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The outlook for the Euro: lessons from the DEM*

Abstract. The Euro started at $1.19 but has fallen as low as $0.82 and risen as high as $1.35. If the Euro behaves like the DEM, the long run value of the Euro is approximately $1.00, and over time, the Euro is likely to rise as high as $1.552 and fall to as low as $0.645. Many have criticized the European Central Bank, often severely, first because the Euro weakened greatly during most of its first three years, starting in January, 1999, and then because it strengthened greatly over the next three years. The Euro has been less volatile so far than the DEM was over the floating period starting in March, 1973; by this standard, the ECB has done as well as the Bundesbank did, and the Bundesbank was acknowledged as by far the best performing European central bank. Based on the record of the DEM, if the new members of the European Union adopt the Euro, they are in for substantial exchange-rate volatility; adopting the Euro may still make a great deal of sense if the new members cannot trust their own central banks to run low-inflation policies.

Keywords: exchange rates; Euro; volatility; stability.
JEL codes: 430; 520.

1. Introduction

The European Union (EU) is large and rich. It is one of the three pillars of world prosperity, along with Japan and the United States. The rest of the world cannot prosper if these big three are in economic trouble, or even if two are in substantial trouble. Naturally, the world has a deep interest in their economic policies, including their exchange rate policies.

Since the Euro came into existence on January 1, 1999, it has shown large fluctuations relative to the United States dollar. The Euro started at $1.19 but has fallen as low as $0.82 and risen as high as $1.35. An important issue is whether these

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fluctuations have been excessive; many observers, including European Union politicians, have argued the fluctuations have been too large. Related is the issue whether comparable fluctuations may be expected in the future. This paper argues that these fluctuations have not been excessive, at least as judged by historical standards; on the contrary, these fluctuations have been smaller than what the Euro's predecessor currencies experienced under the current float. Further, based on historical fluctuations, this paper argues that over time the Euro may well rise as high as $1.552 and fall as low as $0.645.

The Euro's fluctuations are one reason that many commentators and some EU governments have attacked the European Central Bank (ECB). This paper's results suggest that the fluctuations that have occurred in the value of the Euro might have been expected and are not good reasons for changing the structure of the ECB.

The Euro and the ECB have such short track records that it is hard to evaluate how well they have performed over time. One approach to getting around the short sample period for the Euro and ECB is to compare both to the performance of the European currencies and central banks that were forerunners of the Euro and the ECB—in particular, it is reasonable to ask how the Euro has behaved by comparison to how predecessor currencies behaved. For reasons discussed below, rather than compare the Euro with all ten of the currencies that it replaced, this paper, using monthly data, focuses on a comparison of the Euro over the sample period of January, 1999, to December, 2004, to the Deutsche mark over the period January, 1974 to December, 1996. (This DEM sample period is the same that Sweeney (2005) uses in discussing mean reversion in Group-of-Ten nominal exchange rates.) The Euro's performance looks comparable to that of the Deutsche mark, as shown below. Because of this, it appears that the ECB's performance is at least arguably comparable to that of the Bundesbank. One advantage of this approach is that it also provides useful clues about the future behavior of the Euro and the ECB.

This paper compares the behavior of the Euro to that of the DEM. Germany is the country whose currency is the most important component of the Euro, at least in terms of the financial prestige the DEM and Bundesbank had before the introduction of the Euro, as well as the size of Germany's Gross Domestic Product and its population relative to other EMU countries, and the importance of Frankfurt as a financial center. Further evidence on the importance of the DEM is shown in Tables 1.A and 1.B by the correlations of changes in log nominal exchange rates for the sample periods January, 1974, to December, 1996, and January, 1980, to December, 1996, for the ten countries which initially adopted the Euro in 1999[1]. These two sample periods are used because they form the basis for the discussion below. The ten countries are Austria, Belgium, Finland, France, Germany, Ireland,

[1] There were initially eleven members of the European Monetary Union, which use the Euro. Luxembourg, however, used the Belgian franc before the introduction of the Euro. Greece subsequently joined the EMU in 2002.

