foreign real interest rate shocks at managed floating I



The change of the foreign interest rate generally affects domestic demand via the real exchange rate, see equations [47] und [54']. Aggregate demand would shift to the left, resulting in a negative output gap. But the optimal MCI stance is not affected by the foreign real interest rate change, see equation [77]. Thus the only adjustment process results in quadrant IV, where the central bank adapts its policy mix to reach the optimal stance again. The following figure shows that this is reached by a lower real interest rate r_1 and a real appreciation Δq_1.

Figure 18: BMW Model: Foreign real interest rate shocks under managed floating II



That way, the effects on output are compensated, there is no modification in quadrants I and II.

According to the discussion on the monetary policy reaction on shocks, the managed floating strategy is an ideal system: In case of shocks, it gives the central bank the freedom to control the internal as well as the external equilibrium without being forced to violate the one while concentrating on the other.

III.2 Monetary conditions in fixed pegs: a theory of impossibilities

III.2.1 Requirements of balancing the internal and external equilibrium (MCI^{fix} and MCI^{opt})

Within a fixed exchange rates regime, the monetary policy possibilities described above differ. Again, a monetary strategy is successful if it achieves maintaining the internal as well as the external equilibrium in case of shocks. But the central bank does not possess the flexibility to steer the foreign exchange rate path by active intervention and to control the domestic interest rate since the exchange rates have to remain fixed. We will show that this implies that the central bank is no longer able to bring the internal and external balance in line in case of shocks as it was under managed floating.

In the following chapters, monetary policy under these conditions and the problems emerging are discussed. The approach is based on the work of BOFINGER/WOLLMERSHÄUSER (2001, 2002a) and their BMW model in BOFINGER et al. (2002b). Their theory is extended and specified for fixed exchange rate systems.

III.2.1.1 The internal equilibrium

In a first step, the conditions are derived that ensure a setting of the monetary policy instruments in a way that is optimal for the *internal economic balance*. This condition remains unchanged to the one derived for a managed floating strategy: Starting from a loss function of social welfare,

[53] $$L = (\pi - \pi_0)^2 + \gamma y^2 \quad with \quad \gamma \geq 0$$

inserting the Phillips curve, minimising it subject to y, inserting the result into aggregate demand and solving for the optimal MCI yields equation [77].

[77] $$\boxed{MCI^{opt} = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b(d^2+\gamma)}\varepsilon_2}$$

This condition represents the *optimal monetary stance* in terms of a *minimum loss of social welfare in the case of real shocks*. The equation shows that the MCI^{opt} exclusively depends on real shocks and determines how the central bank has to set and adjust its monetary instruments to achieve an *actual monetary stance* MCI^{act} that equals the optimal stance.

[82] $$MCI^{act} = r - \delta\Delta q \overset{!}{=} MCI^{opt}$$

Applied as a rule, the MCI^{act} has to increase - that is monetary policy has to get more restrictive - if the economy is affected by an expansionary demand shock ε_1 so that the MCI^{act} equals the increased MCI^{opt} again. On the other side, monetary conditions have to get more expansionary – that is the MCI^{act} has to decline - in case of deflationary pressure. If the MCI^{opt}-path is abandoned, this triggers internal consequences such as inflationary or deflationary pressures.

This concept of monetary policy follows the popular monetary policy rules for closed economies like the Taylor rule of equation [45]

[45] $$r = r_0 + e(\pi - \pi_0) + fy$$

where monetary policy reacts to output gaps and deviations of the inflation rate from the target value.

Translating this closed economy rule into an open economy rule then gives

[83] $$MCI^{opt} = \widehat{MCI} + e(\pi - \pi_0) + fy\,.$$

assuming that real shocks *(ε_1, ε_2)* are reflected in output gaps unequal to zero and/or deviations of the inflation rate from its target value. Appendix III.A discusses the question of whether the simple monetary rule should consider a direct reaction to real exchange rate changes.

III.2.1.2 The external equilibrium

Apart from the economic requirements, a successful monetary policy in a fixed peg has to take care of an equalized balance of payments in order not to endanger the *external equilibrium* on the foreign exchange market. In order to avoid intervention, this implies that the current account is completely financed by the capital account.

[84] -current account = capital account

What is of special importance for the stability and sustainability of fixed exchange rates, is, that the financing stems from *long-term capital flows* since it is well known that short-term capital flows are

crucial for the vulnerability of fixed pegs against crises. The reason is they are easy to withdraw and in this way provide the potential for speculative attacks[88].

[85] -current account = long-term capital account

Equation [85] is the central *condition for the sustainability* of the peg. As soon as it is violated, financing of the current account is through short-term capital as well which increases the risk of a crisis. As for managed floating, this condition is represented by UIP under free capital mobility.

[86] $i - i^* = E[\Delta s] + \alpha$ [89]

Inserting the Fisher equations gives

[87] $r = E[\Delta s] + \alpha + r^* + \pi^* - \pi$.

Since nominal exchange rate changes do not appear in fixed pegs per definition[90], *E[Δs]* drops out of equation [87]

[88] $r = \alpha + r^* + \pi^* - \pi$

and the real interest rate is simply determined by the foreign real interest rate and the inflation difference of the domestic and the foreign country.

More precisely, this UIP concept covers *credible* pegs since *E[Δs]* only drops out of the equation when there is no reason to expect exchange rate changes. If the commitment to a fixed exchange rate results in a loss of investors' confidence – which is the case in the forefront of a currency crisis – market participants build expectations about potential modifications of the exchange rate. In this case it is equation [86] that counts.

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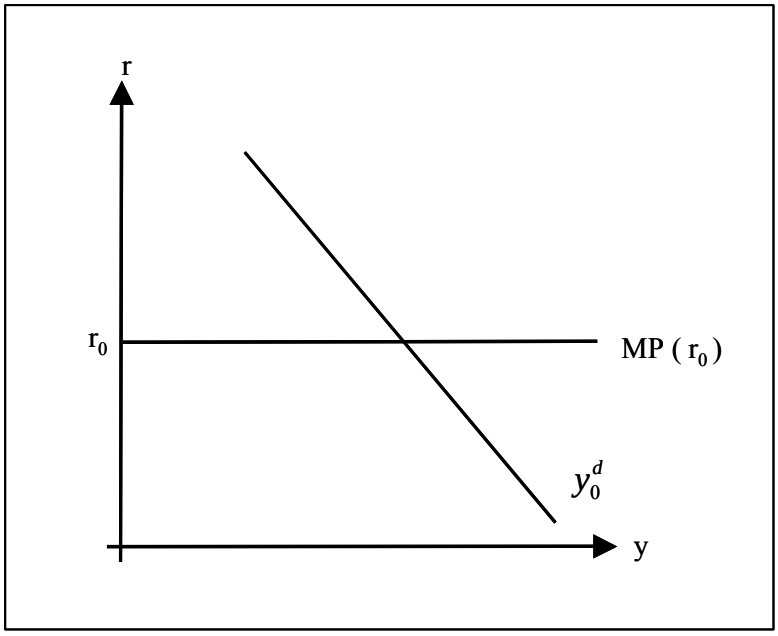
[88] There is a broad consensus on this issue. However, there is not much theoretical and empirical analysis available researching the relation of short-term debt and crisis. See therefore especially Rodrik/Velasco (1999), who develop a theoretical framework for evaluating the effects of short-term capital flows and provide empirical evidence.

[89] Here we consider a risk premium α since the system is not as flexible.

[90] This attitude is somewhat of a simplification since it neglects parity realignments or pegs to baskets of anchor currencies.

Equation [88] thus shows that interest rate setting under fixed pegs is absolutely exogenous, the central bank looses its leeway for a domestically oriented monetary policy. In chapter II.1.3.3, this was modelled graphically as a horizontal MP line (in chapter II, the BMW was not based on the MCI concept yet but modelled only one operating target, the short-term interest rate).

Figure 19: Fixed pegs - no autonomous real interest rate policy



As long as Δs drops out, the real exchange rate is simply the result of the inflation difference

[89] $\Delta s = 0 \;\rightarrow\; \Delta q = \pi^* - \pi$.

In contrast to that, real exchange rate changes under managed floating were determined by

[35'] $\Delta q = r - r^*$

the foreign and domestic real interest rate, what implies that the domestic central bank could control the exchange rate path since r is a determinant of the MCI.

Combining equations [69], [88] and [89] finally generates the monetary requirements of a fixed peg. The index representing these conditions is referred to as MCI^{fix}:

[90] $MCI^{fix} = r - \delta\Delta q = \alpha + r^* + (1-\delta)(\pi^* - \pi)$

Accordingly, the central bank's challenge is to hold the external balance by conducting a monetary policy equalling the MCI^{fix}

$$[91] \qquad MCI^{act} = MCI^{fix}.$$

As already indicated in chapter II 1.3, equation [90] shows even better the difficulties of simultaneously conducting the internal and external balance in the case of shocks. Since the domestic interest rate is completely determined by UIP in fixed pegs, monetary policy in the domestic country depends on the exogenous parameters

- real interest rate of the anchor country
- market risk premium
- and on the difference of the inflation rates.

Accordingly, as soon as the central bank's policy stance deviates from this restriction, disruptions of the sustainability condition for the external balance are the consequence.

By way of deriving a MCI^{opt} and MCI^{fix}, the MCI-concept provides a good method for an analysis that sheds light onto the single parameters that potentially trigger destabilising effects. A particular advantage of this approach is that it extends the one-sided view of the traditional literature. The traditional approaches are limited to discussing domestic monetary policy, which is actively modified for internal reasons. The other perspective – an unintended change of domestic monetary conditions triggered from a change of the anchor country's fundamentals – is generally left out of consideration. The MCI-concept, however, covers these international monetary influences as well, which have a significant impact on fixed pegs, as the case studies will show.

III.2.2 When are fixed exchange rate systems successful? ($MCI^{fix} = MCI^{opt}$)

The introduction of the MCI^{fix} already gives an idea of the problem of simultaneously achieving an internal and an external equilibrium in fixed pegs. However, macroeconomic policy in some popular fixed exchange rate regimes like Austria, the Netherlands and Estonia did and does operate with success. This raises the question under which conditions fixing the exchange rate is a successful monetary strategy.

To recapitulate, the central condition of a functioning peg is that the central bank manages to meet the internal as well as the external monetary requirements.

$$[92] \qquad MCI^{fix} \overset{!}{=} MCI^{act} \overset{!}{=} MCI^{opt}$$

Inserting equation [90] for the MCI^{fix} and [83] for the MCI^{opt} gives[91]

$$[93] \qquad MCI^{fix} - MCI^{opt} = \alpha + r^* + (1-\delta)(\pi^* - \pi) - e(\pi - \pi_0) - fy \overset{!}{=} 0$$

The anchor central bank is assumed to set its real interest rate r^* according to an interest rate rule (a Taylor rule) for closed economies.

$$[94] \qquad r^* = e^*(\pi^* - \pi_0^*) + f^* y^*$$ [92]

This assumption is realistic since the anchors mostly are the US dollar or the Euro. Both currency areas target their relatively closed economy via the interest rate channel – in contrast to a policy according to the MCI via the exchange rate *and* the interest rate channel that is assumed for the pegged country.

Inserting equation [94] changes equation [93] to

$$[95] \qquad MCI^{fix} - MCI^{opt} = \alpha + (1-\delta)(\pi^* - \pi) + e^*(\pi^* - \pi_0^*) + f^* y^* - e(\pi - \pi_0) - fy \overset{!}{=} 0 \ .$$

In order to set the MCI^{fix} and MCI^{opt} equal, it is assumed that the domestic and the anchor countries' targeted inflation rates are alike ($\pi_0 \approx \pi_0^*$) and that there are identical structural parameters ($e \approx e^*$; $f \approx f^*$) in both countries. Thus, equation [95] reduces to

$$[96] \qquad MCI^{fix} - MCI^{opt} = \alpha + (1-\delta+e)(\pi^* - \pi) + f(y^* - y) = 0 \ .$$

Under these conditions, the external and internal equilibrium can be met if

- domestic and foreign inflation are alike ($\pi \approx \pi^*$), there is no inflation difference

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[91] $\hat{MCI}$ is set to zero.

[92] The neutral real interest rate is set to zero again.

- the output gaps are equal ($y \approx y^*$)
- and there is practically no risk premium ($\alpha = 0$).

The first two conditions materialize in countries with relatively similar business cycles, i.e. that face the same real shocks. Only in this case does transferring an anchor country's stabilisation policy to the fixed country attain the latter's economic needs. Such a scenario practically describes the cases of the Netherlands' and Austria's peg to the German mark.

On the other hand, these considerations clearly demonstrate that pegged countries with high inflation differentials to the anchor country cannot be successful systems. This is well-known from the *theory of optimum currency areas* which places a strong emphasis on the fact that real shocks need to have a high correlation between both currency areas since otherwise major inflation differentials occur.

III.2.3 When do internal and external monetary requirements deviate? ($MCI^{fix} \neq MCI^{opt}$)

As long as the internal and external requirements are compatible, the commitment to a fixed exchange rate is the optimal strategy. But as soon as the internal economy requires another policy stance than it is suitable for the foreign exchange market equilibrium, the commitment to the peg tends to burden the economy. To analyse the circumstances leading to an incompatibility of MCI^{fix} and MCI^{opt}, we start from the optimal stage where $MCI^{fix} = MCI^{act} = MCI^{opt}$ and discuss modifications.

Such modifications of this condition could come from outside the domestic country – a changing MCI^{fix} – as well as from a real shock on the domestic economy – a changing MCI^{opt}. In the following, the analysis concentrates on a changing MCI^{fix}, since the focus lies on monetary transmission from abroad. Besides, the problem of asymmetric shocks changing the MCI^{opt} is discussed broadly in the traditional literature for currency crises.

The problem of a changing MCI^{fix} is intuitively logical: It imposes monetary requirements onto the anchoring central bank that are not compatible with the optimal monetary stance for the internal balance. MCI^{fix} and MCI^{opt} are then no longer equal.

[97] $$\alpha + r^* + (1-\delta)(\pi^* - \pi) = MCI^{fix} \neq MCI^{opt} = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b\left[d^2 + \gamma\right)}\varepsilon_2 \overset{!}{=} e(\pi - \pi_0) + fy$$

III.2.3.1 When is $MCI^{fix} > MCI^{opt}$?

In relation to a certain starting point in equation [90], the commitment to the fixed peg requires an inadequately restrictive monetary policy (the MCI^{fix} rises) when

[98] $MCI^{fix} \uparrow = \alpha \uparrow + r^{*} \uparrow + (1-\delta)(\pi^{*} \uparrow - \pi \downarrow)$

- **r^{*} increases**

  If the anchor country pursues a very restrictive monetary policy[93], it has to be adopted by the domestic central bank for UIP reasons. Because of temporarily rigid prices, this results in an increase in the domestic real interest rate and thus in a rising MCI^{fix}.

- **π^{*} rises**

  The underlying transmission channel works as follows: As the anchor central bank is assumed to be pursuing an interest rate policy, a rising inflation rate triggers a rising foreign interest rate i^{*}[94]. Because of the restriction of the fixed peg to hold UIP, the domestic interest rate i needs to rise as well so as not to endanger the peg. With temporarily rigid prices, the domestic real interest rate r increases simultaneously, thus leading to rising monetary conditions MCI^{fix}.

- **π declines**

  A deflationary shock in the domestic country on the one hand results in a real depreciation against the anchor country. On the other hand, because of UIP, i has to be kept constant. Consequently, a falling inflation rate implies a rising real interest rate r. As the real interest rate rise usually overweighs the real depreciation in the composition of the MCI[95], the MCI^{fix} increases with a falling domestic inflation.

- **α increases**

  An increased risk premium demands a rising interest rate again in order to hold UIP[96]. Under temporarily rigid prices, this produces a real interest rate hike and thus a rise in the MCI^{fix}.

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[93] Deflation is not considered the reason for the real interest rate hike as the anchor central bank is assumed to pursue an interest rate setting policy within an inflation targeting strategy.

[94] That does not necessarily say anything about the foreign real interest rate. It could be kept constant, for instance.

[95] As stated before, the interest rate channel overweighs the exchange rate channel in most countries (see footnote 27).

[96] Since UIP demands: $i = i^{+} + \Delta s + \alpha$. A hike of the risk premium can be due to multiple reasons and is currently a central issue of financial research.

III.2.3.2 When is $MCI^{fix} < MCI^{opt}$?

According to the above logic, the reverse situation of an overly expansionary MCI^{fix} in relation to the MCI^{opt} occurs when

[99] $MCI^{fix} \downarrow = \alpha \downarrow + r^{*} \downarrow + (1-\delta)(\pi^{*} \downarrow - \pi \uparrow)$

- **r^{*} declines**
  i.e. a very expansionary monetary policy line of the anchor central bank that has to be pursued by the domestic monetary authority for UIP reasons.
- **π^{*} gets very low**
  A diminishing foreign inflation rate initiates a decrease in the foreign interest rate. Because of UIP, the domestic interest rate has to fall as well, leading to more expansionary monetary conditions.
- **π rises**
  The real appreciation is again over-compensated by the fall in real interest rates: As the nominal interest rate has to be kept unchanged because of UIP, domestic inflationary pressure leads to a falling real interest rate, which is more heavily weighted in the MCI than the real exchange rate change[97].
- **α gets very low**

  A falling risk premium requires a lower domestic interest rate to hold UIP. Under temporarily rigid prices, this results in a lower domestic real interest rate and thus a decline of the MCI^{fix}.

III.2.4 Summary

To sum up, divergences of the externally required monetary policy stance and the internally optimal stance occur for several reasons:

[97] See footnote 95.

Table 3: Constellations of conflict between the internal and external equilibrium

$MCI^{fix} < MCI^{opt}$				$MCI^{fix} > MCI^{opt}$			
$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$

1) Considerable deviations of the foreign real interest rate (corresponding to considerable changes in the foreign nominal interest rate).
2) Significant changes of the inflation difference, be it via foreign or domestic changes in inflation.
3) Substantial changes of the risk premium.

At this point, we can return to the case where modifying MCI^{opt} would be the starting point of a deviation between the MCI^{opt} and MCI^{fix}. This would be the case with an idiosyncratic shock hitting the domestic country. This logic that is applied in traditional currency crisis literature[98], is covered by the preceding argument as well. As shown by equation [97], a shock inducing domestic inflationary pressure would produce an MCI^{opt} exceeding the MCI^{fix} and vice versa. This is consistent with the conclusions of the analysis starting from MCI^{fix}-deviations.

III.2.5 Extension of the bilateral concept for third countries

Up until now, the definition of the *real exchange rate* has referred to the bilateral perspective. The basic real exchange rate (RER) in its price notation that has been applied so far is derived from multiplying the nominal exchange rate *s* with the price level of the anchor country p^* and dividing it by the price level of the domestic country *p*.

[100] $$Q = \frac{S \cdot P^*}{P}$$

respectively a change of the real exchange rate is as derived in chapter II.1.2.1

[101] $$\Delta q = \Delta s + \pi^* - \pi .$$

[98] First and Second Generation models give attention to a domestically oriented economic policy, although they do not necessarily refer to domestic shocks as being the reason.

Accordingly, changes of the real exchange rate stem from

- changes of the inflation differential with the anchor country as well as from
- changes of the nominal exchange rate (which in fixed pegs do not exist per definition).

However, in the context of open economies with multilateral trade structures, it is obvious that it is necessary to use a real effective exchange rate (REER). Applying the REER ensures to cover changes in competitiveness exceeding the bilateral horizon. Potential reasons for such competitiveness changes are

- changes of the inflation differential with third parties – particularly with main trading partners
- and changes in the *nominal* exchange rate to third country's currencies – in fixed pegs this corresponds to the exchange rate of the anchor currency to the third country.

In the bilateral case, such conditions would have to be accepted as an exogenous shock that cannot be explained by the model. The Asian crisis however provides an important empirical example for the need to integrate more than one foreign country into the approach. Thailand suffered from considerable loss of competitiveness when the US dollar appreciated against the Japanese yen in the second half of the nineties, since the Thai bath was fixed to the US dollar and thus became more expensive for its number one trading partner, Japan. In other words, any other trading partners of Japan that were not pegged to the US dollar increased their competitiveness in comparison to Thailand.

III.2.5.1 Introduction of the REER

In order to remedy the bilateral constraint in theory, the REER concept is henceforth applied. For an extensive overview of concepts of calculating a REER and the problems of these approaches, see for example ZANELLO/DESRUELLE (1997), who introduce the IMF's calculation method, the DEUTSCHE BUNDESBANK (1998b), the EUROPEAN CENTRAL BANK (2000), DURAND/GIORNO (1987) and DURAND et al. (1992), who discuss the methodology of the OECD. Generally, for deflating the nominal exchange rates, consumer prices (CPI) and unit labour costs (ULC) are the most popular concepts. This analysis prefers the CPI to the ULC approach, mainly because of better availability and reliability of the data for the countries analysed in the case studies. The OECD's calculation method is comparable to the one of the IMF with one exception: When weighting the trading partners of a domestic country, the IMF takes third market competition into account whereas the OECD does not.

The REER is built as a weighted geometric average of the level of consumer prices of the domestic country relative to that of its trading partners[99]:

$$[102] \quad q^{REER} = \prod_{j=1}^{m} \left[\frac{p \cdot s}{p_j^* \cdot s_j^*} \right]^{w_j}$$

The index *i* marks the domestic country and *j* runs over its trading partners. *W* are the trade weights, *p* the consumer prices and *s* the bilateral nominal US dollar exchange rates of each country, which are defined as units of US dollar per unit of the domestic currency. The asterisk marks the foreign countries.

For three countries, the REER can be written in logarithms (see Appendix III.B for a formal discussion)

$$[103] \quad \Delta q^{REER} = \Delta s - \pi + w_1 \cdot \pi_1^* + w_2 \cdot \left(\pi_2^* - \Delta s_2^*\right) + w_3 \cdot \left(\pi_3^* - \Delta s_3^*\right).$$

As argued before, changes in the nominal exchange rate Δs are not supposed to occur in fixed pegs and hence drop out of the equation

$$[104] \quad \Delta q^{REER} = -\pi + w_1 \cdot \pi_1^* + w_2 \cdot \left(\pi_2^* - \Delta s_2^*\right) + w_3 \cdot \left(\pi_3^* - \Delta s_3^*\right).$$

III.2.5.2 Implementation of the REER into the MCI

Now, the REER is inserted into the MCIs to model the respective conditions more comprehensively. Since the MCI^{opt} only depends on real shocks, it remains unchanged. But the determinants of the MCI^{fix} and of the actual monetary stance MCI^{act} need to be adjusted. As a starting point, the analysis returns to the bilateral equations

$$[74] \quad MCI^{act} = (i - \pi) - \delta(\Delta s + \pi^* - \pi)$$

$$[90] \quad MCI^{fix} = r - \Delta\delta q = \alpha + r^* + (1 - \delta)(\pi^* - \pi).$$

[99] See Zanello/Desruelle (1997), p. 14.

For the monetary conditions given by the fixed peg, inserting [103] gives

$$[105] \quad MCI^{fix} = \alpha + r_1^* + (1-\delta w_1)\pi_1^* - \delta w_2(\pi_2^* - \Delta s_2^*) - \delta w_3(\pi_3^* - \Delta s_3^*) - (1-\delta)\pi \,.$$

The inflation rates of third countries are assumed to remain constant for simplicity. The above equation implies that the **MCI^{fix} will be high when**[100]:

- α is high
- r_1^* is high
- π_1^* is high
- π is low
- w_2 and w_3 are high
- and Δs_2^* and/or Δs_3^* are high, i.e. the domestic country appreciates.

This extended equation again demonstrates the impact of a fixed peg on internal monetary conditions. All parameters are exogenous to the domestic central bank. In addition to the bilateral concept, this interpretation demonstrates the influence of further foreign parameters apart from the ones of the anchor country.

The current monetary conditions pursued by the central bank are derived by inserting equation [103][101] into [74] and applying equation [73]:

$$[106] \quad MCI^{act} = r - \delta\Delta q = i - (1-\delta)\pi - \delta\Delta s - \delta w_1\pi_1^* - \delta w_2(\pi_2^* - \Delta s_2^*) - \delta w_3(\pi_3^* - \Delta s_3^*)$$

One can easily see that a domestic central bank conducting monetary policy via its instruments, interventions Δs and the nominal money market rate i, is simultaneously affected by several foreign country parameters, especially the nominal exchange rate of third countries with important trade links.

Consequently – apart from inflation differences with third countries that are still assumed constant – the **MCI^{act} will rise when**

- r (i.e. i-π) is high
- π_1^* is low

[100] See the explanations for r^*, π^*, π and α in the chapters III.2.3.1 and III.2.3.2.

[101] Equation [103] instead of [104] is inserted for the purpose of demonstrating the instruments.

- π is high (real appreciation)
- Δs_2^*, Δs_3^* are rising, i.e. the domestic country appreciates.

III.2.6 Extended Summary

To summarise, the term **MCI^{fix}** expresses the *conditions* that are *given by the exchange rate arrangement*. These have to be maintained to avoid short-term capital flows endangering the sustainability of the peg. By decomposing the index into its components, the MCI^{fix} demonstrates the impact of *anchor and further foreign country parameters* on the exchange rate peg and consequently on the domestic economy.

[105] $$MCI^{fix} = \alpha + r_1^* + (1-\delta w_1)\pi_1^* - \delta w_2(\pi_2^* - \Delta s_2^*) - \delta w_3(\pi_3^* - \Delta s_3^*) - (1-\delta)\pi$$

The **MCI^{opt}** represents the *optimal monetary stance* that is necessary *for keeping the internal balance*. The optimal monetary policy is derived from the minimisation of a loss function of social welfare since the minimum loss is considered the optimal state of the economy. The **MCI^{opt}** *only changes due to real shocks* and is exogenous to the monetary institutions.

[77] $$MCI^{opt} = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b(d^2+\gamma)}\varepsilon_2$$

Acting in response to changing macroeconomic conditions, the central bank has to adapt its instruments to accommodate the monetary conditions. The actual MCI, **MCI^{act} ,** describes the current monetary policy mix, now extended for third country influences.

Table 4: Overview: The MCI^{fix} and MCI^{opt}

	MCI^{fix}	**MCI^{opt}**
Representing:	Conditions necessary for external balance	Conditions necessary for internal balance
Theoretical foundation:	Uncovered Interest Parity (UIP)	Social Welfare (Loss Function)
Definition:	$MCI^{fix} = \alpha + r_1^* + (1-\delta w_1)\pi_1^* - \delta w_2(\pi_2^* - \Delta s_2^*) - \delta w_3(\pi_3^* - \Delta s_3^*) - (1-\delta)\pi$	$MCI^{opt} = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b(d^2+\gamma)}\varepsilon_2$
Determinants:	high if: • α high • r_1^* high • π_1^* high • π low • $\Delta s_2^*; \Delta s_3^*$ high	high if: • positive demand shock ε_1 • negative supply shock ε_2

Consequently table 3 needs to be adjusted for multilateral parameters ($\Delta s_2^*, \Delta s_3^*$):

Table 5: Situations of conflict between the internal and external equilibrium - extended version

$MCI^{fix} < MCI^{opt}$					**$MCI^{fix} > MCI^{opt}$**				
$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$

In table 4, the effects of the single parameters at first sight seem to be inconsistent since a rising MCI^{fix} on the one hand results from a widened inflation gap ($\pi^* - \pi$) and on the other hand, a rising MCI^{act} results from a reduced inflation gap. But the effects of changing parameters on the MCI^{fix} and their effects on the MCI^{act} need to be distinguished. When observing the *actual MCI stance* with respect to changes of the inflation difference to the anchor country, the MCI^{act} performs in a logical way. If the inflation difference to the anchor country falls, i.e. if the anchor country appreciates in real terms, the *MCI^{act} rises* for the domestic country because an appreciation triggers a loss of competitiveness. When analysing the conditions that the fixed peg produces (MCI^{fix}), one has to take the restriction of UIP

into account. Here, a diminishing difference in inflation with the anchor country results in a real appreciation as well, but on the other hand a higher domestic inflation means a falling real interest rate because the nominal interest rate has to remain unchanged ($r = i - \pi$). The weight of the real interest rate overcompensates that of the real exchange rate, since it is usually more heavily weighted in the MCI, and that is why the diminishing inflation difference leads to a *falling* MCI^{fix}. If a lower foreign inflation rate is the cause for the diminishing inflation difference, it leads to the same result. The lower π^* leads to a falling i^* and therefore a falling i if UIP is not violated. This triggers a decrease in the real interest rate and again a *falling* MCI^{fix}.

III.3 How do MCI^{fix}-MCI^{opt} deviations materialize and how are they covered by traditional models?

Having so far developed a theoretical model framework, attention is now focused on its operation. For didactic reasons, this chapter only discusses stylised situations of deviation between MCI^{fix} and MCI^{opt}. The simplification is to assume that the central bank has a clear preference for satisfying either the external requirements while neglecting the internal ones or vice versa. Accordingly, while generally the following situations of MCI^{fix} versus MCI^{opt} are possible,

Table 6: Possible monetary conditions

$MCI^{fix} > MCI^{opt}$		$MCI^{fix} < MCI^{opt}$	
$MCI^{act} = MCI^{fix} > MCI^{opt}$	$MCI^{act} = MCI^{opt} < MCI^{fix}$	$MCI^{act} = MCI^{fix} < MCI^{opt}$	$MCI^{act} = MCI^{opt} > MCI^{fix}$
$MCI^{opt} < MCI^{act} < MCI^{fix}$		$MCI^{fix} < MCI^{act} < MCI^{opt}$	

compromise solutions – the light grey marked combinations – are not discussed in the following[102].

To keep the focus on monetary influences from "outside", the analysis proceeds assuming the MCI^{opt} remains unchanged[103]. Thus, in the following, the starting point will always be a changing MCI^{fix}. To

[102] However, such a policy between both objectives (that is popular in reality because it tries to avoid completely violating one goal but to spread the burden) is discussed in the case studies section.

[103] In any case, as already pointed out in chapter III.2.4, starting with a deviating MCI^{opt} does not change the logic of the argument.

keep the argument simple, the hypothesis further is that the MCI^{fix} changes because of shocks of the foreign interest rate (i^* respectively r^*). In this case, the effect on the foreign exchange market is intuitively clear: As UIP implies, a changing interest rate difference will motivate short-term capital in- and outflows[104].

Apart from demonstrating the application of the approach, special attention of this chapter is paid to showing the parallels to traditional models in each situation to evaluate the consistency of the approach with traditional currency theory.

III.3.1 The case of $MCI^{fix} > MCI^{opt}$: Effects and parallels in traditional theory

The starting point is a foreign interest rate shock resulting in an MCI^{fix} that exceeds the MCI^{opt} (that remains unchanged by this shock) which is formally depicted in the light yellow side of the table. In other words, to maintain a sustainable external equilibrium, more restrictive monetary conditions are needed than would be optimal for the internal balance. Under these circumstances, two (extreme) choices of behaviour are at the domestic central bank's disposal.

Table 7: Consequences of an upward deviating MCI^{fix}

$MCI^{fix} > MCI^{opt}$		$MCI^{fix} < MCI^{opt}$	
$MCI^{act} = MCI^{fix} > MCI^{opt}$	$MCI^{act} = MCI^{opt} < MCI^{fix}$	$MCI^{act} = MCI^{fix} < MCI^{opt}$	$MCI^{act} = MCI^{opt} > MCI^{fix}$

III.3.1.1 $MCI^{act} = MCI^{fix} \succ MCI^{opt}$

The domestic central bank decides not to risk short-term capital outflows to keep the foreign exchange market stable.

[104] As argued in chapter III.2.3, the index could also have risen or fallen due to other parameters, such as changes in the foreign inflation, an increasing or falling risk premium α or changes in the real exchange rate. While this discussion concentrates on the interest rate to keep the argument clear and direct, the inclusion of the other parameters would not change the argument.

