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Tracking the Euro's Progress*

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Abstract

The evolution of the euro since its inception has appeared inexplicable. This paper develops a monetary model of the euro/US dollar exchange rate to track the progress of the currency, both before and after Stage 3 EMU. The relationship between the exchange rate, money stocks, GDP, interest and inflation rates, and prices is identified. The observed patterns of behaviour during the 1990s are used to predict the euro's value up to mid-2000; a consistent finding is that the euro is over-predicted by 23–30%. This finding is robust to the use of alternative sample periods and alternative estimation methodologies, as long as each of the variables is treated as endogenous.

This monetary model does not give much weight to factors such as productivity. However, the past evolution of European exchange rates suggests that productivity trends are indeed important. Some estimates suggest that an annual one percentage point in the intercountry differential in tradable-nontradable productivity causes a 0.85–1.7% real appreciation of a currency.

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Since recent sectoral productivity data are unavailable, we rely upon potential GDP measures to assess likely trends in the euro. We conclude that without an upward shift in Euroland potential growth, the euro will tend to depreciate over time.

I. Introduction

In late January 2000, the euro breached the parity level of one dollar per euro. A currency inaugurated with such assuredness had, in the course of a year, lost 15% of its value. From an economic perspective, this in itself was not troubling. What was surprising – and in some quarters alarming – was the apparent disconnect between macroeconomic fundamentals and the value of the euro. By September, the currency had lost some 29% of its value, despite clear evidence of a rebound in economic growth in Euroland.

What is missing from journalistic accounts of events is historical perspective. To some extent, the omission is understandable, given the brief history of the euro. In this article, we discuss the historical correlation between the fundamentals and the value of the synthetic euro, relative to the US dollar, and the degree to which that correlation has extended into the post Stage 3 EMU period.

This study is composed of two parts. The first assesses the value of the euro from a conventional, macroeconomic perspective that focuses on monetary factors; it can be considered a medium-term model, insofar as the predicted values are predicated upon current values of the fundamentals, which might or might not be at equilibrium levels. The second looks to long-run factors – primarily productivity differentials – as the driving force behind the value of the euro.[1] To the extent that these productivity trends represent long-term equilibrium, the resulting predictions might be considered equilibrium exchange rates, in the parlance of Clark and MacDonald (1999). To anticipate the results, we find that a monetary model can explain a good portion of the movements in the synthetic euro. However, it is difficult to track movements in the euro post-Stage 3. There are two possible interpretations: the first is that the historical model is not an adequate representation of the euro's behaviour; the second is that the euro is undervalued, relative to the fundamentals. In the absence

[1]We eschew discussion of other determinants of the euro's value, such as the use of the euro as a reserve and vehicle currency, since that has been discussed elsewhere (Demertzis and Hughes Hallett 1999; Portes and Rey 1998).

of knowledge about the true model, the best one can do is to try to safeguard against the first interpretation as much as possible.

A reasonable question is whether one needs any sophisticated models to describe the euro's progress. For instance, Rosenberg (2000) points out that the trade-weighted inflation-adjusted euro has experienced a long-term decline over the past 20 years, and so some continued depreciation is to be expected. Corsetti and Pesenti (1999), argue that a similar point holds for the real bilateral euro/US$ from 1990 onward. Figure 1 shows that the CPI deflated euro has been depreciating by about 1.4% per year. Disconcertingly, it is also possible to obtain an essentially zero depreciation in the real rate by the judicious choice of sample period. For instance, taking the Louvre Accord as a break point, the June 1987–December 1999 trend is essentially flat. Simple models do not guarantee robust conclusions.