Italy, the Netherlands, Portugal and Spain. These countries' currencies show substantial correlations with the DEM, averaging 0.866964 for the longer period and 0.9074541 for the shorter period. In particular, Austria, Belgium and the Netherlands show very high correlations with the DEM in both sample periods; this in not surprising—these countries ran announced policies of pegging their rates closely to the DEM . Further, France shows correlations of 0.917098 and 0.956060; and, even Italy, which went through a number of crises, shows correlations of 0.783943 and 0.853398. Thus, the DEM contains a good deal of information about the other currencies that went into the Euro. Instead of examining the DEM, of course one might look at another EMU currency, for example, the French Franc, or look at a weighted average of the ten currencies that were "irrevocably" pegged to the Euro on January 1, 1999, and then vanished into monetary history with the introduction of the Euro as a currency on January 1, 2002. Such investigations are useful exercises, and sometimes give somewhat different results from examining the DEM. A footnote below examines the implications of the French franc for the outlook for the Euro, and shows that the results are not very different from those found by examining the DEM. Nevertheless, because of Germany's economic weight, the leading role the DEM played, and the importance of the old Bundesbank as a standard of comparison for the ECB, one must examine the DEM no matter what else is done—so why not start with the DEM?

2. Mean reversion in the DEM and Euro nominal exchange rates

Figure 1 shows the end-of-month dollar-DEM exchange rate from 1974 through 1996, measured as the natural logarithm of DEM per USD. It also shows the log real exchange rate, that is, the dollar-DEM rate adjusted for the two countries' price levels. (Figure 2 shows the nominal DEM-USD exchange rate over the same period, and Figure 3 shows the nominal USD-EUR exchange rate from January, 1999, to December, 2004). The log exchange rate in Figure 1 looks strikingly like the typical "random walk" that observers expect to see for asset prices: in essence, the asset's price is as likely to be higher tomorrow as lower, and the best guess is that it will stay the same. Indeed, conventional wisdom since the mid-1970s is that nominal exchange rates for the industrialized countries are essentially driftless random walks (Dooley and Shafer 1976, Logue, Sweeney and Willett 1978, Cornell and Dietrich 1978, Meese and Singleton 1982; Mark 1995 and Mark and Sul 2001). If G-10 exchange rates were random walks, they would have little to say about the outlook for the Euro: The best guess of the Euro's value for tomorrow or for a month or year from now would be today's rate.

Recent results, however, indicate that G-10 log exchange rates relative to the dollar are not random walks over the current floating rate period that started in mid-March, 1973 (see Sweeney 2005). Instead, over sample periods from 1974 through 1996, these nominal rates show a tendency to revert to stable long-run levels, or show mean reversion. Indeed, note that in Figure 1 the log of the DEM-USD real exchange rate looks much like the nominal rate, but many economists have come to accept the view that real exchange rates tend to revert to stable long-run levels[2]. The estimated speeds of adjustment of nominal exchange rates (and also of real rates) are slow, however: Estimates are that each month the gap between the current and long run log nominal rates is closed by somewhere between 1.5% and 2.5% of the gap (Siddique and Sweeney 1998, Sweeney 2005). Under the assumption of mean reversion, and also the bold assumption that the Euro will behave in the future approximately as the DEM did in the past, the history of the DEM under the current float provides a number of lessons for evaluating the outlook for the Euro—and for the ECB. These lessons are discussed in detail below, but are summarized here for convenience.

Summary of results. First, the Euro started off too high relative to its long-run level. The Euro started at approximately $1.19 per Euro (see Figure 3)[3]. The Euro's long-run value is perhaps $1 per Euro, as discussed below. Second, the Euro then became undervalued, reaching a minimum in October, 2000, of approximately $0.82 per Euro. Over time, the Euro strengthened, rising to and remaining above $1.00 in the period December, 2002, and January, 2003. In December, 2004, the Euro rose to over $1.35. Just as the Euro was likely to strengthen when it had fallen to $0.82, so it is likely to weaken now (January, 2005) that it is above $1.30.

Third, the Euro's swings over its short life—from $1.19 to $0.82 to $1.35—are nothing out of the ordinary. The ratio of the high to the low is 1.35 / 0.82 = 1.6463415. The DEM went from about 3.32 DEM per dollar to about 1.38 DEM per dollar over the period in Figure 1, or the ratio of the high to the low is 3.32 / 1.38 = 2.4057971. Indeed, the historical record suggests that the Euro is likely to show even larger swings in the future than it already has. After all, between 1974 and 1996, the DEM

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[2] Among papers that find evidence supporting mean reversion in real exchange rates are Abuaf and Jorion (1990), Coakley and Fuertes (1997), Frankel and Rose (1996), Jorion and Sweeney (1996), MacDonald (1996), Oh (1996), Siddique and Sweeney (1998), Sarno and Taylor (1998) and Wu (1996). Papell (1997) and Papell and Theodoidis (1998) find mixed results. O'Connell (1998) presents evidence against the view that real rates show mean reversion. Huizinga (1987) and Engel (2000) consider the case where the disturbances to the real rate are a combination of stationary and non-stationary terms, and thus deciding the issue of mean reversion if difficult. Sweeney (2005) evaluates some of the methods used in the above papers.

