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ABSTRACT

This paper examines evidence on interest differentials under the Bretton Woods system of fixed exchange rates and under the flexible rate system which succeeded it. Under the Bretton Woods system, many countries resorted to capital controls in an attempt to pursue independent monetary policies. In the three major countries studied in this paper, Britain, Germany and the United States, these capital controls resulted in large differentials between national interest rates covered for exchange risk. The capital controls and resulting interest differentials distorted many cross-border investment and borrowing decisions.

The paper compares these covered interest differentials with uncovered interest differentials in the Eurocurrency markets which are free of capital controls. In both fixed and flexible periods, average uncovered differentials between Eurodollar interest rates and four other Eurocurrency rates are in most cases close to zero. So these average uncovered interest differentials, whether attributable to exchange risk premiums or forecast errors, are much smaller than average covered interest differentials between national markets due to capital controls. If exchange risk premiums have significant effects on uncovered interest differentials in some periods, these premiums must be time-varying with a mean close to zero over the long sample periods studied. Similarly, if forecast errors have systematic components in some periods, in the long sample periods studied these errors have a mean close to zero as well.

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After almost twenty years of experience with flexible exchange rates, many observers have begun to look back nostalgically at the Bretton Woods period of fixed exchange rates. The exchange rate stability offered by the Bretton Woods system of fixed rates helped to facilitate investment and trade decisions by reducing one potentially important source of risk. In the period since exchange rates became flexible in 1973, this stability has been replaced by a high degree of short term volatility like that found in commodity or equity markets. Unhedged positions in any particular currency have resulted in unanticipated gains and losses which far exceed those experienced under Bretton Woods.[1] So as a result, foreign exchange risk premiums have developed to compensate investors for positions in particular currencies. Some observers point to such risk premiums (although they are difficult to measure) as evidence of the costs imposed by flexible rates.

Experience under Bretton Woods, however, suggests that there are also costs associated with fixed exchange rates. The price paid for stable exchange rates under Bretton Woods was a degree of control over international financial transactions which might be regarded as onerous in today's environment of deregulated markets.[2] The extensive capital controls which inhibited flows between most national financial markets led to sizable interest differentials which distorted international financial decisions. This paper will compare the integration of short-term financial markets under Bretton Woods with the

integration of these same financial markets under flexible exchange rates.

Exchange rates naturally became more volatile after the breakdown of Bretton Woods in 1971. Table 1 compares the volatility of changes in exchange rates in the Bretton Woods and flexible rate periods. The changes in exchange rates are measured over three month holding periods corresponding to the maturity of the interest rates to be studied below. The calculations for the Bretton Woods period begin whenever Eurocurrency rates first became available for that currency and end in January 1971.[3] The table shows that the standard errors of the exchange rate changes are from two to fifteen times larger under flexible rates than under fixed rates. Notice, however, that two of the exchange rates, for the \$/£ and DM/\$, have sizable standard errors even in the Bretton Woods period. This is because both currencies were realigned prior to 1971.

The clear division between the Bretton Woods period and the flexible rate period does not hold as well for other financial variables. In the case of interest rates, in particular, the exchange rate regime may not be as important to behavior as the presence or absence of capital controls. Consider Table 2 which reports on the standard deviations and correlations of three sets of Eurocurrency and national interest rates.[4] The interest rates for all three currencies in Table 2 have somewhat higher volatility in the flexible rate period. But the most telling difference in behavior lies in the correlations between

Eurocurrency and national interest rates. In the absence of controls, these correlations are over .99, indicating a high degree of integration between the national and Eurocurrency markets. But the correlations are distinctly lower when controls on the national markets are in effect, whether or not exchange rates are flexible. The paper will try to disentangle the effects of capital controls and exchange rate volatility.

The shift to flexible exchange rates in 1973 has stimulated numerous studies of international financial linkages. Many of these studies have examined the degree of integration between short-term financial markets through tests of uncovered interest parity or related conditions.[5] Almost invariably, these tests have been based on Eurocurrency interest rates rather than national interest rates because the former are free of capital controls. So tests of uncovered interest parity have provided evidence about foreign exchange risk premiums rather than political barriers to the international integration of financial markets. No studies have tried to compare the relative impact of capital controls and exchange risk on interest differentials. Few studies, moreover, have compared interest differentials between the major financial markets under fixed and flexible exchange rates. In fact, most studies begin their sample periods in 1973 or later because financial data are so much more readily available for the more recent period.

This study will examine both Eurocurrency and national financial markets over periods beginning in the early 1960s. The

study will encompass markets in five currencies, the dollar, guilder, mark, sterling and Swiss franc. It will examine the effects of capital controls and political risk on interest differentials between Eurocurrency and national markets, and the effects of foreign exchange risk premia on Eurocurrency differentials.

1. Capital Controls and Political Risk

One of the alleged benefits of flexible exchange rates is that it frees national monetary authorities from balance of payments constraints and thus permits them to relax capital controls. This section will investigate how the breakdown of Bretton Woods led to the removal of controls in several of the major financial markets. This will be done by comparing covered interest differentials in the 1960s with those in later periods.

Covered interest differentials can arise for any of three reasons. First, the securities being considered may differ in default risk.[6] Second, the markets may be segmented by capital controls. Finally, even if no capital controls separate the markets, investors may perceive a political or sovereign risk involving future restrictions.[7] In the interest rate comparisons below, we will attempt to confine comparisons to securities with equal default risk, although as will be evident that is not entirely possible. So covered interest differentials will primarily reflect the joint influence of capital controls and political risk, which we term the "country premium."[8]

Capital controls come in two varieties. Governments may

restrict resident purchases of foreign assets (and sometimes non-resident outflows as well). Such outward controls, which are usually designed to prop up a weak currency, lead to a covered interest differential favoring the foreign market unless there is sufficient flexibility in the controls to permit arbitrage between domestic and foreign markets. Alternatively, governments may restrict non-resident purchases of domestic assets in order to reduce pressures towards appreciation of the domestic currency. Such inward controls may lead to an interest differential favoring the domestic market. Only a few countries like Germany and Switzerland have resorted to such inward controls.

1.1. British Controls

To examine how controls affect markets, consider the case of the British market. The British government maintained a system of controls on resident outflows until as late as June 1979. The controls applied primarily to direct and portfolio investment abroad by U.K. residents, holding of foreign currency deposits by residents, and foreign currency lending by residents including U.K. banks.[9] Residents could invest abroad only by using foreign exchange obtained from the sale of existing securities or from foreign currency borrowing.[10] These controls, which were a holdover from the war-time period, did not prevent London from maintaining its preeminence as a financial center because the Bank of England was farsighted enough to allow the Eurocurrency market to develop in London outside of the system of controls. Banks in London could accept deposits and make

loans denominated in any currency except sterling. Of course, the controls restricted investments by residents in Eurocurrency deposits just like it restricted their investments in markets outside the United Kingdom. The controls also prohibited Eurosterling deposits and loans from being offered by banks located in London, although a Eurosterling market developed in Paris.

The Eurocurrency market itself operated free of any capital controls. Thus host governments (such as the British government in the case of Eurocurrency transactions in London) permitted bank transactions involving foreign currencies by non-residents even when they restricted transactions involving their own currencies. In addition, political risks were perceived to be of negligible importance in this market. Consider the comparison between Eurodollar and Euromark deposits in London. Investors might perceive that both forms of Euro-currency deposits were subject to some political risk, although that risk would be low since the British authorities were unlikely to tamper with a market which could be moved elsewhere so easily. But even if all Eurocurrency deposits were at some risk, there was little reason to believe that the risk was greater for one type of Eurocurrency deposit relative to another type. That is because the British government (or any other government) was unlikely to discriminate among foreign currencies in any extension of controls to the Eurocurrency market. So it was not surprising that covered interest parity always held between any

pair of Eurocurrency deposit rates.

