2008

Preferred Habitat for Liquidity in International Short-term Interest Rates

Vladimir Kotomin
Illinois State University, vkotomi@ilstu.edu

Stanley D. Smith
University of Central Florida

Drew B. Winters
Texas Tech University

Preferred Habitat for Liquidity in International Short-term Interest Rates

Vladimir Kotomin
University of Wisconsin – Eau Claire

Stanley D. Smith
SunTrust Chair of Banking
University of Central Florida

Drew B. Winters
Rawls Professor of Finance
Texas Tech University

This draft: March 7, 2007

Abstract

Risk-shifting window dressing and a preferred habitat for liquidity have been offered as possible explanations as to why U.S. money market rates are higher before the year-end than afterwards. The two hypotheses differ in the timing of the rate decline at the year-end and the evidence on the timing of the decline supports the preferred habitat hypothesis in U.S. money markets. This paper extends this line of research to the behavior of international short-term interest rates at year-ends and quarter-ends using London Interbank Offer Rates (LIBOR) for 11 different currencies. The results suggest that the behavior of LIBOR for five currencies: the U.S. Dollar, Euro, Japanese Yen, Swiss Franc, and German Mark, is consistent with year-end or quarter-end preferred habitats for liquidity. Other currencies do not demonstrate consistently distinct patterns in turn-of-the-year and turn-of-the-quarter yields. None of the results provides any support for risk-shifting window dressing.

Acknowledgments: The authors thank two anonymous referees, Mark Griffiths, and participants at the 2005 FMA and 2005 SFA meetings for their comments.

Corresponding Author:

Vladimir Kotomin
Department of Accounting and Finance
University of Wisconsin – Eau Claire
105 Garfield Ave.
Eau Claire, WI 54702-4004
Phone 715-836-3535 Fax 715-836-3582
Email ***kotomin@uwec.edu***

1. Introduction

Musto (1997) examines the U.S. commercial paper market and finds higher average rates in the last week of the year than in the first week of the next year. Musto attributes this unexpected rate behavior to risk-shifting window dressing. Griffiths and Winters (2005) revisit the U.S. commercial paper market and find similar results to Musto's. However, using different methods they are able to determine that commercial paper rates begin declining a few days before the year-end in a manner inconsistent with the window dressing hypothesis. Griffiths and Winters attribute the year-end pattern in commercial paper rates to a preferred habitat for liquidity.

Griffiths and Winters (1997 and 2005) extend their analysis beyond commercial paper to repos, bankers' acceptances, CDs, euro-dollar deposits, and U.S. Dollar LIBOR and find similar year-end rate patterns across these money market instruments consistent with the year-end commercial paper regularity. We investigate whether this rate behavior is unique to the U.S. market or is a global phenomenon. In the process we examine whether the phenomenon is isolated at the year-end or extends to quarter-ends and whether there is support for risk-shifting window dressing or a preferred habitat for liquidity.[1]

Using British Bankers' Association's (BBA) LIBOR in 11 currencies including the U.S. Dollar, we find a year-end regularity consistent with the preferred habitat identified by Griffiths and Winters (2005) in five currencies: the U.S. Dollar, the Euro,

[1] We will be referring to the ends of quarters one, two, and three as quarter-ends, and to the end of the fourth quarter as the year-end hereafter.

the Japanese Yen, the Swiss Franc, and the German Mark. These year-end rate changes are economically significant. These five currencies also exhibit quarter-end patterns similar to their year-end patterns, but the rate changes are smaller in magnitude. The other six currencies (the Pound Sterling, the Australian Dollar, the Canadian Dollar, the French Franc, the Spanish Peseta, and the Italian Lira) do not exhibit any consistent pattern at the year-ends or quarter-ends. We find no support for window dressing in the rates for any of the eleven currencies.

The five currencies exhibiting a preferred habitat are currencies from major world economies (Switzerland is an international banking center). Five of the remaining six currencies are currencies from smaller economies. The British Pound is the only currency that appears out of place since the British economy is without question a major economy. We are unable to explain why British Pound LIBOR does not follow the same calendar-based rate changes as the other major currencies.

The next section highlights background literature to motivate our study and provides details of our hypotheses and tests. Section 3 describes data and methods. Section 4 presents empirical results and provides the discussion. The fifth section concludes the paper.

2. Background

2.1. Literature and Testable Hypotheses

The works by Musto (1997) and Griffiths and Winters (2005) identify a year-end pattern in U.S. money market rates and offer competing hypotheses as explanations for the observed year-end rate pattern.[2] Musto (1997) finds average commercial paper rates are higher before the year-end than after the turn-of-the-year, which he attributes to risk-shifting window dressing. The window dressing hypothesis was developed by Haugen and Lakonishok (1987) and Ritter (1988) to explain the turn-of-the-year effect in equities. Their argument is that portfolio managers dress-up their portfolios in advance of reporting dates and then return to their 'normal' portfolio compositions following their reporting dates. Thus, window dressing is a financial reporting disclosure date hypothesis; therefore, any pattern created by window dressing is expected to persist across disclosure dates. In the money markets at the year-end, window dressing requires that abnormal rates persist across the year-end and return to normal in the new year.

Griffiths and Winters (1997 and 2005) find abnormally high money market rates prior to the year-end, but they also find that the rates begin declining before the year-end. They suggest this pattern is consistent with a year-end preferred habitat for liquidity. The preferred habitat hypothesis was developed by Modigliani and Sutch (1966) to explain twists in the term structure and was applied to the money markets by Ogden (1987) to explain the Park and Reinganum (1986) finding that the last T-bill to mature in a month tends to have a lower yield than the adjacent T-bills. Ogden (1987) explains this effect with the concentration of cash obligations around the turn-of-the-month and describes the desire to own the last T-bill to mature in a month as a preferred habitat for investors. He points out that in the U.S. the last and first business days of the month are common dates

---

[2] Allen and Saunders (1992) discuss idle-cash window dressing by banks where banks invest otherwise idle cash in advance of financial reporting disclosure dates to avoid showing large amounts of cash on their balance sheets. Idle-cash window dressing suggests lower than normal rates. Since the pattern observed by Musto (1997) and Griffiths and Winters (1997 and 2005) is of rising rates, we do not consider idle-cash window dressing as a viable explanation in this paper.

for contractually scheduled payments such as interest on debt, dividends, wages and salaries with the largest concentration of such payments at the year-end.[3] Money market investors with year-end cash obligations exit securities whose maturities span their obligation dates and re-enter the market after cash obligations have been paid. Year-end cash obligation dates need not align with the last day of the year, so under a year-end preferred habitat for liquidity money market rates can begin returning to normal prior to the year-end. The possibility of rate declines before the year-end distinguishes the preferred habitat hypothesis from the window dressing hypothesis.

