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THE DOLLAR – MARK AXIS

by

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Abstract

Over the last two decades, most European currencies have tended to weaken against the mark as the latter strengthened against the dollar. Moreover, the strength of the response of European cross-rates has tended to remain in the same order over time. I first set out the stylised facts of this phenomenon, referred to as the dollar-mark axis, and then try to identify its determinants. In addition to exchange rate policy, I examine the correlation of cyclical fluctuations and trade links (two factors suggested by the theory of optimum currency areas) and the bias of international investors in the currency composition of their portfolios.

* I thank Frank Smets for helpful comments on an earlier draft and Florence Béranger for excellent research assistance.

Contents

1. Introduction

This paper looks at some stylised facts that have characterised foreign exchange markets over the past 25 years. When the mark strengthened against the dollar during this period, most European currencies tended to weaken against the mark, while the Australian and Canadian dollars tended to weaken against the US dollar. The extent to which different European cross-rates against the mark responded to the dollar remained in roughly the same order over time; for instance, the mark/French franc rate consistently responded less to the dollar's movements against the mark than did the mark/lira rate.[1] The magnitude of the response of European dollar exchange rates to movements in the mark/dollar rate has instead changed over time. After rising between the early 1970s and 1992, it declined into the mid-1990s and has since risen again. Observers have referred to these tendencies in different ways, including the dollar-mark axis or the dollar-mark polarity (Brown, (1979)).[2] In this paper I investigate the determinants of this phenomenon and provide empirical evidence of their importance.

A number of studies have looked at the relationship between currencies and the dollar and the mark and how it has evolved over time, but only a few have attempted to identify the determinants of these regularities and to test their importance empirically. The first discussion of the role of different factors that shape the dollar-mark axis can be found in Brown (1979). According to Brown, while financial factors affect the mark/dollar exchange rate, other factors such as monetary policy or the trade structure determine how currencies react to a given change in the mark/dollar rate. In an influential paper, Giavazzi and Giovannini (1989) ascribe the reaction of currencies to mark/dollar rate changes to a bias in international investors' preferences that results in the size of shifts in asset demand relative to the underlying asset stock being higher for certain currencies than for others. There is now an extensive literature that looks at the determinants of currency links defined in terms of the variability of exchange rates rather than in terms of the response to shocks to the dollar or the mark. This literature finds that two types of factors matter: monetary and exchange rate policy, and factors derived from the theory of optimum currency areas, such as trade links and the co-movement of business cycles. Von Hagen and Neumann (1992) provide evidence of the impact of exchange rate arrangements and monetary policy coordination on currency links. Bayoumi and Eichengreen (1996a, 1996b, 1996c), Bénassy-Quéré (1997), and Frankel and Wei (1993) find that OCA factors explain some but not all of the exchange rate volatility observed over the last three decades.

This paper provides a comprehensive analysis of the determinants of the dollar-mark axis. I look at a set of 15 currencies and try to explain their alignment on the dollar-mark axis over the past two decades. I test the importance of exchange rate policies, the symmetry of cyclical movements, trade

[1] Throughout this paper, the exchange rate of currency *X* against the dollar (mark) is expressed in units of currency *X* per dollar (mark).

[2] Brown refers to the mark and the dollar as "polar currencies".

links and international portfolio bias. The empirical analysis combines time-series and cross-sectional evidence by estimating regression equations with panel data. This analysis is relevant not only for explaining some stylised facts that have characterised foreign exchange markets over the last few decades, but also because it provides a framework for analysing the role that the euro will play in foreign exchange markets. The main findings of the empirical work suggest that exchange rate policy, trade links and international portfolio bias are the principal determinants of the dollar-mark axis.

The rest of the paper is organised as follows. The next section describes in detail the pattern of currency links known as the dollar-mark axis and how it has evolved over the last two decades. Section 3 provides different explanations for these stylised facts. Their importance is tested empirically in Section 4. Section 5 concludes.

2. Stylised facts about the dollar-mark polarity

In this paper I refer to a currency's link with the dollar and the mark in terms of the location of that currency on the dollar-mark axis or dollar-mark polarity. There are different ways of measuring this link. This paper uses the elasticity of a currency's dollar exchange rate with respect to movements in the mark/dollar rate. A currency is located close to the mark (the dollar) on the dollar-mark axis and closely follows the movements of the mark (dollar) if that elasticity is close to one (zero). The focus in this paper is therefore on the response of bilateral exchange rates (with respect to the dollar) to shocks to the bilateral mark/dollar rate. In the literature, shocks to the dollar have often been expressed in terms of changes in the effective dollar exchange rate (see e.g. Del Giovane and Pozzolo (1998)) or the dollar/SDR rate (see e.g. Frankel and Wei (1993)), rather than in terms of shocks to the bilateral mark/dollar rate. Ohno (1999) and McKinnon (1999) look at bilateral exchange rates but use the Swiss franc as numeraire. I look at the bilateral dollar/mark rate rather than expressing all currencies in terms of a common numeraire such as the SDR or looking at effective exchange rates, because I am interested in measuring the response to a shock to a key exchange rate. A similar approach can be followed to measure the response of dollar exchange rates to shocks to the yen/dollar rate. In practice, the elasticity of the dollar exchange rate of currency X can be measured by the slope coefficient β in the regression of (differences of logarithms of) dollar exchange rates on a constant and (the difference of the logarithm of) the mark/dollar rate:[3]

(1) $$X/\$_t = \alpha + \beta \times DM/\$_t + \varepsilon_t$$

where ε_t is a zero mean error term with variance σ^2. Exchange rates are expressed here as differences of logarithms.

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3 See BIS (1996). The equation can be augmented by adding changes in the yen/dollar rate on the right-hand side. In this case the right-hand side coefficients will pick up the response to shocks to the mark/dollar and yen/dollar rates.

An alternative way to measure currency links, which has been frequently used in the literature, is the correlation coefficient of dollar exchange rate changes with mark/dollar rate changes or the R^2 value of the above regressions. The advantage of looking at the elasticity rather than a correlation coefficient is that the former can also provide information on currencies that appreciate against a polar currency when it strengthens against other currencies.

