Monetary Union and the

Interest-Exchange Rate Trade-off

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Abstract

By using a multi-country simulation model this paper analyzes the qualitative effects of joining a monetary union. The transition to EMU (European Monetary Union) is shown to produce interest and exchange rate changes with substantial and countervailing effects on the real economy which can be traced through the model. Observable anticipation effects in the wake of the EMU are substantiated; and some policy recommendations for joining any monetary union are derived. It is also shown that fixing conversion rates at last-day market rates produces a unique outcome and not exchange rate indeterminacy as argued by de Grauwe (1997), Obstfeld (1998), and others.

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Forming or joining a monetary union requires acceptance of a common currency and a common central bank irrespective of cross-country differences in initial conditions. This is sometimes called the "one-size-fits-all" problem. From the perspective of an individual country, the common monetary policy induces *interest rate changes* relative to interest rates obtained under national monetary autonomy, because short term nominal interest rates are equalized across the union. At the same time, national currencies are irrevocably fixed to the common currency at certain conversion rates. There are, therefore, *exchange rate changes* compared to exchange rates that would have prevailed without monetary union.

Nominal interest and nominal exchange rate changes are not exogenous, but depend on the chosen union-wide central bank policy and on the selected conversion rate procedure, respectively. They are not shocks in themselves; instead, they are *caused* by permanent asymmetric shocks (relative to a situation without monetary union) originating in structural changes to the underlying monetary policy conditions. At the same time, interest and exchange rate changes *produce* macroeconomic effects in a monetary union. To emphasize their dual role as being caused by shocks on the one hand and causing effects on the other hand, these nominal changes are henceforth referred to as interest and exchange rate *impulses*.

It is a well-known fact that joining or forming a monetary union causes interest and exchange rate impulses (in joining countries) which, in turn, produce macroeconomic effects. Nonetheless, the discussion on the European Monetary Union (EMU) – prior to its start on 1 January 1999 – largely focused on political issues, in particular on which countries were likely to qualify under the so-called Maastricht Criteria (EU, 1992, articles 109 j (1)). The Economist (11 April 1998) even complained that the "debate about its potential effects has been notable for its absence". This is not entirely true, but some aspects, especially the aforementioned interest and exchange rate impulses, seem to have been ignored in contributions by economists prior to the formation of the EMU. The same is true with respect to future potential candidates to the EMU. Again, there has not been any substantive dis-

cussion of these impulses and their effects on the macroeconomic conditions in prospective member countries.

Based on the formation of a hypothetical EMU, this paper illustrates that these effects may be considerable depending on the initial interest and exchange rate conditions. But the findings of this paper go further than that. Two qualitative results emerge. First, it is shown why interest and exchange rate impulses are typically countervailing. Contrary to standard textbook results, it is argued that lower (higher) interest rates are typically associated with an exchange rate appreciation (depreciation). Prior to monetary union, a country with a low monetary stability record, for instance, suffers from high interest rates and depreciation expectations. Once the monetary union has been joined, interest rates equalize at a lower level and an appreciation is produced because depreciation expectations are eliminated. The second qualitative result is that the interest rate effect typically dominates and determines the overall effect on the real economy. A previously low-stability country, for instance, will gain (i.e. increase its output) from reduced nominal (as well as real) interest rates, even though the elimination of depreciation expectations causes a nominal (and real) appreciation.

For empirical and theoretical reasons, these results can only be obtained in a simulation analysis which is based on both historical data and an elaborate (multi-country) model structure. On an empirical level, it is crucial to account for the role of historical depreciation expectations. They would have to be ad hoc in a theoretical model framework. On a theoretical level, interest and exchange rate impulses can only be captured if the transition to the monetary union *and* the period after its actual start are included in one and the same model. In a multi-country setting, this is virtually impossible within the framework of a (small) analytically tractable model. Therefore, this paper resorts to a comparative simulation analysis based on various specifications of a counterfactual European Monetary Union within the framework of MULTIMOD, the policy analysis model of the International Monetary Fund.

The previous literature on the EMU is quite diverse, but can be categorized according to how each paper accounts for the features of a monetary union, i.e. its common currency and its common central bank. In a first strand of papers (written before the start of the EMU), the monetary union is not modelled explicitly. Hughes Hallett and McAdam (1997) and von Hagen and Lutz (1996) investigate the macroeconomic repercussions of attempts to implement the fiscal convergence criteria of the Maastricht Treaty. They use full scale macroeconomic models (MULTIMOD – also employed here – and the Taylor model, respectively) to devise fiscal adjustments prior to the start of the EMU. By not modelling the EMU itself, they ignore, however, interest and exchange rate impulses as well as anticipation effects caused by the formation of the EMU.

In a second (and larger) strand of papers, specific assumptions are made for the common currency and the common monetary policy. A stylized macromodel is used by van Aarle, Engwerda, Plasmans and Weeren (2001) to capture the interdependence of national fiscal and union-wide monetary policies. Hughes Hallett and Ma (1996) simulate the effects of fiscal consolidations by using a calibrated Dornbusch model with two small countries to form a monetary union. Based on the same model, Hughes Hallett and Vines (1993) advocate fiscal flexibility by analyzing the effects of asymmetric shocks. Masson and Melitz (1991) arrive at similar conclusions. Based on a three-country-version of MULTIMOD, they analyze the response to symmetric shocks when national preferences differ. Furthermore, Clausen (2002) discusses the impact of asymmetric monetary transmission channels in the EMU, whereas Fielding and Shields (2001) study the correlation of price and output shocks in a VAR model for countries participating in the CFA Franc zone. Except for the last (empirical) paper they all theoretically examine a hypothetical EMU after its start. They do not, however, (nor can they) capture effects caused by the formation of a monetary union: changes to interest and exchange rates caused by changes in monetary policy and exchange rate expectations.[1]

Finally, a third strand of papers focuses on specific problems in the wake of the EMU, in

particular the question of how to determine the irrevocably fixed conversion rates between countries. Not only is this issue still interesting from a theoretical point of view, but it is also relevant with respect to future member countries of the EMU. Clausen (1998) discusses the "inappropriate choice of the conversion rates" between two small countries by modelling a "devaluation" within the monetary union.[2] In more abstract settings, de Grauwe (1997), Obstfeld (1998), and de Grauwe, Dewachter, and Veestraeten (1999) argue that there is a possibility of (rational) self-fulfilling prophecies on exchange rates, if the last quotations of market rates before the start of a monetary union are to be used as conversion rates (theoretical indeterminacy problem).

How does this paper relate to and extend the findings of papers of those different strands of the literature? First, the transition from the pre-EMU period to after the start of the monetary union is modelled explicitly. This allows to capture interdependencies between the announcement phase (from the announcement of the EMU to the end of 1998) and the time after 1 January 1999. Second, various procedures for fixing conversion rates are discussed. By doing so, results can be applied to the EMU as of 1999, but also to future members of the real world EMU or any other monetary union. This approach also allows to evaluate empirically the theoretical indeterminacy problem discussed by de Grauwe (1997) and others (as discussed in the previous paragraph). Third and most importantly, this paper focuses on interest and exchange rate impulses caused by a monetary union as such while abstracting from other potential changes (like fiscal convergence criteria, a shift in the monetary stability orientation of the European Central Bank (ECB), potential efficiency gains, or various conceivable adjustments of agents' behavior).

Sections 1 discusses the model and the simulation strategy; and section 2 presents the model changes to account for the EMU. On this basis, *simulation* results for interest and exchange rate impulses are justified qualitatively in section 3. Section 4 relates the simulation findings to results obtained in *standard open economy macroeconomic models*. The role of exchange rate expectations is emphasized and the view of the advocates of a theoretical indeterminacy

problem is challenged. Section 5, again, refers to *simulation* results and discusses real effects qualitatively. Several channels of transmission are identified and a potential trade-off between interest and exchange rate impulses is revealed. In section 6, qualitative findings are applied to the *real world EMU*. Concluding section 7 presents a summary of results, a discussion of limitations, and some general policy recommendations referring to countries joining a monetary union.

1 Experiment Design

In the following, the underlying economic model is characterized and the simulation strategy of constructing counterfactuals in an ex post analysis is justified.

Main Model and Simulation Characteristics

The simulation analysis presented in this paper is based on a 1991 variant of MULTIMOD (cf. IMF, 1991), an annual econometric multi-country model. It was developed by the International Monetary Fund and is widely used for international policy analysis. 470 equations depict ten countries and regional blocs: the seven G7 countries, the rest of the OECD, the oil exporters, and the rest of the developing world. MULTIMOD incorporates rational expectations (in financial markets and the decision-making by firms and households) and complete information. This means it is a perfect foresight model requiring perfect credibility of policy decisions (e.g. on the start and membership of a monetary union).

MULTIMOD follows "the prevailing paradigm in which a broadly neoclassical view of macroeconomic equilibrium coexists with a new Keynesian view of short-to-medium term adjustment" (Mitchell, Sault, Smith and Wallis, 1995). It is an elaborate, dynamic version of the "modified-Mundell-Fleming" model (Krugman, 1995) combining short run demand determination and IS-LM structure with long run steady state properties determined by capital accumulation and aggregate supply. Inflation dynamics depend on capacity utiliza-

tion (a Phillips curve type relationship), imported inflation effects, sticky prices and price expectations. However, for the long run, nominal neutrality is imposed (short run nominal rigidities are smoothed out over time). MULTIMOD accounts for stocks of debt, money, and net foreign assets as well as for international trade and financial flows.[3]

A comparative simulation analysis consists of comparing a benchmark scenario, the so-called *baseline*, to various alternative scenarios, here the *hypothetical EMU scenarios*. In principle, we can choose to conduct ex post or ex ante simulations (Wallis, 1988, p. 226). The former are based on a historical time period (and historical baseline data), the latter on the future (and, hence, forecast baseline data). It is argued that, for the purpose of this paper, ex post simulations for the 1980s are preferable to the seemingly more realistic (ex ante) scenario for the EMU starting in 1999, or to any other (ex post) historical scenario.