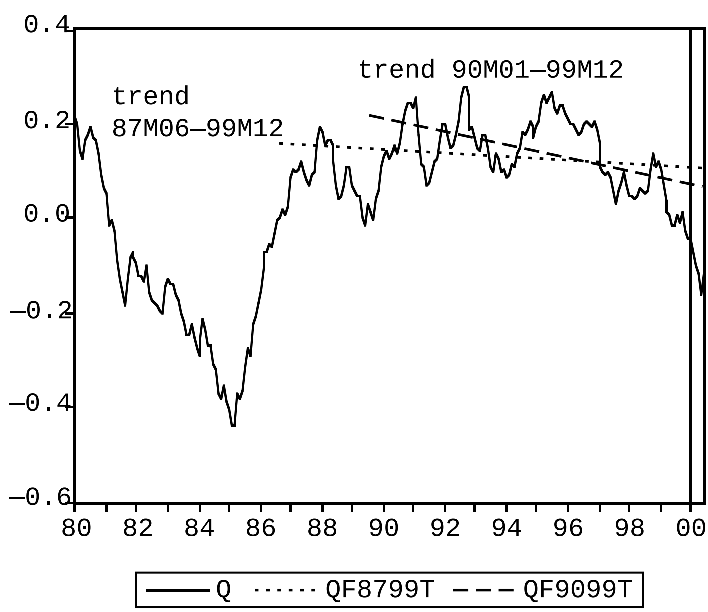

Figure 1: CPI deflated real euro and time trends

In any event, in terms of *understanding* the behaviour of the euro, it is rather unsatisfying to have long-term movements being adduced to unknown factors which are impounded into the trend term, especially if one wishes to make predictions about the future. The judgements presented below do not rely on such calculations.

II. A Monetary Model of the Euro

A. The Model

The most common approach to explaining the nominal exchange rate is the monetary approach; this framework takes the exchange rate as the interaction of the relative supply of, and demand for, two currencies. The greater the stock of euros, the weaker the euro is, holding everything else constant. The higher the demand for euros by Euroland residents, the stronger the euro. In this simple model, the demand for money depends positively on income, due to the transactions motive, and negatively on the interest rate, due to the opportunity cost of holding money. A very general expression for this formulation can be written as

$$s_t = \beta_0 + \beta_2\,(m_t^{\text{US}} - m_t^{\text{euro}}) + \beta_3\,(y_t^{\text{US}} - y_t^{\text{euro}}) + \beta_4\,(i_t^{\text{US}} - i_t^{\text{euro}}) + \beta_5\,(\pi_t^{\text{US}} - \pi_t^{\text{euro}}) + \beta_6\,\omega \tag{1}$$

where s represents the value of the euro in US dollars, m_t is the (log) nominal money stock, y_t is (log) income, i_t and p_t are the interest and expected inflation rates, respectively. ω is the intercountry relative price of nontradables.

In the standard monetary model, the coefficients have structural interpretations which may vary with the assumptions in effect. In monetary models, β_2 equals unity, while $\beta_3 < 0$, where $|\beta_3|$ represents the income elasticity of money demand. If prices are assumed to be flexible, then the interest rate and inflation differential are the same, and the conditions $\beta_4 > 0$ and $\beta_5 = 0$ hold. β_4 is equal to the absolute value of the interest semi-elasticity of money demand. On the other hand, if prices are sticky and there is secular inflation, then $\beta_4 < 0$ and the magnitude of this parameter is positively related to price stickiness; the more rapid price level adjustment is, the smaller this coefficient is, in absolute value terms. With sticky prices and secular inflation rates (Frankel 1979), the coefficient on inflation is positive ($\beta_5 > 0$) and increases with the interest semi-elasticity of money demand and decreases with the degree of price stickiness. The last term is not found in typical treatments of the exchange rate, so that $\beta_6 = 0$. This will be true if there are no nontraded goods. Dropping this condition implies $\beta_6 < 0$. In words, this assumption means that as the relative price of nontradables goes up in the Euroland, the euro appreciates with respect to the dollar, and vice versa.[2]

[2]The low predictive content of structural models such as the monetary model has been reviewed recently by Rogoff (1999). Mark (1995) and Chinn and Meese (1995) suggest that there is some empirical content to the long-run predictions of the monetary model, while MacDonald (1999) argues for predictability at short horizons.

One obvious difficulty in assessing the behaviour of the euro is that, until a little more than a year ago, it did not exist. Even as of September 2000, there exist at most only 21 monthly observations on the euro; observations on the other variables of interest, like real GDP, are likely to have even fewer observations at hand. Because it is impractical to estimate structural monetary models, along with the associated dynamics, with such few observations, the researcher is forced to use data from the pre-Stage 3 period to estimate the models, which means constructing synthetic euro exchange rate data. Similarly, aggregated data for the EU-11 are used for money stocks, real GDP, and prices.