Thus, the testable hypotheses for this study are the following. First, under both hypotheses investors exit the market at year-ends and quarter-ends which drives prices down and rates up. Accordingly, we test whether interest rates are abnormally high (relative to a base rate) when investors would exit the market or interest rates remain at normal levels. Second, if we find abnormally high rates then we examine when rates return to normal levels. If the transition begins after the year-end or quarter-end, then the timing of the transition supports risk-shifting window dressing. If the transition begins before the year-end or quarter-end, then the timing of the transition supports a preferred habitat for liquidity. Third, we also examine the transition into the abnormal period with the expectation that under a preferred habitat for liquidity rates would transition into the abnormal period earlier than under risk-shifting window dressing. Specifically, the transition under a preferred habitat should begin when the maturity of the instrument begins to extend to the investors' cash obligation dates, while under risk-shifting window

[3] Kotomin and Winters (2006) show that the composition of banks' assets and liabilities changes around year-ends and quarter-ends in response to customers preparing for cash obligations at these times.

dressing the transition should begin when the maturity extends to the year-end or quarter-end.

2.2. Payment Patterns and Fiscal Year-ends Outside of the U.S.

Current literature identifies a year-end rate pattern in U.S. money markets and offers two competing hypotheses to explain the patterns that are based on features apparent in the U.S. market. In this section we discuss whether the two hypotheses are viable outside of the U.S.

If other countries have payments concentrating around the turn-of-the-month, then a preferred habitat for liquidity is viable in these countries. We find no discussion of non-U.S. payment patterns in the academic literature. However, central banks typically report on the payment systems for the economies that they oversee. We examine recent payment system reports from the Bank of England, the Bank of Japan, and the European Central Bank and find some evidence of quarter-end and year-end payment system transaction spikes in every report. Accordingly, we conclude that at least some payment systems outside the U.S. also follow a calendar-based pattern with easily observable payment concentrations at year-ends and quarter-ends. Thus, we believe the preferred habitat for liquidity hypothesis based on cash obligation concentrations at the year-end and quarter-ends is viable outside the U.S.

For a window dressing effect outside the U.S. at year-ends and quarter-ends non-U.S. companies would have to concentrate their fiscal year-ends at calendar year-ends or quarter-ends. December 31 reporting year-ends are common, although not universal, in the U.S. and Canada. A number of U.K. companies also have December 31 fiscal year-ends, but quite a few have March year-ends (to correspond with the tax year-end). In Australia, June year-ends are most common.[4] Japanese companies commonly use March 31 as the fiscal year-end. Additionally, U.S. and Canadian public companies provide quarterly financial reports, while U.K., other European, and Australian companies generally provide financial reports only semiannually. Accordingly, window dressing at calendar year-ends and quarter-ends is a viable hypothesis outside the U.S., but any fiscal year-end window dressing outside the U.S. may not be concentrated at the calendar year-end.

3. Data and Methods

3.1 Data

The data are daily London Interbank Offer Rates (LIBOR) for different currencies and maturities obtained from the British Bankers' Association (BBA) website (http://www.bba.org.uk). LIBOR is fixed in each different currency in 15 maturities: overnight, one week, two weeks, and one month through twelve months and likely represents the widest possible range of international money-market interest rates. We concentrate on the shorter end of the maturity spectrum, particularly, on the maturities of one week and one month.[5]

BBA LIBOR is the primary benchmark for short-term interest rates globally and is used as the basis for settlement of interest rate contracts on many of the world's major

[4] We thank the staff at the Canadian Institute of Chartered Accountants for providing this information; our own analysis is consistent with this information.

[5] Summary statistics are each time series of data available upon request.

futures and options exchanges[6] as well as many over-the-counter (OTC) and lending transactions. BBA LIBOR is compiled by the BBA in conjunction with Moneyline Telerate and released to the market shortly after 11:00AM London time each day.[7] As of January 17, 2006 (the end of our sample period), BBA LIBOR fixings were provided in nine currencies: Pound Sterling (GBP), U.S. Dollar (USD), Japanese Yen (JPY), Swiss Franc (CHF), Canadian Dollar (CAD), Australian Dollar (AUD), Euro, Danish Krone (DKK), and the New Zealand Dollar (NZD).[8]

Our analysis focuses on one-week and one-month LIBOR. One-week LIBOR has been reported since the beginning of 1998. One-month LIBOR in USD, JPY, and GBP are available from January of 1986, while one-month LIBOR in Euro, CHF, and AUD are available from January of 1989. One-month LIBOR in CAD became available in July of 1990.

LIBOR for the Euro-in zone currencies (those eventually replaced by the Euro, i.e., the German Mark (DM), French Franc (FF), Spanish Peseta (SP), Italian Lira (ITL), Dutch Guilder (NLG), and Irish Punt (PTE)) ceased to be fixed after the end of 1998. The first four of these Euro-in zone currencies have been included in the analysis in this paper with eight to ten years of data available for analysis.

3.2 Methods

---

[6] Example of futures and options exchanges using BBA LIBOR including London International Financial Futures and Options Exchange (LIFFE), Deutsche Term Burse, Chicago Mercantile Exchange, Chicago Board of Trade, Singapore International Monetary Exchange (SIMEX), and Tokyo International Financial Futures Exchange (TIFFE).

[7] BBA LIBOR is the BBA fixing of the London Inter-Bank Offered Rate. It is based on offered inter-bank deposit rates provided in accordance with the instructions to BBA LIBOR Contributor Banks. For a complete description of LIBOR see the BBA web site at http://www.bba.org.uk .

Ogden (1987) suggests cash obligations concentrate at the turn-of-the-month with the largest concentration at the year-end. Griffiths and Winters (1997, 2005) use dummy variables to test for yield changes around year-ends and we follow their lead. Garbade (1996, p.182) states that quarter-end T-bills are special because of their deliverability. We create a set of dummy variables to test for quarter-end effects in addition to year-end effects.[9] The result is the following AR(1) model estimated using a Marquardt nonlinear least squares algorithm with the White's (1980) adjustment for heteroskedasticity:[10]

$$\Delta R_t = \alpha_0 + \alpha_1(\Delta 3mR_t) + \alpha_2 BYCR + \alpha_3 AYCR + \alpha_4 BYEND + \alpha_5 AYEND + \alpha_6 BQCR + \alpha_7 AQCR + \alpha_8 BQEND + \alpha_9 AQEND + \alpha_{10} SEPT\_12 + \varepsilon_t \quad (1)$$

where:

ΔR_t = the first difference in the one-week or one-month LIBOR of a given currency,

$\Delta 3mR_t$ = the first difference in the three-month LIBOR of the same currency as the dependent variable,

BYCR = a dummy variable that equals 1 on the two trading days before the maturity of the instrument starts to span the end of the year and 0 otherwise,

AYCR = a dummy variable that equals 1 on the two trading days after the maturity of the instrument starts to span the end of the year and 0 otherwise,

---

[8] LIBOR fixings for Danish Krone and New Zealand Dollar commenced in July 2003. These currencies are not included in the analysis due to the short data availability period.

[9] Note that we test for month-end effects for months not at calendar quarter-ends and find no evidence of significant effects.