The decisive drawback of ex ante simulations is that interest and exchange rate impulses caused by a monetary union would be obscured or even completely concealed. In econometric multi-country models, forecasts for the immediate future typically represent an adjustment path to a steady state equilibrium. In this version of MULTIMOD, the steady state is already reached before the start of the real world EMU in 1999. Exchange rates are constant, and interest rates are constant and equal across countries from 1997 onwards. Hence three effects would not appear in an ex ante analysis. (If the steady state were reached a few years later, that is during the first years of the EMU, effects would still be blurred.) First, the introduction of a monetary union could not have an interest equalization effect. Second, underlying appreciations and depreciations in the historical baseline would not feature in a steady state baseline. Hence, there could not be any effects caused by changes in exchange rate expectations caused by the hypothetical EMU. Third, conversion rates could be fixed exogenously at non-steady state values, but there would be no effects under endogenously determined market conversion rates (because the steady state would prevail). Furthermore, it could not be demonstrated that these three effects may be countervailing.

Simulation Scenarios

There are also reasons for choosing a particular historical time period, i.e. the 1980s instead of the 1990s, for introducing a hypothetical EMU. After 1983, the European Monetary System (EMS) was fairly stable, whereas monetary turmoil with the break-up of the Exchange Rate Mechanism and ensuing exchange rate instability, especially for the Lira, could be observed in the beginning of the 1990s. After 1992, the baseline scenario was affected by expectations caused by the announcement of the EMU. The real side, too, was suitable for conducting a simulation analysis based on the 1980s. From 1983, GDP growth rates were positive and very close in the large real world EMU member countries Italy, France and Germany (baseline data is shown in appendix A), not so much in Britain though. Hence, possible recession or overheating effects caused by a hypothetical EMU cannot be blamed on divergent underlying business cycles.

Nonetheless, by choosing the historical conditions of the 1980s as the point of reference, considerable nominal disparities among European countries (much larger than in the 1990s) are incorporated in the analysis. Due to large interest rate differentials between prospective member countries of the hypothetical EMU and exchange rates far away from Purchasing Power Parity, large adjustments are likely to be induced by the introduction of a hypothetical EMU. Hence, quantitative outcomes are exaggerated and less ambiguous, and qualitative interpretations are facilitated. Synchronized business cycles and large nominal disparities provide ideal conditions for analyzing transmission mechanisms of macroeconomic effects that are caused by the EMU (or monetary unions in general).

All in all, the *baseline* scenario is defined by the model specifications in MULTIMOD to capture the historical real world situation. The hypothetical EMU scenarios are to be distinguished from the baseline scenario in the following section. They are all modelled to start in 1983 and to consist of the real world EMU member countries Germany, France and Italy, but not the United Kingdom. (The smaller European countries are not accounted for

separately in this version of MULTIMOD.) The decision on which country to include in the hypothetical EMU is not primarily motivated by the desire to honor the successful bid by Italy and the refusal by Britain to participate in the real world EMU. Instead, it has already been motivated by the macroeconomic constellation as of 1983.

The start of the *hypothetical EMU* in 1983 is preceded by a one year announcement period (1982). It may be argued that markets predicted EMU membership for most countries more than one year in advance, and that future applications for membership will be known at least two years in advance. However, since MULTIMOD requires perfect credibility and full information (as mentioned before), the most realistic assumption is to limit the announcement period to one year. As a consequence, real world anticipation effects may be exaggerated by simulation results, because expectations switch abruptly from one (annual) period to the next and all adjustments are squeezed into one period only. Furthermore, the announcement period is characterized by flexible exchange rates. The idea is to capture anticipation effects unrestrained by government interventions in the foreign exchange markets.

2 Monetary Union

A common currency and a common central bank are the essential components of a monetary union. In the following, exchange rates and monetary policy in the hypothetical EMU are discussed with reference to the baseline. Three hypothetical EMU scenarios based on alternative procedures for fixing intra-EMU conversion rates are specified.

Exchange Rates

In MULTIMOD, exchange rates are determined by the open interest parity condition (relative to the US). In the *baseline*, there are separate exchange rate equations for France, Germany, and Italy. For the *hypothetical EMU* scenarios, individual exchange rates for

member countries are replaced by a single Euro-$ rate (and conversion rates are used to fix each national currency to the Euro). The exchange rate of the (hypothetical) Euro vis-à-vis the US-$ depends on two components: the expected Euro-$ exchange rate for next period Ee^U_{+1} (E is the expectation operator); and the differential between the union-wide short term interest rate i^U (determined by the ECB) and the corresponding US rate i^{US}. The European (open interest parity) exchange rate equation is given by:

$$e^U = \frac{\left(1+\frac{i^{US}}{100}\right) * Ee^U_{+1}}{\left(1+\frac{i^U}{100}\right)} \tag{1}$$

Normalizing the Euro at 1 DM as of 1983, the start of the hypothetical EMU, reduces the number of conversion rates needed. Three alternative procedures for fixing conversion rates are used in this paper. To stay within the logic of an annual model, all rules refer to yearly averages. As an example, the conversion rate between France (F) and Germany (G), $e^{F,G}_{t\geq 1983}$ (French Franc to the Euro or DM), is specified for each case:

$$\textbf{CUR:} \quad e^{F,G}_{t\geq 1983}\left[\tfrac{FF}{Euro}\right] = e^{F,G}_{1982} \tag{2}$$

$$\textbf{PPP:} \quad e^{F,G}_{t\geq 1983}\left[\tfrac{FF}{Euro}\right] = \frac{ppp^F_{1980}}{ppp^G_{1980}} * \frac{P^F_{1982}}{P^G_{1982}} \tag{3}$$

$$\textbf{CP:} \quad e^{F,G}_{t\geq 1983}\left[\tfrac{FF}{Euro}\right] = cp^F_{1982} \tag{4}$$

CUR means conversion at current exchange rates: conversion rates as of 1983 are set to their corresponding *simulated* bilateral exchange rates as of 1982, the year before the start of the hypothetical EMU. An equivalent conversion procedure in the real world would be the fixing at (annually) averaged market rates. Hence, CUR must be interpreted as an averaging procedure suggested by Lamfalussy, the first president of the former European Monetary Institute. In terms of model simulations, CUR conversion rates are entirely endogenous, because simulated rates as of 1982 are used, not baseline rates. PPP and CP are labelled exogenous conversion procedures. Under **PPP**, the purchasing power of 1 Euro is equalized across countries. The PPP procedure uses exogenously determined 1980 estimates for the

purchasing power parity (ppp^k_{1980}) of, say France (F) and Germany (G) relative to the US.[4] They are updated by 1982 prices (P^k_{1980}) which are endogenously obtained in the respective simulation run. According to **CP**, conversion rates correspond to the annual averages of central parities cp^k of the European Exchange Rate Mechanism (ERM). These are entirely exogenous to the model.

None of these corresponds to the conversion procedure chosen for the actual EMU at the EU Summit in May 1998 (EU, 1998), because exchange and conversion rates in MULTIMOD are yearly averages. Nonetheless, exogenous CP and endogenous CUR together capture all important features of the actual conversion procedure used in the real world EMU. In fact, the real world procedure could be considered an intermediate case of CP and CUR. It is exogenous in the sense that *bilateral* (not Euro) conversion rates are fixed in advance at the central parities of the ERM. It is endogenous, because in most countries bilateral central parities do actually reflect economic fundamentals and correspond to market rates. When there was a large deviation, as in the case of the Irish pound before 16 March 1998, central parities were adjusted. As an additional reference, the PPP procedure is used to better represent real economic conditions in each of the member countries.

Interest Rates

As for monetary policy in MULTIMOD's *baseline*, the behavior of the Bundesbank and the non-ERM central banks is described by monetary targeting. All other ERM member countries are assumed to commit to exchange rate targeting vis-à-vis the DM. Once the *hypothetical EMU* starts, the nominal interest rate in member countries is no longer determined by a national interest rate reaction function, but by the interest rate reaction function of the hypothetical ECB. The ECB commits to monetary targeting. There is no conceptual change like, for instance, a switch to inflation targeting. The common European interest rate is modelled as the instrument, and the European money stock as the (intermediate) target for obtaining its price stability objective. As for previously national central banks,

the hypothetical ECB exercises full control over short term interest rates:

$$i^U \;=\; i^U_{-1} \;+\; \left[r * \ln \frac{mt^U}{M^U} \right]. \tag{5}$$

Under the assumption of unchanged (negative) coefficient r (from national equations), the change of the union-wide common interest rate ($i^U - i^U_{-1}$) depends on aggregate European money M^U (M refers to both money demand and money supply in MULTIMOD), and on the construction of exogenous European monetary target mt^U (see below). Under the assumption of behavioral invariability, the aggregated European money stock is derived as the sum of its components, i.e. $M^U = \sum \frac{M^k}{e^{k,G}_{t\geq 1983}}$. (As above, $e^{k,G}_{t\geq 1983}$ is the fixed conversion rate in the union used to express the quantity of money for each member country k in terms of the common currency Euro or DM.) The monetary stability orientation of a central bank is expressed by the time path of its exogenous monetary target (mt_t). Given the level of money M^U in equation 5, the European interest rate is determined by (changes in) the monetary stability orientation of the hypothetical ECB. An expansionary (contractionary) policy – implying lower (higher) union-wide interest rates – is caused by increasing (lowering) the level of mt^U relative to the level of M^U.