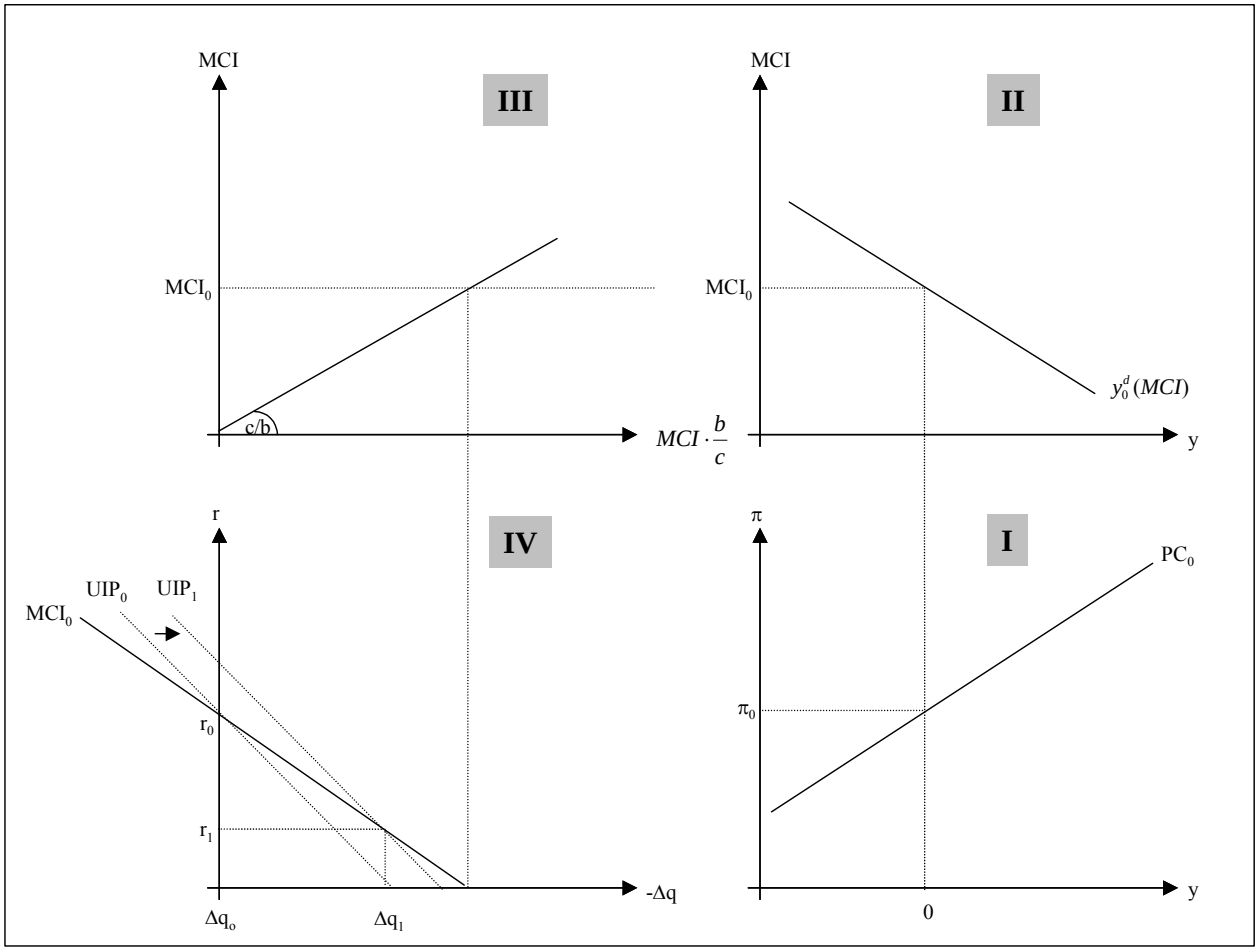
In order to avoid persistent arbitrary capital outflows that would be profitable for investors because of a higher interest rate level of the foreign country, the monetary authority focuses on achieving the required monetary restriction. Generally, the two monetary instruments *intervention* and *interest rate* are at the domestic central bank's disposal. However, it is unreasonable that the central bank keeps the foreign exchange market in balance by intervening repeatedly since the intervention direction is selling foreign currency reserves and absorbing domestic liquidity. Thus, a continuing intervention decreases currency reserves. The theoretical possibility of a final depletion of the reserves stock would be sufficient to expose the central bank to speculative attacks on the peg. Therefore, increasing the domestic interest rate is the only rational option. This policy on the one hand leads to a stabilisation of the foreign exchange market.

On the other hand, the optimal monetary policy remains unchanged by the foreign interest rate shock in the fixed peg regime, see equation [77]

$$MCI^{opt} = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b(d^2+\gamma)}\varepsilon_2 \qquad [77]$$

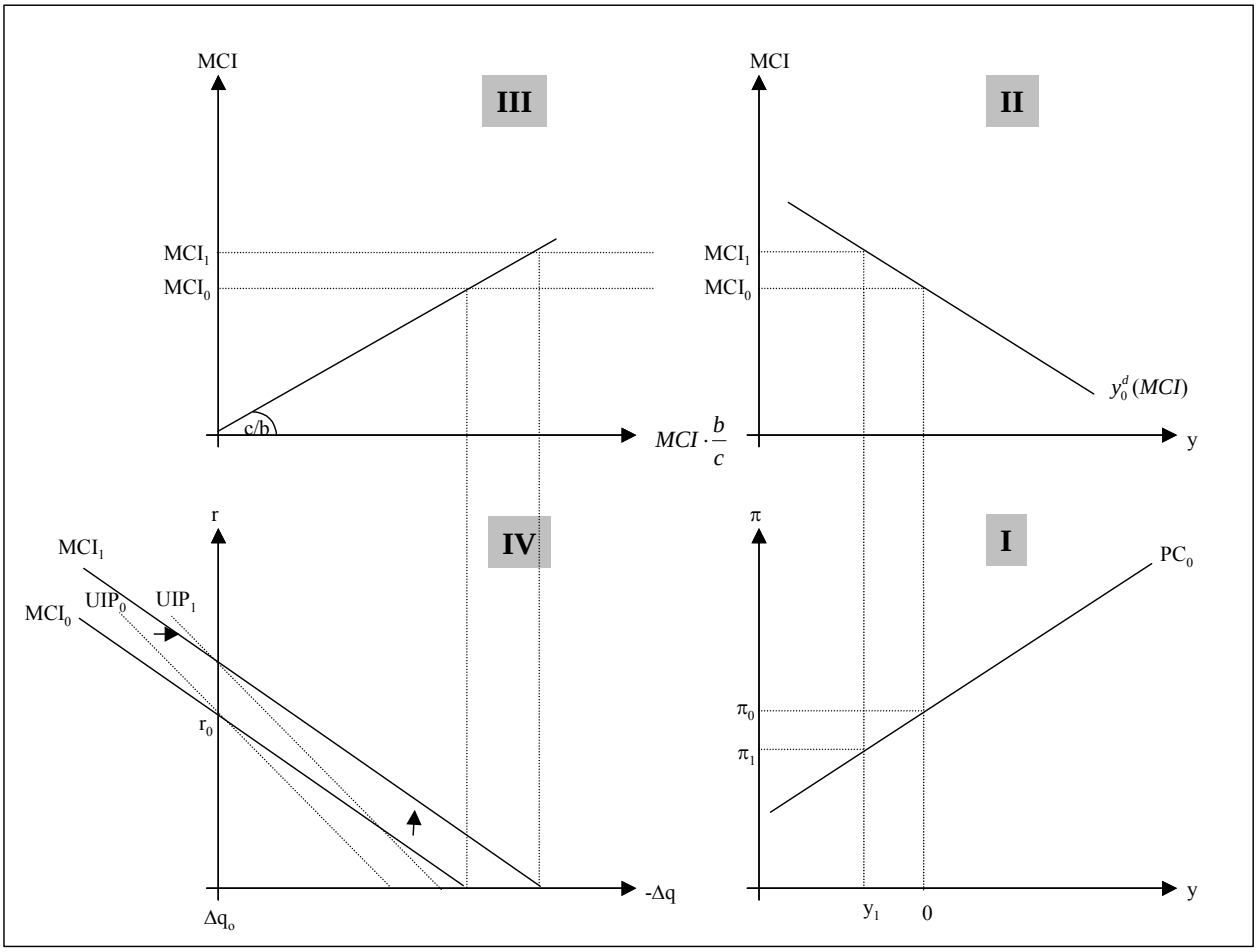
Under managed floating, the MCI^{fix} and MCI^{opt} can be brought in line as the central bank has two operating targets at its disposal, the real interest rate and a change of the real exchange rate. UIP remains valid and at the same time, the initial monetary policy stance is kept by adjusting the policy mix but not leaving the initial MCI stance, MCI_0. Graphically, this balancing of the shock (UIP line shifts upwards) is shown in figure 20, Quadrant IV. As a result, under managed floating, output and inflation remain unaffected $(0, \pi_0)$.

Figure 20: BMW Model: Foreign real interest rate shocks at managed floating II



Under fixed pegs however, the central bank has not these possibilities to bring the MCI^{fix} and MCI^{opt} in line by adjusting the policy mix while keeping the initial MCI^{act} stance (MCI_0=MCI^{opt}) and simultaneously fulfilling the UIP condition. There only remains one operating target – adjusting the real interest rate while no changes in the exchange rate are allowed. To ensure the foreign exchange market stability, the real interest rate has to be increased and without the adjustment via a real exchange rate change, the monetary conditions get more restrictive (MCI^{act} increases). Graphically, this can be modelled by the MCI line shifting upwards from MCI_0 to MCI_1.

Figure 21: BMW Model: Negative foreign real interest rate shocks at fixed peg



While this policy leads to a stabilisation of the foreign exchange market, it negatively affects the internal balance. Since the optimal monetary policy remains unchanged by the shock, the externally oriented monetary policy stance of the central bank becomes too restrictive ($MCI^{act}>MCI^{opt}$). According to the aggregate demand function [52]

[52] $y^D = a - bMCI + \varepsilon_1$ *with a, b, c >0; b, c<1*

and illustrated by figure 21, the more restrictive monetary policy stance negatively affects the output gap (0 ➔ y_1) and reduces inflation (π_0 ➔ π_1).

In sum, under fixed pegs, the central banks does not have the possibility any more to compensate foreign real interest rate shocks by adjusting the monetary instruments mix. With the decision to fulfil

the UIP condition to ensure foreign exchange market stability, the central bank is forced to leave the monetary optimum path and thus has to accept undesirable effects on output and inflation.
As soon as the market anticipates that the worsening economic performance caused by the overly restrictive monetary policy threatens the continuation of the exchange rate system, confidence in the peg weakens. This is reflected in an increasing risk premium.

One might think, on the other hand, the diminishing inflationary pressure devalues the real exchange rate, which should support competitiveness in the export sector. However, corresponding to the theoretical approach, for a large country, such a positive effect is usually over-compensated by a real interest rate hike that results from maintaining UIP. Consequently, the declining inflation rate and subsequently the increasing risk premium itself increase the MCI^{fix}, which again fuels the deflationary process. The ultimate consequence of this vicious circle is an economic downturn. Under such circumstances, the commitment to a fixed exchange rate loses its purpose, because the economic costs exceed the peg's merits in terms of credibility and stability. This increases the incentive for the central bank to change its monetary policy strategy, that is, to move to a float.

This process is covered by the traditional *Second Generation Models* for currency crises where market participants observe the central bank's decisive leeway and expect an abandonment of the peg for economic reasons as soon as its costs exceed its economic benefits. Once the signals for a policy change increase, there is a shift of expectations about the future of the peg that raises the risk premium and therefore the money market rate to an excessive level. This is intolerable for an economically reasonable continuation of the currency regime.

What is more constrained in the present discussion than in Second Generation Models is the trigger of a turnaround in market expectations. While the above description of the process clearly blames fundamental imbalances for a shift of expectations, Second Generation Models stress that changes of market expectations can occur for any reason as soon as a central bank has discretionary leeway to change its monetary strategy.

III.3.1.2 $MCI^{act} = MCI^{opt} \prec MI^{fix}$

The domestic central bank prefers to pursue internal equilibrium at the expense of the foreign exchange market balance.

In this case, the central bank avoids welfare losses by pursuing the monetary conditions that are optimal for the economy (MCI^{opt}). Since the MCI^{opt} is not affected by the foreign interest rate shock, the actual MCI stance needs to be left unchanged as well. Since on the other hand the MCI^{fix} exceeds the MCI^{opt}, the actual monetary conditions turn out to be more expansionary than required from the external equilibrium.

In figure 21, the MCI^{act} remains at MCI_0, while MCI_1 would be required from the foreign exchange market side. In this case, the economic consequences are obvious. Violation of UIP (the interest rate differential $i^* - i > 0$) motivates short-term capital outflows. To avoid depreciation pressure, the central bank has to intervene on the foreign exchange market. At the same time, the intervention volume has to be sterilised to maintain the preferred real interest rate stance. The problem is that the intervention direction – buying domestic currency via selling foreign currency reserves – continuously reduces the currency reserves stock. Since the intervention potential is limited, which is anticipated by the market, the central bank is exposed to speculative attacks which ultimately enforce the breakdown of the exchange rate peg.

The described process has its parallels in traditional literature as well. *Models of First Generation* also blame a monetary policy that is inconsistent with the foreign exchange market equilibrium for triggering currency crises. In analogy to the above situation, the inconsistent monetary policy in First Generation approaches leads to capital outflows that force the central bank to intervene. The market anticipates the budget restriction of a limited intervention potential and a currency crisis is inevitable.

There are some important differences between the traditional argument and the present one. While the First Generation logic assumes that the domestic central bank controls the monetary base, this approach operates under the assumption of a more realistic interest rate targeting. Yet, the effects on the money market and therefore the logic of both arguments correspond to each other. What is a more important difference is that models of First Generation consider the domestic central bank to be responsible for the inconsistent monetary policy. The present argument, however, also considers the transmission of monetary influences from abroad to be a reason for policy inconsistencies. This is best viewed in the case discussed above, where the domestically oriented monetary policy course remains *unchanged* but disruptions arise from modifying MCI^{fix}.

III.3.2 The case of $MCI^{fix} < MCI^{opt}$: Effects and parallels in traditional theory

Now the opposite case shall be examined. Due to a foreign interest rate shock in the contrary direction, the MCI^{fix} gets lower than the MCI^{opt}. The resulting case is marked light yellow in the following table. In monetary terms, the optimal conditions for the economy are more restrictive than those needed for an external equilibrium. Again, this situation offers two possibilities for the domestic central bank.

Table 8: Consequences of a more expansionary MCI^{fix}

$MCI^{fix} > MCI^{opt}$		$MCI^{fix} < MCI^{opt}$	
$MCI^{act} = MCI^{fix} > MCI^{opt}$	$MCI^{act} = MCI^{opt} < MCI^{fix}$	$MCI^{act} = MCI^{fix} < MCI^{opt}$	$MCI^{act} = MCI^{opt} > MCI^{fix}$

III.3.2.1 $MCI^{act} = MCI^{fix} \prec MCI^{opt}$

The preference is set on external equilibrium so that the monetary conditions are overly expansionary for the economy.

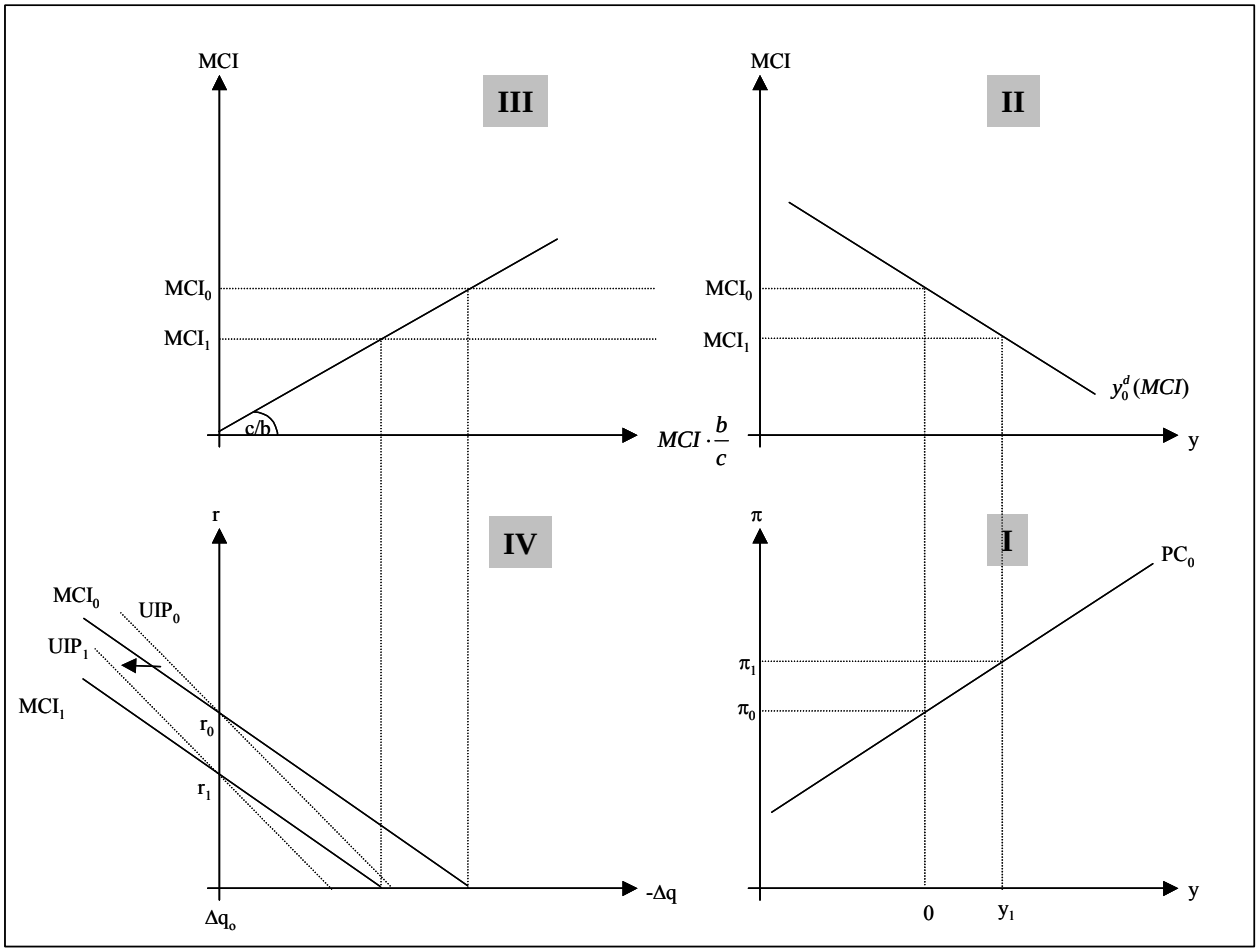
To avoid pressure on the exchange rate, it is essential to maintain UIP. That is, a lower domestic interest rate is needed to reach the MCI^{fix}. Otherwise, the spread in the money market rates would induce short-term capital inflows[105].

Again, while a managed floating regime would provide the option to remain on the current MCI^{act} path while adjusting the policy mix (graphically choose another combination on the MCI line) and thus avoid output effects, under fixed pegs output and inflation are affected.

Graphically, the adjustment processes are:

[105] Generally, a lower MCI could be realised either by an interest rate reduction or by a permanent intervention to compensate the capital inflows. In this case, contrary to the previous situation, the intervention direction would be selling domestic and buying foreign currency. For this reason, no budget restriction limits the effectiveness of monetary policy in the medium-term. Rather, this implies a constantly rising currency reserves stock. On the other hand, this monetary policy course leads to an enlargement of the monetary base resulting in a declining money market rate. Sterilisation however is not practicable in the long run. It would imply immense costs, because in this situation the domestic interest rate level exceeds the foreign one. The yield of the increasing foreign currency reserves is lower than the yield of the rising volume of deposits (see chapter II.1.3.2).

Figure 22: BMW Model: Positive foreign real interest rate shocks at fixed peg



The foreign interest rate shock shifts the UIP line downwards. The central bank adjusts its monetary policy line from MCI_0 to the more expansionary stance MCI_1 to hold UIP (r_0 has to fall to r_1) what affects aggregate demand the way that a positive output gap emerges (y_1) and inflation increases (π_1).

The inflationary pressure additionally reduces the real interest rate level while the increasing difference in inflation with the anchor country appreciates the real exchange rate. In sum, monetary conditions become even more expansionary[106].

But the internal balance would require an optimal monetary policy that minimises the loss function of social welfare,

[71] $$L = (\pi - \pi_0)^2 + \gamma y^2 \quad with \ \gamma \geq 0 \ .$$

[106] The reason again is the more heavily weighted real interest rate in the composition of the MCI.

and thus would require the central bank to set the instruments in a way to reach an actual monetary policy stance

$$[107] \quad MCI^{act} = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b(d^2+\gamma)}\varepsilon_2 = MCI^{opt}.$$

Since it is assumed that the central bank prefers pursuing a more expansionary stance to maintain UIP, this violates the internal equilibrium.

However, these effects are not as directly observable as the effects of a too restrictive monetary policy discussed in the previous chapter, since contrary to a depletion of foreign currency reserves or rising interest rates, a declining real interest rate level and positive output gap is not immediately understood negative for the economy. However, in the medium-term, the lower than economically adequate interest rate stance produces serious disturbances, i.e. bubbles on asset markets. Sketching two main developments shows that both of them raise the vulnerability for a currency crisis.

(A) Real appreciation ➔ Current account deficits

As discussed, the upcoming inflationary pressure appreciates the real exchange rate, which deteriorates the competitiveness of the export sector. The worsening export performance is reflected in the trade balance and in the current account. This surely is a rough and one-sided argument but nevertheless a simple monetary argument for the popular current account deficits in the forefront of a currency crisis.

Since the export performance is an important pillar of the economic performance especially in small open economies, the deterioration of the export dynamics in the medium term manifests severe deteriorations of economic growth.

(B) Over-investment ➔ Asset Bubbles

Furthermore, from the internal perspective, the overly expansionary monetary policy leads to allocative disruptions. The too low real interest rate produces lower than optimal costs of capital. Comparing the too low costs of capital to the internal rate of return of an investment project, more investment projects are considered profitable than would be economically optimal. A situation of over-investment arises. A typical indicator is a markedly enlarging domestic credit volume. This over-investment is recognised economically unsound as soon as the monetary conditions normalise. If the central bank switches from its expansionary to a neutral stance, all the investment projects based on

abnormally low costs of capital get into trouble. In the worst case, they fail and lead to bankrupcy of the investors. This ultimately triggers a financial crisis since investment served as securities for the banks and investors are not able to repay their loans.

Moreover, as soon as the supply of investment becomes inelastic, a circle of rising asset prices crops up. Thus, the distortion of investment decisions through an inadequate monetary policy is the origin of an asset price inflation leading to speculative bubbles. It is apparent that the exaggerated situation is vulnerable to signals appealing to the risk aversion of investors[107].

From the monetary perspective, the over-investment speeds up the inflation rate even more and thus lowers the MCI. Besides, as soon as the investors lose confidence in an ongoing vicious circle, the risk premium increases. This accelerates the decline, as the MCI^{fix} now rises. In order to maintain the conditions for a stable foreign exchange market, the central bank is forced to adopt a more restrictive monetary policy, which burdens the vulnerable asset markets – typically the stock or real estate market – even more. As soon as doubts about the sustainability of the speculative bubble manifest, a self-fulfilling process leads to a "bursting bubble", since the market actors overshoot in the process of normalising their investment activity. Following the logic of a speculative attack, a gradual and controlled correction is no longer realistic. Ultimately, the asset markets crash and the crisis spreads to the financial sector because of defaults of securities and loans.

As discussed in the theory chapter II.2.3.3, the financial crisis itself increases the likelihood of a currency crisis[108]. Apart from that, the accelerating risk premium directly distorts UIP and thus increases the vulnerability of the foreign exchange market. Herding behaviour can finally neither be stopped nor be compensated in the long run by central bank intervention due to limited intervention potential and rising money market rates, especially against the background of monetary policy lags. Consequently, if this self-fulfilling downturn sets in, the central bank is forced to give up the currency peg sooner or later. Such a currency crisis course is especially dangerous, because the weaknesses and disruptions of the economy remain covered for a long time. As soon as the first signals of economic problems occur, a self-fulfilling dynamic is set free that cannot be stopped any more.

In general, such crisis scenarios are comparable with the theory of *Second Generation Models*. Parallels are in particular found in the behaviour of the central bank: While being strictly committed to the exchange rate peg in the beginning, in the course of time, the central bank is faced with a trade off between internal and external equilibrium. As soon as market participants consider a monetary policy

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[107] See Bernanke/Gertler (1999) as well, who give an overview of non-fundamental origins of asset price bubbles including " irrational exuberance".

[108] In the literature about crises, the terms "currency crises", "banking crises" and "financial crises" are often interchanged. The simultaneous occurrence of currency and banking crises also became popular by the term "twin crises".

switch from fixed to floating exchange rates for economic reasons to be sufficiently likely, the risk premium escalates and the currency crisis is inevitable. However, while a deterioration of fundamentals – like case *(A)* of a worsening export performance – is covered by the Second Generation Models[109], the opposite case of over-investment is not regarded. The reason may be that in this case, it is barely possible to recognise the social costs of the fixed peg policy early in advance.

In any case, preceding the Asian crisis – the most characteristic crisis preceded by over-investment and speculative bubbles – nobody drew parallels to traditional currency crises theory. Obviously, Second Generation Models were not sufficiently able to depict such phenomena. That is why the *Third Generation approaches* were set up to rationalize such developments. Within the Third Generation theory, over-investment is one of the main topics[110]. It is however derived from another origin, namely from implicit or explicit debt guaranties from the government, the central bank or international organisations. However, the logic of over-investment remains the same: As a consequence of the guarantees, potential losses of an investment are not considered because they are covered. This distorts the investment calculation and leads to over-investment, which generates a bubble economy and finally triggers the crash. Accordingly, while the Third Generation approach of over-investment does not connect the disruptions with monetary policy effects, it provides another valuable explanation, the moral hazard aspect, and thus valuably supplements the present monetary approach.

III.3.2.2 $MCI^{act} = MCI^{opt} \succ MCI^{fix}$

Priority is given to economic stability.

Whereas the commitment to the peg requires a more expansionary path, the central bank pursues a monetary stance that is consistent with the unaffected MCI^{opt} to avoid domestic distortions. In figure 22, this would be shown as an MCI remaining at MCI_0 (and r_0) whereas MCI_1 (and thus r_1) was required to intersect the UIP_1 line. ($r_0 > r_1$) leads to short-term capital inflows. Apart from foreign capital being invested in the country, the positive interest rate spread is an incentive for the government and private domestic investors to borrow foreign currency since the fixed peg seems to exclude exchange rate uncertainty and the foreign interest burden is lower. That is the reason why the scenario in which $MCI^{act} = MCI^{opt} \succ MCI^{fix}$ leads to *high foreign debt ratios* of the pegged countries.

However, intervening against the capital inflows leads to an expanding money supply that needs to be sterilized in order to maintain the MCI^{opt}. De facto, intervention requires a falling credit volume of the

[109] Typically, the argument refers to a rising unemployment rate or decelerating economic growth.

[110] See chapter II.2.3.4.

commercial banks from the central bank or an accelerating deposit volume. Such an intervention behaviour leads to significant costs of sterilisation in the long run[111]. Assumed that a central bank would accept bearing the sterilization costs, these costs would imply a *stop condition* for the fixed peg. For it is only a question of time until the economic costs would ultimately endanger the sustainability of the fixed peg which erodes the benefits of the commitment to a fixed peg. Ultimately, the following process sets in: The risk premium increases as the market participants notice the burden of defending the peg, the capital inflows stop and turn to outflows and a speculative attack finally forces the monetary authority to give up the fixed exchange rate regime.

For this situation, parallels can be seen in the *First Generation* and *Second Generation* models. First Generation theory also blames an inconsistent, domestically oriented monetary policy for the foreign exchange market imbalances. However, the traditional model argues in the opposite direction when discussing capital outflows and a depletion of the foreign currency reserves. In the present case, the problems occur through capital inflows entailing an intervention associated with sterilisation. Furthermore, First Generation models assume a monetary base control. The most important difference however is that they consider the inconsistent monetary policy to be pursued actively. This approach, on the contrary, also considers a completely unchanged monetary stance becoming inconsistent with the external equilibrium only because of changing monetary requirements coming from abroad (i.e. a changing MCI^{fix}), that is through no responsibility of the central bank itself.

Additionally, the above course of the crisis finds parallels in the theory of the Second Generation of models. In this case, the stop condition is set via accelerating sterilisation costs leading to a loss of confidence in the peg. Second Generation models also argue with the market's expectations about the future of the peg, which depend on the balance of the peg's benefits and social costs. Mounting sterilisation costs in these models would tilt the balance of costs and benefits and the well-known process of capital outflows, increasing risk premium and massive intervention would end in a currency crash.

The discussion of the four stylised cases identifies certain conditions that initiate a speculative attack resulting in the collapse of the fixed exchange rate system. These are called *stop conditions* of the peg, subdivided into *short-term* and *medium-term stop conditions.*

[111] as the domestic interest rate exceeds the anchor country's interest rate. Thus the rising foreign currency reserves yield less than the central bank loses from the declining commercial banks' credit volume.

- A *short-term stop condition* arises from an imbalance in the foreign exchange market when the intervention potential is limited[112].
- *Medium-term stop conditions* come from rocketing costs of sterilisation or from fundamental disruptions, leading to a recession or a bubble economy in the medium-term.

III.4 Summary

To summarize, chapter III introduced a monetary conditions index to discuss the challenge of conducting monetary policy within a fixed peg regime. First, monetary policy options were discussed for the case of a managed floating to demonstrate the possibilities of monetary policy conduction in the case of shocks if the foreign exchange rate regime wasn't completely fixed. It can be shown, that the central bank has the possibility to compensate foreign interest rate shocks (UIP shocks) by an adjusted monetary policy mix without jeopardizing the external or internal balance.

Afterwards, the options of monetary policy reactions to shocks were discussed for fixed exchange rates. Therefore, a MCI^{fix} for fixed rates was derived, which illustrates the parameters influencing monetary conditions that are guaranteeing the fulfilment of UIP. This MCI^{fix} was faced with the conditions which are optimal for the internal balance, the MCI^{opt} , that was derived from minimising a loss function of social welfare. With this theoretical framework, it could be shown that fixing the exchange rate is only an optimal monetary strategy in the case of similar business cycles in the anchor and the pegged country when these face the same real shocks.

In any other case, problems occurred with such a fixed peg strategy, since shocks cause the MCI^{fix} and the MCI^{opt} to diverge. Whereas the MCI^{opt} only changes due to domestic shocks, the MCI^{fix} depends on foreign monetary parameters such as the foreign real interest rate and the foreign inflation rate. The impact of a change of those parameters becomes clear when examining the possibilities of monetary policy that are left to the domestic central bank. To keep the argument clear, discussion is restricted to four polar situations which all lead to a currency crisis.

We can show that the framework provides a metatheory for the traditional approaches and at times goes beyond it. Some Third Generation approaches are not covered because of the focus of the theoretical framework to a macroeconomic perspective but sometimes they provide valuable psychological complements. Some other Third Generation approaches such as the theory of contagion

[112] This does not require a factual depletion of the reserves. Simply the possibility of a depletion is sufficient for a speculative attack against the central bank, as it guarantees the success of such an action.

and herding behaviour are not relevant to the four cases. Nevertheless, they do not contradict with the approach, they just have to be classed with chapter III.2.3, as they give reasons for an exogenous increase of the risk premium.

On the whole, one main advantage of this paper's model is the integration of monetary influences coming from abroad and the discussion of their impact on the domestic internal and external balance. It allows an explanation of currency crises without necessarily blaming the domestic central bank for them, as the institution possibly does not even change its monetary course.

The second achievement is, that the MCI-concept allows integrating the different generations of currency crises theories:

- The classical line of argument of First Generation approaches is represented by $MCI^{act} = MCI^{opt} \prec MCI^{fix}$ or $MCI^{act} \prec MCI^{opt} \prec MCI^{fix}$
- the Second Generation model principally corresponds to $MCI^{act} = MCI^{fix} \succ MCI^{opt}$
- and the Third Generation generally corresponds to a rising risk premium α. In the stylised cases, the sharp rise in the risk premium was a consequence of over-investment, represented by $MCI^{act} = MCI^{fix} \prec MCI^{opt}$.

The following table provides an overview of the context of the monetary transmission an open economy with fixed exchange rates is subject to and the consequences that are discussed by several crisis theories:

Table 9: Integration of traditional theory

A comprehensive framework for currency crises										
Monetary influences:	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Case:	**$MCI^{fix} < MCI^{opt}$**					**$MCI^{fix} > MCI^{opt}$**				
Central bank behaviour:	**$MCI^{act} = MCI^{fix} < MCI^{opt}$**			**$MCI^{act} = MCI^{opt} > MCI^{fix}$**		**$MCI^{act} = MCI^{fix} > MCI^{opt}$**			**$MCI^{act} = MCI^{opt} < MCI^{fix}$**	
Stylised discussion in chapter:	III.3.2.1			III.3.2.2		III.3.1.1			III.3.1.2	
Parallels in traditional theory:	• Second Generation models • Third Generation models			• First Generation models • Second Generation models		• Second Generation models			• First Generation models	

Appendices to chapter III

III.A Should the MCI^{opt} contain a direct reaction to real exchange rate changes?

When the MCI^{opt} is structured as a monetary policy rule, the question arises whether a direct reaction of the central bank to real exchange rate changes should be included the way open economy Taylor rules do[113]:

[108] $$i = \hat{r} + e(\pi - \pi_0) + fy + h\Delta q$$ [114]

Following the argument of TAYLOR (2001), interest rules that do not directly react to exchange rate changes turn out to be advantageous. TAYLOR discusses the popular studies of BALL (1999), SVENSSON (2000) and TAYLOR (1999) and concludes that no superior performance of rules including the real exchange rate can be stated consistently. If the extended rule performed better, the improvement would only be miniscule. On the other hand, in some cases, the open economy rules even would perform worse because of directly reacting to the exchange rate.

According to TAYLOR, a reasonable explanation for the fact that the rules directly reacting to the exchange rate obviously are not superior is that the structure of the basic rule reacting to output and inflation already contains an indirect reaction to real exchange rate changes. TAYLOR gives the example of the process following a real appreciation: This leads to real output losses (via dampened net exports) and a declining inflation rate (via declining import prices) in the future. The downturn in real growth additionally dampens inflation. Empirically, this process occurs with a lag. Given that the central bank behaves the way the basic Taylor rule implies, consequently, the expectation of reduced growth and inflation in the future in turn leads to expectations of lower interest rates in the future.

> *"With a rational expectations model of the term structure of interest rates, these expectations of lower future short term interest rates will tend to lower long-term interest rates today."* TAYLOR (2001, p. 266).

[113] For the theoretical derivation of an optimal monetary policy rule, this question is discussed by Bofinger/Wollmershäuser (2002a), Appendix I.

[114] An increase in q is a real appreciation.

As a consequence, the real appreciation today produces a decrease of the interest rates today although the basic rule only comprises a direct reaction to inflation and output.

> *"What might appear to be a closed economy policy rule is actually just as much an open economy rule as if the exchange rate appeared directly."* TAYLOR (2001, p. 266).