[10] We estimate equation (1) separately for each currency, which implies that the error terms are orthogonal. We believe this is a reasonable assumption because interest rates in each currency are determined by the supply and demand for that currency and then interest rate parity operates through adjustments in exchange rates. We examine the Euro/U.S. dollar and the Yen/U.S. dollar exchange rates and find no evidence of a quarter-end or year-end effect on these exchange rates which suggests that year-end and quarter-end interest rate effects operate within the market for individual currencies.

BYEND = a dummy variable that equals 1 on the last two trading days of the year and 0 otherwise,

AYEND = a dummy variable that equals 1 on the first two trading days of the year and 0 otherwise,

BQCR, AQCR, BQEND, and AQEND are the turn-of-the-quarter dummy variables defined similarly to the turn-of-the-year dummies,

SEPT_12 = a dummy variable that equals 1 on September 12, 2001 and 0 otherwise.[11]

Following Griffiths and Winters (2005), we select the daily change as the dependent variable because we are interested in testing for rate changes at year-ends and quarter-ends. Regression coefficients are interpreted as daily changes in the one-week or one-month LIBOR for a given currency in percentage points. The three-month LIBOR has been chosen as the base rate that serves as a control for a general level of interest rates for a given currency. Its choice was stipulated by the finding in preliminary tests that the three-month LIBOR is the shortest maturity not exhibiting significant quarter-end or year-end effects. Using the three-month LIBOR as the base rate reduces as much as possible the maturity mismatch between the rate being studied and the base rate and provides a control for a general level in short-term rates.[12]

We estimate an autoregression of order 1 (AR(1)) to address the autocorrelation in residuals. The year-end and quarter-end dummy variables are our test variables. Their expected signs under window dressing and a preferred habitat are as follows:

[11] This variable controls for a dramatic change in short-term interest rates and spreads on the day following the terrorist attacks on the U.S. Its exclusion does not qualitatively influence our results.

Variables	Window Dressing	Preferred Habitat
BYCR	= 0	> 0
AYCR	> 0	=> 0
BYEND	= 0	< 0
AYEND	< 0	<= 0
BQCR	= 0	> 0
AQCR	> 0	=> 0
BQEND	= 0	< 0
AQEND	< 0	<= 0

Recall that under the preferred habitat hypothesis, cash obligation dates can cover several days around year-ends and quarter-ends. Window dressing, however, is tightly defined because disclosures are based on reporting positions on the last day of the year and quarter, which allows us to differentiate between the two hypotheses. The clearest differences relate to the expected signs for BYCR, BYEND, BQCR, and BQEND. Under a preferred habitat for liquidity we expect rate changes in advance of the year-end and quarter-end, while under window dressing the rate changes must come after the year-end or quarter-end. We also provide expectations under each hypothesis for the transition into the period of abnormally high rates. Again, rates move earlier under the preferred habitat hypothesis than under the window dressing hypothesis.

The studies cited herein have dealt with private-issue U.S. securities such as commercial paper, repurchase agreements, and banker's acceptances. The U.S. interbank market (federal funds market) has been avoided because it has well-documented regularities that may complicate the analysis. While the data utilized in this study represent interbank loan rates, there is no reason to suspect regularities similar to those in

[12] Choosing a longer maturity as the base rate, for example, six months, does not qualitatively affect the estimation results. Also, the results are not qualitatively different if we use a spread, a change in the spread, a relative spread, or a change in a relative spread as the dependent variable.

the U.S. federal funds market in the London interbank markets.[13] The use of BBA LIBOR presents a very good opportunity for testing for year-end and quarter-end effects in short maturities in different currencies.

4. Empirical Results

We use interest rates of two maturities in eleven different currencies to examine year-ends and quarter-end effects. Accordingly, we partition our results by method and then by maturity to make the discussion tractable. We use two methods of analysis: (1) plots of spread patterns and (2) regressions on rate changes. The plots are used to determine if an economically significant pattern exists, while the regressions are used to determine if statistically significant rate changes occur at the calendar break points. Both methods are needed to test for the two hypotheses because we must have (1) abnormally high rates in advance of the year-end and quarter-end to support either hypothesis and (2) rate decreases around the year-end and quarter-ends with the timing of the decline determining which hypothesis (if either) is supported.

We present separate plots for one-week and one-month maturities. The purpose of the plots is to determine if economically significant rate increases occur at the year-end and quarter-ends. Stigum (1990) suggests that a 10 to 20 basis point yield differential in the money markets is an attractive arbitrage opportunity, and based on this metric, Griffiths and Winters (1997, 2005) find economically significant preferred habitats across money market securities at the year-end. We follow this lead and define a spread

[13] Most regularities in the U.S. federal funds market are created by biweekly settlement with the Fed (Cyree and Winters (2001)) and occur in the overnight market. Cyree, Griffiths and Winters (2003) show a U.S.

increase of 10 basis points or more as economically significant and then use this metric to discuss our results.

4.1 Spread Plots

4.1.1. One-week Spreads

We begin by plotting year-end and quarter-end excess spreads between one-week and three-month LIBOR for each of the seven currencies with available one-week data: USD, GBP, Euro, JPY, CHF, AUD, and CAD.[14] Figures 1 and 2 plot the average excess spread between the one-week and three-month LIBOR around year-ends and quarter-ends from 1998 through the beginning of 2006 excluding the turn-of-the-year from 1999 to 2000.[15] We define excess spread as the difference between the spread on the days surrounding year-ends or quarter-ends and all other days. For example, the excess spread on trading day -10 relative to the year-end is equal to the average spread on day -10 across all year-ends minus the average spread on all "regular" days (for the one-week maturity, all days excluding days -10 through 5 relative to year-ends or quarter-ends, and for the one-month maturity, all days except days -25 through 5 relative to year-ends or quarter-ends). Each year or quarter ends with day -1 and begins with day 1; that is, there is no day 0. If spreads do not show any large changes around year-ends or quarter-ends, the plot points will be near zero.

---

settlement effect in overnight U.S. dollar LIBOR. In addition, they note the British banks settle daily, so the settlement process in the U.K. should not have any effect on daily LIBOR rates.

[14] Because only one year of one-week LIBOR fixings is available for the Euro-in zone currencies, these data were not included in this part of our analysis.

[15] One-week LIBOR skyrocketed in six out of seven currencies (excluding GBP) prior to the New Year 2000. The end-of-year effect would be exaggerated had we included Y2K when constructing the graphs.

Figure 1 plots one-week maturities at year-ends. The USD, Euro, JPY, and CHF display an economically significant spread increase in a pattern consistent with a year-end preferred habitat for liquidity. Specially, each of these currencies show a spread spike on trading day -5 with abnormally high spreads continuing through day -3 and then returning to near normal levels on day -2.

The excess spreads on days -5, -4, and -3 exceed 10 basis points, which provide an economically attractive opportunity for traders. For these economically significant spreads to persist across three days there must be a reason why traders do not trade against this known regularity. To trade against these abnormal spreads would be to lend funds to earn the abnormally high rates. The best explanation, given the persistence of the observed pattern, is that many potential lenders need their cash to cover their own year-end obligations. Then, once the year-end cash obligations are met, traders re-enter the market and return the spreads to near normal on day -2. Returning to the market on day -2 suggests the rate spike is not the result of window dressing because window dressing requires remaining out of the market across the turn-of-the-year. Notice that from day -2 through day +5 the excess spreads are under 10 basis points.

