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Determinants of Short-Term Real Interest Differentials between Japan and the United States

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Many past studies of relative financing costs in the United States and Japan have relied on interest rates from the 1970s and earlier when Japanese financial markets were subject to numerous regulations and controls and were shielded by capital controls from financial markets abroad. Interest rates on bank loans, the most important source of financing in Japan, in fact, systematically underestimated the true costs of borrowing. In the United States, capital controls were being dismantled by the early 1970s, but the prime loan rate used in past studies had by then become an unreliable measure of the true cost of borrowing in the United States.

This study shows that most of the reported gap in short term financing costs between the two countries can be traced to past features of the national markets which have largely disappeared. Now that markets have been deregulated and international capital flows liberalized, national interest rates are closely related to those in the unregulated Eurocurrency markets. And, as this study shows, average real interest differentials in the Eurocurrency markets have been close to zero over the last twenty years.

I. Introduction

In the past decade, there have been numerous studies of the relative costs of financing in the United States and Japan. Most of these studies have based their analysis on evidence from the 1970s and earlier when financial markets were subject to numerous regulations and controls. Japanese interest rates, in particular, were governed by market conventions and regulations which often obscured the true cost of funds. And they were partially shielded from international influences by a network of capital controls which inhibited both inflows and outflows of funds from abroad. By 1973 when this study begins, American capital controls were being dismantled and regulations on interest rates were being lifted, but conventions in the American bank loan market were rapidly

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changing so as to make problematical comparisons between borrowing costs in the two countries.

This study estimates how much of the gap between short term financing costs in the two countries can be attributed to distortions in the national markets. It does this by examining interest rate distortions between regulated and unregulated national markets and by comparing national financing costs with costs in the unregulated Eurocurrency markets.

Past studies have provided a range of estimates of relative financing costs in the United States and Japan. For example, Friend and Tokutsu (1987) found that between 1970 and 1984 Japanese real interest rates, weighted between short and long term instruments, were 1.7 % below those in the United States. Hatsopoulos and Brooks (1987) found that over a similar period long term real interest rates were 1 % lower in Japan. On the other hand, Bernheim and Shoven (1987) found that between 1971 and 1982 Japanese short term real rates were about 2.8 % lower than in the United States. Some studies of the relative costs of equity as opposed to debt financing have found even larger gaps between costs in the two countries, no doubt in large part because of the large run-up of Japanese equity prices in the 1980s.[1]

Past studies of relative financing costs have examined financing with both bonds and bank loans, but this study will focus on bank loan financing alone for two reasons. First, the effects of market distortions and capital controls can be assessed more accurately in the bank loan market because there is a reliable benchmark for comparisons in the unregulated Eurocurrency market. Second, and more importantly, the Japanese firms who have allegedly benefited from low real interest rates borrow predominantly from the bank loan market rather than from the domestic or international bond markets.

The second point about loan financing perhaps needs to be confirmed with evidence since bond financing in Japan has received so much attention recently. Table 1 shows clearly that bank loans continue to represent the most important source of external finance for Japanese firms. The table reports a breakdown of external funding by Japanese corporations for three periods beginning in 1973. During the 1973 – 80 period, less than 9 % of financing was obtained from securities markets through the issue of bonds or equity. The remainder of the financing took the form of trade credits or bank loans. By the 1981 – 85 period, financing through the securities market had risen to 13.7 %, while by 1986 – 89 that financing had risen to 24.6 %. But even during that last four year period, bank loans provided 53.6 % of total external financing compared with 16.0 % from the bond and commercial paper markets combined.

[1] Such studies have based their estimates of equity financing costs on the earnings-price ratios which declined dramatically in Japan in the 1980s, at least until the collapse of equity prices in 1990.

Table 1
Sources of Funding by Japanese Corporations (%)

	1973 - 80	1981 - 85	1986 - 89
Securities: Total	8.8	13.7	24.6
Domestic Bonds	3.2	2.5	3.2
Foreign Bonds	0.8	4.9	7.8
Commercial Paper			5.0
Stocks	4.8	6.4	8.7
Loans and Trade Credits: Total	91.8	83.9	71.8
Loans	55.8	72.7	53.6
Trade Credits	36.0	11.1	18.3
Other	−0.5	2.4	3.5

Source: Flow of Funds Accounts in Bank of Japan, *Economics Statistics Annual*, various issues.
Note: The columns do not add to 100 % because of rounding errors.

II. Determinants of Relative Financing Costs

The study begins by examining the principal determinants of real interest differentials between the two countries. The cost of financing in any country can be unambiguously defined if we consider a domestic firm financing in its own market and selling products in that market. Suppose that a Japanese firm's primary source of funding is from bank loans with a (continuously compounded) interest rate of i_{JLt} and that the expected inflation rate in Japan is π_{Jt} where

$i_{JLt} = \ln(1 + I_{JLt})$, where I_{JLt} is the (simple) Japanese loan rate, and
$\pi_{Jt} = E_t[\ln(P_{Jt+1}/P_J)]$, where P_{Jt} is the price level in Japan.

Then the real cost of borrowing can be defined as $i_{JLt} - \pi_{Jt}$. Similarly, American firms face a real cost of borrowing of $i_{ALt} - \pi_{At}$. Under certain conditions, namely if uncovered interest parity (UIP) and purchasing power parity (PPP) both hold, these two real borrowing costs are the same:

$$(i_{ALt} - \pi_{At}) = (i_{JLt} - \pi_{Jt}). \tag{1}$$

In that case, then "real interest parity (RIP)" is said to hold.[2]

Some observers believe that RIP should hold as long as financial markets are free of any controls or distortions. But RIP involves comparing borrowing costs for two distinct sets of firms who measure nominal interest costs in two different currencies and real costs

[2]Studies of RIP include Cumby and Obstfeld (1984), Frankel and MacArthur (1988), and Mishkin (1984).

by deflating by two different inflation rates. As will be made clear below, if real interest rates favor one set of firms over another, there is no simple arbitrage transaction that will eliminate the real interest differential.

There are four distinct factors which affect relative borrowing costs between American and Japanese firms. Two of these factors are associated with government regulations and market conventions which are likely to be of far less importance in the current era of deregulated markets than they were in the last twenty years. But two other factors are characteristic of completely deregulated markets, and therefore may persist in the future. We will describe each of these factors as they affected real borrowing costs in the last two decades.

Domestic distortions

In both national markets, there were often large differentials between bank loan rates charged to firms and money market rates offered for large scale, short term investments (which we denote i_{AMt}, i_{JMt}). The resulting differential

$$U_{1t} = (i_{ALt} - i_{AMt}) - (i_{JLt} - i_{JMt}) , \qquad (2)$$

is a measure of the impact of these distortions on real interest rates. In the next section, the specific nature of these distortions will be discussed in detail.

National capital controls

There were also capital controls separating the national markets from the Eurocurrency markets abroad, although by the end of 1973 the United States had lifted its controls. The impact of the controls can be measured by comparing American with Eurodollar interest rates and Japanese with Euroyen interest rates. The resulting differential,

$$U_{2t} = (i_{AMt} - i_{\$t}) - (i_{JMt} - i_{¥t}) , \qquad (3)$$

can be positive or negative depending upon how the controls were designed.

Deviations from uncovered interest parity

The third source of differentials in real borrowing costs is the differential in the expected nominal cost of financing in a *common currency*,

$$U_{3t} = i_{\$t} + x_{¥t} - i_{¥t} , \qquad (4a)$$

where $x_{¥t} = E_t[\ln(S_{¥t+1}/S_{¥t})]$ is the expected depreciation of the yen and where $S_{¥t}$ is the yen price of the dollar. If UIP holds, then this differential in the nominal costs of financing is equal to zero.