Exchange rate volatility is another common measure of currency links employed in the literature. From (1), the variance of the *X*/$ rate is given by

$$(2) \qquad \mathrm{var}\left(X/\$_t\right) = \beta^2 \times \mathrm{var}\left(DM / \$_t\right) + \sigma^2$$

Hence the volatility of the dollar exchange rate of currency *X* can be viewed as driven by three factors: mark/dollar volatility, the elasticity of the *X*/$ rate with respect to movements in the mark/dollar rate, and idiosyncratic volatility (captured by the error term ε). If idiosyncratic movements explain little of the variance of the *X*/$ rate, estimating equation (1) will give an R^2 value close to one. In this case, given the variance of the mark/dollar rate, the elasticity β will determine the variance of the *X*/dollar rate.

Table 1 shows average dollar elasticities for 13 European currencies and the Canadian and Australian dollars estimated with daily data over the sample period January 1994 to December 1997. For every 1% appreciation of the mark against the dollar, the Swiss franc appreciated on average by 1.10% against the dollar. Seen from another perspective, the Swiss franc appreciated by around 0.10% against the mark when the latter appreciated by 1% against the dollar. The dollar elasticities of the Dutch guilder, the Belgian franc and the Austrian schilling are around 1%. Hence these currencies moved about one to one with the mark against the dollar. The elasticities of the Danish krone, the French franc, the escudo, the markka and the peseta fall somewhat short of 1%. The Irish pound, the pound sterling, the lira and the Swedish krona have the lowest sensitivities among European currencies, and tended to share about half of the dollar's movements against the mark. These currencies also exhibit high idiosyncratic movements, as indicated by their lower R^2 values. At the other end of the spectrum, the Australian and Canadian dollars depreciated on average by more than 1% against the DM for each 1% depreciation of the US dollar against the mark. Very similar results obtain when the exchange rate elasticities are estimated using data at monthly or quarterly frequency.

Although the dollar-mark axis characterised foreign exchange markets consistently over time, the alignment of currencies along the axis has changed. This is shown in Figure 1, which plots elasticities estimated over rolling windows of 125 days over the last 20 years. Between the late 1970s and the mid-1990s the exchange rate elasticities of European currencies followed a hump-shaped pattern. After a sharp rise around the start of the ERM, the elasticities remained close to one until 1992. During this period, movements of the mark against the dollar were generally accompanied by movements of

Table 1

Currency links with the mark and the dollar, 1994–97

Currency	**Elasticity**	**R^2**
Swiss franc	1.10	0.88
Austrian schilling	1.00	1.00
Dutch guilder	0.99	1.00
Belgian franc	0.98	0.99
Danish krone	0.91	0.97
French franc	0.88	0.92
Escudo	0.86	0.92
Markka	0.80	0.74
Peseta	0.79	0.80
Irish pound	0.58	0.57
Swedish krona	0.57	0.39
Lira	0.53	0.37
Pound sterling	0.43	0.37
Canadian dollar	–0.11	0.05
Australian dollar	–0.11	0.02

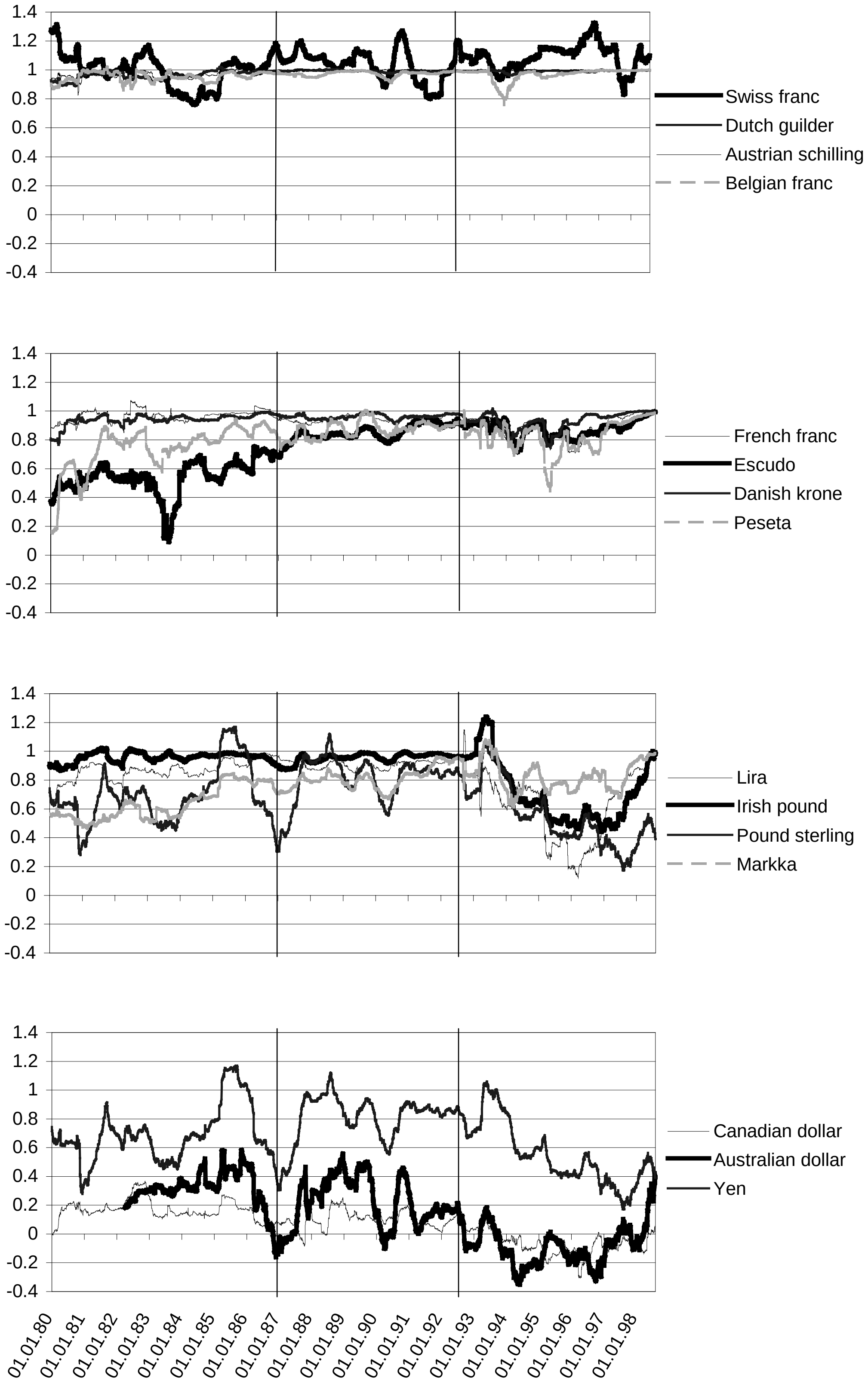
Note: The first column reports elasticities obtained from regressions of (the difference of the logarithm of) the dollar exchange rate of a currency on a constant and (the difference of the logarithm of) the mark/dollar exchange rate. They are estimated with daily data (taken at 2.15 p.m.) over the period January 1994–December 1997. Adjusted R^2s for the regressions are reported in the second column. Over the same sample period, the yen had an elasticity with respect to mark/dollar rate changes of 0.69 and an R^2 of 0.38.

