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Open-Economy Macroeconomics: Developments in Theory and Policy

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Abstract

This paper surveys recent research in open-economy macroeconomics, using questions raised by European economic and monetary unification to guide the topics discussed. A striking empirical regularity is the tendency for changes in the nominal exchange rate regime systematically to affect the variability of nominal and real exchange rates alike. This regularity (which disappears in high-inflation conditions) can be explained by sticky-price theories or by models of asset-market liquidity effects. But plausible liquidity models have difficulty generating enough persistence (in output and real exchange rates, in particular) to match the data. Thus the macroeconomic costs of giving up the exchange-rate realignment option, emphasized in Mundell's optimum currency area concept, seem empirically relevant. The paper discusses other possible costs of currency unification, associated with a reduced number of asset markets. On the benefit side, our theories of the efficiencies due to a common currency remain unsatisfactory, despite recent advances. A key motivation for the choice of a common currency over a fixed exchange rate between national currencies is the fear of speculative attack. The paper concludes by showing how self-fulfilling currency crises can occur, and describes recent progress in narrowing the range of multiple equilibria in adjustable-peg regimes.

The evolution of the international gold standard stands out as the central factor in European (indeed, world) macroeconomic history in the first half of the twentieth century. When future historians look back over Europe's macroeconomic performance in the early twenty-first century, a similarly dominant role no doubt will be attached to the transition to economic and monetary union (EMU). The drive toward EMU has its roots in European reconstruction a half-century years ago, and it is scheduled to reach fruition, at least for a first wave of participants, on January 1, 1999. It is now difficult to believe that some form of EMU will not be put in place on that date, or soon afterward. This paper is focused on the question of international monetary unification, which provides a useful lens for examining much of the recent thinking and progress in open-economy macroeconomic analysis.

In its interwar incarnation, the international gold standard had staggering costs in terms of output and employment, as is now widely agreed (see Eichengreen 1992). EMU will aid countries with inflationary histories in achieving more stable price levels (while possibly delivering more inflation than Germany would like). But will EMU entail significant output and employment costs? The answer depends in part on the efficacy of macroeconomic (especially monetary) policy for stabilization of output and employment. Motivated by the need to understand macroeconomic policy effects, I devote sections I and II below to understanding what nominal and real exchange rate movements can tell us about the flexibility of nominal prices. If nominal prices are sticky in the short run, there is a strong presumption that national authorities can deploy monetary and fiscal policy to offset unexpected shocks to output and employment. Under EMU, however, member countries may largely be constrained from responding to unpleasant macroeconomic surprises.

If EMU is costly in terms of macroeconomic stability, its membership

could be unstable. But monetary union is thought to involve offsetting *microeconomic* benefits—wholly apart from the political dividends that have been a dominant factor propelling EMU from the idea's inception. These microeconomic benefits involve efficiency gains in exchange and production, such as transaction-cost savings and a more rational international division of labor. Balancing the economic costs and benefits, one arrives at the notion of an optimum currency area, which I discuss in section III. In that section I also explore some models and empirical results pertinent to the efficiency benefits of monetary unification, though these results are largely conjectural. As Krugman (1995) has observed, the theoretical foundation for our beliefs about the efficiency benefits of common currencies remains quite narrow.

A final question, addressed in section IV, has implications for the transition to EMU and its operation as it evolves. Prior to January 1, 1999 speculative attacks on European Monetary System (EMS) exchange parities remain a logical possibility. Uncertainty over the eventual conversion rates between member currencies is likely to exacerbate volatile capital flows. Even after EMU is inaugurated, the "outs" who target the euro in the hope of ultimately entering EMU remain vulnerable to attack, and such attacks could trigger intervention by the "in" bloc. A new literature on currency crises suggests that even countries following conservative monetary and fiscal policies may become vulnerable to attack. In the final substantive section of this paper I review the implications of these models, along with some new questions they raise.

I. Currency movements in light of sticky-price theories

Are nominal prices sticky in the short run? This question, central to all of macroeconomic debate, also is critical for assessing the influence of the nominal exchange rate regime on the macroeconomy. The joint distribution of real and nominal exchange rates provides some of the most striking ev-

idence that models with sticky prices can potentially explain international macroeconomic data. This point was forcefully made by Mussa (1986). Developments since his seminal article was published only reaffirm its findings.

The basic empirical regularities are two under moderate inflation rates. First, changes in the nominal exchange rate regime appear systematically related to the variability of real as well as nominal exchange rates. Shifts from regimes of controlled nominal rates to floating rates apparently cause short-run real exchange rate volatility to rise, whereas opposite shifts reduce short-run real exchange rate volatility. High-frequency real and nominal volatility tend to be approximately the same under floating rates. Second, under floating exchange rates, though not necessarily under more controlled exchange rate regimes, real and nominal exchange rate movements are nearly perfectly correlated in the short run.[1]

The findings are easily explained if price levels are slow to adjust compared with nominal exchange rates, so that nominal exchange rate changes translate virtually one-for-one into international relative price level changes. Under conditions of very high inflation, however, matters are different: floating nominal rates are more volatile than the corresponding real rates when inflation is high, and the short-run correlation between changes in the two rates lies substantially below unity. These changes are consistent with flight from nominal contracting in conditions of monetary instability.

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[1]The high short-run correlation between real and nominal exchange rates under floating has been ascribed by some to real or output-market shocks that alter exchange rates without much affecting national price levels. The seeming dependence of the correlation on the nominal regime is, however, evidence against the "real shock" view. Further evidence that monetary shocks indeed have played a big role comes from long-run data on price levels and exchange rates. Over the period since 1973, industrial-country price levels have changed quite a bit (see, for example, Obstfeld 1995, p. 123, figure 1). The cumulative inflation furnishes a *prima facie* case that monetary shocks have been important.

I.1 Evidence from moderate-inflation economies

The case of the lira/deutsche mark rate (see table 1) illustrates how the preceding regularities operate in cases of moderate and low inflation.[2] Let e denote the nominal exchange rate (the domestic-currency price of foreign currency) and r the real exchange rate, ep^*/p (where p^* and p are foreign and home money CPIs). Table 1 (like the two tables that follow it) displays the standard deviations of the monthly log differences in e and r, denoted by hats, as well as the correlation coefficient between $\hat{e}$ and $\hat{r}$. Notice that on the above measure of volatility, a currency depreciating at a constant rate (as in a steady crawling peg) would display zero variability. The variables $\hat{e}$ and $\hat{r}$ are graphed in figure 1 for Italy relative to Germany.

Table 1: Italy/Germany

Period	Std($\hat{e}$)	Std($\hat{r}$)	Corr($\hat{e}, \hat{r}$)
February 1957-February 1973	0.008	0.010	0.89
March 1973-February 1979	0.027	0.027	0.97
March 1979-December 1989	0.009	0.009	0.85
January 1990-August 1992	0.004	0.006	0.78
September 1992-November 1996	0.029	0.029	0.99
December 1996-June 1997	0.009	0.009	0.98

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[2]Real exchange rates in tables 1 and 2 are based on consumer price indexes and monthly average nominal exchange rates. Wholesale price indexes, when available, imply very similar behavior. Data, measured at monthly frequency, are taken from International Monetary Fund, *International Financial Statistics*. The relative-price data in table 3 below, which are based on relative export price indexes rather than relative CPIs, come from the same source.