EMU means – by definition of a monetary union – a single monetary policy, but allows for various levels of union-wide monetary stability orientation. From the perspective of an individual country, the change in stability orientation is caused by equalizing monetary policy on an average level and (possibly) by shifting away from that average. A union-wide shift to a higher level of stability orientation à la Bundesbank, for instance, or to a lower level is not captured in this paper. In the approach chosen, the monetary policy of the hypothetical EMU is constructed as the 'average' of historical national monetary policies. Formally, a monetary target is specified in MULTIMOD for each country, even for ERM member countries committing to exchange rate targeting (so that the withdrawal of individual countries from the ERM could be modelled). It corresponds to the actual monetary policy in the historical baseline. Thus, the 'average' monetary policy of the hypothetical ECB is determined endogenously by aggregating national baseline targets (analogous to the

aggregation of the European money stock): $mt^U = \sum \frac{mt^k}{e^{k,U}_{t\geq 1983}}$.

This approach may be criticized from two angles. First, the real world EMU has already shown to conduct more stability-oriented monetary policies. It has been said before, however, that it is not intended to model a realistic European Monetary Union. Second, simply adding up national target values given in the baseline of MULTIMOD is a crude way for describing the hypothetical ECB policy as an average of historical European monetary policies. Nonetheless, this procedure suffices to capture a crucial feature of any monetary union, the equalization of short term nominal interest rates.

3 Simulation Results 1: Interest and Exchange Rates

Simulation results for the hypothetical EMU relative to the baseline (cf. appendices A and B) hinge on impulses of nominal interest and nominal exchange rates caused by any monetary union. Conceptually, the causes for these nominal impulses (this section and section 4), and their transmission in the real economy (section 5) can be distinguished. Once the features of each of the impulses are understood (this section), their countervailing nature is interpreted in the light of results from standard open economy models (section 4). On this basis, the transmission of impulses and their countervailing real effects can be discussed (section 5).

Interest Rate Impulses

The link between the *common monetary policy* and *equalized short term interest rates* is straightforward. In the simulations, averaging the monetary stability orientation of the ECB (compared to the policy stance of the – formerly independent – national central banks) produces average interest rates across the union from 1983 onwards. Relative to national baseline rates, each year interest rates fall in countries with historically high interest rates (e.g. Italy) and go up in those with traditionally low interest rates (Germany). As a result,

interest-sensitive national money demand (hence M^U) as well as the real side are affected. A reduction of nominal interest rates, for instance, is similar to expansionary monetary policy in a national country setting and is likely to produce overall stimulating effects in the country in question. Hence mere averaging of the monetary stability orientation in Europe produces macroeconomic effects in each year – relative to the baseline.

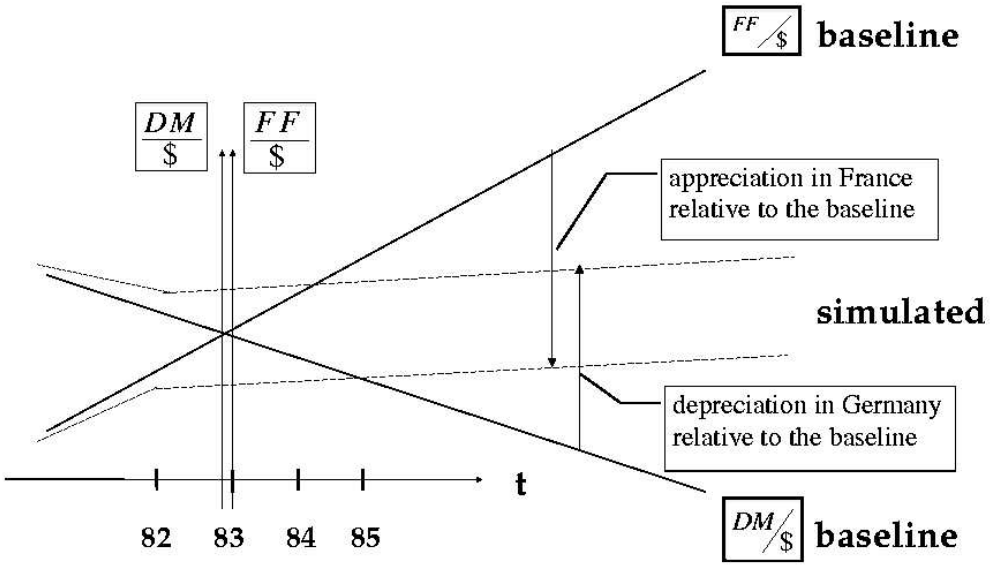
However, from the perspective of the national country, the link between a *change in national monetary stability orientation* relative to the baseline and a *change in interest rates* is not straightforward. It depends on the relative level of interest rates in member countries. Typically, a country with a historically low monetary stability record (like Italy) exhibits high nominal interest rates in the baseline. Hence, if nominal interest rates are averaged in the union, they decrease for that country, even though its monetary stability orientation rises relative to the baseline. (In section 5, it is shown that real interest rates do not necessarily go down, too.) Nominal interest rate figures presented in appendices A and B confirm this finding for the three hypothetical EMU scenarios analyzed in this paper. To make use of the result further down a generalization is given in

Observation 1 (Interest Rate Impulse) *A member country of a monetary union experiences short term interest rate impulses due to the common monetary policy in the union. – Interest rate impulses for historically low-stability countries (e.g. Italy) are likely to be expansionary (reduced nominal interest rates), even though – from a national perspective – the monetary stability orientation rises.*

Exchange Rate Impulses under CUR

Figure 1 offers a stylized representation of changes to exchange rates vis-à-vis the US-$ (cf. simulated data in appendix A) caused by the hypothetical EMU under CUR (within the framework of MULTIMOD). The downward and upward sloping straight lines depict baseline exchange rates for a historically strong currency (DM) and a weaker currency (FF

Figure 1: **Exchange Rates under CUR (Stylized)**



or Lira), respectively. The figure captures two diagrams: one for FF-$ rates, one for DM-$ rates. Ordinates are adjusted (scales differ) so that the baseline curves intersect in 1983, the start year of the hypothetical EMU.

The two dashed lines represent the simulated outcome from 1983 onwards; i.e. two representations of the Euro-$ exchange rate (cf. section 2): DM-$ (= 1 * Euro-$ – due to normalization), FF-$ (= FFConversionRate * Euro-$). The dotted lines depict the anticipation effect in 1982. Under CUR, there is an appreciation relative to the baseline for the FF and a depreciation for the DM, throughout. This applies for the anticipation period, too. Simulated conversion rates differ from bilateral 1983 baseline exchange rates, so that the (simulated) curves in figure 1 do not intersect any more. Both curves lie between baseline curves when moving out to the right. Note also that the distance between the two curves capturing simulation results must be "constant" from 1983 onwards, because conversion rates are fixed and interest rates are identical in the hypothetical EMU.[5]

Actual simulation results under CUR (presented in appendix A) correspond to the stylized representation in figure 1. France and Italy experience appreciations, Germany depreciations relative to their national currency in the baseline. Exchange rate impulses become stronger from period to period in the early years of the hypothetical EMU, but persist on a more or less constant level from 1986/1987, i.e. exchange rates to the US-$ relative to the baseline remain constant. Considering the magnitudes of appreciations/depreciations relative to the baseline, this is a very strong empirical result (based on an econometric model and the conditions of the 1980s). As it will be referred to later, this result for the endogenous conversion procedure CUR is summarized in

Observation 2 (Exchange Rate Impulse under CUR) *In a monetary union with conversion rates determined by the market, a country with an originally weak (strong) national currency typically experiences appreciative (depreciative) exchange rate impulses.*

Exchange Rate Impulses under PPP and CP

The underlying causality is different for endogenous (CUR) and exogenous conversion rate procedures (PPP and CP). Relative exchange rate impulses between two member countries (from 1983) can be represented by the simple quotient of baseline and simulated cross rate identities:

$$\frac{e_t^F(s)}{e_t^F(b)} = \left(\frac{e_t^G(s)}{e_t^G(b)}\right) * \left(\frac{e_t^{F,G}(s)}{e_t^{F,G}(b)}\right), \tag{6}$$

where $e_t^k(l)$ refers to the exchange rate (at time t) of country k ($k = G$ for Germany and $k = F$ for France – in local currency per US-$) with l indicating whether it is a simulated ($l = s$) or a baseline ($l = b$) exchange rate. Cross rates are expressed by $e_t^{F,G}(l)$. Simulated cross rates are either endogenous (with $e_t^{F,G}(s)$ flexible) or exogenous (with $e_t^{F,G}(s) = \overline{e_t^{F,G}(s)}$ fixed).

Under PPP or CP (relative to the baseline), the French Franc (vis-à-vis the US-$) appreciates by comparison to the the DM $\left(\frac{e_t^F(s)}{e_t^F(b)} < \frac{e_t^G(s)}{e_t^G(b)}\right)$, if and only if the exogenously given bilateral conversion rate $\left(\overline{e_t^{F,G}(s)}\right)$ is revalued relative to the corresponding bilateral baseline exchange rate $\left(e_t^{F,G}(b)\right)$. This is a mere tautology. However, it pinpoints the difference between (endogenously determined) market conversion rates (CUR procedure) and purchasing power rates or central parities which are imposed under the PPP or CP conversion procedures, respectively. The next observation is straightforward:

Observation 3 (Exchange Rate Impulse under Exogenous Conversion Procedures) *In a monetary union with exogenously fixed conversion rates, relative exchange rate impulses between two member countries can be produced by the (political) choice of the conversion rate.*

4 Interpretation 1: Simulation versus Analytical Results

Despite this difference in the underlying causality between CUR and exogenous conversion procedures PPP and CP, the FF and the Lira appreciate by comparison to the DM in all

cases – relative to the baseline. In fact, PPP results (cf. appendix B) are very similar to those under CUR. These results raise two questions. Why is there such a similarity between simulation results for an endogenous and an exogenous conversion procedure? Can we reconcile that FF and Lira exchange rates appreciate relative to the baseline, even though interest rates go down – relative to the baseline? (Conversely, we could ask why the DM exchange rate depreciates when interest rates increase.)

