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Information and Volatility in the FX Markets

The role of information in determining asset price behavior has long been an important research topic in finance. For example, in studies of market efficiency, the testable implications of rational expectations center on the specification of how particular information is incorporated into security prices. Until recently, this literature has focused on the effect of information arrival on the level of asset returns. In the context of foreign exchange (FX) markets, studies have examined the impact on exchange rates of different economic announcements, such as U.S. money supply disclosures [1]. Recently, increasing attention has been devoted to the impact of news on asset volatility, but few studies have addressed the effect of information trading on FX volatility. This paper focuses on the influence public and private information have on volatility in the FX futures market. By measuring volatility as the unconditional variance of price changes, we capture the sum of predictable volatility and volatility induced by contemporaneous shocks.

An examination of the FX markets is interesting for several reasons. First, it is the largest financial market in the world with a total daily volume that exceeds $500 billion. Second, the focus of the market microstructure literature has been on common equity in the United States. For example, OLDFIELD and ROGALSKI (1980), WOOD, McINISH, and ORD (1985), FRENCH and ROLL (1986), and others document empirical patterns in the equity market. Third, the FX markets are highly liquid, have low transaction costs, and are open around the clock - features that give rise to a rich set of possible volatility patterns.

Fourth, the FX markets provide a distinctive arena for examining the relation between information trading and asset volatility. The nature of public and private information is more clearly defined in the FX markets. Event studies using data from the equity markets attempt to infer the repercussions on asset prices of firm-specific information. However, event studies are not capable of inferring market-wide information. In the FX markets for the U.S. dollar, U.S. macroeconomic news constitutes the single most important component of public information that affects dollar exchange rates. The effect of macroeconomic disclosures on FX volatility can be examined since the important news releases are concentrated on Thursdays and Fridays between 7:15 am and 8:30 am Central Time (CT).

The difficulties of studying the influence of private information on equity prices are well-known. In particular, the identity of the privately informed trader is usually hidden. Even in the event that the identity of the informed trader can be determined, the timing of his trades often is unavailable. However, in the FX markets, the identity of the most important privately informed trader for dollar exchange rates is probably the New York Federal Reserve Bank. The trading desk of the Fed conducts open market operations around 10:35 am to 11:15 am during weekdays [2].

Finally, an analysis of FX volatility is of practical usefulness to practitioners like traders, financial analysts, and portfolio managers. Since periods of high volatility are often associated with periods of high risk, they are important determinants of asset prices. For example, option prices are directly dependent on the volatility of the underlying asset. The practical usefulness to practitioners is further enhanced by knowing the impact of public and private information on FX volatility. By recognizing the various sources of market volatility, the practitioner is better able to predict future volatility. The forecasts are valuable for numerous purposes, including portfolio managers who make asset allocation decisions and risk-averse investors who choose to avoid periods of high anticipated volatilities.
The structure of the FX markets also has its limitations for an analysis of information trading and market volatility. The FX markets consist of markets for spot, forward, futures, and options, although the volume of trading is concentrated in the markets for spot and forward contracts. However, the spot and forward markets do not have central trading sites, but are located in places such as the trading rooms of money-center banks. Therefore, we focus our attention on FX futures. Another drawback of the FX market structure is that trade volumes are not easily available as it requires aggregating volumes from different locations. Moreover, price data may deviate from one source to the next. We confine our analysis to transaction data on FX that are obtained from the centralized futures transactions on the Chicago Mercantile Exchange's International Monetary Market (IMM) and the London International Financial Futures Exchange (LIFFE).

1. A Description of FX Markets

The FX market has the largest volume of any financial market in the world. It is effectively open 24 hours a day, seven days a week, and is facilitated by electronic trading and a succession of overlapping business hours. Most of the FX trading is concentrated in the over-the-counter interbank spot and forward markets, and only a small portion of the total FX trading takes place in the futures market. However, the FX futures market is intimately linked to the spot and forward trades conducted in the interbank market. In the interbank market, simultaneous trades often occur at different prices, so that the single price posted by the futures exchange becomes an important source of information to the traders who are typically active in both markets.
On the IMM, the exchange rates are quoted as U.S. dollars per unit of foreign currency, and trading occurs between approximately 7:30 am CT and 1:30 pm CT. During the sample period that we study, the LIFFE also trades some currency futures that are identical to the IMM contracts.