Lira/DM
nominal and real exchange rates
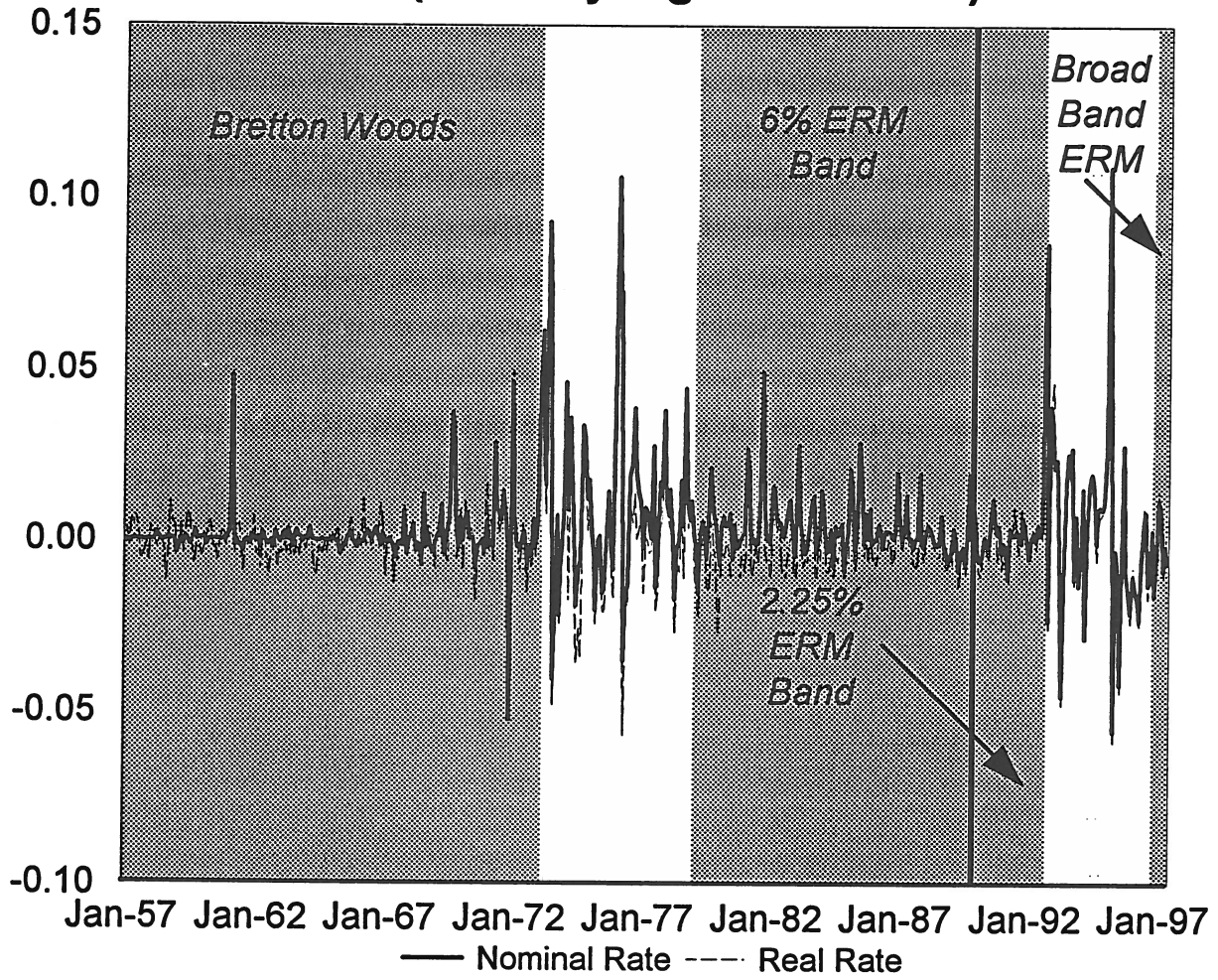## (monthly log differences)

Figure 1

Nominal and real rate volatility are low under Bretton Woods, but with the advent of floating both increase roughly threefold and the real-nominal correlation coefficient rises. Italy's ±6 percent ERM band (1979-89) reduces exchange rate volatility to Bretton Woods levels, realignments notwithstanding, and the shift to the ERM's ±2.25 percent narrow band in January 1990 reduces volatility further. The real-nominal correlation drops in that period because most real rate variation comes from price-level movements. During Italy's absence from the ERM (September 1992-November 1996), volatility and correlation return to the same pattern as in the pre-EMS float, 1973-79. Italy's end-1996 return to the ERM in order to qualify for EMU brings a sharp drop in real as well as nominal volatility. In all episodes real and nominal variability are close or equal.

Table 2: Israel/United States

Period	Std($\hat{e}$)	Std($\hat{r}$)	Corr($\hat{e}, \hat{r}$)
February 1957-February 1973	0.036	0.039	0.93
March 1973-June 1985	0.063	0.042	0.69
July 1991-August 1996	0.030	0.020	0.68

I.2 Evidence from high-inflation economies

Somewhat different empirical regularities apply in cases of high or hyperinflation, as stressed by Leiderman and Bufman (1995). Table 2 and figure 2 show data on Israel's exchange rate against the dollar, calculated consistently on the basis of the present Israeli currency. The year 1973 ushered in a period of sharply higher Israeli inflation. Thus, until the stabilization of July 1985, nominal volatility rises with almost *no corresponding average increase in real volatility*. Furthermore, the real-nominal correlation drops sharply (having been dominated by realignments before 1973). One theory explaining this

Israel/US
nominal and real exchange rates
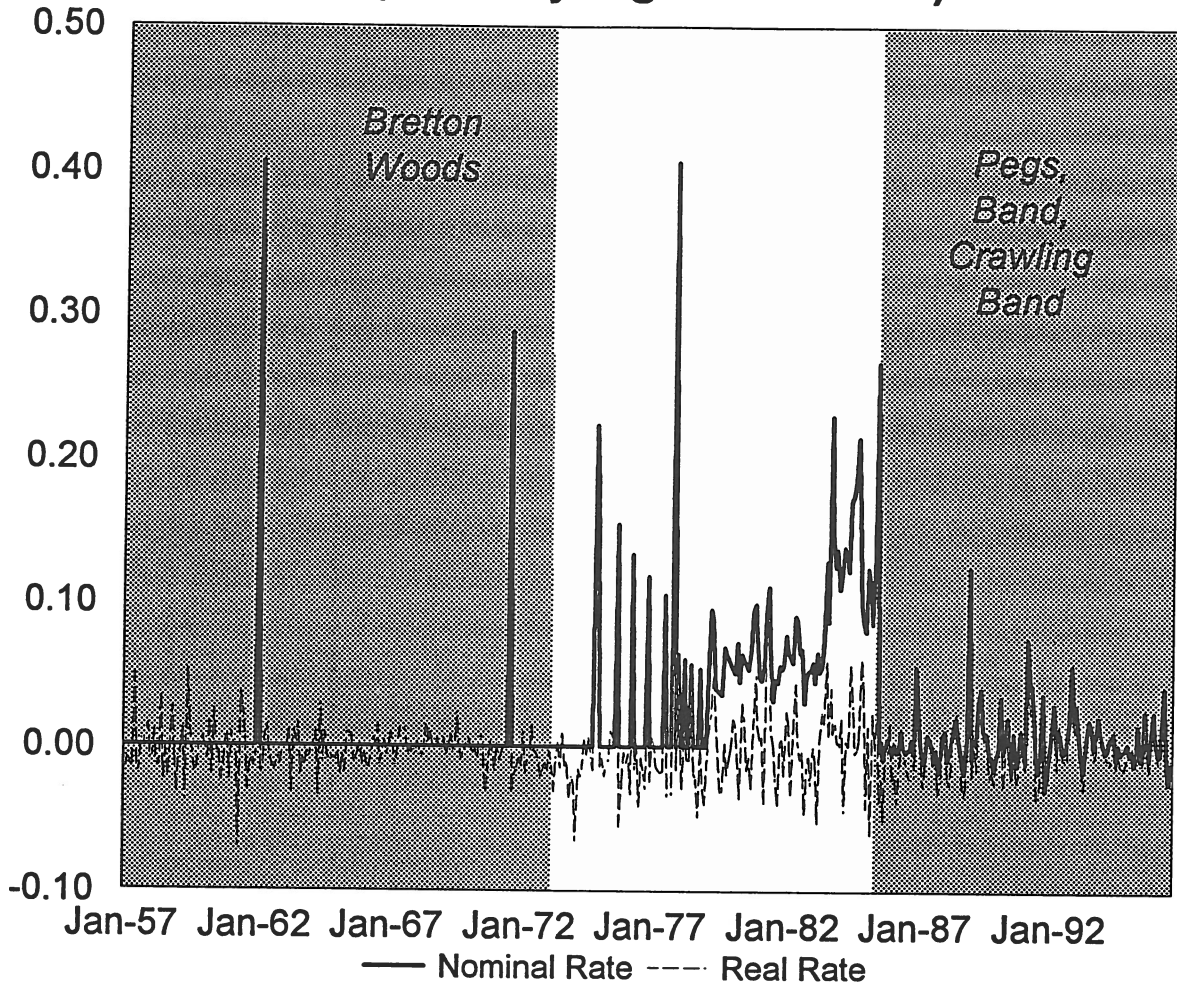# (monthly log differences)

Figure 2

development is that nominal contracting simply becomes too costly when inflation is high and variable. In response, dollarization spreads through the economy. Similar patterns characterize recent data for other sometime high-inflation economies, such as Argentina, and for interwar inflationary episodes (see, for example, De Grauwe, Jansens, and Leliaert 1985).