Figure 1 also contains plots of the turn-of-the-year excess spreads for GBP, AUD and CAD. The Pound Sterling (GBP) shows an end-of-year spread increase of more than 10 basis points. However, the pattern is delayed one day (this delay is not enough to support window dressing) and does not exhibit the plateau effect seen in the other currencies. The daily pattern of excess spreads in CAD hints at a year-end preferred habitat, but the size is economically small. There is no suggestion of a year-end pattern in AUD.

Figure 2 plots the turn-of-the-quarter excess spreads. The plot shows spread changes consistent with a quarter-end preferred habitat in the same four currencies as in Figure 1. However, using our 10 basis point metric, these results suggest that the concentration of cash flows at quarter-ends is sufficient to create economically significant spread increases in CHF and, arguably, USD, but not in Euro and JPY.[16] Again, GBP hints at a preferred habitat with a delayed pattern but the rate pressures are not economically significant. AUD and CAD show very small changes in spreads consistent with a preferred habitat.

4.1.2. One-month Spreads

Next, we graph spread changes between the one-month and three-month LIBOR around year-ends and quarter-ends. Figures 3 and 4 are constructed similarly to Figures 1 and 2. Since the maturity of a one-month loan starts spanning the end of the year or quarter around trading day -21 relative to the end of year (quarter), we plot average excess spreads for days -25 through +5. Although we excluded the end of Year 1999 to be consistent with our one-week graphs, it does not play the major role in the one-month maturity that it plays in the one-week LIBOR.

Figure 3 includes the currencies plotted in figures 1 and 2 and we add four currencies that were replaced by the Euro – DM, FF, SP, and ITL.[17] The U.S. Dollar

[16] Visual comparison of Figure 1 and Figure 2 may create an impression that the increase in spreads preceding year-ends starts two days later than the increase preceding quarter-ends (trading day -5 vs. trading day -7). However, this is due to the fact that there are only three trading days between the issuance and maturity of a seven-day loan originated close to the end of the year: BBA LIBOR is not reported on Christmas (December 25th) and Boxing Day (December 26th).

[17] The one-month time series begin 10 to 12 years before the one-week time series so sufficient data is available on these currencies in the one-month term for inclusion in this analysis.

(USD), the Euro, the Japanese Yen (JPY), and the Swiss Franc (CHF), plus the German Mark (DM) show a pattern that is consistent with a year-end preferred habitat driven by a year-end concentration of cash flows. These results are similar to the one-week results reported in Figure 1 with the addition of the DM. The spread patterns for the other currencies (GBP, AUD, CAD, FF, SP, and ITL) do not support either hypothesis. In fact, instead of a consistent pattern at the year-end in these currencies, there is a great deal of noise in these plots.

Figure 4 plots turn-of-the-quarter excess spreads. The JPY exhibit an economically significant pattern consistent with a preferred habitat for liquidity. The USD, Euro, DM and CHF display patterns consistent with a preferred habitat, but any concentration of cash obligations that may exist at the quarter-ends is not sufficient to cause spreads to deviate from normal in an economically significant manner. There is no discernable pattern in spread differences at quarter-ends in the other currencies.[18]

4.2 Regression Results

The plots identify a group of currencies (USD, the Euro, JPY, CHF, and DM) with economically significant spread increases prior to the year-end with spreads beginning to decline toward normal before the year-end. This pattern is consistent with a preferred habitat. In this section we report regression results. The regressions are designed to determine if statistically significant rate changes occur at the year-end or quarter-ends and whether these changes are consistent with either hypothesis.

4.2.1. One-Week Regression Results

Table 1 presents the regression results with the daily change in the one-week LIBOR as a dependent variable. Because the dependent variable is specified as a change, a dummy variable coefficient should be interpreted as a change in the short-term LIBOR in percentage points *on each of the two days* covered by the dummy. For example, the total turn-of-the-year changes in one-week LIBOR for the Euro are about 18 basis points after controlling for changes in the general level of rates for this currency. The coefficients of the year-end preferred habitat dummy variables (BYCR and BYEND) are statistically significant at the 1% level for the Euro and at the 10% level for USD. The parameter estimates for JPY and CHF are large in magnitude and have the signs consistent with preferred habitat for liquidity, but large standard errors prevent statistical significance. The small number of observations (seven year-ends after controlling for Y2K) may be responsible for the lack of statistical significance.[19] The year-end results on CAD are statistically significant at the 5% level in a pattern consistent with a year-end preferred habitat. The Pound Sterling shows a large significant decline prior to the year-end, while the preceding increase is not statistically significant. The Australian Dollar exhibits some statistically (but not economically) significant relative spread changes around the end of the year, but direction and timing of these changes are not consistent with either hypothesis.

---

[18] The spike in the plot of SP on day -6 in Figure 8 is due to one outlier.

[19] To isolate the effect of the Y2K, we created a separate set of four turn-of-the-year dummy variables similar to those in equation (1). Their coefficients are not reported in Table 3 to focus attention on "usual" year-ends and for brevity but are available upon request. We control for Y2K because changes in shortest LIBOR maturities were extremely large around it. The results are not qualitatively different when the model is estimated without the Y2K controls.

Turn-of-the-quarter dummy variable coefficients in the one-week maturity are substantially smaller than their turn-of-the-year counterparts. This is not surprising since the highest need for liquidity normally arises at year-ends (Ogden (1987)).[20] The rate changes for USD, Euro, JPY, and CHF in our economically significant group are statistically significant at either the 1% or the 5% level on days covered by BQCR and BQEND, which is consistent with a preferred habitat for liquidity. The Australian Dollar shows statistically but not economically significant changes consistent with a preferred habitat. The Canadian Dollar shows a statistically significant decrease before the end of the quarter but without the preceding significant increase. The Pound Sterling does not exhibit statistically significant changes in the one-week maturity around quarter-ends. The rate changes in all currency are not consistent with window dressing.[21]

4.2.2. One-month Regression Results

The one-month LIBOR regression results are reported in Table 2. Panel A reports the results for currencies that are presently in existence, while Panel B contains regression results for the currencies eventually replaced by the Euro. Year-end effects consistent with preferred habitat for liquidity are very noticeable in the five currencies in the economically significant group (USD, Euro, JPY, CHF, and DM). One-month GBP

---

[20] Ogden (1987) also suggests the turn-of-the-month effects in yields. In our data sample, turn-of-the-month effects are statistically significant only in USD and CHF and marginally economically significant only in CHF. Excluding turn-of-the-month controls does not influence other regression coefficients. Thus, these results are not reported but are available upon request.