[3] Note that these are end-of-month data, and the Euro had already fallen from its level of $1.19 per Euro at the start of January, 1999. Similarly, the end-of-month data show a low of $0.85 rather than the true low of approximately $0.82 that was observed within a day. The comparable is true for the value of the Euro in December, 2004.

had 23 years in which to hit highs and lows, and the Euro has had only six years. With a longer sample, it is reasonable to expect the Euro to show even more extreme values than it already has. Another, related, approach to evaluating possible longer-term fluctuations is to compare the first six years of the Euro's existence with the first six years of the DEM under floating and the DEM's later experience. The sample standard deviation of changes in the natural log of the Euro was 2.8929%/month from January, 1999, to December, 2004, and for the DEM was 3.0947%/month from January, 1974 to December, 1979. Over the period January, 1974, to December, 1996, the DEM standard deviation was 3.33355%/month, suggesting that as time goes on, the Euro's fluctuations may well be larger than they have been.

Estimates of the Euro's long-run value. If the log of the DEM/USD rate is mean reverting, a key step is to estimate the long-run value to which it reverts. Many estimators are available. Focus on using the sample mean of the log DEM/USD rate as an estimator of its long-run value; by no means is this necessarily the optimum estimator, but with mean reversion, the sample average is a consistent estimator of the long-run rate. A wide variety of sample periods might be used to form an estimate. The mean of the log rate over the whole 1974 through 1996 period might be used. Or, to leave out the first few years of the float, when markets and central banks were adjusting to a new exchange-rate regime, the mean log rate for 1980 through 1996 might be used. Table 2 shows both these mean log rates (the sample period 1987-1996 is discussed below). For these possible long-run log rates, the implied long-run DEM/USD rates are found by taking anti-logs. For present purposes, these long-run DEM rates are converted into long-run USD/EUR rates by noting that the DEM is permanently locked to the Euro at DEM 1.956 per EUR. From Table 2:

Period	mean log rate	Long-run DEM/USD	Long-run USD/EUR
1974:01-1996:12	0.693482	2.000670	**0.977673**
1980:01-1996:12	0.650440	1.916384	**1.020672**

Of course these two estimates differ, but it is revealing that they rather closely bracket "parity" of one USD for one EUR[4]. Figure 2 shows the number of DEM per USD, and shows the estimated long-run rate of DEM 2.0 per USD[5].

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[4] If the median log rate is used from Table 2:

Period	median log rate	Long-run DEM/USD	Long-run USD/EUR
1974:01-1996:12	0.644743	1.905497	**1.026504**
1980:01-1996:12	0.582718	1.790899	**1.092189**
1987:01-1996:12	0.496432	1.462849	**1.337168**

[5] This paper focuses on the DEM rate relative to the USD, but it is worthwhile showing briefly some comparable results for the French franc. Over the sample period January, 1974, to December,

The Euro's initial value was above its long-run value. Did it ever make any sense to think that the Euro's initial value, $1.19, was its long-run value? Consider another estimator. Ignore the 1970s and the first six years of the 1980s, and look only at the period from 1987 through 1996. From Table 2:

Period	mean log rate	Long-run DEM/USD	Long-run USD/EUR
1987:01-1996:12	0.493754	1.638455	1.193808

Then an estimate of the long-run value of the Euro is $1.1938 per Euro. Put it more starkly. The belief that $1.19, where the Euro was initially set in January, 1996, is the Euro's long-run value is plausible only if the tremendous strength of the dollar during the 1980s, peaking in early March, 1985, should be ignored. This implies treating the first half of the 1980s as a fluke, however, a statistical aberration that contains no information about the future.

Adjustment to the long-run value—and possible over-shooting. If the long-run value of the Euro is approximately $1, then the Euro is currently substantially over-valued. At a current value of approximately $1.30 (in January, 2005), the Euro has to fall by about 30% over time, relative to the long-run value of $1.00, to get to its long-run level. This is good news for the many people who pine for a stronger dollar—and for those EMU firms that compete internationally[6].

The history of the DEM shows that this 30% fall in the Euro may be a long time coming. Further, the Euro may shoot right past $1.00 to a substantially lower level—this is what happened when the Euro fell from its January, 1999, opening value of $1.19.