While is it easy to manufacture the aggregate series in a mechanical sense, the researcher has to be particularly wary of the Lucas Critique in this context. How the arithmetic sum of separate national monies affect the weighted average of the constituent exchange rates may be very different from how the aggregate euro money stock affects the actual euro. Furthermore, the relationships between money stocks and income, and money stocks and interest rates, are unlikely to be completely invariant to the exchange rate regime. Still, preliminary evidence indicates that the most critical functional relation – the EU-11 money demand function – has not exhibited substantial instability since Stage 3 of EMU (Hayo 2000), suggesting that the historical correlations might still be informative with respect to post-Stage 3 behaviour.

B. Estimates

The monetary model is estimated using the Johansen (1988) multiple equation approach, which allows one to detect possibly multiple long-run relationships. The analysis covers the period from January 1991 to June 2000.[3] To account for the events surrounding the EMS crises of 1992–93, a dummy variable that assumes the value of one from August 1992 to September 1993 is included.

The results of estimating equation (1) over the August 1991–June 2000 period are reported in the first two columns of Table 1; the results in the first column assume that there is no linear trend component in the data series, while those in the second column allow for such linear trends. In both cases,

[3]Details of the econometric methodology are reported in Chinn (2000). Exchange rates are expressed in US$/euro, and money stocks are defined as M1. Income is measured by real GDP. For interest rates, the three-month offshore euro rate is used for EU-11 interest rates, and the Federal Reserve Funds rate for the USA. Inflation rates are calculated as the 12-month difference of the log-CPI. p^N and p^T, used to construct ω, are represented by the CPI and PPI. Further details are contained in the Appendix.

Table 1: A Monetary Model of Exchange Rates Long Run Coefficients

	1991M08–2000M06 [1]	1991M08–2000M06 [2]	1991M08–1998M12 [3][a]	1991M08–1997M12 [4][b]
$m^{US} - m^{euro}$	0.804***	0.743***	0.673***	0.709***
$y^{US} - y^{euro}$	–0.300	–0.592	–1.051***	–1.324***
$i^{US} - i^{euro}$	3.427***	3.286***	2.904***	2.990***
$\pi^{US} - \pi^{euro}$	3.666	3.732*	5.562	6.029***
ω	–1.837**	–1.492*	–0.118	–0.275

Notes: Long run coefficients from Johansen system approach, assuming one long run relationship. Column [1], [3] and [4] estimates assume no deterministic trend in the data, while column [2] does assume a deterministic trend.
*(**)[***] indicates significance at 10%(5%)[1%].
[a]Two cointegrating vectors at 5% MSL, using finite sample critical values.
[b]One cointegrating vector at 5% MSL, using finite sample critical values.

there is substantial evidence of at least one long-run relationship.[4] Moreover, the estimates from both specifications are broadly in line with the monetary model. Since the exchange rate is expressed in terms of the number of dollars per euro, increases in the US money supply depreciate the dollar (increase s), and the estimates are close to the theoretical value of 1. US income has the correct sign – an increase in US income appreciates the dollar (decreases s) – but is not significant at conventional significance levels.

Aside from money, the most statistically significant coefficient is on interest rates, but it has the wrong sign. A possible explanation is that the effects of the EMS crises of 1992–93 might be obscuring expected effect. The nontradables price variable enters with the correct sign and is significant, as in Clostermann and Schnatz (2000). Finally, inflation is marginally significant and has the expected effect: a one percentage point increase in inflation weakens the currency by 4%, lower than Hayo's (1999) estimate of the Euroland interest semi-elasticity of money demand of approximately 10.[5]

[4]The reported results are based on a 1% marginal significance level and finite sample critical value adjustment following Cheung and Lai (1993). If one uses the asymptotic critical values from Osterwald-Lenum (1992), one would conclude that there are three long-run relationships. Omitting two of the long-run relationships reduces the efficiency of the estimates, but will not bias them. In any event, the second and third long-run relations do not typically conform to any obvious economic relationships.

[5]Note that under the sticky price formulation, the inflation coefficient is the interest semi-elasticity *plus* $1/\theta$, where θ is the rate of exchange rate reversion to its long-run value.