[21] Recall from the discussion in Section 2.2 that fiscal year-ends outside the U.S. are not necessarily concentrated at the calendar year-end. Accordingly, to take a closer look at possible fiscal year-end reporting-date effects, we created a separate set of dummy variables (BQCR, AQCR, BQEND, and AQEND) for each of the first three quarters and re-estimated our regressions. The results are consistent with the preferred habitat hypothesis. We find nothing in these results to suggest fiscal-year-end window dressing at calendar quarter-ends, so we do not present them in table form for brevity.

and CAD rates exhibit statistically significant rate increases without accompanying statistically significant decreases later. AUD exhibits statistically insignificant changes around the year-end.

Among the currencies that were replaced by the Euro (other than DM), ITL exhibits a rate change pattern that hints at a year-end preferred habitat for liquidity. However, the rate decrease before the year-end lacks statistical significance. It also appears that the one-month LIBOR for ITL is not consistently abnormally high across the month which is needed to support a year-end preferred habitat (see Figure 3). The parameter estimates for FF and SP are not statistically significant. None of the currencies exhibits behavior consistent with flight-from-risk window dressing.[22]

Table 2 also reports quarter-end effects in the one-month maturity. USD, JPY, and CHF have statistically significant parameter estimates at the 1%, 1%, and 10% levels, respectively, consistent with quarter-end preferred habitats. However, Figure 4 shows that the quarter-end spread increase reaches 10 basis points only in JPY. Preferred habitat at quarter-ends is not strong enough to create an economically significant event in other currencies. There is no support for risk-shifting window dressing in parameter estimate patterns at quarter-ends.

Checking for the influence of fiscal-year-end reporting dates, we find that, similar to the one-week maturity, the most pronounced turn-of-the-quarter effects are in JPY in the first quarter (see Footnote 21). We relate it to March 31 being the fiscal year-end in Japan.

[22] The results for the two-month LIBOR are qualitatively similar to those for the one-month LIBOR but they are much less pronounced. To save space, they are not reported.

4.3. Further Discussion and Comparison of the Results between Maturities and Markets

Our empirical results suggest that we have two distinct groups of interest rates. One group exhibits an economically significant year-end pattern and weaker quarter-end regularities that are both consistent with a preferred habitat for liquidity. The alternative group does not show any consistent pattern. The currencies in the group with economically significant year-ends and weaker quarter-end changes consistent with a preferred habitat (USD, Euro, JPY, CHF, and DM) are the currencies of major world economies (e.g., in terms of GDP, export, and import). The currencies in the other group (GBP, AUD, CAD, FF, SP, and ITL) generally represent smaller economies. This suggests that a certain level of economic activity appears to create calendar-based preferred habitats.

There are two currencies that appear to be in the wrong set based on the size of each economy – GBP and CHF. We believe that the international banking activity in Switzerland can explain the economically significant results on CHF. Great Britain is a major world economy by any measure. Despite data verification checks, method checks, and checks of institutional features of British markets, we are unable to explain why GBP rate changes are inconsistent with those of the other major currencies.

5. Conclusion

Using London Interbank Offer Rates (LIBOR) for short-term loans in different currencies, this study extends the literature on calendar-time effects in the money markets by examining year-end and quarter-end changes in short-term interest rates for various currencies. Pronounced year-end and quarter-end effects consistent with preferred habitat for liquidity were found in the one-week and one-month LIBOR in the U.S dollar and three of the other major world currencies: the Euro, the Japanese Yen, and the Swiss Franc. We also year-end and quarter-end preferred habitats in DM before it was replaced by the Euro and Germany is certainly a major world economy. Other currencies show either less pronounced rate changes consistent with preferred habitat or no distinct patterns in rate changes around year- and quarter-ends. Behavior of short-term yields of the currencies that do not exhibit signs of preferred habitat is not consistent with the competing hypothesis, risk-shifting window dressing.

We take a strong and specific stand on economic significance with our 10 basis point metric. This is done to be conservative in our approach to identifying an effect. However, we find statistically significant parameters in our regression analysis consistent with a preferred habitat in some currencies that are not do not clear our economically significant hurdle. These regression parameters may represent economically attractive opportunities to the market participants and therefore may represent stronger evidence of preferred habitats than we suggest. We leave this inquiry for further research.

Overall, the findings further emphasize the importance of investors' preferred habitats and their influence on money market yields. The evidence presented in this paper does not refute window dressing but it suggests that year-end and quarter-end preference for liquidity has more influence on the behavior of short-term interest rates for major world currencies.

References

Allen, L., and A. Saunders, 1992, Bank window dressing: Theory and evidence, *Journal of Banking and Finance* 16, 583-623.

Cyree, K., M. Griffiths, and D. Winters, 2003, On the Pervasive Effects of Federal Reserve Settlement Regulations, *Federal Reserve Bank of St. Louis Review*, 85, No.2, 27-46.

Cyree, K., and D. Winters, 2001, Analysis of the federal funds rate changes and variance patterns, *Journal of Financial Research* 24, 403-418.

Garbade, K., 1996, *Fixed Income Analytics*, MIT Press.

Griffiths, M. and D. Winters, 2005, The-turn-of-the-year in the money markets: Tests of the risk-shifting window dressing and preferred habitat hypotheses, *Journal of Business* 78, 1337-1364.

Griffiths, M. and D. Winters, 1997, On a preferred habitat for liquidity at the turn-of-the-year: Evidence from the term-repo market, *Journal of Financial Services Research* 12, 21-38.

Haugen, R., and J. Lakonishok, 1987, *The incredible January effect*, Homewood, IL: Dow Jones-Irwin.

Kotomin, V., and D. Winters, 2006, Quarter-end effects in banks: Preferred habitat or window dressing? *Journal of Financial Services Research* 28, 61-82.

Modigliani, F., and R. Sutch, 1966, Innovations in interest rate policy, *American Economic Review* 56, 178-197.

Musto, D., 1997, Portfolio disclosures and year-end price shifts, *Journal of Finance*, 52, 1563-1588.

Ogden, J., 1987, The end of the month as a preferred habitat: a test of operational efficiency in the money market, *Journal of Financial and Quantitative Analysis* 22, 329-344.

Park, S., and M. Reinganum, 1986, The puzzling price behavior of treasury bills that mature at the turn of calendar months, *Journal of Financial Economics* 16, 267-283.

Ritter, J., 1988, The buying and selling behavior of individuals at the turn-of-the-year, *Journal of Finance*, 43, 701-717.

Stigum, M., 1990, *The Money Market*, Third Edition, Dow Jones-Irwin.

White, H., 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48, 817-838.