1996, the FFR ranged from 9.770000 to 5.000000, or had a ratio of 1.954. This compares to the ratio for the DEM of 2.4057971 and the ratio for the Euro (over the sample period January, 1999, to December, 2004) of 1.6463415. For the sample period January, 1974, to December, 1996, the mean of the log FFR rate is 1.9496769, which implies the level FFR 7.0264317 per USD. The FFR locked into the Euro at FFR 6.5596 per Euro. If the rate FFR 7.0264317 per USD is taken as the long-run rate, the lock-in rate of FFR 6.5596 per Euro implies a long-run value of the Euro of $1.0711677. If an equally weighted average of the estimate from the DEM and the FFR is used, (1/2) ($1.0711677 + $0.977673), the long-run rate is estimated as $1.0244204 per Euro. Because of (a) the leading role of the DEM and the prestige of the Bundesbank, (b) Germany's larger GDP and population relative to France, and (c) the greater importance of Frankfurt as a financial center relative to Paris, an equally weighted average probably assigns too large a weight to the FFR.

[6] The sample period available for the Euro, January, 1999 to December, 2004, is too short to allow inferences to be drawn with any confidence, but calculations similar to those for the DEM can of course be done. The mean of the natural log of the USD price of one Euro is 0.025755. If this is taken as an estimate of the long-run log exchange rate, it implies a long-run exchange rate of $1.0260895. The sample median of the log rate is 0.007121, implying a long-run rate of $1.0071464. Given sampling variability, especially for the Euro over its short sample period, these estimates from the Euro are consistent with those from the DEM.

Mean reversion says this: If there are no further economic disturbances, the Euro will fall by between approximately 6.0 and 10.0 cents (or by 4.7% to 7.9%) over the next year[7], with approximately similar falls in following years until the Euro is at $1. On average, then, it takes several years for a currency to return to its long-run value.

More important, there are always further economic disturbances. Based on the sample standard deviations in Table 3 the Group of Ten countries (but omitting Canada, which is a special, low-volatility case relative to the U.S.), the standard deviation of the Euro might be estimated as approximately 3.30%/month in continuously compounded terms. One piece of good news for the Euro or bad news for the dollar might cause the Euro to rise by say 4.4 to 8.9 cents in a single day[8], "using up" a good part of a whole year's worth of adjustment. The force drawing the Euro towards its long run value is just one of many forces that work on the exchange rate, and it is often overwhelmed. In 1984, for example, the DEM was undervalued by an important amount, as Figure 2 shows, but the dollar nevertheless rose by a substantial amount during 1984.

Further, when the dollar finally began to fall in March 1985, it fell far more than it needed to get back to a long-run value of DEM 2 / USD. Certainly, this is not to say that the dollar ***always*** overshoots its equilibrium value. Rather, it is another illustration of the fact that the force pulling the exchange rate back to its long-run level is only one of the many forces that drive the dollar, and by no means the strongest. Allan Greenspan, chairman of the Fed, can say something today that will change tomorrow's rate by several percent, and so can Jean Claude Trichet, chairman of the ECB.

Many commentators and politicians—especially politicians—think the Euro has had a hard time over its brief life. It started at $1.19 and fell as low as $0.82. In continuously compounded terms, this range is 37.24% —ln($1.19 / $0.82) = 0.3724. But during 1974-1996 period, the DEM went from DEM 3.3225 to DEM 1.3805, giving a range of ln(3.3225 / 1.3805) = 0.87827, or 87.827%. To be sure, the swing

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[7] The estimated speed of adjustment is between 1.5% and 2.5% per month, or 0.015 and 0.025 per month of the gap between the natural log of the current exchange rate and the log of its long-run value. With a current value of approximately $1.30 and a long run value of $1.00, the gap in terms of natural logs is [log(1.30) - log(1.00)] = log(1.30) - 0.00 = 0.26236. Over the next year (12 months), as an approximation the rate will fall by between 12 x 0.015 = 0.18 and 12 x 0.025 = 0.30 of the gap. With the gap [log(1.30) - log(1.00)] = log(1.30) - 0.00 = 0.26236, the rate will fall by approximately 0.18 x 0.26236 = 0.047 → 4.7% to 0.30 x 0.26236 =0.079 → 7.9%, where the percentages are in continuously compounded terms. Thus, log(1.30) will fall to between approximately 0.21536 and 0.18336, or in dollar terms the Euro will fall to between approximately $1.24031 and $1.20125, or will fall by between 5.969 and 9.875 cents.