Besides, TAYLOR gives a second argument not to include the real exchange rate into the rule. In his view, in some cases, exchange rate changes are not supposed to be adjusted by interest rate reactions (for example real exchange rate changes that result from productivity gains). According to TAYLOR, the danger is that the consequences of an interest rate reaction to such changes may trigger worse effects on output and inflation than the exchange rate fluctuations themselves, even if the exchange rate swings are caused by irrational reasons. Accordingly, the

> *"indirect effect may have advantages compared with the direct effect because it results in fewer and less erratic fluctuations in the interest rate."* TAYLOR (2001, p. 267).

The present approach follows this argument and leaves the exchange rate out of the simple monetary rule that is intended to express the MCI^{opt}-path in the framework model.

[61] $$MCI^{opt} = \widehat{MCI} + e(\pi - \pi_0) + fy\,.$$

III.B The real effective exchange rate

An example for the REER is set up with three foreign countries: the anchor country and two additional foreign countries of special importance for the domestic country – may it be the main trading partners or important third market competitors.

$$[109] \quad q^{REER} = \left[\frac{p \cdot s}{p_1^* \cdot s_1^*}\right]^{w_1} \cdot \left[\frac{p \cdot s}{p_2^* \cdot s_2^*}\right]^{w_2} \cdot \left[\frac{p \cdot s}{p_3^* \cdot s_3^*}\right]^{w_3}$$

Since the exchange rates s_j^* are denominated in relation to the anchor country's currency, which in most cases is the US dollar, s_1^* (for example US dollar per US dollar) equals one and drops out of the equation.

Up until now, the REER has expressed units of US dollars per unit of domestic currency $\left(q = \frac{s \cdot p}{p^*}\right)$.

According to the more popular textbook version of a real exchange rate $\left(q = \frac{s \cdot p^*}{p}\right)$, the reciprocal value of the equation is used for a real exchange rate (keeping the parameter q as the symbol) that expresses units of domestic currency per unit of US dollar. This transforms equation [81] to[115]

$$[110] \quad q^{REER} = \left[\frac{s \cdot p_1^*}{p}\right]^{w_1} \cdot \left[\frac{s \cdot p_2^*}{p \cdot s_2^*}\right]^{w_2} \cdot \left[\frac{s \cdot p_3^*}{p \cdot s_3^*}\right]^{w_3}$$

respectively in logarithms

$$[111] \quad \Delta q^{REER} = \Delta s - \pi + w_1 \cdot \pi_1^* + w_2 \cdot \left(\pi_2^* - \Delta s_2^*\right) + w_3 \cdot \left(\pi_3^* - \Delta s_3^*\right).$$

[115] The nominal exchange rate s seems to remain unchanged but the logic behind the parameter was inverted as well: It now represents units of domestic currency per US dollar.

Chapter IV:
Selected case studies

From the point of view of this theoretical framework, chapter IV examines the most serious currency crises of fixed peg systems. The objective is to evaluate the applicability of this approach for discussing crises of different decades in countries of different size and structure. Here again, the analysis aims at exposing monetary influences coming from abroad as a central reason for the occurrence of currency crises.

The selection of the case studies, crises of fixed peg regimes, goes back to the definition and empirical classification of fixed exchange rate arrangements and the understanding of a currency crisis in chapter I.2. The selection comprises widespread currency crises that have been a central focus of the traditional models, the crisis of the European Exchange Rate Mechanism (ERM), the Asian Crisis[116], the crises of the Czech Republic's fixed peg and Argentina's currency board.

When discussing the cases, we focus on the macroeconomic and particularly monetary dimension on the basis of the preceding framework. Consequently, popular indicators which usually are enumerated in the context of currency crises studies such as budget balances, the current account, foreign debt volume and structure and instabilities of the banking system are only discussed to a limited extent in the context of the present model. Furthermore, no detailed discussion and chronological description of the specific situation immediately preceding each crisis is provided, since these episodes – the intensification of currency troubles (speculative attack) – is more or less standardized in each crisis and widely discussed in the literature. Rather, this analysis seeks a longer-term approach, starting discussion several years before the crisis, to identify main reasons for imbalances beforehand. Data for the figures, tables and discussion are taken from the IMF International Financial Statistics unless otherwise stated.

IV.1 Existing empirical research

There already exists a broad variety of empirical research regarding currency crises, which has especially mushroomed in recent years. The empirical challenge of crises literature is to construct an

[116] The Bretton Woods System however is not considered in these case studies since this era was subject to a different monetary environment (restrictions to capital mobility) and data availability is very limited in this period.

early warning system that predicts currency turbulence with adequate advance notice in a sufficiently reliable way. Besides focusing on the qualitative observation and description of the fundamental development of a country's economy before and after a currency crisis, more comprehensive studies econometrically examine the relation between single indicators and construct composite indicators that are called "stress indicators", "vulnerability" or "pressure indices" to model the fundamental vulnerability and the probability of success of a potential speculative attack. A common insight of the authors and studies is the necessity not to reduce analysis to single indicators but to consider an adequate set of indicators and interpret them as a whole.

From the classical theoretical models, a variety of parameters can be derived for examining currency crises. The aim of all research about crises is to extract those indicators from the substantial pool of theoretically possible parameters, which possess a statistically significant quality of predicting currency turmoil.

This paper refrains from giving its own detailed summary of empirical studies about identifying and explaining currency crises since this is extensively done in the literature. Recent examples are the study of ABIAD (2003), who reviews 30 empirical studies written since 1998, and BERG et al. (2004), who focus on re-examining models from 1999 onwards.

In the following, the popular approach of KAMINSKY et al. (1998) is introduced, who provide another comprehensive overview of existing empirical studies and propose an own, indicator-based early warning system, that has become standard. KAMINSKY et al. (1998) summarise 28 studies about currency turmoil, ranging from the 1950s until 1998 and comprising industrial as well as developing countries[117]. The authors separate the empirical work into four groups of methodologies (and refer to numerous examples of studies)[118]:

1) studies that discuss the indicators of crises qualitatively without performing any sort of formal test to assess their predicting quality

2) studies that compare the performance of parameters preceding and following a currency crisis to a control-group that has not experienced turbulence to identify systematic deviations.

3) a group of empirical research that sets up estimations of devaluation probabilities based on a theoretical model to extract statistically significant indicators.

[117] It is important to notice, however, that the authors review research for pegged as well as floating exchange rates.

[118] See Kaminsky et al. (1998), pp.7-8. See Flood/Marion (1998), chapter III, as well.

4) studies that are based on the second approach to compare indicators in tranquil and in crisis periods, but that define thresholds to give warning signals when these threshold values are exceeded. These authors then evaluate the individual and combined predicting qualities of the indicators.

Furthermore, KAMINSKY et al. (1998) list numerous potential indicators of currency crises and value their predictive qualities. Following their approach, the most popular indicators used in empirical literature are[119] :

- *Capital account*: international reserves, capital flows, short-term capital flows, foreign direct investment, and differential between domestic and foreign interest rates.
- *Debt profile*: public foreign debt, total foreign debt, short-term debt, share of debt classified by type of creditor and by interest structure, debt service, and foreign aid.
- *Current account*: real exchange rate, current account balance, trade balance, exports, imports, terms of trade, price of exports, savings, and investment.
- *International variables*: foreign real GDP growth, interest rates, and price level.
- *Financial liberalization*: credit growth, change in the money multiplier, real interest rates, and spread between bank lending and deposit interest rates.
- *Other financial variables*: central bank credit to the banking system, gap between money demand and supply, money growth, bond yields, domestic inflation, "shadow" exchange rate, parallel market exchange rate premium, central exchange rate parity, position of the exchange rate within the official band, and M2/international reserves.
- *Real sector:* real GDP growth, output, output gap, employment/unemployment, wages, and changes in stock prices.
- *Fiscal variables*: fiscal deficit, government consumption, and credit to the public sector.
- *Institutional/structural factors*: openness, trade concentration, dummies for multiple exchange rates, exchange controls, duration of the fixed exchange rate periods, financial liberalization, banking crises, past foreign exchange market crises, and past foreign exchange market events (i.e. significant changes in the exchange rate).
- *Political variables*: dummies for elections, incumbent electoral victory or loss, change of government, legal executive transfer, illegal executive transfer, left-wing government and new finance minister; also, degree of political instability (qualitative based on judgment).

[119] See Kaminsky et al. (1998), p. 9 and p.10.

By examining the findings of all reviewed empirical papers with parametric (not qualitative) approaches, KAMINSKY et al. (1998) conclude that the following indicators are most often tested statistically significant and therefore are the most valuable[120]:

- The real exchange rate
- International reserves and money growth
- Credit growth and credit to the public sector
- Domestic inflation

Indicators that were also broadly considered useful were:

- Trade balance and export performance
- Fiscal deficit
- (Un-)employment
- and real GDP growth

Additionally, the authors come to the conclusion that external debt related indicators do not survive the statistical tests. It is important to notice that the theoretical approach is consistent with the findings above. In chapter III, the line of argument is based on just these indicators: When we discuss the central bank behaviour and the optimal policy under fixed pegs, we evaluate the theoretical findings with focussing on the indicators listed above to observe the economic development and potential disruptions.

In the course of their analysis, KAMINSKY et al. (1998) further introduce an own early warning system that is based on 15 indicators selected in a sample of 20 countries from 1970 until 1995. For these indicators, thresholds are calculated which when exceeded signal currency troubles[121]. The whole system of single indicators is intended to announce the currency crisis probability for a certain country at any time in the coming 24 months.

All of the above indicators are widely used in the literature. One of the studies covered by the work of KAMINSKY et al. (1998) deserves special attention in the context of the present paper: FRANKEL/ROSE (1996) conducted a study based on a large sample of developing country indicators from 1971 through 1992. The authors principally use the variables filtered out by KAMINSKY et al.

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[120] See p. 12 and table A4 in their paper.

[121] These thresholds explicitly incorporate signaling errors.

(1998), but embrace another spectrum that is of special interest: They emphasise statistically significant foreign factors, namely the *foreign short-term interest rate*[122] and *real OECD output growth*. The present framework theory's considerations fit with their empirical finding that increasing foreign interest rates raise the likelihood of a currency crisis[123]:

> *"A one percentage point increase in the foreign interest rate raises the probability of a crash by over one percent, holding all other influences constant."* FRANKEL/ROSE (1996, p. 18).

Generally the main criticism of vulnerability systems arises from the observation that in most cases, *in sample* crises are announced well, i.e. the systems succeed in identifying historical crises *ex post*. But the models are mostly insufficient in foreseeing *out of sample* crises, i.e. predicting crises *ex ante*, and sporadic correct predictions must be judged as random occurrences that do not function systematically. Thus, up until now, the heterogeneity of triggers and the courses of currency crises hinders relying on models derived from historical cases for predicting future crises.

The present theoretical framework and empirical discussion addresses this issue. It tries to make some contribution to discover relations between different crisis episodes that could serve as input for future early warning models.

IV.2 Proceeding

Similar to the proceeding in the theoretical part, the analysis starts with the monetary conditions required for a stable fixed peg (MCI^{fix}). The index is calculated from the components of the MCI^{fix} (interest rate differences, real exchange rate movements, rising risk premia) to deduce the development of the MCI^{fix}. When assigning the findings to theory – by matching the development of the MCI^{fix} with the theory table – it is important to keep in mind that the assumption of a MCI^{opt} remaining unchanged is still valid. Furthermore, the MCI^{opt} is supposed to equal the MCI^{fix} in the beginning of the fix peg regime[124].

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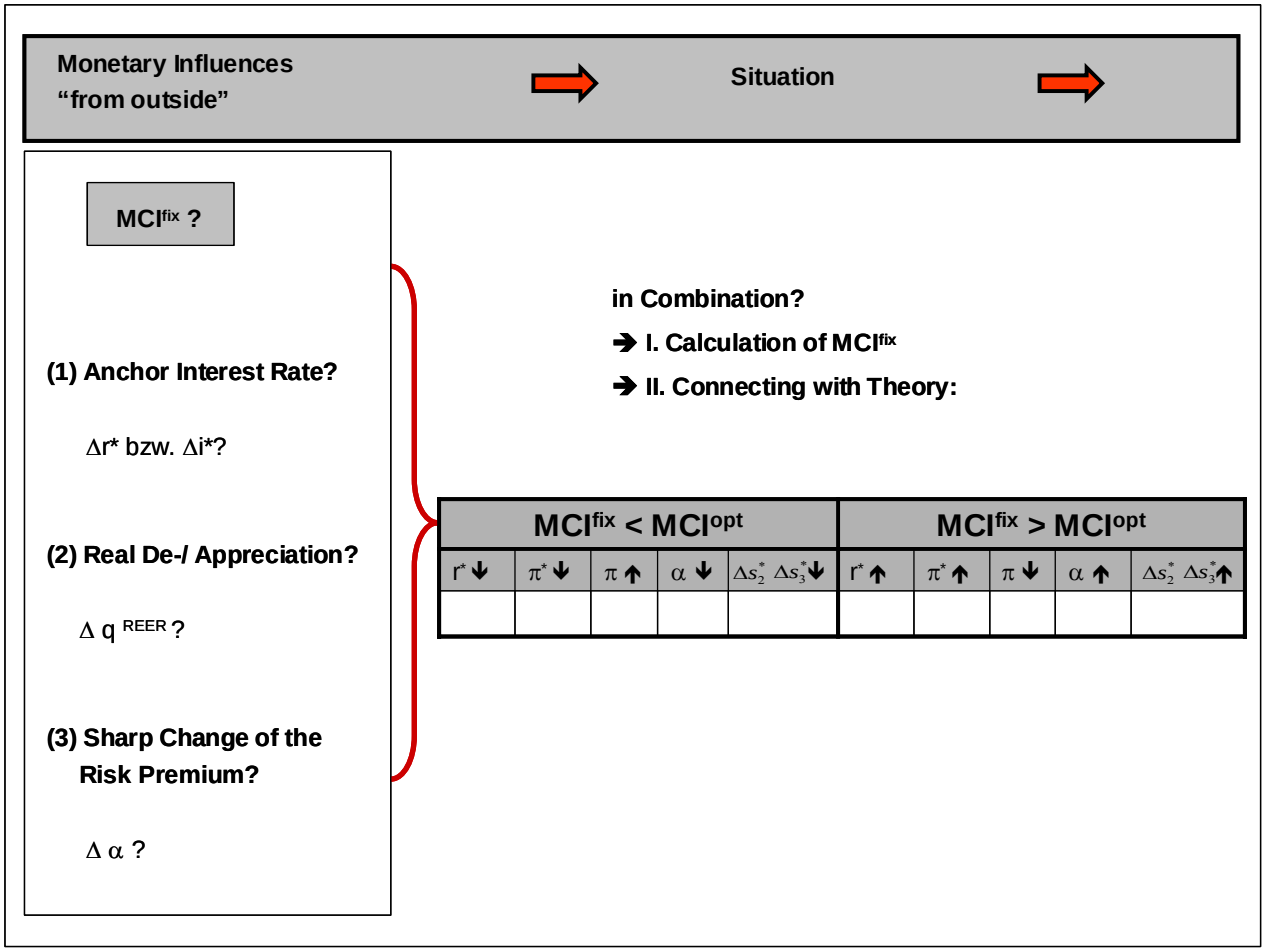
[122] They calculate a weighted average of short-term interest rates of the USA, Germany, Japan, France, the UK and Switzerland to build the so-called „foreign interest rate".

[123] In the theoretical framework of this paper, this leads to an increasing MCI^{fix}, which triggers adjustment problems.

[124] For this reason, the pure theory case can produce misleading results. For example, the finding that the MCI^{fix} decreased, produces the situation where $MCI^{fix} < MCI^{opt}$ in the theory table. At the same time, the true relationship could be $MCI^{fix} > MCI^{opt}$, if the MCI^{opt} decreased to an even larger extent. The analysis takes this into account in the sequel of each case study.

Figure 23: Proceeding I



To discuss the individual components of the MCI^{fix}, the following parameters are applied: For the interest rates, money market rates or treasury bill rates are taken, depending on their availability, volatility and market determination (in contrast to officially set rates). To analyse the real effective exchange rate, an official REER is used[125].

The market risk premium is a highly complex and broadly discussed topic that is a central subject in financial research. Analysis is restrained by the availability of data when applying an adequate proxy for the risk premium. Possible proxies are:

- The spread of external-currency denominated bonds of the domestic and anchor country that filters expectations about exchange rate changes and that way contains the risk premium demanded for the credit standing of the domestic country.

[125] When using the REER published in the IMF's International Financial Statistics, it has to be added instead of substracting it, because an increasing REER index reflects an appreciation.

- For emerging markets, JPMorgan emerging market indices are used if available, namely the Emerging Markets Bond Index Plus (EMBI+), the Emerging Markets Bond Index (EMBI) and the Emerging Markets Bond Index Global (EMBI global). These measures cover the external-currency debt markets and are constructed by first aggregating the returns for external debt instruments of a selection of countries, consisting of external-currency denominated Brady bonds, loans, Eurobonds and local market debt instruments issued by sovereign and quasi-sovereign entities. In a second step, the chosen countries are aggregated by weighting them with their market capitalisation[126].
- In the case of no liquid external-currency debt markets, the discussion goes back to comparing the spread of money market rates. Theoretically, comparing money market rates for foreign currency to the anchor country's money market rate again filters out risks in the credit standing. Comparing local money market rates to the respective money market rates for foreign currency filters out the exchange rate premium. Unfortunately, a considerable lack of data restrains this proceeding and in many cases only allows a simple comparison of the spreads on the short end of the yield curve. When available, the JPMorgan Emerging Local Markets Index Plus (ELMI+) is a possible proxy that covers the returns for local-currency-denominated money markets instruments. For construction, JPMorgan takes the most liquid money market instrument out of treasury bills, foreign exchange forwards and deposits[127].

In order to sum up the three main components and visualise the development of the MCI^{fix}, the index is computed. However, for neither of the indices (MCI^{act}, MCI^{fix}, MCI^{opt}) to be calculated is an attempt made to calibrate or estimate the weights for the parameters. To keep it simple, these are selected according to what is usual in standard literature. The numerical results are therefore only indicative.

The MCI^{fix} is calculated by applying the formula derived in the theoretical part, adding a constant of 100 as a neutral level:

$$[112] \quad MCI^{fix} = 100 + \alpha + r_1^* + (1-\delta w_1)\pi_1^* - \delta w_2(\pi_2^* - \Delta s_2^*) - \delta w_3(\pi_3^* - \Delta s_3^*) - (1-\delta)\pi$$

[126] For a comprehensive overview of the construction and ideas of the JPMorgan indices see JPMorgan (1995) and JPMorgan (1999). According to JPMorgan, the EMBI index and the extended version of the index, $EMBI^+$, are highly correlated (correlation coefficient: 0.98).

[127] Money market statistics from national authorities however often tend to be insufficiently market-determined, very volatile or incomplete. For further details about the index construction, see JPMorgan (1996).

When an official REER is available, this reduces the above equation to[128]

$$[113] \quad MCI^{fix} = 100 + \alpha + r_1^* + \pi_1^* - \pi - \delta \Delta q^{REER}$$

Third countries' inflation rates are further on assumed to remain constant[129].

For reasons of simplicity, a weight of 0.3 is used for δ (the relation of exchange rate elasticity to interest rate elasticity of domestic aggregate demand), a measure that is often used in the literature for open economies[130].

Having an indication of the monetary influence from outside, attention is drawn to the central bank behaviour in this system and on the consequences resulting for the internal and external balance.

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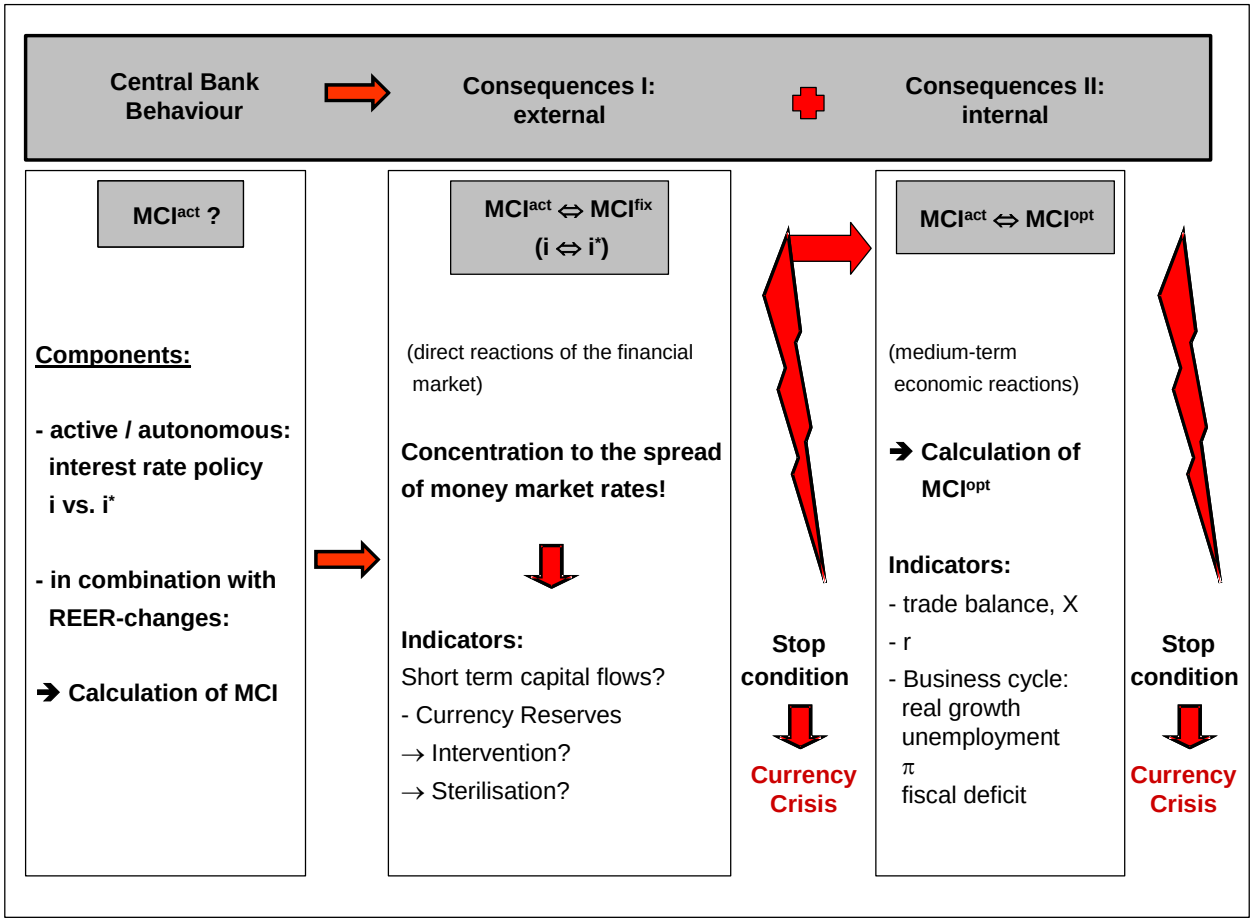
[128] For calculating Δq, a base year level q_0 is defined. The definition of the base year is of no numerical importance, since different base years only shift the MCI^{act} and MCI^{fix} for a constant. The base year for q_o was always chosen equal with the base year for normalizing the MCI^{act} and the MCI^{opt}. The method for deriving this base year is explained on p. 113.

[129] Calculating the index two times, once integrating third countries' inflation rates and once without these, shows that the indices do not deviate significantly. For the purposes of visualisation only, the method of assuming constant inflation rates of third countries (i.e. all countries not being the domestic or anchor country) is appropriate.

[130] The following studies estimate a δ representing the relation of the exchange rate elasticity to interest elasticity of domestic demand the way our paper does: $\delta = \frac{\delta_2}{\delta_1}$, with δ_2 representing the exchange rate elasticity and δ_1 being the interest rate elasticity. The IMF (1996) estimates δ=⅓ for France, Italy and the UK and ¼ for Germany. Dornbusch et al. (1998) are close to these estimates for Italy and France – they estimate ⅓ for Italy and ½ for France – but 1/1.4 for Germany (see their table 5.6). Studies of the Banque de France (1996) and Smets (1997) show that the estimates vary heavily. The Banque de France (1996) for example suggests a ratio of ¼ for Germany and ⅓ for France comparable to the others, but a ratio of 1/0.1 for Italy. Smets (1997) on the other side derives a weight of 1/2.6 for Italy comparable to the IMF (1996) and Dornbusch et al. (1998), while his weight for France is considerably higher (1/1.33). Freedman (1995) in his classical paper on MCIs again suggests ⅓ for Canada. ⅓ seems to be appropriate for smaller open economies too. For example, Hataiseree (1998) suggests ⅓ for Thailand. See as well Mayes/Viren (1998), p. 8, who provide an overview of ratio estimations.

Figure 24: Proceeding II



Therefore, the case studies proceed by considering the interest rate setting process and real exchange rate changes. Aggregating both components then yields the MCI^{act} by applying its basic definition

$$[114] \quad MCI^{act} = r - \delta\Delta q \,^{131}$$

Being aware of the central bank behaviour, the question is if it fits with the exchange rate regime restrictions. To deduce deviations from the externally given monetary stance, the MCI is compared to the MCI^{fix}. If the indices diverge, which traces back to violations of UIP, instabilities of the external balance should arise in the form of short-term capital in- or outflows.

Consequently, this discussion evaluates whether the indications drawn from the index comparison are backed by the performance of the fundamentals. When discussing capital flows, our analysis

[131] When calculating the index, again a constant of 100 is added and the base year for calculating Δq is chosen equal with the base year for normalizing the MCI^{act} and MCI^{opt}.

accordingly refers to interest rate induced capital flows, that is short-term money market instruments as long as they are available – mostly, the best proxy available is the financial account adjusted for direct investment and equity transactions – and furthermore consider foreign exchange reserve changes. Such intervention activity, however, is not directly related to instabilities of the external equilibrium since it can be due to long-term capital transactions as well. Since the study is restricted by data availability, above-average and persistent currency reserve changes in one direction are considered as a signal for disruptions of the requirements for a sustainable external equilibrium. As soon as external instabilities are de facto stated, the question is if this disparity leads to a sudden "stop condition" for the peg the way the stylised discussion in chapter III.3 indicates. Some scenarios identify a short-term "stop condition", such as a total depletion of the foreign currency reserves because of intervention. A currency crisis as a result is inevitable and logical.

Apart from consequences for the foreign exchange market equilibrium, the question is whether the pursued monetary stance corresponds with the needs of the economy. Analysing the internal balance rather has the character of a longer-term and indirect view rather than considering the market's reactions. Assessing the economic consequences begins with comparing the MCI-course to the optimal monetary conditions. To calculate the MCI^{opt}, the simple monetary policy rule set up in chapter III.2.1.1 is used.

[115] $$MCI^{opt} = \widehat{MCI} + e(\pi - \pi_0) + fy$$ [132].

For the sake of simplicity, the preference parameters of the simple rule, e and f, are supposed to be equal (0.5 each) similar to the classical TAYLOR (1993) approach. As explained in *III.2.1.1*, $\widehat{MCI}$ represents the equilibrium (or neutral) value and just shifts the index value by a constant, as the MCI is an index.

Since a direct comparison of the numerical results of MCI^{act} and MCI^{opt} is not possible[133], a simple approach is applied for comparing the two measures: When the economy is in an equilibrium state, the current monetary conditions are supposed to correspond to the MCI^{opt} per definition. This expression of a balanced economy refers to a period of real GDP growth in line with its growth potential. In technical terms, there is no output gap. With normalizing MCI^{act} and MCI^{opt} in this period, a comparison of the development of the monetary measures is possible.

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[132] Here again, $\widehat{MCI} = 100$.

[133] Because of their different structure, the absolute level is of no importance. Conclusions can only be derived from the changes in development.

The next step in this discussion again assesses if deviations of the MCI^{act} and the MCI^{opt} that point to disruptions of the economic development in the medium-term can be confirmed with the fundamental situation. Therefore, a selection of indicators is employed, as maintained by the theoretical structure and confirmed to be valuable for predicting currency crises by KAMINSKY et al. (1998) in the preceding chapter – for example the real interest rate, real GDP growth, inflation, the unemployment rate, domestic credit expansion, the fiscal position and external trade[134]. If internal disruptions are discovered, it is again evaluated if this disparity leads to a "stop condition", this time in the medium-term – like a loss of confidence because the economic costs of the peg were seen to exceed its use – corresponding to the argument developed in chapter III.3.

To conclude, each case is summarized, evaluated to which extent it is covered by the theoretical framework and examined for parallels in traditional theory.

[134] As discussion concentrates on the monetary macroeconomic perspective, the microeconomic dimension is brought up only when didactically valuable.

IV.3 Studies of crises of fixed exchange rate systems

IV.3.1 Argentina ("Tango Crisis" 2001/2002)

In 1991, Argentina chose to fix its currency in the most restrictive way possible. After a serious inflation problem in 1990 – the monthly inflation rates exceeded 10,000 % in the middle of 1990 – it established a currency board and fixed the currency to the US dollar with an exchange rate of 1:1 in order to import monetary credibility and stability from the anchor country. Consequently, the monetary authority abandoned any monetary flexibility, because it had to back the national currency with 100 % of foreign currency reserves[135]. For that reason, the domestic monetary base entirely depended on the balance of payments.

The case studies section begins with the Argentine crisis since this is the most recent crash of a fixed exchange rate regime. At the same time, it is an ideal case to start with since it is the most rigid of all forms of currency pegs which automatically requires MCI^{act} to comply with MCI^{fix}: Because of the impossibility of an active monetary policy, both indices are always identical.

In the following, we will investigate how Argentina's monetary policy has performed in reality. The analysis starts as described in the preceding chapter. Beginning with assessing the monetary requirements originating from the exchange rate system, it follows by examining the behaviour of the central bank within this corset and discusses the consequences.

IV.3.1.1 Monetary influences from outside

As the formal depiction of the MCI^{fix} shows, one has to examine changes in the interest rate of the anchor country, modifications of the real exchange rate and risk premium deviations.

(1) Anchor Country Interest Rate Movements?

As Argentina was anchored to the United States, the Fed Funds Rate had an important influence onto the performance of the currency board. Observing the Fed Funds Rate shows that the Federal Reserve Board pursued an extraordinarily expansionary monetary policy until the beginning of 1994. Money market rates declined by more than 4 percentage points from January 1991 until December 1992 and

[135] to assure its obligation to change national currency into foreign currency and the other way around at the fixed rate at any time.

remained at that level of 3.0% until the end of 1993. As of January 1994, the Fed Funds rates went up again by 300 basis points in 15 months.

The cycle of interest rate *lowering* did not have a significant impact on Argentina until 1993, because during the first years of the peg, the macroeconomic environment was not stable. It took until mid 1994 for inflation to come down from more than 700% to 5%. During this stabilisation process, the new currency regime had to gain confidence, going along with the Argentine money market rates showing a high volatility. Since a US influence on the Argentine interest rate development cannot seriously be derived during that period, the analysis concentrates on the period from 1994/1995 onwards[136].

The consequences of an *increase* in the US interest rate as of 1994, however, have a remarkable influence on the Argentine economy, since stabilisation had proceeded, volatility had decreased and the Argentine money market rate then was de facto tied to the US rates. As theory implies, the American interest rate hike is reflected in the Argentine money market rates because the currency board regime left Argentina no other option than copying the FED stance. Referring to the 12 months moving average[137], the domestic nominal money market rate was boosted from less than 6% in mid 1993 to more than 10% in the second half of 1994[138].

(2) Real De-/Appreciation?

Looking at the second component of the MCI, the real effective exchange rate development, gives even more evidence of restrictive conditions coming from the exchange rate arrangement. The REER appreciated continuously in relation to third countries[139]. One main reason for this is an appreciating US dollar in 1995. From mid 1995 until mid 1998, the dollar appreciated about 60% against the yen and against the euro, the dollar appreciated by 50% until the end of 2000. What is more, the currencies of main trading partners like Brazil and Chile depreciated heavily in the period preceding the Brazil economic and currency crisis in 1999. As a consequence, the Argentine peso appreciated about 20% in real terms from 1995 until the first half-year of 2001, which translated into a continuous deterioration of the international competitiveness in the foreign trade sector[140].

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[136] However, it is certainly true that the expansionary anchor country stance facilitated Argentina's entrance into the fixed peg, as it provided an adjustment for a diminishing risk premium.

[137] to smoothen volatility.

[138] Actual nominal rates rose to a peak of 20.1 % in May 1995. An important factor that contributed to this peak was rising risk aversion due to the Mexican currency crisis.

[139] Since the IFS provide no REER for Argentina, data in this case is drawn from JPMorgan.

[140] See also Bundesministerium der Finanzen (2002) and Eichengreen (2001).

(3) Sharp Changes in the Risk Premium?

As of the end of 1994, when stabilisation had made headway, no substantially and persistently increased risk premium was observed. For Argentina, the money market rates spread is an adequate proxy for a risk premium because of the currency board[141]. Further and more detailed information about risk is given by the comparison of the Argentine money market rate to the one for foreign currency, since it filters liquidity risks (the debtor is the same) and thus provides a measure of exchange rate uncertainties. Comparing the money market rate for foreign currency against the Fed funds rate, on the other hand, yields information about liquidity risks of Argentina while filtering exchange rate risks (same currency, see the respective figures in the set of figures no. 25).

Monitoring the spread of money market rates or the JPMorgan EMBI+ spread, unusually sharp rises in the risk premium are observed twice before the Argentine crisis itself, both times during crises of neighbouring countries[142]. So far, these risk premium increases are to be considered the classical contagion effects, which go along with short-term capital outflows of the country. As these temporary premia swellings followed periods of enormous capital inflows, they did not trigger serious consequences but were rather corrections in the investors' behaviour.

For this reason, until the Argentine financial market turmoil in 2001, the risk premium is not considered crucial for currency troubles. For the enormous increase in the premium in 2001, it will be argued later that this is a medium-term consequence of previous violations of the essential economic balances.