Notice that this nominal differential can be written in real terms as follows:

$$U_{3t} = (i_{\$t} + x_{¥t} - \pi_{Jt}) - (i_{¥t} - \pi_{Jt})\,. \tag{4b}$$

This differential compares the real borrowing costs of a Japanese firm in the Eurodollar market with the real borrowing costs of that same firm in the Euroyen market.[3] It is this real interest differential, rather than one involving both countries' inflation rates, which can be eliminated by market forces as firms shift financing to the cheaper source.

Expected deviations from purchasing power parity

The final factor causing relative interest differentials between the two countries is the expected deviation of inflation rates from PPP:

$$U_{4t} = \pi_{At} + x_{¥t} - \pi_{Jt}\,. \tag{5}$$

Notice that what matters is the expected inflation rate and expected rate of depreciation of the yen over the upcoming period, not the level of prices and exchange rates this period.

The four factors together account for any gap between real lending rates in the two countries, since

$$(i_{ALt} - \pi_{At}) - (i_{JLt} - \pi_{Jt}) = U_{1t} + U_{2t} + U_{3t} - U_{4t}\,. \tag{6}$$

The following sections investigate these factors in detail.

III. Domestic Distortions

In this section, interest rates on Japanese bank loans are compared with other money market rates in Japan, while a similar comparison is made for American bank loans. In each case, the objective is to determine whether distortions in the domestic loan market may account for some of the differential in real loan rates between the two countries.

A. The Japanese Domestic Market

To measure the cost of financing in Japan, it is important to obtain a reliable measure of the cost of bank loans. The Bank of Japan and OECD both report a prime lending rate series for Japanese banks. Prior to 1989, this rate was called the "standard rate" defined as the rate on loans of "especially high credit standing." The standard rate was tied through informal guidelines to the Bank of Japan's discount rate.[4] In January 1989, banks switched to what is formally called a "prime rate" which is a market-oriented

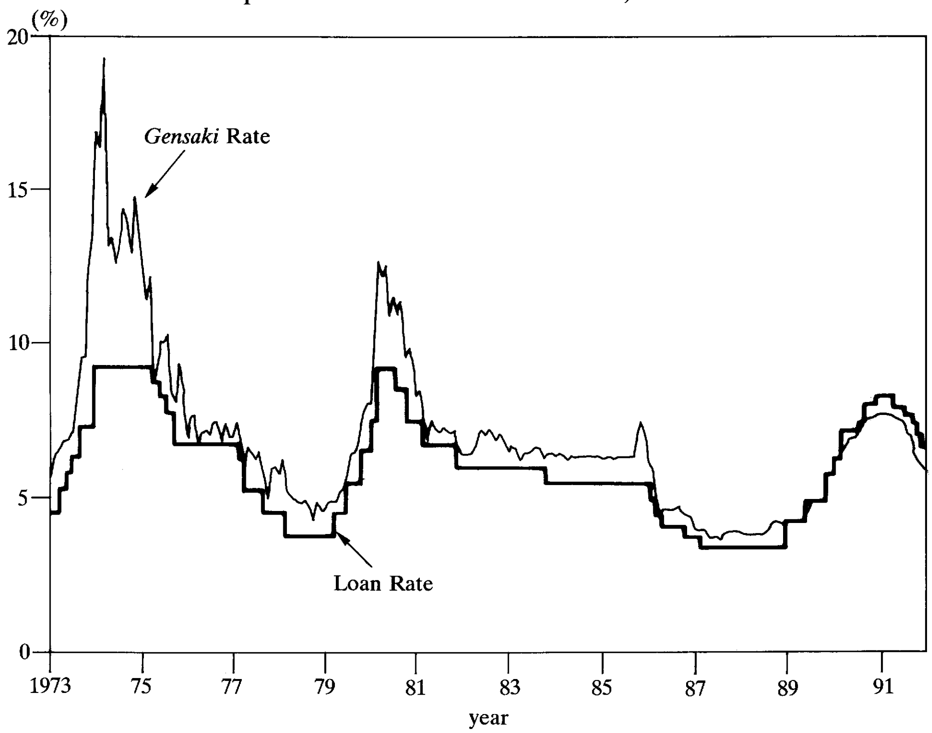
[3]Equation (4a) could also be written in real terms using American inflation rates, in which case the comparison would be from the American firm's perspective.

[4]The Federation of Bankers Association of Japan changed this rate every time there was a change in the discount rate. For most of the 1970s it stayed at 0.25 % above the discount rate, while for most of the 1980s it was 0.50 % above that rate. *See* Suzuki (1987, p. 145).

rate tied more closely to the banks' cost of funds than to the discount rate.

Because prior to 1989 the prime rate was tied by convention to the discount rate, abrupt changes in monetary conditions often left the loan rate in disequilibrium.[5] This would be easy to show if bank deposit rates were set by market forces, but these latter rates were also tied to the discount rate. For most of the 1970s, in fact, the only short term rate free to reflect current monetary conditions[6] was the *gensaki* rate, the interest rate on repurchase agreements.[7] Figure 1 compares the *gensaki* rate with the prime rate. It is evident from this figure that the loan rate responded only sluggishly to market conditions as represented by the *gensaki* rate. In fact, the correlation between changes in

Figure 1
Japanese Loan and *Gensaki* Rates, 1973-91



[5]For studies of credit rationing and disequilibrium in the Japanese loan market, *see* Ito and Ueda (1981) and Hamada *et al.* (1977).

[6]A market for certificates of deposit (*i.e.* bank deposits that are negotiable) was not instituted until 1979, and even that market was limited to large deposits (over ¥ 500 million) and specific maturities (three to six months). Since April 1985 when most restrictions were lifted, the CD market has begun to surpass the *gensaki* market in importance.

[7]In a typical transaction, a securities firm will agree to sell a government bond to a corporation and repurchase it at an agreed upon price at a later date. As Suzuki (1987, p. 118) explains, this is equivalent to a corporation lending short term funds to the securities firm.

the two rates was only 0.377 over the sample period.

Figure 1 also shows that the *gensaki* rate was systematically higher than the prime rate. Over the period as a whole, the loan rate had a mean of 5.96 % while the *gensaki* rate had a mean of 6.99 %, more than 1 % higher.[8] This points to a serious drawback in using the loan series. The cost of Japanese loans is generally higher than the rate quoted because most companies maintain "compensating balances" during the period of the loan.[9] Interest is paid on those compensating balances (because they are typically held in short term time deposits), but the interest rate is always below that paid on the loans themselves. If i_{Lt}' is the contractual loan rate, i_{Dt} is the deposit rate, and b_t is the ratio of compensating balances to loans, then the *effective* loan rate, i_{Lt}, is given by:

$$i_{Lt} = \frac{i_{Lt}' - i_{Dt} * b_t}{1 - b_t} \,. \tag{7}$$

By requiring compensating balances, banks can raise the effective cost of a loan even in the presence of interest rate ceilings on loan rates.

To obtain an estimate of compensating balances, we rely on a survey of small to medium size companies conducted by the Japanese Fair Trade Commission.[10] This survey gives the ratio of compensating balances to loans for most years of the sample period (as shown in Table 2). The survey also gives the ratio of *total* deposits to loans by these same firms. In evaluating the profitability of loans, banks may take into account the total deposits of firms rather than just those deposits reported (by the firms) as compensating balances. So two measures of compensating balances are developed corresponding to reported compensating balances and total bank deposits. Monthly series for these measures are obtained by interpolating the annual data in Table 2.