[8] If the Euro rises by one standard deviation from $1.30, this mean log(1.30) = 0.26236426 rises to 0.26236426 + 0.033 = 0.29536426, and the Euro rises to $1.34362, or by 4.36 cents. Similarly, if the Euro rises by two standard deviations, it rises by 8.869 cents.

from the Euro's minimum (so far!) of $0.82 to it maximum (so far!) of $1.35 is 49.856%—ln(1.35 / 0.82) = 0.49856. The DEM had a larger range than the Euro by a factor of 1.7616 (= 0.878127 / 0.49856). If the Euro's range over time grows to be as large as the DEM's, its range will be $1.5517 to $0.6445[9]. Will the ECB and the politicians who second guess it have the nerves to face such rates?

3. Political attacks on the European Central Bank

Long before the European Central Bank (ECB) came into existence, EU politicians were criticizing it. Even before the Maastricht Treaty was signed in 1992, France and a number of other countries were calling for the creation of a political "counterweight" to the ECB and its alleged focus on economic issues to the neglect of social and political concerns. The ups and downs of the Euro have done nothing to reduce political pressures on the ECB. Among industrialized countries, the ECB's exchange rate policies have been the most controversial since the era of the strong U.S. dollar that ended in March 1985[10]. The ECB is far more controversial than say the Fed or the Bank of England.

One problem is that the Euro started off too high relative to its long-run level—it started at approximately $1.19 per Euro. This became a big political mistake—a political mistake, not an economic mistake. When the Euro came into existence, the market judged that a rate of $1.19 was appropriate. The ECB did not make an economic mistake starting at $1.19—indeed, it had little choice but to let the Euro's price be what the market wanted at the start of January, 1999. The mistake was political, and it was made by EU politicians. Many EU political leaders talked big: The Euro was going to be a rival to the dollar, might even replace it over time, and might even replace it rather soon. As evidence, they could and often did point to the Euro being worth more than a dollar—in fact, $1.19. When the Euro then fell over time from this initial value, the politicians' bragging looked pretty silly. Many of them turned the ECB into a whipping boy. The Euro did not do what the politicians had said it would, but many of the politicians said that was the ECB's fault. The chauvinistic politicians could find some rays of light: Many new bond issues

[9] In log terms, the range of the DEM was 0.87827, with 0.87827 / 2 = 0.43914. If the long-run value of the Euro is $1.00, the log of the implied upper value of the Euro is ln(1.00) + 0.43914 = 0.43914, and the value in dollar terms is $1.5514. The log of the implied lower value of the Euro is - 0.43914, and the value in dollar terms is $0.6446.

[10] Both the Clinton and Bush administrations claimed to run "strong dollar" policies. As is seen below, in neither case was the dollar nearly as strong as during the run up to February, 1985. Instead, what both administrations really meant, to the extent they were not simply talking for talk's sake, they meant that they were not going to take overt action to weaken the dollar.

were denominated in Euros, and so forth. Still, relative to its low of $0.82, the Euro declined in the first two years by approximately 45% [≈ 100 x (1.19/.82 - 1)].

The Euro was substantially undervalued when it reached its minimum (so far) in October, 2000, of approximately $0.82 per Euro. Relative to a long-run value of say $1.00, the Euro was undervalued by 21.95% [= (1.00 / 0.82 - 1) 100]. Over time, the Euro strengthened, rising to and remaining around the equilibrium level of $1.00 in the period December, 2002, and January, 2003. By December, 2004, the Euro had risen to over $1.35. The Euro was overvalued by 35%. Note, however, that the Euro was only 13.45% [= (1.35 / 1.19 - 1) 100] higher than its initial value of $1.19. This did not stop EU politicians from severely criticizing the ECB because of the negative effect of the Euro's strength on the EU's competitive position in international trade.

On the one hand, the ECB has such a short track record that it is too soon for an objective observer to sneer that it is a failure or to claim it is a success. On the other hand, its short history provides no achievements to make our minds rest more easily. It has not built up the sort of track record that contributed to the old Bundesbank's prestige and allowed it to ride out period's where the Deutsche mark seemed too strong or too weak to politicians.

In the face of the ECB's own short history, has compared the ups and downs in the Euro to those observed in the Deutsche mark relative to the dollar. The Deutsche mark showed substantially greater variations than the Euro has so far. As noted above, the DEM's variations occurred over 23 years, and the Euro's over only six years; over a longer period, the Euro might well show larger variations, on the order of what the DEM showed. The EU politicians who have criticized the ECB so severely seem to have misunderstood or overlooked the lessons of history.

