Real Interest Parity, Dynamic Convergence and the European Monetary System

by

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Abstract

Is further economic convergence between European Monetary System (EMS) member countries desirable? This paper addresses some of the convergence issues currently being raised in the debate over Economic and Monetary Union (EMU) in Europe, with particular emphasis on the behaviour of real interest rates. The important distinction between static and dynamic convergence is highlighted. A standard analytical framework is presented which illustrates the importance of the components of the real interest differential—namely capital controls, risk premia and the real exchange rate—as endogenous mechanisms for the transmission of policy. As such, variations in the real interest differential are shown potentially to be important for ensuring dynamic convergence to a steady-state EMU.

1 Introduction

Is further economic convergence between members of the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS), prior to eventual Economic and Monetary Union (EMU) between them, necessarily desirable? While the on-going EMU debate appears to have taken the desirability of further economic convergence as axiomatic, the answer to this question—as often in economics—is twofold: yes and no.

In this paper we aim to address some of the convergence issues currently being raised in an EMU context. Our particular focus is the behaviour of real interest rates across the ERM bloc. By defining more precisely the concepts underlying the convergence debate, we are able to shed light on apparent empirical irregularities (or incidences of apparent 'lack' of convergence) among ERM members, such as observed violations of real interest parity (Haldane and Pradhan (1991)): see Section 2. This is achieved using a standard analytical framework, augmented to characterise as accurately as possible the historical behaviour of ERM members in the system: see Section 3. Our findings suggest that, while empirical comparative statics may indicate a failure of convergence between ERM members on the basis of simple, static differentials, these differentials may themselves be important for ensuring a stable dynamic convergence path. Section 4 briefly summarises and concludes.

2 Convergence: statics and dynamics

The economic rationale for further convergence between ERM members as a pre-condition of eventual EMU appears to be based around 'real' cost minimisation, where the real costs are defined in terms of the prolonged (and potentially permanent) under-utilisation of factors following a shock. The first-best path to monetary union is then simply the one which offers the least costly means of dynamic adjustment. Following Mundell (1961), these costs will be determined by the degree of cross-country factor mobility/price flexibility. Defined in these terms, convergence clearly has an important role to play in ensuring this factor mobility/price flexibility is such as to limit *dynamic* adjustment costs.

There is also, however, a *static* aspect to convergence: identifying terminal conditions is a pre-requisite to determining the least costly means of dynamic adjustment. These terminal conditions are also implicit in Mundell (1961). Given freedom of goods and factor movement, steady-state EMU will be characterised by a combination of real factor price equalisation (FPE) and absolute purchasing power parity (PPP) for all goods and factors which are tradeable. For our exercise, the relevant equilibirum condition is that cross-country real interest rates be aligned (FPE hold for capital), theoretically along the entire yield curve. Real interest parity could therefore be said to be a reflection of *static* convergence having obtained: this is the 'yes' part of the question posed at the outset.

In a recent empirical study (Haldane and Pradhan (1991)) we found little evidence of real interest parity prevailing among ERM members. Indeed, there is little evidence of real interest rate covariances having increased markedly since the inception of the EMS. These observations are inconsistent with static convergence between ERM members. To some extent these findings may be counterintuitive given the (apparent) progress made towards integration of goods and financial markets within Europe in recent years.

To rationalise this finding, however, we need only refer back to our earlier distinction between the static and the dynamic aspects of convergence. While real interest rate parity is a necessary characteristic of the static steady-state, it is neither necessary, nor in some instances desirable, as a characteristic of the dynamic convergence path towards this steady-state. For example, if domestic real interest rates are restricted to move commensurably with those abroad, an important element within the monetary transmission mechanism is blocked. This is undesirable to the extent that it eliminates one channel through which ultimate convergence in the performance of the system could be brought about: *static* real interest rate differences may be legitimate today to the extent that they are helping foster *dynamic* macroeconomic stability tomorrow. This is evidently the 'no' part of the question raised initially. Below we offer a simple theoretical framework of the dynamics of nominal interest rates, prices and exchange rates, and the mechanisms of monetary transmission implicit within the real interest differential. Observing such mechanisms of monetary transmission—and in particular their role in fostering dynamic convergence—in turn provides a justification for the violations of real interest parity alluded to earlier.