Table 1. One-week LIBOR regression results

	USD		EURO		JPY		CHF		GBP		AUD		CAD	
Variable	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**
$\Delta 3mR_t$	0.929	0.001	0.845	0.000	1.391	0.001	1.317	0.000	1.161	0.000	0.628	0.000	0.874	0.000
BYCR	0.241	0.069	0.091	0.000	0.066	0.286	0.200	0.120	0.060	0.476	-0.005	0.592	0.023	0.001
AYCR	-0.050	0.204	-0.067	0.189	0.063	0.526	-0.083	0.278	0.190	0.232	-0.030	0.009	0.018	0.492
BYEND	-0.200	0.078	-0.089	0.002	-0.092	0.274	-0.199	0.067	-0.132	0.030	-0.001	0.898	-0.022	0.013
AYEND	0.002	0.874	0.009	0.105	0.010	0.528	0.042	0.004	0.004	0.950	-0.024	0.019	0.004	0.360
BQCR	0.035	0.000	0.021	0.000	0.029	0.027	0.058	0.001	0.004	0.835	0.009	0.065	0.004	0.268
AQCR	0.008	0.037	0.003	0.276	-0.005	0.442	-0.012	0.016	0.023	0.322	0.006	0.142	0.007	0.030
BQEND	-0.050	0.000	-0.023	0.000	-0.027	0.012	-0.073	0.000	-0.002	0.930	-0.012	0.031	-0.017	0.003
AQEND	-0.002	0.438	-0.001	0.658	-0.005	0.223	0.002	0.658	-0.002	0.905	-0.003	0.504	0.003	0.161
Sept_12	0.639	0.000	0.111	0.000	0.006	0.000	-0.124	0.001	0.211	0.000	0.254	0.000	0.232	0.000
F-stat.	101.99	0.000	108.16	0.000	605.65	0.000	155.45	0.000	17.65	0.000	147.84	0.000	248.28	0.000
Adj. R^2	0.43		0.44		0.82		0.53		0.11		0.52		0.65	

The table reports turn-of-the-year and turn-of-the-quarter effects in LIBOR for major world currencies in the one-week maturity. The parameters are estimated using the following AR(1) model with the White's adjustment for heteroskedasticity:

$$\Delta R_t = \alpha_0 + \alpha_1(\Delta 3mR_t) + \alpha_2 BYCR + \alpha_3 AYCR + \alpha_4 BYEND + \alpha_5 AYEND + \alpha_6 BQCR + \alpha_7 AQCR + \alpha_8 BQEND + \alpha_9 AQEND + \alpha_{10} SEPT\_12 + \varepsilon_t$$

The dependent variable is the daily change in the one-week LIBOR for a given currency; the independent variables include the change in the three-month LIBOR for a given currency and dummy variables. Dummies BYCR, AYCR, BYEND, and AYEND are designed to capture changes in the relative spread associated with the turn of the year, while BQCR, AQCR, BQEND, and AQEND perform the same function for turns of quarters one, two, and three. SEPT_12 is a dummy equal to one on September 12, 2001.

A separate set of the turn-of-the-year dummies was created to isolate the effect of the Y2K (BYCR2K, AYCR2K, BYEND2K, and AYEND2K); they were used in the estimation of equation (1) but their coefficients are not reported in the table for brevity. The results are not qualitatively different when the model is estimated without the Y2K controls.

Table 2. One-month LIBOR regression results

Panel A. Major world currencies														
	USD		EURO		JPY		CHF		GBP		AUD		CAD	
Variable	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**
$\Delta 3mR_t$	0.894	0.000	1.013	0.000	0.970	0.000	1.079	0.000	0.908	0.000	0.812	0.000	0.963	0.000
BYCR	0.160	0.000	0.053	0.000	0.047	0.007	0.118	0.000	0.016	0.021	0.010	0.172	0.020	0.014
AYCR	-0.018	0.018	0.014	0.278	-0.005	0.401	-0.019	0.070	-0.002	0.751	0.006	0.400	0.012	0.180
BYEND	-0.108	0.000	-0.021	0.010	-0.040	0.001	-0.052	0.000	-0.018	0.114	0.008	0.325	-0.004	0.774
AYEND	-0.007	0.405	-0.001	0.839	-0.007	0.141	0.006	0.300	0.010	0.220	-0.012	0.020	0.012	0.038
BQCR	0.019	0.000	0.000	0.961	0.046	0.000	0.020	0.071	0.004	0.389	0.008	0.031	0.004	0.319
AQCR	-0.001	0.598	-0.003	0.258	-0.003	0.162	-0.004	0.246	-0.002	0.660	-0.004	0.269	-0.002	0.475
BQEND	-0.024	0.000	-0.011	0.033	-0.046	0.000	-0.027	0.000	0.000	0.943	-0.004	0.234	-0.001	0.929
AQEND	0.005	0.009	-0.007	0.115	-0.008	0.005	0.005	0.046	-0.007	0.129	0.000	0.893	0.007	0.258
Sept_12	0.190	0.000	0.061	0.000	0.003	0.001	-0.071	0.000	0.083	0.000	0.163	0.000	0.123	0.000
F-stat.	390.98	0.000	565.15	0.000	306.34	0.000	414.57	0.000	560.80	0.000	488.82	0.000	631.92	0.000
Adj. R2	0.54		0.66		0.47		0.59		0.62		0.63		0.71	

Panel B. Euro-in zone currencies								
	DM		FF		SP		ITL	
Variable	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**	**Coeff.**	**p-val.**
$\Delta 3mR_t$	0.915	0.000	1.397	0.000	1.971	0.000	1.689	0.000
BYCR	0.117	0.000	-0.031	0.177	0.009	0.490	0.107	0.070
AYCR	-0.016	0.082	0.021	0.389	-0.005	0.782	-0.006	0.787
BYEND	-0.046	0.004	-0.003	0.821	-0.015	0.449	-0.041	0.269
AYEND	-0.005	0.300	0.015	0.447	0.005	0.882	0.031	0.193
BQCR	0.014	0.000	-0.005	0.315	0.021	0.502	-0.012	0.293
AQCR	0.000	0.960	-0.007	0.326	-0.006	0.565	0.013	0.240
BQEND	-0.008	0.327	0.007	0.528	0.030	0.235	-0.003	0.928
AQEND	-0.002	0.666	-0.012	0.488	0.006	0.694	0.000	0.988
F-stat.	464.36	0.000	1143.74	0.000	2464.57	0.000	948.86	0.000
Adj. R2	0.60		0.82		0.92		0.82	

The table reports turn-of-the-year and turn-of-the-quarter effects in LIBOR for major world currencies in the one-month maturity. The parameters are estimated using the following AR(1) model with the White's adjustment for heteroskedasticity::

$$\Delta R_t = \alpha_0 + \alpha_1(\Delta 3mR_t) + \alpha_2 BYCR + \alpha_3 AYCR + \alpha_4 BYEND + \alpha_5 AYEND + \alpha_6 BQCR + \alpha_7 AQCR + \alpha_8 BQEND + \alpha_9 AQEND + \alpha_{10} SEPT\_12 + \varepsilon_t$$

The dependent variable is the daily change in the one-month LIBOR for a given currency; the independent variables include the change in the three-month LIBOR for a given currency and dummy variables. Dummies BYCR, AYCR, BYEND, and AYEND are designed to capture changes in the relative spread associated with the turn of the year, while BQCR, AQCR, BQEND, and AQEND perform the same function for turns of quarters one, two, and three. SEPT_12 is a dummy equal to one on September 12, 2001.

A separate set of the turn-of-the-year dummies was created to isolate the effect of the Y2K (BYCR2K, AYCR2K, BYEND2K, and AYEND2K); they were used in the estimation of equation (1) but their coefficients are not reported in the table for brevity. The results are not qualitatively different when the model is estimated without the Y2K controls.