In examining the data, it is useful to consider what biases may be present in these measures of compensating balances. The second measure based on total deposits undoubtedly overstates the true measure because it includes transactions accounts which firms would have to maintain even in the absence of bank loans. On the other hand, both measures may be regarded as overestimates to the extent that larger firms hold a smaller proportion of compensating balances than the small and medium size firms in the survey.[11] Without further information on compensating balances, it is not possible to reach a definitive judgement on which measure is preferable. Most likely the best

[8]Since the *gensaki* repurchase contracts are collateralized, there is no reason to believe that the 1 % differential is a default risk premium.

[9]For a recent study of the Japanese loan market which examines the link between loans and compensating balances, *see* Bank of Japan (1991).

[10]Japan Fair Trade Commission, *Survey of Compensating Balances*, 1991. Firms in this survey have capitalization less than ¥ 100 million.

[11]Large companies presumably have higher credit standing on average than smaller companies and therefore are not required to maintain the same ratio of compensating balances.

Table 2
Compensating Balances at Japanese Banks (%)

Year	Ratio of Compensating Balances to Loans	Ratio of Total Deposits to Loans
1973	17.6	41.7
1976	16.8	39.2
1978	10.3	35.9
1979	9.6	36.8
1980	10.9	38.9
1981	9.2	35.9
1982	9.1	41.2
1983	8.7	36.8
1984	8.2	37.1
1985	7.4	34.1
1986	7.1	33.8
1987	6.0	35.0
1988	5.4	35.1
1989	6.0	31.8
1990	4.8	31.8
1991	4.5	28.6

Source: Japan Fair Trade Commission, *Survey of Compensating Balances*, 1991.

measure of compensating balances lies somewhere in between our two measures.

How much difference the compensating balances make to loan costs may be judged by considering a particular example. In January 1974 when loan rates hit a peak of 9.25 %, firms received 5.75 % on compensating balances held in the form of time deposits. If the ratio of compensating balances to loans is used to adjust the loan rate, then the "*effective*" (*i.e.*, adjusted) loan rate is 10.10 % or 0.85 % above the unadjusted loan rate. If the ratio of total deposits to loans is used instead, then the effective loan rate is 12.05 % or 2.80 % above the unadjusted loan rate.

Figure 2 shows the two adjusted loan series formed by adjusting the prime loan rate by the ratio of compensating balances to loans and by the ratio of total deposits to loans. Once the two loan series are adjusted, the loan and *gensaki* rates move closer together. But at times even the loan rate series adjusted by total deposits falls below the *gensaki* rate. In 1974-75, the differential between *gensaki* and loan rates is especially large.

Table 3 compares the prime loan rates adjusted by the two methods with the *gensaki* rate. The sample period is divided between the 1970s and 1980s to show whether the behavior of loan rates changed in the 1980s. For each sample period, the mean of the interest differential between the loan rate and the *gensaki* rate is reported as well as the

Figure 2

Japanese Loan and *Gensaki* Rates

Adjusted for Compensating Balances

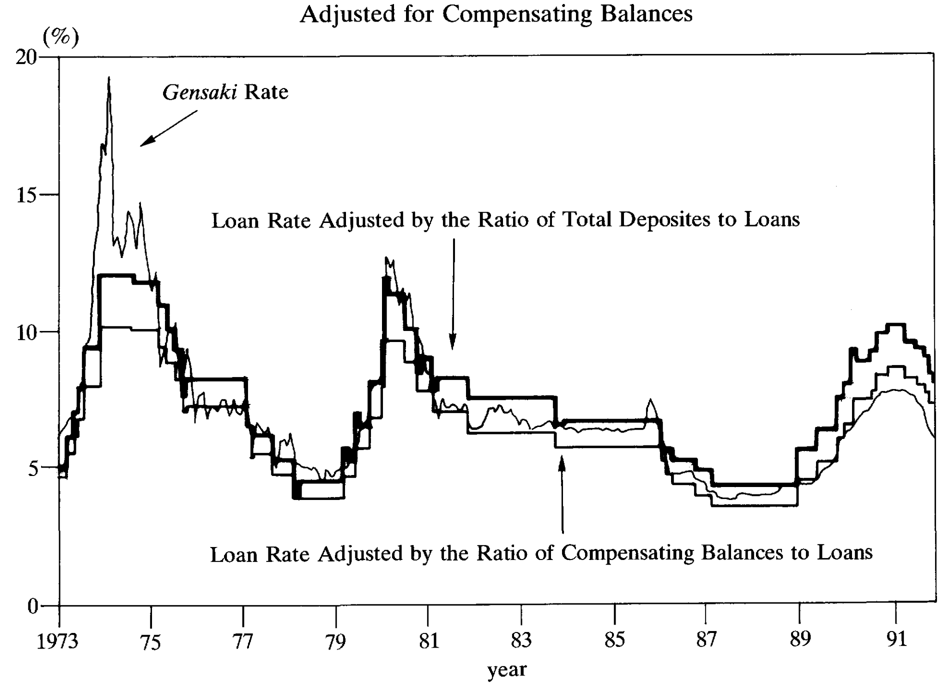


Table 3

Interest Differentials between Japanese Loan and *Gensaki* Rates, 1973.1 – 1991.11

	Unadjusted Prime Rate - *Gensaki*	Adjusted by Compensating Balance Ratio	Adjusted by Total Deposit / Loan Ratio
1973.1 - 1980.12			
Number of Observations	96	96	96
Sample Mean	−1.87*	−1.48*	−0.43
Standard Error of Mean	0.30	0.28	0.24
t-Statistic	−6.16	−5.30	−1.78
1981.1 - 1991.11			
Number of Observations	131	131	131
Sample Mean	−0.40*	−0.23*	0.83*
Standard Error of Mean	0.08	0.08	0.11
t-Statistic	−5.03	−2.86	7.75

Source: *See* the data appendix.

Notes: The standard errors of the means are calculated as if there were $N/3$ observations. The means marked with an asterisk (*) are statistically different from zero at the 5 % level.

standard error of this mean and its t-statistic.[12] During the 1970s, the loan rate is on average almost 2 % below the *gensaki* rate. This differential is reduced when the cost of compensating balances is taken into account, but not even the adjustment by total deposits is sufficient to raise the effective loan rate as high as the *gensaki* rate. During the 1980s, the unadjusted loan rate as well as the smaller of the adjusted measures is still on average below the *gensaki* rate, although the loan rate adjusted by total deposits is now 0.83 % above the *gensaki* rate.

What conclusions can be drawn from this analysis? First, it is obvious that it is very difficult to obtain an accurate measure of the loan rate prior to the late 1980s. Without better information about compensating balances, the adjusted loan rates must be regarded as only rough estimates of the true costs of the loans. Second, even if we had reliable estimates of the true cost of loans in the regulated environment of the 1970s and early 1980s, these estimates would not tell us what the cost of funds would have been in a *deregulated* environment where loan rates were freely determined by competitive market conditions. The recent deregulation of Japanese markets makes evidence from previous decades largely irrelevant to present conditions.

B. The U.S. Domestic Loan Market

Obtaining a reliable measure of the cost of bank loans in the United States is also difficult, but in this case it is because the meaning of the prime rate itself has changed fundamentally. As firms have obtained greater access to direct financing from the commercial paper market as well as from the Eurodollar market abroad, banks increasingly have lent at rates *below* prime rate to their prime customers. So the prime rate no longer reflects the true cost of funds to prime borrowers.