These questions are answered in reverse order. First, the link between interest and exchange rates is discussed in the light of results from standard open economy macroeconomic models. It is claimed that standard model results cannot be applied to the problem of forming or joining a monetary union because expectations must be adjusted for in a way they are not in such models. Second, it is argued that the CUR conversion procedure endogenously produces the same adjustment of expectations as the PPP procedure imposes exogenously. This explains why results for CUR and exogenous conversion procedures can be very similar. Third, it is then asserted, however, that the CP conversion procedure is actually fundamentally different (to both CUR and PPP).

The Role of Depreciation Expectations

The link between interest and exchange rates is analyzed in the standard theoretical literature (take the monetary model, the Mundell-Fleming model or the Dornbusch model). In these models, we learn that expansionary monetary policy is typically associated with both a nominal depreciation and either lower or constant interest rates.[6] Simulation results in this paper seem to contradict all of these models: countries with a fall in interest rates experience an appreciation, not a depreciation.

Even though exchange rates are fixed with the start of the monetary union, the comparison to (but not an application of) the aforementioned analytical models is still possible. For instance, the simulation under CUR captures a shift in monetary policy for each country

in the year prior to the start of the monetary union (i.e. the announcement period). As exchange rates are fixed at the endogenously determined rate in that year, changes in bilateral exchange rates are ruled out and interest rates are already equalized in that year (due to the open interest parity condition). In theoretical terms, we could say that simulation results reflect an immediate jump to the long run equilibrium starting in the year prior to the start of the monetary union. Even though national monetary targets have not changed in the announcement period, interest rates decrease in France and Italy, produce expansionary effects, and should, therefore, cause a depreciation. In Germany, higher interest rates should cause an appreciation.

This is not so, however, because the model baseline incorporates depreciation expectations for France and Italy relative to Germany (as well as to other countries) which are not captured in the theoretical models. (The same is true for appreciation expectations for the DM.) These expectations are based on the historical development of exchange rates.[7] By forming or joining a monetary union, these expectations become void. Thus, freed from depreciation expectations, simulation results show large appreciations for France and Italy – *relative to the baseline*. The elimination of bilateral depreciation expectations (here, for France and Italy) is a reflection of imported monetary stability due to the membership in the monetary union.

In the short and long run, there are – relative to the baseline – two potentially countervailing effects on the real economy. On the one hand, there is an *expansionary* effect (if the reduction in nominal interest rates translates into falling real interest rates – relative to the baseline). On the other hand, there is a *contractionary* impact caused by the appreciation (if the nominal appreciation is also a real one – relative to the baseline). The overall effect is not clear a priori and will be investigated in section 5.

The Role of Purchasing Power Parities

Based on the previous analysis of the link between interest and exchange rates, we can now turn to the discussion of similarities between results for endogenous and exogenous conversion procedures. Depreciation expectations for the FF and Lira imply that, in the baseline, FF and Lira are undervalued – based on the open interest parity. The opposite applies for the DM in the baseline. The PPP conversion procedure enforces a correction by imposing purchasing power parity exchange rates. The interesting result is that the CUR conversion procedure produces a very similar correction: near purchasing power parity rates are *endogenously* obtained. For two reasons, this makes sense. First, markets are freed from depreciation (appreciation) expectations caused by differences in monetary policy in the historical baseline. Second, the long run in the simulation model does not incorporate differential productivity or growth prospects.

Observation 4 (The Link between CUR and PPP Conversion Procedures) *Weak currencies are undervalued because of depreciation expectations caused by historically low monetary stability. Forming or joining a monetary union eliminates these expectations. If conversion rates are determined by the market, they turn out to be close to purchasing power parities. Hence CUR and PPP conversion procedures produce similar macroeconomic results.*

Obtaining near purchasing power parity rates under the market mechanism (i.e. the CUR conversion procedure) contradicts the theoretical indeterminacy problem: de Grauwe (1997), Obstfeld (1998), and de Grauwe, Dewachter, and Veestraeten (1999) argue that there is a possibility of (rational) self-fulfilling prophecies (on exchange rates), if the last quotations of market rates before the start of a monetary union are to be used as conversion rates. This is exactly the procedure used for CUR (irrespective of the fact that annual data is used here). The simulation results in this paper show, however, that there is no such indeterminacy problem once economic interdependencies of a large model are incorporated

in the analysis. In fact, one and only one outcome obtains in a perfect foresight setting. This is so, because the conversion rate in MULTIMOD must be consistent with a long run goods market equilibrium which requires "reasonable" exchange rates with respect to the real side.

For two reasons, the finding of near-purchasing power parity conversion rates under CUR is not just coincidental, but a strong empirical result. First, the solution is far away from the start values of the simulation run. Second, each simulation result is the outcome of hundreds of iterative loops of a forward-looking algorithm which has proved to be very robust.[8]

Differences for Central Parities

Under CP (cf. appendix B), there is a qualitative difference. The DM appreciates vis-à-vis the US-$ (not as much as the FF or Lira though) in the first years of the hypothetical EMU relative to the baseline. However, after 1985 the DM depreciates and crosses the unity line in 1987 (i.e. there is no change relative to the baseline). Also note that Lira and FF exchange rates to the US-$ remain almost constant between 1985 and 1987 relative to the baseline, although there was a reinforced appreciation under CUR.

These features result from the fact that exogenous CP conversion rates do not have any economic justification. That is why the CP procedure is actually very different to CUR and PPP. Under CP, there is a conflict between the steady state properties in the long run and imposed central parity conversion rates from 1983 which are taken from outside the model. A split outcome obtains to reconcile the restriction in the short run and the long run requirement. In the longer term, the DM depreciates, and the FF and Lira appreciate relative to the baseline (similar to CUR). In the short run, they cannot diverge as much as required and possible under market conditions (CUR). All currencies appreciate. The medium term (most visibly, the years 1986 and 1987) is a period of adjustment. German exchange rates – relative to the baseline – appreciate by more, Italian and French ones by

less than under CUR.

5 Simulation Results 2: Impulse Transmission and Real Effects

Causes for interest and exchange rate impulses produced by any monetary union have been explored in the previous two sections and the results have been summarized in observations 1 to 4. Comparing the (historical) baseline to hypothetical EMU scenarios in a simulation analysis produces results which contradict those obtained in standard open economy models. The introduction of a monetary union is shown to produce an appreciation and lower interest rates in Italy and France, i.e. countervailing (contractionary) exchange and (expansionary) interest rate effects. Germany experiences just the opposite (except for the case of the CP scenario).

This section captures the transmission of impulses into real variables as revealed by the simulation analysis. First, relevant transmission effects are discussed for each country under CUR, PPP, and CP scenarios. Then, a potential trade-off between interest and exchange rate impulses is brought out.

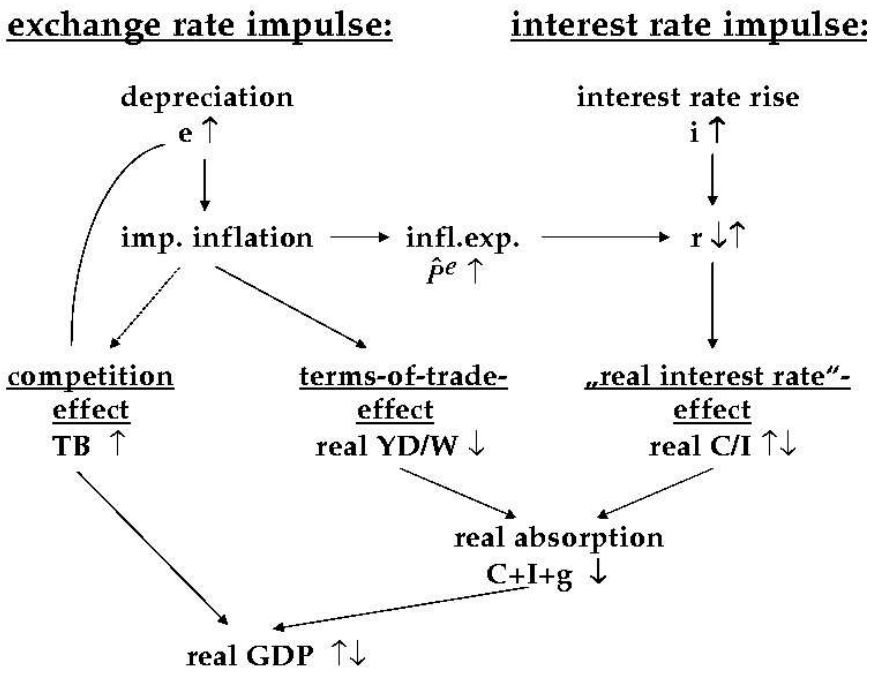
The Transmission of Impulses in Germany under CUR

In all scenarios, the transmission of interest and exchange rate impulses into the real economy can be summarized as follows:

Observation 5 (Transmission Mechanisms) *Interest and exchange rate impulses produce real effects, which can be explained by three transmission mechanisms: a competition effect, a terms of trade effect, and a real interest rate effect.*

As an example for observation 5, effects on the real economy are presented for Germany – under CUR – in figure 2. The representation of simulation findings is simplified by focusing

Figure 2: **Transmission of Impulses in Germany under CUR**



on the three already mentioned transmission mechanisms: a positive competition effect, a negative terms of trade effect on income and wealth, and a real interest rate effect that is positive in the short run, but negative in the medium and long run. The overall impact on German GDP is positive at first, but turns negative after 1985.