2. Data Description

Our data consist of foreign currency futures transactions on the IMM from July 21, 1980 to May 10, 1988. We use the nearby futures contract on all days with one exception. On the last day of trading, we jump to the next-out futures contract to avoid the early closing time. Opening and closing prices are obtained by taking the first transaction price in the first 20 minutes of trading and the last transaction price in the last 20 minutes of trading. The hourly returns are from Open-8:30 through 12:30-Close. They are computed by using the transaction price that is closest to the half-hour, but within a five minute band on each side of the half hour.

3. Opening Volatilities and Information Trading

Both the source and the timing of the relevant public information disclosures for the FX markets are identifiable. For the U.S. dollar exchange rates, the U.S. macroeconomic news releases are the most important public information. The U.S. macroeconomic news is also communicated regularly between 7:15 and 8:30 am CT [3]. Many macroecono-

mic announcements, such as the Producer Price Index and the Civilian Unemployment Rate, are released by the start of trading on the IMM at 7:30 CT on Fridays. In addition, capacity utilization rates are always announced on Fridays. The effects of other announcements may also become apparent at the opening on Fridays. For example, starting in February 1984, the Federal Reserve Bank begins releasing money supply aggregates on Thursdays at 3:30 pm CT after the IMM has closed. Thursday is the second most important weekday for the frequency of macroeconomic news releases. For example, half the announcements of figures for plant and equipment expenditures occur on Thursdays.

Figures 1 to 5 plot the intraday variances by day of the week over the period July 21 1980 to May 10, 1988 for British pound futures, Swiss franc futures, Deutsche mark futures, Japanese yen futures, and Canadian dollar futures, respectively. A test of variance equality shows that except for the Swiss franc, the intraday variances are significantly different from one another. The figures display the high opening volatilities on Thursdays and Fridays relative to other days of the week. The large volatilities observed at the opening on Fridays may be attributed to U.S. public news announcements since the time slot coincides with the large number of U.S. macroeconomic announcements. The high Friday opening volatility is not caused by the expiration of the contract since the expiration takes place two business days before the third Wednesday of each month. The Thursday opening volatilities are clearly elevated though not as high as the Friday openings. Perhaps the high opening volatilities on Thursdays are no coincidence since Thursdays also happen to be the second most frequent weekday for macroeconomic news releases.

The elevated Friday opening variances are also consistent with the implications of the private information models of both ADMATI and PFLEIDERER (1988) and FOSTER and VISWANATHAN (1990). ADMATI and PFLEIDERER illustrate the theoretical concentration of volatility in the presence of a particular type of adverse selection but not its timing. If there is an increase in nondiscretionary liquidity trading just before and after any

Figure 1: Volatility of IMM British Pound Futures, July 21, 1980 to May 10, 1988.