The stabilization initiated under Michael Bruno's governorship of the Bank of Israel began with a pegged exchange rate, but has since followed more flexible forms of exchange rate targeting, most recently a crawling target zone. This flexibility has allowed some accommodation of inflation with the goal of preventing real currency appreciation. Both real and nominal volatility have dropped under nominal exchange rate targeting, as one would expect, but the correlation between real and nominal exchange rate movements has not risen relative to the period of high inflation. This may be due to the accommodative exchange rate policy of the Israeli authorities, which resists incipient real currency appreciations through nominal exchange rate adjustments.

I.3 Exchange rates and terms of trade

The above empirical regularities have been developed from the perspective of real exchange rates defined in terms of consumer prices. Similar regularities hold, albeit somewhat less strongly, for comovements between nominal exchange rates and terms of trade. Figure 3 shows changes in the France/Germany nominal exchange rate along with changes in French relative to German export prices.[3] The statistics in table 3 suggest that in general both nominal exchange variability and variability in relative export prices rise when currencies float (or when there are large discrete realignments, as in 1969-73). The numbers also suggest that exchange rate changes

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[3]For the analogous picture with CPIs, see Obstfeld (1995, p. 131).

Franc/DM nominal exchange rate and terms of trade (monthly log differences)
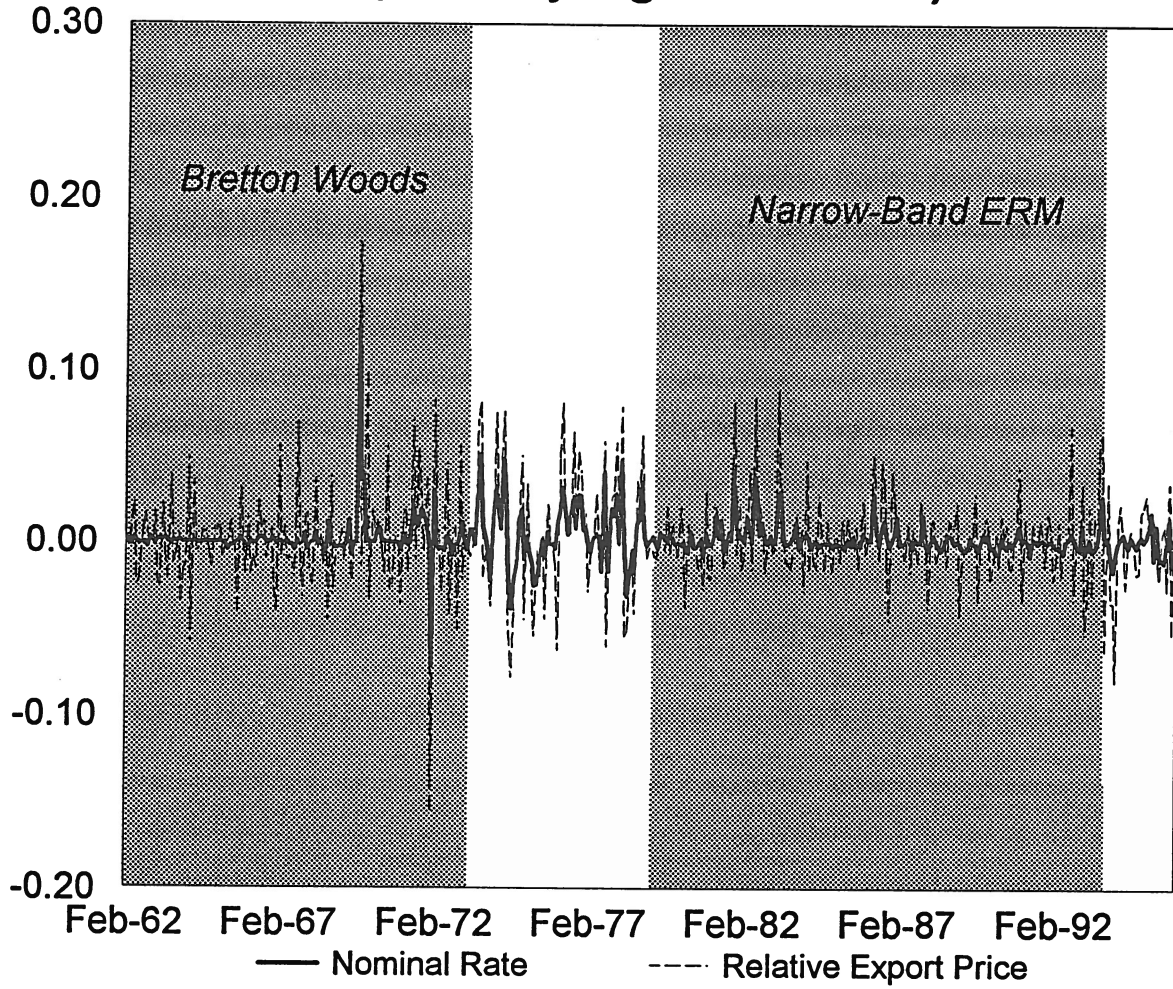

Figure 3

are highly correlated with changes in relative export prices in a flexible-rate regime. Even in the short run, however, terms of trade display considerably more variability than the nominal exchange rate regardless of the monetary regime. This behavior could be due to different export composition and destination for the two countries, and differences in pricing-to-market.

Table 3: France/Germany

Period	Std($\hat{e}$)	Std($\hat{r}$)	Corr($\hat{e}, \hat{r}$)
February 1962-February 1973	0.014	0.035	0.68
February 1962-July 1969	0.003	0.022	0.06
March 1973-February 1979	0.019	0.038	0.83
March 1979-July 1993	0.007	0.022	0.61
August 1993-December 1995	0.009	0.031	0.55

I.4 Macromodels and the "purchasing power parity puzzle"

The acceptance of a sticky-price basis for the comovements between relative prices and nominal exchange rates has important implications for stabilization policy. Price stickiness provides a channel through which macropolicies can offset shocks that were not anticipated when prices were set, and that potentially have real effects pending the complete adjustment of prices. In an open economy with nominal price and wage stickiness, the government's option to adjust the exchange rate in response to unexpected shocks has a stabilization value that is foregone under an irrevocably fixed exchange rate or currency union.

The modified IS-LM model of Mundell, Fleming, and Dornbusch, which has been the workhorse analytical tool of policymakers for decades now, is consistent with the preceding conclusions. But the model doesn't come to grips with several important areas quite critical for the evaluation of sta-

bilization policies. Among these are the dynamics of current accounts, the dynamics of fiscal imbalances, and the foundations of aggregate supply.