We also attempt to use M3 as a money stock measure, since the ECB has stressed the importance of this aggregate as an indicator. The results were not promising. Although the point estimate on the money stock was positive and significantly different from zero, the estimated coefficient on income is implausibly large – approximately 6.5. Moreover, the relative nontradables price variable also had an extremely large, statistically significant and incorrectly signed coefficient. We speculate that these results arise because the M3 aggregate proxies better for a credit, rather than monetary, measure.

Since the landscape of the empirical literature is littered with failed models that fit well in-sample, it behoves the researcher to test the model out of sample. This wariness is heightened by the obvious regime shift that occurred with the actual introduction of the euro in January 1999. The next subsection assesses the model in this light.

C. Is the Pre-Euro World Different from the Post-Euro World?

The first step in answering this question is to assess whether omitting post-euro data changes the estimates substantially. The third column of Table 1 reports results for the regression restricted to the August 1991–December 1998 period, without a time trend assumed in the data. The parameter estimates are similar to those obtained from the full sample, so a preliminary conclusion is that the results are not sensitive to the addition of these data; however, a more relevant test is whether the estimates obtained from the pre-euro period predict out of sample.

In Figure 2, the euro and predicted values from a dynamic simulation starting in January 1999 are depicted. Using the no-trend assumption, dynamic forecast S1F9198 is the result, indicating a 25% over-prediction in June 2000. Matters are not helped if one allows for deterministic trends in the data (not displayed): then the over-prediction is some 30%. The dynamic simulations appear to do poorly because some of the endogenous variables – namely the interest and relative tradables/nontradables price variable – are modelled with some imprecision.

To investigate whether the mis-prediction is sensitive to the manner in which the other endogenous variables are treated, the exchange rate is also modelled using a single equation approach.[6] A parsimonious error correction model

[6]This procedure is appropriate if the exchange rate changes in response to the long-run relationship (as it does in this sample), but also that the other variables do not. In this case, this condition does not hold exactly: the inflation rate does appear to respond to the deviations from the long-run relationship so it is not strictly valid to estimate only the marginal error correction model.

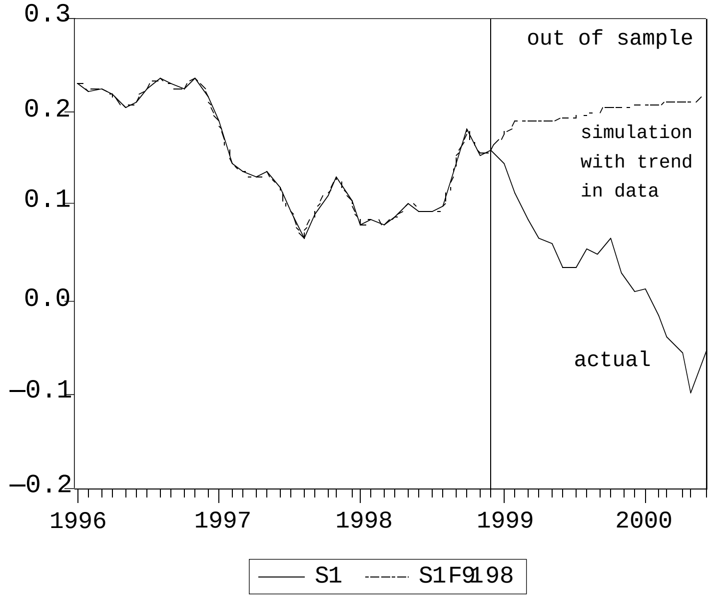

Figure 2: Dynamic simulation of vector error correction model estimated over 1991–98 period

estimated over the August 1991–December 1998 period[7] yields an out-of-sample over-prediction of about 8% (S1FECM9198) in Figure 3, a substantially smaller prediction error than that generated by the specifications that treat the other variables as endogenous.

If the model is estimated over the August 1991–December 1997 period and the out-of-sample dynamic simulation is initiated at January 1998, then the model predicts an overvaluation of 26% in June 2000; see Figure 4. Thus, the results appear to depend somewhat upon the particular estimation methodology, but not, interestingly, upon whether one takes the run-up in value of the euro prior to its inception as exceptional or not.