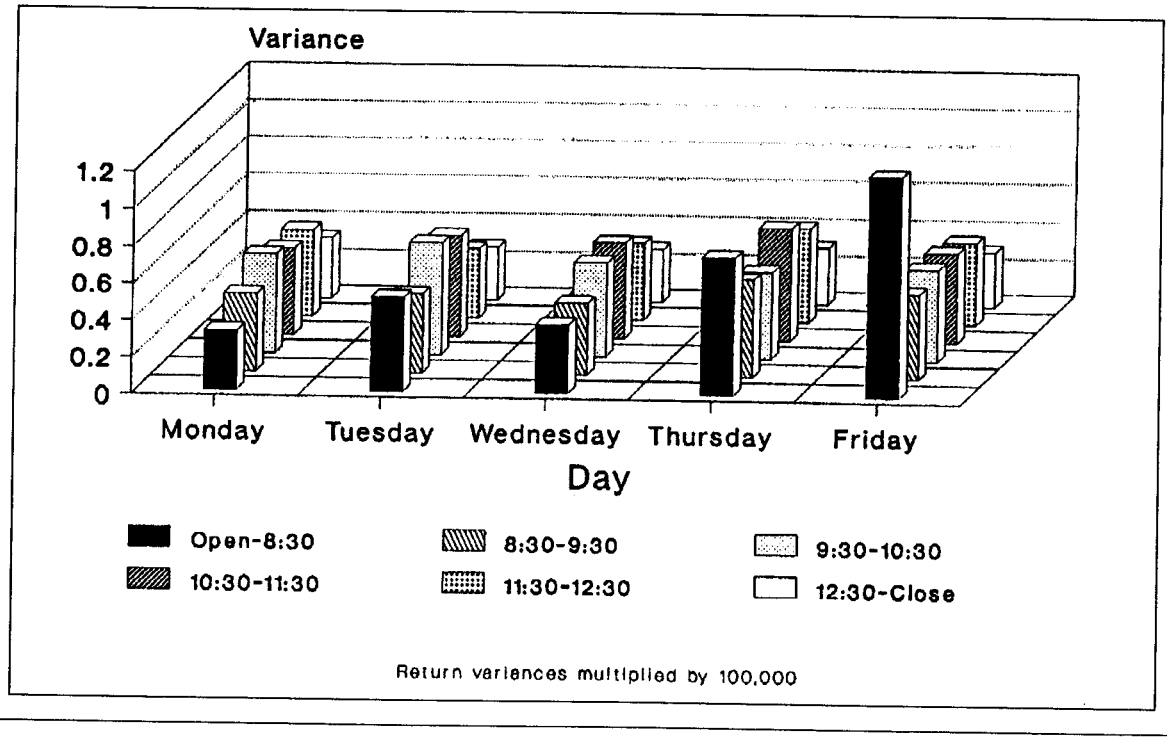


Figure 2: Volatility of IMM Swiss Franc Futures, July 21, 1980 to May 10, 1988.

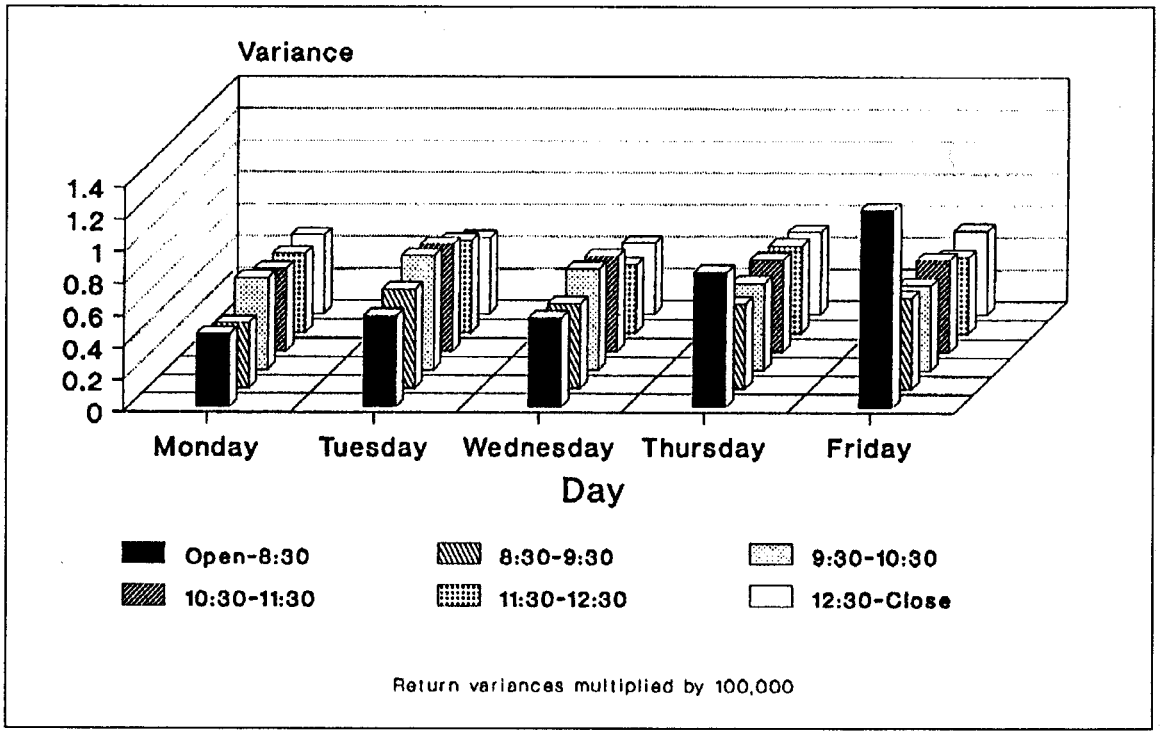


Figure 3: Volatility of IMM Deutsche Mark Futures, July 21, 1980 to May 10, 1988.