Consider the comparison between Eurodollar and Eurosterling interest rates. If the Eurodollar interest rate is adjusted for the cost of forward cover, then the two returns expressed in sterling should be equal:

(1) $i_{£t} = i_{\$t} + f_{£t}$, Covered interest parity

where $i_{\$t} = \ln(1 + I_{\$t})$ where $I_{\$t}$ is the Eurodollar interest rate,

$i_{£t} = \ln(1 + I_{£t})$ where $I_{£t}$ is the Eurosterling rate,

$f_{£t} = \ln(F_t/S_t)$ where F_t is the forward exchange rate and S_t is the spot exchange rate, both expressed in £/$.

The two returns should be identical except for transactions costs.

In the case of comparisons involving the British interest rate (i_{Bt}), in contrast, a covered differential could reflect a country premium resulting from capital controls or political risks associated with the British market. Since covered interest parity always holds for the Eurocurrency markets, we may measure the deviation of British rates from covered interest parity in two ways using the Eurodollar rate and the forward premium or the Eurosterling rate alone.

(2a) $i_{\$t} + f_{£t} - i_{Bt} = U_{1t}$.

(2b) $i_{£t} - i_{Bt} = U_{2t}$.

The first equation measures U_{1t}, the deviation between the covered Eurodollar rate and the British interest rate. The second equation measures U_{2t}, the deviation between the Eurosterling rate and the British interest rate. Since British

capital controls limited outflows of capital, we would expect both deviations to be positive (or equal to zero when the control is not binding).

Table 3 reports monthly interest differentials for the sterling markets for the period from April 1961, when Eurosterling interest rates were first reported by the Bank of England, to June 1979, when British capital controls ended. The underlying data are published by the Bank of England Quarterly Bulletin. The interest rates reported are for three month maturities expressed in percent per annum, so the differentials are calculated in logs as follows (for the case of the Eurodollar and British interest rates):

$$(2a') \quad \{\ln[1+(I_{\$t}/400)] + \ln[F_{£t}/S_{£t}] - \ln[1+(I_{Bt}/400)]\} * 400$$

The forward and spot exchange rates are expressed in £/$ after having been inverted to conform with practices in other exchange markets. The table reports differentials between Eurodollar and British rates, between Eurosterling and British rates, and between Eurodollar and Eurosterling rates. The first and last differentials are calculated using the forward premium on the pound, while the second differential omits the forward premium because both interest rates are expressed in sterling.

Table 3 illustrates how effective capital controls can be in driving wedges between national and Eurocurrency interest rates. According to this table, interest differentials between the British market and either Eurocurrency market averaged over 1 % per annum during the period of the controls. The standard errors of

the sample means of these differentials were less than 0.20 %, so both of these means are statistically different from zero at the 5 percent level.[11] In the absence of controls, differentials of this size would induce immediate arbitrage activity by bank traders. The fifth row of the table reports the band for interest rate differentials within which 95 % of the observations fall.[12] That band includes differentials as large as 4.23 % in the case of comparisons between Eurodollar and British rates and 3.78 % in comparisons between Eurosterling and British rates. These differentials were large enough to provide firms within the British market with substantial advantages over firms with access only to international markets. During the period of the controls, therefore, multinational firms with operations in Britain as well as elsewhere found it advantageous to finance as much as possible behind the British control barrier. Rather than being a high cost center, the British sterling market offered financing at lower rates, when measured in dollars, than in markets with seemingly low interest rates such as Germany.

The table also shows covered differentials between the Eurodollar and Eurosterling markets. The differentials averaged only 0.08 % per annum over the period of the capital controls. Although 0.08 % is statistically different from zero, it is not economically significant since transactions costs are most likely large enough to eliminate any profits from arbitrage activity.[13] Some of the observed differentials were several times as large as 0.08 %, since the 95 % band included differentials as large as

0.38 %. But that is more likely to reflect imperfections in the data rather than genuine arbitrage opportunities open to bank traders. In studying the 1960s and 1970s, researchers have to contend with poorer data than are available today. In the case of the British market, the data are of relatively high quality coming from one source, the Bank of England. But the Bank of England data are not all synchronous, since the Paris market where the Eurosterling quotes originate closes one hour later than the London market where the Eurodollar and exchange rate quotes originate. So the few large differentials observed between the two markets are probably due to interest rate movements in Paris in the last hour of trading.

To study the impact of controls in greater detail, we break up the sample period into three subperiods: (a) the last decade of the Bretton Woods period, 1961(4)-1971(4),[14] (b) a period of flexible exchange rates when capital controls were still in place, 1973(1)-1979(6), and (c) the post control period, 1979(7)-1989(7). For each period, we study the differentials between the Eurosterling and British interest rates.

Table 4 reports the sample means of the interest differentials between the two markets, the standard errors of these means and their t-statistics, and the band within which 95% of the observations lie. To show the asymmetric nature of the controls, which inhibited outward flows but not inward flows, we report separate statistics for the positive differentials of the Eurosterling rate over the British interest rate. If the controls

are asymmetric, the differentials should be predominantly positive, especially the large differentials found when the controls are most binding.

In the two periods when the British market was subject to controls, the interest differentials were quite substantial. During the Bretton Woods period, the differential averaged 0.78 % with the 95 % band occuring at a differential as large as 4.14 %. In the flexible period, the average differential was even larger at 1.50 %. In this latter period, 93.6 % of the differentials were positive. In both periods, the mean differentials are statistically different from zero at the five percent level.

Once the controls were removed in 1979, the differential dropped to -0.03 % with only 52.9 % of the differentials being positive. Figure 1 illustrates how dramatically different were the differentials in the post control period. This figure shows the differential between the Eurosterling rate and the British interbank rate during the flexible rate period. A vertical line indicates when the controls were removed. Both Table 4 and Figure 1 show clearly that the controls had a very substantial effect on interest differentials, and therefore on the relative costs of financing in the British and external markets.

1.2. German Controls

As in the British case, the German government resorted to capital controls in an attempt to shield the domestic financial markets from international pressures. But German controls were designed to limit inflows rather than outflows of funds.

In the late 1960s, the mark came under attack periodically because of a widespread belief that it was undervalued relative to the dollar and other major currencies. In October 1969, the German authorities revalued the mark by 8.5 %. But when the pressure on the mark resumed in 1970, the authorities began to impose capital controls inhibiting inflows from abroad in an attempt to limit further appreciation of the mark. The controls eventually included bans on interest payments to foreigners, the imposition of cash deposits on borrowings abroad (initially 40 %), restrictions on the purchase of domestic bonds by non-residents, and, finally, general restrictions on borrowing abroad.[15] The controls resulted in a negative gap between interest rates in the Euromark market and the German market. The move to flexible exchange rates in early 1973 reduced the incentives to invest in the German market, but it was not until February 1974 that the authorities began to remove the network of capital controls.

Table 5 reports evidence on the differential between the Euromark and German interbank rates for the period from 1966 to 1989. The sample is broken up into three periods: (a) the Bretton Woods period prior to the imposition of controls, 1966(1)-1970(3), (b) the control period from 1970(4)-1974(1), and (c) the post-control period, 1974(2)-1989(10). The control period includes about a year when the DM/$ rate was still fixed as well as three years when this rate was allowed to vary (at least periodically).

It is evident from the table that the pre-control Bretton Woods period resembles the post-control period much more than the period of controls. The differential averages -0.40 % during the pre-control period and -0.23 % during the post-control period, but -2.97 % during the period of controls.[16] Similarly, the 95 % band is much larger in the period of controls than in either non-control period. In the control period, the 95 % band includes a differential as large as 8.89 %. Differentials that large are unheard of in periods free of controls. In this situation it paid multinational firms to finance as much as possible outside of Germany and to build up working balances behind the control barrier in Germany.