Relative to the baseline, the depreciation of the DM raises prices for imports, thereby causing imported inflation. Since prices are sticky, future inflation goes up as well, so do inflation expectations ($\widehat{P^e} \uparrow$) due to rational expectations. Hence, by definition, real interest rates r are lowered. However, at rising nominal interest rates, the net effect on German real rates is ambiguous a priori. In the short run, strong interest rate equalization effects are overcompensated due to even stronger effects on expected inflation. In the medium term, however, elevated nominal interest rates relative to the baseline dominate the behavior of real rates.

Even though real interest rates decrease in the announcement period and in the first years of the hypothetical EMU, German private investment I and consumption C (government consumption g is exogenous) stay below baseline levels throughout. This is due to a negative terms of trade effect lowering real wealth W and real disposable income YD. National purchasing power is reduced. Nonetheless, German GDP increases up to 1985 because of a boost to trade caused by the real depreciation. This competition effect is caused by the nominal depreciation which clearly dominates the countervailing effect of rising prices (dashed line in figure 2). Notwithstanding the lasting nature of the positive trade effect (trade balance $TB \uparrow$), the contractionary impact of rising nominal *and* real interest rates determines the overall outcome in Germany in the medium and long run.

Supply side aspects (which are not captured in figure 2) reinforce the inflationary impact of the DM depreciations. Since the capital stock is systematically run down (relative to the baseline), and output increases in the announcement period and the beginning of the hypothetical EMU, capacity utilization rises until 1985 – relative to the baseline. Inflation caused by capacity utilization effects (according to the Phillips curve relationship) augments

imported inflation effects. As seen above, inflation causes real interest rates to decrease in the first years despite higher nominal interest rates. After 1985, capacity utilization returns to baseline levels, thus eliminating additional inflation effects in Germany.

Impulse Transmission in the Other Cases

The transmission of impulses in France is basically a mirror image of those in Germany except that the trade balance is positive in the first few years. Nonetheless, contractionary effects in the short run are stronger than corresponding expansionary ones in Germany. This is possible because of the rather moderate relative decrease of nominal interest rates reflecting the intermediate position of French interest rates in the historical baseline.

In Italy, results are much more clear-cut than in France and Germany. Throughout there is a negative competition effect, a positive terms-of-trade effect, and a very strong positive real interest rate effect. Overall, GDP is permanently above baseline levels. Despite a build-up of capital, capacity utilization increases (thereby pushing up costs). The ensuing inflationary impact (due to the Phillips curve relationship) is strong enough to cancel out imported disinflation effects. At inflation near baseline rates and sharply decreasing nominal interest rates, clearly, the real interest rate effect on output must be positive and very strong.

Most impulses, effects, and results (as discussed for CUR) prevail, qualitatively, under exogenous conversion procedures. The interest rate impulse remains almost unchanged, because interest equalization invariably applies to all conversion procedure. In contrast to CUR, the PPP or CP exchange rate impulse is affected by fixed conversion rates. In particular, depreciation impulses are considerably smaller for France under PPP, and for France and Italy under CP. As a result, effects are dampened, but not drastically changed.

The situation is different for Germany under CP. There is a nominal appreciation until 1986 – in contrast to the permanent depreciation under CUR. The appreciation causes a switching of signs for most variables in the short to medium term in figure 2. In the an-

nouncement period and the first few years of the hypothetical EMU, disinflation is imported and reinforced by capacity utilization below baseline levels. As a result, the real interest rate effect on absorption is negative in those years, not positive as under CUR. Despite a positive terms-of-trade effect in these first years (due to imported inflation), absorption falls throughout – relative to the baseline. Overall economic activity measured by GDP permanently stays below baseline levels, although the trade balance is more positive during the entire period. (In the years with appreciations relative to the baseline, the competition effect remains positive because appreciations are overcompensated by the ensuing disinflation.)

The Interest-Exchange Trade-Off

Nominal impulses in terms of interest and exchange rates are the determinants of real effects caused by the EMU – relative to the baseline. In the case of an appreciation combined with a rise in interest rates, as for Germany under CP, the effect was unambiguously negative (except for the smaller terms of trade effect). In all other cases, there was a potential trade-off, either between depreciations and interest rate rises relative to the baseline, or between appreciations and a drop in interest rates.

In a trade-off situation, real interest rates seem to be decisive, empirically. If one of the nominal impulses determines the effect on the real interest rate r *and* produces a large change in r relative to the baseline, then the overall outcome is governed by the real interest effect. As an example, take the nominal interest impulse in Italy. Under all conversion procedures, it is so powerful, that real interest rates clearly decrease in most periods (or are close to the baseline – in *some* periods under CP and PPP). As a result, Italy gains under all conversion procedures. These empirical findings are summed up in

Observation 6 (Real Effects) *Real macroeconomic effects for individual countries forming or joining a monetary union depend on a potential trade-off between interest and exchange rate impulses. Typically, a decisive change in real interest rates determines the*

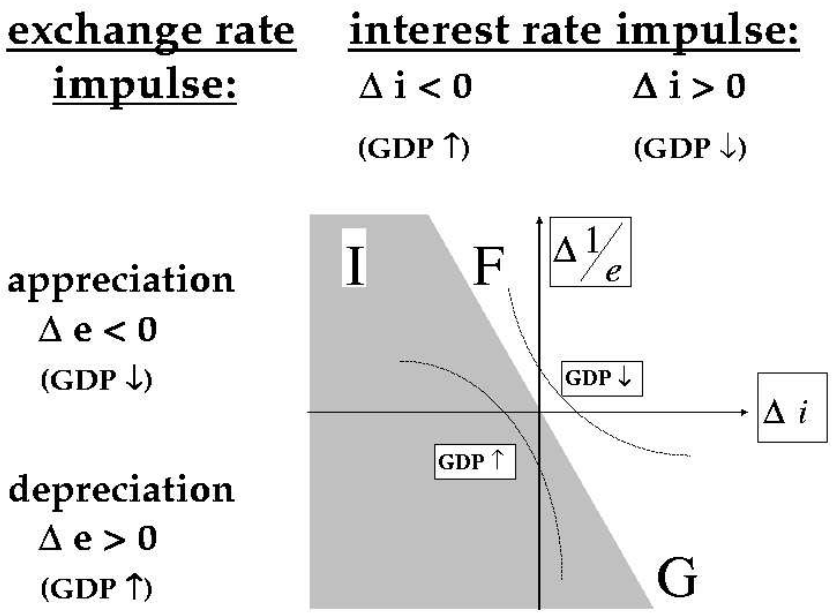
overall outcome.

The trade-off – with respect to effects on the real economy – between interest and exchange rates is conventional wisdom. It clearly depends on the openness of a national economy. But there seems to be almost no empirical or theoretical literature. In particular, no attempt has been made, to my knowledge, to apply a formal trade-off argument to the real world EMU. Only McRae (1998) mentions – with wrong numbers though – a so-called "four-to-one rule of thumb that is sometimes applied to the UK (four percentage points on the [real] effective exchange rate are equivalent to one point on [real] interest rates)".[9]

However, the trade-off discussed in this paper refers to nominal variables. It is a qualitative description of simulation results. The diagram in figure 3 presents the impact of nominal interest and exchange rate impulses on GDP – relative to the baseline – in a stylized way. It shows that effects are unambiguous in the first and third quadrant, but countervailing in the others. No quantitative results are presented, because it is not claimed that a regular relationship or even a law was discovered. In fact, the trade-off is likely to depend on economic conditions, the time period, and the temporal link (e.g. a lag) to the original impulse. The dividing line between positive and negative GDP effects may be jagged or fuzzy.

Under CUR and within the framework of figure 3, Italy is positioned in the fourth quadrant and moves up right over time, but stays well within the area of positive GDP effects. France, in the same quadrant, starts out in the area of negative GDP effects, but ends up in the shaded area, although her position moves up right as well. (The overall GDP effect for France after 10 years remains negative though.) The German position in the second quadrant changes from the shaded area to the area associated with negative GDP effects – despite the fact that the interest rate decreases relative to the baseline (leftward movement) and the depreciation slightly increases over time (downward movement). By expanding the model, it could be attempted to get a *quantitatively* better understanding of the actual

Figure 3: **Nominal Impulses and Real Effects (Stylized)**



trade-off between interest and exchange rate impulses in a monetary union relative to a situation without monetary union. This task must be left for future research.

6 Interpretation 2: Real World EMU

Simulation results depend on assumptions of the underlying model MULTIMOD, on how the EMU is taken account of in this paper, and on the historical baseline. There is almost unlimited scope for alterations and extensions of the simulation exercise. In particular, changes of private agents' behavior could be incorporated in the analysis to account for the Lucas Critique. For instance, the higher degree of monetary stability experienced in some countries due to the formation of the real world EMU (e.g. in Italy) is likely to have raised private money holdings, and additional financial opportunities could have affected the interest sensitivity of money demand in individual member countries.

Furthermore, monetary and fiscal policies could be modelled to conform more closely to the real world situation of the real world EMU. A fiscal consolidation (cf. Bohn, 2002) and a more stability-oriented hypothetical ECB would have to be included in the analysis. However, in this paper the focus is on fundamental impulses and their transmission effects and trade-offs, not on the correct description of and *quantitative* predictions for the actual EMU. Nonetheless, the relevance of *qualitative* simulation findings for the real world European Monetary Union is discussed in this section by asking four questions. They relate to the existence of interest and exchange rate impulses in the real world EMU (question 1); anticipation effects in the run-up to the real world EMU (question 2); macroeconomic effects after its start in 1999 (question 3); and the decisions taken at the EU Summit in Brussels on 2 May 1998 (question 4).