similar magnitude of the European currencies against the dollar. This tightening of links with the mark and loosening with the dollar has been documented in the literature. Haldane and Hall (1991), for example, use a time-varying regression method to study how the relationship between the dollar/pound or mark/pound exchange rate and the mark/dollar rate evolved between January 1976 and August 1989. Their results suggest a sharp weakening of the pound's link with the dollar and a sharp increase in its link with the mark over their sample period. The co-movement of European currencies with the mark was particularly strong during the "hard ERM" period between January 1987 and August 1992, during which no realignments took place within the ERM. From late 1992 to mid-1995, the link with the mark weakened. This was true especially for the currencies that had left the ERM – the pound, the lira, and the Swedish krona – and the Irish pound. Between 1995 and 1998, however, all European currencies with the exception of sterling tended towards co-moving very closely with the mark. Figure 1 also highlights that while the elasticity of each currency, and hence its location on the dollar-mark axis, changed over the last two decades, its relative position remained fairly stable.

Figure 1

European currencies, the Canadian and Australian dollars and the dollar-mark axis

Elasticities with respect to mark/dollar changes



Note: The elasticity of currency X with respect to mark/dollar rate changes is estimated by regressing (the difference of the logarithm of) the X/$ exchange rate on a constant and (the difference of the logarithm of) the dollar/mark rate. Elasticities are estimated with daily data (taken at 2:15 p.m.) over rolling windows of 125 days. The area between the two vertical lines corresponds to the "hard ERM" period during which no realignments took place.

Source: BIS.

Consistent with Brown's (1998) assertion that the interactions among the G3 currencies are complex, the yen is not just another currency trading along the dollar-mark axis. Figure 1 shows that the elasticity of the yen/dollar rate with respect to movements in the mark/dollar rate varied widely during the last two decades, with none of the consistency seen among the European currencies. To a large extent, the movements of the yen seem to have been idiosyncratic, as the low R^2 in the regression of yen/dollar rate changes on mark/dollar rate changes suggests. We conclude from these results that the movement of the yen cannot be well explained in terms of the dollar-mark polarity.

Table 2

Currency links with the yen and the dollar, 1994–97

Currency	**Elasticity**	**R^2**
Taiwan dollar	0.09	0.05
Thai baht	0.08	0.00
Singapore dollar	0.08	0.05
Malaysian ringgit	0.03	0.00
Korean won	0.02	0.00
Hong Kong dollar	0.00	0.01
Canadian dollar	–0.05	0.02
Australian dollar	–0.08	0.02

Note: The first column reports elasticities obtained from regressions of (the difference of the logarithm of) the dollar exchange rate of a currency on a constant and (the difference of the logarithm of) the yen/dollar exchange rate. They are estimated with daily data over the period January 1994–December 1997. Adjusted R^2s for the regressions are reported in the third column.

If the yen is not just another currency trading along the dollar-mark axis, neither has it long shown the gravitational pull of the dollar or the mark. Table 2 verifies the existence of a dollar-yen polarity by identifying the links of six Asian currencies (the Taiwan dollar, Thai baht, Malaysian ringgit, Singapore dollar, Korean won and Hong Kong dollar) and the Australian and Canadian dollars with the dollar and the yen. The elasticities with respect to yen/dollar rate changes are estimated with daily data over the sample period 1994–97.[4] A high (low) elasticity indicates a close link with the yen (the dollar). The elasticities in Table 2 cluster around zero, ranging between –0.08 (for the Australian dollar) and 0.09 (for the Taiwan dollar). This result suggests that on average, during the period 1994–97, all these currencies followed the dollar very closely.[5] The same results obtain when the SDR