Figure 2 illustrates the variation in the differential during the period of the controls and the period directly after the removal of controls. The differential was almost uniformly negative since the controls inhibited outward flows of funds. It is evident from the figure that the stringency of the controls varied widely, with the controls being most binding in 1972 and 1973.

1.3. U.S. Controls

The last sets of controls to be studied are those imposed on U.S. residents in the 1960s. The U.S. balance of payments deteriorated in the 1960s as the dollar became increasingly overvalued relative to other major currencies. The Kennedy Administration responded by imposing an interest equalization tax on foreign securities purchased by Americans, but it was only later during the Johnson Administration that comprehensive

capital controls were put in place. These controls restricted outflows of capital by both banks and nonbank residents. For example, under the Voluntary Foreign Credit Restraint Program, there were restrictions on lending abroad by commercial banks and non-bank financial institutions. There were also restrictions on direct investment under the Foreign Direct Investment Program.[17] These controls made it difficult to fund foreign operations from the United States, and led to large differentials between interest rates in U.S. markets and markets abroad, including the Eurodollar market. The effects of the capital controls were complicated by banking regulations which put ceilings on interest rates paid on bank deposits including certificates of deposit (CDs). Regulation Q of the Federal Reserve limited CD rates on three month deposits to 6 % through 1969 and 6.75 % beginning in January 1970.

Figure 3 illustrates the combined effects of the controls and Regulation Q ceilings on interest rates in the major dollar markets. The figure shows that the interest rate ceiling resulted in an inversion of the normal relationship between Treasury bill (TB) rates and CD rates. In 1968 through 1970, the TB rate was often above the CD rate when the latter hit its ceiling. The effects of the capital controls are evident in the widening differentials between Eurodollar rates and Treasury bill rates. In 1969, that differential rose over 4% per annum. With controls inhibiting funds flowing from the United States to London, the Eurodollar rate rose way above U.S. rates. A U.S. (or foreign)

firm was able to raise funds much more cheaply in the United States, although because of the controls these funds could not generally be used for foreign operations.

Table 6 reports interest differentials between the Eurodollar and U.S. market for two time periods: (a) the period of U.S. capital controls, 1966(1)-1973(12), and (b) the post-control period, 1974(1)-1989(7). As in the case of the German controls, the control period extended into the period after the Bretton Woods system collapsed, so the division between control and post-control periods does not coincide very well with the division between fixed and flexible periods. The interest rates, end of month rates for three month instruments, are drawn from Morgan Guaranty Trust's World Financial Markets. For the period of the controls, the table reports two sets of differentials: the Eurodollar-CD differential and the Eurodollar-Treasury bill differential. The latter differential is free of the distortions caused by the Regulation Q ceilings.

The table reveals large differentials during the control period. The differential between Eurodollar and CD rates averaged 1.35 % with the 95 % band occuring as a differential of 4.17 %. The differential involving the Treasury bill rate was of similar size. Both sets of differentials are statistically different from zero at the five percent level. The capital controls were evidently binding for much of the period.

Comparing the control and post-control periods, it is evident that U.S. controls resulted in raising the relative costs of

financing in the Eurodollar market by a little over one percent, and even more in 1969 and 1970 when interest differentials reached their peak. By cutting off the Eurodollar market from its national counterpart, moreover, the U.S. controls encouraged the development of the former. Firms which were not allowed to draw on U.S. markets for their financing naturally turned to the Eurodollar market. The interest differentials between these two markets never reached the size found in the German market, but the controls had a major impact on the relative costs of financing.

In the post-control period, the differential between the Eurodollar and CD rates averaged 0.53 % with the 95 % band occuring at a rate of 1.50 %. This differential is much smaller than during the control period, but larger than differentials in the mark and sterling markets after controls were removed. Much of this differential can be explained by banking regulations which require banks to hold reserves against deposits at U.S. banks, but which exempt Eurodollar deposits from reserve requirements.[18] During some of the post-control years, however, the interest differential between Eurodollar and CDs was much larger than 0.53 %. The first period was in 1974-75 during the Herstatt Bank crisis and the second period was in 1980-83 when U.S. bank lending came under scrutiny. Both sets of years were free of capital controls, so higher interest rates in the Eurodollar market must be attributed to the market's assessment of risks. Consider the period of the Herstatt crisis. During that period, the market

demanded risk premiums for bank deposit rates whether the deposits were in the U.S. or Eurodollar markets. The U.S. CD rate at times rose several percent above the treasury bill rate as investors moved to the safety of government securities.[19] The Eurodollar rate, in turn, rose above CD rates, even when both deposits were at branches of the same bank, because of a perception that Eurodollar deposits were subject to greater default risk. Similar differentials emerged during the 1980-83 period, especially after the Mexican debt crisis which began in August 1982.[20] The interest differential found in the post control period suggests that investigators should be wary about ignoring default premiums when comparing national and Eurocurrency rates.

2. Exchange Risk and Uncovered Interest Parity

Once exchange rates became flexible early in 1973, governments could contemplate removing controls on their markets since they no longer faced balance of payments constraints. Two of the first countries to remove controls were the United States and Germany at the end of 1973. Britain retained controls until June 1979 because of the chronic weakness of sterling. But since that time, all three countries have been free of capital controls.

As we have seen, the removal of controls permits investors to take advantage of interest differentials between the Eurocurrency and national markets. But with flexible rates, firms are faced with a new factor affecting the cost of financing,

unanticipated changes in exchange rates. Exchange rates are notoriously difficult to predict, and ex post returns vary widely depending on whatever exchange rates prevail at the time of repayment. So flexible exchange rates lead to the emergence of foreign exchange risk premiums which may drive wedges between ex ante returns in different markets.

2.1. Deviations from Uncovered Interest Parity

To examine the effects of risk premiums on relative returns, consider the comparison of returns in the U.S. and British markets. If both returns are expressed in sterling, then the expected (ex ante) interest differential between U.S. and British interest rates can be written as follows:

$$(3) \qquad i_{At} + x_{\pounds t} - i_{Bt} = U_{3t},$$

where $x_{\pounds t}$ is the expected change in the pound price of the dollar, $E_t[\ln(S_{\pounds t+1}/S_{\pounds t})]$. In the absence of barriers to investment such as capital controls or political risk, U_{3t} is a measure of the risk premium separating the returns in the two markets. But in the presence of capital controls or political risk, U_{3t} reflects both the exchange risk premium and a country premium. To isolate the exchange risk premium, therefore, we turn to the corresponding Eurocurrency interest differentials which are free of country premiums.

Measuring that risk premium is difficult because we cannot observe exchange rate expectations directly. What we do observe is the actual (ex post) interest differential which can be decomposed into the expected differential and a forecast error:

$$(4) \qquad (i_{\$t} + x_{£t} - i_{£t}) + (s_{£t} - x_{£t}) = \epsilon_{1t}$$

where $s_{£t}$ is the actual change in the spot exchange rate, $\ln[S_{£t+1}/S_{£t}]$. The error term, ϵ_{1t}, reflects the combined influence of two factors, the risk premium and the forecast error. If the exchange market is efficient, the forecast error should have an expected value equal to zero. So the expected value of ϵ_{1t} should reflect the exchange risk premium alone.

In any sample period, however, the average value of ϵ_{1t}, representing the average uncovered interest differential, need not be equal to zero even in the absence of a risk premium. First, there may be discrete changes in the exchange rate which are expected but not realized in that particular sample period. This phenomenon has been called the "peso problem" (in reference to the behavior of the Mexican peso prior to its devaluation in 1976).[21] Peso problems can be found in fixed exchange rate periods when parity changes are possible, but they may also occur in flexible rate periods if major economic disturbances (including shifts in policy regimes) are expected. The second reason that average uncovered differentials may not be equal to zero is that the market may be learning about changes in regimes which have occurred. In that case, forecast errors may be systematically positive or negative even though market participants are processing information in a rational manner.[22] With longer sample periods, however, forecast errors associated with learning should become less of a problem unless there are frequent changes in regimes.