Finally, one can consider the case without assuming the existence of a long-run relationship in the levels. In that case, the appropriate objects of investigation would be growth rates; that is, the rate of exchange rate depreciation is related to differential *growth rates* in money, income, interest and inflation rates, and relative prices of nontradables. If one takes this view, and applies it to the period ending December 1998, then one finds that most of the coefficients are correctly signed. Ordinary least squares regression estimates are

[7]This model – a single equation error correction model – includes one lag of the exchange rate difference, three lags of money supply, two lags of GDP, and no lags of the inflation rate or the relative price variable. The error correction term is that indicated in Table 1, column [3].

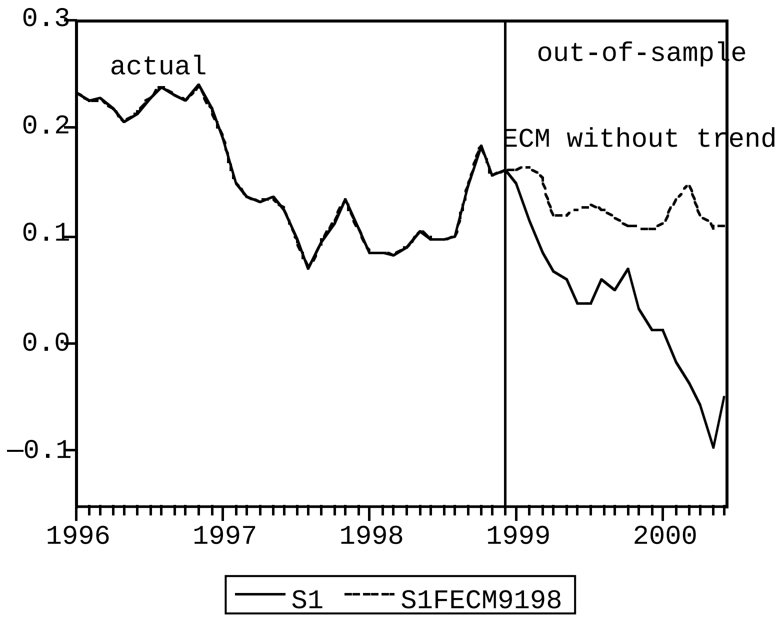

Figure 3: Dynamic simulation of single equation error correction model estimated over 1991–98 period

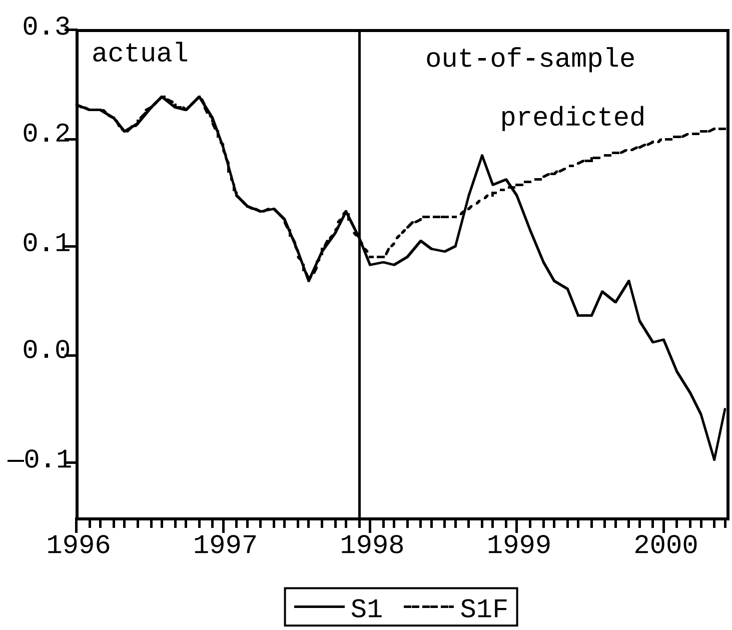

Figure 4: Dynamic simulation vector correction model simulated over 1991–97 period

used to generate the out-of-sample forecasts, resulting in an over-prediction of 23% in June 2000.