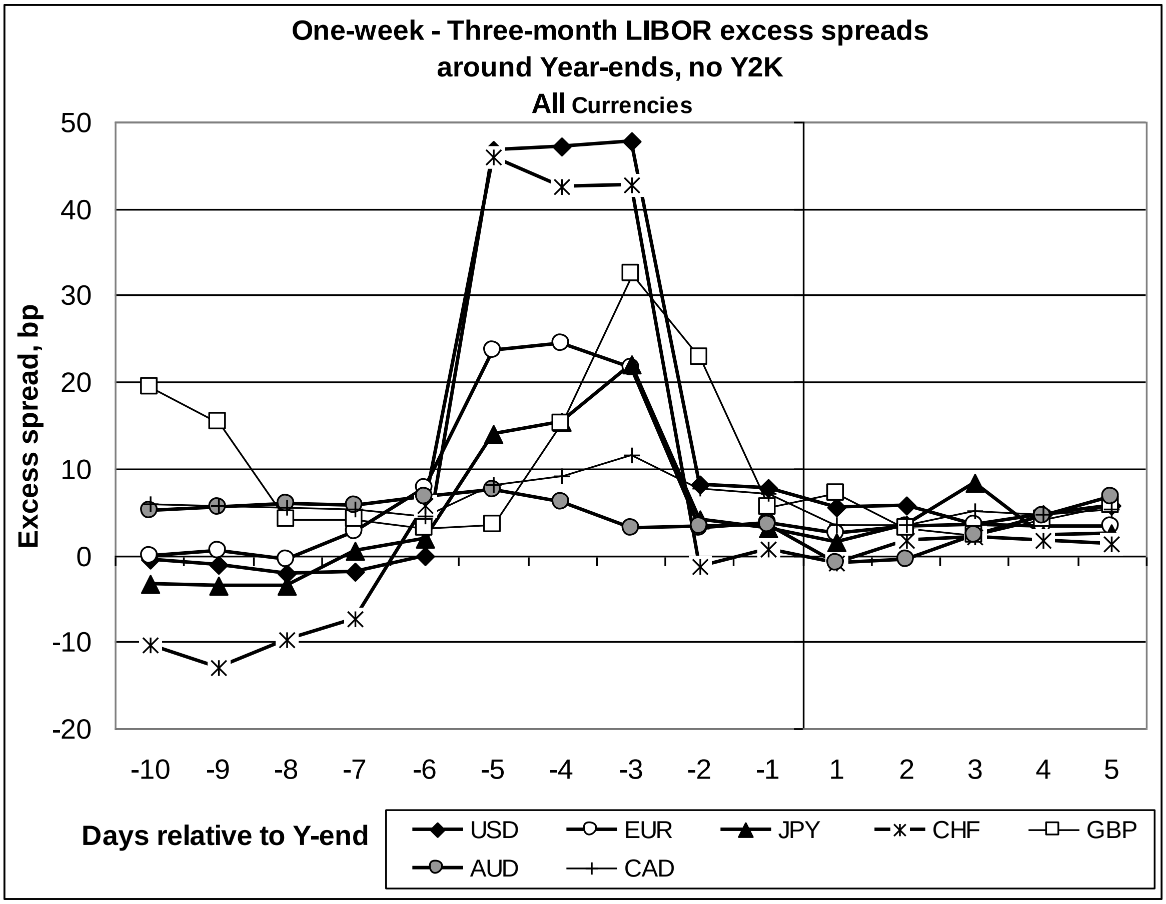

Figure 1. Average excess spread in basis points around year-ends 1998 through 2006, excluding Y2K, between the one-week and three-month LIBOR for all currencies (USD, Euro, JPY, CHF, GBP, AUD, and CAD).

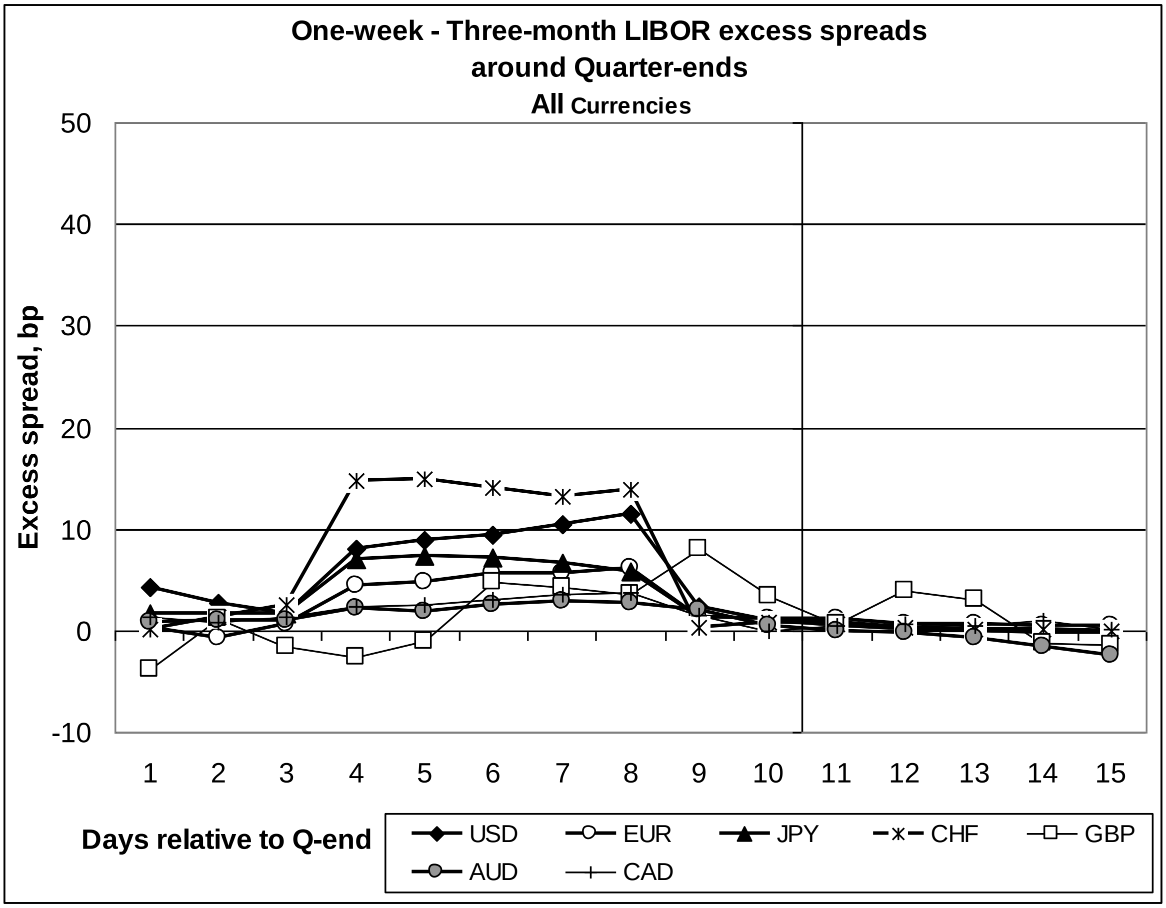

Figure 2. Average excess spread in basis points around quarter-ends excluding year-ends from 1:98 through 3:05 between the one-week and three-month LIBOR for all currencies (USD, Euro, JPY, CHF, GBP, AUD, and CAD).