Note that simulation results and findings of the analysis are based on relating *hypothetical EMU scenarios* to a reference scenario, the *historical baseline*. However, for the observable *real world scenario* of the actual EMU, there is no readily available reference scenario.

Instead, based on conjectures, a *conceptual scenario* with no plans for a monetary union must be constructed (in one's mind's eye).

Question 1: *Do the underlying economic (policy) conditions for the actual EMU resemble those found in the simulations?*

More precisely, the question is if the change from the aforementioned conceptual scenario to the real world EMU corresponds qualitatively to the change from the historical baseline to the hypothetical EMU scenarios as postulated in the simulation exercise. The economic conditions in the real world are likely to differ from those in the conceptual scenario. How do nominal interest and exchange rates differ? These two nominal impulses were shown to trigger the effects on the real economy in the simulations on the hypothetical EMU – relative to the baseline. To assess their role in the actual EMU the question can, therefore, be split into two parts: (i) would noteworthy short term interest differentials have remained, if the real world EMU had *not* been announced in 1992 nor set up in 1999 (conceptual scenario); (ii) are there reasons that justify deviations of conversion rates in the real world EMU from bilateral exchange rates in the conceptual scenario without EMU? Both questions are answered with a clear yes.

Consider nominal short term interest differentials first. Interest rates observed a few years before the start of the EMU in 1999 already incorporate changes in monetary policy in prospective member countries conducted in anticipation of the start of the real world EMU. Table 1 presents nominal interest rates at various points in time prior to the start of the actual EMU. The interest differential for Germany and Spain, for instance, has shrunk to 1.13 % in January 1998. If interest rates for a situation without the EMU (conceptual scenario) are to be conjectured, one must look at rates prior to the announcement of the real world EMU. In 1992, the year of the Maastricht Treaty, interest rate differentials are large between the Southern countries (e.g. Spain and Italy) and the more stability-oriented so-called core countries, especially Germany, (Austria, and the Netherlands could be added), but also France (since the 'Franc Fort' policies eventually lead to low interest rates in the

Table 1: **Nominal Short Term Interest Rates prior to EMU**

Three months interbank rates or yields on 3-months Treasury bills

	Germany	France	Italy	Spain	USA
Jan. 1982	10,46	15,07	20,96	n.a.	13,38
Jan. 1992	9,53	9,98	12,36	12,88	4,47
Jan. 1998	3,57	3,62	6,09	4,70	5,54

Source: OECD, Main Economic Indicators, January 2003, April 1998, July 1993, July 1983 (nominal short term interest rates [in percent])

early 1990s). The data may be seen as evidence for considerable differentials (between European countries) that would have prevailed – at least to some extent – in a conceptual scenario without EMU.[10] On this basis, the real world EMU is likely to have caused and still cause large interest rate impulses relative to the conceptual scenario – qualitatively identical to those found in the simulation runs conducted in this paper.

As to exchange rates, consider changes in long term monetary stability (cf. section 3). Since the Maastricht Treaty in 1992, a formidable effort towards harmonization of monetary policies – at a high level of stability – can be observed. Monetary stability convergence implies less pressure for currencies of low stability countries. In fact, central parities of the ERM which were used as conversion rates in the real world EMU did not have to be changed for most countries after 1992.[11] By contrast, in the conceptual scenario without monetary union, there is no reason why monetary stability policies would have harmonized to such a degree in so many European countries. Thus, bilateral exchange rates in a hypothetical situation without the prospect of the EMU (i.e. the conceptual scenario) might well have differed (at least in some countries) from actual conversion rates used in the real world EMU. Thus, relative to the conceptual scenario, the real world exchange rate impulses, too, are likely to be qualitatively identical to those found in the simulations.

Question 2: *Do anticipation effects observed in the run-up to the real world EMU correspond to anticipation effects produced by the simulations?*

It has already been mentioned that the model does not exactly capture the real world situation. In reality, the period between announcement and actual start of the EMU was longer. Also, there was uncertainty about the prospect of the EMU project altogether. Hence, anticipated adjustments are likely to be more clear-cut in simulations, with stronger level effects, but less volatility (in an annual model) than in the run-up to the real world EMU.

However, qualitatively, there is strong real world evidence to confirm anticipation effects found in the simulations. Depending on political events and on market expectations on the prospects of the (real world) EMU as well as on participating countries, long run interest rate differentials between potential EMU countries changed drastically (cf. IMF, 2001 and 1998). For instance, the long rate differential for Germany and Italy came down to 3.5 % in 1994, widened again to 5.3 % in 1995 (when Italy's participation in the EMU seemed less likely) and was down at 0.3 % in February 1998 (when markets were convinced that Italy would be a member).

The effect of narrowing long run interest differentials is captured in the simulations. Under all conversion procedures, long rates in all EMU countries equalize around 13 % (CP: 12.5) in 1983, the first year of the hypothetical EMU. In the announcement year 1982, they are between 13 % (CP: 11.5) in Germany (up from 9 % in the baseline) and 15 % (CP: 12.5) in France and Italy (down from 16 and 20 % respectively).

The validity of anticipation effects for both interest and exchange rates was shown most clearly, when there were rumors that Britain would join the real world EMU as of 1999. Within a few hours, the British-German (long) interest differential shrank by 22 basis points to only 96. At the same time, the Sterling depreciated by 4 pfennigs to an exchange rate of 2.83 DM, because an even lower conversion rate is said to have been expected (Financial Times, 29 September, 1997).

Question 3: *Did countries benefit from the European Monetary Union?*

More precisely, the question is if we can make conjectures (or an "educated guess") about the macroeconomic effects of the real world EMU *relative to* the conceptual scenario. It was argued in question 1 that nominal impulses in simulations conducted in this paper do actually exist in reality, at least qualitatively. However, it was also acknowledged in section 2 that nominal interest rates are lower and the monetary policy is more stability-oriented in the real world EMU than under the hypothetical EMU scenarios presented in this paper. Acknowledging that the ECB does actually pursue monetary stability à la Bundesbank, interest rates in the real world EMU are likely *not* to have been affected much in Germany *relative to* the conceptual scenario without monetary union; but they must have fallen sharply in Italy or Portugal, for instance – *relative to* the conceptual scenario. At the same time, there has probably been a minor depreciation of the DM *relative to* a situation without monetary union. The real world Euro depreciation in 1999 may be seen as supporting evidence. The conjecture of a *relative* depreciation for the DM in the real world EMU is based on the assumption that prospective EMU member countries would have conducted monetary policies geared at somewhat less monetary stability on average under the conceptual scenario without monetary union.

On balance, Germany no longer seems to suffer from the formation of a monetary union as suggested by simulation analysis presented in this paper. Instead, she is likely to have gained from a minor competition effect and also (due to imported inflation) from somewhat reduced real interest rates – *relative to* the conceptual scenario. In other words, the slump in Germany in 2002 and 2003 might have been worse in the absence of the EMU. Similar conjectures can be made for Austria, the Netherlands, and France, for instance. Countries (like Italy, Portugal, Spain) with a more ambiguous monetary stability record in the past are likely to have experienced an appreciation *relative to* the conceptual scenario without monetary union, but to have enjoyed reduced nominal and real interest rates. Italy with an excessively high nominal interest rate in the conceptual scenario (leveraging on her huge fiscal deficit) is likely to have gained most by the introduction of the real world EMU – just

as presented for the hypothetical EMU.

Prima facie, it seems likely that a Pareto-superior outcome (in terms of aggregate output over the longer term) obtains in the real world EMU – relative to the conceptual scenario – compared to the simulation results. This is due to the larger expansionary interest rate impulse for Italy and the elimination of the contractionary interest rate impulse in Germany.

Question 4: *Was the interest-exchange trade-off (illustrated in this paper) relevant for decisions associated with the EU Summit in Brussels on 2 May 1998?*

Question 4 examines the normative application of simulation findings to real world politics. Could the knowledge of a potential trade-off between interest and exchange rate impulses have been used for the decisions on membership and conversion rates taken at the EU Summit in Brussels on 2 May 1998? Could it have been used for enabling Britain to be part of the EMU?

Decisions taken at the EU Summit in Brussels were largely determined by political considerations. To avoid haggling over conversion rates central parities of the European Monetary System were used as conversion rates. Even though market rates of all currencies (but the Irish punt) adjusted to them more than a year before the start of the real world EMU, it is questionable if these conversion rates were justified on economic grounds. (In section 4, it was shown for the hypothetical EMU scenario that CP conversion rates did not have an economic justification.) The point can best be demonstrated for the Irish case. Markets generated exchange rates substantially different from conversion rates before 1998. They were still about 6% different in early 1998. The EMS realignment in March 1998 narrowed the gap to about 3%, but market rates gradually depreciated to central parities once the final decision was taken at the Brussels Summit that central parities would be used as conversion rates at the start of the EMU. By doing so, the EMS did not acknowledge market rates, but forced the Irish punt to depreciate.

The findings of this paper suggest that this was unreasonable, at least in the case of Ireland.

Producing an expansionary exchange rate effect meant reinforcing an expansionary interest rate effect which was caused by the reduction of interest rates with the start of the EMU. As a result, Ireland enjoyed a competitive advantage in the EMU, but at the cost of fuelling an already hot economy. Therefore, the competitive edge did not last long. Asset price inflation and imported inflation effects lead to an appreciation of real exchange rates. However, the economic downturn expected by some economists did not happen. The effect of reduced interest rates (which is much stronger than the one caused by depreciating exchange rates) is corroborated in The Economist as of 14 November 1998. These adverse effects could have been alleviated, if the conversion rates had been adjusted at the start of the EMU.