Recent intertemporal models of price setting by imperfectly competitive firms and/or unions provide a framework for exploring these issues; see, for example, Obstfeld and Rogoff (1996, chapter 10). The best way to introduce nominal and real rigidities so as to capture the stylized facts of business cycles remains the subject of active research. Alternative calibration exercises by Chari, Kehoe, and McGrattan (1996) and by Kollmann (1996) consider models with monopolistic elements and sticky nominal prices and/or wages (à la Calvo). The first of these papers assumes complete asset markets, while the second, more realistically, assumes that monies and nominally risk-free bonds are the only assets available. Taken together, however, the papers show that nominal price and wage rigidities offer the potential to rationalize the exchange-rate behavior discussed above, along with other regularities, such as a persistent effect of nominal shocks on real exchange rates; see, for example, Clarida and Gali (1994) and Schlagenhauf and Wrase (1995).

The models developed to date still leave some important business-cycle phenomena unexplained, and no doubt will be extended. For example, the persistence of monetary effects on real exchange rates, while high in the models mentioned above, is not as extremely high as the real exchange rate persistence seen in the data. Generally it is found that the half-life of real exchange rate deviations from trend is on the order of four to five years, far longer than the typical business cycle. Stockman (1988) asked how that discrepancy could be consistent with a monetary-*cum*-sticky price account of real exchange rate movements. Rogoff (1996) calls the conundrum the "purchasing power parity puzzle."

There are (at least) two responses to the puzzle. The first observes that the rate of reversion of real exchange rates to a linear trend need not measure

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the pace of adjustment to a specifically monetary shock. For example, let u_t be a positive shock to national aggregate excess demand. The shock follows a first-order autoregressive process with serial correlation $\rho \in (0,1)$. Let r_t denote the real exchange rate, defined as the price of foreign in terms of domestic goods. In the log-linear Mussa (1982) model of exchange rates, it can be shown that the real exchange rate evolves according to the process

$$\Delta r_{t+1} = -\theta\delta r_t + (1 - \rho - \theta\delta)\frac{u_t}{\delta} + \epsilon_{t+1},$$

where θ is the speed of nominal price response to excess output demand, δ is the real exchange rate elasticity of output demand, and ϵ_t is a random date t disturbance.

If u_t were constant, applying least squares to the preceding equation—the exercise prevalent in the PPP literature—would yield a consistent estimate of the adjustment speed to nominal shocks, $\theta\delta$. But in truth real shocks do occur, and r_t and u_t tend to be *negatively* correlated because a rise in aggregate demand causes real currency appreciation. If real shocks are at all persistent (ρ near 1), so that $1 - \rho - \theta\delta < 0$, then least squares regression of Δr_{t+1} on r_t alone gives an estimate of $\theta\delta$ that is biased toward zero. The estimate appears to imply slower elimination of monetary shocks' real effects than is the case in reality, because the data confound persistent real shocks with monetary shocks. Nonetheless, monetary shocks might still explain most exchange rate variability at relatively short horizons.

A second response to the PPP puzzle is based on the observation that real rigidities, when coupled with nominal rigidities, can dramatically prolong the adjustment to monetary shocks (Kimball 1995; Jeanne 1997). Whether plausible real rigidities can generate the real exchange rate persistence in the data remains an open question for research.

Before rushing to embrace sticky price exchange rate models, however, note that alternative flexible-price models have some similar implications for

real and nominal exchange rates to those just discussed. The next section explores this point.

II. Models with separated goods and asset markets

Even when goods prices and wages are perfectly flexible, lags in the transmission of monetary shocks from asset to goods markets can generate unexpectedly high nominal exchange rate variability, as well as correlations between nominal and real exchange rates similar to those usually seen in conditions of low to moderate inflation. Rotemberg (1985) first made this observation, but the recent emergence of explicitly stochastic models along the lines he proposed has allowed a more systematic study of the empirical implications of impediments to the flow of money and information between markets.[4]

II.1 A basic framework

A bare-bones framework for exploring exchange- and interest-rate implications of asset-market segmentation is provided by Grilli and Roubini (1992), who build closely upon Lucas (1990).

In a variant of the framework, there are two countries, Home and Foreign, producing distinct perishable consumption goods. As a convenience in depicting equilibrium I will assume that residents in the two countries have

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[4]Similar effects can occur in random matching models where agents exchange national monies against each other and against commodities; see Head and Shi (1996). The problem with such models is that they abstract from the interest-bearing assets whose trade is thought to be central to exchange-rate determination in reality. Stockman (1988) showed how the possibility of capital or trade controls under a fixed exchange rate could dampen the variability of real exchange rates in a flexible price model. However, the empirical regularities noted in the last section apply even to such episodes as France's 1926 return to the gold standard (see De Grauwe, Jansens, and Leliaert 1985), which would not itself have generated heightened expectations that stringent capital controls would be imposed. For a discussion of interwar capital controls, see Obstfeld and Taylor (1997a).

identical preferences and have pooled their output risks (as in Lucas 1982) so that the representative Home and Foreign residents both own exactly half of the stochastic Home output process $\{Y_{Ht}\}_{t=0}^{\infty}$ and half of the stochastic Foreign output process $\{Y_{Ft}\}_{t=0}^{\infty}$. The further assumption that Home and Foreign residents start out with equal holdings of the Home and Foreign monies allows us to work in terms of a world representative household, that is assumed to maximize

$$U_0 = \mathrm{E}_0 \left\{ \sum_{t=0}^{\infty} \beta^t u \left(c_{Ht}, c_{Ft} \right) \right\}, \quad \beta \in (0,1).$$

The complete menu of assets held and the assumed organization of asset and commodity trading are as follows: At the start of a period t the household output levels $y_{Ht} = \frac{1}{2}Y_{Ht}$ and $y_{Ft} = \frac{1}{2}Y_{Ft}$ are revealed and households hold domestic nominal balances money m_{Ht} and foreign nominal money balances m_{Ft}. Then one member of each (two-member) household takes $n_{Ht} \leq m_{Ht}$ currency units to the goods market, purchasing $c_{Ht} = n_{Ht}/p_{Ht}$ units of the domestic good and $c_{Ft} = n_{Ft}/p_{Ft}$ units of the foreign good, where p_{Ht} and p_{Ft} are the local-currency prices of the two goods, while simultaneously receiving $p_{Ht}y_{Ht}$ and $p_{Ft}y_{Ft}$ in money dividends that cannot be spent until period $t+1$.[5]

The household's second member takes $m_{Ht}-n_{Ht}$ and $m_{Ft}-n_{Ft}$ Home and Foreign currency units to an asset market, which operates contemporaneously with the goods market but has no communication with the latter. In the asset market, monies may be traded against each other at an exchange rate of e_t Home currency units per Foreign currency unit. Also, monies may be traded against government discount bonds denominated in the issuer's domestic currency. A bond is a promise to pay a single currency unit after a period.

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[5]Households cannot consume their own output. I assume that nominal interest rates always are positive, so that the cash-in-advance constraints $p_{Ht}c_{Ht} \leq n_{Ht}$ and $p_{Ft}c_{Ft} \leq n_{Ft}$ always bind at the individual level.

It is in the asset market that the model's other random shock is realized, the shock representing the supply of one-period bonds. If $M_{Ht} = 2m_{Ht}$ and $M_{Ft} = 2m_{Ft}$ are aggregate money supplies at the start of t, the two governments' bond issues are:

$$B_{Ht} = x_{Ht}M_{Ht}, \quad B_{Ft} = x_{Ft}M_{Ft}.$$

By making money transfers, governments pay off bonds issued in period t at the start of period $t+1$, before households have split to visit the two markets. Thus, B_{Ht} and B_{Ft} represent gross rather than net bond issues—possibly a very large number relative to the money supply in countries such as Italy where most public debt is rolled over frequently. The date t own-currency market prices of Home and Foreign bonds are q_{Ht} and q_{Ft}. When governments initially auction off bonds, each insists on trading its bond issue against its *own* currency, so that in equilibrium the conditions

$$
\begin{aligned}
B_{Ht} &= x_{Ht}M_{Ht} = q_{Ht}\left(M_{Ht} - N_{Ht}\right), \\
B_{Ft} &= x_{Ft}M_{Ft} = q_{Ft}\left(M_{Ft} - N_{Ft}\right),
\end{aligned}
\tag{1}
$$

must hold (where $N_{Ht} = 2n_{Ht}$ and $N_{Ft} = 2n_{Ft}$).