3 The dynamics of nominal interest rates, prices and exchange rates

To understand the endogenous transmission mechanisms implicit within the real interest differential, let us begin with an identity:

$$ {}_t r_{t+j} - {}_t r_{t+j}^* \equiv {}_t i_{t+j} - E_t\,({}_t \pi_{t+j}) - {}_t i_{t+j}^* + E_t\,({}_t \pi_{t+j}^*) $$

where ${}_t r_{t+j}$ = real return on a j-period bond held between time t and $t + j$

${}_t i_{t+j}$ = nominal return on the above j-period bond

${}_t \pi_{t+j}$ = inflation rate between t and $t + j$

E_t = expectations operator

$*$ denotes a foreign variable

Following Frankel and MacArthur (1988), this expression can then be rewritten trivially as:

$$ {}_t r_{t+j} - {}_t r_{t+j}^* \equiv ({}_t i_{t+j} - {}_t i_{t+j}^* - {}_t F_{t+j}) + ({}_t F_{t+j} - E_t(\Delta e_{t+j})) \quad (1) $$
$$ + (E_t(\Delta e_{t+j}) - E_t({}_t \pi_{t+j}) + E_t({}_t \pi_{t+j}^*)) $$

where $_tF_{t+j}$ = forward discount on domestic currency between time t and $t+j$

e = log of the domestic currency price of foreign exchange

Δ = first difference operator.

The first term in (1) is the covered interest differential, which picks up the impact of capital controls (actual and prospective), default risks and transactions costs. It is therefore a summary measure of obstacles to perfect capital market integration across countries. The second term in (1) measures the extent to which the (riskless) forward exchange rate is a biased predictor of the future spot exchange rate. In the absence of systematic expectational errors, it is therefore a summary measure of the extent to which foreign exchange markets are imperfectly integrated, *ie* the degree of (imperfect) substitutability between currencies—or so-called risk premium. Taken together, the first two terms in (1) gauge the extent to which uncovered interest parity is violated; that is, the importance of imperfectly integrated financial (foreign exchange and capital) markets.(1) The third term in (1) measures the expected real depreciation of domestic currency, *ie* the extent to which ex-ante PPP is violated. This can be thought to arise as a result of imperfect integration of goods (and labour) markets. In summary, any real interest rate differential can be thought of as measuring the degree to which the markets in goods, capital and foreign exchange between two countries are imperfectly integrated. As such, the real interest differential, when decomposed as in (1), is suggestive of the markets in which further integration will be necessary if *static* convergence on a single real rate of return is to be achieved.(2)

The real interest differential decomposition (1) also raises questions regarding *dynamic* convergence. As defined in (1), the differential is simply an identity and hence devoid of behavioural content. Capital controls, foreign exchange risk premia and the real exchange rate are potentially important mechanisms for the transmission of policy in their own right, however. In a properly specified model, the latter two would clearly be endogenous and the first potentially also if operated through a reaction function. As observed earlier, to the extent that real interest differentials embody such transmission mechanisms, they may be justified currently as a means of ensuring the steady-state stability of the system. This would in turn lend one interpretation to the observed violations of real interest parity. And, moreover, one which is consistent with ultimate static convergence of the system. It is with a view to determining the relative importance of the elements within the real interest

(1) Our definition of imperfect integration is fairly restrictive here in that it includes the risk premium. Perfect integration would require that returns across financial markets be equalised after accounting for expected exchange rate changes, as indicated by the forward exchange rate. Any divergence of returns in excess of this we define as resulting from imperfect integration.

(2) An empirical decomposition of (1) is reported in Haldane and Pradhan (1991), who address this static convergence question directly.

differential as dynamic transmission mechanisms helping ensure the steady-state stability of the system that we now turn.