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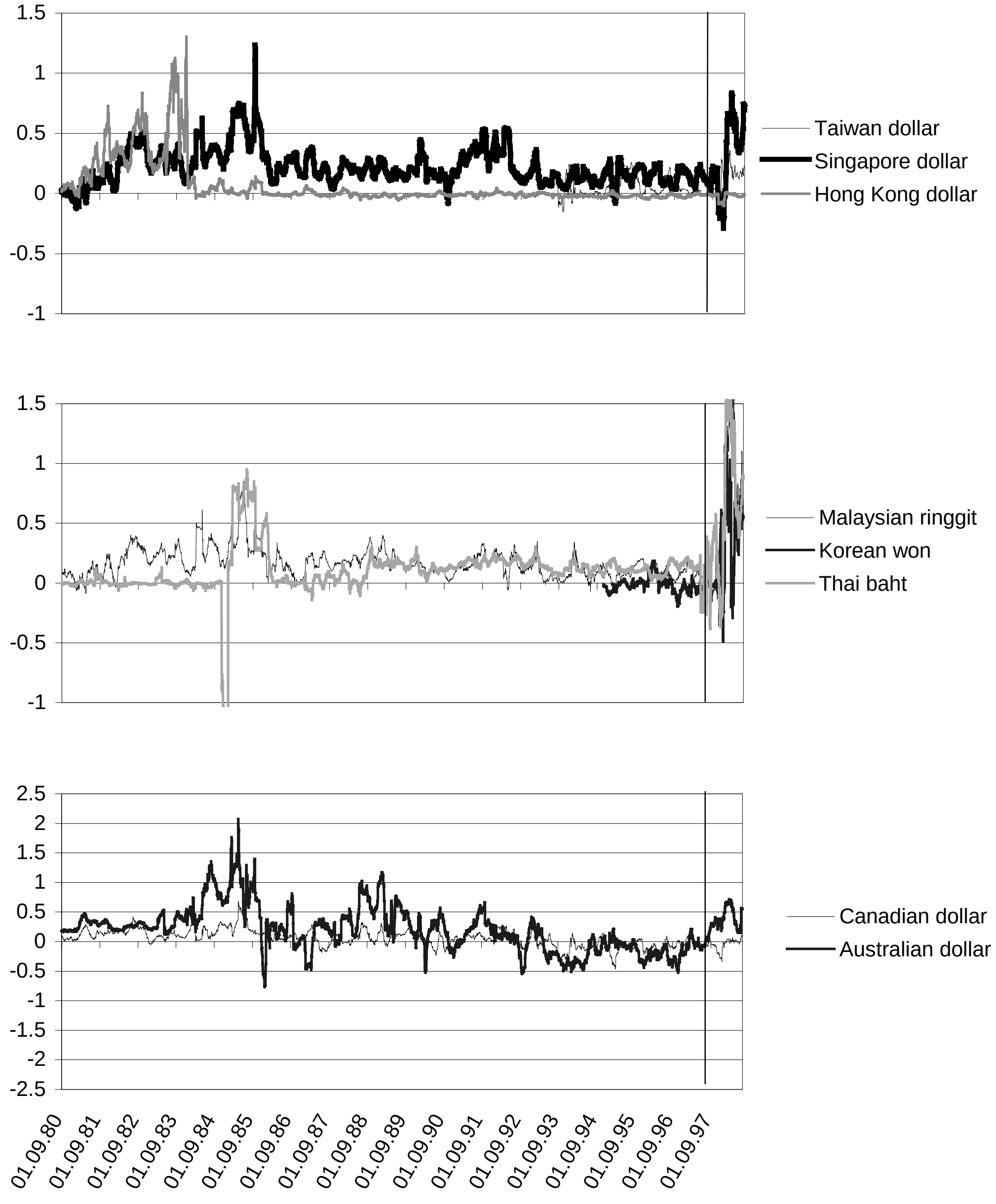
4 Unlike the regressions reported in Table 1, the regressions shown in Table 2 were estimated with daily data taken at different times of the day. As a result, the slope coefficients are biased downwards.

5 This is true even allowing for the timing issue mentioned in the previous footnote.

is used as numeraire and the exchange rate of each currency in Table 2 is regressed on the dollar and the yen expressed in terms of SDRs. An important conclusion from this evidence is that the yen did not play a significant role in Asia.

Figure 2

Asian currencies, the Canadian and the Australian dollar and the dollar-yen axis
Elasticities with respect to yen/dollar changes



Notes: The elasticity of currency X with respect to yen/dollar rate changes is estimated by regressing (the percentage change of) the X/$ rate on a constant and (the percentage change of) the yen/dollar rate. Elasticities are estimated with daily data over rolling windows of 125 days. The vertical line is drawn at 2 July 1997, when the Thai authorities abandoned the defence of the baht.
Source: BIS using Bank of Japan data.

In the wake of the devaluation of the Thai baht in July 1997, a number of currencies in Asia and the Pacific tended to co-move more with the yen following shocks to the yen/dollar rate (Figure 2). However, the dollar elasticities of these currencies have moved back towards zero since autumn 1998. Based on this evidence, it seems difficult to support the market commentary frequently heard in 1998 about a "break-up of the dollar bloc in East and South-East Asia".

3. Explaining the dollar-mark polarity

Exchange rate and monetary policies are obvious factors that may explain dollar-mark polarity. The well documented fact that European currencies drew closer to the mark in the late 1970s and the 1980s has been explained by participation in the ERM and associated monetary policies. An early study by Padoa-Schioppa (1985) reports that the correlation between exchange rates of European currencies against the mark and the mark/dollar rate is significantly higher during the EMS period (March 1979 – March 1984) than before (March 1973 – March 1979). This finding is confirmed in an influential paper by Giavazzi and Giovannini (1989), who use data with different frequencies between 1973 and 1987 to estimate the elasticity of bilateral mark exchange rates with respect to the effective dollar rate before and during the EMS period. They find lower sensitivities of mark rates in Europe during the EMS period, which is equivalent to finding values close to one of the elasticities reported in Table 1. More recently, Del Giovane and Pozzolo (1998) use a simple model to show how the sensitivity of currencies to movements of the dollar or the mark depends on the relative weight assigned to these two currencies in a country's exchange rate policy. Using data for the period 1987–92, they found that exchange rate and monetary policies explain the bulk of currency links with the mark.

While the role of exchange rate arrangements has been emphasised in the literature, they cannot account for all the time-series and cross-sectional variation of the observed currency links. The pound sterling's abandoning the ERM in 1992, for example, has been explained by the asynchrony of the business cycle in Germany and the United Kingdom in the early 1990s. Moreover, the synchrony of the UK and US business cycles in the mid-1990s can be used to explain sterling's closer link with the dollar during that period. And even if exchange rate policies play a key role, this begs the question of why countries join an exchange rate mechanism in the first place (Bayoumi and Eichengreen (1996b)). I therefore investigate whether underlying forces other than exchange and monetary policy have been driving currency links.