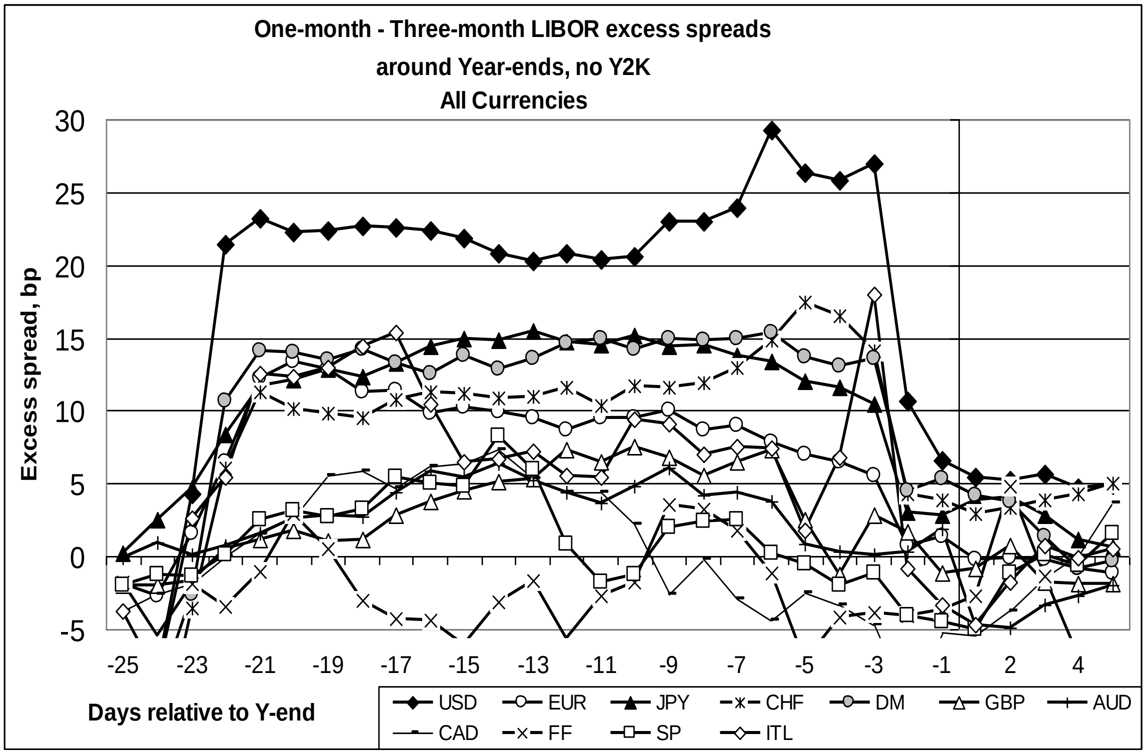

Figure 3. Average excess spread in basis points around year-ends, excluding Y2K, between the one-month and three-month LIBOR for all currencies (USD, Euro, JPY, CHF, GBP, AUD, CAD, DM, FF, SP, and ITL). Data availability periods differ for different currencies.

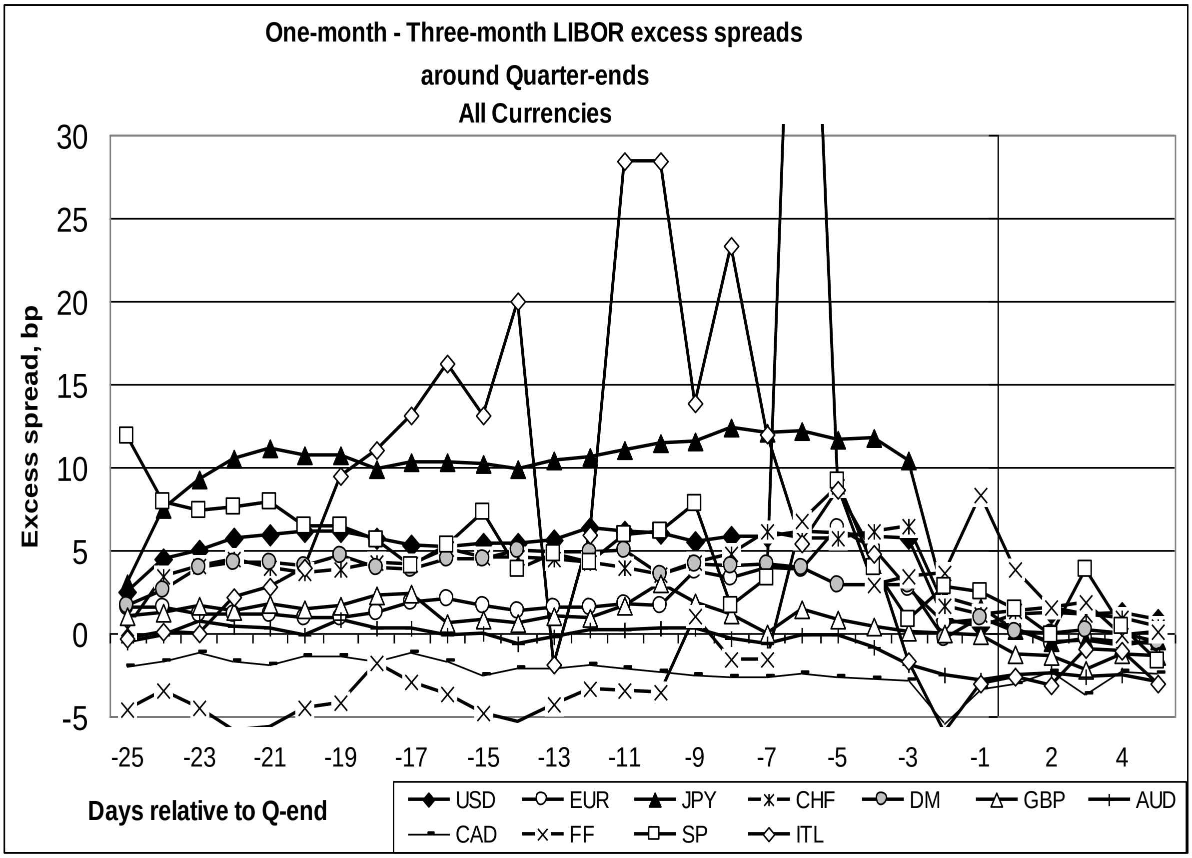

Figure 4. Average excess spread in basis points around quarter-ends between the one-month and three-month LIBOR for all currencies (USD, Euro, JPY, CHF, GBP, AUD, CAD, DM, FF, SP, and ITL). Data availability periods differ for different currencies.