We begin with a simple, but general, two-country system of dynamic equations, familiar from the part-rational sticky-price models of Dornbusch (1976), Buiter and Miller (1981) and more recently in an ERM context Giavazzi and Spaventa (1990), Miller and Sutherland (1990).(1) We then generalise this framework to accord with observed ERM behaviour and reassess the dynamic properties of the system. Consider the following:

$$y_t = -\delta[i_t - E_t(Dp_t)] + f_t + \eta y^* \tag{2}$$

$$Dp_t = \phi(y_t - \hat{y}) \qquad ie\ p_t = \phi \int_{-\infty}^{t} [y(s) - \hat{y}]ds \tag{3}$$

$$E_t(De_t) = i_t - i_t^* \qquad ie\ E_t(e_t) = \int_t^{\infty} [i(s) - i(s)^*]ds \tag{4}$$

Equation (2) is a stylised IS curve in which domestic output (y) is a negative function of real interest rates (p being the level of prices and D the differential operator, *ie* $Dx = dx/dt$) and a positive function of the government's fiscal stance (indexed f and treated here as an exogenous 'shock' variable) and overseas output (through the export component of final demand).(2) Equation (3) is a familiar Phillips curve in which prices are assumed to adjust to output deviations from its natural rate ($\hat{y}$, normalised to zero in logs). The level of prices is hence a *backward-looking* sum of past output 'excesses'. Finally equation (4) gives an uncovered interest parity condition: the expected level of the exchange rate is determined by the *forward-looking* integral of future interest differentials. We assume that the same system of equations exists for the foreign country and that parameter elasticities are equal across countries.

We aim first to assess the stability of this simple counterfactual system as it stands and then add back the components of the real interest differential shown in (1) to illustrate their potential importance as endogenous transmission mechanisms. In assessing the dynamic convergence of the system we draw upon the methodology of Aoki (1980), which involves taking cross-country differences in the system of equations (2)–(4). The Aoki methodology would seem to be ideally placed to address questions regarding cross-country economic convergence. If cross-country differences are growing over time the system is evidently failing to converge; it is

(1) Note that we now switch to a continuous-time formulation of the model for analytic ease, *ie* we let $j \rightarrow 0$. For example, i_t is now to be interpreted as the nominal return on an instantaneous 'bullet' bond.

(2) Note the absence of a real exchange rate term in (2). We aim to assess the stability of this (purely counterfactual) system as it stands before adding in the real exchange rate as one of the transmission mechanisms implicit within the real interest differential.

dynamically unstable. Specifically, we look to assess the inflation dynamics within our system, as given by a reduced-form of equation (3).

Two further simplifying assumptions are needed to enable us to isolate the important parameters for the analysis. Since we are concerned primarily with the convergence path on steady-state EMU, we take (rigidly but not irrevocably) fixed exchange rates as our limiting case of the ERM's operation ($De = 0$). Given (4), this then implies nominal interest parity and the dynamics of real interest rates can be determined by considering the inflation dynamics of the system in isolation.(1) We assume additionally that the inflation forecast errors in (2) are white noise and cancel out on differencing.

Defining $x_d = (x - x^*)$ and substituting (see Appendix for a full derivation) yields:(2)

$$Dp_d = \alpha f_d \qquad (5)$$

where $\alpha = \phi\,(1 - \phi\delta + \eta)^{-1} > 0$ for plausible parameter values.

The solution (5) indicates that any steady-state fiscal policy differences (f_d) will be reflected in inflation divergences and hence instabilities between member countries. This, in some ways odd, result from our counterfactual model derives from two principal sources. First, the fact that nominal interest rates are tied up by the nominal exchange rate commitment (uncovered interest parity obtains), which means that fiscal excesses are implicitly all money-financed—thus translating directly into price differences. That is, in this simple counterfactual form of our model fiscal policy is essentially doing the work of monetary policy. Second, there is as yet no offsetting effect from inflation on the IS curve in the model. Such an effect would help restrain demand in the (relatively) high inflation country and hence help foster stability. These are (overly restrictive) assumptions which we look to relax below in the context of extensions of the model which embody capital controls and risk premia (such that uncovered interest parity no longer obtains), and a real exchange rate effect (such that an offsetting inflation effect appears in the IS curve). Under these limiting assumptions, however, fiscal policies which, on average, are not consistent across countries will engender steady-state inflation instabilities in the simplistic world of equations (2)–(4).

While principally a counterfactual exercise, the above conclusions would appear to have some relevance to the ERM experience between 1979–83, during which time fiscal policy divergences between members were great and instabilities in the

(1) This in turn justifies the absence of an *explicit* LM curve from the system of equations (2)–(4).