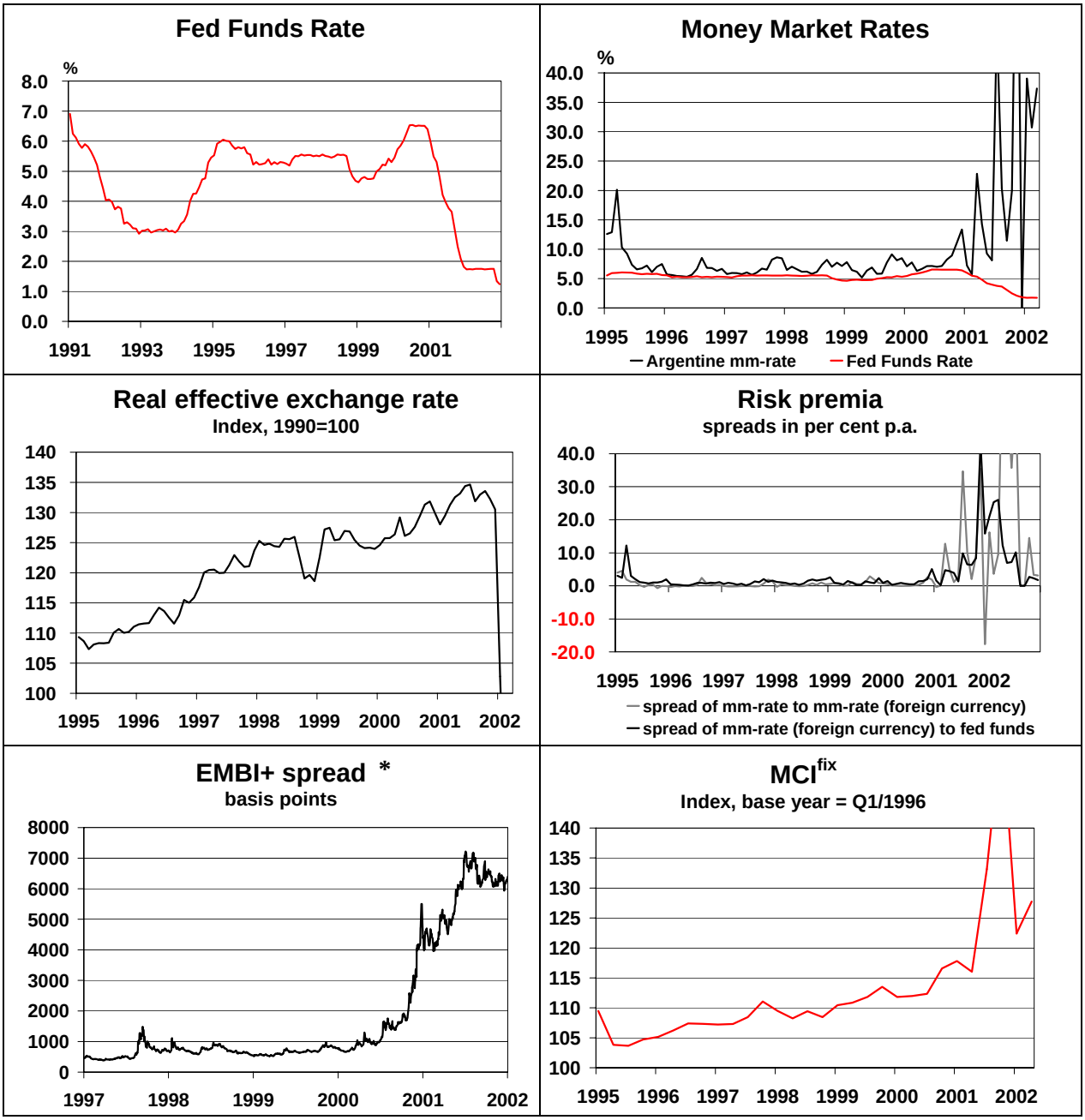
(4) Situation

Combining these parameters yields an MCI^{fix} of the following type (last figure in the set of figures below):

[141] that rigorously reduces the monetary policy leeway to UIP.

[142] Unfortunately, the EMBI+ spread is only available from 1997, but the money market spread also shows that risk premium increased temporarily during the period of the Tequila crisis 1995.

Figure 25: Argentina – The composition of the MCI^{fix}



* Data for the EMBI+ spread is only available from 1997.

Interpreting the course of the index, the currency board required more and more restrictive monetary conditions as of mid 1995. This already indicates the restrictive burden of the exchange rate regime transmitted from the anchor country and third countries. Assigning this course to theory, the development is depicted the following way:

Table 10: Argentina – Monetary conditions

	$MCI^{fix} < MCI^{opt}$					$MCI^{fix} > MCI^{opt}$				
	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Monetary influences:	---	---	---	---	---	X	---	X	---	X

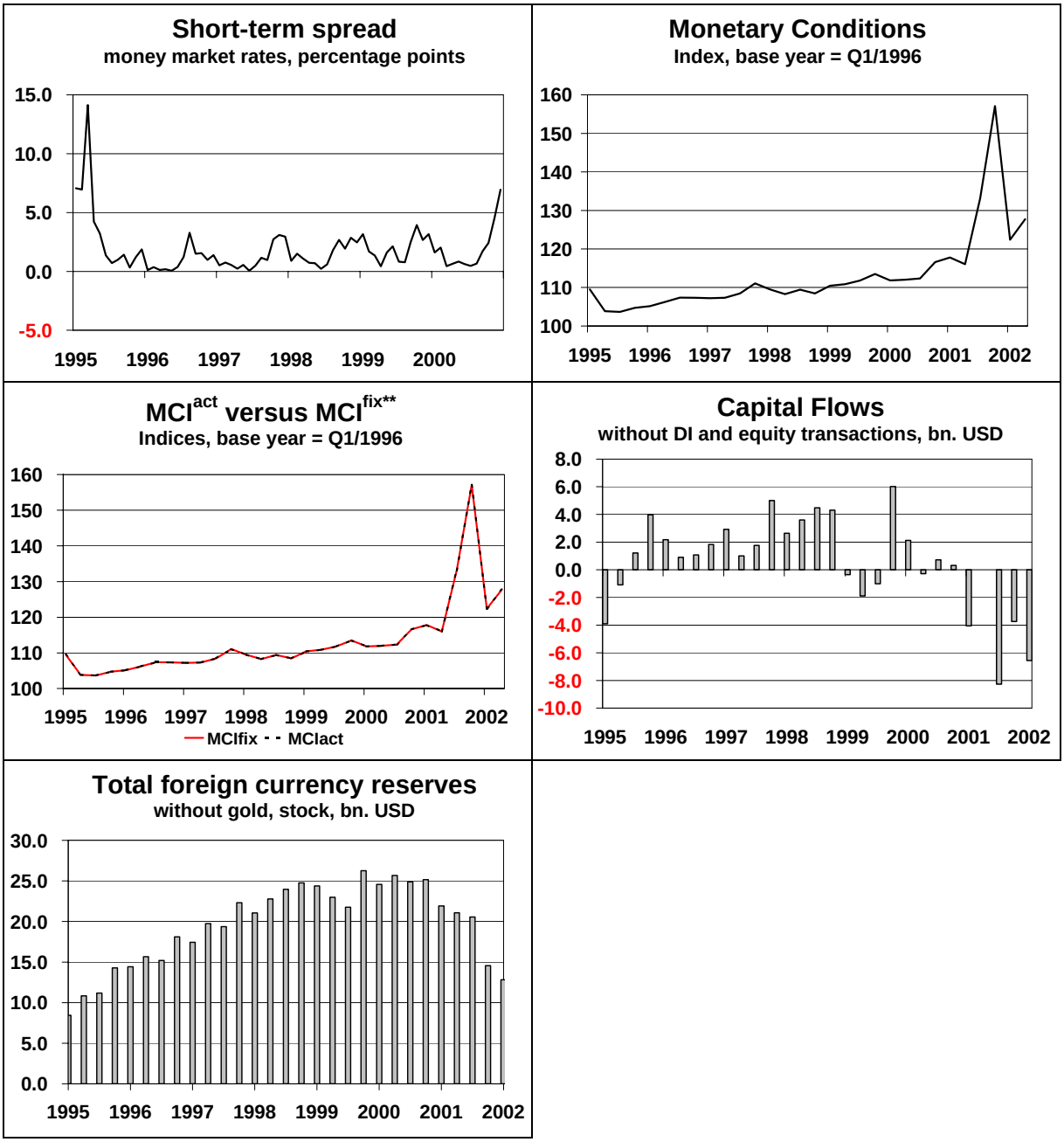
- From January 1994 to March 1995, the anchor interest rate increased 300 basis points.
- The REER, on the one hand, continuously appreciated due to an ongoing stabilisation process in the domestic country (declining inflation rate). On the other hand, the main trading partners' exchange rates depreciated while the US dollar gained value.
- Except a temporary increase in 1995, the risk premium did not show considerable movements in the 1990s[143].

IV.3.1.2 Central bank behaviour and consequences

Questioning the behaviour of the domestic central bank within this framework is simple in the Argentine case. Since there is no leeway for an autonomous interest rate policy line because of the currency board, the money market rate remained close to the Fed Funds rate.

[143] The rise from 2001 onwards reflects the beginning of the outbreak of the crises, discussed in chapter IV.3.1.3.

Figure 26: Argentina – Central bank behaviour and external consequences



**: MCI^{fix} is dotted to make the MCI^{act} visible, as both indices are identical.

In combination with the appreciation of the REER, the MCI^{act} in Argentina kept on rising steadily (see the set of figures no. 26, second chart), which implies more and more restrictive conditions. Nevertheless, the extent to which monetary conditions were tightened was not extreme until 2000. What is of greater concern is how the direction of the monetary course fits with the external needs and the needs o f the domestic economy.

(1) External Consequences

In the currency board regime, the result of comparing the MCI^{act} and the MCI^{fix} is intuitively logical: both indices are equal (see the third chart in the set of figures 26).

[116] $$MCI^{act} = MCI^{fix}.$$

According to theory, this would not point to short-term capital in- or outflows that could endanger the foreign exchange market balance.

At first sight the data does not seem to back the theory since it shows that de facto, the economy continuously attracted capital inflows, except in periods of relatively high uncertainty during the Tequila Crisis and the Brazil Crisis (see the respective chart in set 11). From the second half of 1995 until the end of 1998, an average volume of 2.6 billion US dollars per quarter poured into the country. From then on, volatility of capital flows rose considerably, first most likely due to the Brazil crises and from autumn 2000 onwards due to growing uncertainty about the future of the exchange rate system.

However, the fundamental findings do not necessarily contradict with the presented approach. As this analysis is restrained by the availability of data, it is the financial account (adjusted for direct investment and equity transactions) that is the proxy to illustrate capital movements. This position, however, includes all maturities of portfolio investment while only short-term capital flows are considered problematic for currency pegs and thus are covered by the MCI theory. Especially considering the background of Argentina's credible fixed peg guaranteeing the absence of currency risks, it is plausible that until the Brazil crisis, a majority of the investment matured in the mid- and long-term. Since volatility increased significantly as of 1999 – capital flows even changed between positive and negative until the end of 2000 – it is probable that from then on, investment volume was reduced and maturities were transformed to the shorter term. 1999 also brought a decrease in the currency reserves stock lasting for three quarters. However, this did not imply a direct stop condition for the currency board but reversed to increasing reserves again until the ultimate crash at the turn of 2001/2002.

Thus, while the external requirements on the whole seem to have been met throughout the nineties, the second question for the sustainability of the nominal anchor strategy is if it matched economic needs. If not, economic disruptions would be the result.

(2) Internal Consequences

In examining the effects of the monetary stance on the domestic economy, the MCI^{opt} is calculated to represent optimal monetary conditions. To derive the MCI^{opt}, inflation targets are assumed, since the Argentine central bank did not publish target values for that period. The central bank only affirmed the aim to bring the inflation rate to single digits. To test the impact of different inflation targets, the MCI^{opt} is calculated for two target values:

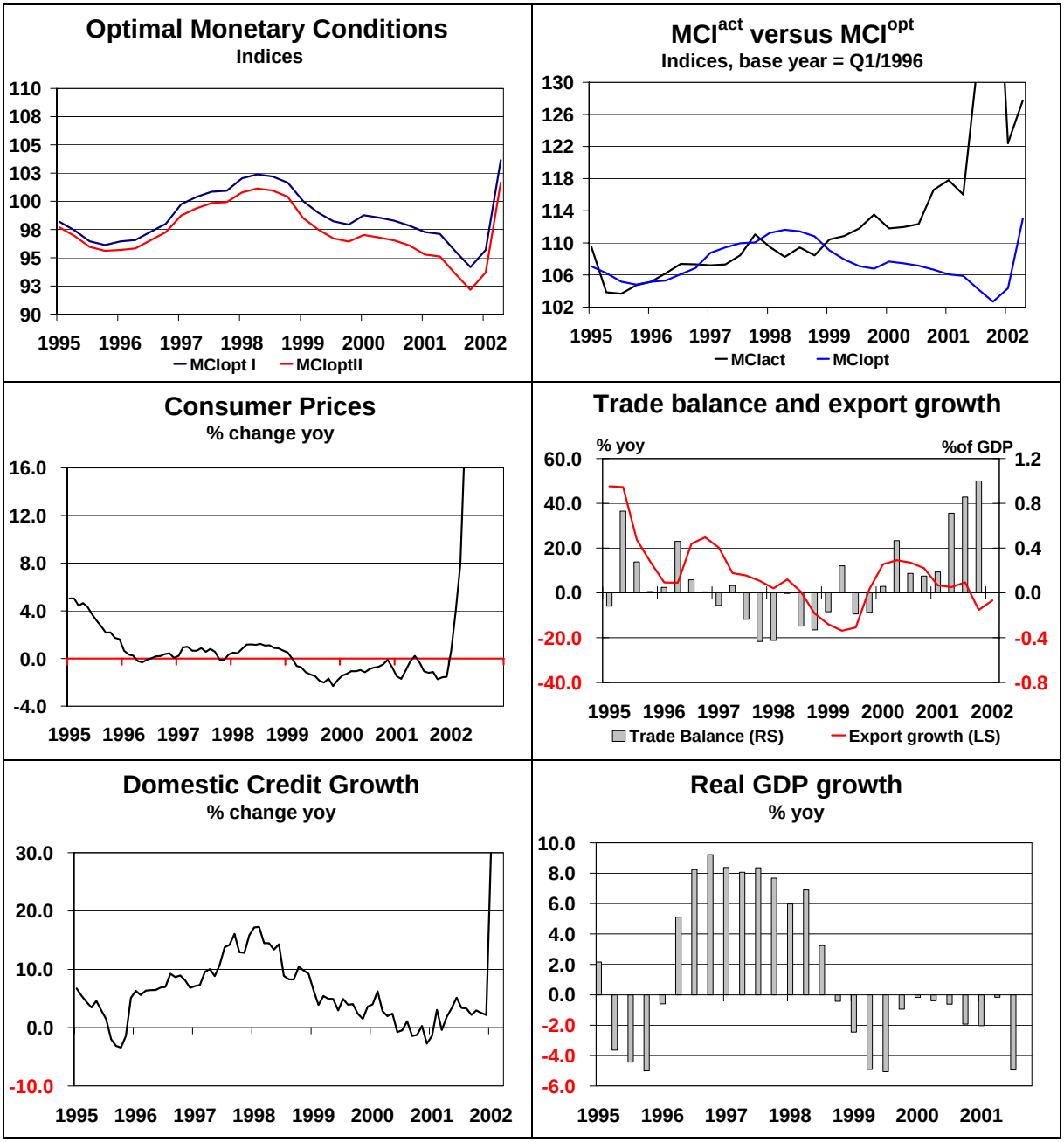
1. for the upper end of the single-digit target: an inflation rate of 9.0 %.
2. for an inflation target that is gradually improving to 5% reflecting stabilisation. Thus, the chosen starting target value is 9.0 % in 1992, assumed to gradually decline by 0.5 percentage points every year.

The output gap was calculated as is common in the standard literature[144]. In the outcome, the two MCI^{opt} indices practically follow the same course (see the first chart in the set of figures no. 27). As of 1993, they move sideways in a range of 95 to 105 index points. The inflation target value only shifts the index curve slightly. MCI^{opt} I emerges from the gradually declining inflation target, MCI^{opt} II goes back to the 9.0 % target. Since this discussion does not pay particular attention to the numerical results but bases its argument on the trend of the indices, assuming a reasonable constant target value is sufficient.

In the next step, the MCI^{act} is compared to the MCI^{opt} to give an indication of the compatibility of the pursued monetary stance with economic needs.

[144] It represents the deviation of the actual output from trend output that was smoothed by the Hodrick-Prescott - filter.

Figure 27: Argentina – Central bank behaviour and internal consequences



To obtain comparable indices, the first quarter of 1996 has been considered an internally balanced period because the output gap is zero during that time. In this instance, the MCI^{act} equals the MCI^{opt} per definition. Accordingly, the calculated index level of MCI^{opt} has been normalized to the MCI^{act}. The resulting index comparison suggests that the implications of the peg – producing an MCI^{act} that conforms with the MCI^{fix} – put a strain on the economy as of 1999. While the MCI^{act} kept on increasing, the MCI^{opt} shows that the economy demanded a more expansionary stance from then on (see the second figure in the set no. 27). This constellation is formally described by

[117] $MCI^{fix} = MCI^{act} \succ MCI^{opt}$

The fundamental situation backs these theoretical suggestions:

- The overly restrictive monetary stance obviously resulted in a continuously declining inflation rate. The change in consumer prices, which amounted to more than 3 % until mid 1995, decreased rapidly to stagnation in the first quarter of 1996 before even getting substantially deflationary (more than minus 2 %) from 1999 onwards (see the third chart in figure set no. 27).
- This deflationary process put pressure on the real interest rate since the nominal interest rate was exogenous in the currency board regime[145]. In 1999, the real interest rate increased substantially, from 7.3 % in January to 10.3 % in December. This constituted a monetary restriction increasing the MCI^{act} of the domestic economy even more and slowing down business activity[146]. What is more, the real interest rate boost itself hampered inflation, stimulating the vicious circle.
- Credit growth indicates the flagging momentum in the domestic economy as well (see chart 5 in figure no. 27). Having recovered after the 1995 recession and growing for more than 15 % in the beginning of 1998, momentum waned and the credit volume even declined in 2000 (-2.7 %).
- Additionally, the export sector was negatively affected by the real appreciation. Especially the negative influence of the depreciation of the Brazil Real during the Brazil crisis is quite visible: After coming to a virtual standstill in 1998, export growth rates were even negative in 1999 (see figure four in the set no. 27). Until 1998, this resulted in a constant worsening of the trade balance, though the deterioration is not very distinctive (from + 1 % of GDP in 1995 to –1 % 1998)[147]. From 1998 onwards, the trade balance improvement is somewhat misleading, as it is simply the result of the import volume (-5.4 billion US dollars in 1999) shrinking more considerably than the export volume (-3.1 billion US dollars).

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[145] Beforehand, the real interest rate had already been pushed up by the foreign interest rate hike. The effect was an enormous upswing of the real interest rate from negative territory (the 12 months moving average being at around -4.0 % mid 1993) to positive digits. As of 1995 it hovered around 6 % and, fuelled by the ongoing stabilisation process, never dropped below the 5 %-mark again until the currency crisis.

[146] The theoretical advantage of a real devaluation caused by the deflationary process is weighted less than the real interest rate rise in the MCI-calculation. To sum up, the monetary reins become even more restrictive.

[147] which has to be attributed to the low external trade share (export quota to GDP: about 10 %).

- All in all, after recovering from the 1995 recession, real GDP growth quickly and ultimately lost its steam. From the final quarter of 1998 onwards, quarterly year on year growth rates were negative and never recovered until the breakout of the currency crisis.
- Finally, following the economic cycle with a time-lag, the labour market signalled the same information. After having peaked at more than 17 % during the 1995 recession, the unemployment rate recovered somewhat (to around 13 %) before rising in 1999.

Altogether, while the monetary stance avoided triggering a direct stop condition by maintaining the external balance, it lead to aberrations in the business cycle in the medium-term. Fitting with the simplified theoretical considerations of chapter III 3.1.1, the overly restrictive stance from the internal perspective led to a deflationary process accompanied with a substantial worsening of economic indicators. As argued in chapter III 3.1.1, this was the trigger for a medium-term stop condition of the peg, since the market participants would realise that the costs of maintaining the currency board would increase and could finally outweigh the peg's benefits.

IV.3.1.3 Outbreak of the currency crisis

Indeed, from the beginning of 2001, the tolerance threshold of market participants obviously was exceeded. Capital outflows increased, reflecting the diminishing confidence of investors in the system. The impact of upcoming foreign exchange market pressure is indicated by the development of the foreign currency reserves as well, which began dropping from their peak of more than 25 billion US dollars in 2001 and never stopped diminishing again until the outbreak of the crisis.

Conversely, money market rates jumped up from an annual average of 8 % in 2000 to more than 20 % in 2001. This naturally boosted the real interest rate and subsequently the internal burden[148]. Thus, the vicious circle began and was no longer stoppable. As of 2001, the crash was apparent.

- The share price index of the Buenos Aires stock exchange that had risen to a peak of more than 18.500 points in mid-January, reversed its course to a continuous downward trend. Until the forthcoming end of the peg, it reached an all-time low of 9,265 points.
- In 2001, the spread of Argentine government bonds to the American benchmark of the same maturity[149] widened over a one-year period from 770 basis points to ultimately more than 4000 basis points.

[148] Averaging at an already high level of 9.5 % in 2000, real interest rates increased to an annual average of 23.5 % in 2001.

[149] Covered by the spread index EMBI+, calculated by JP Morgan.

- Volatility of short-term interest rates increased considerably as of March 2001, reaching a level of more than 90 % at one juncture.
- In the central bank balance, this loss of confidence of the financial market actors left its marks. Reflecting the escalating exchange market pressure, foreign currency reserves diminished continuously from January 1, 2001, despite a stand-by credit from the IMF in December 2000. Within one year, the stock of reserves shrank by more than 10 billion US dollars.

As soon as such a development – designated as a speculative attack in the literature – sets off, the extra risk premium on the yields and interest rates stresses the weak economy even more. In theoretical terms, α itself increases the MCI^{fix} additionally. Altogether, three main steps contributed to raising the MCI^{fix} in Argentina:

1. the appreciating REER
2. in the second round, the deflationary tendencies that increased the real interest rate
3. and finally the sharply rising risk premium α.

The consequences of the speculative attack were visible in a period of increasingly restrictive consumer and industrial sentiment. All in all, private consumption diminished more than 5 % in 2001, investment even more than 15 %. After previous years of recession, real GDP change in 2001 amounted to -4.4 %. Price developments were deflationary in 2001 for the third time in a row (-1.1 %). Unemployment swelled to more than 17 %.

Since this trend could not continue in the same direction, market participants finally forced the crash. At the end of the year 2001, pressure onto the exchange rate regime was increased to a level that left monetary authorities no other alternative than to float the exchange rate, since the complete depletion of the currency reserves stock was only a question of time. On January 6, 2002, the end of the currency board was announced[150].

The abandonment of the peg generated heavy consequences similar to other crises. The peso plummeted from then on and “stabilised” for the first time at around 3.6 ARS/USD in the second half of 2002. Compared to the peg value of 1:1, this was a depreciation of the peso of more than 70 %. Such a drop in the currency value coincided with significantly increasing the dollar-denominated foreign debt volume and therefore the debt and interest rate service. As a result of the debt servicing problems and of the plummeting peso, the spread on Argentine government bonds versus the US

[150] For a detailed chronology see Hornbeck (2002).

benchmark widened to more than 7000 basis points[151]. Real GDP growth in 2002 amounted to –11 % and the inflation rate was 26 %.

IV.3.1.4 Contagious effects on the region

Recent experiences in several Asian countries, following Thailand in a currency crisis from 1997 onwards, brought up the issue of possible contagious effects in Latin America. The main difference between Asia and Latin America is that in Latin America the most important neighbours and capital markets, Brazil as well as Mexico and Chile, had a free floating currency. Thus, contagion could potentially cause serious economic and financial disruptions but no sudden currency crash in the form of a break-down of the exchange rate regime. Some other countries in the region like Venezuela and Uruguay had pegged their currency to the US dollar, but – apart from Ecuador – in a rather flexible crawling band.

Consequently, this approach is not adequate to explain potential pressure onto the exchange rate, since it is constructed for fixed peg systems. The logic nevertheless remains unchanged. Risk aversion of investors results in foreign exchange market pressure that result either in capital movements or in direct exchange rate changes.

Table 11: Latin America – Contagion in theory

Brazil et al.	**$MCI^{fix} < MCI^{opt}$**					**$MCI^{fix} > MCI^{opt}$**				
	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Monetary influences:	---	---	---	---	---		---	---	XX	X

In Brazil, contagion became visible in the second quarter of 2002. The Brazilian real plummeted from an average of 2.4 BRL/USD in the first quarter, starting in April, to 3.6 BRL/USD at year-end. This corresponds to a depreciation of about 35 %. Furthermore, the currency weakness stopped the trend of receding inflation. Declining until 2001 (to 6.8 %), consumer prices increased in 2002, averaging 8.5 % in 2002. The bond market also suffered from the poor performance of the real. Spreads versus the equivalent US bonds quickly extended to more than 2000 basis points. What is more, the currency depreciation worsened the debt position, as the major part of the debt was indexed with the exchange

[151] according to JPMorgan's EMBI Index.

rate. Although the IMF did not raise any doubts about its general support, volatility of the bonds as well as of the currency remained high. It was the vicious circle of currency losses, increasing interest rates and escalating indebtedness that made the rating agencies downgrade Brazil in August 2002[152].

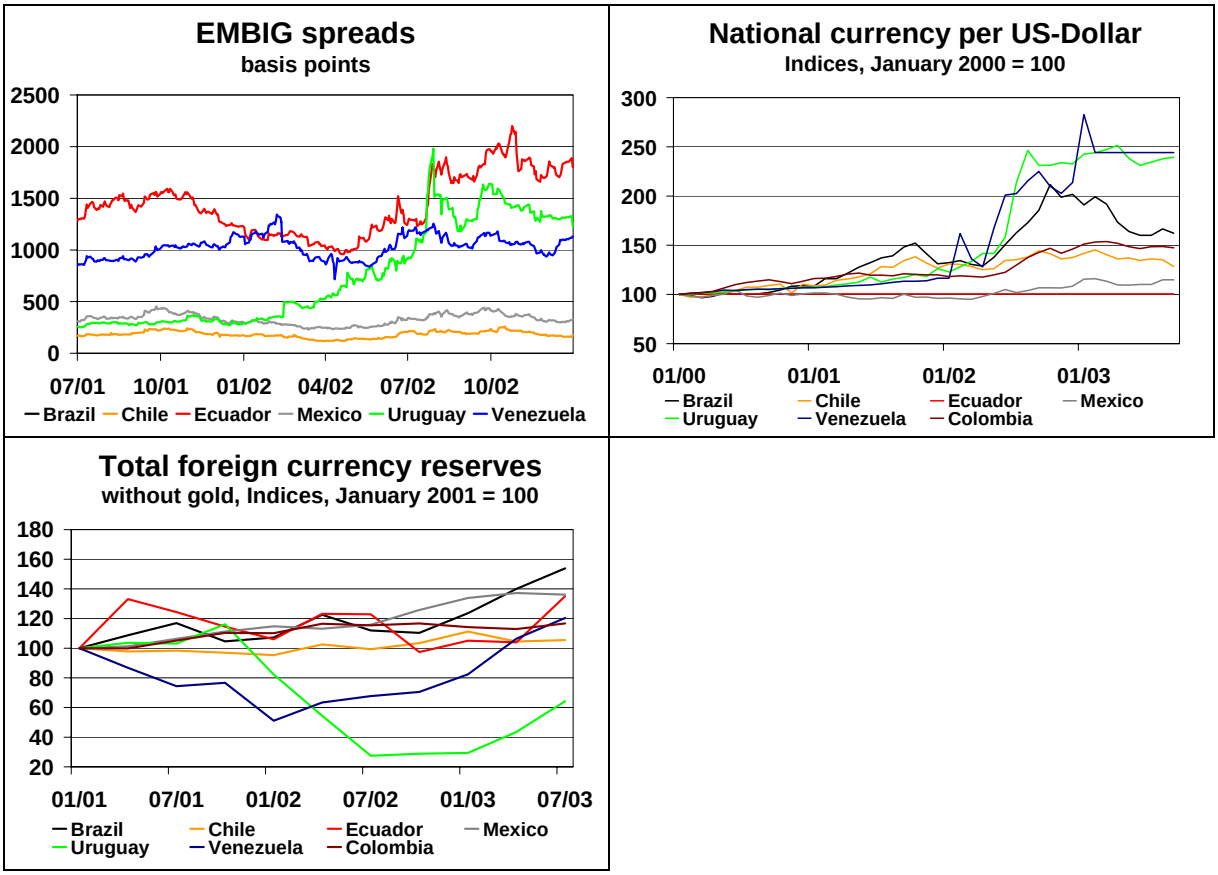
Uruguay also was faced with consequences of the Argentine instability. The downward trend set off in April 2002 as well. Within half a year, the Uruguayan peso had lost nearly half of its value, reflecting investors' loss of confidence in the exchange market. Bank deposits were frozen to avoid a collapse of the financial market.

The same picture is true for Mexico, Chile and Venezuela (see figure 28). They all suffered from the classical contagion channels. In Chile, devaluation began in the second quarter of 2002 as well (however at just about 10 % at year's end). For Venezuela, which until the end of 2002 had experienced depreciation of 40 % since April, the loss of value quickly induced inflationary pressure. Being on track for single digit inflation rates in 2001, the consequences of political and currency turbulences bounced inflation up to 22.4 % in 2002 (from 12.5 % in the year before). The Mexican peso also began to devalue in the second quarter of 2002, and depreciated by about 10 % until the end of the year.

Even the less capitalised markets of Ecuador and Columbia were not spared from the contagious effects. Up until the beginning of 2002, the Ecuadorian currency board could be maintained, but the spreads of Ecuadorian dollar-bonds rose by about 700 basis points. The Colombian peso depreciated around 20 % from April to December 2002 and the spread increased by about 500 basis points.

[152] What was especially serious in this case was Moodys' downgrading to B2, which implied that the country lost its investment grade status.

Figure 28: Argentina – Spillover in the region



Since these cases do not fall into the classification of fixed pegs' crises, this approach's logic is not applicable one-to-one. Since most of the countries were faced with political elections or other domestic political problems, it is however reasonable that the central banks did not consequently prefer to stabilise the foreign exchange market and instead put more emphasis on internal stability. In terms of theory, these cases approach the situation where

[118] $MCI^{fix} \succ MCI^{act} \succ MCI^{opt}$.

If the currencies were entirely fixed, foreign currency reserves should have declined as a consequence and the countries should have developed as discussed in chapter III.3.1.2. According to figure 28, foreign currency reserves de facto declined from 2001 onwards in those countries that were pegged, Uruguay and Venezuela. Within rigidly fixed pegs, the above figure illustrates the classical case that produces a direct stop condition – a sudden depletion of the reserves stock. Since in reality the exchange rates were more flexible, the situation produced a mix of depreciating exchange rates and loss of foreign currency reserves.

IV.3.1.5 Summary regarding equivalences to traditional theory

On the whole, this discussion identifies crucial monetary influences originating from the anchor country and third countries. Also, these interferences arose several years before the ultimate crisis. As it was argued theoretically, the situation that occurred produced an overly restrictive monetary stance from the domestic view. Since the exchange rate regime forced the central bank to act according to the external balance, it simultaneously forced the Argentine monetary authority to neglect the domestic economic situation. In the medium term, this produced a stop-condition for the peg because the economic situation was no longer sustainable for the merits of a stable peg. Accordingly, as argued in a simplified way in theory, this logic has its parallels in the line of argument of the *Second Generation* – there is no longer a balance between the benefit of the exchange rate commitment and the social costs of keeping it.

Table 12: Summary of the Tango Crisis

Argentina – the "Tango Crisis"										
Monetary influences:	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Case:	**$MCI^{fix} < MCI^{opt}$**					**$MCI^{fix} > MCI^{opt}$**				
Central bank behaviour:	**$MCI^{act} = MCI^{fix} < MCI^{opt}$**			**$MCI^{act} = MCI^{opt} > MCI^{fix}$**		**$MCI^{act} = MCI^{fix} > MCI^{opt}$**			**$MCI^{act} = MCI^{opt} < MCI^{fix}$**	
Stylised discussion in chapter:	III.3.2.1			III.3.2.2		III.3.1.1			III.3.1.2	
Parallels in traditional theory:	• Second Generation models • Third Generation supplements			• First Generation models • Second Generation models		• Second Generation models			• First Generation models • Third Generation approaches	

Argentina	*Contagion*

On the other hand, the contagion effects emerging from the Argentina crisis are covered by theory in a simple way with a rising risk premium. Though not a fitting case for this theoretical approach (no fixed pegs), the courses of the crises are roughly following the argument of chapter III.3.1.2. More comprehensive explanations for increasing risk aversion are provided by the traditional currency crisis theory within the Third Generation approaches. Fundamental evidence can be discovered for several approaches of Third Generation theories in the Latin American case.