2.2. Evidence on Uncovered Interest Parity

In Table 7, we present sample means for the uncovered interest differentials between the Eurodollar rate and four other Eurocurrency rates.[23] The differentials are reported for both fixed and flexible exchange rate periods as well as for the entire sample. The fixed rate sample period begins in the early 1960s whenever a Eurocurrency interest rate series first becomes available for that currency and ends in January 1971. As discussed above, the Bretton Woods period is assumed to end in April 1971 prior to the floating of the mark and guilder in mid-May 1971. In order for the (ex post) three month returns to be defined entirely within the Bretton Woods period, the last observation must be in January 1971. The flexible period extends from January 1973 until the end of the sample period in July 1989. Table 7 also reports separate statistics for the post Bretton Woods period beginning in May 1971.

The Bank of England's series for Eurodollar and Eurosterling rates begins in April 1961, so there are 340 monthly observations available for these rates. The first row of Table 7 reports the mean uncovered differentials between these rates over various periods. During the Bretton Woods period, the mean uncovered differential is equal to -0.15 %/annum, with a standard deviation for this mean of 1.51 %. During the flexible period, the mean differential is somewhat smaller in absolute value at 0.10 %, but with a much larger standard deviation of 3.05 %. Neither of these means is statistically different from

zero. They are also small in economic terms, being comparable to the covered interest differentials between Eurocurrency rates reported in section 1. The average uncovered differential is also small over the twenty-eight year sample period as a whole during which the mean differential is -0.12 % and over the post Bretton Woods period during which the mean differential is -0.07 %.[24]

Uncovered interest differentials between Eurodollar and Euromark rates are reported in the second row of Table 7. The sample period begins in January 1963 when Euromark interest rates were first published by the OECD and ends in July 1989. During the Bretton Woods period from January 1963 to April 1971, the mean uncovered differential between Eurodollars and Euromarks is - 0.01 % with a standard deviation of 0.84 %. During the flexible period, the mean increases to 0.85 %/annum with a standard deviation of 3.16 %. Although this mean is not significantly different from zero, it is nonetheless much larger than covered interest differentials for Eurocurrency rates. The mark appreciated substantially against the dollar between the end of the Bretton Woods period and the beginning of 1973, so by extending the sample period back until May 1971 the mean uncovered differential falls to 0.01 %/annum. For the whole sample period beginning in January 1963, moreover, the mean differential is only -0.13 %.

Table 7 also reports statistics for the only other two Eurocurrency rates available from the early 1960s, the Euroguilder and Euro-SF. The results are similar to those of the

other Eurocurrencies. There are uncovered interest differentials ranging from -0.07 % to 1.03 % for subperiods. Two of these interest differentials, those defined for the Bretton Woods period in the first column of the table, are statistically different from zero. As discussed below, the excess returns on Eurodollars relative to Euroguilders and Euro Swiss francs may be compensating for an expected appreciation of these currencies -- an appreciation which did not in fact occur until after the end of Bretton Woods. The mean differentials for the whole sample period are only -0.06 % for Euroguilders and 0.10 % for Euro Swiss francs. Comparable differentials are found for Euro French francs for the period from January 1973 to July 1989.[25]

There is some evidence of peso problems in shorter sample periods during the 1960s, specifically prior to the devaluation of sterling in November 1967 and the revaluation of the mark in October 1969. If a devaluation or revaluation is anticipated, there will be ex post deviations from uncovered interest parity until the change in parity actually occurs. Table 8 compares uncovered interest differentials for the whole Bretton Woods period (starting when Eurocurrency data became available) with differentials for the periods ending prior to these changes in parities.[26] The results suggest that these parity changes may have been anticipated. If the sample period for sterling returns ends prior to the sterling devaluation of November 1967, the average uncovered differential is 1.20 % in favor of sterling relative to the dollar. The higher return for

sterling compensated the investor for the expected loss due to the devaluation of sterling. If the sample period for the mark ends prior to the mark revaluation in September 1969, the average uncovered differential is 1.14 % in favor of the dollar relative to the mark. In this case, the higher return for the dollar compensated the investor for the expected gain on the mark due to its revaluation. In both cases, the average interest differentials are statistically different from zero (at the five percent level). Over the whole sample period, however, the uncovered interest differentials are very close to zero.

Neither the Dutch guilder nor Swiss franc was revalued during the Bretton Woods sample period,[27] but both currencies were revalued in the Smithsonian Agreement of December 1971 which tried to reestablish fixed parities (although with wider bands of 2.25 %). Table 9 examines uncovered interest differentials for the Bretton Woods period through December 1971.[28] The average uncovered interest differential for the Eurodollar relative to the Euroguilder declines from 0.62 % for the Bretton Woods period alone to -0.14 % for the period including the Smithsonian Agreement. Similarly, the differential for the dollar relative to the Swiss franc declines from 1.03% to 0.22%. So in both cases, the revaluations between May and December 1971 compensated investors for the lower interest rates paid on the guilder and Swiss franc prior to the breakdown of Bretton Woods.

2.3. Interpretations of the Evidence on Uncovered Differentials

The evidence presented in Tables 7-9 suggests that average uncovered interest differentials are close to zero over long sample periods under both fixed and flexible exchange rates. If average uncovered interest differentials are this small, then ex ante uncovered interest differentials must also be quite small on average, since forecast errors should have an average value close to zero over these long sample periods. But in that case, exchange risk premiums must also be small on average.

These results do not rule out the existence of time-varying risk premiums which are both positive and negative for shorter sample periods.[29] But to be consistent with the evidence, these risk premiums would have to have a mean close to zero over the long sample periods studied here. Nor do the results rule out the possibility of systematic forecast errors that do not have a mean of zero over shorter sample periods. Forecast errors could be systematically positive or negative over shorter periods either because (as explained above) the market is learning about changes in regimes or because of expectations that there might be a regime switch in the future (the peso problem). But over the longer sample periods studied here, risk premiums and forecast errors have little net effect on uncovered interest differentials.

The unconditional estimates of uncovered differentials in Tables 7-9 provide a different perspective on risk premiums than conditional estimates based on time series regressions. These

regressions relate uncovered interest differentials to variables in the current information set such as in the following equation:

$$(5) \qquad (i_{\$t} + s_{£t} - i_{£t}) = \alpha + \beta Z_t + \epsilon_{2t},$$

where Z_t is a variable or set of variables known at period t.[30] If β is significantly different from zero, then there is said to be evidence of time-varying risk premiums (or, alternatively, evidence of forecast errors systematically related to current variables). To investigate this possibility, we estimated equations explaining the uncovered differentials for four Eurocurrencies (relative to the dollar) as a function of three variables in the current information set: the simple interest differential (e.g., $i_{\$} - i_{£}$), the percentage change in the spot rate over the previous twelve months, and the inflation differential over the previous twelve months.[31] The results are reported in Table 10 for two alternative post-Bretton Woods periods beginning in May 1971 and January 1973.

The first column of Table 10 gives the mean of the fitted values from each regression. This conditional mean measures the <u>average</u> risk premium over the period (or, alternatively, the average forecast error).[32] The second column reports the F-statistics testing whether the explanatory variables in the regressions are jointly significant. Except in the case of the mark, regression coefficients in all of the equations are statistically significant at the five percent level.[33] So there does seem to be a systematic element in the uncovered interest differentials, whether it is due to risk premiums or systematic

forecast errors.