The theory of optimum currency areas (OCA) first proposed by Mundell (1961) provides a framework for analysing these forces.[6] According to this theory, strong trade links and highly correlated business

[6] For a survey of the empirical literature on the OCA, see Bayoumi and Eichengreen (1996a).

cycle fluctuations are two key criteria for participating in a currency area, along with high labour mobility (or strong responsiveness of wages to exchange rate movements) and a well developed system of fiscal transfers. While the OCA theory asks which criteria should be satisfied for a set of countries to benefit from fixing their exchange rates, I turn this argument on its head. Using the approach followed by Bayoumi and Eichengreen (1996b) and, with a focus on Asian currencies, by Bayoumi and Eichengreen (1996c) and Bénassy-Quéré (1997), I ask whether stronger trade links and more correlated cyclical fluctuations lead to closer currency links. More specifically, I ask whether the currency of a country that, ceteris paribus, has a more synchronous business cycle and stronger trade links with Germany than with the United States co-moves more with the mark than with the dollar.

While Switzerland's synchrony of cyclical fluctuations and trade links with Germany may explain why the Swiss franc tracks the mark's movements against the dollar very closely, the OCA argument cannot explain why the Swiss franc tends to appreciate against the mark as the mark strengthens against the dollar. Financial factors, and more specifically safe haven arguments, have typically been used to account for this phenomenon. I therefore investigate to what extent the observed exchange rate sensitivities can be explained by how portfolio shifts between the dollar area and Europe are distributed across currencies. I postulate the international portfolio bias hypothesis according to which the sensitivities depend on the shifts in asset demand relative to the underlying asset stock in response to shocks to the mark/dollar exchange rate. The higher the shift in demand for a currency relative to the underlying stock of that currency, the stronger the reaction of that currency will be. This hypothesis appears to be particularly apt in explaining the behaviour of Swiss money markets and the Swiss franc in reaction to portfolio shifts away from the dollar and into Europe. In response to these shifts, the Swiss franc appreciates against the mark when the mark appreciates against the dollar. The intuition underlying this effect is that shifts of funds from North America to Europe would have no effect on European exchange rates if they were distributed neutrally across European assets and every economy got its share. Switzerland gets more than its share of funds switched into Europe; conversely, other economies get less than their share. The Swiss franc will therefore appreciate more against the dollar than the mark.

The literature provides little evidence of this type of argument. Giavazzi and Giovannini (1989) address it and argue that, owing to capital controls, exchange rate variability is influenced by the different depth and segmentation of financial markets. They argue that France's and Italy's foreign exchange controls limited the size of financial markets in their own currency, and hence their financial assets were less substitutable for assets denominated in other currencies. As a result, an exogenous change of expected rates of return or of the risk premium would have a smaller impact on the French franc and the lira than on other currencies, such as the Swiss franc, whose international market is bigger. The exchange rate of these two currencies against the mark (the dollar) is therefore more (less) exposed to movements in the value of the dollar. However, the behaviour of exchange rates after the abolition of capital controls at the beginning of the 1990s refutes their conclusions. More recently, Del Giovane and Pozzolo (1998) provide some evidence that differences in information costs across markets may have led to market segmentation and hence driven differences in currency links. However, their evidence is based on a very indirect measure of information costs – amounts of dollar transactions against other currencies as a fraction of the stock of international assets denominated in that currency.

While no empirical analysis of the dollar-mark axis can be found in the literature, several papers have looked at the determinants of currency links measured by exchange rate volatility (see e.g. Bayoumi and Eichengreen (1996b, 1996c) and Bénassy-Quéré (1997)). The primary goal of these studies is to establish how well OCA factors explain currency links. The empirical method that is typically followed consists in estimating cross-sectional regressions for different sets of exchange rates over different sample periods. Measures of exchange rate volatility are regressed on variables capturing the OCA and different control variables. The results suggest that OCA variables perform quite well in explaining the variability of bilateral exchange rates in the G-10 and in non -G -10 European countries, particularly in the 1970s and 1980s. By contrast, OCA variables do not explain why Asian currencies track the dollar (Bénassy-Quéré (1997)). Bénassy-Quéré and Lahrèche-Révil (1998) show that policies that target the external balance by stabilising both external competitiveness and the real price of external debt also play a role.

4. Empirical evidence

In this section I look at three types of determinants of the mark/dollar axis: variables suggested by the OCA that measure the intensity of trade links and the correlation of business cycles; a variable that captures exchange rate policies; and a variable that describes financial factors (the portfolio bias of international investors). Both a graphical analysis and a regression analysis are used to gauge the importance of these different factors.

In order to investigate how well the co-movement of cyclical fluctuations of country *X* with Germany and the United States explains the alignment of its currency along the dollar-mark axis, I look at the correlation coefficient of output gaps in country *X* with those in Germany and the United States. Output gaps are estimated with quarterly data of real GDP using the Hodrick-Prescott filter method. A high correlation coefficient indicates highly symmetric cyclical fluctuations. Bayoumi and Eichengreen (1996a) argue that observed movements in output reflect the combined effect of shocks and the response of labour and capital to these shocks. In a strict sense, the OCA argument focuses on the symmetry of aggregate shocks that hit different countries rather than the co-movement of measures of output across countries. Direct tests of currency areas would therefore involve identifying the shocks that hit the different countries.[7] For the present analysis, however, this distinction is not relevant, since I am interested more generally in the response of exchange rates to the relative cyclical position of the countries involved, regardless of whether it is the direct result of shocks or the reflection of the adjustment process.[8]

Figure 3 provides cross-sectional graphical evidence that the correlation coefficients of output gaps with Germany (the United States), computed over the period 1990-1997, are positively (negatively) related to the exchange rate elasticity with respect to mark/dollar rate changes. In other words, a closer correlation of business cycle fluctuations with Germany (the United States) is associated with a location closer to the mark (the dollar) on the dollar-mark axis. It is interesting that, in the 1990s, the UK business cycle co-moved closely with the US cycle and little with the German cycle. This relative cyclical position is one of the forces that drove sterling out of the ERM and closer to the dollar.