The danger is that the carping by EU politicians may unjustly undermine confidence in the ECB to a serious extent. Confidence is a valuable asset for any central bank, and one that it is hard to gain. The public's confidence in any central bank is based in part on the evidence that it has the support of the government or governments that it represents. Carping has to undermine confidence at least to some extent, and may even undermine confidence enough to cripple the ECB. The track record of EU governments in this regard is not encouraging.

Things may not be as bad as they seem. The politicians who run the EU sometimes, though hardly always, show stronger nerves than might be thought. From a distance, they mostly look like dreary socialists haggling in an ugly, endless way for narrow national self-interest. But step even further back, and see the bold, even brave, steps the EU has on a few occasions taken. The Franco and Salazar dictatorships were hardly over before Spain and Portugal were invited into the Union. Certainly, economic self-interest did not motivate the then-members to issue these

invitations. It was a bold gamble, almost a romantic gamble[11], to draw Spain and Portugal into western Europe, to help turn them over time into normal, western European countries. An even bolder gamble was to invite Greece, though perhaps the plan was gravely botched by not inviting Turkey at the same time.

The hope must be that EU politicians will have the wisdom to step back and allow the ECB the time needed to establish itself as a worthy successor to the Bundesbank and a respected peer of the Fed. There is no guarantee that the ECB will be successful, but a continuation of the political sniping that has gone on will surely reduce the chances of the ECB being successful.

4. The decision to adopt the Euro

In 2004, the EU admitted ten more countries, eight of them in Central and Eastern Europe (The Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia), and Bulgaria and Romania are likely to be admitted within less than a decade. To be sure, the Union's invitation to Central and Eastern European countries was not with wide-open arms. And the mingy, small-minded haggling that went on for so long seemed designed to kill any feelings of neighborliness, let alone gratitude, on the part of the new members. Still, the Union is capable, every now and again, of the big, bold, idealistic decisions required for greatness.

New members of the European Union must think long and hard about joining the European Monetary Union. Monetary policy is no place for the bold, romantic gesture. If the new member's central bank and government cannot be trusted to run an anti-inflation monetary policy at least as successful as the ECB's, then join the EMU. If the member's central bank and government can be trusted, the decision turns on the balance of many considerations from optimum currency area theory. Making a mistake on optimum currency area grounds, however, is much less costly than a mistake about the ability of a country's central bank to run a successful, credible anti-inflation policy.

The new EU member that joins the EMU is likely to be in for a wild ride. Eventually, the Euro's history is like to show much the same extremes as the DEM[12]. The consolation is that going it alone with a poorer anti-inflation policy will be far worse in the long run.

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[11] Romantic in the sense of the nineteenth century Romanticism, rejecting the rationalism of the Enlightenment, and taking big gambles on the basis of emotion.

[12] To be sure, the Euro might be more stable than the DEM was, but it also might be less stable. Even an optimist who thinks the Euro will be more stable might agree that the probability of greater stability is say 0.60—with perhaps a probability of 0.40 of greater instability.

Table 1.A. Correlations—1974:01 to 1996:12[a]

	Austria	Belgium	Finland	France	Germany	Ireland	Italy	Nether.	Portugal	Spain
Austria	1.000000	0.974200	0.796114	0.923897	0.992952	0.867621	0.788103	0.983550	0.772850	0.725232
Belgium	0.974200	1.000000	0.795385	0.922349	0.975827	0.866809	0.777059	0.972311	0.772236	0.729904
Finland	0.796114	0.795385	1.000000	0.771831	0.797362	0.768127	0.768220	0.785231	0.690149	0.683780
France	0.923897	0.922349	0.771831	1.000000	0.917098	0.868060	0.809195	0.918806	0.794099	0.728250
Germany	**0.992952**	**0.975827**	**0.797362**	**0.917098**	**1.000000**	**0.867406**	**0.783943**	**0.981626**	**0.769722**	**0.715883**
Ireland	0.867621	0.866809	0.768127	0.868060	0.867406	1.000000	0.804906	0.871435	0.748362	0.711261
Italy	0.788103	0.777059	0.768220	0.809195	0.783943	0.804906	1.000000	0.782612	0.699841	0.695229
Nether.	0.983550	0.972311	0.785231	0.918806	0.981626	0.871435	0.782612	1.000000	0.770849	0.738703
Portugal	0.772850	0.772236	0.690149	0.794099	0.769722	0.748362	0.699841	0.770849	1.000000	0.695219
Spain	0.725232	0.729904	0.683780	0.728250	0.715883	0.711261	0.695229	0.738703	0.695219	1.000000