An agent already in the date t asset market and deciding bond purchases b_{Ht} and b_{Ft} faces the portfolio constraint $(m_{Ht} - n_{Ht}) + e_t\left(m_{Ft} - n_{Ft}\right) = q_{Ht}b_{Ht} + e_t q_{Ft}b_{Ft}$ and must be indifferent between allocating a marginal Home currency unit (say) to Home or Foreign government bonds. This result provides the "uncovered interest parity" condition for this model. Before households split up at the start of a period t, they are similarly indifferent between sending a marginal currency unit to the goods or asset market. The result is a pair of intertemporal Euler conditions, one for each currency. In equilibrium price levels thus are determined by

$$p_{Ht} = N_{Ht}/Y_{Ht}, \quad p_{Ft} = N_{Ft}/Y_{Ft}.$$

Define $z_{Ht} = (m_{Ht} - n_{Ht})/m_{Ht}$ and $z_{Ft} = (m_{Ft} - n_{Ft})/m_{Ft}$ as the fractions of individual (in equilibrium, aggregate) money holdings devoted to security purchases. Equation (1) gives equilibrium bond prices as

$$q_{Ht} = \frac{z_{Ht}}{x_{Ht}}, \quad q_{Ft} = \frac{z_{Ft}}{x_{Ft}}. \tag{2}$$

If all uncertainty is i.i.d., z_H and z_F will be time-invariant constants. To make my main points it suffices to describe the equilibrium in the special case $u(c_H, c_F) = \gamma \log c_H + (1 - \gamma) \log c_F$. Observe that individual consumption of Home goods satisfies (for all t)

$$c_{Ht} = \frac{n_{Ht}}{p_{Ht}} = \frac{(1 - z_H)m_{Ht}}{p_{Ht}}.$$

At the same time domestic money holdings at the start of period $t + 1$ equal payments on domestic bonds b_{Ht} plus proceeds from the sale of last period's Home-generated output, $p_{Ht}y_{Ht}$:

$$m_{Ht+1} = b_{Ht} + p_{Ht}y_{Ht}.$$

Parallel relationships apply for Foreign-goods consumption and Foreign-money holdings.

According to eq. (2), the constancy of z_H and z_F imply that unanticipated bond issues will cause unanticipated increases in nominal interest rates (q_H is the inverse of $1 + i_H$, in the obvious notation, and similarly for Foreign). There is no way, in the model, for financial market changes to feed contemporaneously into the goods market, so asset-market clearing requires that bond prices fluctuate more than they would in a Walrasian model.

Anticipated bond issues, however, will have no such effects. For example, suppose a government has been issuing bonds equal to 10 percent of its money supply. Suddenly it announces it will henceforth raise that figure to 20 percent, thereby withdrawing 20 percent of its money stock from circulation

at the end of each period via the asset market. In that case people will simply double their allocation of currency to the bond market (relative to its prior path), causing the price level in the goods market to fall (relative to its prior path) in proportion to the additional end-of-period money-supply contraction. Bond prices are unaffected. The effect is the same as if the monetary contraction had occurred prior to the opening of the goods market.

Of central interest are the model's implications for the nominal exchange rates and the real exchange rate, the latter defined here in terms of GDP deflators, so as to correspond to the terms of trade. From the model's interest parity condition one derives the equilibrium exchange rate with log utility as:

$$e_t = \frac{1-\gamma}{\gamma} \cdot \frac{z_H(1-z_H)}{z_F(1-z_F)} \cdot \frac{x_{Ft}}{x_{Ht}} \cdot \frac{M_{Ht+1}}{M_{Ft+1}}. \tag{3}$$

Given this last result, analysis of the *real* exchange rate is simplest if it is defined as

$$r_t = \frac{e_t p_{Ft+1}}{p_{Ht+1}} = \frac{1-\gamma}{\gamma} \cdot \frac{z_H}{z_F} \cdot \frac{x_{Ft}}{x_{Ht}} \cdot \frac{y_{Ht+1}}{y_{Ft+1}}, \tag{4}$$

that is, as the notional relative price of Home and Foreign goods evaluated at the most recent market exchange rate.[6]

Equations (3) and (4) show that the nominal and real exchange rates will be positively correlated because of the common multiplicative term x_{Ft}/x_{Ht}, which is absent in more common flexible-price models such as that of Lucas (1982). In essence, the relative shock x_{Ft}/x_{Ht} affects the nominal exchange rate but does not feed into the subsequent goods market, so it affects the real exchange rate as well. From an empirical point of view, however, it is

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[6] "Real exchange rate" is a misnomer, since equation (4) actually describes the terms of trade. As observed above, however, the relevant empirical regularities applying to real exchange rates also characterize terms of trade to a significant degree. Furthermore, if nontraded goods were incorporated into the model, the patterns of real and nominal exchange rate behavior described in the next paragraph would emerge.

very questionable whether this model, interpreted literally, can explain the data. The bond-market shocks that drive exchange rates are, for most countries, simply too small to explain their variability, especially over very short periods. In addition, the model above does not generate the *persistent* real exchange rate movements we see in reality. Even if serially correlated output shocks are introduced, monetary shocks will not have the persistent effects on the real exchange rate that the data suggest. The results reported by Schlagenhauf and Wrase (1995) suggest that these problems cannot be remedied simply by introducing endogenous output and capital accumulation.[7]

II.2 Modeling persistence in exchange rates

Alvarez and Atkeson (1996) advance a related model intended to overcome some of these empirical shortcomings. In their complete-contingent-claims setup households receive monetary transfers and output endowments at the start of a period. However, families are split up into "parents" and "children." Parents trade currencies and contingent bonds in the asset market, then sell endowments for money in the goods market. Children are shoppers who purchase consumption goods with currency gifts from their parents. Children's trips into the goods market have stochastic lengths, however, so that shoppers need not return home at the end of the day.

Why do monetary shocks affect real exchange rates in their model despite the fact that new money diffuses immediately into the goods market? Output prices are determined by the total monetary demand of those shoppers who have just received gifts from parents and those who have not; in contrast, only a fraction of existing money balances are traded in asset markets

[7]Christiano, Eichenbaum, and Evans (1997) compare a closed-economy flexible-price model of this *genre* with a sticky-price model, and find that neither is a satisfactory representation of U.S. data. They conjecture that greater attention to wage rigidities might help resolve the empirical anomalies they detect.

and monetary innovations therefore have larger proportional effects on exchange rates than on price levels. Nominal and real exchange rate movements therefore are positively correlated once again.

Furthermore, movements in real and nominal exchange rates can be quite persistent in Alvarez and Atkeson's model. Unlike in the Lucas-Grilli-Roubini setup, even *anticipated* monetary changes can have real effects. This logical implication of the model strikes me as quite unrealistic, although it is needed for the model to generate persistence in real and nominal exchange rates through persistent monetary growth. Shoppers stranded in the goods market do not come home when future monetary changes are announced, or come home more frequently when inflation is higher. Thus, even expected monetary changes have amplified effects on exchange rates compared to commodity prices. Persistent real exchange rate movements result from persistent money-growth shocks.

Both the Grilli-Roubini model, see eqs. (3) and (4), and the Alvarez-Atkeson model imply that real and nominal exchange rate changes will become decoupled in conditions of very high inflation. But they do so for the wrong reason, in my judgment. In the Alvarez-Atkeson story, for example, shoppers' money balances become a negligible fraction of the economy's total money holdings when inflation is extremely high, so exchange rates, like price levels, move roughly in proportion to the total money supply. In reality, however, financial-market structure and the interface between goods and asset markets is not invariant to the rate of inflation. As Keynes (1923) reported of the post-World War I Austrian hyperinflation:

> In Vienna mushroom exchange banks have sprung up at every street corner, where you can change your krone into Zurich francs within a few minutes of receiving them, and so avoid the risk of loss during the time it will take you to reach your usual bank.