Another factor suggested by the OCA, the relative trade links of a country with the United States and Germany, is measured here by the ratio of that country's bilateral trade with Germany to bilateral trade with both the United States and Germany. As a variation of this indicator, I also look at the ratio of bilateral trade with the "mark area" to the sum of bilateral trade with the "mark area" and the "dollar area". The "mark area" is assumed here to comprise of Germany and countries with exchange rate elasticities close to one (Switzerland and the "core" European countries: the Netherlands, Belgium, Denmark and France), while the "dollar area" comprises the United States and countries with elasticities close to zero (Canada, Australia, New Zealand, Hong Kong, Singapore, Taiwan, Korea, Thailand, Indonesia, Malaysia and India). As an alternative indicator of trade links of country *X* with Germany and the United States, I also use the ratio of weights on Germany to the sum of weights on Germany and the United States in the BIS effective exchange rate of country *X*'s currency. This indicator has the advantage that it takes account of the importance of trade in third markets. However, since these weights are not updated on a regular basis, the use of this indicator is limited to cross-sectional analysis only.

Figure 4 shows that both the indicator based on the BIS effective exchange rate weights and the one based on the relative share of the "mark area" and the "dollar area", measured in 1997, convey the same information. As a country's trade intensity with Germany (the United States) increases, its currency co-moves more closely with the mark (the dollar) following a shock to the mark/dollar rate. In the United Kingdom both the cyclical behaviour and trade are more closely linked with the United States than Germany. Time-series evidence (not reported here) shows that trade integration between the United Kingdom and Germany rose in the 1980s and into 1991, but has fallen since 1991.

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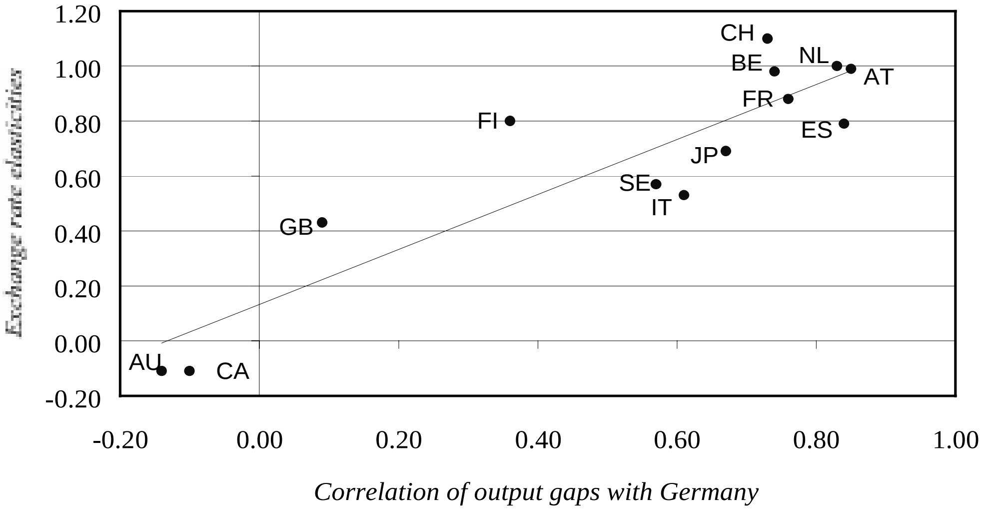
7 In the literature, these shocks have been typically measured by estimating VAR models with long-run restrictions.

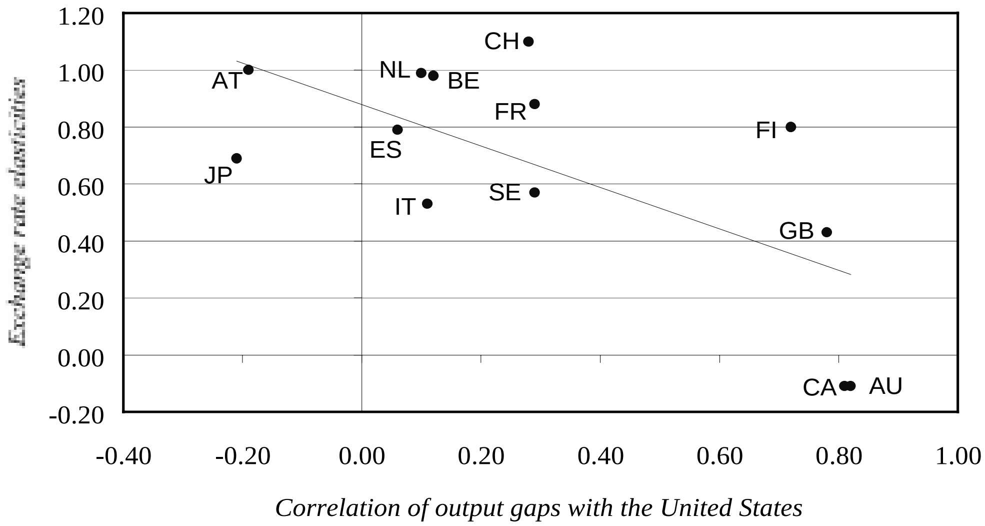
8 In related work (BIS (1997)), I also look at the cross-country correlation of supply shocks identified by estimating bivariate VAR models with output growth and inflation and imposing the standard long-run restrictions.

Figure 3

Correlation of business cycles and currency links



Note: Exchange rate elasticities with respect to mark/dollar rate changes are estimated following the method described in Table 1. The correlation of output gaps between a country and Germany is computed over the period 1990-97. Output gaps are estimated by detrending quarterly real GDP series using the Hodrick-Prescott filter.