Consider the relationship between the prime rate and the certificate of deposit (or CD) rate which is the rate paid by banks on large scale, negotiable deposits. Unlike the comparison between *gensaki* and Japanese loan rates, this interest rate comparison offers a direct measure of the margin between the deposit and loan rates. Figure 3 shows the time series for these rates, while Table 4 reports the mean differential for the 1973.1 – 1991.3 period. If the prime rate were a true measure of the cost of bank loans (to the highest-rated firms), then bank lending would be profitable indeed, since the average differential over the period is 1.64 %.

Banks were forced to lend below prime because of competition from other sources of funds. To indicate how severe that competition could be, consider the comparison between the interest rate on prime industrial paper and the prime loan rate. Prime industrial paper is issued by firms with high credit ratings, many of whom would qualify for prime borrowing rates. Table 4 estimates the average gap between the prime rate and

[12]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 three month rates in their study of real interest differntials.

Figure 3
U.S. Bank Loan and CD Rates, 1973-91

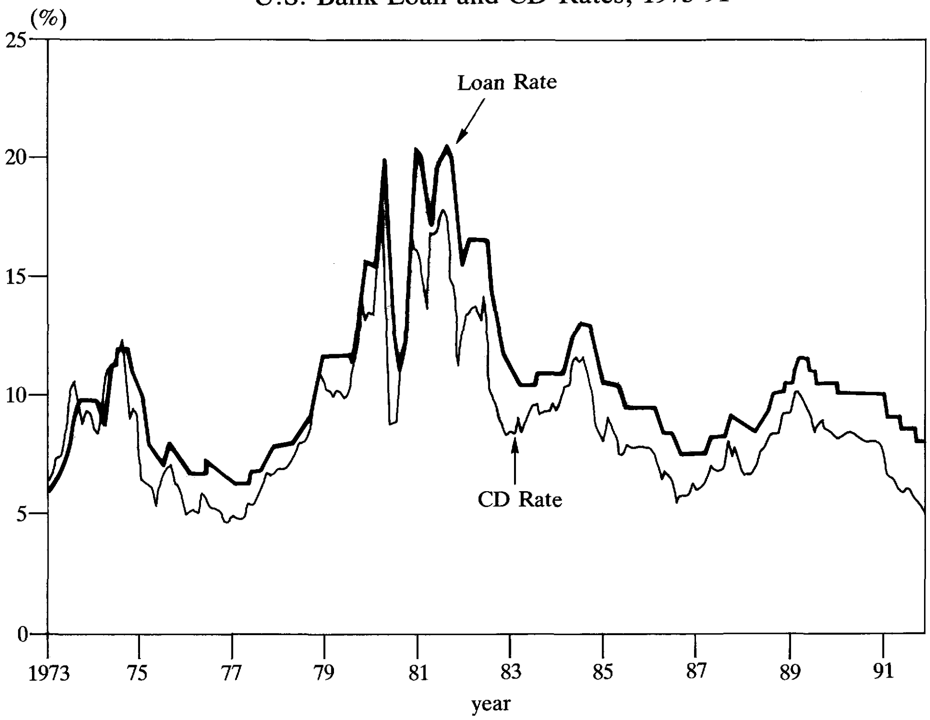


Table 4
Interest Differentials between U.S. Loan and Other Money Market Rates, 1973.1 - 1991.3

	Loan - CD Rate	Loan - Industrial Paper Rate
Number of Observations	227	227
Sample Mean	1.64	1.57
Standard Error of Mean	0.14	0.14
t-Statistic	11.40	11.14

the industrial paper rate as 1.57 %. With such a huge gap, firms (at least those with access to this alternative market) could extract much lower loan rates from banks.

The practice of lending below prime rate has become so routine that the Federal Reserve has begun reporting statistics for loans "made below prime" in its *Survey of Terms of Bank Lending*. Wolfson and McLaughlin (1989) have compiled statistics from this publication which summarize loan behavior between 1984 and 1988. According to these authors, between 67.7 % and 85.2 % of total loans were made at loan rates below prime rate. Many overnight and other very short term loans are tied to the federal funds rate, so it is more instructive to look at loans with a maturity greater than one month. Of these loans, between 43.3 % and 57.9 % were made at rates below prime.

Thus the "prime rate" has ceased to have its original literal meaning of loans to "prime" customers. A court case against the First National Bank of Atlanta has even forced banks to be careful in how they describe the prime rate in loan documents. In 1981 a class action suit was brought against First Atlanta by some of its loan customers charging that it had overcharged prime-based borrowers by tying their loan rates to the prime rate rather than the below market rate offered to First Atlanta's prime customers. As a result, many banks now refer to the prime rate simply as a "reference rate."

It is interesting to compare the biases caused by market conventions and regulations in the two national markets. In the Japanese market, loan rates seriously underestimate the true costs of borrowing because they omit the cost of compensating balances. As we have seen, they also underestimate the marginal cost of funds in the unregulated *gensaki* market, although most firms did not have direct access to this market. Like the Japanese series, the series for the American loan rate is an unreliable measure of the true cost of funding. But in contrast to the Japanese series, the American series overestimates the true cost of funding, at least for prime customers. The biases involved in estimating the costs of bank loans in the Japanese and U.S. markets both lead to *overestimation* of the real interest differential faced by U.S. relative to Japanese firms.

IV. Capital Controls

Domestic regulations and market conventions would soon break down in the absence of capital controls limiting the access of domestic firms to external financing or the access of domestic investors to markets abroad. 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.[13] Alternatively, governments may restrict non-resident purchases of

[13]For previous treatments of capital controls, *see* Dooley and Isard (1980) and Marston (1992). The latter study examines capital controls in three countries during the Bretton Woods period.

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.

A. Japanese Controls

The Japanese government maintained a system of capital controls throughout most of the 1970s. In general, both inflows and outflows of funds were restricted by the controls, but the regulations varied in intensity and effect.[14] From November 1973 to June 1974, for example, controls on the *outward* flows of funds from Japan were tightened considerably. During this period of the first oil shock, residents were prohibited from holding short term foreign government securities, and were restricted in their holding of foreign currency. As a result, the normally positive forward premium on the yen became a forward discount which at one point reached 28 % per annum. With arbitrage between Japan and the external markets curtailed, the Euroyen rate rose far above Japanese interest rates. Between June 1977 and January 1979, in contrast, the controls were generally binding in the opposite direction, limiting inflows of funds to Japan. So during this period, Japanese interest rates exceeded the Euroyen rate by as much as 5 %.

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. So it was not surprising that covered interest parity (CIP) always held between any pair of Eurocurrency deposit rates.

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

$$i_{¥t} = i_{\$t} + f_{¥t}, \tag{8}$$

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 Euroyen 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 Japanese interest rate (i_{Jt}), in contrast, a covered differential could reflect the effects of capital controls. Since covered interest parity always holds for the Eurocurrency markets, we may measure the deviation of

[14] Previous studies of Japanese capital controls include Frankel (1984), Horne (1985), Ito (1986), and Otani and Tiwari (1981). This section draws particularly on Ito's discussion of interest rate behavior in the 1970s and on Horne's chronology of control regulations.

Japanese rates from covered interest parity in two ways using the Eurodollar rate and the forward premium or the Euroyen rate alone.

$$i_{\$t} + f_{¥t} - i_{Jt} = V_{1t}. \quad (9a)$$

$$i_{¥t} - i_{Jt} = V_{2t}. \quad (9b)$$

The first equation measures V_{1t}, the deviation between the covered Eurodollar rate and the Japanese interest rate. The second equation measures V_{2t}, the deviation between the Euroyen rate and the Japanese interest rate.