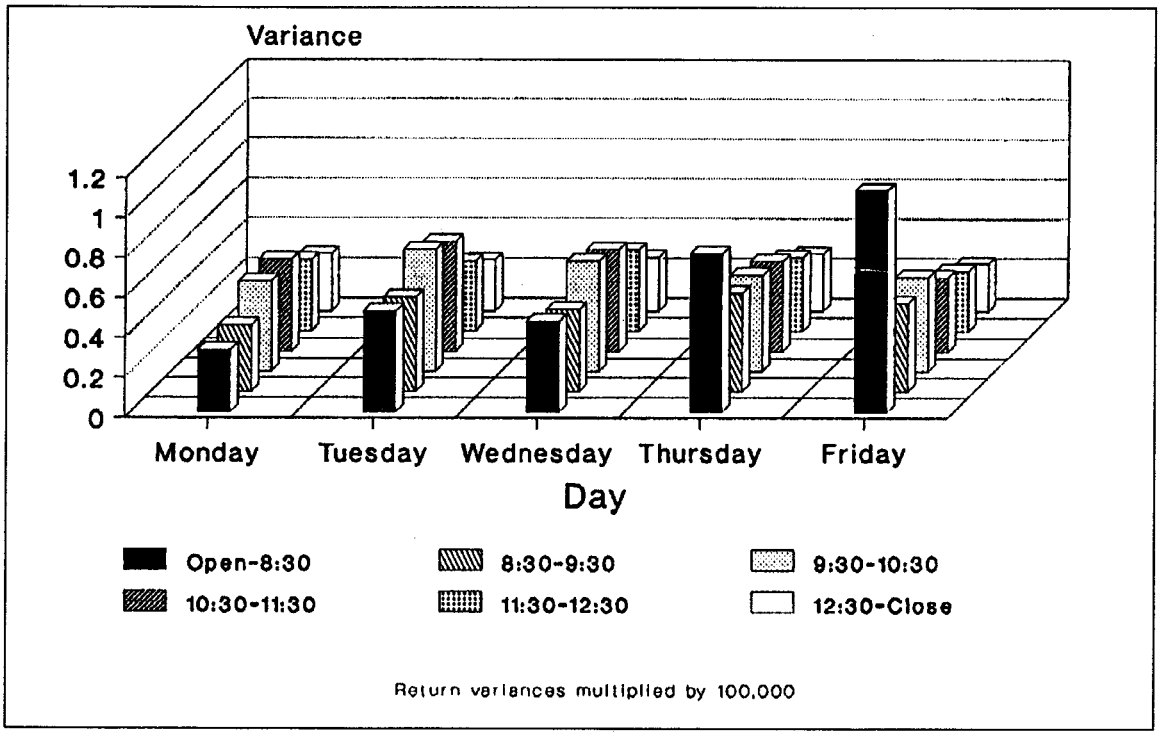


Figure 4: Volatility of IMM Japanese Yen Futures, July 21, 1980 to May 10, 1988

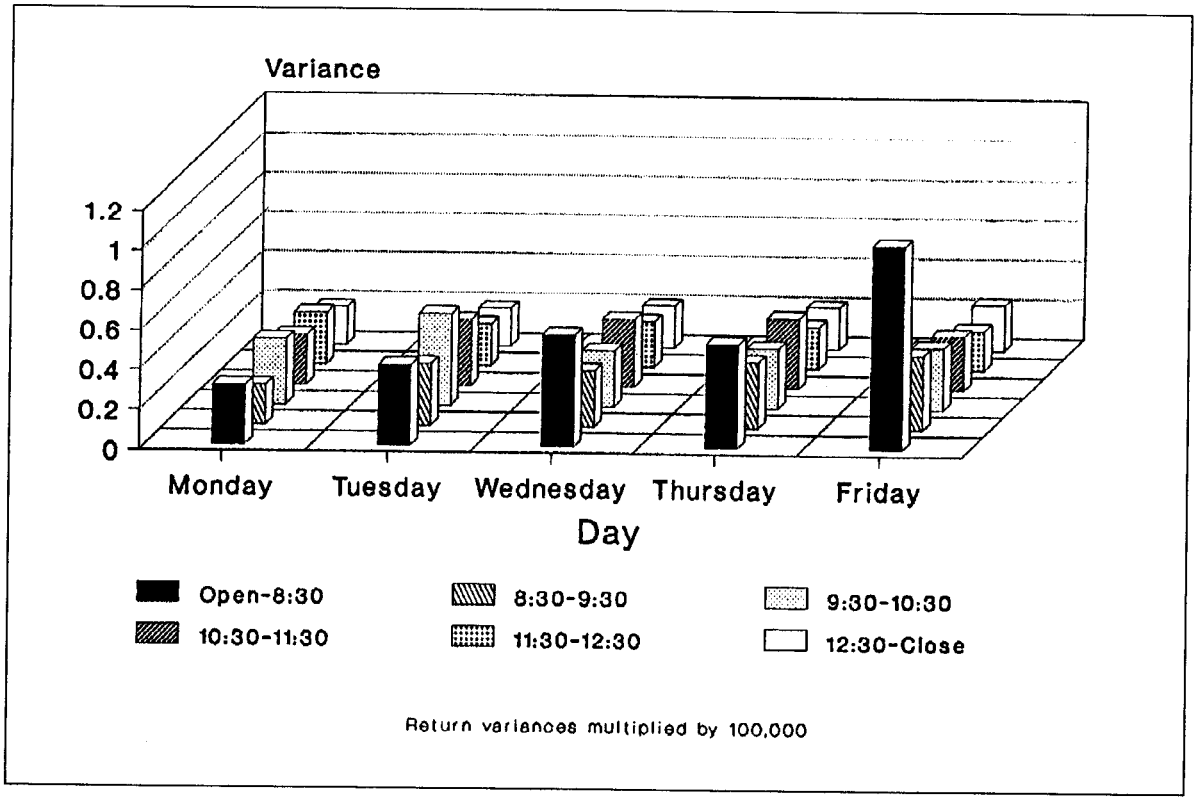
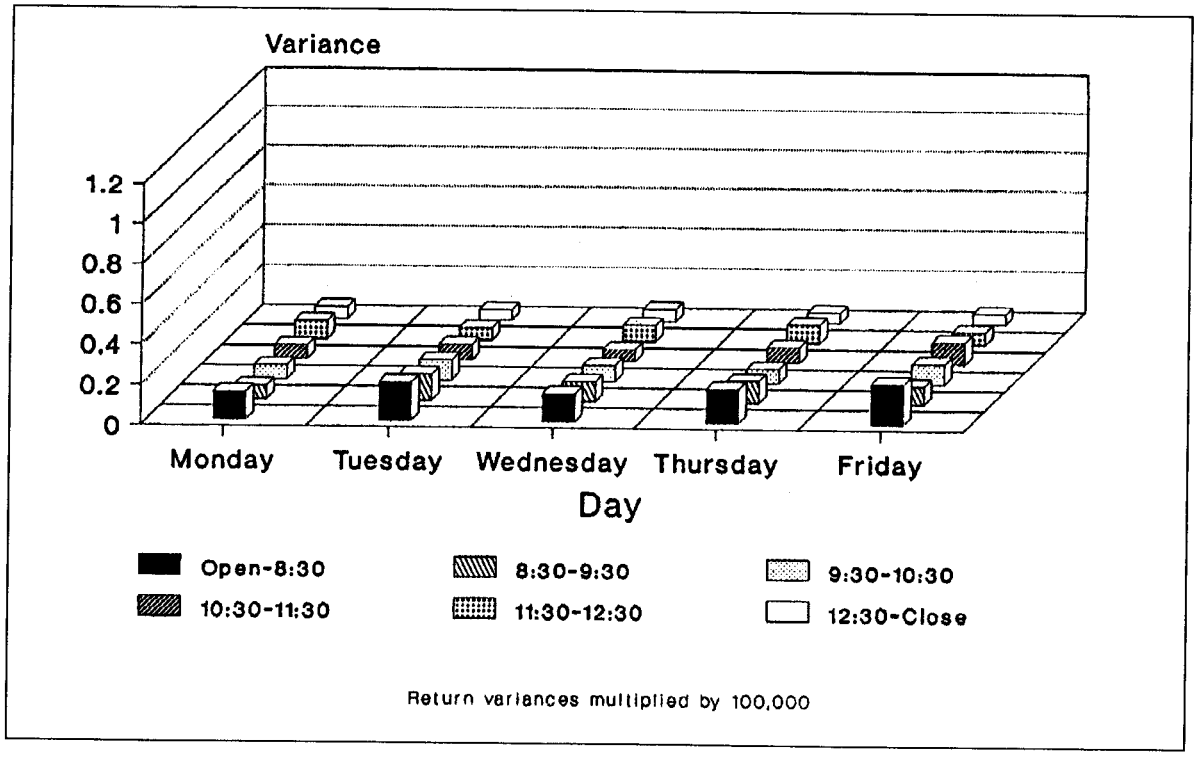


Figure 5: Volatility of IMM Canadian $ Futures, July 21, 1980 to May 10, 1988.



period in which it is difficult to trade, then their model would predict prices to be more volatile and informative just after the open and just before the close.