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More recent examples abound (see Dornbusch and Reynoso 1993).[8] Innovation in individual market access (on-line portfolio management, etc.) should weaken the liquidity effects of money shocks if the models of this section capture the main forces at work. Evidence that this is so has yet to emerge.

II.3 A role for sterilized intervention

Liquidity models such as that of Grilli and Roubini can imply a role for sterilized foreign exchange interventions, which are defined as interventions that do not alter the paths of national money supplies. Suppose the Home government (randomly) decides to accept Foreign currency in payment for some of its bond issue; it simultaneously uses this Foreign currency to purchase part of the Foreign government's bond issue. This operation does not alter money supplies on any date, assuming the Home government rebates to the private sector the next-period payments on its Foreign bond purchases that it receives from Foreign's government.[9]

How are asset prices affected? The Foreign-bond equilibrium condition in eq. (2) does not change, but because the Home government is allowing Foreign-currency holders directly to purchase some of its bonds, their price q_H rises, that is, i_H falls. This development makes Foreign-currency bonds incipiently more attractive. As market actors attempt to sell Home for Foreign currency in order to buy more Foreign bonds, Home's currency depreciates against Foreign's until both types of bond once again are equally attractive at the margin.

In practice, central banks use sterilized interventions to defend exchange

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[8]One might hope to improve the models' empirical performance by endogenizing the frequency of contact between goods and asset markets. Romer (1987) illustrates the difficulties in carrying out this program.

[9]To maintain the Lucas (1982)-style perfectly-pooled real equilibrium, one has to assume that, ex ante, private agents trade claims on the currency rebates due to stochastic sterilized interventions.

rates when they do not wish their actions to impinge on monetary aggregates. The evidence that sterilized interventions affect asset prices, especially over the longer term, is mixed and difficult to interpret (see Obstfeld and Rogoff 1996, chapter 8). But it has long been vaguely conjectured that asset-market frictions could give sterilized interventions some bite in the very short run. Here we see just such a short-run effect. Clearly, however, the model provides little support for the idea that central banks can systematically exploit sterilized intervention to attain policy objectives over any significant period of time. For understanding the short-run dynamics of the interactions between exchange markets and governments, however, more detailed attention to the micro-structure of money and exchange markets plainly is in order.

III. Optimum currency areas

It is an article of faith among economists, more than a quantifiable fact, that allocative efficiency is enhanced by merging under a single currency two markets previously served by separate currencies with a flexible exchange rate. Relative prices become more predictable, currency conversion and calculation costs are avoided, the economic basis for trade becomes more transparent, and so on.

When nominal prices or wages are sticky, however, this gain in allocative efficiency comes at a price: asymmetrical shocks that alter employment unevenly in different parts of the currency area cannot be cushioned through nominal exchange rate adjustments, which shift aggregate demand among regions by quickly altering relative prices. An optimum currency area efficiently trades off the allocative gain from expanding the zone of exchange-rate stability against the increased vulnerability to local economic shocks. Mundell (1961), who introduced the concept (building on earlier insights of Meade 1951), identified the optimal currency area as an area of factor mobility, one within which factors can avoid unemployment through migration.

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The concept was refined further by McKinnon (1963) and Kenen (1969).[10]

III.1 Optimum currency areas and asset-market structure

The optimum currency argument has always been based on the tacit assumption that asset markets are incomplete, so that factors cannot pool income risks. In a country is hit by an adverse demand shock, the resulting higher unemployment is likely to be distributed unevenly over the labor force: some lose their jobs entirely. An exchange-rate induced terms-of-trade deterioration eases unemployment via a real national income reduction with a much more uniform, and therefore less harsh, incidence. From this interpretation flows the importance of fiscal federalism, stressed by Ingram (1973) and others. Government redistribution partially replaces private risk pooling when asset markets are incomplete.

Under asymmetric information, problems of moral hazard and adverse selection tend to eliminate many forms of contingent contracting, for example, most forward sales of labor income. Clever incentive contracts sometimes can be devised so as to prompt truthful revelation of private information, but these tend to break down when agents can unravel their provisions through unobserved side transactions in asset markets. As illustrated in Obstfeld and Rogoff (1996, chapter 6), noncontingent contracting will tend to predominate in these circumstances.

Financial liberalization within a currency area may be of limited help for another reason. Capital is much more footloose than labor, which, within the EU is still generally highly immobile between countries (and typically within them). In these cases, capital-account liberalization of the type the EU

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[10]See Bayoumi and Eichengreen (1996) for a recent survey of empirical work. An additional cost of currency union is the loss of discretion over seigniorage financing of the fiscal deficit. I will not take up that topic here, however. Stabilization questions are widely agreed to be more important.

has now achieved may actually worsen the optimum-currency-area dilemma. Countries hit by adverse shocks will see capital leave, adding to the woes of the workers who are left behind.

Currency unions may have a subtle additional cost: they affect how near incomplete asset markets can come to an efficient allocation of risks. Neumayer (1998) has developed this point in some generality, but a simple example may be based on Lucas's (1982) model of international risk sharing with complete markets.[11]

Lucas's 1982 model is similar in its basic setup to the Grilli-Roubini liquidity model of section II. However, there is no separate cash-in-advance constraint for securities purchases, only a constraint for goods purchases, and the timing of events is different. Information on endowments and money transfers is revealed at the start of the period, then money and securities are exchanged in an asset market, after which monies are traded for national outputs in goods markets.

Lucas models a perfectly pooled (complete-markets) allocation in which representative Home and Foreign households each own exactly half of the stochastic Home output process $\{Y_{Ht}\}_{t=0}^{\infty}$ and half of the stochastic Foreign output process $\{Y_{Ft}\}_{t=0}^{\infty}$. Consider the following incomplete-markets setup, however. The only assets traded are nominal bonds denominated in Home and Foreign currency, and the national money stocks M_H and M_F are constant. The representative Home resident holds a perpetuity issued by Foreign, which pays its owner $\frac{1}{2}M_F$ Foreign currency units at the start of each

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[11]Mundell (1973) was the first formally to tie the choice of exchange rate regime to its implications for risk allocation. His model, however, assumes that the only internationally traded asset is a noninterest-bearing reserve asset of fixed purchasing power—presumably "gold"—and that there can be no reserve flows under floating rates. Helpman and Razin (1982) further explored the question in models with more realistic (incomplete) asset markets.

period, while symmetrically, the Foreign resident holds a perpetual claim to half Home's constant money stock, $\frac{1}{2}M_H$.

Interestingly, this allocation will be perpetuated over time, as it replicates Lucas's perfectly pooled equilibrium, in which each country own exactly half of the other's endowment process. Assuming positive nominal interest rates, the goods-market equilibrium conditions

$$Y_{Ht} = M_H/p_{Ht}, \; Y_{Ft} = M_F/p_{Ft},$$

imply that the Home household's endowment at the start of a period will be $\left(Y_{Ht} - \frac{1}{2}M_H/p_{Ht}, \frac{1}{2}M_F/p_{Ft}\right) = \left(\frac{1}{2}Y_{Ht}, \frac{1}{2}Y_{Ft}\right)$. The Foreign household's endowment has the identical value. Each Home household, for example, uses the Home currency left over after paying interest to Foreigners to purchase domestic goods; its Foreign interest receipts exactly finance its imports.

Fixing the exchange rate, in this environment, would undermine the efficiency of the equilibrium by removing one asset. However, the conclusion that a fixed exchange rate reduces welfare is easily overturned once money-supply randomness is introduced, as Neumayer (1998) points out. Monetary shocks contaminate the perfect sharing of output risks that noncontingent nominal contracts otherwise allow, and are likely to inhibit international asset trade, as in Bacchetta and van Wincoop (1997). Overall welfare therefore may rise, especially if the adoption of a fixed rate or common currency reduces monetary instability throughout the currency area. The argument complements traditional political-economy justifications of EMS or EMU based on importing the Bundesbank's low-inflation credibility (Giavazzi and Pagano 1988), although in practice it remains to be seen how closely the planned European Central Bank will mirror German inflation aversion.