The study of Japanese capital controls is hampered by the lack of adequate data for both the Japanese and Euroyen markets.[15] As discussed above, in the 1970s most Japanese interest rates were insensitive to market conditions. Bank deposit rates, for example, were set by banking regulations, while loan rates were tied informally to the discount rate. One important exception was the *gensaki* rate, the interest rate paid on repurchase agreements, which fluctuated freely in response to market conditions. The *gensaki* market was rather thin until at least 1975. Indeed, most published sources begin quoting *gensaki* rates only in the mid-1970s or later. The series we will employ is an unpublished series provided by the Bank of Japan.

Interest rates for the Euroyen market are available only beginning in January 1975 from published sources. Banks quoted Euroyen rates in the early 1970s, but the market was much smaller than the Euromark or Eurosterling markets which were established in the early 1960s. Prior to 1975, the only way to obtain Euroyen rates is to use the same CIP condition which banks use to generate Eurocurrency quotes. The resulting series as shown in Figure 4 fluctuated sharply in 1973 – 74, but that is because the forward premium on the yen also fluctuated widely. It is not clear how to interpret these fluctuations. The forward market was limited in size by the "actual demand principle" which required that foreign exchange transactions by Japanese firms be related to certain approved transactions such as export or import payments. On the other hand, the range of variation of Euroyen rates is similar to that of the Eurofranc and Eurolira interest rates in the 1980s when speculative pressure led to large forward discounts on the franc and lira. In the case of those European currencies, forward discounts reflected expectations of possible realignments of these currencies within the European Monetary System. Whether the observed forward discounts on the yen during the oil crisis of 1973 – 74 reflect expected depreciations of the yen of similar size is difficult to determine.

Table 5 reports monthly interest differentials for the yen markets for the period from January 1973 to November 1991. The interest differentials are studied during three subperiods: (1) January 1973 to December 1974, a period when the speculative pressure against the yen was predominant;[16] (2) January 1975 to December 1980, a period when

[15]For an interesting discussion of data limitations, *see* Ito (1986).

[16]This period is also when no Euroyen quotes are available, so the differential is between the covered Eurodollar rate and the *gensaki* rate.

Figure 4

Euroyen and *Gensaki* Interest Rates, January 1973 – December 1983

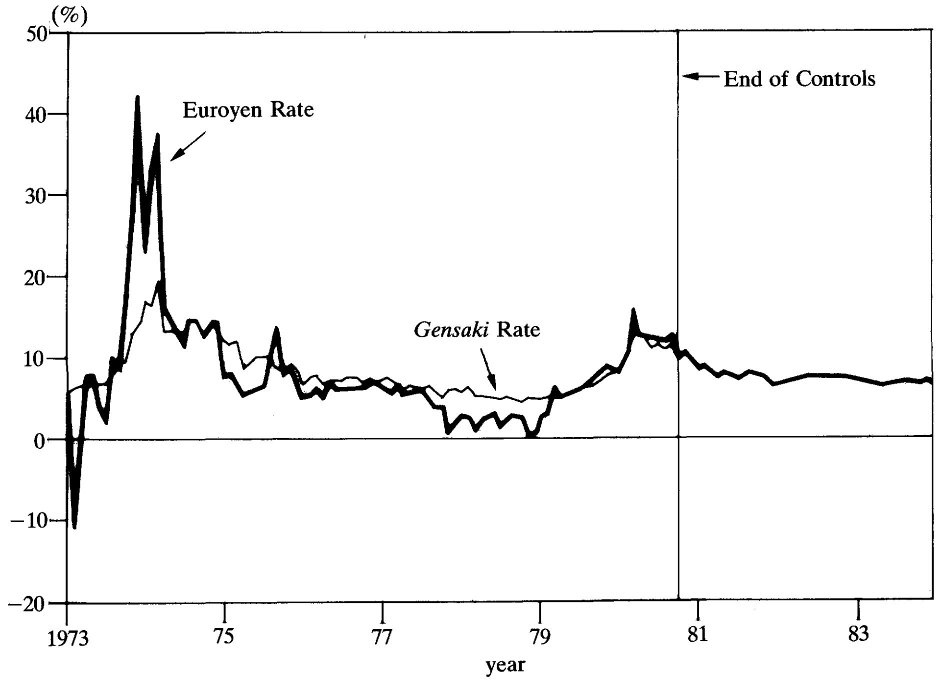


Table 5

Interest Differentials between the Eurocurrency and National Markets, 1973.1 – 1991.11

	Euroyen – *Gensaki* Rates			Eurodollar – CD Rates
	1973.1 - 1974.12	1975.1 - 1980.12	1981.1 - 1991.11	1973.1 - 1991.11
Number of Observations	24	72	131	227
Sample Average	2.50	−1.18*	0.25*	0.49*
Standard Error of Mean	3.07	0.38	0.05	0.06
t-Statistic	0.81	−3.10	5.40	8.82
Band for 95 % of Observations	17.22	4.47	0.83	1.50

the controls led to a forward premium rather than discount on the yen; and (3) January 1981 to November 1991, a period free of most controls. The second period ends in the month, December 1980, when the Foreign Exchange and Foreign Trade Law was enacted eliminating most capital controls on short term assets.[17] The interest rates reported are for three month maturities expressed in percent per annum, so the differentials are calculated in logs as follows where

$$\{\ln[1+(I_{¥t}/400)] - \ln[1+(I_{Jt}/400)]\} * 400. \qquad (9b')$$

Prior to 1975, the Euroyen rate is replaced by the sum of the Eurodollar rate and the forward premium (also defined in logs as $\ln[F_{¥t}/S_{¥t}]$).

Table 5 illustrates how effective capital controls can be in driving wedges between national and Eurocurrency interest rates. According to this table, the premium of Euroyen rates over *gensaki* rates averaged 2.50 % per annum during the first period of the controls. In several of the months, the differential favoring Euroyen was over 15 %, so the controls on outflows must have been very effective.[18] During the second period ending in 1980, the premium dropped to a *negative* 1.18 %. Here the incentive was to raise money abroad and invest in the Japanese market, but the controls clearly inhibited such activity. With a standard error of only 0.38 %, this second differential is statistically different from zero. 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.[19] That band includes differentials as large as 4.47 % in the 1975 – 80 period.

Once the controls were removed following the December 1980 law, the differential dropped to 0.25 %.[20] Figure 4 illustrates how dramatically smaller were the differentials in the post control period. A vertical line indicates when the controls were removed in December 1980. Both Table 5 and Figure 4 show clearly that the controls had a very substantial effect on interest differentials, and therefore on the relative costs of financing in the Japanese and external markets.

[17]The December 1980 law established the principle that capital flows were free unless specifically prohibited. Under previous law, capital flows were restricted unless explicitly authorized. As early as May 1979, however, non-residents were allowed to enter into *gensaki* agreements. *See* Ito (1986, p. 226).

[18]As is evident in Figure 4, the differential over this first period was at first negative, then positive. Although the average differential is very large at 2.50 %, the standard deviation is even larger so the differential is not statistically significant.

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

[20]This differential is statistically different from zero (given a standard error of 0.05 %), but it is probably small enough to be attributed to transactions costs and non-synchronization of the data (since the Euroyen rate is from the London market and the *gensaki* rate from the Tokyo market which closes hours earlier). It is also possible that market participants believe that default risks are greater in the Eurocurrency markets. On this last point, *see* the discussion of the dollar markets below.