(2) Time subscripts have been dropped to simplify the exposition.

system—manifest as frequent realignments—correspondingly widespread.(1) In practice, the convergence of inflation rates within the ERM was probably due as much to the budgetary austerity measures taken by deviant ERM members, as to the policies of monetary stringency adopted in the second half of the 1980s; in particular given the reluctance of most governments to resort to tax finance over this period. The Mitterand fiscal policy U-turn following the March 1983 ERM realignment is a particularly illuminating episode in this respect.

We now aim to augment our simple macro framework with each of the elements implicit within the real interest differential shown in (1), thus relaxing the limiting assumptions imposed upon the counterfactual form of the model. Our aim in doing this is to determine whether these provide additional, potentially stabilising, channels for monetary transmission. In doing this we relate each of these elements to variables endogenous to our model; frequently the external balance given that this is a reflection of—and potentially an ultimate offset to—disequilibrium between two regions. We use our knowledge of the experiences of member countries within the ERM as the basis for determining these linking relationships.

(i) Capital controls

First consider introducing capital controls (or other impediments to capital movement) into our model.(2) Assuming no foreign exchange risk premium, we can augment our uncovered interest parity condition thus:

$$i_t - i_t^* - E_t(De_t) = \tau_t$$

where τ_t denotes the (time varying) tax imposed as a result of capital controls.

If $\tau_t > 0$, this would indicate capital controls on inflows into the centre country and/or controls on outflows from the 'other' country in the system. Conversely, $\tau_t < 0$ would imply impediments to capital outflows from the centre country and/or to capital inflows into the 'other' country. What then is the appropriate policy rule determining the use of capital controls? ERM experience would suggest two polar cases need to be distinguished. The first is one in which capital controls are used as a *complement* to domestic monetary policy. That is, the higher the cumulative surplus (deficit)

(1) Though evidently the fixed nominal exchange rate assumption precludes the model from being a strictly accurate representation of the *historical* experiences of a *semi*-fixed exchange rate system such as the ERM. In this respect, the model perhaps has greater value in its implications for *future* convergence to a regime of EMU.

(2) We assume that the other possible factors responsible for a violation of covered interest parity, for example transaction costs, are essentially fixed, or at least are not related endogenously to the other variables in the system.

run-up by the centre (other) country, the greater the desire on the part of that country to prevent further capital outflows (inflows).[1] The economic rationale here is that capital inflows into a high external deficit country place incipient downward pressure (ie, an appreciation) on the exchange rate which, if allowed to appreciate, would worsen the cumulative external balance (hence causing further capital inflows). Capital controls on inflows prevent such a deleterious currency appreciation, while still allowing interest rates domestically to remain high, hence helping bear down on inflationary pressures. To this extent capital controls are complementing domestic interest rate setting. A relevant ERM example here would be the Spanish experience during 1989 and 1990, when selective capital controls were introduced to staunch large-scale capital inflows, which had caused the peseta to rise to the top of its ERM bands. Capital controls thereby prevented Spain having to lower interest rates (for a fixed exchange rate), which would have been contrary to inflation, and hence external balance, objectives.

Next, consider the second of the policy rule cases. These are situations in which countries which experience persistent problems *financing* large external deficits seek to prevent capital outflows rather than capital inflows, *ie* $\tau_t > 0$ when a country is in cumulative external surplus. This is necessary such that the deficit continues to be financeable without increasing pressures for a depreciation of the nominal exchange rate to help achieve the necessary adjustment in the external (im)balance. Examples from the ERM here would include the French and Italian experiences during the EMS' early years, when capital controls were used to prevent capital outflows from these high external deficit countries. These controls in turn helped stave-off potential speculative attack in anticipation of realignments, which may have been used to alleviate external balance difficulties (see, for example, Giavazzi and Giovannini (1990)). When capital controls are used in this way, they can be seen as effectively acting as a *substitute* for domestic policy adjustment.