In Brazil, the reasons for the increasing market volatility and worsening economic performance can – apart from political instability in the preceding of the presidential elections – be assigned to some of the classical elements of spill-over approaches:

- *External trade relations*: Less than a tenth of the Brazil export volume goes to Argentina, about 11 % is imported from there. With such a relatively low trade linkage, the worsening economic situation is only partly attributable to losses of competitiveness due to the peso devaluation. Apart from that, instead of being seen to cause a substantial appreciation of the real versus the peso in 2002, the expected currency revaluation should rather have been considered a correction of bilateral competitiveness: The external competition between both countries already experienced a considerable change during the Brazil crisis in 1999 when Argentina suffered from the substantial real and nominal Brazil real depreciation. Anyhow, the peso crisis affected the Brazil economy negatively, at least since the external trade advantages previously enjoyed were no longer realized.
- *Credit Crunch*: Reacting upon the massive defaults of investment in Argentina, creditors reduced their involvement in the whole region. As of mid 2002, the BANK FOR INTERNATIONAL SETTLEMENTS (2002) pointed to a considerable credit rationing for Latin America and especially Brazil as a consequence of the massive losses in Argentina.

  „Turning to emerging markets, banks further reduced their exposure to Latin America while continuing to lend to Asia and Europe. Latin America's share of foreign claims on all developing countries fell to 37,4 % at end-June 2002 from 41,6 % a year earlier." Bank for International Settlements (2002, p. 3).

For Uruguay, Third Generation approaches again provide an explanation for a rising risk premium preceding the Argentina crisis as they are backed by the facts: Since Uruguay formerly was considered a safe haven in Latin America because of political and economic stability, Argentines transferred a considerable amount of private wealth into Uruguayan accounts. When the access to private accounts in Argentina was limited in the course of the crisis, Argentines began to withdraw their capital from the Uruguayan accounts and thus most likely initiated the capital flight. Several banks broke down as a consequence and Uruguay suffered from a downgrading of its government bonds. This again is a clear way in which a financial crisis in one country spreads to another country in the region.

IV.3.2 Czech Republic (Currency crisis 1997)

The analysis of the Czech currency breakdown is restricted by a reduced availability of data because of the young history of the Czech Republic – data series mostly start in 1993 or 1994. This data availability sets restraints for calculating the essential components (for example a sufficiently reliable output gap) or discussing the developments of indices and fundamentals.

Since the official establishment of the Czech Republic in 1992, the country was seen to go through the transformation process relatively quickly and become pro-western and pro-market oriented. From the beginning, the exchange rate of the koruna had been officially fixed against a currency basket (in May 1993 this basket was reduced to two currencies: 65 % mark and 35 % US dollar)[153] with a 1 % fluctuation band with its main purpose to stabilise inflation during the process of liberalising prices. According to REINHARD/ROGOFF (2002) and the general opinion, the German mark was the de facto currency anchor. As of February 28, 1996, the bandwidth was enlarged to +/- 7.5 % around the central rate. Until currency troubles arose in the first half of 1997, ongoing macroeconomic stability attracted investors' confidence. In May 1997, the peg finally was abandoned because of currency turmoil and a managed floating was adopted. To analyse the circumstances of the failing fixed peg, the following discussion proceeds the way described in chapter IV.2, beginning with assessing outside monetary influences.

IV.3.2.1 Monetary influences from outside

(1) Anchor Country Interest Rate Movements?

Observing the interest rate stance of the Bundesbank shows that from the very beginning of the Czech exchange rate peg until its end, the anchor interest rate gradually kept on falling. While the German money market rate still averaged 9.4 % in 1992, it steadily decreased to 3.2 % in 1997.

Against the background of the UIP logic it is apparent that the foreign interest rate reduction had its impact on the Czech monetary policy if the peg was intended to remain stable.

(2) Real De-/Appreciation?

The second component of the MCI^{fix}, the real effective exchange rate, also shows a marked and persistent course: it appreciated continuously throughout the fixed peg's whole lifetime – 46 % from

[153] Precisely, the currency was already fixed as of January 1, 1991, i.e. in Czechoslovakian times.

January 1992 to April 1997. Until mid 1995 this was mainly due to a positive inflation differential to the main trading partners and depreciating trading partners' exchange rates[154].

This development somewhat counteracts the impact of the declining anchor interest rate on monetary conditions. While the declining German money market rate has an expansionary impact, the appreciating real exchange rate tendentiously raises the monetary conditions index.

(3) Sharp Changes in the Risk Premium?

When examining the third main component of the monetary conditions index, the risk premium, the only measures available are the money market rate and the two year government bond spread[155].

The money market rate decreased drastically from more than 800 basis points in the first half of 1993 to less than 300 basis points in mid 1994, as is logical in the beginning of a credible fixed peg. The commitment to fixed exchange rates serves as an insurance against unexpected exchange rate volatility and indirectly against inflationary pressure, since it supports stabilisation. In 1995, the money market spread increased again to a relatively high level of around 800 basis points and remained at this level until mid 1997.

However, taking the money market spread as a proxy for the risk premium within the MCI-framework has significant shortcomings. When calculating the MCI^{fix} upon it, this risk measure implies at the outset that UIP holds permanently ($i\text{-}i^{*}=\alpha$). That way, it produces a MCI^{fix} equalling the MCI^{act} per definition and looses its explanatory value to evaluate disruptions of the domestic monetary policy.

Since there are no longer term interest rates available, we therefore use the two year government bond spreads as a proxy for the risk premium[156]. This spread also declined to a low of 2.2 basis points at the end of 1994 and then, different to the money market spread, increased continuously. Until the end of 1995, it increased by nearly 300 basis points and by another 260 basis points to a level of 7.8 percentage points until the end of 1996.

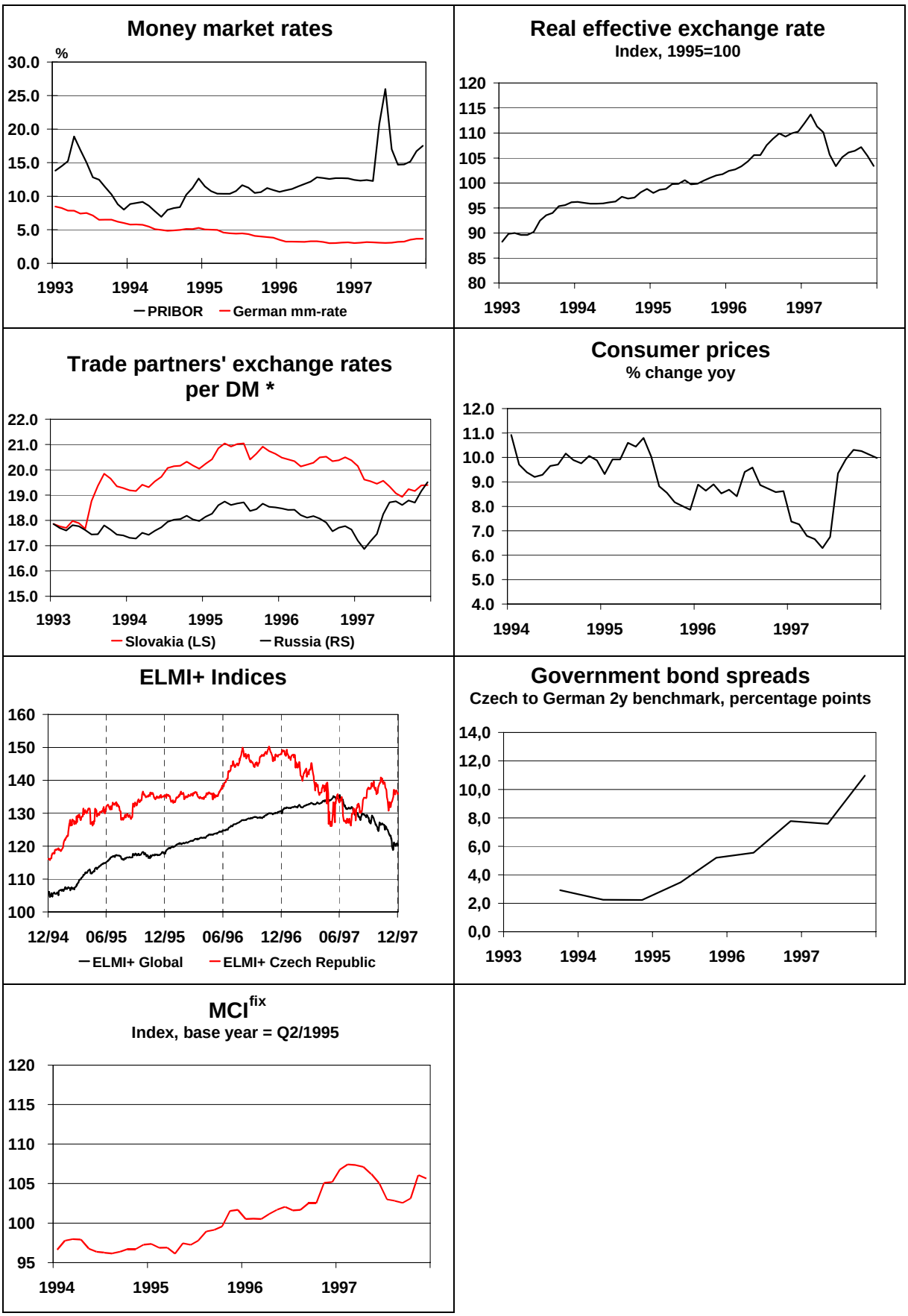
[154] See Horvath and Jonas (1998), p. 15, where they quantify the CPI difference: According to the authors, during six years the Czech CPI increased by around 70 percentage points more than the CPI in advanced economies.

[155] Neither long-term government bond spreads nor suitable JPMorgan EMBI Indices are available.

[156] being aware of the relatively high correlation to the money market rates and the associated objections.

(4) Situation

Figure 29: Czech Republic – The composition of the MCI^{fix}



* According to the Direction of Trade Statistics, 2002, Slovakia and Russia were the Czech Republic's most important trading partners – apart from Austria, which was pegged to the German mark.

Because of the limited data availability, calculation of the MCI^{fix} only starts in 1994. The index values suggest that the monetary requirements for a sustainable peg tightened constantly as of mid 1995 and became particularly restrictive in the first half of 1997.

Integrating this development with theory does not lead to a clear result since it affects both sides of the table:

Table 13: Czech Republic – Monetary conditions

	$MCI^{fix} < MCI^{opt}$					**$MCI^{fix} > MCI^{opt}$**				
	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Monetary influences:	X	X	---	X	---	-----	-----	X	X	(X)

- The German money market rate declines continuously throughout the nineties.
- The continuous real appreciation surely stems from the inflation differential of the Czech Republic towards "the rest of the world" as well as third countries' exchange rate changes. Depicting this in the table is not so simple, however, since it is a mixture of elements. The domestic as well as anchor country's inflation rate fall over time, while important trading partners' exchange rates depreciate roughly until mid 1995 and then begin to appreciate again.
- The risk premium finally declines until 1995 and then continuously increases until the outbreak of the crises.

IV.3.2.2 Central bank behaviour and consequences

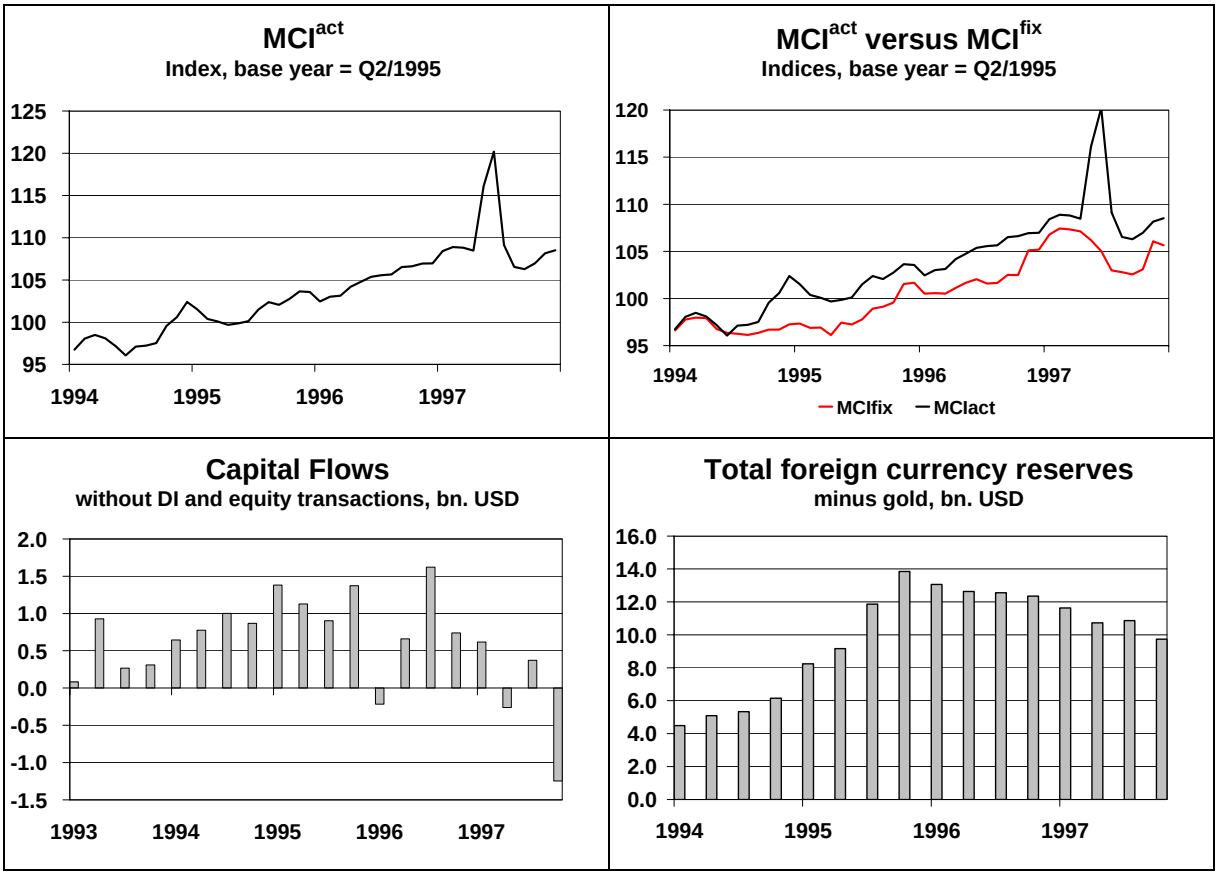
Having an indication of the peg's required monetary stance, the question is how the domestic central bank performs in achieving the internal and external needs. Regarding the Czech and German money market rates from 1993 onwards displays two phases of Czech interest rate policy (see figure 29):

1) Until mid-1994, the Czech interest rate continuously approached the anchor rate. Consequently, the spread to the German short-term interest rate diminished to 250 basis points. We will not consider this period, since the MCI^{fix} only starts in 1994.

2) From this low, the interest rate quickly rose to 12.7 % at year-end and remained between 10 and 13 % until the breakout of the crisis. With a declining anchor interest rate at the same time, this meant a spread rise from 250 to 880 basis points within six months.

Adding the continually appreciating real exchange rate caused even more restrictive monetary conditions. Overall, the MCI^{act} is continually rising as of mid 1994 (see the first figure in set 30).

Figure 30: Czech Republic – Central bank behaviour and external consequences



(1) External Consequences

Comparing the MCI^{act} and the MCI^{fix} to deduce information about the success of the domestic central bank in keeping a stable foreign exchange balance reveals a deviation as of mid 1994. From then on, the index comparison suggests that the Czech central bank applied an overly restrictive monetary stance. Czech monetary policy approached the MCI^{fix} again from mid 1995 onwards but remained more restrictive than externally required. According to theory, this should have endangered the sustainability of the peg by inducing short-term capital inflows[157] (see the second chart of the set of figures 30).

[119] Until mid 1994 $MCI^{act} = MCI^{fix}$

[120] From mid 1994: $MCI^{act} > MCI^{fix}$

Analysis will show in the following that the change in the monetary policy stance from mid 1994 was pursued for internal reasons.

Capital inflows sped up until 1995 and became especially volatile in 1996. On average, the quarterly inflow of capital – since no data for short-term capital is available, the financial account adjusted for direct investment and equities is taken as a proxy – amounted to one billion US dollars per quarter from 1994 to the first quarter of 1997. The literature confirms that the capital inflows consisted mainly of short-term maturities[158]. Capital liberalisation also surely contributed an important part to the acceleration of capital inflows[159]. On the whole, fundamentals back the suggestions of the theoretical approach.

For the purposes of balance of payments adjustment - to avoid pressure on the foreign exchange market - excess liquidity had to be compensated[160]. The central bank intervened by buying foreign and selling domestic currency, which is reflected in the foreign currency reserves stock rising to an all-time high of 13.8 billion US dollars by the end of 1995. Finally, as of 1996, the extremely worsened

[157] An explanation for investors not trading arbitrarily upon the remarkable money market spread until mid 1994 is the relatively high premium in the beginning of the new peg that countered potential interest rate gains.

[158] See the Czech National Bank (2003), Buch/Heinrich (1997) and Begg (1998b).

[159] When the Czech Republic joined the OECD, this was associated with full capital liberalisation, which came into operation on October 1, 1995.

[160] i.e. inflowing liquidity that exceeded the financing of the current account deficit. It is important to stress again that the short-term capital inflows are crucial for the sustainability of the peg, whereas the longer-term maturities are not problematic.

trade balance obviously could no longer be compensated by capital inflows and the central bank had to intervene in the opposite direction to adjust the balance of payments and to keep the peg stable[161].

Since the currency reserves stock increased continuously until 1996, it did not produce a short-term stop condition. However, coupled with the changes in the currency reserves stock, the central bank's policy stance had a significant impact on the domestic economy.

(2) Internal Consequences

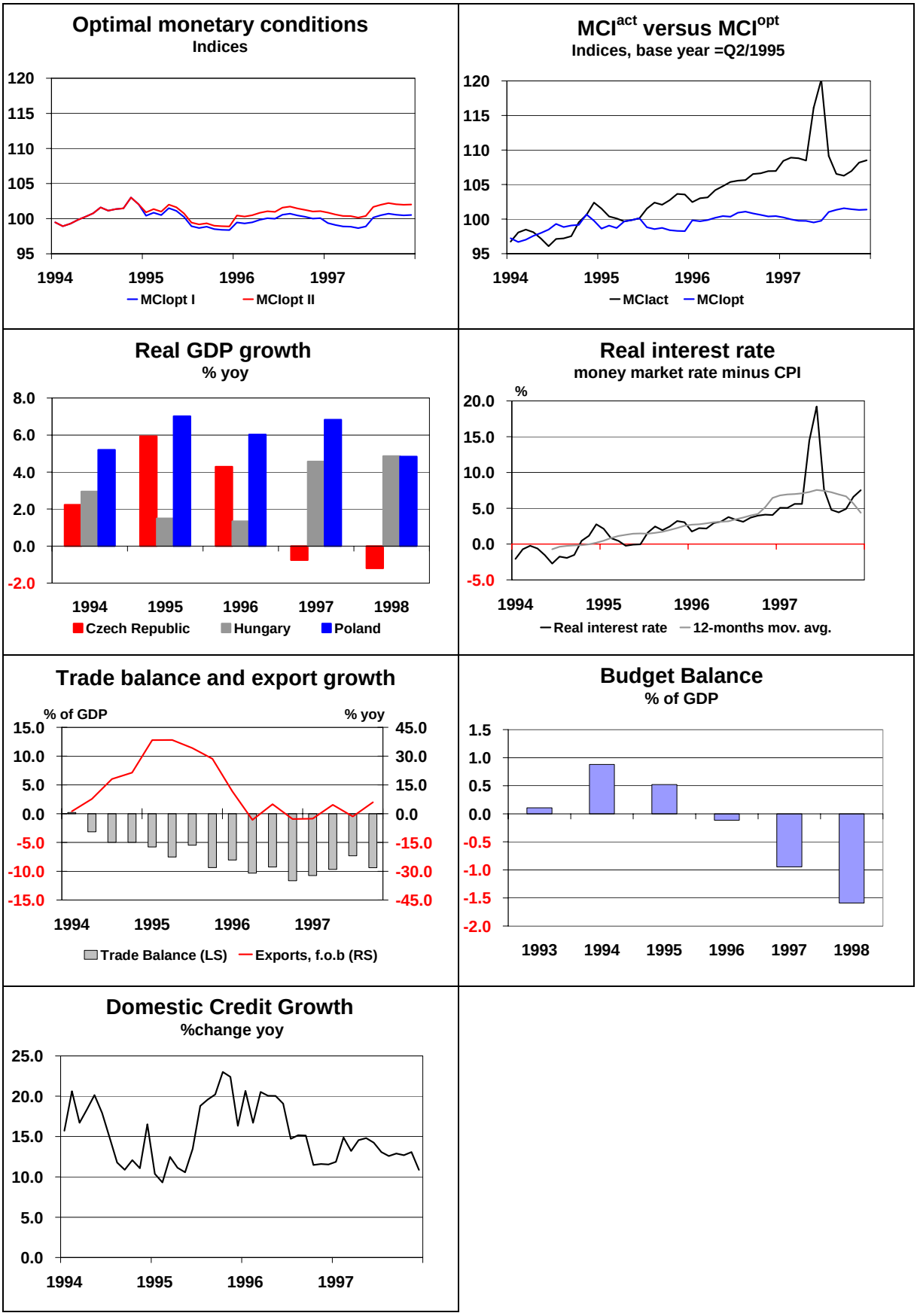
To assess whether the monetary policy stance coped with the Czech economy's needs, discussion begins with calculating the MCI^{opt} and comparing it to the MCI^{act}. The output gap is derived from the deviation of the actual output to trend output (calculated by applying the Hodrick-Prescott filter to the seasonally adjusted GDP data). Some scope remains for the inflation target of the Czech National Bank, as the institution publicises concrete target levels only from 1997 onwards. The overall target for the fixed peg period clearly reduced the inflation rate to single-digit-levels. Thus, we assume two target values: Firstly, 9,0 %[162] and secondly a linear inflation target declining by one percentage point every year in order to gradually approximate to the target level band of 5.5 to 6.5%[163] pronounced in 1997. Since the conclusions from the figures only have an indicative and not a numeric significance, the minor deviations of the two resulting MCI^{opt} courses can be neglected (see the figure below).

[161] See Begg (1998a).

[162] which results in a more expansionary index level than when using lower single-digit targets. However, the level of the target value is only of symbolic importance as it only affects the level of the index and not its course.

[163] More precisely, the Czech National Bank (CNB) on its website refers to "net inflation", which is only calculated from unregulated prices.

Figure 31: Czech Republic – Central bank behaviour and internal consequences



For normalizing the MCI^{opt} to the MCI^{act}, the second quarter of 1995 is considered the quarter representing an internal equilibrium (where $MCI^{opt} = MCI^{act}$) since its output gap is closest to zero[164]. The development of the indices shows that after being somewhat too expansionary in mid 1994, the actual monetary policy stance approached the MCI^{opt} and exceeded it but remained close to the optimal conditions until mid 1995. After mid 1995, the MCI^{act} kept on increasing and again came within reach of the MCI^{opt} by the end of 1995 before getting more and more restrictive until the outbreak of the crisis.

Overall, until mid 1994, monetary policy seemed to pursue a course that succeeded in stabilising the external balance, but began to get too expansionary for the domestic equilibrium.

[121] $$MCI^{fix} = MCI^{act} \prec MCI^{opt}.$$

The mismatch obviously was corrected in mid 1994: the three months interbank rate rose from 6.9% in June to 12.7 % in December 1994. Regarding the indices, the MCI^{act} approached the MCI^{opt}, becoming more restrictive which now was at the expense of the external balance.

[122] $$MCI^{opt} \approx MCI^{act} \succ MCI^{fix}$$

While the Czech money market rate remained in a corridor of around 10.5% to 11.5% for the next one and a half years (until June 1996), the continuous appreciation of the real effective exchange rate obviously made the MCI^{act} become overly restrictive as of mid 1995 from the internal as well as the external balance view.

The next step is to take a look at the fundamentals and compare them to the theoretical considerations. The real interest rate stance reflects the policy shift towards the internal requirements from mid 1994. With a negative real interest rate from January until September 1994, monthly consumer price changes had begun to increase again and had been hovering at around 10 % year on year from then on. So, to continue the stabilisation process, it was necessary to tighten the nominal interest rates. As a consequence, the real interest rate returned to positive territory.

From then on, on the whole, the economic indicators related to the economy do not seem to be burdened by an inadequate monetary policy before the end of 1996. The foreign trade indicators

[164] Unfortunately, because of the young history of the country, no long-term data is available.

however clearly show the burden of the continuous real exchange rate appreciation (see the respective figures in set 31) [165].

+ Domestic credit growth was quite volatile, but overall signalised a dynamic domestic demand. Still in the beginning of 1997, the monthly growth rates remained at about 15 %.

+ The fiscal position showed surpluses in 1994 and 1995, receding somewhat in 1996 but still remaining balanced.

+ The unemployment rate remained under the 4.0 % mark until the second quarter of 1996.

+ Overall, economic growth was solid until the end of 1996, with quarterly growth rates of at least 4.0 %.

- However, the durable real appreciation seriously deteriorated the competitiveness in the foreign trade sector. The export growth rates visualise the speed of the downward trend. Having performed robustly until mid 1995, from then on the level of appreciation obviously harmed competitiveness since the growth trend collapsed. In mid 1996, export volume stagnated. Accordingly, the trade balance became more and more negative, additionally burdened by a vivid import performance. Starting from a small deficit of -1.5 % in 1993, the Czech Republic had accumulated a trade balance deficit of 10 % in 1997[166].

Thus, apart from foreign trade, the Czech economy remained relatively balanced until the end of 1996. This is attributable to the fact that the central bank not only offset the negative effects of MCI^{act} exceeding the MCI^{fix} by continuous intervention but by sterilised intervention to maintain the intended interest rate path.

Table 14: Czech Republic – Sterilisation of the intervention activity

Simplified central bank balance sheet	
Credits to the banking system ↓	Deposits of the banking system ↑ (among which minimum reserves)
Currency reserves ↑	Currency in circulation

[165] Here, only the economic indicators are discussed. The banking sector is not explicitly observed, there however, serious problems arose. For a detailed discussion, see the Czech National Bank (2003).

[166] Smídková et al. (1998) and the IMF (1998b), pp.107, give a more comprehensive explanation for the external balances deterioration that exceeds our monetary approach.

Pursuing such a monetary policy raised interest costs of sterilisation considerably [167]. This results from a de facto rising stock of currency reserves on the one hand and from increasing deposits of commercial credit institutions or a diminishing credit position, on the other hand, to compensate the money supply growth. The rising currency reserves only earned the foreign interest rate whereas the Czech central bank had to pay the higher domestic interest rate for the rising amount of bank deposits. Conducting this policy, the Czech monetary authority permanently made losses due to the spread of the money market rates ($i-i^*$).

Apart from these explicit costs of sterilising, the IMF considers certain implicit costs for calculating total costs of sterilising capital flows for the Czech Republic[168]. Total costs in the IMF's approach are:

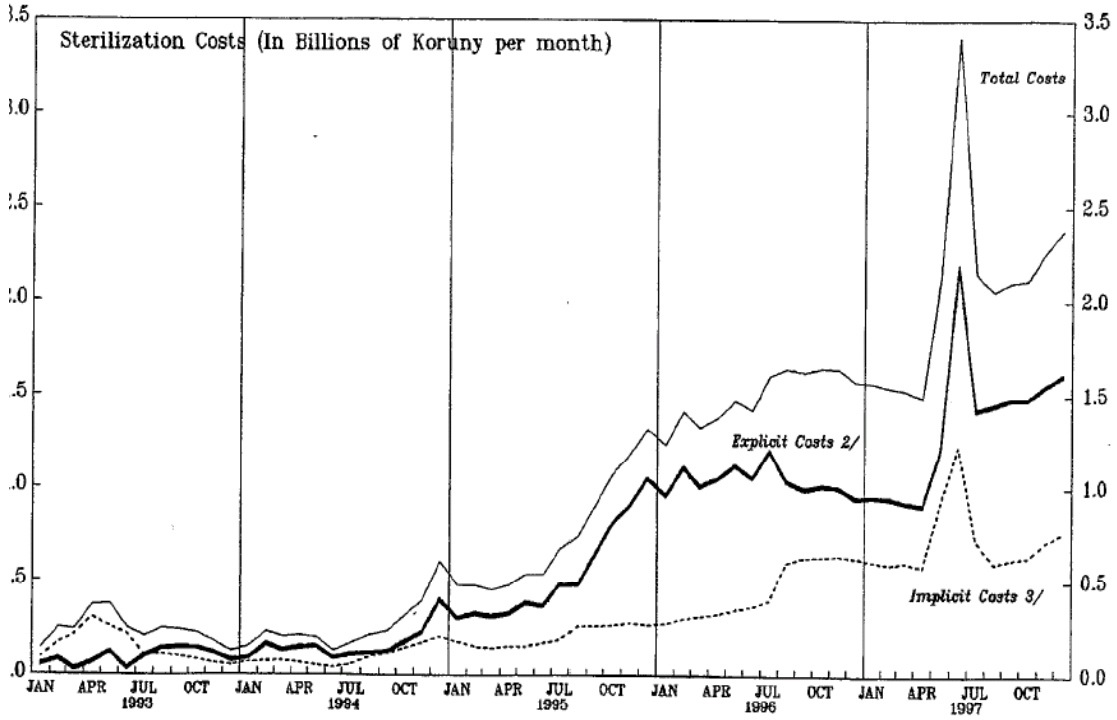
- Explicit costs: The interest rate differential times the sum of central bank bills and the transfer of deposits.
- Implicit costs: The interest rate differential times the part of required reserves related to sterilisation.

By this yardstick, deviating from the required monetary conditions for an external equilibrium became an increasingly costly policy. From the beginning of 1996, total sterilisation costs amounted to more than one billion koruny per month, and increased to more than 1.5 billion koruny per month by mid-1996.

[167] See chapter II.1.3.2.

[168] See IMF (1998b), p. 69.

Figure 32: Czech Republic – Costs of sterilisation



Source: IMF (1998b), p. 69, figure 17.

Accordingly, monetary policy violated the condition of sustainability for the external balance. While this did not lead to an immediate stop-condition of a sudden depletion of the reserve stock, the consequences of the intervening activity had to be sterilised to keep the economically optimal interest rate stance. Thus, the chosen policy led to a medium-term stop condition, since the accelerating costs of sterilisation were not bearable in the long run. This discussion correlates properly with the stylised theoretical argument in chapter III.3.2.2.

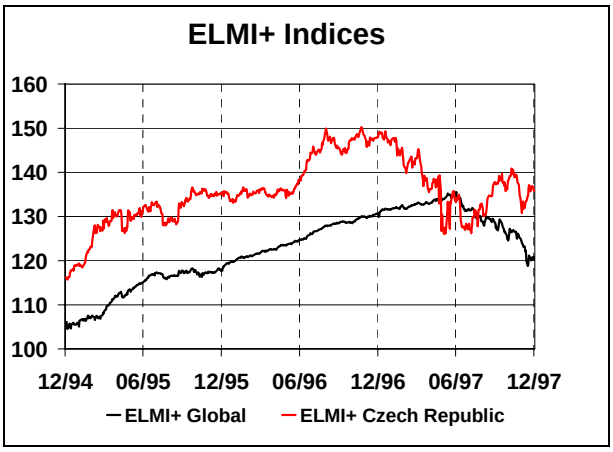
IV.3.2.3 Outbreak of the currency crisis

In addition to the accumulating social costs of the peg, subsequent to a widening of the exchange rate band in February 1996 to +/- 7.5 % around the central rate, uncertainty about the credibility and sustainability of the peg accumulated in the market[169]. The comparison of the JPMorgan indices

[169] See also Horvath and Jonas (1998), p. 21.

ELMI+ global [170] and the sub-index for the Czech Republic shows that while the EMBI+ global increased continuously over time, the sub-index for the Czech Republic turned to a rapid downward trend from the end of 1996.

Figure 33: Czech Republic – Market risk assessment



In the first quarter of 1997, uncertainty of the investors about the adequateness of the monetary policy course accelerated, since the increasing costs of the peg were reflected in quickly worsening fundamentals, getting along with the even tighter MCI^{act} than externally and internally desirable. Obviously, the central bank tried to counter the increasing uncertainty about the sustainability of the peg by intervening and increasing the money market rate, which burdened the situation even more. The model reflects this as MCI^{act} exceeding the MCI^{fix} as well as the MCI^{opt}.

Apart from the economic deterioration, the timing of rocketing uncertainty has to be attributed to the currency crises in Asia, that increased the risk aversion of investors for emerging markets as a whole. Furthermore, political instabilities in the Czech Republic amplified the mistrust against the continuation of the peg[171]. That way, speculative attacks became increasingly profitable as the breakdown of the peg got more and more likely motivating investors to withdraw their capital from the Czech Republic in the expectance of a major currency devaluation. After all, this made the

[170] The JPMorgan Emerging Local Markets Index Plus (ELMI+) covers the returns for local-currency-denominated money markets instruments. For construction, JPMorgan takes the most liquid money market instrument out of treasury bills, foreign exchange forwards and deposits. For further details about the index construction, see JPMorgan (1996).

[171] See also Smídková et al. (1998) and the IMF (1998b), p. 126, who also blame the combination of weakening fundamentals, doubts about the policy continuation and the Asian crisis for the rapid loss of investor confidence.

intervention necessary and sterilisation costs began shooting up. Shortly before abandoning the peg in the second quarter of 1997, sterilisation costs rose to an all-time peak of nearly 3.5 billion koruny per month. It is clear that this policy had no future – the central bank could no longer afford to defend the peg. The fixed rate regime was abandoned May 26, 1997.

Subsequent to the regime switch, the currency devalued about 10 % until the end of the year, which was a relatively modest loss of value compared to other crises like the Asian crisis. It was often argued, that with the announcement to pursue a managed floating against the reference currency German mark[172], the central bank managed to stop the koruna from plummeting but stabilised the currency rather quickly.