The last two columns of the table, however, suggest that most of the movement in the uncovered interest differential remains unexplained. The third column reports the unconditional standard errors of the uncovered interest differentials, while the fourth column reports the standard errors of the residuals from the estimated equations. These latter conditional standard errors are almost as large as the unconditional errors, thus indicating that unsystematic forecast errors rather than risk premiums or systematic errors account for most of the variability of the interest differentials.

To summarize this evidence, there does seem to be a systematic component to uncovered interest differentials which can be attributed to risk premiums or peso-type phenomena. But the mean of this systematic component is close to zero, and most of the variation in uncovered differentials remains unexplained. So there may be time-varying risk premiums (or systematic forecast errors) evident in the data, but they account for only a fraction of the total variation in the uncovered differentials and their average effect on any interest differential is close to zero.

We can compare the estimates of the average exchange risk premiums of Tables 7-10 with the country premiums for the three national markets reported earlier in Tables 4-6. The uncovered interest differentials measured over the long sample periods in Table 7 are substantially smaller than those due to

capital controls in the national markets as reported in Tables 4-6. Consider the case of Euromark interest rates. In Table 5, the average differential between Euromark and German interest rates is -2.97 % during the capital control period from April 1970 to January 1974. In Table 7, the average uncovered differential between Eurodollar and Euromark interest rates is only -0.13 % over the entire sample period and from 0.01 % to 0.85 % over shorter sample periods. The country premiums measured in Tables 4-6, moreover, are average premiums, so they underestimate the effects of the capital controls during periods when the controls were most binding (such as 1969-70 in the United States).[34] At the very least we can say that capital controls under fixed rates can lead to ex ante interest differentials at least as large as those due to exchange risk premiums under flexible rates.

Fixed exchange rates do not necessarily require capital controls to sustain them, at least if the national monetary authority is willing to refrain from pursuing a monetary policy independent of those abroad. So fixed exchange rates could bring the best of both regimes: free capital mobility combined with limited exchange rate volatility. But the Bretton Woods system itself degenerated into a system plagued with controls. And that system led to interest differentials which are large by any standard, and more specifically larger than average differentials under flexible rates in the absence of controls.

3. Conclusion

This paper has examined evidence on interest differentials under fixed and flexible rates. The paper has shown that in three major national markets capital controls imposed during the Bretton Woods period led to large covered interest differentials which distorted investment and borrowing decisions. The three countries involved, Britain, Germany, and the United States, all relaxed controls under flexible rates, although Britain maintained its controls until as late as 1978. The paper compared these covered interest differentials with uncovered interest differentials in the Eurocurrency markets which are free of capital controls. In both fixed and flexible periods, average uncovered interest differentials between the Eurodollar market and four other Eurocurrency markets studied are in many cases close to zero. So if exchange risk premiums are present, they must be time-varying with a mean close to zero over the long sample periods studied in the paper.

ENDNOTES

1. McKinnon (1988) presents the case against flexible rates. He argues that many business risks associated with flexible rates cannot be hedged because of the lack of contingent forward markets in goods and services.

2. Giovannini (1988) presents evidence that restrictions on capital flows have been an important feature of three fixed exchange rate regimes: the gold standard (at least in times of crisis), Bretton Woods, and the European Monetary System. Eichengreen (1989), however, shows that the period of fixed exchange rates between the world wars was notably free of

capital controls.

3. The Bretton Woods system collapsed in May 1971, so changes in exchange rates defined over three month holding periods must end in January 1971. The five currencies represented in Table 1 are the only ones which have Eurocurrency rates available from the early 1960s.

4. These three sets of interest rates will be studied in detail in the next section.

5. Hodrick (1987) presents a critical survey of these empirical studies. Other references are given below.

6. Government securities, for example, are generally regarded as less subject to default risk than private assets. Assets may also differ in tax status and eligibility for discounting at the central bank as well as in other characteristics.

7. Political or sovereign risk arises because of concern that the national authorities of one country might impose controls, taxes, or other regulatory measures on foreign investment in their market or on their residents' investments in other markets.

8. For previous treatments of capital controls and political risk and their implications for covered interest parity, see Aliber (1973), Dooley and Isard (1980), Frenkel and Levich (1975), and Marston (1976). Frankel and MacArthur (1988) also use the term country premium in their study of covered interest differentials over the 1982-86 period.

9. Artis and Taylor (1989) describe these capital controls in more detail.

10. An investment dollar market grew up with a premium over the official exchange rate reflecting the tightness of the controls.

11. Since the monthly observations of three month interest differentials overlap, the standard errors of the means are calculated as if there are only N/3 observations. Frankel and

MacArthur (1988) make a similar adjustment for the three month rates in their study.

12. This statistic gives some indication of how distortionary the controls are when they are most binding.

13. The recent study by Clinton (1988) used bid-ask spreads to measure transactions costs associated with covered interest transactions. He estimated that transactions costs were as low as 0.06 % for a six month period in 1985-86. Whether transactions costs were that low over the entire twenty-nine year period is difficult to say in the absence of better data.

14. The effective end of Bretton Woods is assumed to occur in May 1971 when the mark and guilder began a period of floating and when the Swiss franc was revalued. There was an attempt to reestablish fixed parities in the Smithsonian Agreement reached in December 1971, but the new parities could not be sustained.

15. The controls are described in Deutsche Bundesbank (1985) and Dooley and Isard (1980).

16. The sample means are statistically different from zero in all three periods. In the two non-control periods, however, the means are much smaller, although probably not small enough to be explained by transactions costs. The differentials may be attributable to differences in the risk characteristics of Euromark deposits and German interbank deposits. See the discussion of default risk in the dollar markets below.

17. The controls are described in the International Monetary Fund (1975).

18. At times the U.S. authorities have imposed reserve requirements on liabilities of U.S. banks to their foreign branches, but not on the dollar deposits of these branches. For a discussion of the effects of reserve requirements on relative interest rates, see Kreicher (1982).

19. Over the whole post control period, the average premium of CD rates over Treasury bill rates was 0.77 % with the 95 % band occurring at 2.14 %. Treasury bills are free of state and local income taxes, so even in the absence of default risk there would be a gap between TB and CD rates. With a marginal state and local tax rate of 5 percent and a CD rate of 10 percent, a gap of 0.50 percent can be attributed to taxes alone. See Cook (1986).

20. Even without the debt crisis, higher interest rates might have increased default risk on CDs because higher rates increase the risk of default on bank loans.

21. For a concise discussion of the peso problem, see Froot and Thaler (1990).

22. Market participants, for example, may use Bayesian methods to update their expectations as in Lewis (1989).

23. These differentials are calculated as follows (for the Eurosterling case):

$$\{\ln[(1+(I_{\$t}/400))(S_{£t+3}/S_{£t})] - \ln[1+(I_{£t}/400)]\} * 400,$$

so they are expressed in percent per annum.

24. The table does not report the bands within which 95 % of the observations lie since the width of these bands would primarily reflect the size of the forecast errors rather than risk premiums (or peso phenomena). Only by averaging the ex post interest differentials over long sample periods are we able to abstract from such forecast errors.

25. Euro-French franc rates are available from the OECD only beginning in January 1973. Over this period, the mean uncovered interest differential between the Eurodollar and Euro-FF is -0.40 % with a standard error of 2.97 %.

26. In the case of sterling, the period ends in July 1967 because the three month return beginning at the end of August overlaps with the November devaluation. The mark was floated on

September 28 and formally revalued on October 24, 1969, so the last observation is in May 1969 with the return defined over the May to August period.

27. The guilder was revalued by 4.7% in 1961 prior to the beginning of the sample period.

28. The last observation is in September 1971 because the return defined for that month spans the September to December 1971 period.