The interest-exchange trade-off could have also been exploited (along the same lines as for Ireland) to facilitate Britain's membership in the EMU from an economic point of view. But the decision to stay out of the real world EMU was politically motivated anyway. The participation in the EMU would have produced economic problems, because business cycles in Britain (as in Ireland) and on the Continent were asynchronous in 1998. Lower (equalized) interest rates caused by the real world EMU would have lead to an overheating of the economy (as it did in Ireland). In principle (see qualifications in the next paragraph), it would have been possible though, on an *aggregate level*, to use an appreciative exchange rate impulse for curbing the ensuing overexpansion – just as in Ireland.

In reality, this was unrealistic for two reasons. First, there would have been considerable allocative and distributive effects, but this is also true for Ireland. Second, and probably more importantly, Britain was not likely to overcome its political rejection of joining at a high Sterling conversion rate, say at 2.9 or 3 $\frac{DM}{£}$. This view has some economic justification, because high exchange rates (of 2.7 to 3.0 $\frac{DM}{£}$ during 1998) were overvalued (in contrast to the situation in Ireland). For instance, purchasing power exchange rates were estimated at 2.4 or 2.5 $\frac{DM}{£}$ and real effective exchange rates had drastically risen since 1995 (OECD, October 1998), i.e. there had already been a considerable loss in competitiveness. All in all, the case for Britain to join the EMU at high rates was not as strong as it was to revalue

the central parities for the Irish punt (by 6 instead of 3% to match market rates) in order to somewhat alleviate expansionary effects caused by the interest rate impulse.

7 Conclusions

Comparative simulation analyses are often used to present results for a particular quantitative question. In this paper, the scope of the analysis is deliberately restricted to understanding and applying qualitative findings. Results are derived in a four stage process. In the first stage, various scenarios for a hypothetical EMU are devised (in sections 1 and 2) and simulation results obtained. In the second stage, nominal interest and exchange rate impulses – relative to a situation without monetary union – are analyzed (in sections 3 and 4). Observations 1 to 3 summarize the findings for each impulse under alternative conversion procedures. Observation 4 captures the crucial role of exchange rate expectations. Two inferences emerge: (i), standard textbook results cannot be used for analyzing effects produced by the transition to a monetary union; and (ii), it is disputed that conversion rates could be indeterminate due to (rational) self-fulfilling prophecies (as argued by de Grauwe, 1997, Obstfeld, 1998, and de Grauwe, Dewachter, and Veestraeten, 1999), if the last quotations of market rates before the start of a monetary union are to be used.

As for the third stage, observations 5 and 6 (in section 5) capture the role of transmission mechanisms and emphasize the potential trade-off between interest and exchange rate impulses. It is shown that the interest rate effect typically determines the overall effect on the real economy. In the fourth stage, results and insights are applied to the real world EMU by examining 4 questions (in section 6). Since economic (policy) conditions are qualitatively captured by the simulation analysis, it is possible to substantiate anticipation effects observed in the run-up to the real world EMU. Furthermore, the knowledge of a potential trade-off between interest and exchange rate impulses can be used in two ways: (i) to make an "educated guess" (for each current member) of the expected overall macroeconomic costs

or benefits of joining the EMU; and (ii) to critically review the decisions taken at the EU Summit in Brussels on 2 May 1998. The main result is that the EMU has probably benefitted most countries, but the interest-exchange trade-off could have been better exploited, for instance in the Irish case.

The trade-off between nominal interest and nominal exchange rate impulses can also be used for making some policy recommendations concerning future enlargements of the real world EMU or relating to any other monetary union. Since most prospective member countries are likely to gain from lower interest rates, they can be required to join at realistic (not devalued or undervalued) exchange rates. This may be particularly relevant for prospective applicants from Eastern Central Europe like Poland, Hungary, or the Czech Republic. However, care must be taken to avoid recession or overheating effects, in case interest and exchange rate impulses reinforce one another (instead of exhibiting trade-off effects). The right timing for joining a monetary union is crucial, if policy makers want to make sure that conditions are advantageous for all countries involved.

The analysis of this paper and its interpretations may be criticized, because the interest-exchange trade-off is not the only effect relevant in a monetary union. First, numerous behavioral changes (especially concerning money demand and financial markets) which are conceivable in the real world EMU are not captured. Second, contractionary fiscal policies required by the Maastricht Treaty may have significant consequences. In principle, the positive picture for (previously) high interest and high debt countries like Italy may darken considerably in the short to medium term (though it may prove to be advantageous in the long run).

However, these limitations do not challenge the main findings of this paper for three reasons. First, interest and exchange rate impulses and real effects discussed here may be affected (or even dominated) by other effects, but they are relevant in any monetary union, nonetheless. In fact, in Bohn (2002) it is shown that the beginning of the EMU offers ideal conditions for fiscal consolidations because of countervailing expansionary interest rate impulses caused by

the EMU in highly indebted countries. Second, it may be argued that behavioral changes or additional requirements (like fiscal consolidations) would have partly happened, even if the EMU had not been envisaged to start on 1 January 1999. Third, additional requirements and behavioral changes do not apply in all countries to the same degree because, for instance, financial markets work differently in different countries or fiscal consolidations are not required. Britain is an example for the latter. The main future candidate for the real world EMU does not have an excessive debt or a deficit beyond the limits set down by the Maastricht Treaty.

To conclude, this paper has shown that joining members of any monetary union are likely to experience considerable macroeconomic effects – relative to a situation without monetary union. This is due to changes in interest and exchange rates which are caused by the transition to a monetary union. Although this is conventional wisdom, it was not and still is not accounted for in debate on the EMU. The reason may be that the current discussion lacks sound theoretical and empirical underpinnings, because the transition to the EMU *and* the period after its actual start are typically not included in the same model. Nonetheless, there is still a need for studying the macroeconomic effects caused by joining a monetary union as there are future EMU candidates and, possibly, other emerging monetary unions. Various qualitative effects cannot be shown within the framework of a small theoretical model, but require the type of simulation exercise presented here: (i) the endogenous change in depreciation expectations; and (ii) the potential trade-off between interest and exchange rate impulses.

The implications are far-reaching. First, policy makers may consider to use last-day market rates as conversion rates, if such conversion rates are – as shown in this paper – economically sound as well as rationally and uniquely determined (i.e. there is no theoretical indeterminacy problem). As for the EMU, this would be an alternative to fixing conversion rates at central parities of the ERM II. Second, if better understood, the interest-exchange trade-off could be exploited by policy makers to cushion the early implications of membership in any

monetary union. This is particularly relevant for the future enlargement of the EMU. All in all, it is vital that policy makers are given the theoretical and empirical basis for the understanding of all effects (micro and macro) produced by joining a monetary union.

Notes

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Some preliminary work was done at Princeton University. Financial support by Princeton University, the International Finance Section, the German Academic Exchange Service, and the Landesgraduiertenförderung of Baden-Württemberg is gratefully acknowledged.
All remaining errors are mine. – Comments most welcome.

[1] In the papers written prior to the start the real world EMU, the procedure for implementing a common currency is either derived from a joint optimization problem for the two hypothetical EMU countries (in Hughes Hallett and Ma, 1996, and Hughes Hallett and Vines, 1993) or the market exchange rates of the reference model are imposed as bilateral conversion rates (in Masson and Melitz, 1991).

[2] He can formally show that, initially, the devaluing country experiences a real depreciation and a positive effect on the current account and on output. Over the medium term, there is an aggregate expansion, but prices go up, too (due to the excess demand for goods and because of imported inflation effects). In the long run, the real exchange rate and output are back at their original levels.

[3] A more complete description of the model can be found in Masson, Symansky, and Meredith (1990). It includes theoretical underpinnings and estimation details (univariate, mul-

tivariate, pooled estimations; error correction models; calibrations) as well as examples for using MULTIMOD in policy analyses and standard simulation exercises illustrating the properties of the model. Inter alia cf. also Bohn (1997) for a stylized core model of MULTIMOD, and Mitchell, Sault, Smith and Wallis (1995) for comparisons with other multi-country models.

[4] Hill, 1986, p. 140, table 3, bottom line.

[5] To be exact, it is not the distance, but the ratio of exchange rates to the US-$ that must be constant. Even though conversion rates are fixed at 1982 exchange rates under CUR, this ratio is typically different in 1982, because interest rates are not yet fully harmonized in the announcement year.

[6] In the case of the Dornbusch model, interest rates rise for an increase in the growth rate of the money supply, but remain constant for a level increase.

[7] Since the introduction of the European Exchange Rate Mechanism in 1979 there were numerous devaluations in Italy (and to a lesser extend in France) as well as revaluations in Germany. This is certainly true up to 1987, but it might have continued in the 1990s, if Italy had not dropped out of the ERM in 1992, and if the EMU had not been announced.

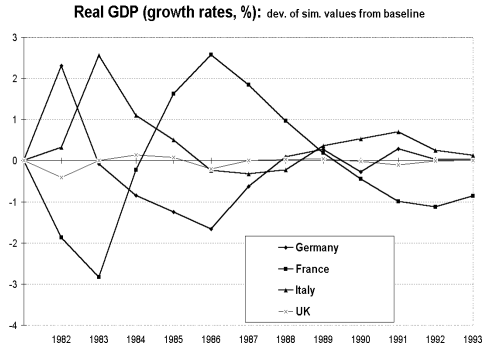
[8] The Fair-Taylor algorithm (Fair and Taylor, 1983) contains a Gauss-Seidel algorithm and is more reliable than Newton-Raphson procedures. There is no formal proof that model solutions are unique, but many simulation experiments based on MULTIMOD (for instance, by Hughes Hallett and collaborators, Masson et al., and Wallis et al.) and own sensitivity analyses indicate that unique model solutions can be expected.