IV.3.2.4 Summary regarding equivalences to traditional theory

On the whole, while the monetary authority from mid 1994 preferred to support the economy and the process of stabilisation, the peg's monetary requirements were neglected. Thus, it is not particularly the "rest of the world" that is responsible for contagion spreading to the Czech Republic. It is more of a mixture: On the one hand, the anchor country's declining interest rate and continuous appreciation affect the MCI^{fix}. On the other hand, it is the Czech central bank itself that actively tightens its interest rate stance and accepts the deviation of the whole MCI^{act} from the MCI^{fix}. While this situation did not trigger an immediate stop-condition in the form of a sudden depletion of the currency reserves, the sterilisation policy produced a medium-term stop condition in the form of rocketing costs of sterilisation corresponding to the line of argument in the theoretical chapter III.3.2.2. By arguing that way, this approach explains the Czech currency troubles fundamentally, a view that BUCH/HEINRICH (1997) and others share.

[172] in a band going from 17 to 19.5 CZK/DEM.

Table 15: Summary of the Czech Currency Crisis

The Czech Currency Crisis										
Monetary influences:*	$r^*\downarrow$	$\pi^*\downarrow$	$\pi\uparrow$	$\alpha\downarrow$	$\Delta s_2^*; \Delta s_3^*\downarrow$	$r^*\uparrow$	$\pi^*\uparrow$	$\pi\downarrow$	$\alpha\uparrow$	$\Delta s_2^*; \Delta s_3^*\uparrow$
Case:	**$MCI^{fix} < MCI^{opt}$**					**$MCI^{fix} > MCI^{opt}$**				
Central bank behaviour:	**$MCI^{act} = MCI^{fix} < MCI^{opt}$**			**$MCI^{act} = MCI^{opt} > MCI^{fix}$**		**$MCI^{act} = MCI^{fix} > MCI^{opt}$**		**$MCI^{act} = MCI^{opt} < MCI^{fix}$**		
Stylised discussion in chapter:	III.3.2.1			III.3.2.2		III.3.1.1		III.3.1.2		
Parallels in traditional theory:	• Second Generation models • Third Generation models			• First Generation models • Second Generation models		• Second Generation models		• First Generation models • Third Generation approaches		

* Remember in this case, that it is not mainly monetary influences from abroad that trigger the drifting apart of the MCI^{fix} and MCI^{opt}, but a MCI^{opt} exceeding the MCI^{fix}. Thus, this row does not clearly suggest the resulting case of MCI^{fix} and MCI^{opt} within the next row, since it was developed in the theory chapter to derive shifts of the MCI^{fix} while assuming a constant MCI^{opt}.

Since the Czech crisis was associated with external disruptions finally leading to declining currency reserves, this hints to parallels within First Generation models. However, the other key characteristic of First Generation theory, a substantial fiscal deficit, was not significant in the Czech Republic. Furthermore, currency reserves declined before the crisis, but rather gradually than suddenly. Thus, the First Generation logic is only partly applicable to this case[173]. Second Generation considerations fit better since their central argument – a shift of the peg's balance of costs and merits triggering a shift in market confidence – is observable in the Czech case. The social costs are particularly transparent in this case as they are de facto costs accumulating from sterilisation. Additionally, social costs occur from the economic slowdown in 1997. For the Czech case, these considerations again show that the analysis does not contradict traditional model elements but integrates their logic and at times exceeds it.

[173] See Begg (1998a), p. 676 as well.

IV.3.3 Thailand (Asian Crisis 1997)

Having pursued an impressively sustainable growth and stability in the eighties and nineties, practising a stability-oriented policy was one of the key factors for the success of the Southeast Asian countries like Thailand, Indonesia and Malaysia. For macroeconomic policy, these economies particularly emphasized the target of low inflation rates and relatively robust exchange rates. Nevertheless, these countries experienced a severe setback in 1997, when currency and financial turmoil emerged in Thailand and spread throughout the whole region.

There is a vast amount of research about what triggered the currency troubles in Asia. In fact, this crisis inspired researchers on the theoretical as well as on the empirical side to search for new explanations. On the theoretical side, new issues like moral hazard, over-investment and the phenomenon of contagion came to the forefront. CORSETTI et al. (1998) and KRUGMAN (1998a, b) are among the most popular modellers of such theories, classified as fragments of *Third Generation* currency models. On the empirical side, mainly the research about the vulnerability of Thailand and the Asian region came into focus, as contagion to this extent was a surprising phenomenon.

However, what is not considered in most of those approaches is the monetary perspective. The present approach aims to fill this shortcoming by evaluating if the Asian crisis can be integrated in the proposed framework. In this context, aspects of the microeconomic perspective are mostly left out of the discussion – particularly the whole problem of the structure, deregulation and supervision of the Thai financial system, which is broadly discussed in literature[174].

IV.3.3.1 Monetary influences from outside

The first step again is to evaluate the monetary requirements of the exchange rate regime. Being pegged to the US dollar, the Federal Reserve Bank's monetary policy was of central importance for the Thai economy.

(1) Anchor Country Interest Rate Movements?

Preceding the currency crisis by several years, significant monetary influences affected the pegged economy. As of the end of 1990, the Fed turned to an extremely expansionary monetary course[175]. The

[174] For a good overview see IMF (1998c), chapter III, pp. 89.

[175] The IMF (1997) focuses on a wider perspective and refers to the decline in asset yields in industrial economies as well, which makes emerging market countries like Thailand gain attractiveness for investors.

first chart in figure 34 shows that the Fed funds rate was lowered for more than 500 basis points in 24 months. Already at the very beginning of the discussion, it is clear that such an expansionary stance influenced Thailand due to UIP. In 1994, the Fed started the upward interest cycle again, acting with the same determination: Fed Funds increased 300 basis points in 15 months.

(2) Real De-/Appreciation?

From the real exchange rate side, until 1995, no significant modifications affected the economy. From then on, the REER[176] appreciated steadily (see the second chart in figure 34), mainly because its anchor currency, the US dollar, appreciated against its main trading partner's currency, the Japanese yen. Also from 1993-1996, Thailand's inflation was drifting up slightly more than "the weighted average of trading partners' inflation rates, thus contributing to the erosion of competitiveness" IMF (1997, chapter II, p. 8).

(3) Sharp Changes in the Risk Premium?

Finally, observing the third main component of the MCI^{fix}, the risk premium, turns out to be a problematic issue. Because of underdeveloped securities markets and therefore a lack of convenient data such as (market determined) government bond yields or a JPMorgan spread series, the only data available for this period are money market spreads. As stated before, this measure is critical because it implies that the UIP holds ($\alpha = i - i^*$) and therefore generates a MCI^{act} equalling the MCI^{fix} by definition. Apart from the theoretical shortcoming, until the beginning of the crisis in 1997, the spread of Thai to US money market instruments is rather volatile but does not indicate a trend suggesting upcoming or vanishing risk sentiments in the market. Contrary to this, the relevant literature[177] presumes a declining risk premium over the peg's lifetime, since the combination of the fixed peg and economic success boosted investors' confidence. That is why, following the literature, this discussion assumes a declining risk premium over time[178] to model its effects onto the MCI^{fix}.

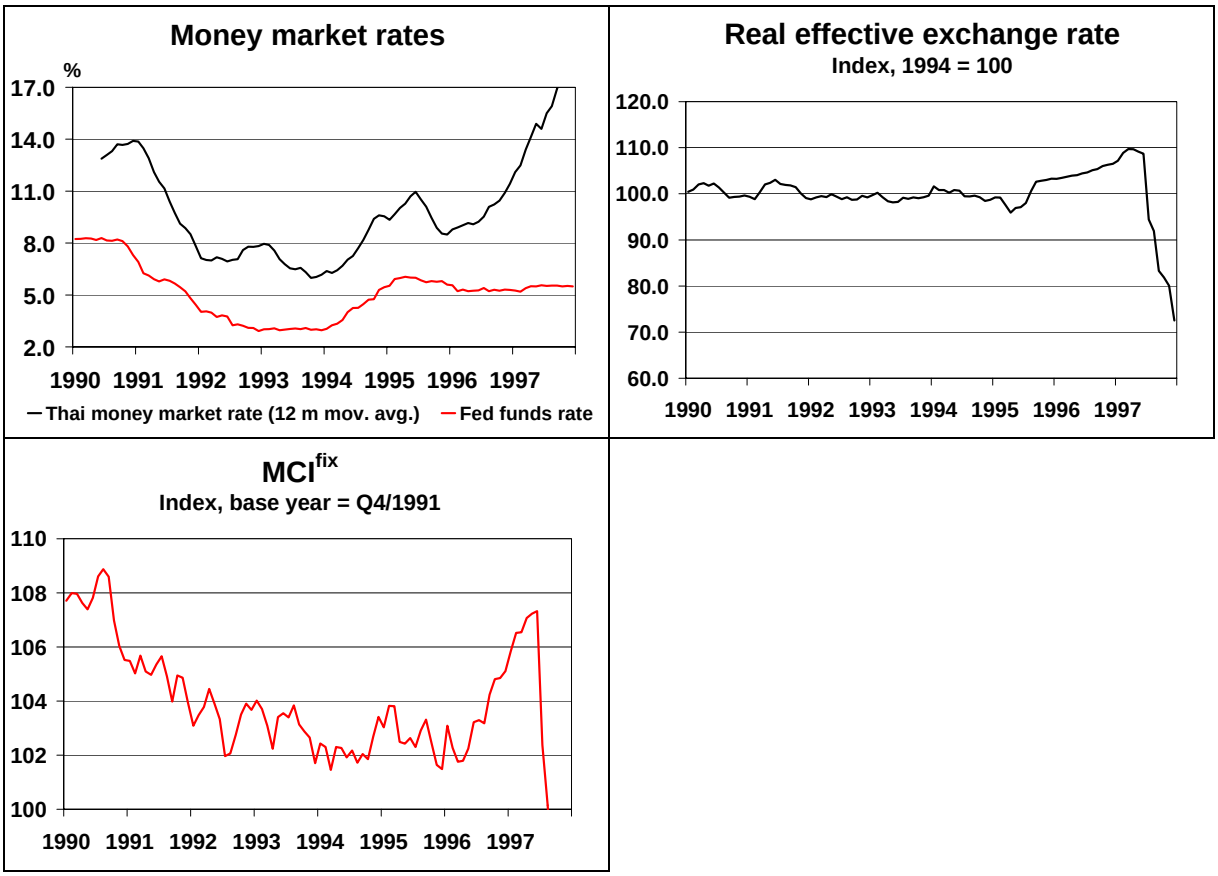
[176] REER data in this case comes from the Thai central bank, since the IFS provide no REER for Thailand.

[177] See IMF (1997), pp. 5 and IMF (1998d), pp. 20 where the IMF refers to the EMBI spread, which is dominated by Latin America, though. See furthermore Corsetti et al. (1998), p. 22 and Aschinger (2001), pp. 224.

[178] By assuming a risk premium linearly declining from 500 basis points in the beginning of 1992 to 250 basis points as of 1996, a reasonable level is chosen – during this time, the long-term as well as short-term spreads to the anchor country ranged in this band-width of 250 to 500 basis points. The risk is supposed to decline until the end of 1996, when signals of market uncertainty increased.

(4) Situation

Figure 34: Thailand – The composition of the MCI^{fix}



Calculating the MCI^{fix} by combining the three key components, the course of the index entails that the monetary conditions given by the peg constantly eased until 1995, when they stabilised. In mid 1996, the index started to tighten again. Assigning this performance to theory, until 1995, the MCI^{fix} follows the logic of the left side of the table:

Table 16: Thailand – Monetary conditions I

	MCI^{fix} < MCI^{opt}					**MCI^{fix} > MCI^{opt}**				
	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Monetary influences:	X	---	X	X	(X)	---	---	---	---	---

- The anchor interest rate declined until 1994.
- The REER remained relatively stable until 1995. Although the yen depreciated against the US dollar until 1995, which would imply a real appreciation for the bath pegged to the US dollar, no such development occurs. A reasonable explanation would be the Thai inflation rates that exceeded those of the main trading partners.
- The risk premium declined continuously.

From 1995/1996 onwards, the change in the MCI^{fix} is portrayed in the table on the right side:

Table 17: Thailand – Monetary conditions II

	$MCI^{fix} < MCI^{opt}$					**$MCI^{fix} > MCI^{opt}$**				
	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Monetary influences:	---	---	---	(X)	---	X	---	---	(X)	X

- (As of 1994:) The anchor interest rate stance became more strict.
- The REER appreciated from 1995.
- The risk premium further declined until the end of 1996, when it finally escalated rapidly.

It is important to keep in mind that this table was simplified in the theoretical section for didactical reasons by assuming the MCI^{opt} to remain constant. Thus, the table deduces an MCI^{fix} exceeding the MCI^{opt} as of 1995. In reality, however, this was not the case because the MCI^{opt} changed significantly as well. This logic will be expanded in the following[179].

IV.3.3.2 Central bank behaviour and consequences

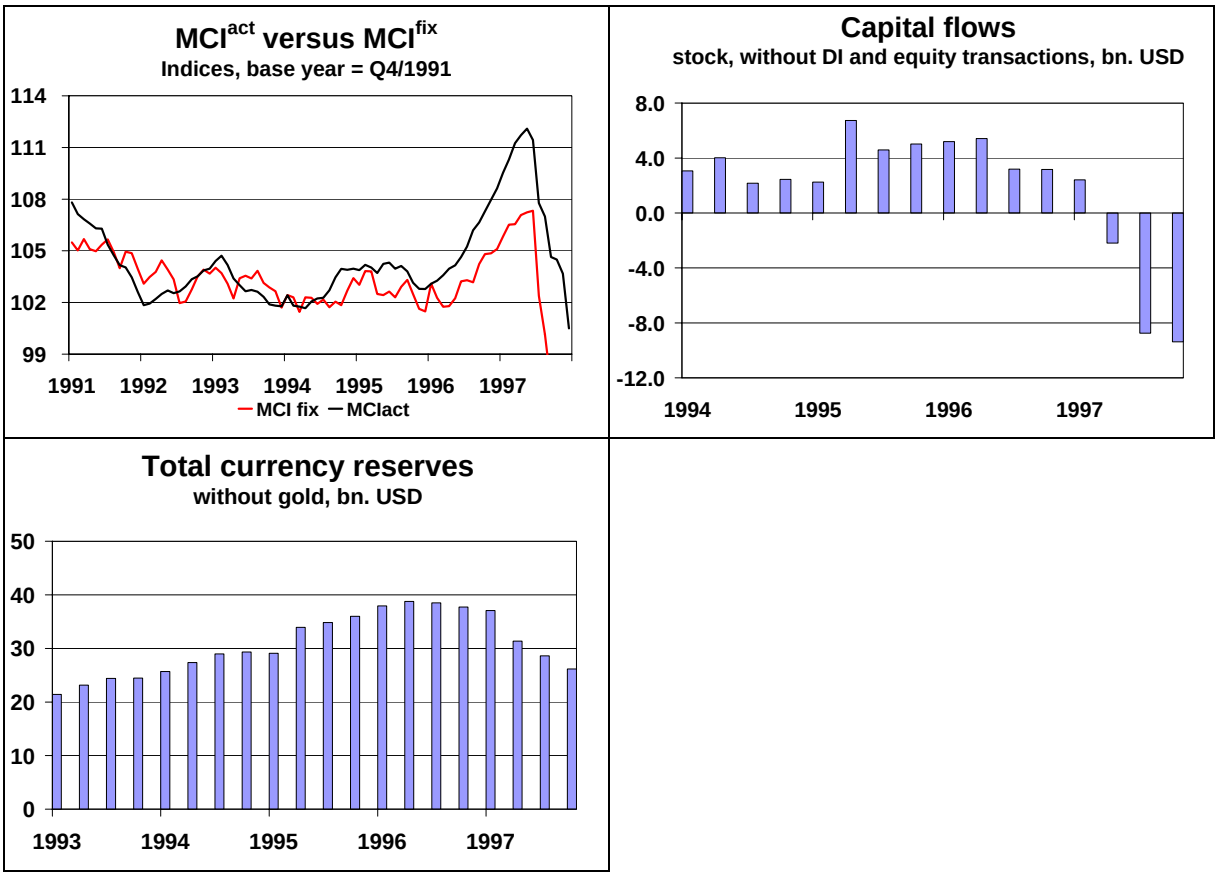
Having an indication of the monetary environment, the central question is that of the behaviour of the domestic central bank. Regarding its interest rate stance (figure 34), the Bank of Thailand followed the Fed funds while maintaining a certain spread. Combining the interest rate policy with REER changes

[179] See especially the table in the summary of this case study.

generates the domestic MCI- path, which more or less moved sideways until the beginning of 1996. From then on, the index shows rapidly tightening monetary conditions.

The central question for the Thai exchange rate regime is whether the policy stance conducted by the Thai central bank met the external and internal requirements.

Figure 35: Thailand – Central bank behaviour and external consequences



(1) External Consequences

Comparing the MCI^{act} with the MCI^{fix} in order to assess the sustainability of monetary policy from the external perspective indicates that until 1996, the central bank's monetary policy did not get in serious conflict with the external balance. The MCI^{act} more or less equalled the MCI^{fix} (see the corresponding figure in the set of figures 35).

From 1996 on, the figure clearly shows that the two indices fell apart. Obviously, the Thai central bank pursued a more restrictive monetary course than is adequate for the fixed peg in that period.

[123] Until 1995: $MCI^{act} \approx MCI^{fix}$

[124] As of 1996: $MCI^{act} > MCI^{fix}$

Looking at the interest rate clearly depicts that the Thai central bank tried to switch to an autonomous, active monetary policy in 1996 while the Fed Funds rate declined. Additionally, a real appreciation had set in in mid 1995 and the risk premium kept on falling[180]. Altogether, this produced a falling apart of the MCI^{act} and the MCI^{fix}.

According to these considerations, theory would not imply substantial short-term capital inflows until 1996. In 1996, the line of argument points towards capital inflows. Regarding the financial account's capital flows – that cover all maturities but are adjusted for direct investment and equities – as a proxy for short-term capital inflows[181] shows capital inflows already before 1996. However, fundamentals do not necessarily contradict the line of argument since although the financial account is adjusted for direct investment and equities, long-term portfolio investment is included in this aggregate[182]. Considering the

- fixed peg supporting investors' confidence,
- implicit government guarantees[183],
- and the attractive fundamental situation – during that period, apart from above-average real growth rates, inflation was under control and fiscal balances were sound (Thailand even showed budget surpluses until the crisis),

it is reasonable to assume that a substantial part of that capital was of longer maturities.

From mid 1995 onwards, an acceleration of the capital inflows can be recognized (see the second figure in set 35). Having amounted to 2-3 billion US dollars per quarter until the second quarter of 1995[184], from then on capital inflows amounted to more than 4.5 billion US dollars and even accelerated until mid 1996, not decreasing until the second quarter of 1997.

The BANK FOR INTERNATIONAL SETTLEMENTS (1998, p. 122) backs the suggestions of the index approach when stating that this acceleration of capital inflows coincided with a change of

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[180] While the risk premium countered the positive interest rate spread in the beginning of the 1990s, the increasing confidence of investors (declining risk premium) over time should have encouraged the Thai central bank to approach the money market rates to the US level correspondingly, which it obviously declined from doing.

[181] No other data is available.

[182] Certainly, financial liberalisation was another important factor for accelerating capital inflows.

[183] The government assured in several statements that financial institutions could count on government guarantees in the case of troubles. See Frenkel (2000), p. 92.

[184] with one exception in the second quarter of 1994.

structure of external financing: “Reliance on international bank and bond finance increased and the relative importance of net equity inflows (direct investment and portfolio) declined. Inter-bank lending was particularly important.” The BANK FOR INTERNATIONAL SETTLEMENTS (1998, p. 122) explicitly states that ”capital inflows were becoming more short-term”.

Table 18: International bank and bond finance for five Asian countries[A]

	1990-94	1995 Q1 – 1996 Q3	1996 Q4 – 1997 Q3
	at annual rates in billion of US dollars		
Net interbank lending	14	43	11
Bank lending to non-banks	2	15	11
Net bond issuance	3	17	32
Total	19	75	54
Memorandum item:	1990-94	1995-96	1997
Net equity inflows[B]	11	17	2

Source: BIS (1998), p. 122.

[A] Indonesia, Korea, Malaysia, the Philippines and Thailand.

[B] IIF estimates of direct investment and portfolio equity flows

DORNBUSCH (1998) shares the opinion that the biggest part of investment flows to Thailand in the period from 1996 consisted of short-term capital.

> *“Within the short period from end of 1995 to June 1997, Asia accumulated an extra $83 billion dollars in debt or a 28 percent increase in indebtedness. Of this debt, more than 62 percent had a maturity of less than 3 months.” DORNBUSCH (1998, p. 15)*

As DORNBUSCH already indicates, apart from foreign investment flowing to Thailand, the interest rate difference encouraged borrowing from abroad. Again, the fixed peg served as an insurance against unexpected losses because of exchange rate changes. Thus, private borrowing from abroad as well as government foreign debt increased considerably[185].

[185] Because of low total government indebtedness and positive fiscal balances, the growing foreign liabilities are not to be considered as a sign of a worsening credit standing, though. The external debt service ratio, for example, did not exceed 5 % of GDP during the nineties.

Table 19: Thailand – Indebtedness in foreign currency

	1990	1991	1992	1993	1994	1995	1996
Foreign liabilities of banks*	6.4	6.0	6.9	11.7	20.3	24.3	23.3

* % of total liabilities of the banking system

Source: IMF (1997), Statistical Appendix, Table A1.

The foreign capital inflows resulted in an increase of total currency reserves (without gold) to stabilise the exchange rate. The intervention direction, buying excess foreign currency from the commercial banks – that is selling domestic currency – did not imply a direct stop condition since the stock increased and peaked at nearly 40 billion US dollars in mid 1996. From that point of view, the peg was still sustainable.

Also, since the excess domestic liquidity was not sterilised, the money base increased and accordingly the liquidity of the commercial banks, which allowed the banks to increase the domestic credit volume[186]. This raises questions about whether the domestic monetary policy was compatible with the internal, economic balance, since apart from the direct foreign exchange market effects, this is the mid-term precondition for a stable peg.

(2) Internal Consequences

Optimally, the pursued MCI^{act} should have coped with the internal requirements of the economy (MCI^{opt}). Calculating the MCI^{opt} and comparing the indices, however, suggests that the domestic monetary stance deviated from the optimal conditions (see the first chart in the set of figures 36). The MCI^{opt} was calculated by applying 3.5% for the inflation target[187]. As there is no official output gap data available, the gap is calculated from trend GDP (by applying the HP-filter to seasonally adjusted real GDP) and actual GDP[188]. To get comparable indices, the index levels of MCI^{act} and MCI^{opt} are normalized in the fourth quarter of 1991, when the output gap is closest to zero. The comparison

[186] See IMF (1997).

[187] This value was published by the Bank of Thailand as a maximum value for core inflation. A target value for CPI inflation was not published.

[188] In order to have a long time series (1970-2002) of real GDP data – which is important for reducing the often criticised end-point problem of the HP-filter – calculation applies a yearly frequency.

shows that while the MCI^{act} remains at a constant level until 1996, an optimal monetary stance would have been much more restrictive from 1993 onwards.

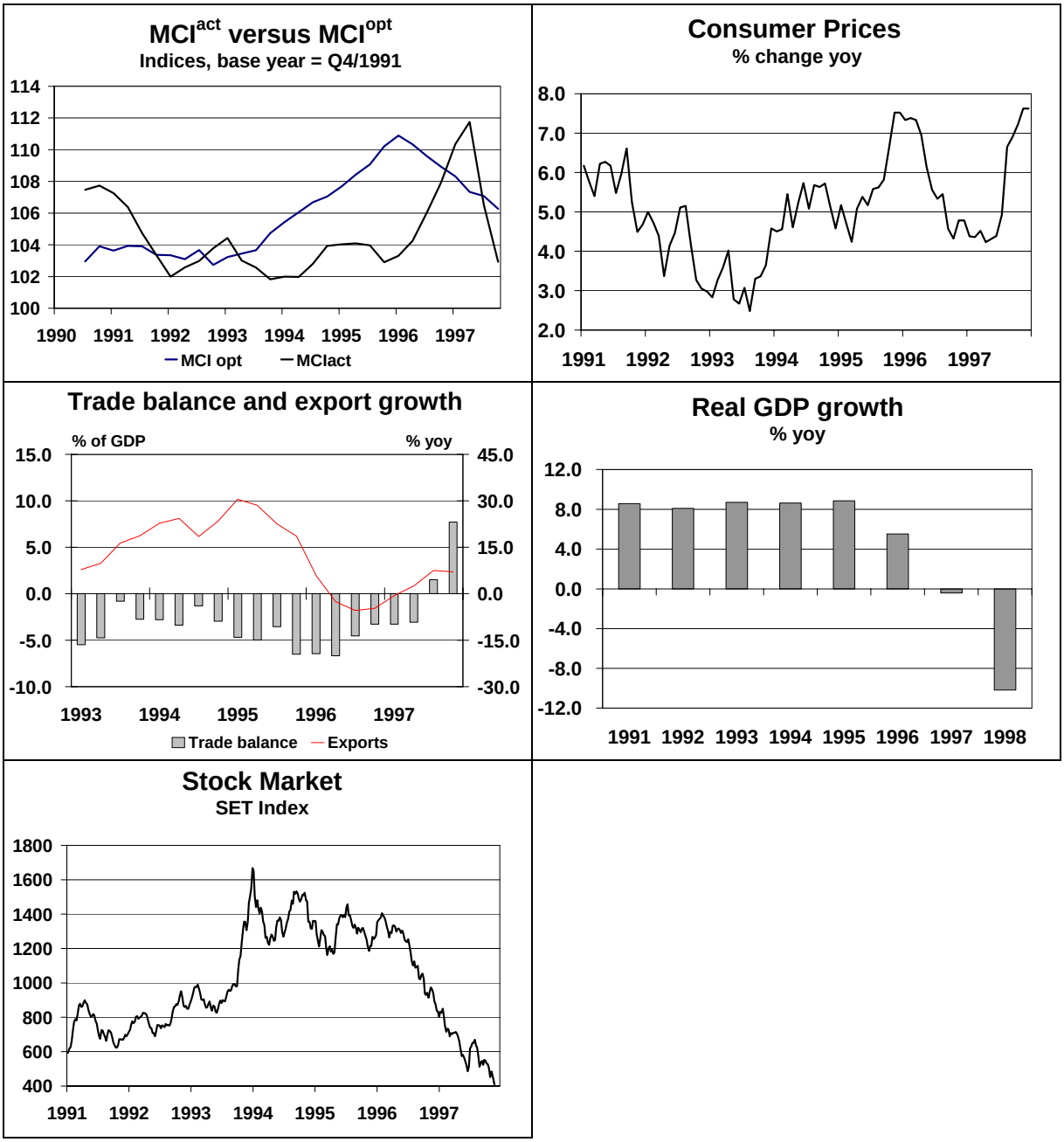
Comparing the internal and external balances and central bank behaviour, the indices imply that the central bank pursued a policy that until 1996 was rather successful in fulfilling the requirements of the exchange rate regime but at the cost of being too expansionary for the business cycle.

[125] Up until 1995: $MCI^{opt} \succ MCI^{act} = MCI^{fix}$

According to the MCI^{act}-MCI^{opt} comparison, the central bank obviously recognised the inappropriate monetary stance for the economic cycle as of 1996, since it switched to a clearly more restrictive policy that approached the MCI^{opt} – accepting disruptions on the foreign exchange market on the other hand.

[126] 1996 and onwards: $MCI^{opt} \succ MCI^{act} \succ MCI^{fix}$

Figure 36: Thailand – Central bank behaviour and internal consequences



Examining the performance of the fundamentals confirms the implications of the index framework of an overly expansionary monetary stance from the domestic view up until 1996:

- In mid 1991, domestic credit growth rose constantly to up to 30 % year on year, reflecting the dynamic domestic demand[189]. Not until mid 1995 did credit growth begin to decline substantially, and then especially in 1996 and 1997, along with a rising MCI^{act} (and MCI^{fix}).

Table 20: Thailand – Credit growth

% yoy	1990	1991	1992	1993	1994	1995	1996
Domestic credit	27.6	19.2	20.4	22.6	28.3	27.4	19.1

- The expanding credit volume is closely linked with the foreign capital inflows, as these increased the commercial banks' liquidity. The foreign capital inflows were used for expanding investment activity. This signals the gap between the domestic savings ratio and the investment ratio during the 1990s:

Table 21: Thailand – Use of capital inflows

% of GDP	1990	1991	1992	1993	1994	1995	1996
Domestic saving	32.6	35.2	34.3	34.9	34.9	34.3	33.1
Fixed capital formation	40.2	41.6	39.2	39.4	39.9	41.8	40.8

Source: IMF (1997), Statistical appendix, table A1.

- Private investment went to a considerable degree into the construction of real estate. The overheating investment activity is mainly to be attributed to the inadequate monetary stance[190]: The overly expansionary monetary policy leads to a lower than economically adequate interest rate. This results in distorted investment decisions, because the internal

[189] Besides the *cyclical growth* of domestic credit volume, that is the reflection of domestic demand dynamics, the *level* of private sector debt in all Southeast Asian economies expanded quickly. The reason for this lies in the underdeveloped securities and bond markets at that time. See IMF (1998c), pp. 92.

[190] This is surely not the only factor. Another important accelerator of investment activity certainly was the insufficiency in regulation and supervision of financial institutions accompanying the financial liberalisation process.

rate of return of an investment project is opposed to inadequately low capital costs (whether these are capital inflows or domestic savings). As a consequence, investment projects were realised in Thailand that would not have been profitable under reasonable monetary conditions. As a consequence, it is obvious that these investment projects got into trouble when monetary conditions returned to an economically reasonable stance[191]. Indeed, after a while, signals of asset price inflation arose, among them price inflation in the real estate sector. This market trend additionally attracted speculative investors, who typically do not invest according to risk and expected return but simply on expectations about the future price development[192].

- Associated with the overheating of the economy, the inflation rate that had been drifting down to monthly inflation rates of 2.5 % until mid 1993 sped up again. In two and a half years inflation accelerated to a high of 7.5 % at the turn of 1995/1996 (see the figure in the set of figures no. 36).
- The upcoming inflationary pressure, as well as the Japanese yen depreciating versus the US dollar, caused the REER to appreciate about 13 % from mid 1995 onwards until mid 1997. This became a burden for foreign trade, since the rising REER weakened the competitiveness of the export sector. The deterioration of the trade balance clearly reflects this burden of a plummeting export performance from the first quarter of 1995 onwards[193](see the figure in the set of figures no. 36).
- As well as the trade balance, the current account balance also shows a significant and persistent deficit, that besides foreign trade development is attributable to the interest rate service for foreign capital.
- Overall, real GDP growth outperformed its long-term growth average until 1995, increasing by more than 9 %. The economic momentum began to slump in 1996, though still growing by 5.9 % before tumbling into recession in 1997 (-1.4 %, see the figure in the set of figures no. 36).

[191] Bearing in mind that that these overvalued investment projects also served as securities in the commercial banks' balances establishes the connection to the microeconomic sphere of banking sector instabilities.

[192] See Resinek (2001), p. 51.

[193] Apart from changes in trade competitiveness, the decline in prices in the market for semi-conductors seriously affected trade performance. Furthermore, increasing competition from China put the Thai export market under pressure, see Corsetti et al. (1998).

To sum up, the internally overly expansionary monetary stance that was adopted to keep the peg stable led to serious economic disruptions. It was foreseeable, as argued in chapter III.3.2.1 that the bubble would burst in the end, leading to rapid capital outflows, which would in turn reflect the stop-condition for the peg in the medium-term. Furthermore, since the central bank obviously switched its monetary stance to slow down the booming economy as of mid 1995, this policy set incentives for short-term capital inflows and supported a potential speculative attack as chapter III.3.2.2 argues. To balance the domestic economy, this attempt, however, was too late.

This crisis makes it especially hard to recognise the potential for a crash in advance. The challenge was to realize that the situation was overheated. But developments like a solid growth momentum stemming from dynamic aggregate demand and lively investment activity along with an appreciating real exchange rate and a solid fiscal policy with budget surpluses are not intuitively related with fundamental economic disturbances. Thus, in the Asian case, it was extremely difficult to be aware of the situation ex ante[194].

IV.3.3.3 Outbreak of the currency crisis

The stated problems, coming from internal disruptions, manifested themselves in 1997. Since the economic deficits were apparent by then – the large current account deficits, the burst of the asset price bubble and finally the whole economic slowdown along with a high short-term foreign debt ratio could not be ignored any longer – speculation about a depreciation of the peg escalated. Although government officials kept on denying intentions of abandoning the peg, speculation against it rapidly accelerated the risk premium, along with

- a crashing stock market. The SET index, being at its high in the beginning of 1994 at 1,670 index points and moving within a band from 1,200 to 1,550 index points from then on, reversed to a downward trend in February 1996. As of July, the losses increased and the index went down to 490 index points until the end of the peg lifetime.
- a constantly rising money market rate. As of January 1997, the short term interest rate increased to more than 12 %[195] even rising to more than 15% in July.
- fast and voluminous outflows of capital. This happened very late, though, highlighting the short-term maturities of investment. In the first quarter of 1997, there was still portfolio capital flowing into the country and only in the second quarter did outflows start.

[194] See also Frenkel (2000), p. 88, and Dornbusch (1998), p. 4.

[195] Referring to the 12 months-moving average to smoothen the high volatility.

- diminishing currency reserves. While more or less stagnating in 1996, the reserve stock began to decline seriously in 1997. Within one year, from July 1996 to July 1997, foreign currency reserves decreased by 10 billion US dollars because of massive intervention activity of the central bank to defend the peg.