D. The Dow and the Dollar?

Recently, two alternative hypotheses have been advanced regarding the relationship between equity returns and the exchange rate, and particular attention has been focused on the euro/dollar rate. On the one hand, the financial press has attributed the weakness of the euro to the strength in the USA equity markets; see for example, Bogler (2000) and the *Economist* (18 March 2000, p. 81). According to this view, the net inflow of capital from Euroland into US equity markets has appreciated the dollar because of higher than expected returns to holding US equities. On the other hand, there is the claim that higher equity returns tend to accompany a more depreciated currency (Crise 2000). This view argues that the US equity markets are 'New Economy' stock markets and therefore US assets enjoy a lower equity risk premium *vis-à-vis* the 'Old Economy' Euroland stock markets. This lower equity risk premium induces a net capital inflow, which appreciates the dollar.

Superficially, there appears to be a correlation between US equity price indices and the euro/dollar exchange rate over the 1991–2000 period. The elasticity of the exchange rate with respect to the Dow Jones Industrial Average (DJIA) is –0.18, with a standard error of 0.03; the proportion of variation explained is 44%. The elasticity of the exchange rate with respect to the NASDAQ Composite Index is –0.13, with a standard error of 0.03, and the explained variation is two thirds. Restricting ourselves to 1999–2000, which is the relevant period for testing the impact of the performance of US equities on the exchange rate, yields results that support the first view: the coefficient on the DJIA is –0.52, with a standard error of 0.28, and the coefficient on the NASDAQ is –0.20, with a standard error of 0.04. The regressions explain 16% and 59% of the euro's variation, respectively. The negative correlation between the value of the euro and US equity prices is more pronounced during 1999–2000 for the NASDAQ index.

However, it is the *relative* performance of the US and Euroland equity markets that should enter into the equation. In Figure 5, relative returns on the DJIA and NASDAQ indices with respect to the Dow Jones EUROSTOXX index are plotted against the euro/dollar rate. Insofar as there is a relationship between relative equity returns and the value of the euro, the correlation appears stronger for the relative returns on the NASDAQ from 1999 onwards, which is to be expected if one accepts the recent performance of the US equity market as an explanation for the weakness of the euro. That said, the euro

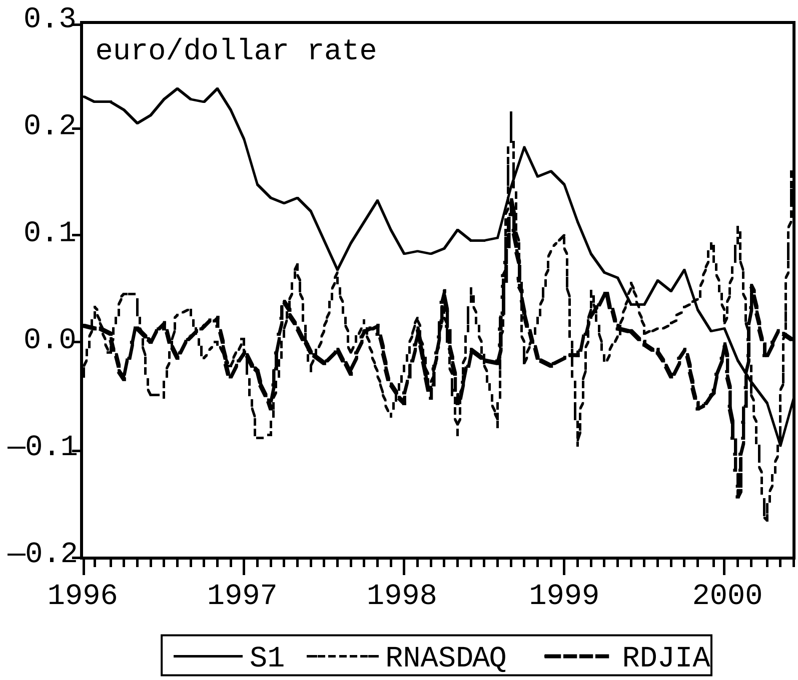

Figure 5: The exchange rate and relative equity returns

continues to depreciate despite the decline in the NASDAQ in April 2000. In addition, the story relies on a specific choice of the equity market; there is no discernable relationship between relative returns on the DJIA and the euro.