III.2 Allocative gains from currency unification

Quantification and even theoretical modeling of the microeconomic efficiency

gains from monetary union has proven very elusive. Perhaps the best known number is the Commission of the European Communities (1990) calculation that the savings from eliminating currency conversion costs alone could be as high as 0.4 percent of EU GDP. Interestingly, the European banks currently lamenting the foreign exchange business they will lose under EMU refer to the same gains consumers will reap as resources now devoted to prospectively redundant financial transactions are liberated for more productive uses.

Rodríguez Mendizábal (1996) analyzes a formal model of the transaction costs in a multicurrency system. Based on calibrating the model, his preferred upper–bound estimate for currency conversion costs is around 0.7 of EU GDP, somewhat above the European Commission's figure. In the spirit of Baumol and Tobin, all financial transactions in the model have a bank as counterparty and there is a fixed cost of a trip to the bank. But in the spirit of Lucas (1982), transactions in a given country require prior withdrawal of its currency from the bank. When transactions occur stochastically, individuals will not, as optimally occurs with perfect foresight, exhaust all their currency holdings at once. Thus extra trips to the bank will occur, producing an excessive cost from a multiple currency system, even under fixed exchange rates.

Economists also believe that use of a single currency within Europe will simplify the trading process. One model that potentially captures the effect is a random matching model of monetary exchange, along the lines of Head and Shi (1996). In such models international trade with a single currency may welfare-dominate an equilibrium in which many currencies are used because on average trades that lead to immediate consumption occur more often. This "thick market" effect offers a means of rationalizing the "network externalities" in money use posited by Dowd and Greenaway (1993). Unfortunately, the random matching monetary models are quite stylized and

underestimate the ability of real financial markets to overcome the double-coincidence-of-wants problem through credit instruments.[12]

Another literature bearing on the question is the extensive empirical research seeking an effect of exchange-rate volatility on trade flows. This research is largely inconclusive; see Obstfeld (1995) for discussion. A newer tack is to look directly at international departures from the law of one price (LOOP) for tradable goods. Engel and Rogers (1995) find that the variability of LOOP deviations is systematically related to nominal exchange rate volatility. Obstfeld and Taylor (1997b) use the same data set to estimate a model in which transport and other trade costs lead to a range of LOOP deviations within which arbitrage is unprofitable (the "commodity points" suggested by Heckscher 1916). For all four tradable commodity groups they analyze, their trade-cost estimates have a strong, positive cross-sectional correlation (across location pairs) with nominal exchange rate volatility. The implication seems to be that exchange-rate volatility indeed inhibits profitable trade flows, although more reliable inferences must await further modeling of international arbitrage and intraindustry trade under uncertainty.

One implication of the discussion is that small and very open countries may gain more than large ones from joining a currency union, as they trade more and therefore bear higher costs from exchange rate fluctuations. Small countries also gain less from macro policy sovereignty (McKinnon 1963). The general stability of the United States currency union can be ascribed to high levels of inter-state trade, coupled with inter-state labor mobility and America's federal fiscal system. These favorable conditions are not reproduced among European countries.

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[12]In a model with a potentially richer array of assets, Rey (1996) assumes a transaction technology incorporating a related thick market externality. For further discussion of externalities in models with non-Walrasian trading frictions, see Cooper's (1998) section on search models.

Political economy intrudes here as well. Unquestionably, floating exchange rates make it harder for governments to resist sectorial pressures for protection. In an EU context, floating rates are viewed as inimical to maintaining and extending the single market. Currency unification thus can have a substantial indirect microeconomic payoff to the extent that it discourages protectionism. Needless to say, this payoff, too, has eluded rigorous quantification.

IV. The stability of fixed exchange rates

In the run-up to EMU, core members will likely be defending existing or new EMS exchange parities, whereas countries aspiring to join after EMU is launched will target the euro as part of their entry requirement. In line with the Maastricht convergence criteria, "outs" will also be targeting low inflation and reduced levels of public deficits and debt. A major question is whether these transitional arrangements will run smoothly or be riddled by speculative crises, as in 1992-93. Macroeconomic probity may be no guarantor of a smooth ride: a new generation of crisis models suggests that even sustainable currency pegs may be attacked and even broken. If so, the case for moving to a common currency from fixed exchange rates, as in EMU, is strengthened.

The focus of these models is on the government's continuous comparison of the net benefits from changing the exchange rate versus defending it. Like a run on a bank, speculation against a currency creates objective economic conditions that make liability devaluation more likely.[13] As a result, even pegged exchange rates that could be sustained indefinitely in the absence of a speculative attack can succumb to adverse market sentiment. Underlying macroeconomic "fundamentals" are far from irrelevant to the outcome, however, for

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[13] Cooper (1998) briefly touches on the theoretical literature on bank runs.

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they determine the range of possible equilibria. Some currency pegs are unequivocally doomed by bad macroeconomic fundamentals—unemployment, real currency appreciation, government deficits, large foreign debts, and so on. For others, the fundamentals are so favorable that the exchange rate plainly is immune to speculative attack. But there is also a grey area in which multiple equilibria are possible, with seeming tranquility in exchange markets suddenly giving way to currency collapse.

IV.1 A prototype model with multiple equilibria

A barebones model illustrates how the coordination problem of currency-market traders changes when changing macroeconomic fundamentals alter the degree of discomfort a government will suffer because of an attack.[14] The model contains three agents, a government that sells foreign reserves to fix its currency's exchange rate and two private holders of domestic currency who can continue holding it or sell it to the government for foreign currency. I have in mind an economy with many competitive money holders, of course, but the two-trader paradigm captures important features of more realistic cases.

The government commits a finite reserves stock, R, to defend the currency peg. This assumption need not reflect an inelastic lower limit to reserve holdings; more realistically, alternative reserve "limits" reflect differing degrees of commitment to the exchange rate's defense. The tenacity with which the exchange rate is defended can depend on a variety of developments in the domestic economy, as in the fully-articulated models to be reviewed below. For now the government's payoffs are not modeled explicitly.

The size of the committed reserve stock defines the payoffs in the one-shot noncooperative game that the two private traders play. A first game, shown

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[14]This subsection's discussion draws on Obstfeld (1996).

in normal form in figure 4a, is the High Reserve game. Committed government reserves, R, are 20 and each trader has domestic money resources of 6 which can be sold to the government for reserves ("Sell"), or held ("Hold"). (Think of these resources as a measure of the strength of market opinion, as well as of the extent of leverage, the amount of speculative "firepower.") To sell, thereby taking a position against the current rate, traders bear a cost of 1. But even if both sell their resources of 6 to the government, its reserves remain at 8 and allow it to maintain the fixed exchange rate. So a trader who speculates receives a payoff of -1, regardless of what the other one does, while one who holds gets 0. Speculation thus is a strictly dominated strategy. The sole Nash equilibrium is the northwest corner: the currency peg necessarily survives.

The game in figure 4b is the Low Reserve game. Committed reserves $R = 6$, meaning that either trader alone can take out the currency peg.[15] Suppose that in the event of giving up its peg the government devalues by 50 percent. A trader who has sold *all* his domestic currency has a capital gain (in domestic currency terms) of 3, for a net gain of 2 after paying the transaction cost. If both traders sell, however, each gets half the government reserves and earns only $\frac{3}{2} - 1 = \frac{1}{2}$. Now, holding is a strictly dominated strategy; so the unique Nash equilibrium is the southwest corner, implying a collapse of the exchange rate.

Figure 4c shows the Intermediate Reserve game, which is the most interesting case. Here $R = 10$, so neither trader alone can run the government's reserves although both can if they sell together. The payoff structure is derived as follows. Either trader acting alone fails in an attack, bearing the cost -1 while the player who holds earns 0. But if both attack, each gains

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[15]The assumption here that either player can unilaterally cause a collapse is simply a crude device for making collapse inevitable, as in Krugman's (1979) original model.