In monetary terms, the risk premium escalated the MCI^{fix} and forced the central bank to defend the peg, thus moving the MCI quickly upwards, burdening the economy even more. Consequently, signals of economic downturn became more and more apparent. On May 23, Thailand's largest finance company, *Finance One,* failed because of heavy losses in the real estate sector. Confidence was eroded even more when the finance minister resigned on June 19. Eight days later, 16 financial institutions with liquidity problems were closed to regain stability in the financial sector. As of July 2, 1997, the peg finally had to be abandoned[196].

This caused the currency to depreciate by nearly 40% until the end of the year. The exchange rate regime was transformed into a managed floating from then on. Depreciation of the bath seriously affected the foreign debt service, as foreign liabilities, denominated in foreign currency, gained value. This led to solvency problems for the commercial banks and enterprises. To get the economic and financial crisis under control, the Thai government reached an agreement with the IMF in August 1997, consisting of financial aid of 17.2 billion US dollars[197].

IV.3.3.4 Contagion spreading to Asia

As is well known, the ASEAN 4 countries *Indonesia, Malaysia, the Philippines* and *Singapore* immediately followed Thailand into the currency crisis. Moreover, in the course of the crisis, spill-over effects spread even further in the Asian region, especially to South Korea and Hong Kong. To discuss these effects, new approaches were developed and were labelled as the *Third Generation* of currency crises models.

However, the spill-over effects can be depicted in the theoretical framework as well. Most of Thailand's neighbour countries were not pursuing entirely fixed exchange rate systems but more flexible policies like crawling pegs or managed floats. According to BUBULA/ÖTKER-ROBE (2002), Indonesia pursued a crawling peg, and Singapore, Malaysia and the Philippines a managed floating. In 1995, Indonesia loosened the exchange rate regime somewhat extending the peg to a

[196] For a comprehensive chronology of the Asian Crisis see Roubini (2004).

[197] For further details about the IMF agreement and its economic reform program, see Aschinger (2001), pp. 245.

crawling band, while Malaysia changed to a tight managed float and the Philippines turned to a fixed peg in the same year.

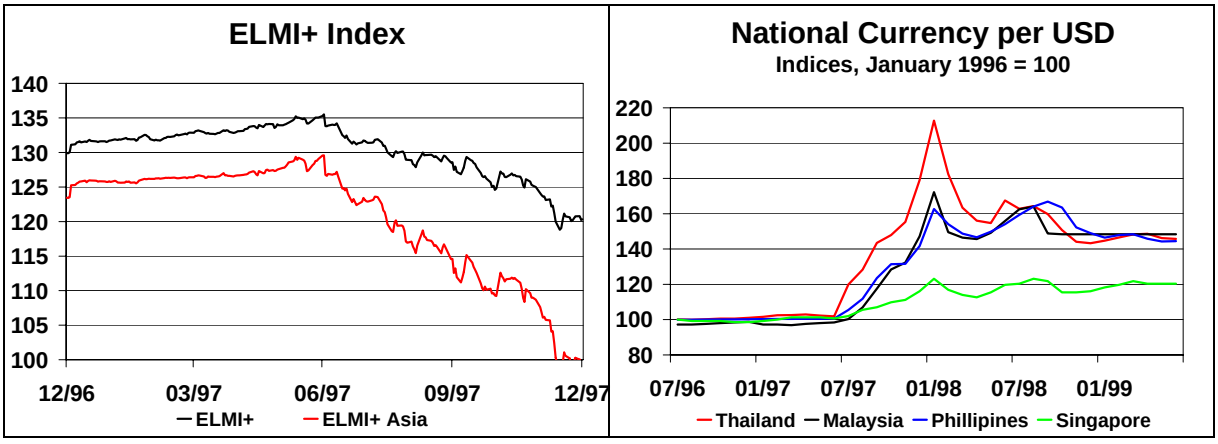
The logic of covering contagion effects within the framework theory is simple. They are modelled by a rapidly rising risk premium along with an external shock. Consequently, the respective MCI^{fix} rises quickly and requires the central bank to intervene to keep the foreign exchange market balanced. As the intervention policy is not able to stand the immense pressure for long – either because of currency reserves depletion or an unbearable money market rate – this contagion falls under the classical category of a short-term stop condition discussed in chapter III.3.1.2. A rapid speculative attack onto the domestic currency is the inevitable consequence.

Table 22: Asia – Contagion in theory

Indonesia, Korea, Malaysia, Philippines	**$MCI^{fix} < MCI^{opt}$**					**$MCI^{fix} > MCI^{opt}$**				
	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Monetary influences:	---	---	---	---	---	---	---	---	XX	---

The main difference from Thailand's crisis is that for the infected countries, the *exogenously* rising risk premium itself was the initiator of the currency crises and not long-run disturbances ultimately expressed in a rising risk premium (see the figure of the ELMI+ Index[198] in figure 37).

Figure 37: Asia – Spillover in the region



[198] Unfortunately, no spread data is available for that period. We therefore consider the global ELMI+ index and the sub-index ELMI+ for Asia.

The first wave of contagion appeared very rapidly. The currency crisis of Thailand spread most quickly to the *Philippines*, where the Philippine peso was floated on July 11, after unsuccessfully defending it via raising the interest rate and intervening. In *Malaysia,* the ringgit devalued considerably as of July 14, when the central bank gave up backing the currency by intervention. *Singapore* followed into the crisis on July 17, 1997 when it started floating the Singapore dollar. Finally, merely a month later, *Indonesia* gave up its peg on August 14 and floated the rupiah after having tried to defend the peg and having widened the intervention band from July 11 onwards[199].

A second wave of diminishing confidence that lead to currency troubles was observed for the *Taiwan dollar*, the *Hong Kong dollar* and the *Korean won*. Interest rates rose to defend the exchange rate pegs, yield spreads widened and stock markets plummeted. In Taiwan, the central bank de facto gave in to speculative pressure and widened the fluctuation band of the Won from 2.25 % to 10 %. Finally, the Taiwan dollar was floated on December 15, 1997. Korea widened the bandwidth of its tight managed float from 4.5 % to 20 % on October 20. Only Hong Kong managed to defend its currency board with massive intervention. The commitment of maintaining the peg by defending it obviously was credible because of Hong Kong's massive foreign currency reserves stock (93 billion US dollars in 1997), supported by China agreeing to defend the Hong Kong dollar with its intervention potential as well. At last, the *Indonesian rupiah* depreciated against the US dollar by about 70 % from June 1997 until its low in April 1998.

All in all, until the end of 1997 Thailand, Malaysia, the Philippines and Korea had lost between 30 and 40 % of their currency's initial value, Indonesia about 50 % and Singapore about 15 %. This widespread and severe currency turmoil had severe consequences for economic growth and price stability of the region. After having had a robust economic performance in Thailand, Malaysia, Singapore and Korea with real GDP growth rates of more than 8 % and of more than 6 % in Indonesia and Hong Kong, all countries faced a seriously deteriorating real growth combined with inflationary pressure. Depreciation had led to hiking import prices - except in Hong Kong, which managed to keep its price trend stable. To stabilise the region, the IMF supported countries like Indonesia and Korea with financial and economic aid agreements[200].

[199] For a more comprehensive discussion of the waves of contagion see BIS (1998), chapter III.

[200] For details about the programs see Aschinger (2001), pp. 247, who also gives an assessment.

Table 23: Asia – Economic consequences of the currency crash

	THAILAND	INDONESIA	MALAYSIA	PHILIPPINES	KOREA	HONG KONG	SINGAPORE
	Real GDP growth (% yoy)						
1997 Q1	1.0	N/A	8.6	5.5	4.9	5.4	6.8
1997 Q2	-0.6	N/A	8.4	5.6	6.2	6.4	10.4
1997 Q3	-1.6	N/A	7.7	4.9	5.5	5.8	-24.9
1997 Q4	-4.2	N/A	5.6	4.7	3.6	2.5	7.7
1998 Q1	-7.1	-3.3	-3.1	1.1	-4.6	-2.9	3.8
1998 Q2	-13.9	-14.5	-5.2	-0.9	-8.0	-5.3	0.4
1998 Q3	-13.9	-16.2	-10.9	-0.8	-8.1	-7.1	45.2
1998 Q4	-7.2	-17.6	-10.3	-2.2	-6.0	-5.7	-1.2
	Inflation rate (% yoy)						
1997 Q1	4.4	4.7	3.2	5.3	4.7	6.1	1.7
1997 Q2	4.3	5.0	2.5	5.3	4.0	5.6	1.7
1997 Q3	6.2	7.5	2.3	5.9	4.0	6.0	2.3
1997 Q4	7.5	9.7	2.7	7.2	5.1	5.4	2.3
1998 Q1	9.0	27.2	4.3	7.9	8.9	5.0	1.2
1998 Q2	10.3	49.5	5.7	9.9	8.2	4.4	0.1
1998 Q3	8.2	74.5	5.7	10.4	7.0	2.9	-0.9
1998 Q4	5.0	77.5	5.4	10.6	6.0	-0.8	-1.5

Source: Data is taken from the IFS - data for Taiwan is not provided.

IV.3.3.5 Summary regarding equivalences to traditional theory

All in all, the crucial roots of the crash in Thailand are not revealed immediately before the outbreak of the crisis, but rather several years in advance. For Thailand, the risk premium itself is not to be blamed as the trigger of the crisis. The rising risk in fact was a consequence of the medium-term imbalances that to an important part stemmed from monetary influences from the anchor country and important further trading partners. In view of this result, we join the group of researchers that blames medium-term macroeconomic, especially monetary, disruptions for the currency turmoil of

Thailand[201]. The other main wing of interpreters of the Asian crisis believes in panic-driven losses of confidence, leading to an accelerating risk and triggering a speculative attack[202].

Table 24: Summary of the Asian Crisis

The Asian Crisis										
Monetary influences:	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$ A)	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$ A)	$\Delta s_2^*; \Delta s_3^*$ A) $\uparrow$
Case:	**$MCI^{fix} < MCI^{opt}$**					**$MCI^{fix} > MCI^{opt}$**				
Central bank behaviour:	**$MCI^{act} = MCI^{fix} < MCI^{opt}$**			**$MCI^{act} = MCI^{opt} > MCI^{fix}$** A)		**$MCI^{act} = MCI^{fix} > MCI^{opt}$**			**$MCI^{act} = MCI^{opt} < MCI^{fix}$**	
Stylised discussion in chapter:	III.3.2.1			III.3.2.2		III.3.1.1			III.3.1.2	
Parallels in traditional theory:	•Second Generation models •Third Generation supplements			•First Generation models •Second Generation models		•Second Generation models			•First Generation models •Third Generation approaches	

Thailand until 1995	*Thailand from 1996*	*Contagion*

A): Here, contrary to the first chapter of this case study, which derives a $MCI^{fix} > MCI^{opt}$ as of 1996 from the performance of the MCI^{fix}, now modifications of the MCI^{opt} are taken into account. It turns out, that the increase of the MCI^{opt} exceeds that of the MCI^{fix} so that in spite of a rising MCI^{fix} the constellation $MCI^{fix}<MCI^{opt}$ arises.

Thus, discussing the *Thai currency crisis* applies the argument of Second Generation models – the economic disruption erodes the balance of benefits and social costs that is important for the sustainability of the peg. However, the fundamental situation did not provide reasons for speculating about monetary strategy changes until very shortly before the outbreak of the crisis itself, as the

[201] See among others Corsetti et al. (1998), who support this fundamental view.

[202] See Radelet/Sachs (1998).

monetary development was not recognised as an imbalance. But finally in 1997, when the worsening economic situation was reflected in the fundamentals – expanding current account deficit, rising real interest rate, declining domestic credit growth, fading real GDP growth, capital flight and diminishing foreign currency reserves – it is Second Generation elements that can be applied to explain the emergence of a speculative attack.

Since this monetary approach is not designed to explain microeconomic developments, the Third Generation approaches provide some good additional explanations. Above all, the microeconomic *moral hazard* approaches gained attention in order to explain the financial disruptions leading to the bubble economy bursting in the end. They focus on the Thai financial intermediaries operating in the environment of implicit state guaranties on liabilities and thus tempting investors to invest without adequately taking the risk into consideration. One of the main representatives of this approach, KRUGMAN (1998b), relates his theory particularly to the Asian crisis. From the moral hazard approach, KRUGMAN also deduces the upcoming *over-investment* in Thailand. That is, he complements this approach's line of argument about over-investment coming from distorted investment decisions (because of economically inadequate capital costs) by showing that over-investment stemmed from moral hazard. FRENKEL (2000) also models the Asian crisis based on moral hazard. According to his theory, market risk sentiment shifted as soon as the government-backed credit volume exceeded the contingent of currency reserves.

In another approach, KRUGMAN (1999) emphasized the role of *the structure of corporate balance sheets* in the Asian case. Since the corporate balances included a high level of foreign liabilities, they were vulnerable to depreciation of the currency.

In order to explain the occurrence of rapid *contagion*, Third Generation approaches again provide valuable extensions to the present simple model via a rising risk premium. There are Third Generation theories that directly deal with fundamental and psychological reasons for direct economic contagion or spill-overs via rising risk premia.

- According to the BANK FOR INTERNATIONAL SETTLEMENTS (1998, p. 132), investors grouped the Asian countries together, which was partly due to macroeconomic similarities. Thailand's neighbour countries were recognised as being homogenous to the Thai case because of lack of information and apparent structural similarities like the peg to the US dollar (in a more or less fixed way).
- Contrary to that, the often stressed direct trade linkages could not have played an important role. Because of minor bilateral trade shares, a loss of competitiveness against depreciating Thailand did not become much of a burden. A more serious issue was the loss of competitiveness against the yen on third markets.

- But, obviously, the financial linkage played an important role in increasing the vulnerability to speculative attacks. BOORMAN et al. (2000, p. 40) state "clearly a sharp fall in external finance available" for the East Asian economies. KAMINSKY/REINHART (2000) affirm that all Asian countries except Hong Kong were commonly exposed to Japanese commercial banks and that asset returns were highly correlated to Thailand[203].

[203] See Fratzscher (2002) as well.

IV.3.4 European Monetary System (Crisis 1992/93)

Starting in 1979, the European Monetary System (EMS) went through some major modifications finally resulting in the well-known crisis of its Exchange Rate Mechanism (ERM) in 1992/1993. In principle, however, it was operated until the beginning of the European Monetary Union and still exists in the form of its successor, the ERM II.

Its institutional set-up is well known[204]:

- All EC countries[205] were members of the EMS, and all except the UK and Greece took part in the ERM[206], seeking the stability-oriented and credible monetary policy of the Bundesbank. In the beginning, the eight members of the ERM were structurally rather different (e.g. in GDP per capita and inflation).
- Formally, the currencies were pegged via a parity grid of all bilateral exchange rates with a bandwidth of +/- 2.25 % (+/- 6 % for the lira). When the upper or lower limit of the band was reached, the respective member country was obliged to intervene in order to defend the peg. This was called "marginal intervention", as also "intra-marginal intervention" was possible. For marginal intervention at the limits of the currency band, central banks had access to the "Very Short Term Financing Facility" (VSTFF), which provided unlimited liquidity but imposed deadlines for repayment.
- Weighing all currencies together, a currency basket in the form of the ECU was set up. It was used as a unit of account.
- While the official anchor certainly was the parity grid with respect to the ECU, de facto the official exchange rate peg was modified by the member countries[207]. Italy's currency policy, for example, de facto represented a crawling band around the German mark with a bandwidth of +/- 2 % as of 1983. France tightened its currency peg over time. Beginning with a de facto crawling peg to the mark in 1979 and maintaining it until 1986, it changed to

[204] Therefore, discussion only reviews the essential basics necessary for the following case study. For details about the institutional set-up of the EMS see the resolution of the European Council of December 5, 1978 on the establishment of the European Monetary System and related matters. See also De Grauwe (2000), chapter V, Gros/Thygesen (1992) and Bofinger (1991).

[205] The Luxembourg franc was set equal to the Belgian franc.

[206] i.e. the UK and Greece were only formal members but their currencies were included in the calculation of the currency basket ECU.

[207] See Reinhard/Rogoff (2002).

pursuing a fixed peg to the mark in January 1987. Altogether, de facto, the mark was the monetary anchor of the system.

- Under certain conditions[208], a realignment of the exchange rate parity was possible. This option was applied frequently until 1987[209]. From then on, no realignments occurred except from the rather technical lira adjustment in 1990, where the lira was based in the lower half of its wide fluctuation band. Thus, as of 1987, the regime was a truly fixed exchange rate system from then on. Considering this changed nature of the peg, GIAVAZZI/SPAVENTA (1990) established the term "New EMS".

In order to keep the following discussion clear, the analysis focuses on the two big EMS-members paid most attention to in literature – that is Italy and France. When illustrating the developments, the focus is on the time period from 1987 onwards, the phase when adaptation to the German stability requirements was in an advanced state and the fixed peg was taken more seriously[210]. The progress in stability is visible in narrow government bond spreads and a increasing price stability (from then on less than 4% in France, and in Italy finally in the single digits). The change in character of the peg is obvious when observing the realignments.

In the following discussion of triggers of ERM currency troubles, the analysis again proceeds in the defined way by first examining the monetary interdependencies with the anchor and third countries before assessing the central bank' s performance within these conditions.

IV.3.4.1 Monetary influences from outside

(1) Anchor Country Interest Rate Movements?

On the topic of monetary influences on the ERM member countries (stemming from the exchange rate peg), the German interest rate policy played the dominant role, as the mark was the de facto anchor currency. During the ERM, the Bundesbank policy can be split into two phases:

(1) From the beginning of the system until 1988

(2) From 1989 until "the end" of the system

[208] which were regulated in paragraph 3.2 of the resolution of the European Council of December 5, 1978 on the establishment of the EMS.

[209] See Gros/Thygesen (1992), p. 68, table 3.1.1.

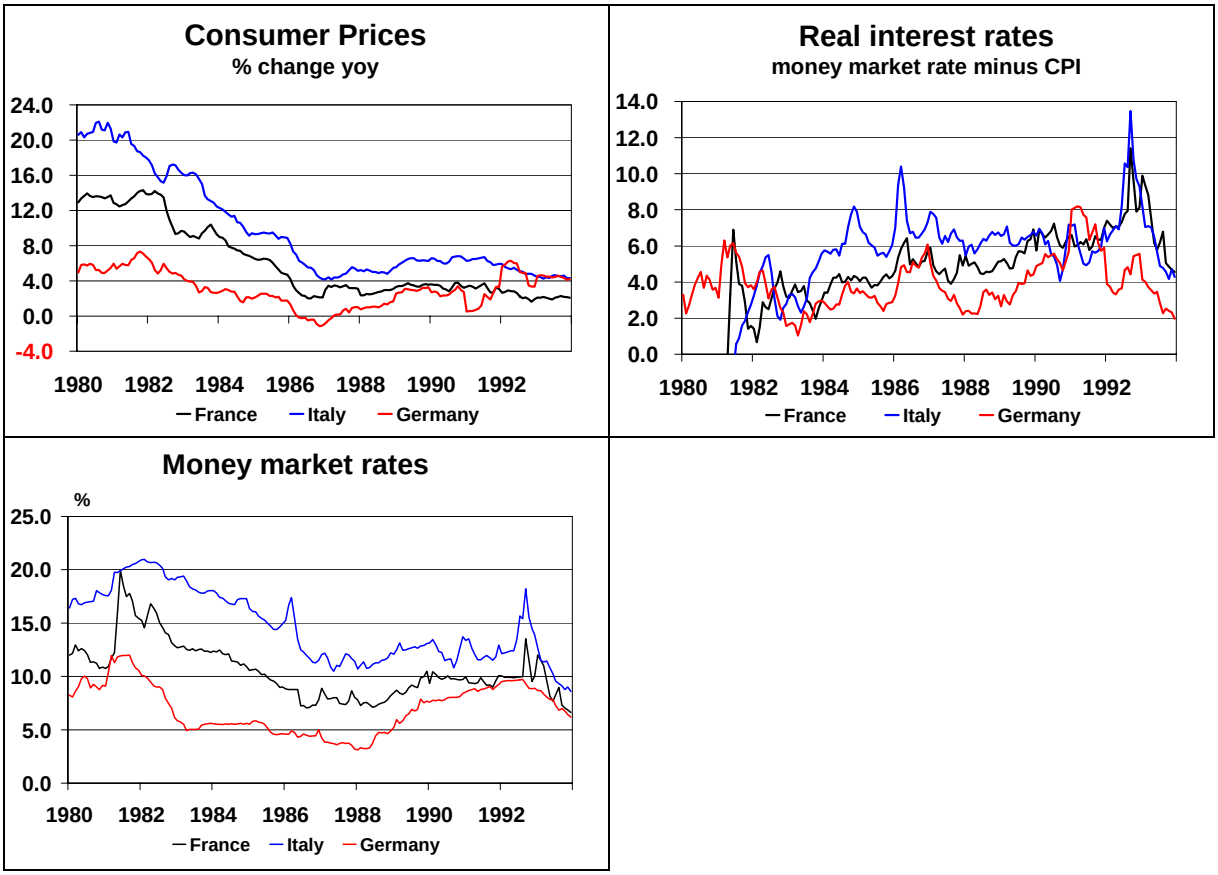
[210] For a chronological discussion from 1979 onwards see Gros/Thygesen (1992).

During the first phase, the anchor interest rates continuously decreased from a level of more than 10 % in 1981 to 3.2 % in 1988. Nevertheless, this phase did not entail major monetary disruptions for the pegged countries because the German monetary policy met a disinflation process not only going on in Germany but in all pegged countries (see the first figure in the set of figures 38). Hence, the Bundesbank's policy was consistent with the other economies' internal situation. A glance at real interest rates – that increased until mid 1986 and then stabilized in France and Italy (see the second figure in set 38) – confirms that the Bundesbank's policy in the first phase did not at all set off an overheating in other member countries. And if the Bundesbank's policy would not have been compatible with a member country's situation, a realignment of the parity was a way to correct monetary imbalances. Since realignments were rather frequently applied until 1987, this phase can rather be considered a managed float phase than a classical fixed peg.

This situation changed in the second phase, starting in 1989. Exchange rates remained fixed from then on, and because of German unification, the Bundesbank switched to an increasingly restrictive monetary course to cope with the demand shock that had generated an inflationary process[211]. It is already obvious in this early stage of the analysis that the exchange rate system required the other member countries to follow the restrictive monetary policy stance that did not fit with their economic cycle, since they were not suffering from such a demand shock (see the third figure in set 38).

[211] Yearly German consumer price changes exceeded the mark of 3 % in single months in 1989 and 1990.

Figure 38: ERM – The impact of anchor interest rate movements



(2) Real De-/Appreciation?

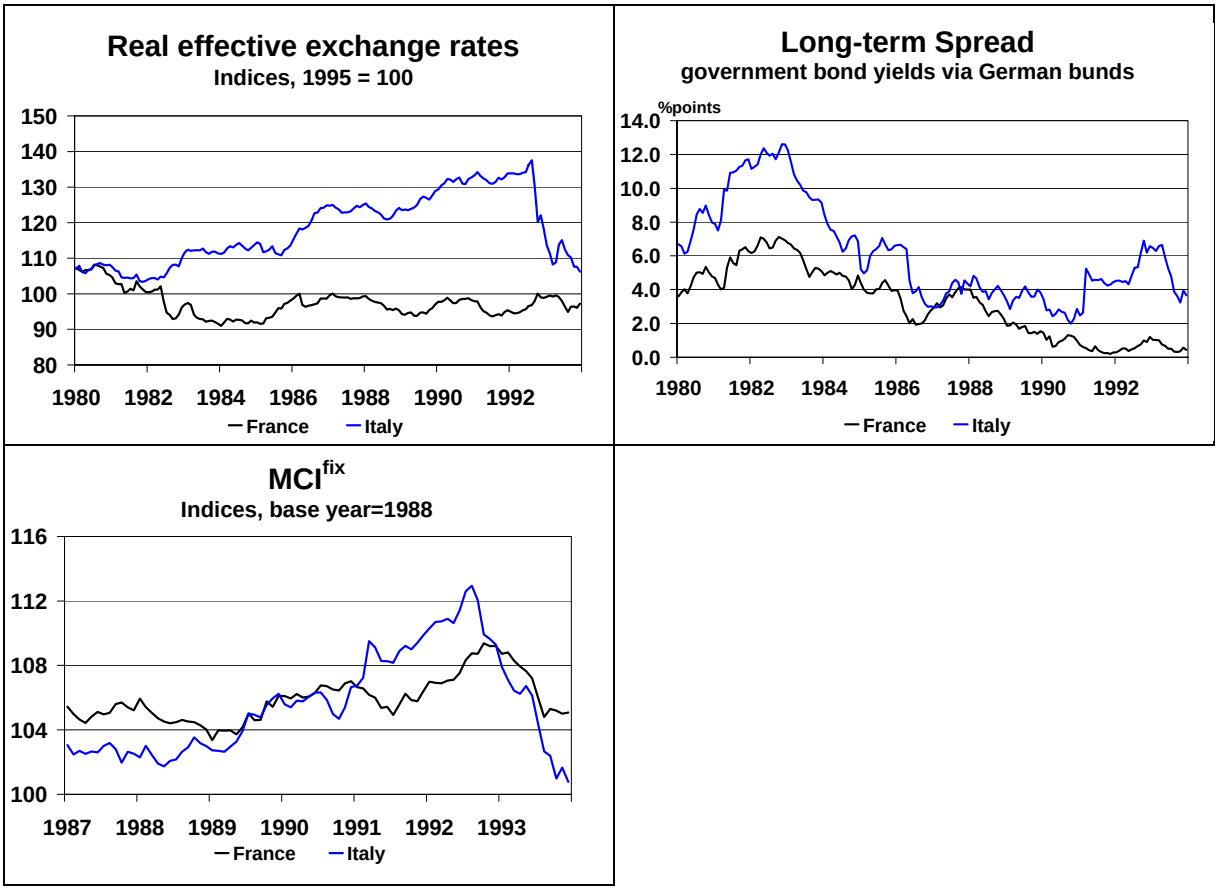
Real exchange rate imbalances were particularly a problem for Italy. Italy was faced with a continuous real appreciation (see figure 39) that mainly stemmed from the inflation gap to Germany. Although Italy managed to reduce its inflation rate since the early 80s, the inflation gap never closed. What is more, the German mark appreciated against the US dollar as of 1985. Since there were no lira realignments after 1987 that would compensate for the real exchange rate changes, from then on, the real appreciation negatively affected the Italian competitiveness. At the same time, France's inflationary trend on the whole was similar to that of Germany, so that competitiveness was not seriously affected.

(3) Sharp Changes in the Risk Premium?

Finally, for the third major component of the MCI^{fix}, the risk premium required for investment in ERM-countries, the best proxy available are long-term government bond yield spreads to the German Bunds. From the second half of the eighties until 1991, the risk premium for France and Italy declined remarkably, in Italy falling from more than 1000 to 200 basis points (see figure 39, second chart).

(4) Situation

Figure 39: ERM – The composition of the MCI^{fix}[212]



Summarizing the components of the MCI^{fix}, the indices imply that the externally required monetary conditions tightened substantially as of 1989 in both Italy and France. This principally reflects the German interest rate stance. As Italy was moreover faced with the real appreciation, the monetary restriction required by the peg was stronger than in France.

In the theoretical framework, the situation as of 1988/89 can be understood as follows:

[212] More concrete, the base periods for the real exchange rate to calculate the MCI^{fix} are: for France, the fourth quarter of 1988 and for Italy, the first quarter of 1988, since these are considered to represent internal balances. These base years are identical to the base for normalizing the MCI^{act} and MCI^{opt} later in this case study (chapter IV.3.4.2).

Table 25: EMS – Monetary conditions

France, Italy	**$MCI^{fix} < MCI^{opt}$**					**$MCI^{fix} > MCI^{opt}$**				
	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Monetary influences:	---	---	---	---	---	X	X	---	(X)	X

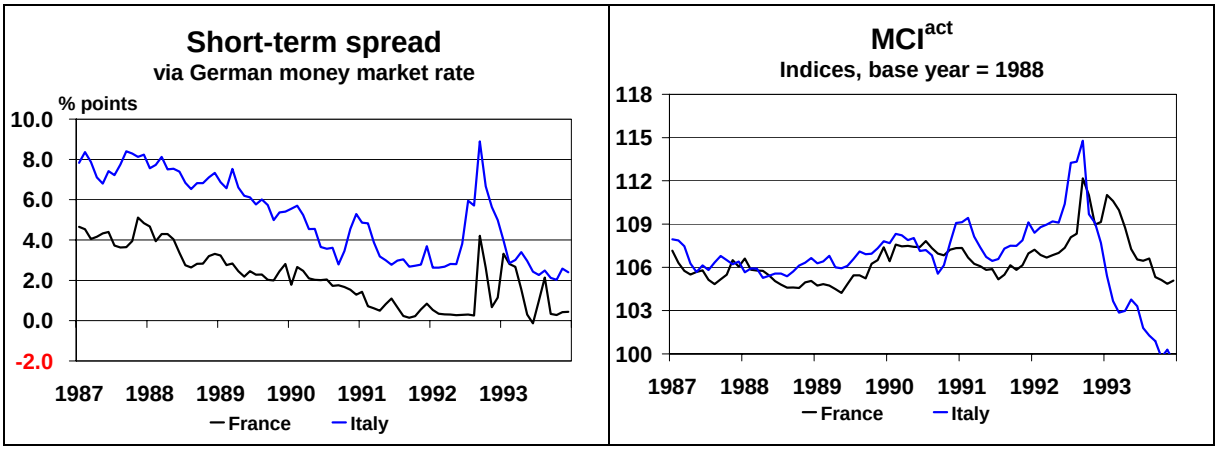
- Since 1988, the real anchor interest rate rose substantially,
- as of 1987, inflation accelerated in the anchor country,
- only in Italy did the risk premium rise notably and considerably in advance of the crisis (as of 1991)
- and the German mark appreciated against the US dollar as of 1985.

Having an indication of the external balance's requirements, the question is which monetary policy stance the domestic central banks chose and the consequences this triggered for the internal and external balance.

IV.3.4.2 Central bank behaviour and consequences

The interest rate stances of France and Italy as of 1987 illustrate that both countries clearly aimed to follow the Bundesbank's policy while maintaining a certain spread. This interest rate difference, however, was actively reduced (see the first chart of figure 40). In France, it went down from about 400 basis points in 1987 to practically zero in mid-1991. In Italy, the spread diminished from more than 800 basis points in 1987 to about 270 basis points in mid-1991. Adding the second component of the MCI, real exchange rate movements, generates the following monetary conditions paths:

Figure 40: ERM – Central bank behaviour[213]



The indices suggest that the monetary conditions driven by the national central banks remained rather stable: In France, the MCI^{act} hovered around the mark of 106 index points until becoming more restrictive in 1992. In Italy, the MCI^{act} remained in a corridor of 105 to 110 until escalating in 1992.

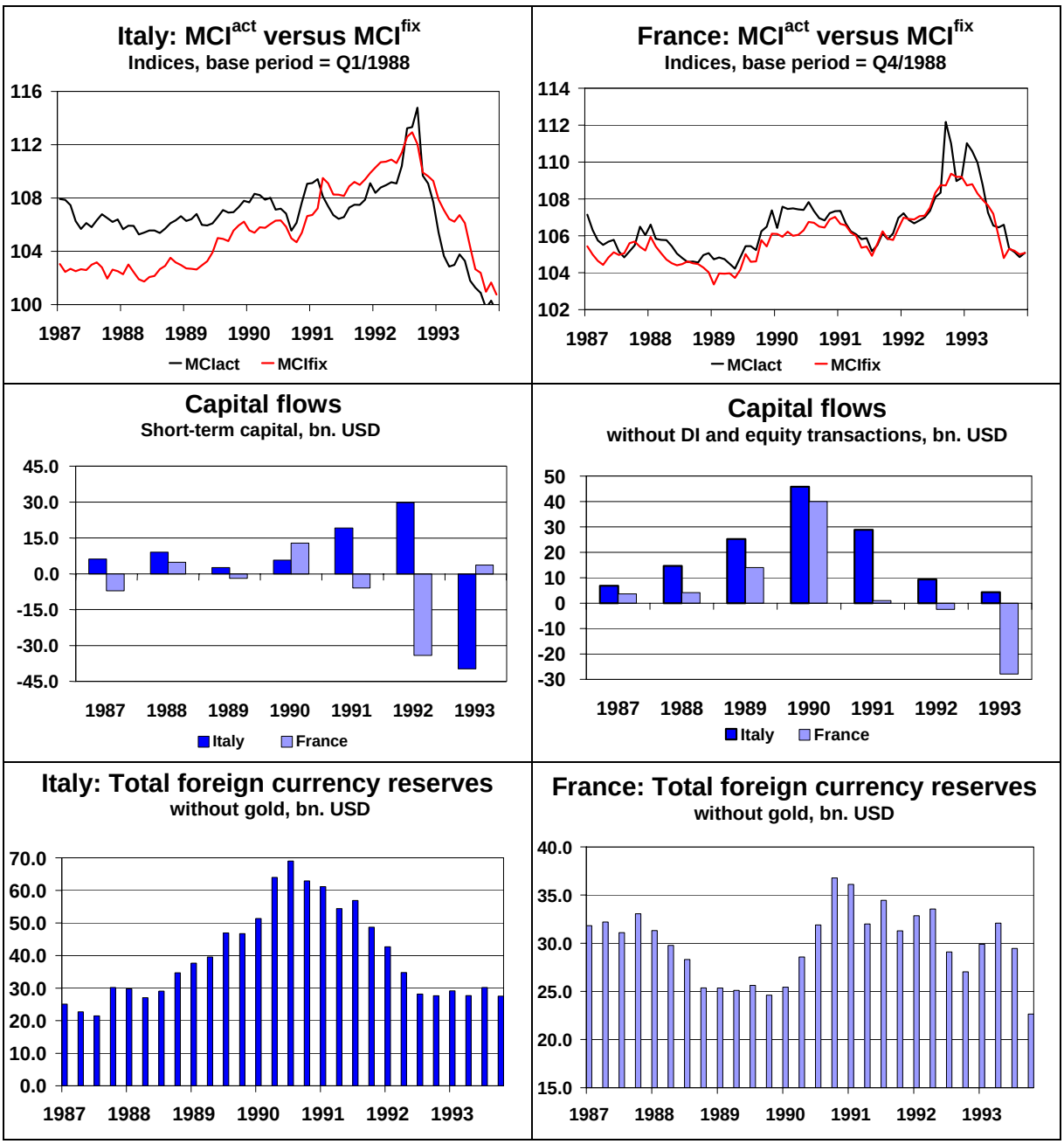
To evaluate whether these monetary policy stances met the requirements of the peg, in a second step we compare the MCI^{act} to the MCI^{fix} and look for evidence in the fundamentals.