Table 1.B. Correlations—1980:01 to 1996:12

	Austria	Belgium	Finland	France	Germany	Ireland	Italy	Nether.	Portugal	Spain
Austria	1.000000	0.973655	0.794939	0.955961	0.996221	0.928229	0.851456	0.988279	0.826750	0.839569
Belgium	1.000000	0.973655	0.795107	0.955871	0.975174	0.926864	0.845769	0.972936	0.831406	0.846516
Finland	0.794939	0.795107	1.000000	0.780232	0.799332	0.797846	0.826324	0.794587	0.734879	0.777626
France	0.955961	0.955871	0.780232	1.000000	0.956060	0.930858	0.849101	0.956009	0.864756	0.835746
Germany	**0.996221**	**0.975174**	**0.799332**	**0.956060**	**1.000000**	**0.930649**	**0.853398**	**0.990058**	**0.827546**	**0.838649**
Ireland	0.928229	0.926864	0.797846	0.930858	0.930649	1.000000	0.866424	0.932905	0.827497	0.836017
Italy	0.851456	0.845769	0.826324	0.849101	0.853398	0.866424	1.000000	0.848207	0.780176	0.811502
Nether.	0.988279	0.972936	0.794587	0.956009	0.990058	0.932905	0.848207	1.000000	0.829464	0.848434
Portugal	0.826750	0.831406	0.734879	0.864756	0.827546	0.827497	0.780176	0.829464	1.000000	0.849360
Spain	0.839569	0.846516	0.777626	0.835746	0.838649	0.836017	0.811502	0.848434	0.849360	1.000000

[a] The data are changes in log nominal exchange rates for the currencies of the ten European Monetary Union member-countries that adopted the Euro on January 1, 1999. After January 1, 1999, these countries locked their exchange rates irrevocably and after January, 2002, use the Euro as their currency. Luxembourg used the Belgian franc before joining the EMU, and so is not included. Greece joined the EMU in 2002 and is not included.

Table 2. The Lessons from Long-Run DEM/USD Exchange Rates

Mean and Median Exchange Rates, Current Floating Rate Period, 1974:01-1996:12			
Period	Mean log rate	Long-run DEM/USD	Long-run USD/EUR[a, b]
1974:01-1996:12	0.693482	2.000670	0.977673
1980:01-1996:12	0.650440	1.916384	1.020672
1987:01-1996:12	0.493754	1.638455	1.193808

Strongest and Weakest DEM Rates, Current Floating Rate Period, 1974:01-1996:12		
	DEM/USD	Forecast[c] of USD/EUR
Weakest DEM (Euro)	3.322500	$0.6445
Strongest DEM (Euro)	1.380500	$1.5517

[a] The DEM is pegged to the EUR at DEM 1.956 / EUR. The "Long-run USD/EUR" is equal to DEM 1.956 / EUR divided by the given DEM/USD rate.

[b] If the median log rate is used:

Period	median log rate	Long-run DEM/USD	Long-run USD/EUR	Weakest USD/ EUR	Strongest USD/EUR
1974:01-1996:12	0.644743	1.905497	1.026504	$0.6615	$1.5928
1980:01-1996:12	0.582718	1.790899	1.092189	$0.7039	$1.6948
1987:01-1996:12	0.496432	1.462849	1.337168	$0.8617	$2.0749

[c] This assumes that the long-run value of the Euro is $1.00.

Table 3. G-10 Nominal Exchange Rates, USD Base

Standard Deviations of Continuously Compounded Percentage Rates of Change Monthly, 1974:01 to 1996:12	
Belgium	3.37 percent/month
Canada	1.29
France	3.26
Germany	3.34
Italy	3.15
Japan	3.30
Netherlands	3.34
Sweden	3.17
Switzerland	3.76
United Kingdom	3.28

Source: End-of-month exchange rates, market values, from International Financial Statistics, International Monetary Fund; calculations by author.