Extensive searching did not reveal robust evidence of a stable long-run relation between the monetary fundamentals, augmented with relative returns on equities, over the period from January 1992–June 2000. To the extent that relative returns on the DJIA and the NASDAQ enter into a co-integrating relationship with the exchange rate and monetary fundamentals, the DJIA entered with the co-integrating relation positively whereas the NASDAQ entered it negatively. Neither variable, however, is significant at conventional levels. When one looks at relative returns on both indices from 1999 onwards, the effect of higher relative returns in the US is ambiguous. For the DJIA, higher relative returns depreciate the dollar while higher relative returns on the NASDAQ appreciate the dollar. These results indicate there is no clearly identifiable causal relationship between relative equity returns and the exchange rate in our data set.

III. Long-Term Prospects

The presence of long-term swings in exchange rates far away from their fundamental values is a widely held belief, even if the econometric evidence is less than fully persuasive. *If* one believes that, in the long term, the fundamentals will assert themselves, then one must take a stand on *which* fundamentals are relevant. Because no consensus exists in this literature, our long-term assessments must be considered tentative at best.

The long-term analysis used here takes as its starting point the detection of a role for productivity in the real exchange rate, discussed implicitly in Section 2. Recall the relative price of traded to nontraded goods was partly a function of productivity differentials. One approach, attributed to Balassa and Samuelson, makes explicit the link between relative productivity levels and relative prices in the traded and nontraded sectors. If one assumes that the common currency price of tradables is equalized, and the weight of nontradables is α, then the real exchange rate depends upon the intercountry relative price of nontradables, ω. Assuming in the long run that supply side factors dominate yields:

$$q_t = -\alpha\,[(a_t^{\mathrm{T,US}} - a_t^{\mathrm{N,US}}) - (a_t^{\mathrm{T,euro}} - a_t^{\mathrm{N,euro}})] \qquad (2)$$

As a first approximation, we use the following equation: tradables are mining, manufacturing, agriculture and transport, while nontradables are services and construction. The productivity variable is total factor productivity (TFP), which is the residual between output and capital and labour.[8]

The results of estimating this equation for France, Germany, Italy and the Netherlands (FR, GY, IT and NE) over the 1975–92 period are reported in Table 2. In column [1], the basic specification is presented. A one percentage point increase in the US–Euroland tradable productivity differential results in a 1.7 percentage point real appreciation in the US dollar. This slope coefficient is statistically significant. The nontradable productivity coefficient should be opposite in sign to the coefficient on tradable productivity. In this case, the estimate is not statistically significant. The failure of nontradable productivity to evidence the posited sign is probably due to the large measurement errors entailed in measuring real nontradables output, and, more specifically, in measuring the output of services.

Estimating equation (2) yields the estimate of –0.847 in column [2], while omitting nontradable productivity (in column [3]) yields the statistically significant estimate of –1.528, a value very similar to that obtained in column [1]. Thus the impact of productivity on the real exchange rate is in the range

[8]The equation is also augmented by one additional regressor – the real price of oil. The oil price variable is allowed country-specific slope coefficients.

Table 2: Real Exchange Rates and Relative Productivity Differentials Long Run Coefficients

Variable	[1]	[2]	[3]
$a^{T,US}-a^{T,\,euro}$	−1.703**	−0.847***	−1.528***
$a^{N,US}-a^{N,\,euro}$	−0.112	+0.847***	—
N	72	72	72

Notes: Dependent variable: GDP deflator adjusted real exchange rate. Panel Dynamic OLS(1,2) parameter estimates (Mark and Sul, 1999). Regressions include currency-specific slope coefficients for the real price of oil. No leads and lags of real oil price included. Heteroskedasticity consistent standard errors in parentheses.
*(**)[***] denotes significance at 10%(5%)[1%] significance level.
Source: Chinn and Johnston (1999).

[0.85, 1.70]. Using these estimates to make forecasts into the future is a difficult exercise because TFP data disaggregated by sectors are usually available with a lag of several years.