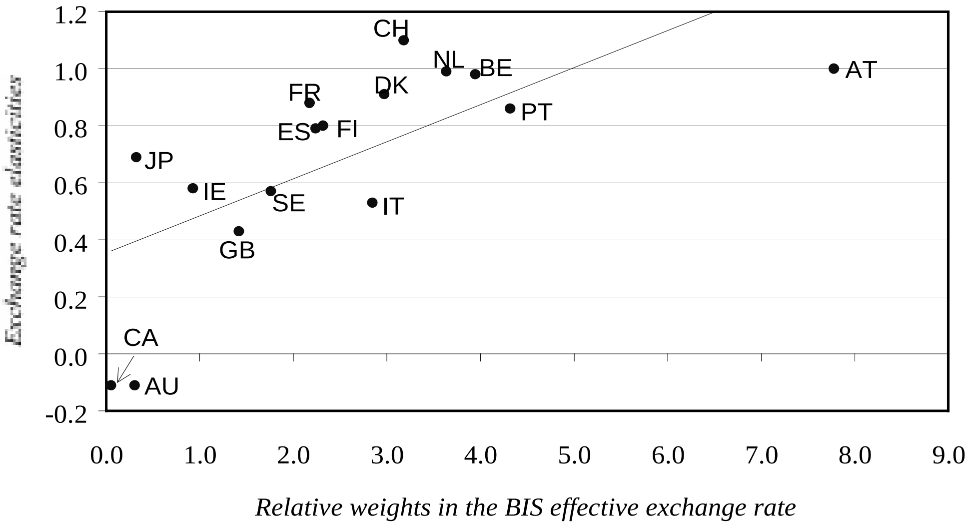


Note: Exchange rate elasticities with respect to mark/dollar rate changes are estimated following the method described in Table 1. The correlation of output gaps between a country and the United States is computed over the period 1990-97. Output gaps are estimated by detrending quarterly real GDP series using the Hodrick-Prescott filter.

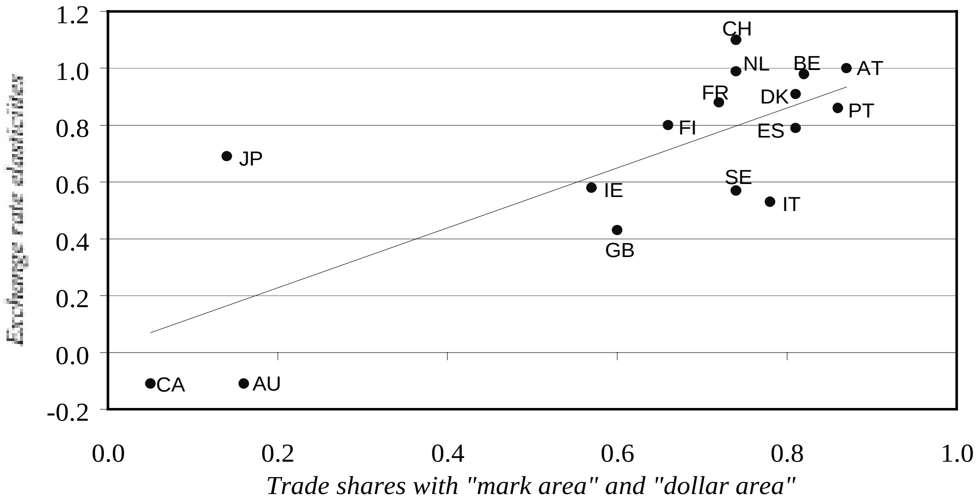
It is difficult in practice to find a variable that can accurately represent international portfolio bias. The measurable extent of foreign holdings of bank deposits denominated in different currencies provides a measure of average portfolio allocations among currencies. While it is hard to measure portfolio shifts in different currencies, it seems reasonable to assume that these marginal allocations are distributed similarly to average allocations. Furthermore, it seems reasonable in practice to approximate the

Figure 4

Trade links and currency links



Note: Exchange rate elasticities with respect to mark/dollar rate changes are estimated following the method described in Table 1. The horizontal axis shows for each country the relative weight of Germany and the United States in the BIS effective exchange rates.



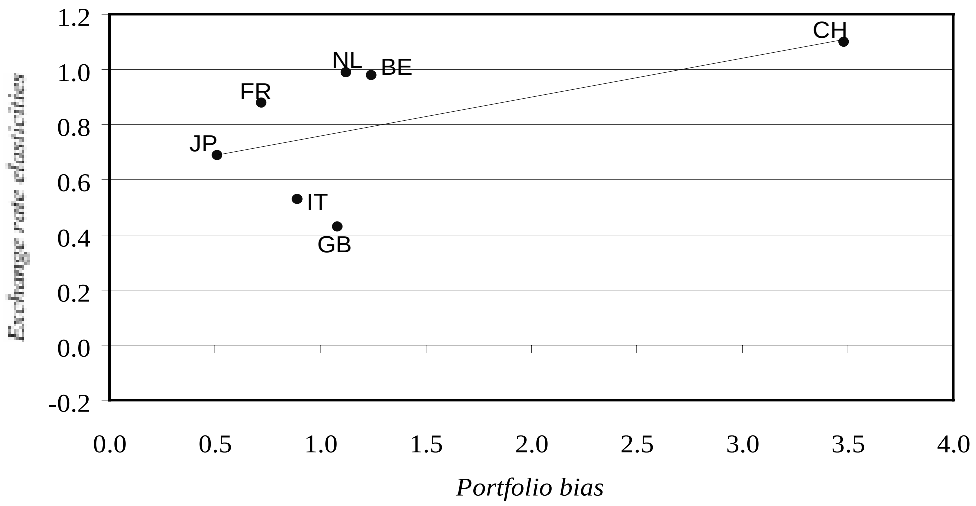
Note: Exchange rate elasticities with respect to mark/dollar rate changes are estimated following the method described in Table 1. The horizontal axis shows for each country the 1997 value of the ratio of trade with Germany, the Netherlands, Belgium, Denmark, France and Switzerland to trade with the United States, Canada, Australia, New Zealand, Hong Kong, Singapore, Taiwan, Korea, Thailand, Indonesia, Malaysia and India.

neutral allocation of asset stocks in Europe by GDP shares. I therefore use the ratio of international and eurocurrency deposits to GDP as a measure of international portfolio bias.

Figure 5 reports the ratio of international and eurocurrency deposits for some of the countries in Table 1. Figure 5 confirms that the position of the Swiss franc on the dollar-mark axis is driven by financial factors. These factors instead seem to play a minor role in determining the position of other European currencies on the axis.

Figure 5

International Portfolio bias and currency links



Note: Exchange rate elasticities with respect to mark/dollar rate changes are estimated following the method described in Table 1. Portfolio bias is defined as the ratio of International and Eurocurrency deposits to GDP measured in 1997.