Given the two polar cases outlined above, both based on observed ERM experiences, we can specify the following policy rule relating our capital controls term to the cumulative external account position of each country. That is:

$$\tau_t = - \kappa \, CCB_t$$

where CCB_t denotes the cumulative current account surplus (deficit) of the centre (other) country. *A priori* it is not possible to determine the sign of κ, since this will be conditional on the form of the policy rule affecting capital controls. Note that from (2) we have an implicit current balance equation of the form:

$$CB_t = - \eta \, y_d$$

(1) Note that this implies $\tau_t < 0$ when a country is in cumulative external surplus.

where CB_t denotes the single-period current balance.(1) Some integration and substitution (see Appendix) enables us to solve this system, thus:

$$Dp_d = -\kappa\beta\, p_d + \alpha f_d \tag{6}$$

where $\beta = \eta\delta(1 - \phi\delta + \eta)^{-1} > 0$ for plausible parameter values.

The root of the differential equation (6) is conditional on the sign of κ. In the first case outlined $\kappa > 0$, and hence the system is stable (the root is negative). This suggests that capital controls are potentially stabilising as we move to steady-state, provided such controls are operated according to the first rule outlined. The intuition behind this result is simple enough: the effect on a large external deficit country of using capital controls to help stem further capital inflows (for a given exchange rate)—which in turn enables it to keep interest rates high so as to bear down on inflation and demand—is to iron out external imbalances in steady-state.

Conversely, in the second case $\kappa < 0$ and the capital controls transmission mechanism evidently is not assisting convergence (the root of the differential equation is positive). The intuition behind this result carries across as the converse of that used to explain the first policy rule above. While potentially serving a useful short-term *stabilising* function in the second case (by insulating currencies from speculative attack), therefore, historically the role of capital controls during the ERM's early years may have been more often to hinder than to enhance dynamic macroeconomic *convergence* of the system. It is for these reasons that, at least during the ERM's formative years, capital controls were used largely as a temporary measure. The transient nature of capital controls has latterly been made official with the passing of the 1988 Capital Liberalisation Directive.(2)

(1) We omit interest, profit and dividend flows from our equation for the current balance. This is done for expositional reasons, since including such flows would require introducing (at least) two further sources of endogeneity into our model. First, it would require that natural rates of output differ across country (due to cumulative net overseas interest payments), and hence the specification of an aggregate supply schedule. Second, it would require a more explicit formulation of capital account flows, current and historical; that is, specification of the distribution of net external assets as between gross assets and gross liabilities, and the currency in which these gross stocks are denominated. These represent potentially important behavioural channels, which are not without interest from a stability/sustainability perspective. Their inclusion lies outside the aims of the model as it stands; though we believe the qualitative conclusions drawn here are robust to their incorporation.

(2) In practice, there are of course further reasons why capital controls might be considered undesirable; reasons which are not pursued here. First, such controls are rarely perfectly efficient, often allowing considerable leakage. Second, on a related point, doubts have been raised regarding the equity of capital controls, with the impact of these controls often felt disproportionately by 'less-sophisticated' investors.

(ii) Foreign exchange risk premia

Next consider augmenting the uncovered interest parity condition (4) with the second term implicit within our real interest differential, the foreign exchange risk premium. Assuming there is complete freedom of capital movement we have:

$$i_t - i_t^* - E_t(De_t) = \rho_t$$

where ρ_t denotes the foreign exchange risk premium. If $\rho_t > 0$, this would suggest that the conditional riskiness of the centre country's currency is perceived as greater than that of the other country, and conversely for ρ_t negative.

Relating the risk premium to its (endogenous) determinants is more problematic: the empirical literature on well-defined determinants of the foreign exchange risk premium is conspicuous by its absence. Recent work on single equation exchange rate modelling has, however, suggested measures of domestic indebtedness, both external (see, for example, Fisher et al (1990), Hooper and Morton (1982) and Meese and Rogoff (1983)) and internal (see Henry and Pesaran (1990)). Cohen and Wyplosz (1989) find a significant role for public sector (rather than private sector) current accounts in determining the French risk premium. The rationale for this comes from the solvency constraint which potentially may bind for a country at some future point, necessitating exchange rate adjustment. We take the former course here in relating the foreign exchange risk premium to the cumulative deficit on the external account:(1)

$$\rho_t = -\lambda\, CCB_t$$

Theoretically, if we were relating the risk premium to the perceived sustainability of a country's external deficit, we would normalise *CCB* by the natural rate of output (productive potential). Since $\hat{y}$ is assumed to be equal across countries in our model, however, this term drops out on differencing. Solving as before gives:

$$Dp_d = -\lambda\beta\, p_d + \alpha\, fd \qquad (7)$$

where β is defined above (see Appendix).