An alternative view that links productivity to potential, or 'full employment', GDP suggests a way in which to assess the euro's trend using more contemporary data. Rosenberg (2000) ascribes the weakness of the euro to the deficiencies in Euroland manufacturing competitiveness and rigidities in labour markets that stunt productivity and hence output growth. Similarly, Coppel et al. (2000) interpret an acceleration in productivity as an enhancement to growth in potential GDP. One possibility is that higher potential long-term growth, and attendant investment, could induce greater capital inflows that appreciate a currency.[9]

There does appear to be a correlation between potential output ratios and the real value of the euro. Over the 1991–99 period, each 1 percentage point change in the ratio between US–EU11 potential output is associated with a 1.6 percentage point depreciation of the euro (standard error of 0.5).[10] While the point estimate is statistically significant, the degree of precision is sufficiently low such that one would not want to assert much more than the existence of a relationship between the two variables.[11] Hence the downward trend in the

[9]Measures of expectations gleaned from survey data indicate that there is a strong correlation between US GDP growth surprises, and the weakness in the euro (Coppel et al. 2000). To the extent that such surprises proxy for revisions in potential output, they buttress the argument that we are forwarding.

[10]Potential output is inferred from growth rates and output gaps reported in OECD (2000). We thank Robert Z. Lawrence for pointing out this relationship to us.

[11]Over the 1982–93 period, the correlation between US potential and the ratio of tradable to nontradable productivity is approximately 1 for 1. Hence, potential GDP can be viewed as proxy measure for the productivity ratio, if one desired.

euro's value can be interpreted as the reflection of the higher growth rate of potential GDP in the US since 1995, a trend that stands in contrast to the lack of a similar effect in Euroland.

IV. Conclusions

The accounts in the recent commentary regarding the euro's behaviour fall into two categories: those that ascribe the common currency's weakness to remarkably strong macroeconomic conditions in the USA, combined with a certain wariness of how monetary and regulatory policy will be conducted in Euroland; and those that view the 1998 appreciation of the euro as an aberration and hence the subsequent depreciation as a resumption of the trend nominal depreciation in the euro.

This study indicates that there is an element of truth to both views. However, the most notable aspect of the simulations is that, as of June 2000, in almost all cases, the euro appears approximately 23–30% below its predicted value, even when omitting the period just before the euro's inception.

It is important to recall the limitations of statistical analyses such as this one. The weakness of the currency may be due to expectations regarding events not easily captured by the historical correlations of macroeconomic variables. Such factors include the new operating procedures of the ECB, expectations regarding expansion of EMU to Greece, and other EU candidates, and the differential impacts of the New Economy in the US and in Euroland. In some ways, there are too many candidate explanations for the euro's current weakness.

Over the longer term, the differential in potential GDP growth may be the most likely candidate for the euro's trend. This interpretation buttresses the case for those who argue that a trend appreciation of the euro will require a sustained resurgence in Euroland economic growth above that observed over the past decade.

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Appendix

The US data for Section II are from IMF, *International Financial Statistics*, September 2000 CD-ROM, and the EU-11 data are from internal databases supplied by V. Coudert (Bank of France) and B. Schnatz (Deutsche Bundesbank).

Bilateral exchange rate in US$/euro, period average, from the Pacific website (http://pacific.commerce.ubc.ca/xr/), for 1993M01-2000M08. Pre-1999M01 data are synthetic euro exchange rates. For 1990M01–1994M12, synthetic euro exchange rates are created using the conversion weights, and period average exchange rates from *IFS*, line *ah*.

Narrow money is national concept M1.

GDP is interpolated from quarterly data.

The EU-11 interest rate are offshore 3-month deposit rates. The US interest rate is the Federal Reserve Funds rate.

Equity prices are the Dow Jones Industrial Average, the NASDAQ Composite index, and Dow Jones EUROSTOXX index from Bloomberg.

The EU-11 CPI is the harmonized index of consumer prices for 1995M01 onward. Prior to that, national CPIs are aggregated using the conversion weights.

Inflation is the 12-month difference of log(CPI).

The relative price variable is defined as:

$$\tilde{\omega} \equiv \log(CPI^{US}/PPI^{US}) - \log(CPI^{euro}/PPI^{euro})$$

The data for the productivity portion of Section III were drawn from *IFS* and from the OECD's *International Sectoral Data Base* (*ISDB*).

Exchange rates are bilateral, period average, *IFS* line *rf*. The real exchange rate is defined using aggregate GDP deflators.

Price deflators and total factor productivity (TFP) series are from *ISDB*. Traded sectors: mining, manufacturing, agriculture and transportation. Non-traded: all other services, construction.

Oil prices are crude petroleum export prices, in 1990 US$, calculated using the US CPI.

The data for potential output calculations of Section III were drawn from *OECD Economic Outlook 2000*.