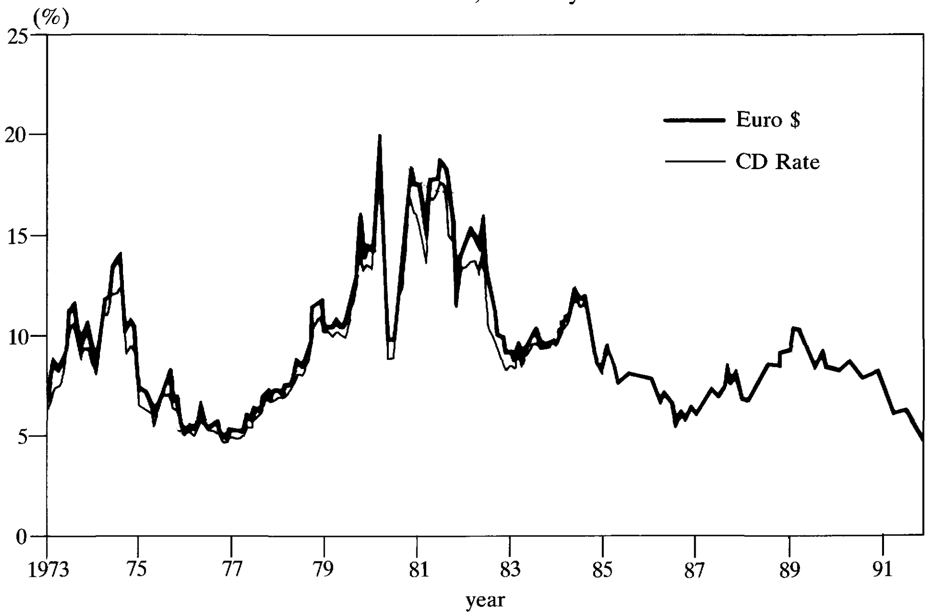
B. U.S. Controls

The United States developed a system of capital controls beginning with the interest equalization tax of 1963. The controls were designed to limit capital outflows during the last few years before the Bretton Woods system of fixed exchange rates collapsed. The Nixon administration, however, removed virtually all of the controls in late 1973. So for almost all of the sample period covered in this study, we can regard U.S. markets as being free of capital controls.

To see how closely integrated are the U.S. and Eurodollar markets, it is natural to compare U.S. bank CD rates and Eurodollar rates. The CD market has been free of interest rate controls (under Regulation Q) since the early 1970s. Figure 5 shows how closely together the Eurodollar and CD rates moved over the period from 1973 to 1991. According to Table 5, the differential between the Eurodollar and CD rates averaged 0.49 % over this period with the 95 % band occuring at a rate of 1.50 %. This differential is much smaller than it was during the period of controls, but larger than differentials in the yen markets after Japanese 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.[21] The

Figure 5

Eurodollar and U.S. CD Rates, January 1973 – November 1991



[21]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).

standard error of the mean was only 0.06 % which suggests that the differential was rather stable over time as it would be if banking regulations created a relatively constant wedge between national and Eurocurrency rates.

During some of the post-control years, however, the interest differential between Eurodollars and CDs was much larger than 0.49 %. 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.[22] 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.[23] The interest differentials found in the post control period suggests that investigators should be wary about ignoring default premiums when comparing national and Eurocurrency rates.

Over the period as a whole, however, the differential between CD and Eurodollar rates can be explained primarily by banking regulations. At the margin, these two sets of rates were tied closely together by arbitrage.

V. Deviations from Uncovered Interest Parity in the Eurocurrency Markets

In the absence of domestic distortions and capital controls, interest rates in different countries should be linked closely together by investment and borrowing decisions. Since these types of distortions *were* important in the cases of Japan and the United States (for at least part of the sample period), we must look to Eurocurrency rates to find out how closely interest rates are linked in non-regulated markets.

Consider the comparison between Eurodollar and Euroyen interest rates. If returns on Eurodollar deposits are expressed in yen to make them comparable, then the expected (*ex ante*) interest differential between Eurodollar and Euroyen interest rates can be written as follows:

$$i_{\$t} + x_{¥t} - i_{¥t} = U_{3t}, \tag{10}$$

[22]Over the whole post control period, the average premium of CD rates over Treasury bill rates was 0.77 %. 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 % and a CD rate of 10 %, a gap of 0.50 % can be attributed to taxes alone.

[23]Even without the debt crisis, higher interest rates might have increased default risk on CDs because higher rates can increase the risk of default on bank loans by worsening the borrower's financial condition.

where $x_{¥t}$ is the expected change in the yen price of the dollar, $E_t[\ln(S_{¥t+1}/S_{¥t})]$. Since the Eurocurrency markets are free of barriers to investment such as capital controls, U_{3t} is a measure of the risk premium separating the returns in the two markets.

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:

$$(i_{\$t} + x_{¥t} - i_{¥t}) + (s_{¥t} - x_{¥t}) = \epsilon_{1t}\,, \qquad (11)$$

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).[24] 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.[25] With longer sample periods, however, forecast errors associated with learning should become less of a problem unless there are frequent changes in regimes.

The top part of Table 6 presents unconditional estimates of the means of ϵ_{1t} together with standard errors and t-statistics.[26] Estimates are provided for three sample periods: the 1973 – 80 period (spanning the first few years of the Euroyen market), the 1981-91 period, and the full sample period beginning in 1973. During the 1970s, the interest

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[24]For a concise discussion of the peso problem, *see* Froot and Thaler (1990).

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

[26]These differentials are calculated as follows:

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

so they are expressed in percent per annum. The estimates end in March 1991, the last date for which Eurocurrency interest rates from Morgan Guaranty Trust are available. Because exchange rates are measured over a three month holding period, the last observation for the exchange rate is in June 1991.

Table 6
Deviations from Uncovered Interest Parity, Eurocurrency Interest Rates, 1973.1 – 1991.3

	1973.1 - 1980.12	1981.1 - 1991.3	1973.1 - 1991.3
Unconditional Estimates			
Number of Observations	96	123	219
Sample Mean	−2.57	−0.59	−1.45
Standard Error of Mean	4.12	4.23	2.98
t-Statistic	−0.62	−0.14	−0.49
Sample Standard Error	11.65	13.54	12.73
Conditional Estimates			
F-Statistic	1.01	2.92	2.75
Standard Error of Residual	11.07	12.18	12.03

differential favored the yen by over 2.5 %, while during the 1980s that differential fell to 0.5 %. For the sample period as a whole, the average interest differential was −1.45 %. None of these means is statistically different from zero, since the standard errors are very large (as is typically the case when exchange rates are flexible). Yet the average differentials, if accurate, are large enough to have given investors a sizable excess return from rolling over Euroyen investments. The excess return is confined primarily to the 1970s. Indeed, the average uncovered interest differential in the 1980s is no larger than that found between the Eurodollar rate and the CD rate.

How is such an excess return to be interpreted? There are at least three possible interpretations. The first one is the simplest, that the excess return is simply sampling error with no economic significance. The forecast errors in predicting exchange rates are so large that accurate estimates of excess returns are difficult to obtain in such a relatively short sample period. Second, the excess return may be due to a risk premium on the yen. The risk premium could be constant or *time-varying* as long as its average value is as given in the table.[27] If it is time-varying, then it may be possible to relate movements in the risk premium to variables in the current information set (as discussed below). Third, the excess return may be due to *systematic* (*i.e.*, non-random) forecast errors that do not have a mean of zero. Forecast errors can be systematically positive or negative over periods of several years 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). Under this interpretation, the excess return on the yen in the 1970s might have arisen because investors had difficulty forming accurate expectations about movements in the yen following the switch to flexible exchange rates in 1973. In the absence of further information, it is difficult to choose among these alternatives.

[27]Fama (1984), for example, attributes much of the variance of exchange rate changes to a time-varying risk premium.