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(1) Alternatively, relating the risk premium to the internal indebtedness of a country through f_d (via a parameter ζ, say) gives a solution similar to (5) above (see Appendix):

$$Dp_d = \alpha\,(1 - \delta\zeta)\, f_d$$

That is, the (fiscal) risk premium introduces an additional *stabilising* feedback onto inflation. This effect is, however, unlikely to offset instabilities caused by pronounced or prolonged fiscal deviance, and may be an apt description of the Italian experience in recent years. Certainly it squares with the finding in Haldane and Pradhan (1991) that the covariance between German and Italian real interest rates is little different today than it was in the early 1980s.

We find that the system is stable (the differential equation has a negative root) once allowance is made for the risk premium as an endogenous transmission mechanism. The intuition is again simple enough: a high external deficit (surplus) country will carry a high positive (negative) risk premium within its nominal interest rate, which in turn helps depress (raise) inflationary pressures and output and ultimately reverse any external imbalance problem between high and low inflation currencies as we approach steady-state. The risk premium thus potentially represents a stabilising channel implicit within the real interest differential which will push in the direction of inflation (and hence real interest rate) convergence. This effect may, for example, be an accurate characterisation of one of the channels helping depress inflationary pressures in the United Kingdom economy in recent years, with risk premium-inflated nominal interest rates observed following the problems of mounting external deficits between 1986–89.

(iii) The real exchange rate

Finally consider adding in the third term within the real interest differential in (1), the real exchange rate. As well as representing the third of the elements within our real interest differential decomposition, this term also provides us with an offsetting inflation effect within our IS curve, absent from earlier models. Augmenting our IS curve:

$$y_t = -\delta[i_t - E_t(Dp_t)] + f_t + \eta y_t^* + \gamma c_t$$

where $c_t = E_t(e_t) + E_t(p_t^*) - E_t(p_t)$, *ie* competitiveness. If we then solve (assuming uncovered interest parity) this gives:

$$Dp_d = -\chi p_d + \alpha f_d \tag{8}$$

where $\chi = 2\gamma\alpha > 0$ for plausible parameter values (see Appendix).

The root of the differential equation is again negative, indicating steady-state convergence of inflation (and hence of real interest rates). The transmission mechanism here is a fairly familiar one from an ERM perspective: any adverse movements in relative inflation rates translate directly into a worsening of competitiveness under a fixed nominal exchange rate regime, which in turn depresses output and prices and hence helps bring about steady-state inflation convergence. This mechanism again operates directly through the external account channel. The role of competitiveness effects in exerting discipline upon high relative inflation currencies within a semi-fixed exchange rate regime is well-recognised in the literature (see, for example, Giavazzi and Pagano (1988), Kremers (1990)). In effect, a fixing of exchange rates rules out the 'soft option' of a competitive devaluation (or at least one which is fully inflation accommodating), helping ultimately to narrow returns to both capital (profit margins) and labour (wages) and hence helping lower prices in steady-state. Additionally, owing to its impact upon policy credibility and hence inflation expectations, the discipline imposed through this competitiveness channel is shown in Giavazzi and Pagano (1988) to lower the output costs of disinflation. Both as an intuitive and theoretical matter, therefore, we would expect the real exchange rate transmission mechanism identified to be a relatively important, stabilising one from an ERM perspective.[1]