(1) External Consequences

In the Italian case, the index comparison points to a monetary path that continuously was somewhat more restrictive than required by the external balance. The first chart in figure 41 shows that from 1983 to 1990, the MCI^{act} exceeded the MCI^{fix} by some index points. It will become clear in the following that Italy chose this stance for internal reasons. According to the index evaluation, the French central bank, however, strictly behaved the way traditional nominal anchor theory implies; that is, following the external preconditions. The MCI^{act} was in line with the MCI^{fix} all the time.

[213] See the previous footnote: The concrete bases are the fourth quarter of 1988 for France and the first quarter of 1988 for Italy.

Figure 41: ERM – External consequences



* For Italy, equity transactions could only be filtered from 1989 onwards. For the years before, no data for equity securities liabilities were available.

Because of the more restrictive monetary policy stance in Italy, external imbalances should have been the logical consequence. The data confirms this line of argument. As depicted in chart 3 of figure 41, Italy was indeed faced with substantial short-term capital inflows[214], lasting until 1992. When referring

[214] This data was taken from the Balance of Payments Statistics Yearbook 1994. Unfortunately, no data is published for most of the other crises discussed in the case studies section.

to another proxy for short-term capital, the financial account adjusted for direct investment and equity investment, the same picture is shown: continuous capital inflows, within this measure accelerating until 1990 and still remaining positive in 1993.

Contrary to that, the same charts illustrate that inflows and outflows into and from France remained rather balanced until 1991, with the exception of 1990, where data shows strong capital inflows into France. This observation again corresponds to the index comparison that on the whole suggested that France managed to meet the external requirements better and only in 1990 showed a significant deviation of the MCI^{act} and the MCI^{fix}. As soon as the short- and long term interest rate spread had declined to zero in France (1991), capital outflows set in.

Because of the amount of capital inflows as of 1987 (when the realignment phase ended), Italy was forced to intervene continuously in order to maintain the exchange rate balance, which drove up their currency reserves. Until July 1990, the reserves had more than tripled and peaked at nearly 70 billion US dollars. At the same time, France's currency reserves remained much more stable (see the last row of charts in set 25). A reason for the timing of the capital inflows (after 1987) in Italy surely is the discontinuance of the frequent realignments. Together with the relatively wide fluctuation bands, the realignments beforehand had allowed Italy to keep the currency peg stable despite of economic differences (mainly inflation) during most of the eighties. Anyhow, although obviously external imbalances arose in Italy, the rising foreign currency reserves did not indicate a short-term stop condition for the fixed peg. In France, not even substantial external imbalances (apart from the inflows in 1990) arose.

But apart from the external situation, the internal situation is also crucial in the medium-term for a sustainable peg.

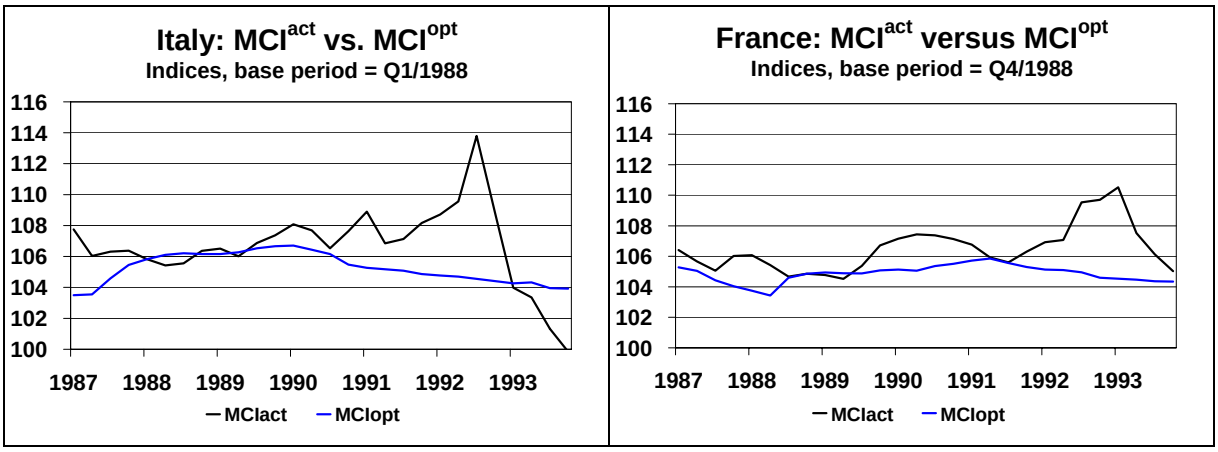
(2) Internal Consequences

Apart from the needs of the foreign exchange market, the Italian and French central banks had to care about their internal performance. To assess whether both central banks succeeded in supporting their business cycles while belonging to the exchange rate regime, the MCI^{opt} that visualises the internal requirements is calculated for both countries. As there are no explicit inflation targets available for France and Italy during the eighties, a gradually declining inflation target is assumed corresponding to the stabilisation process[215]. The output gaps originate from the OECD. In order to receive comparable indices, the MCI^{opt} is normalized to the MCI^{act} [216].

[215] As a base period, in France, the fourth quarter of 1988 and in Italy, the first quarter 1988 are applied. These periods with output gaps close to zero are considered an internal balance. For Italy, an inflation target

The figures in set 42 show the comparison of the MCI^{opt} of Italy and France with their actual monetary policy stance. They suggest that until 1990, both economies were relatively successful in upholding their internal requirements.

Figure 42: ERM – Internal navigation



According to the indices, France more or less managed to achieve the internal needs from 1987 until the end of 1991. Temporarily – from the beginning of 1990 - the MCI^{act} got more restrictive than internally desired to cope with the restrictive Bundesbank monetary policy, but a few months later, monetary conditions in France approached the MCI^{opt} again. As of 1992 finally, France switched to a much more restrictive course (for exchange rate reasons) than internally acceptable. Italy also seems to have been quite in line with the monetary conditions that were optimal for the economy until the beginning of the nineties. While the Italian economy demanded an even more expansionary course as of 1990, the central bank chose to pursue a different course for fixed peg reasons. In theoretical terms, the Italian situation up to mid 1990 was

$$[127] \quad MCI^{opt} = MCI^{act} \succ MCI^{fix}$$

but from mid 1990 onwards, the Italian priority of monetary policy changed to

declining from 15 % in 1980 to 5 % in 1990 is applied. In France, the analysis starts with a target value of 12 %, gradually decreasing to 2 % in 1990.

[216] However, it was not closest to zero over all the years. A minor output gap existed in 1992 for France as well as for Italy. The discussion chose 1988 to equalize the indices, since 1992 was already the beginning of the currency crisis. Thus, even if the output gap signalises a nearly balanced internal economy, there were already serious external disruptions going on and the situation in the year 1992 must have been very unstable.

[128] $MCI^{fixt} = MCI^{act} \succ MCI^{opt}$

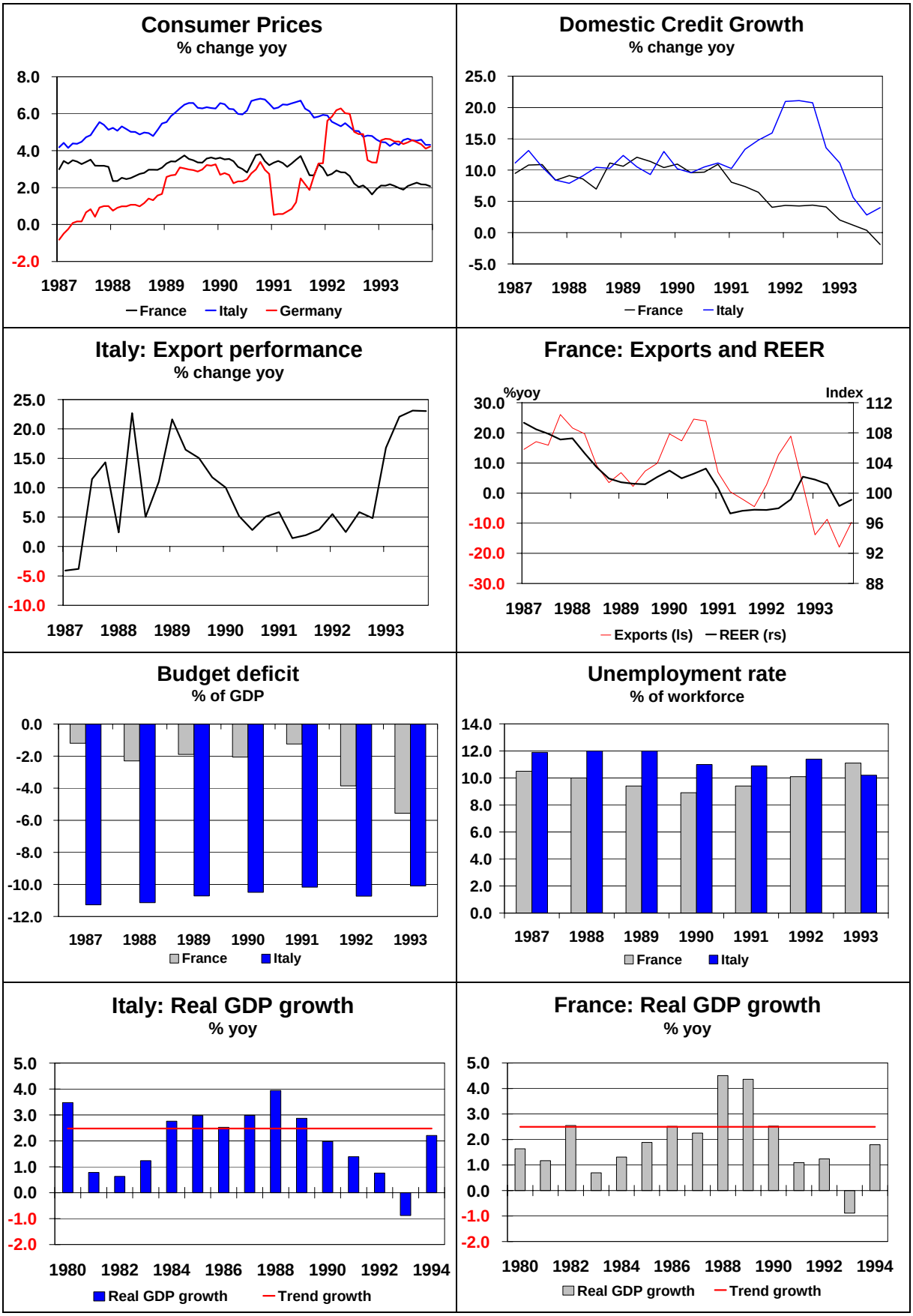
to get the external imbalances under control.

France however did not as early turn away from the internal balance but kept committed to it for a longer time (until 1992, with the exception of 1990).

[129] $MCI^{fix} = MCI^{act} \approx MCI^{opt}$.

Accordingly, France as well as Italy adopted the restrictive Bundesbank policy. If reality backs the considerations of the index approach, fundamentals should show that the stance was rather acceptable for France than for Italy.

Figure 43: ERM – Internal consequences for Italy and France



In fact, Italy (see the figures above) showed clear signs of deteriorating economic performance:

- Only domestic credit growth remained vivid throughout the peg's whole lifetime, even accelerating in 1992, indicating a sound domestic demand.
- Contrary to that, as of 1989, real appreciation burdened the export sector. Export growth deteriorated significantly from then on.
- As of 1991, inflation slowly came back from its high levels of more than 6 %.
- The government budget deficit and the unemployment rate were extremely high (more than 10 %).
- Overall, coming from a sound economic growth of nearly 4 %, real GDP growth conclusively lost momentum. As of 1990, economic growth fell behind its long-term growth average[217].

France, however, showed no such critical economic imbalances until 1992 (see the figures of set 43 again):

- Until 1992, the inflation rate remained relatively stable at about 3.0 to 3.5 %. From 1992 on, however, it quickly receded.
- Domestic credit, which until 1991 grew relatively consistently at around 10 % year on year, receded considerably from then on.
- France did not face such a clear loss of competitiveness in the export sector as Italy did, since it was not faced with a real appreciation. The export performance also fluctuated noticeably and parallel to REER changes, but could recover from losses until 1993. From then, export dynamics broke down for a longer period.
- The budget deficit remained modest (less than -3 %, in 1991 even -1.2 %) before rapidly deteriorating in 1992.
- The French labour market situation was tense as well. Until 1990, the situation improved a bit and the quota fell under 10 %, from then on it worsened again. However, unemployment was at least lower than in Italy.
- Comparing real GDP growth to its long-term trend shows that as of 1991, the French economic growth fell behind its average.

[217] The averages are based on the period 1971 to 2000.

In total, the data shows that especially Italy's fundamentals (particularly the continuous real appreciation) would principally have demanded for a correction of the nominal exchange rate. In contrast, monetary policy according to the exchange rate regime led to a growing violation of the internal balance, since this country had much less cyclical overheating than Germany[218]. France obviously could better come to terms with the situation. Anyhow, while the currency reserves did not deplete suddenly, it was clearly the medium term imbalances within the economies – earlier and more obviously in Italy than in France – that finally eroded the confidence in the exchange rate peg and triggered the speculative attack corresponding to the theoretical discussion in chapter III.3.1.1[219].

IV.3.4.3 Outbreak of the currency crisis

In the Italian case, it was clearly visible to observers that the monetary restrictions ($MCI^{fixt} = MCI^{act} \succ MCI^{opt}$) jeopardized the economy. So it was only a question of how long the Italian central bank would stand the economic losses in favour of the fixed peg. An alarming signal was already the turnaround from rising to falling foreign currency reserves as of mid 1990. From then on, the possibility of a monetary strategy change – giving up the peg – was apparent. Consequently, market investors anticipated potential future exchange rate losses by demanding a higher risk premium on investment in Italy. Within only one month, from February to March 1991, the spread of government bond yields rose from 250 to more than 500 basis points and remained on a level of more than 450 basis points for the next months.

In any case, capital outflows out of Italy started late and remained small. One reason is that the intervention activity was accompanied by a resolute increase of the Italian money market rate from around 12.5 % in May to more than 18 % in September 1992. Unfortunately, this stressed economic activity even more. What is more, Italy had a high debt burden of which a substantial part was short-term financed. Thus, the interest rate hike worsened the debt-service conditions and widened the budget deficit even more (see the budget deficit figure in set 43)[220].

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[218] Substantial private and government spending in the wake of unification had fuelled inflation in Germany. In the first half of 1992, monthly inflation rates had exceeded 6 %.

[219] More specifically, Italy reflects a mixed situation. Before 1990, the Italian situation fits better with chapter III.3.2.2. In mid 1990, however, the monetary policy stance is switched in favour of the external balance, a situation described in chapter III.3.1.1.

[220] In 1992, the budget deficit again swelled to a negative record of -10.7 %.

In France, contrary to Italy, economic imbalances were not as severe until the crisis set in. DE GRAUWE (2000)[221] examines the question of whether the crises had been foreseen by the market participants. He concludes that while the Italian currency crisis had been anticipated well in advance – during the second half of 1991 – the French currency crisis principally came as a surprise. ROSE/SVENSSON (1994) even state that the 1992 crisis in general was not anticipated by the market well in advance. That is why in the literature, speculation is often claimed to be the reason for exchange rate troubles, especially in France. EICHENGREEN/WYPLOSZ (1993) refer to both arguments in the case of the EMS crisis: first, anticipated monetary policy shifts due to the fundamental situation, and second – and they put more emphasis on this argument – self-fulfilling speculative attacks in the absence of fundamental problems. In the last argument, the attack itself produces economic and social costs (due to the required intervention activity that leads to a stricter monetary policy) that in the end outweighs the peg's benefits.

According to the preceding discussion and DE GRAUWE (2000), the present analysis shows that there are more indications for the latter point in the French case. The crisis was not anticipated well in advance and most of the fundamental problems did not become evident before 1992. From the last quarter of 1991, capital outflows are observable that most likely stem from speculation against the French franc, because there were no serious fundamental problems at that time. Since these capital movements required defending activities from the central bank, the real interest rate had to be increased. This was the crucial reason burdening economic growth, which began to decelerate, inducing deflationary pressure. A comparison of the MCI^{act} and the MCI^{opt} shows that as of 1992, the monetary stance became definitely too restrictive for the French economy. Whereas the Bundesbank was counteracting the expansionary impulses stemming from unification, France had had no such expansionary stimulus in advance and hence was pushed into recession. Thus, the speculative attack itself generated social costs exceeding the peg's benefits in 1993[222].

[221] See chapter II.5.5 in his study.

[222] When considering reasons for the speculative attack in France, a loss of credibility of and confidence in the system is often mentioned. Eichengreen/Wyplosz (1993) provide another reason for the speculative attack: The Treaty of Maasticht. They point to the fact that the stabilisation of the exchange rate within the narrow band of the ERM was one of the four convergence criteria for qualifying as a member of European Monetary Union (EMU). This provided an incentive to change the exchange rate regime once the exchange rate could no longer be held in the bandwidth of ERM. Since the membership requirement for the EMU would have been neglected anyway, a policy of austerity would no longer be necessary. Thus, the speculative attack would be successful.

More than by fundamental and credibility reasons, the confidence of the existing system was politically undermined by the "no" of the Danish population in July 1992 in the referendum about the Treaty of Maastricht and about becoming a member of the EMU – particularly since the referendum in France was forthcoming in September. Additionally, the wave of speculative attacks against the ERM member currencies was fuelled by the speculator George Soros, who bet on a breakdown of the peg of the British pound with a short position of about 15 billion US dollars. Soros was successful and the United Kingdom exited the ERM on September 17, 1992. There is a broad discussion in the literature, regarding whether Soros was the trigger of the crisis or whether the obvious economic imbalances would have provoked a speculative attack even without Soros. Italy left the ERM on the same day as the UK, on September 17, 1992. France remained committed to the exchange rate system one more year, until the economy had drifted in a deep recession and the incentive for the monetary authority to switch the exchange rate system was clearly visible. Speculation against the French franc became severe and would have forced France to exit. However, France did not ever formally exit because on August 2, 1993, the EC Ministers of Finance agreed in widening the fluctuation band to +/-15 %. This widening of the band, which on the whole permitted the ERM currency fluctuations of 30 %, in principle brought an end to the ERM.

It is often cited that Italy and France would have been able to defend the peg via intervention. They should have been able to buy an unlimited amount of foreign currency from the Bundesbank within the VSTF system. But firstly, credits and interests from this short-term financing generally had to be paid back to the Bundesbank within 3 1/2 months[223]. Secondly, in the long run, the Bundesbank was unwilling to provide liquidity since this was not compatible with its own commitment to monetary stability. As soon as further liquidity could not have been sterilised any more, further provision of German mark amounts would have implied an expansion of the monetary base, which was against the Bundesbank's monetary stance[224].

[223] There were possibilities of prolongation and medium term financing, for further information see Bofinger et al. (1996), pp. 606.

[224] See De Grauwe (2000). According to Eichengreen/Wyplosz (1993), the Bundesbank even recognised that its policy reaction to unification implied a monetary shock for the other ERM members and thus asked for a realignment. But France and other countries denied the request.

IV.3.4.4 Summary regarding equivalences to traditional theory

Overall, it is very obvious in the ERM case that the anchor countries' monetary policy drove a wedge between the external and internal equilibrium of the pegged countries[225]. In the words of BOFINGER/FLASSBECK (2000, p. 19) "the problem of the ERM was a common monetary policy that was determined by purely German macroeconomic data". KRUGMAN (1998a) also emphasises the dominance of the Bundesbank's restrictive monetary policy as the key factor of producing disruptions.

Since, here again, the MCI^{opt} in the case studies did not remain constant contrary to the theory assumption[226], the cases studies depicted in the lower table do not entirely match with the inequality $MCI^{fix} \succ MCI^{opt}$ marked in the theory table above.

Table 26: Summary of the EWS Crisis

The Crisis of the EWS										
Monetary influences:	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Case:	**$MCI^{fix} < MCI^{opt}$**					**$MCI^{fix} > MCI^{opt}$**				

[225] By conducting a survey among foreign exchange traders, Eichengreen/Wyplosz (1993) discovered that 68 % of the respondents believed the high German interest rates were the reason for the ERM crises.

[226] Especially in Italy, see figure 26.

	$MCI^{fix}=MCI^{opt}$	$MCI^{fix} < MCI^{opt}$		$MCI^{fix} > MCI^{opt}$	
Central bank behaviour:	**$MCI^{act}= MCI^{fix}= MCI^{opt}$**	**$MCI^{act} = MCI^{fix} < MCI^{opt}$**	**$MCI^{act} = MCI^{opt} > MCI^{fix}$**	**$MCI^{act} = MCI^{fix} > MCI^{opt}$**	**$MCI^{act} = MCI^{opt} < MCI^{fix}$**
EMS					
Italy			X (to mid 1990)	X (from mid 1990)	
France	X (until 1992, except 1990)			X (in 1990 and from 1992)	
Stylised discussion in chapter:	III.2.2	III.3.2.1	III.3.2.2	III. 3.1.1	III.3.1.2
Parallels in traditional theory:	*NO CRISIS*	• Second Generation models • Third Generation supplements	• First Generation models • Second Generation models	• Second Generation models	• First Generation models • Third Generation approaches

Theory Case	*Italy*	*France*

The ERM crisis is a classical case covered well by Second Generation theory. The logic of economic costs (in the form of a recession or unemployment) exceeding the benefit of pegging one's exchange rates motivated the ERM members' central banks to take a monetary strategy shift into consideration. Thus, in the European Monetary System case, the proposed theoretical approach does not contradict the logic of traditional currency crisis theory but integrates its line of argument.

Chapter V:
Conclusion

V.1 Summary: Performance of the Approach with Respect to Empirics

Reviewing the case studies, the proposed monetary approach on the whole serves well in depicting reality across different periods. In the Argentine case, it depicts the overly restrictive monetary stance from the domestic point of view leading to a crash of the system and in the Czech Republic it explains why the Czech monetary policy produced escalating sterilisation costs that were the ultimate reason for giving up the peg. For the Asian crisis, the indices illustrate that monetary policy fulfilling the peg's requirements initiated a bubble economy and its burst. When discussing the EMS, the framework model points out the burden of the exchange rate regime for the Italian and French economy that finally caused the collapse of the system.

However, the case studies also reveal limitations of the proposed approach. The results are sensible for sufficient and reliable data. A major problem of data is finding an adequate proxy for the risk premium. Measuring risk in financial markets however is a central issue of today's financial research, which will improve the application of the approach for future crises. Another problem of suitable data arises for the short-term capital flows. An appropriate aggregate is only very limitedly provided by the IFS or BoPS. However, these limitations can be overcome by future research as well, since the IMF conducts a *Coordinated Portfolio Investment Survey (CPIS)* on an annual basis from 2001 onwards to provide reliable data on portfolio investment flows.

Bearing these limitations in mind, the cross-generational framework provides a supportive instrument to analyse currency crises of different decades. When recapitulating the results of the case studies, a main aspect of the present approach needs to be emphasized: It allows examination of the main monetary influences affecting each crisis country or region. Summarizing these influences shows, that the fixed exchange rate policy in each of the cases has been substantially influenced by foreign parameters[227]:

[227] Risk premium accelerations due to the final speculative attack causing the currency peg to collapse are not depicted here, since they are not to be considered a root of distortions but their consequences. For further assumptions or period limitations see the corresponding case study.

Table 27: Systematic summary with respect to monetary influences[228]

	$MCI^{fix} < MCI^{opt}$					$MCI^{fix} > MCI^{opt}$				
Monetary influences:	$r^* \downarrow$	$\pi^* \downarrow$	$\pi \uparrow$	$\alpha \downarrow$	$\Delta s_2^*; \Delta s_3^* \downarrow$	$r^* \uparrow$	$\pi^* \uparrow$	$\pi \downarrow$	$\alpha \uparrow$	$\Delta s_2^*; \Delta s_3^* \uparrow$
Argentina	-	-	-	-	-	X	-	X	-	X
Brazil et al.	-	-	-	-	-	-	-	-	XX	X
Czech Republic	X	X	-	X	-	-	-	X	X	X
Asia										
Thailand[1]	X	-	-	X	(X)	X	-	-	-	X
Malaysia et al.	-	-	-	-	-	-	-	-	XX	-
EMS										
France, Italy	-	-	-	-	-	X	X	-	(X)	X

1) The Thai case has to be split into two periods, the left one reflecting Thailand's monetary environment until 1995, the right one the case from 1995 onwards.

This survey clearly shows that monetary influences stemming from the anchor country's interest rate policy and third countries' exchange rate changes played an important role in affecting the monetary environment of the pegged countries. The question that directly follows from this is how and to what extent such parameter changes resulted in disruptions of the external and internal balance. To examine the roots of such distortions, analysing the behaviour of the domestic central bank is crucial.

[228] Here again, it has to be kept in mind that this method assumes a constant MCI^{opt}, initially equal to the MCI^{fix}. This assumption is lifted from the following table onwards. Thus, a changing MCI^{fix} principally does not contradict with $MCI^{fix}=MCI^{opt}$, as soon as the MCI^{opt} modifies the same way. See chapter III.2.2.

Table 28: Systematic summary with respect to the domestic central bank's behaviour[229]

	$MCI^{fix}=MCI^{opt}$	$MCI^{fix} < MCI^{opt}$		$MCI^{fix} > MCI^{opt}$	
Central bank behaviour:	$MCI^{act}= MCI^{fix}= MCI^{opt}$	$MCI^{act} = MCI^{fix} < MCI^{opt}$	$MCI^{act} = MCI^{opt} > MCI^{fix}$	$MCI^{act} = MCI^{fix} > MCI^{opt}$	$MCI^{act} = MCI^{opt} < MCI^{fix}$
Argentina	X (1992-1995 and 1996-1998)[230]			X (from 1999)	
Brazil et al.				X^{A}	
Czech Republic		X (to mid 1994)	X (to mid 95)		
Asia Thailand Malaysia et al.		X (to 1995)	X (from 1996)		X
EMS France Italy	X (until 1992, except 1990)		X (to mid 1990)	X (in 1990 and from 1992) X (from mid 1990)	
Stylised discussion in chapter:	III.2.2	III.3.2.1	III.3.2.2	III.3.1.1	III.3.1.2
Parallels in traditional theory:	*NO CRISIS*	• Second Generation models • Third Generation supplements	• First Generation models • Second Generation models	• Second Generation models	• First Generation models • Third Generation approaches

A) refers to the compromise course $MCI^{fix}>MCI^{act}>MCI^{opt}$.

Reviewing the case studies shows that the domestic central banks did not completely give up an autonomous monetary policy under the fixed peg restriction. They obviously pursued different approaches – trying to keep close to the internal requirements, trying to fulfil the external requirements or deciding a monetary policy in the middle of both targets. The case studies spread over each of the theoretically possible situations listed above – at least for a certain period.

[229] See footnote 227, especially for the French case.

[230] Apart from the 1995 recession, the currency board on the whole seems to have coped with the internal and external requirements until 1999.

But the survey of cases also shows that regardless of how the domestic central bank decided to react, a currency crisis in the end was inevitable as soon as the MCI^{fix} and the MCI^{opt} had drifted apart. While the development of upcoming foreign exchange market disruptions and economic imbalances was different, nevertheless each of the four behavioural options triggered the collapse of the system in the end. The ultimate stop conditions ranged from depleting reserves to escalating costs of sterilisation or an economic collapse. Argentina, as well as Italy and France within the EMS suffered from an economic downturn. Thailand's fate was a burst bubble economy, and the Czech Republic could not bear escalating sterilisation costs any more.

Finally, the discussion demonstrated in each of the cases that the approach does not contradict with the insights from traditional theory but integrates their elements. First and Second Generation model fragments as well as Third Generation approaches back the line of argument and in some cases provide valuable extensions.

V.2 Concluding Remarks

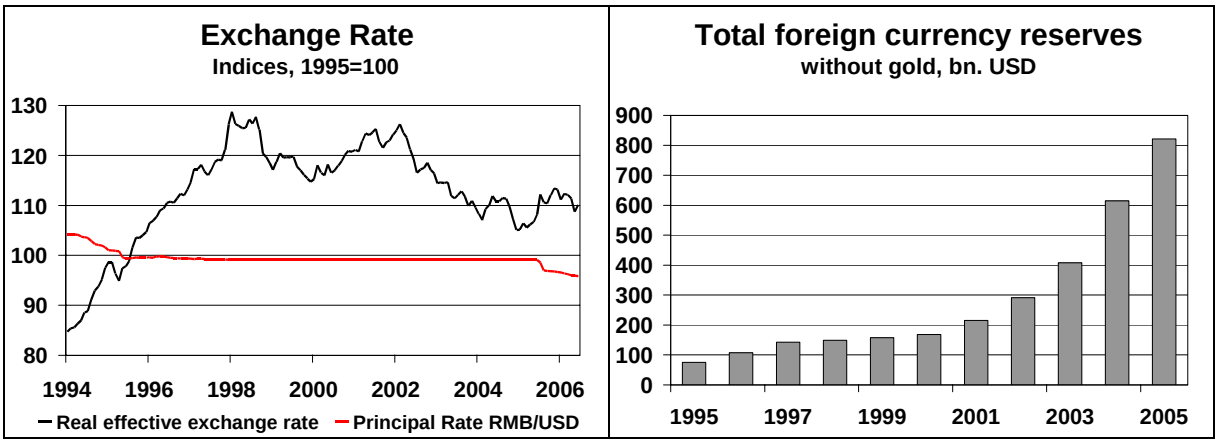
As a result of the theoretical and empirical findings (apart from pure contagion), this study does not share the view of currency crisis literature, which reduces the trigger of currency crises to speculative attacks. In most of the popular currency crises, crucial monetary disruptions are identified at an early stage that trigger currency crises several years later. Nor does this analysis follow research that concentrates on blaming the domestic central bank for monetary disruptions. In view of the present theoretical and empirical findings, the analysis rather chooses not to neglect the transmission of monetary impulses from outside sources, mainly from the anchor country and important third countries. In the words of FRATZSCHER (2002, p. 27), no economy, "even one with relatively sound fundamentals and policies, is capable of insulating itself from events in the rest of the world".

While this framework aimed at making a contribution to systematize the past crises and establish connections, it remains to be seen if it is suitable for future currency crises of fixed exchange rate regimes as well. The present development in China fits quite well with the suggestions of the theory approach.

China pegged the renminbi yuan to the US dollar in 1994 and stabilised the currency at a rate of 8.28 RMB/USD. In recent times, the People's Republic has been faced with reproaches to maintain an artificially undervalued currency for reasons of competitive advantage. Especially the United States, Japan and other smaller Asian economies require China to adopt a more flexible exchange rate that permits an appreciation of the currency. These demands are emphasized by comparing the nominal exchange rate to the performance of the real (effective) exchange rate, which has continuously appreciated from 1994 (see figure 44). Apart from the political debate, the undervaluation of the

Chinese currency triggers economic consequences as theory implies. Observing the central bank's currency reserves clearly shows the need for continuous intervention to defend the currency peg against an appreciation. On account of restrictions of capital mobility, short-term capital inflows have up to now remained limited. However, the central bank is required to sterilise the intervention volume to offset its liquidity effect. This induces massive sterilisation costs since the foreign currency only can be invested in low-yielding, safe assets. Apart from the political pressure, this is a central reason why the Chinese government relents to release the peg step by step term. A first step was to peg the currency to a basket of currencies in July 2005.

Figure 44: China's exchange rate policy



However, although the overall knowledge of reasons of currency crises continuously increases and early warning systems develop, it does not seem realistic to prevent future crises of fixed exchange rate systems. The problem stems from the system itself. According to EICHENGREEN (2001) it is the nature of pegs that they are fragile[231] and that it is difficult to exit a peg or smooth it without precipitating a crisis. EICHENGREEN (2001, p. 10) adds that "the longer a peg is retained, the more vulnerabilities build up in the financial system". Accordingly, for countries committed to a fixed peg, the only possible way to avoid currency turmoil seems to be permanently evaluating if the current environment still fits with the previously chosen currency regime. In order to be prepared for potential distortions, an exit from the peg has to be considered well in advance. The list of countries that succeeded in doing so is short, however[232].

As a potential solution to the bipolar view of fixed exchange rate regimes versus flexibly floating exchange rate regimes, the economic research about *Managed Floating* proposes approaches to

[231] See Bubula/Otker-Robe (2003) as well.

[232] See Eichengreen (2001). For a comprehensive analysis of exits from pegged exchange rates see Duttagupta/Otker-Robe (2003).

overcome the conflict. Here, monetary policy is able to simultaneously control the interest rate and the exchange rate[233], a monetary policy approach that is widely applied in today's de facto exchange rate policy.

[233] See Bofinger/Wollmershäuser (2001, 2002a), Bailliu/Murray (2002) and Goldstein (2002).

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