29. Fama (1984), for example, attributes much of the variance in forward market forecast errors to a time-varying risk premium.

30. Conditional estimates are provided in numerous studies including Bilson (1981), Cumby and Obstfeld (1984), and Fama (1984). Hodrick (1987) surveys this literature.

31. Frankel and MacArthur (1988) use a similar set of variables in their study of interest differentials in the 1982-86 period.

32.Each conditional mean, defined as

$$\alpha + \beta\bar{Z}_t$$

where $\bar{Z}_t$ is the average value of Z_t, is equal to the corresponding unconditional mean of Table 7 because of the properties of the least squares.

33. These results are consistent with most previous evidence based on regression analysis (such as the studies cited above).

34. Exchange risk premiums may also vary through time, although, as explained above, it is difficult to measure these premiums over short intervals. In a short sample period, the average forecast error need not be close to zero, so the average uncovered interest differential as measured by ϵ_{1t} in equation (4) may not reflect an exchange risk premium alone.

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TABLE 1
VOLATILITY OF CHANGES IN EXCHANGE RATES
Standard Errors of Percentage Changes (in %/annum)

	$/£ Rate 1961.04-1989.07	DM/$ Rate 1963.01-1989.07	Dfl/$ Rate 1962.01-1989.07	SF/$ Rate 1963.01-1989.07
Bretton Woods Period (to 1971.01)				
No of Obs.	118	97	109	97
Sample Mean	-1.46	-1.19	-0.05	-0.08
Sample SE	4.57	2.64	0.76	0.80
Flexible Rate Period (73.01-89.07)				
No of Obs.	199	199	199	199
Sample Mean	-2.60	-2.68	-2.04	-4.26
Sample SE	11.89	12.67	12.41	14.02

Sources: For the $/£ rate, Bank of England, Quarterly Bulletin; for other spot rates, International Monetary Fund, International Financial Statistics.

Notes: The percentage changes in exchange rates have been calculated over 3 month holding periods (since all interest rates used in the study are for 3 month maturities), then annualized.

TABLE 2
VOLATILITY OF EXCHANGE RATES AND INTEREST RATES
Standard Errors (In %/Annum) and Correlation Coefficients

Pound Sterling	Standard Error % Change $/£ Rate	Standard Error Euro-£ Interest Rate	Standard Error British Interest Rate	Correlation Between Interest Rates
Bretton Woods With Controls (61.04-71.01)	4.57	1.43	0.77	.898
Flexible Rates With Controls (73.01-79.06)	10.42	1.62	1.26	.921
Flexible Rates W/O Controls (79.07-89.07)	12.78	1.26	1.26	.998
DM	**Standard Error % Change DM/$ Rate**	**Standard Error Euro-DM Interest Rate**	**Standard Error German Interest Rate**	**Correlation Between Interest Rates**
Pre-Control (66.01-70.03)	3.52	0.94	0.92	.954
Control Period (70.04-74.01)	11.89	1.39	1.50	.583
Post-Control (74.02-89.07)	11.94	1.25	1.29	.994
Dollar		**Standard Error Euro-$ Interest Rate**	**Standard Error U.S. Interest Rate**	**Correlation Between Interest Rates**
Control Period (66.01-73.12)		0.67	0.92	.778
Post-Control (74.01-89.07)		1.55	1.70	.993

Sources: For exchange rates, see Table 1; for interest rates, see later tables.

TABLE 3

COVERED INTEREST DIFFERENTIALS IN THE $/£ MARKETS
In Percent Per Annum, 1961(4) - 1979(6)

	Euro-$/ British	Euro-£/ British	Euro-$/ Euro-£
Number of Obs.	219	219	219
Sample Mean	1.12	1.04	0.08
S.E. of Mean	0.18	0.17	0.02
t-Statistic	6.35*	6.17*	3.04*
Band for 95 % of Obser-vations	4.23	3.78	0.38

Source: Bank of England, Quarterly Bulletin, various issues.

Notes: The standard errors of the mean are calculated as if there were N/3 observations. The means marked with an asterisk (*) are statistically different from zero at the 5 % level. The British interest rate is the 3 month local authority deposit rate through 1971 and the sterling interbank deposit rate thereafter.

TABLE 4

INTEREST DIFFERENTIALS BETWEEN THE EURO-£ AND BRITISH MARKETS
Percent Per Annum, 1961(4) - 1989(7)

	Bretton Woods Period 1961(4)-1971(4)	Flexible Rates with Controls 1973(1)-1979(6)	Flexible Rates w/o Controls 1979(7)-1989(7)
No. of Obs.	121	78	121
Sample Mean	0.78	1.50	-0.03
SE of Mean	0.25	0.25	0.02
t-Stat.	3.17*	5.94*	-1.05
Band for 95% of Obs.	4.14	3.78	0.36
Positive Obs. % of Obs.	72.7%	93.6%	52.9%
Sample Mean	1.15	1.61	0.06

Source: Bank of England Quarterly Bulletin, various issues.

Notes: See Table 3.

TABLE 5

INTEREST DIFFERENTIALS BETWEEN EUROMARK AND GERMAN MARKETS
In Percent Per Annum, 1966(1) - 1989(7)

	Pre-Control (Bretton Woods) Period 1966(1)-1970(3)	Control Period 1970(4)-1974(1)	Flexible Rates w/o Controls 1974(2)-89(7)
No. of Obs.	51	46	186
Sample Mean	-0.40	-2.97	-0.23
SE of Mean	0.14	0.67	0.03
t-Stat.	-2.94*	-4.42*	-6.70*
Band for 95% of Obs.	1.11	8.89	0.79
Negative Obs.			
% of Obs.	82.4%	100.0%	86.6%
Sample Mean	-0.56	-2.97	-0.29

Sources: Euromark interest rate: OECD, Financial Statistics Monthly (Computer Diskette) for 1966-75, thereafter from Morgan Guaranty Trust, World Financial Markets; German interbank rate: MGT, WFM.

Notes: See Table 3.

TABLE 6

INTEREST DIFFERENTIALS BETWEEN THE EURODOLLAR AND U.S. MARKETS
In Percent Per Annum, 1966(1) - 1989(7)

	Control Period 1966(1)-1973(12)		Post-Control Period 1974(1)-89(7)
	Euro-$ / CD	Euro-$ / TB	Euro-$ / CD
Number of Obser.	96	96	187
Sample Mean	1.35	1.66	0.53
S.E. of Mean	0.20	0.15	0.06
t-Stat.	6.71*	10.85*	9.01*
Band for 95 % of Observations	4.17	3.16	1.50
Positive Obs.			
% of Obs.	100.0 %	100.0 %	98.4 %
Sample Mean	1.35	1.66	0.54

Source: Morgan Guaranty Trust, World Financial Markets, various issues.

TABLE 7
UNCOVERED INTEREST DIFFERENTIALS BETWEEN THE EURO MARKETS
Eurodollar Rate Minus Other Eurocurrency Rates
In Percent Per Annum, Various Periods

	Bretton Woods Period	Flexible Rates Period	Post Bretton Woods Period	Whole Sample
Eurosterling	61(4)-71(1)	73(1)-89(7)	71(5)-89(7)	61(4)-89(7)
No of Obs.	118	199	219	340
Mean	-0.15	0.10	-0.07	-0.12
SE of Mean	1.51	3.05	2.82	1.89
t-Statistic	-0.10	0.03	-0.03	-0.07
Euromark	63(1)-71(1)	73(1)-89(7)	71(5)-89(7)	63(1)-89(7)
No of Obs.	97	199	219	319
Mean	-0.01	0.85	0.01	-0.13
SE of Mean	0.84	3.16	2.93	2.03
t-Statistic	-0.01	0.27	0.00	-0.07
Euroguilder	62(1)-71(1)	73(1)-89(7)	71(5)-89(7)	62(1)-89(7)
No of Obs.	109	199	219	331
Mean	0.62	0.43	-0.35	-0.06
SE of Mean	0.29	3.14	2.91	1.93
t-Statistic	2.15*	0.14	-0.12	-0.03
Euro-SF	63(1)-71(1)	73(1)-89(7)	71(5)-89(7)	63(1)-89(7)
No of Obs.	97	199	219	319
Mean	1.03	0.83	-0.07	0.10
SE of Mean	0.27	3.56	3.33	2.29
t-Statistic	3.79*	0.23	-0.02	0.04

Sources: for Eurodollar/Eurosterling comparisons, Bank of England, Quarterly Bulletin; for other Eurocurrency comparisons, OECD, Financial Statistics Monthly (interest rates until 1976), Morgan Guaranty Trust, World Financial Markets (interest rates from 1976 on), IMF, International Financial Statistics (for exchange rates).