(iv) The full model

If we enter into the model all three of the transmission mechanisms implicit within the real interest differential (capital controls, risk premia and real exchange rate changes) —thus generalising our earlier assumptions regarding both uncovered interest parity and competitiveness effects in the IS curve—we can solve to get:

$$Dp_d = - \nabla p_d + \alpha f_d \qquad (9)$$

where $\nabla = (1 - \phi\delta + \eta)^{-1}(2\gamma\phi + \delta\phi(\kappa + \lambda)(\eta\phi^{-1} + 2\gamma\int_{-\infty}^{t})) > 0$ for plausible parameter values. Unsurprisingly, the system converges faster (has a larger negative root) than in any of the above cases in isolation, given that at least two, and potentially all three, of the real interest differential transmission mechanisms are now pushing in the direction of convergence. Indeed, the system converges faster even than the sum of the roots in the three individual cases, by an amount $2\gamma\int_{-\infty}^{t}$. This hysteretic element gauges the extent to which the real exchange rate and risk premium transmission mechanisms are mutually reinforcing in the disinflationary stimulus they provide, with changes in the former leading movements in the latter through the impact of mounting external imbalances upon currency risk premia (see Appendix).

It is important also to recognise, however, that while capital controls, risk premia and the real exchange rate all have the potential to be inflation-stabilising in the stylised setting presented above, the latter two are *endogenous* while the first is typically an *exogenous* policy decision. Moreover, capital controls may impose externalities and be inefficient—hence the shift towards greater capital mobility across the ERM bloc. As a result, κ is in practice likely to be small and historically may even have been negative. Correspondingly, the risk premium and the real exchange rate are likely to be the more important of the stabilising channels implicit within the real interest differential, with the latter believed to be especially important from an ERM perspective. Ultimately, quantifying such effects is an empirical matter. Encouragingly, the theoretical results presented here are consistent with those from the empirical study by Haldane and Pradhan (1991), which found strong real

(1) Miller and Sutherland (1990) illustrate the importance of the real exchange rate as an equilibrating force helping offset potential steady-state instabilities resulting from 'excess-credibility' of a semi-fixed exchange rate regime.

exchange rate and risk premia effects among ERM members when conducting an empirical decomposition of (1).

4 Conclusions

Convergence—if it is to have a meaningful economic interpretation from an EMU perspective—must be defined in terms of dynamic costs of adjustment, and not purely in terms of empirical comparative statics. In this paper we have illustrated the essential differences between the static and dynamic aspects of convergence, with particular emphasis on the behaviour of real interest rates. Given that the relative economic performance of the ERM member countries has been diverse over the EMS period, we have argued that real interest rate differentials may actually have assisted the process of convergence between countries: economies that are characterised by different economic performances require differences in real rates of return in order to bring about dynamic convergence. This in turn provides a rationale for observed violations of real interest parity across the ERM bloc.

Following from this, the real interest differential was shown to embody within it a number of endogenous transmission mechanisms. The stabilising properties of these dynamic mechanisms were illustrated using a simple macroeconomic framework, with additional endogenous relationships established by reference both to theoretical considerations and to knowledge of how the ERM has itself operated historically. An interesting line of further research might be to define the transmission mechanisms—whether convergent or divergent—operational within other (for example, labour) markets during the process of dynamic adjustment to steady-state EMU. Without identifying more precisely the potential channels for policy transmission and their dynamic properties approaching steady-state, much of the convergence debate is likely to remain economically vacuous.

Appendix

Taking differences of equations (2)–(4) ($x_d = x - x*$) gives the following set of equations:

$$y_d \quad = - \delta i_d + \delta Dp_d + f_d - \eta y_d \tag{2'}$$

$$Dp_d = \phi y_d \tag{3'}$$

$$0 \quad = i_d \tag{4'}$$

Substituting (3') and (4') into (2') and rewriting gives:

$$y_d = (1 - \delta\phi + \eta)^{-1} f_d$$

which on substitution back into (3') gives:

$$Dp_d = \alpha f_d \tag{5}$$

where $\alpha = \phi(1 - \delta\phi + \eta) > 0$, provided the restriction $\delta\phi < \eta + 1$ is satisfied. Any fiscal excesses will hence feed directly into inflation divergences.