An additional perspective on these excess returns can be obtained from *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:

$$(i_{\$t} + s_{\text{¥}t} - i_{\text{¥}t}) = \alpha + \beta Z_t + \epsilon_{1t}' , \tag{12}$$

where Z_t is a variable or set of variables known at period t.[28] 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).[29] To investigate this possibility, we estimated equations explaining the uncovered differentials as a function of three variables in the current information set: the simple interest differential (*i.e.*, $i_{\$t} - i_{\text{¥}t}$), the percentage change in the spot rate over the previous twelve months, and the inflation differential over the previous twelve months. The results are reported in Table 6 for the same three periods discussed above.

The first row under the heading "conditional estimates" gives the F-statistic testing whether the explanatory variables in the regressions are jointly significant.[30] Two of the three equations have F-statistics which exceed the critical value at the 5 % level (although not at the 1 % level). So there is some evidence of a systematic element in the uncovered interest differentials, whether it is due to risk premiums or systematic forecast errors.
systematic forecast errors.

The last row of the table, however, suggests that most of the movement in the uncovered interest differential remains *unexplained.* This row gives 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 time-varying risk premiums or systematic forecast errors account for only a fraction of the total variation in the uncovered interest differentials, and their *average* effect on the Eurodollar-Euroyen differential is small, at least in the 1980s. Before interpreting this evidence in terms of real interest differentials, we turn to evidence on inflation differentials.

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[28]Conditional estimates are provided in numerous studies such as Cumby and Obstfeld (1984) and Fama (1984). Hodrick (1987) surveys this literature.

[29]If only α is significantly different from zero, then the risk premium is constant rather than time-varying.

[30]Note that the mean of the fitted values, which measures the average risk premium (or average forecast error) over the sample period must be the same as the unconditional mean reported earlier in the table (since the equation residual has a mean of zero).

VI. Deviations from PPP and RIP

The real interest differential between dollars and yen also depends on inflation rates in the two countries, and, more specifically, on the expected deviation of the yen from purchasing power parity, $\pi_{At} + x_{¥t} - \pi_{Jt}$. This *ex ante* version of PPP measures the expected rate of depreciation of the yen relative to the expected rates of inflation in the United States and Japan.[31]

To investigate *ex ante* PPP, we must again rely on *ex post* data. Equation (13) expresses the *ex post* deviation from PPP in terms of the *ex ante* deviation from PPP and forecast errors in predicting the spot rate and the inflation rates in the United States and Japan, respectively:

$$(\dot{P}_{At}+s_{¥t}-\dot{P}_{Jt})=(\pi_{At}+x_{¥t}-\pi_{Jt})+(s_{¥t}-x_{¥t})+(\dot{P}_{At}-\pi_{At})-(\dot{P}_{Jt}-\pi_{Jt}) = \epsilon_{2t} . \quad (13)$$

In this equation, $\dot{P}_{At}$ (or $\dot{P}_{Jt}$) is the actual U.S. (or Japanese) inflation rate, where $\dot{P}_{At}$ = ln (P_{At+1}/P_{At}) . So $(\dot{P}_{At} - \pi_{At})$ is the forecast error from predicting American inflation and $(\dot{P}_{Jt} - \pi_{Jt})$ is the corresponding forecast error for Japanese inflation. The error term, ϵ_{2t} , reflects two separate influences, *ex ante* deviations from PPP and forecast errors in predicting the depreciation of the yen and inflation in the two countries.

Before considering evidence on PPP, we also reformulate the expression for the differential between American and Japanese real interest rates. The *ex post* measure of this real interest differential can be written as the difference between the uncovered interest differential and the deviation from PPP:

$$(i_{\$t}-\dot{P}_{At})-(i_{¥t}-\dot{P}_{Jt})=[i_{\$t}+s_{¥t}-i_{¥t}]-[\dot{P}_{At}+s_{¥t}-\dot{P}_{Jt}] . \quad (14)$$

Notice that *ex post* measures of RIP are *not sensitive* to forecast errors in the exchange market (the two $s_{¥t}$ terms cancel out in equation (14)). *Ex post* measures of the deviations from UIP and PPP are both dependent on forecast errors in the exchange market, but measures of real interest differentials are not. The *ex post* real interest differential can be rewritten in an alternative form which emphasizes the sources of such differentials:

$$[(i_{\$t}-\pi_{At})-(i_{¥t}-\pi_{Jt})]-(\dot{P}_{At}-\pi_{At})+(\dot{P}_{Jt}-\pi_{Jt})=\epsilon_{3t} . \quad (15)$$

The error term, ϵ_{3t}, reflects two sets of influences. First, there may be *ex ante* real interest differentials between dollars and yen. As explained above, there are no equilibrating forces in the financial market ensuring that *ex ante* RIP holds. Even if (nominal) UIP holds, RIP will not hold unless *ex ante* PPP holds. Second, the error term, ϵ_{3t}, may

[31]Roll (1979) argues that commodity speculation alone should ensure that *ex ante* PPP holds. In that case, however, *ex ante* PPP would hold only for individual commodity prices, and not necessarily for broad-based price indexes like the consumer price index (CPI) or the wholesale price index (WPI). Other studies of *ex ante* PPP include Adler and Lehmann (1983) and Cumby and Obstleld (1984).

also be due to errors in forecasting inflation.

The inflation rates are calculated using three different sets of price indexes. Many previous studies of real interest rates have used consumer price indexes (CPIs) to calculate inflation rates. When comparisons are made between financing costs in the United States and Japan, however, the primary aim is to understand the financing costs of firms which compete internationally. Consumer price indexes include the prices of many non-traded goods and services which have no impact on the real cost of financing by such firms. In the case of Japan, the inflation rate for the non-traded sector is much higher than that of the traded sector, so the use of the consumer price may seriously bias measures of real financing costs.[32] Wholesale price indexes (WPIs) are more suitable for measuring inflation facing such firms since these indexes exclude most non-traded goods and services.[33] So we will also provide a set of estimates of real interest rates based on these prices. Because U.S. and Japanese firms competing internationally are predominantly from the manufacturing sector, a third set of estimates will be based on inflation rates in the manufacturing sector alone using wholesale prices in manufacturing.

A. Estimates of PPP Deviations

Table 7 presents estimates of deviations from PPP using the three sets of price indexes discussed above. If CPIs are used in the calculations, the average deviation from PPP is − 2.70 % per annum over the 1973 – 91 period. Since PPP is being measured as the U.S. inflation rate minus the Japanese inflation rate, a negative deviation represents a real appreciation of the yen. This large deviation implies a cumulative real appreciation of the yen by 39 % over this eighteen year period. Note, however, that the estimate is not statistically significant. If wholesale prices are used, the average deviation falls to − 1.52 % per annum. If wholesale prices in manufacturing alone are used, the average deviation falls further to − 1.33 % per annum.[34]

Table 7 also reports the sample standard deviation for each differential. The sample standard deviations are as large as those found for deviations from UIP. To investigate whether these *ex post* differrentials are forecastable, equations were estimated relations each *ex post* differential to the same three information variables used in the equations for UIP. Table 7 reports F-statistics for these regressions as well as the standard deviations of the residuals. The low values for the F-statistics indicate that in none of the three regressions are the information variables jointly significant. As in the case of the equa-

[32]Marston (1987) examines the bias in measures of purchasing power parity associated with consumer price indexes. Yoshikawa (1990) provides estimates of PPP based on costs in the export sectors of Japan and the United States.

[33]The WPI used for Japan is defined for domestic goods alone, so the effects of energy and imported raw material prices can also be excluded.