Notes: The Bretton Woods sample period ends in January 1971 since the three month (ex post) return beginning in January spans the three months ending in April 1971. Differentials marked with an asterisk (*) are statistically different from zero at the five percent level.

TABLE 8
UNCOVERED INTEREST DIFFERENTIALS UNDER BRETTON WOODS
SAMPLE PERIODS INCLUDING AND EXCLUDING CHANGES IN PARITIES

	Eurodollar-Eurosterling		Eurodollar-Euromark	
	Bretton Woods Period 61(4)-71(1)	Prior to 1967 Devaluation of £ 61(4)-67(7)	Bretton Woods Period 63(1)-71(1)	Prior to 1969 Revaluation 63(1)-69(5)
Number of Obs	118	76	97	77
Mean	-0.15	-1.20	-0.01	1.14
SE of Mean	1.51	0.32	0.84	0.44
t-Statistic	-0.10	-3.69*	-0.01	2.60*

Sources: same as Table 7.

Notes: The devaluation of sterling occurred in November 1967, so the three month return from the end of August to the end of November 1967 reflects the devaluation of sterling. Accordingly, the sample period excluding the devaluation ends in July 1967. The mark was revalued in October 1969, but it was floated on September 28, so the last observation is in May 1969.

TABLE 9
UNCOVERED INTEREST DIFFERENTIALS
BRETTON WOODS PERIOD THROUGH SMITHSONIAN AGREEMENT

	Eurodollar-Euroguilder		Eurodollar-EuroSF	
	Bretton Woods Period 62(1)-71(1)	Through Smithsonian 62(1)-71(9)	Bretton Woods Period 63(1)-71(1)	Through Smithsonian 63(1)-71(9)
Number of Obs	109	117	97	105
Mean	0.62	-0.14	1.03	0.22
SE of Mean	0.29	0.60	0.27	0.66
t-Statistic	2.15*	-0.24	3.79*	0.34

Sources: same as Table 7.

Notes: The Smithsonian Agreement was signed in December 1971, so the last observation is the three month return spanning the period from September to December 1971.

TABLE 10
UNCONDITIONAL AND CONDITIONAL ESTIMATES
OF UNCOVERED DIFFERENTIALS
Euro-$ Rate Minus Other Eurocurrency Rates in %/Annum

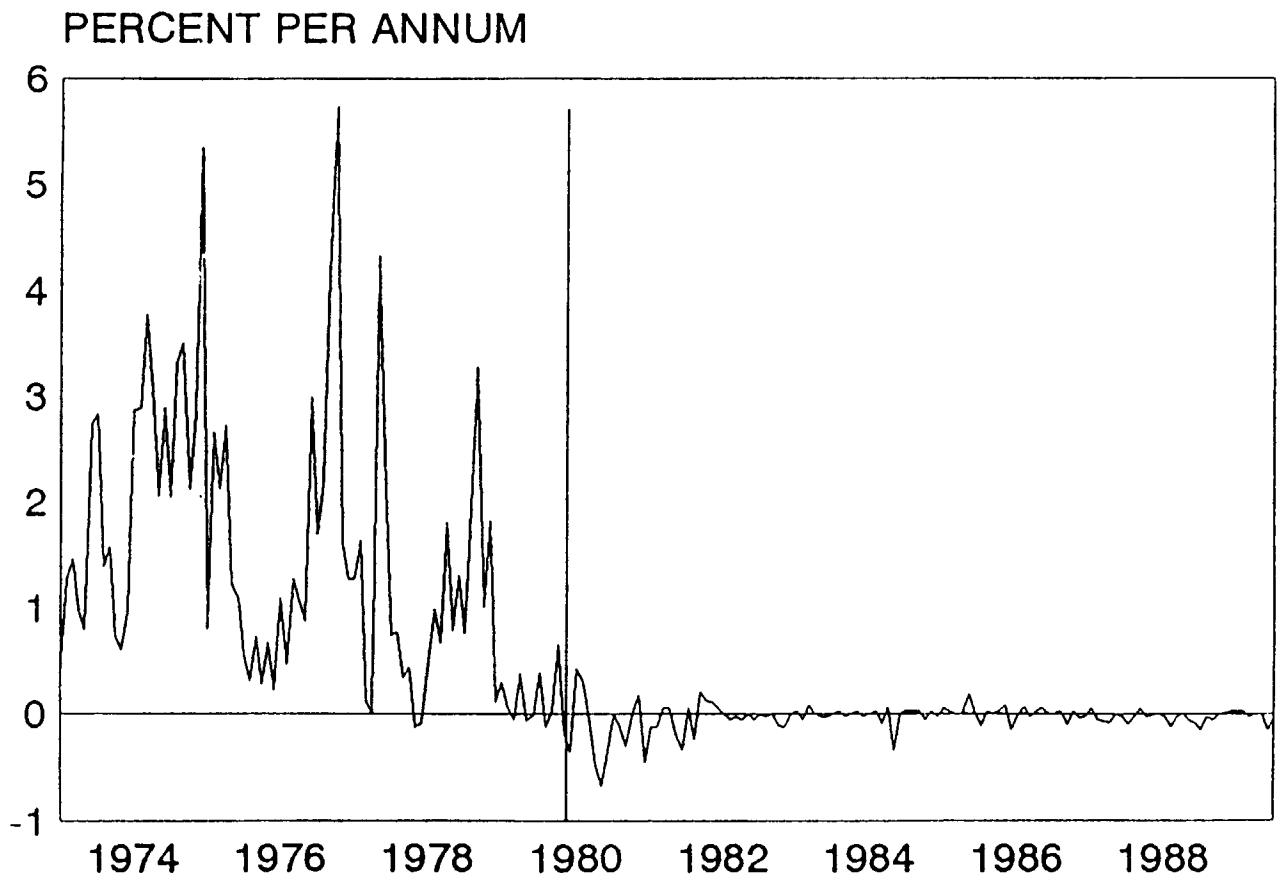
	Mean of Conditional Estimate	F-Stat for Conditional Estimate	SE of (Uncondit.) Uncovered Interest Differential	SE of Residual from Conditional Estimate
71.5-89.7				
Euro-£	-0.07	4.20	12.05	11.08
Euromark	0.01	1.92	12.51	12.02
Euro-Dfl	-0.35	3.15	12.42	11.65
Euro-SF	-0.07	4.21	14.20	13.06
73.1-89.7				
Euro-£	0.10	4.28	12.40	11.28
Euromark	0.85	1.52	12.83	12.39
Euro-Dfl	0.43	2.78	12.75	11.97
Euro-SF	0.83	3.35	14.47	13.42

Sources: same as Table 7.

Notes: The standard error of the residual is obtained from a regression of the uncovered interest differential on variables in the current information set (as described in the text). The F-statistic tests the restriction that all coefficients are equal to zero. The standard errors and F-statistics have been adjusted for overlapping observations.