(i) Capital controls

Respecifying (4') to allow for the policy rule determining the use of capital controls:

$$\tau_t = -\kappa\, CCB_t = i_d \tag{4''}$$

From our IS curve (2), we have an implicit current balance equation of the form:

$$CB_t = -\eta\, y_d$$

which substituting into (3') gives:

$$CB_t = -\eta\phi^{-1}\, Dp_d$$

Taking a backward-looking integral between time $-\infty$ and t gives:

$$\int_{-\infty}^{t} CB(s)\, ds = CCB_t = -\eta\phi^{-1}\, p_d$$

Hence: $$i_d = \kappa\eta\phi^{-1}\, p_d \qquad \text{from (4'')}$$

which substituted into (2') gives:

$$y_d = -\delta\kappa\eta\phi^{-1}\, p_d + \delta\, Dp_d + f_d - \eta\, y_d$$

Substituting again through (3') and solving as above gives:

$$Dp_d = -\kappa\beta\, p_d + \alpha f_d \tag{6}$$

where $\beta = \delta\eta(1 - \delta\phi + \eta)^{-1}$. The root of the differential equation will be stable (negative) provided the restriction $\delta\phi < \eta + 1$ is satisfied, which is likely for plausible parameter values. This is equivalent to the restriction that prices are sluggish in their adjustment to equilibrium ($\phi \not\to \infty$), which would not appear an implausible assumption; or, more precisely, $(1 + \eta)/\delta > \phi$. Stability will, of course, depend additionally upon the sign of κ: $\kappa > 0$ for stability; $\kappa < 0$ for instability.

(ii) Foreign exchange risk premia

Respecifying (4') to allow for the determinants of risk premia:

$$\rho_t = -\lambda\, CCB_t = i_d \tag{4'''}$$

which can be solved in an exactly analogous way to (i) above to give:

$$Dp_d = -\lambda\beta\, p_d + \alpha f_d \tag{7}$$

where β is defined above and the same restrictions as for (i) apply vis. stability.

Alternatively, if we were relating our risk premium term to the PSBR, then, in a two-country world we can write:

$$\rho_t = \xi f_d = i_d$$

which gives us:

$$y_d = -\,\delta\xi f_d + \delta Dp_d + f_d - \eta y_d$$

Substituting through (3') and solving as above gives:

$$Dp_d = \alpha\,(1 - \delta\xi)\, f_d$$

which tells us that the effects of any fiscal excesses upon the inflation dynamics of our system are offset partly (wholly for $\delta\xi > 1$) by risk premium effects.

(iii) The real exchange rate

Having augmented our IS curve with a real exchange rate term, and noting $De = 0$ and hence $c = -p_d$, we get on differencing:

$$y_d = -\delta\, i_d + \delta\, Dp_d + f_d - \eta\, y_d - 2\gamma p_d \tag{2''}$$

$$0 = i_d \tag{4'}$$

Substituting (3') and (4') into (2'') and rewriting gives:

$$y_d = -2\gamma\,(1 - \phi\delta + \eta)^{-1}\, p_d + (1 - \phi\delta + \eta)^{-1} f_d$$

which substituting back into (3') gives:

$$Dp_d = -\,\chi\, p_d + \alpha f_d \tag{8}$$

where $\chi = 2\gamma\alpha > 0$. Again the system is stable provided the restriction from (i) above is satisfied.

(iv) The full model

With capital controls, risk premia and real exchange rate movements all included we have:

$$y_d = -\delta\, i_d + \delta\, Dp_d + f_d - \eta\, y_d - 2\gamma p_d \tag{2'''}$$

$$\tau_t + \rho_t = -\,(\kappa + \lambda)\, CCB_t = i_d \tag{4''''}$$

Note, however, that our implicit current balance equation now takes the form:

$$CB_t = -\,\eta y_d - 2\gamma\, p_d$$

Substituting for (3') and integrating:

$$CCB_t = -\eta\phi^{-1}\, p_d - 2\gamma \textstyle\int_{-\infty}^{t} p_d$$

Hence: $$i_d = (\kappa + \lambda)\,(\eta\phi^{-1} + 2\gamma \textstyle\int_{-\infty}^{t})\, p_d$$

Substituting into (2''') and using (3') enables us then to solve thus:

$$Dp_d = -\,\nabla\, p_d + \alpha f_d \tag{9}$$

where $\nabla = (1 - \delta\phi + \eta)^{-1}(2\gamma\phi + \delta\phi\,(\kappa + \lambda)\,(\eta\phi^{-1} + 2\gamma \int_{-\infty}^{t}))$, which is stable subject to the usual restriction and the sign on κ.

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