[34]There is reason to believe that even this estimate based on wholesale prices in manufacturing overstates the real appreciation of the yen experienced by Japanese firms in the export sector. *See* Yoshikawa (1990).

tions for uncovered interest differentials, moreover, the standard deviations of the residuals are almost as large as those of the *ex post* differentials themselves. This is not surprising, since both sets of differentials are affected by exchange rate forecast errors. Most of the *ex post* variability in the UIP and PPP differentials appears to be due to this forecast error. In fact, the correlation between the two disturbances, ϵ_1 and ϵ_2, is 0.94 over the sample period.

B. Differentials in Real Financing Costs

The real interest differential in which we are interested is the *ex ante* differential based on expectations of inflation. The real interest differential that is observed is an *ex post* measure based on realized inflation rates. The real interest rate facing Japanese firms borrowing in the Euroyen market, for example, is calculated as:

$$r_{Jt} = [\ln (1 + (I_{¥t}/400))] - \ln (P_{Jt+3}/P_{Jt})] * 400 . \quad (16)$$

So the differential to be analyzed, $r_{At} - r_{Jt} = \epsilon_{3t}$, will reflect both *ex ante* differentials and forecast errors.

The bottom half of Table 7 reports statistics on real interest differentials using Eurocurrency interest rates. The mean differential based on consumer price indexes is 1.24 % per annum with a t-statistic of 1.84. The differentials based on the two measures of wholesale prices, however, are very close to zero. Both of the latter measures have t-statistics close to zero as well. So based on these preferred measures of prices, there does not seem to be any real interest differential between the Eurodollar and Euroyen markets.

This is not to deny that real interest rates can vary relative to one another over shorter sample periods. Indeed, there is evidence in Table 7 that variations in real interest differentials are forecastable. Conditional estimates of these differentials based on any of the price series have F-statistics which are statistically significant even at the 1 % level. But *average* real interest differentials are still close to zero.

It is interesting to trace this result to the two underlying determinants of real interest parity. As equation (14) indicates, the real interest differential is equal to the difference between the uncovered interest differential and the deviation from PPP. As shown in Table 6, the uncovered interest differential between Eurodollar and Euroyen has a mean of −1.45% over the whole sample period from 1973 to 1991. But this nominal interest differential is cancelled out almost completely by a differential in inflation rates causing a deviation from PPP of −1.52 % if based on overall wholesale prices or a deviation of −1.33 % if based on prices in manufacturing. In any case, neither the deviations from UIP nor the deviations from PPP are statistically different from zero.

How do we interpret the result that real interest differentials between Eurodollar and Euroyen rates are so close to zero? Recall that there is no *direct* economic mechanism that ensures the equality of real interest rates. So real interest parity relies on its

Table 7
Evidence on PPP and Real Financing Costs Based on Eurocurrency Rates, 1973.1 - 1991.3

Deviations from Purchasing Power Parity			
	CPI	WPI	WPI for Manufacturing
Unconditional Estimates			
Sample Mean	−2.70	−1.52	−1.33
Standard Error of Mean	2.93	2.90	2.91
t-Statistic	−0.92	−0.52	−0.46
Sample Standard Error	12.54	12.39	12.43
Conditional Estimates			
F-Statistic	1.39	0.62	0.51
Standard Error of Residual	12.17	12.23	12.30

Differentials in Real Financing Costs			
	CPI	WPI	WPI for Manufacturing
Unconditional Estimates			
Sample Mean	1.24	0.07	−0.12
Standard Error of Mean	0.68	1.03	1.08
t-Statistic	1.84	0.06	−0.11
Sample Standard Error	2.89	4.41	4.61
Conditional Estimates			
F-Statistic	9.07	7.22	8.60
Standard Error of Residual	2.45	3.85	3.93

two underlying components: (nominal) UIP and PPP. While neither holds perfectly over this eighteen year period, there are no statistically significant deviations from either parity condition. And, as we have seen, the two deviations almost exactly cancel out. If deviations from UIP and deviations from PPP are driven by a common factor, exchange rate forecast errors, then this cancelling out is to be expected. On the other hand, if each deviation is driven by independent factors, deviations from UIP driven by risk premiums and deviations from PPP driven by real trade factors such as secular changes in competitiveness, then this cancelling out could only have occurred by chance. Unfortunately, we cannot distinguish between these two possibilities without further evidence.

Table 8
Range of Estimates of Real Interest Differentials 1973.1 - 1991.3

	U.S. - Japanese Bank Loans		Eurodollar - Euroyen
	Based on CPI	Based on WPI in Manufacturing	Based on WPI in Manufacturing
Mean	3.41	2.04	−0.12
Standard Error of Mean	0.64	1.01	1.08
t-Statistic	5.31	2.03	−0.11

VII. Comparing National and Eurocurrency Financing Costs

To conclude this analysis, we now consider the range of estimates for relative financing costs in the two countries. The first column of Table 8 presents the average differential between real rates on bank loans using CPIs in the measures of inflation. The average differential is 3.41 % over the eighteen year period. This differential is statistically different from zero at the 1 % level. It would be smaller if compensating balances were considered in the calculations, if *gensaki* rates replaced loan rates in Japan, or if industrial paper rates replaced American loan rates. Rather than examine a number of partial adjustments to this measure, the last column of the table presents the average differential in the completely unregulated Eurocurrency markets using wholesale prices in manufacturing. The two measures are over 3 % per annum apart. The middle column allows the reader to decompose two factors which are important here. By using wholesale prices in manufacturing rather than consumer prices, the real interest differential for loan rates is lowered from 3.41 % to 2.04 % per annum. The remaining 2.16 % discrepancy between columns one and three is attributable to the effects of regulation: the domestic distortions in the loan rates of both countries and the capital controls which the Japanese government maintained until 1980.

Now that national markets have been deregulated, real interest differentials between the two national markets should be close to those found in the Eurocurrency markets. In that case, average real interest rates will differ only if nominal returns in one currency are consistently higher than in another or if relative prices consistently diverge between the two countries. Relative financing costs will no longer depend on the peculiar features of national loan markets shielded from international competition.

Data Appendix

Interest rates and exchange rates: All series are end of month quotations.

Japanese loan rate: standard rate on loans of especially high credit from 1973.1 – 1988.12; thereafter the prime rate; both from the Bank of Japan, *Economic Statistics Annual.*

Japanese deposit rate (used in the calculation of compensating balance costs): 3 month time deposit rates from the Bank of Japan, *ESA*.

Gensaki rate: 3 month rate from the Bank of Japan database.

U.S. loan rate: prime rate from OECD *Financial Statistics Monthly* database.

U.S. CD rate: 3 month rate on large certificates of deposit from Morgan Guaranty Trust, *World Financial Markets.*

U.S. industrial paper rate: 3 month rate on prime industrial paper from MGT, *WFM.*

Eurodollar rate: 3 month rate from MGT, *WFM.*

Euroyen rate: 3 month rate from MGT, *WFM* from 1976.1 – 1991.3; from BIS databank from 1975.1 – 1975.12; calculated using spot and forward rates from the Bank of Japan database from 1973.1 – 1974.12.

Spot exchange rate: from International Monetary Fund, *International Financial Statistics* database.

Price series:

The consumer price indexes for Japan and the United States are from the IMF's *International Financial Statistics* (data base), line 64.

The wholesale price index for the United States is also from the *IFS*, line 63.

The wholesale price index for Japan is from the Bank of Japan's, *Price Indexes Annual* (data bank).

The WPI for Japan is defined for domestic goods only, since the weight of fuels and imported materials in the overall wholesale price index is so large in Japan (No comparable domestic series is available for the United States).

The Japanese wholesale price index for manufactured products is also from the Bank of Japan, defined for domestic goods only.

The U.S. index is for producer prices in manufacturing from the U.S. Department of Commerce's *Survey of Current Business.*

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