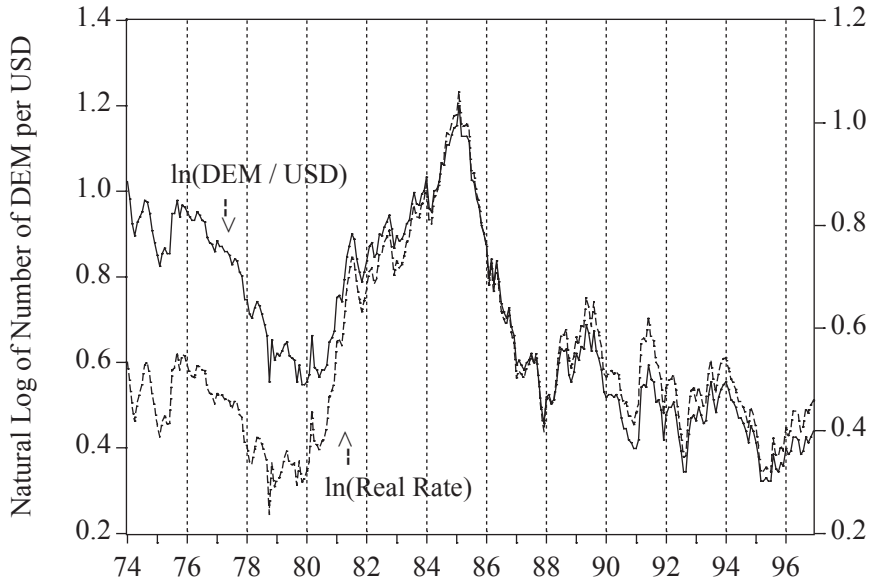

Figure 1. The Natural Log of the DEM Exchange Rate, and the Natural Log of the DEM Real Exchange Rate

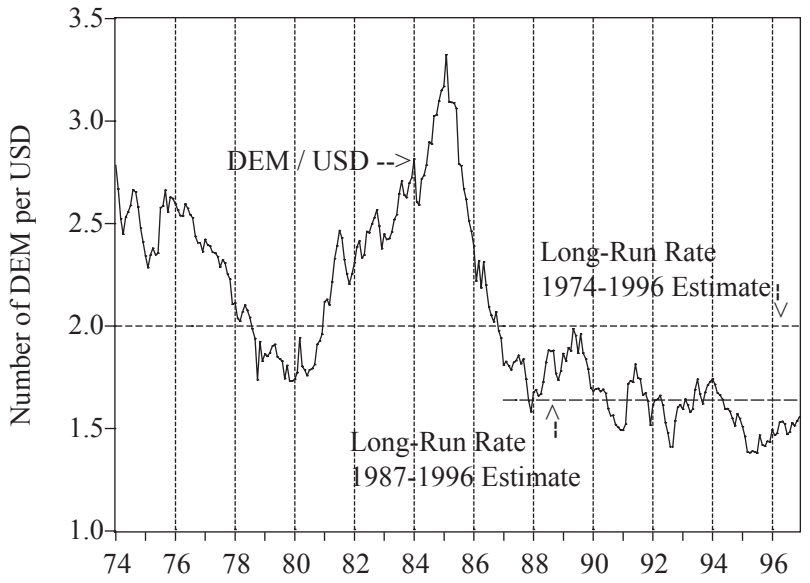

Figure 2. Number of DEM per USD, and Two Estimators of the Long-Run Exchange Rate

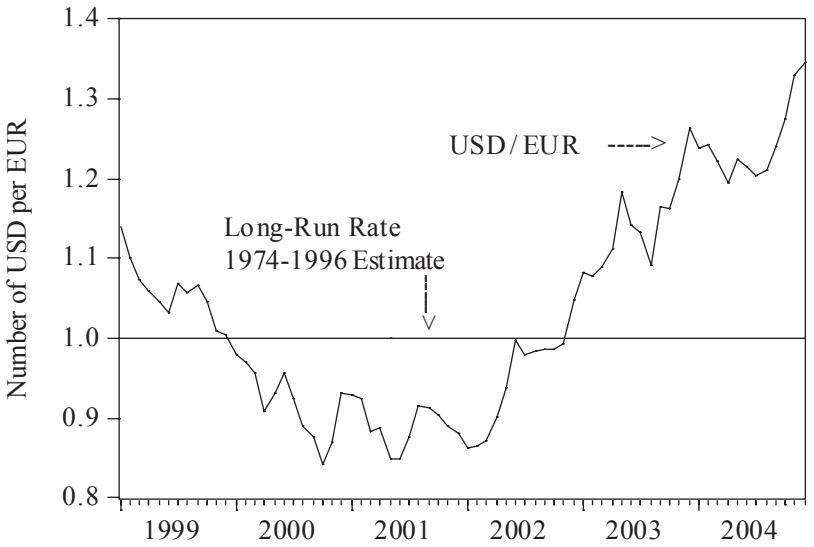

**Figure 3. Number of USD per EUR,
with an Estimator of the Long-Run Exchange Rate**

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