In order to test more formally the role played by the correlation of cyclical fluctuations, trade links and the international portfolio bias in shaping the dollar-mark axis, I estimate the following equation:

(3) $$\beta_{it} = a + b_1 \times \mathrm{cov}\,us_{it} + b_2 \times \mathrm{cov}\,de_{it} + b_3 \times trade_{it} + b_4 \times port_{it} + b_5 \times dumerm_{it} + \varepsilon_{it}$$

The co-movement of cyclical fluctuations is represented by the correlation coefficient of output gaps with the United States (covus) and Germany (covde) computed over rolling windows of five years. I measure trade links with Germany and United States for country *X* by the ratio of trade with the mark countries (Germany and "core" Europe) to trade with the dollar countries (the United States, Canada, Australia and Asian countries with currencies pegged to the dollar). The results are robust in narrowing down trade partners to the United States and Germany. In addition to these two variables, which are similar to those commonly used in the literature, I also introduce two variables that capture international portfolio bias and exchange rate policy. The ratio of international and eurocurrency deposits to GDP is used to describe the portfolio bias (port). A discrete variable (dumerm) was introduced to capture ERM participation, distinguishing different bandwidth (i.e. tighter or looser bands). As an alternative, I also use the short-term interest differentials with respect to US and German rates as regressors. However, both variables turn out not to add explanatory power to equation (3).

In the literature, equations such as (3) have typically been estimated using cross-section data.[9] When I estimate equation (3) with cross-section data for 1996, the coefficient estimates for both OCA variables – the correlation of output gaps with Germany and the relative trade intensity with the "mark

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9 See Bayoumi and Eichengreen (1996b) and Bénassy-Quéré (1997).

area" and the "dollar area" – turn out positive and statistically significant, while the coefficient on the variable measuring ERM participation does not.[10] These results are consistent with the findings of Bayoumi and Eichengreen (1996a, 1996b). However, a shortcoming of this estimation approach is that it neglects important information provided by the time-series variation of the data. I therefore prefer to use panel data (and a random effects model) to estimate equation 3, since they exploit both the time dimension and the cross-sectional dimension.

The estimation of equation (3) with panel data for seven countries for the sample period 1980–97 gives the following results (t-statistics are given in parentheses): [11]

$$\beta_{it} = 0.58 - 0.02 \times \operatorname{cov} us_{it} - 0.02 \times \operatorname{cov} de_{it} + 0.13 \times trade_{it} + 0.13 \times dumerm_{it} + 0.11 \times port_{it} + \varepsilon_{it}$$

(12.50***)[12] (–0.58) (–0.53) (1.67*) (5.38***) (5.70***)

The model fits the data reasonably well, as suggested by an adjusted R^2 of 0.48. Unlike the cross-sectional regression, the results from the panel regressions reveal that the coefficients on the variables that capture the correlation of cyclical fluctuations with Germany and the United States are not significant. The coefficient on the trade intensity variable is positive and statistically significant, but only at the 10% confidence level. This result seems to be consistent with several studies that have found evidence of a positive and statistically significant effect of trade links on the correlation of cyclical movements across countries (De Cecco and Perri (1996); Frankel and Rose (1996a, 1996b)). An interpretation of the results for equation (3) is that the co-movement of cyclical fluctuations affects currency links mainly through trade links. Overall, I find that OCA factors are not as important in explaining the cross-sectional and time-series patterns of the dollar-mark axis as shown by Bayoumi and Eichengreen (1996a, 1996b) and others, who explain only cross-sectional differences in exchange rate variability.

The variable that captures exchange rate policy is now positive and statistically significant. This finding is consistent with those studies (e.g. von Hagen and Neumann (1992) and Del Giovane and Pozzolo (1998)) that have found evidence of the significant role of monetary and exchange rate policy. I also find that the variable measuring portfolio bias is positive and significant. Figure 5 suggests that this result is driven by the observations for the Swiss franc.

In summary, the regression results suggest that three main factors play a significant role in shaping the dollar-mark axis. Not surprisingly, exchange rate policy is one of them. OCA variables also matter, although only trade links remain important once exchange rate policy is taken into account and the time-series dimension is considered. An important variable which has received little attention in the

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10 Results are not reported here. Since the portfolio variable is only available for a few countries, I exclude it from the cross-section regressions.

11 The reduced number of currencies in this regression is dictated by data availability for the portfolio bias variable.

12 * = significant at the 10% level, ** = significant at the 5% level, *** = significant at the 1% level.

literature is international investors' portfolio bias. Taken together, these factors explain about half of the movements of currencies against the dollar or the mark.

5. Conclusions

In this paper I analyse some stylised facts that have characterised foreign exchange markets over the last few decades, and which are referred to as the dollar-mark axis. I first document how currencies have followed a pattern in responding to shocks to the mark/dollar rate and how this pattern has evolved over time. I show that the yen does not fit well into this pattern and, furthermore, that its role in Asia does not match the role of the dollar in North America and the mark in Europe. I then identify three factors that have shaped the dollar-mark axis. I provide evidence that, in addition to exchange rate policies, trade links and the preferences of international investors in their portfolio allocation have played a significant role.

It is too early to ascertain the extent to which the euro's role will evolve from that which the mark played up to end-1998. However, six months after the introduction of the euro there is already evidence that a dollar-euro axis has formed. In early 1999 a number of currencies including sterling, the Swiss franc, the Swedish krona and most eastern European currencies reacted to movements in the euro/dollar rate in a similar way to how they reacted to movements in the mark/dollar rates in recent years. On average, the Swiss franc depreciated by about 1.07% for every 1% depreciation of the euro against the dollar. The krona tracked the euro somewhat less closely, and tended to depreciate by about 0.7% for every 1% decline of the euro. The Czech and Slovak korunas are behaving similarly to the krona, while the forint and the zloty on average shared less than half of the euro's rate changes against the dollar. The pound took the same position on the dollar-euro axis as it had on the dollar-mark axis. In the first months of 1999 it tended to share about half of the euro's movements against the dollar.

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