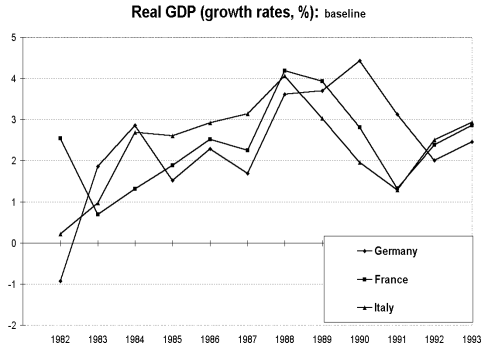
[9] He presumably refers to the Monetary Conditions Index given by the IMF (1997). The correct ratio for the UK is 3 to 1.

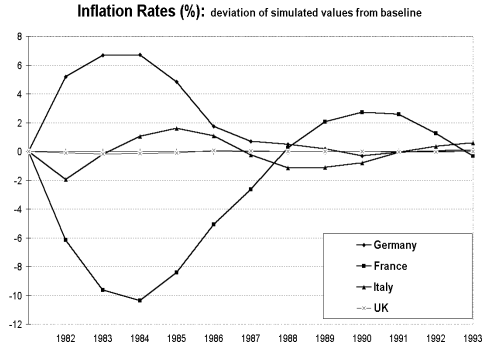
[10] It must be admitted that the data in table 1 could be interpreted differently. If we include earlier periods, we could argue that there is a trend towards smaller interest rates and smaller differentials, that would have prevailed with or without the EMU. However, this view ignores effects originating from obligations for the creation of independent central banks and from each country's desire to fulfill the (nominal) Maastricht Criteria.

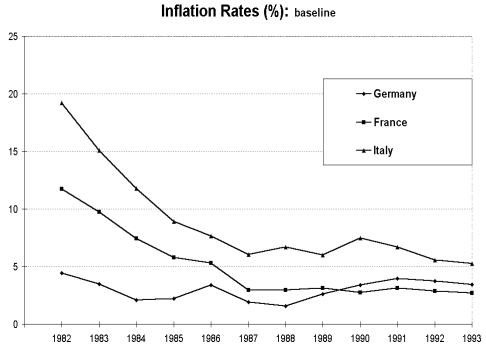
[11] Ireland joined, Italy rejoined the ERM in 1996; the Irish punt was *revalued* by 3% shortly before the EU Summit in May 1998.

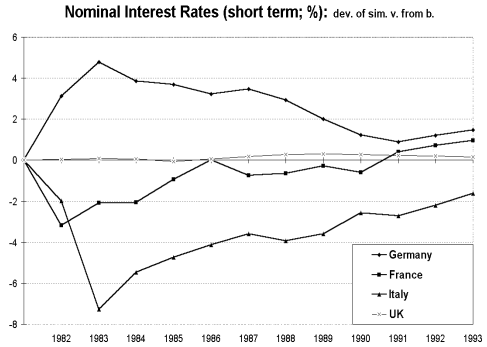
Appendix A: 'CUR' Results (left) and Baseline (right)

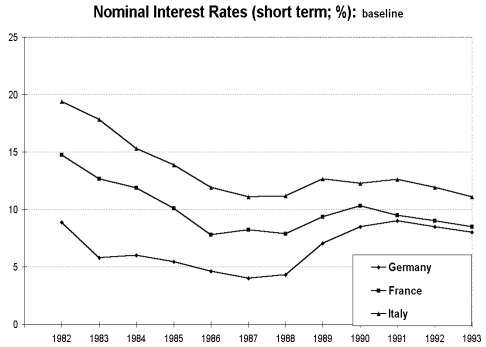


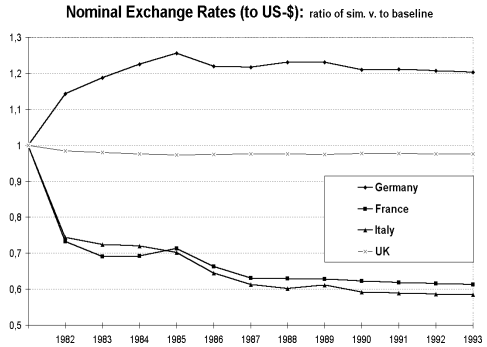


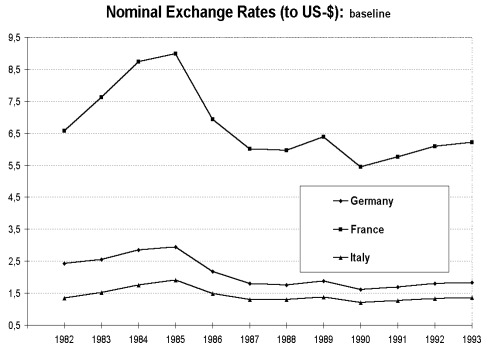






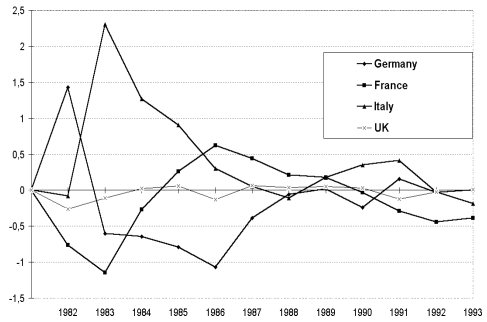




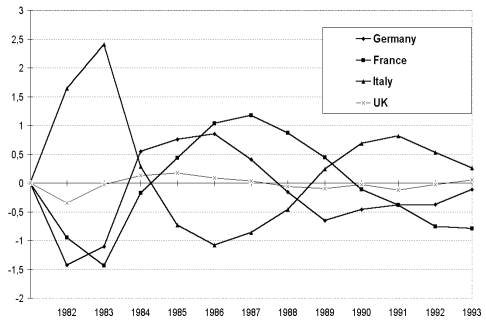


Appendix B: 'PPP' (left) and 'CP' (right) Results

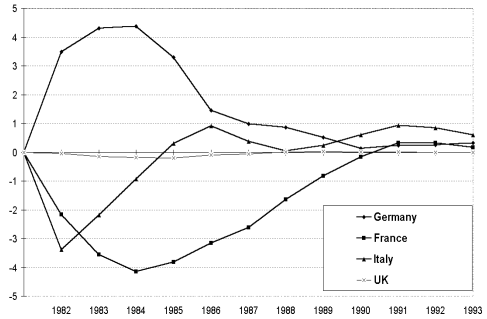
Real GDP (growth rates, %): dev. of sim. values from baseline



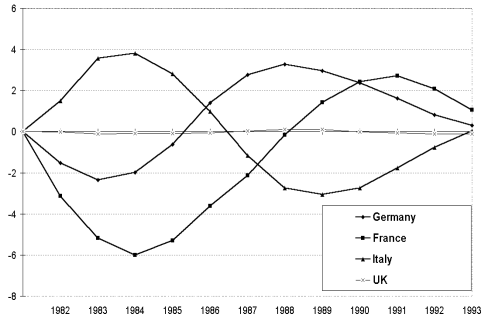
Real GDP (growth rates, %): dev. of sim. values from baseline



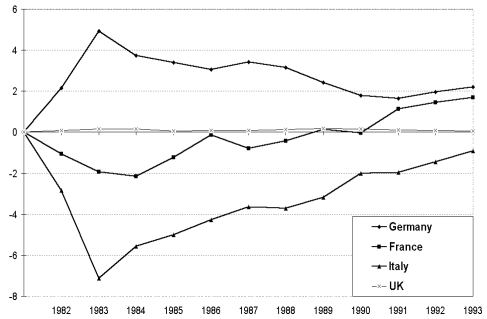
Inflation Rates (%): deviation of simulated values from baseline



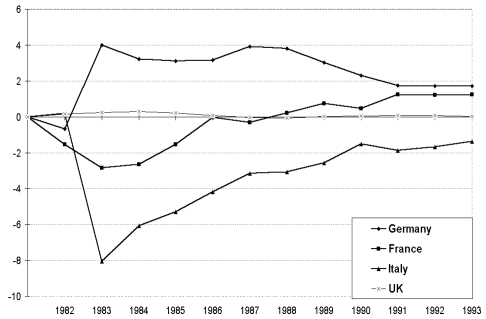
Inflation Rates (%): deviation of simulated values from baseline



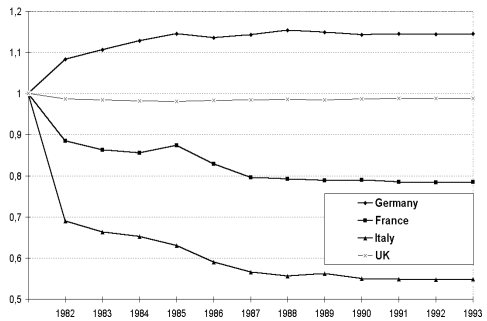
Nominal Interest Rates (short term; %): dev. of sim. v. from b.



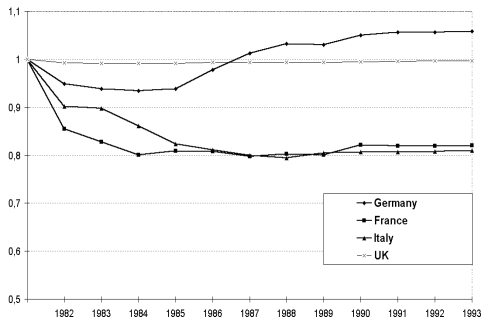
Nominal Interest Rates (short term; %): dev. of sim. v. from b.



Nominal Exchange Rates (to US-$): ratio of sim. v. to baseline



Nominal Exchange Rates (to US-$): ratio of sim. v. to baseline



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