FIGURE 1: EUROSTERLING/BRITISH INTEREST DIFFERENTIALS

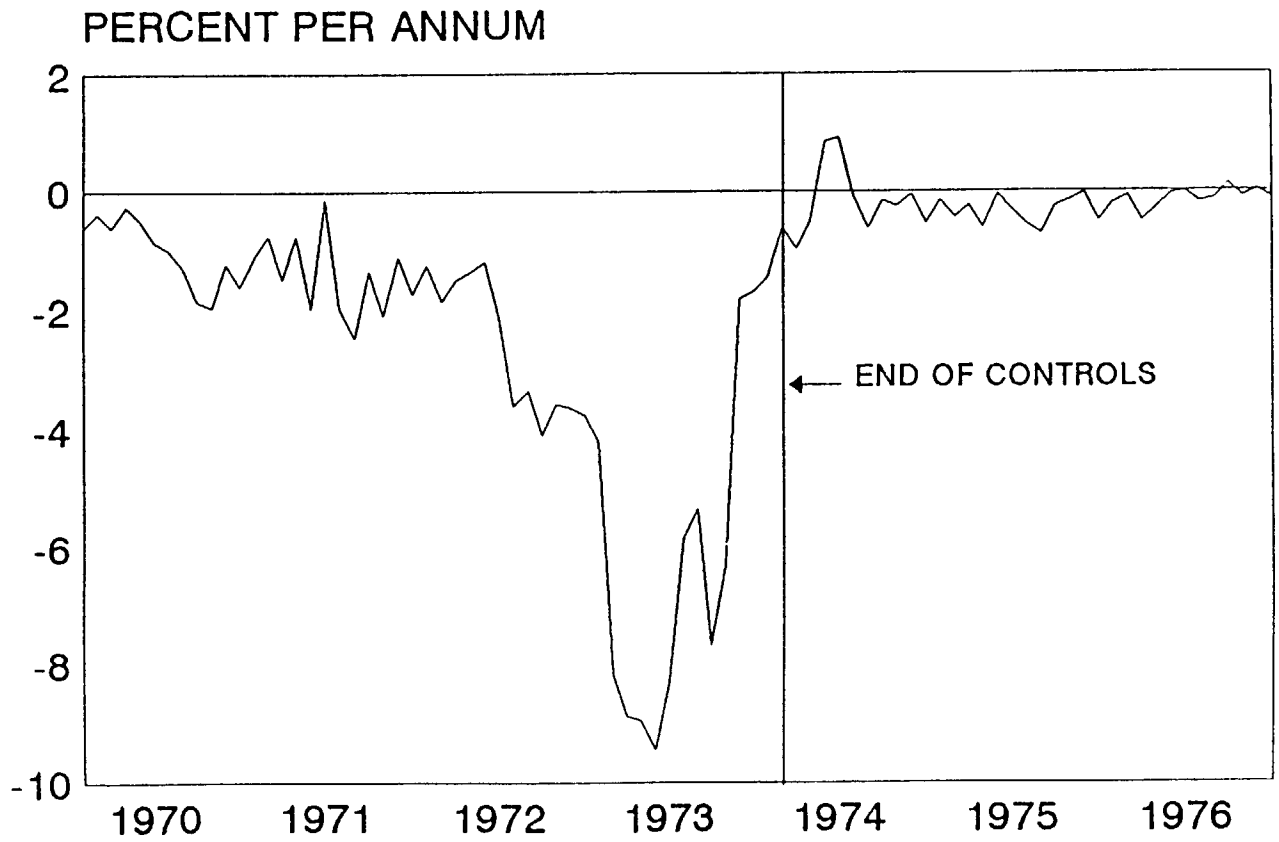
FLEXIBLE RATE PERIOD, 1973(1)-1989(7)



SOURCE: BANK OF ENGLAND QUARTERLY BULLETIN

FIGURE 2: EURO-DM/GERMAN DIFFERENTIALS

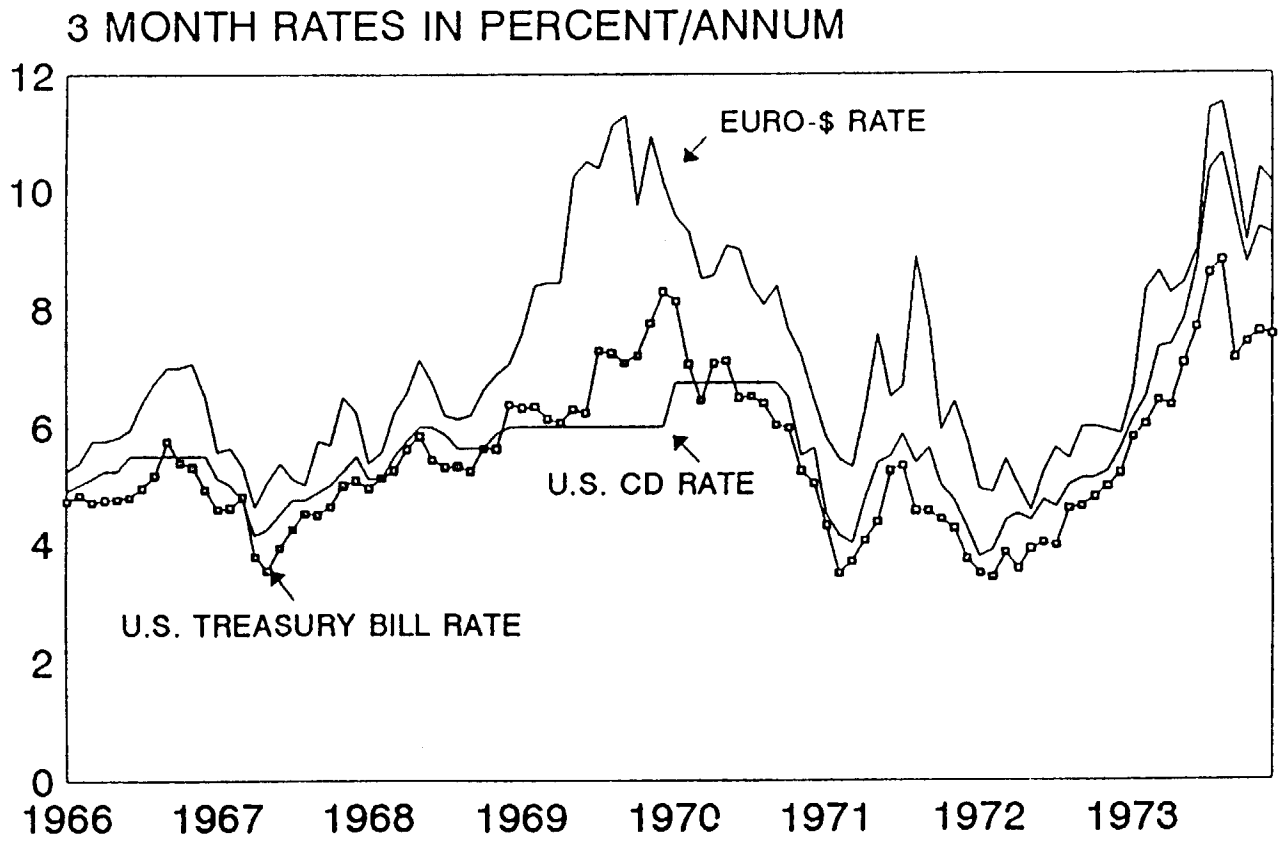
1970(1)-1976(12)



SOURCES: MORGAN GUARANTY AND OECD

FIGURE 3: EURO-$ AND U.S. INTEREST RATES

PERIOD OF CONTROLS, 1966(1)-1973(12)



SOURCE: MORGAN GUARANTY TRUST