Figure 4

Trader 2

	Hold	Sell
Hold	0, 0	0, -1
Sell	-1, 0	-1, -1

Trader 1

(a) High Reserve game
($R = 20$)

Trader 2

	Hold	Sell
Hold	0, 0	0, 2
Sell	2, 0	1/2, 1/2

Trader 1

(b) Low Reserve game
($R = 6$)

Trader 2

	Hold	Sell
Hold	0, 0	0, -1
Sell	-1, 0	3/2, 3/2

Trader 1

(c) Intermediate Reserve game
($R = 10$)

Firepower of speculators = (6,6)

$\frac{5}{2}-1 = \frac{3}{2}$. There are now two Nash equilibria. In the first, shown in the southeast corner, both traders sell and the currency peg falls. But if neither trader believes the other will attack, the Nash equilibrium in the northwest corner results and the currency peg survives. In this game the attack equilibrium has a self-fulfilling element because the exchange rate collapses if attacked, but survives otherwise. The intermediate state of fundamentals (government reserves) makes a collapse possible, but not an economic necessity.[16]

A fairly robust prediction of this setup, noted in a different model by Jeanne (1995), is that the health of fundamentals determines the existence and multiplicity of attack equilibria. In the simplest Krugman (1979) model, fundamentals are either consistent with long-run fixity of the exchange rate or are not. Here the same is true for extreme values of fundamentals, but there is also a large middle ground over which fundamentals are neither so strong as to make a successful attack impossible, nor so weak as to make it inevitable.

IV.2 The role of government objectives

The literature contains more detailed accounts of crises which explicitly model the government's objectives; see Obstfeld (1996) for a brief survey. Many mechanisms have been discussed. Labor union expectations of devaluation may translate into higher wage demands, real appreciation, and unemployment. In such circumstances, the government is more likely to be pushed into realignment by an adverse shock. The process is clearly circular, since heightened devaluation expectations themselves make devaluation more likely, given the government's objectives. Nominal public debt provides another channel for self-fulfilling crisis, since high domestic nominal interest

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[16]Experimental evidence (e.g., Cooper et al. 1994) suggests that if the structure of the game is indeed as in figure 4c, speculators may not coordinate on the equilibrium that maximizes their joint profits.

rates may worsen the public finances to the point where devaluation appears the optimal (or only) way out for the government. In many experiences a weak banking system has proven the Achilles' heel of an otherwise sustainable exchange rate policy, as rising interest rates induced governments to step in and essentially backstop bank solvency with official reserves (see, for example, Kaminsky and Reinhart 1995).

In these models, governments ratify market expectations through accommodative devaluation and monetary expansion. Yet, Eichengreen, Rose, and Wyplosz (1995, p. 283) find, for a panel of industrial-country crisis episodes, that "there is little evidence that speculative attacks, whether self-fulfilling or not, typically prompt governments to ease fiscal and monetary policies." Some authors, for example Flood and Marion (1996), take this as evidence against the idea that crisis-induced realignments reflect official accommodation of market pressures.[17] A more accurate interpretation of the data, to my mind, is that there is substantial heterogeneity in country experiences and circumstances that is not well captured by Eichengreen, Rose, and Wyplosz's averages over a rather widely dispersed sample. The experiences of Britain and Italy after the 1992-93 crises offer examples of post-devaluation monetary expansion. In addition, devaluation alone can be expansionary.

IV.3 Narrowing the range of equilibria

In an important contribution, Morris and Shin (1995) show how the presence of uncertainty can render the attack outcome the *unique* outcome in speculation games with uncertainty. In essence, their point is this: if it isn't too costly to take a position against a currency and if it there is a good chance other speculators believe the peg to be unsustainable, then it is prudent to speculate yourself even if you know the peg to be conditionally viable. This

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[17]Flood and Marion also present an interesting model in which the authorities can sterilize so as to avoid monetary expansion after a devaluation.

result can eliminate the multiplicity of equilibria, but it is hardly good news for fixed exchange rates, as it implies that pegs that could survive absent speculation will necessarily be attacked.

Consider the following static Bayesian game. There are again two traders. Each is independently endowed with "firepower" of 6 or 10; but traders don't observe the endowments of others. Thus, it is never common knowledge that the exchange parity is not unconditionally unsustainable. If Trader 1 has 6, he sees the contingent payoffs shown in figures 5a and 5b.

Let π be the common probability of a trader having 10. Suppose Trader 2's strategy is

$$\sigma^2(6) = sell, \quad \sigma^2(10) = sell.$$

In that case Trader 1's expected profit from a strategy with $\sigma^1(6) = sell$ is $(1 - \pi) \cdot \frac{3}{2} + \pi \cdot \frac{7}{8} > 0$, whereas that from $\sigma^1(6) = hold$ is 0. Of course, $\sigma^1(10) = sell$ also is a best response to the foregoing strategy of Trader 2. There thus is one equilibrium in which everyone always sells, regardless of information.

What if Trader 2's strategy instead is

$$\sigma^2(6) = hold, \quad \sigma^2(10) = sell?$$

Now Trader 1's expected profit from $\sigma^1(6) = sell$ is $(1-\pi)\cdot(-1)+\pi\cdot\frac{7}{8}$ whereas his expected profit from $\sigma^1(6) = sell$ equals 0. Thus, strategy $(\sigma(6), \sigma(10)) = (hold, sell)$ is a best response to itself if and only if

$$(1 - \pi) \cdot (-1) + \pi \cdot \frac{7}{8} \leq 0 \iff \pi \leq \frac{8}{15}.$$

For $p \leq \frac{8}{15}$, there therefore are *two* pure-strategy equilibria,

$$(\sigma(6), \sigma(10)) = (hold, sell)$$

and

$$(\sigma(6), \sigma(10)) = (sell, sell),$$

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Figure 5

Trader 2

	Hold	Sell
Hold	0, 0	0, -1
Sell	-1, 0	3/2, 3/2

Trader 1

(a) Firepower = (6,6)

$(R = 10)$

Trader 2

	Hold	Sell
Hold	0, 0	0, 4
Sell	-1, 0	7/8, 17/8

Trader 1

(b) Firepower = (6,10)

$(R = 10)$

in a parallel with the Intermediate Reserve game of figure 4c.

If $\pi > \frac{8}{15}$, however, $\sigma^1(6) = sell$ always is better so the second equilibrium above, the attack equilibrium, is the *only* one. Introducing a high enough probability that other traders will defeat the central bank and reap all the profits on their own eliminates the possibility that the traders, both finding themselves endowed with 6, find it optimal not to mount an attack. Uniqueness could also be guaranteed, of course, by making the cost of speculation (here -1) sufficiently low.

It is an important task for research, one fraught with consequences for exchange-rate policy, to understand the factors that generate crises and determine their timing. Some research will focus on the microdynamics of asset markets, as might be fruitful also for understanding sterilized interventions and other tactics governments employ in their defenses of exchange rates. This literature is in its infancy, but surely will mature in the years ahead.

V. Conclusion

The theoretical and empirical progress in open-economy macroeconomics in recent years has led to new ways of thinking about the economic costs and benefits of a project like EMU. Unfortunately, a reliable quantitative analysis of costs and benefits in specific cases remains elusive. In particular, our current theoretical basis for evaluating the microeconomic efficiency gains from currency unification is much too slim. For this reason, observers like the Swedish commission on EMU (Calmfors et al. 1997) viewed early entry as inadvisable, at least under the current circumstances of high unemployment.

At this juncture, the most persuasive arguments for EMU remain those based on political-economy considerations. Currency misalignments could promote protectionist sentiment and undermine the single market. By taking the issue away, EMU can promote further economic integration. Furthermore, EMU can help establish and maintain a broad zone of monetary

and possibly fiscal stability. Finally, if the politically practical alternative to EMU is fixed exchange rates bedevilled by credibility problems and capital controls, some form of currency union might be preferable. Unfortunately, the laudable goals could be thwarted by popular backlash and disintegration if EMU ultimately is seen as a cause of slow growth and unemployment.

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