The IMM opening coincides with the early afternoon trading in the European markets. From Monday to Thursday, the Continental banks close at 9:30 am CT and the London banks close at 10:30 am CT. On Friday, the European markets close around 5:00 to 6:00 am CT. Therefore, the European banks have been closed for over an hour when the IMM opens on Fridays. If nondiscretionary liquidity trading tends to increase before and after a period when it is relatively difficult to trade, then these would be the times that the ADMATI and PFLEIDERER model would predict volatility concentrations. Given the presence of continuous and multiple markets for foreign exchange, it is unlikely that U-shaped intraday volatility patterns found in the analysis of U.S. common equity markets would be observed. However, given the early closure of the European markets on Fridays, volatility may be concentrated at the opening on Fridays.

FOSTER and VISWANATHAN (1990) have developed a model of interday trading in which informed traders have more private information on Mondays after the stock market has closed for the weekend. Since informed traders have an incentive to trade before the information is publicly disseminated, their model predicts higher trading costs and variability of price changes on Monday. The FOSTER and VISWANATHAN model would also suggest high opening Friday volatilities, because informed traders can replenish their stock of private information after important components of the European FX markets close early and before the IMM opens on Fridays.

In summary, the elevated opening volatilities on Thursdays and Fridays are consistent with the prediction of the public information hypothesis. An application of the private information models of ADMATI and PFLEIDERER (1988) and FOSTER and VISWANATHAN (1990) to the FX markets can also explain the elevated volatilities on Friday openings because the Friday opening follows two hours of low liquidity in Europe. However, these models are unable to explain the high variances at the opening on Thursdays.

4. Multiple Sources of Public Information News

Individual exchange rates react to public economy-wide information of the two countries that comprise the exchange rates and possibly to other countries as well. Therefore, dollar exchange rates likely are affected by public information that is released outside the U.S. Therefore, FX volatility may be concentrated during the times when the most relevant macroeconomic news is released. This issue is addressed by HARVEY and HUANG (1991a).

HARVEY and HUANG (1991a) compare the volatility during IMM trading and non-trading intervals. When variances from Friday close to Monday open returns are compared with open-to-close return variances during the week, they obtain a variance rate ratio for all currencies traded on the IMM of 6.5 [4]. This is sharply lower than the ratio of 71.8 reported by FRENCH and ROLL (1986) for common equity and reflects the 24 hour nature of the FX markets. Since there are relatively few macroeconomic news announcements on weekends, a variance rate that is greater than unity may be attributed to trading based on public information. This interpretation is also supported by the fact that the weekend variance rate ratio for the Canadian dollar is higher than for the other contracts. Since trading on the Canadian FX markets coincides substantially with trading on the IMM, this result is also consistent with the public information hypothesis. In contrast, the Japanese markets are open during the nonexchange trading hours and the Japanese yen variance rate ratio is the smallest of all the contracts. The weekend variance rate ratios of the three European currencies are between the Japanese yen and the Canadian dollar contracts which is what we would expect for currencies with overlapping trading hours. Specifically, the numerator of the IMM ratios contains two and one-half hours of trading when both the IMM and LIFFE are operating and three and

one-half hours of IMM trading alone. When the variance rate ratios for daily (open-to-close) returns to overnight (close-to-open) returns for the IMM FX futures are examined, the ratio of 3.4 for the FX contracts traded on the IMM is sharply lower than the value of 16.2 for U.S. common equity found by STOLL and WHALEY (1990).

HARVEY and HUANG (1991a) also conduct a direct comparison of volatility during trading hours on the LIFFE and the IMM. They find that the U.S.-European exchange rates are, on average, twice as volatile during IMM trading hours. The volatility of the European exchange cross-rates is generally concentrated during European trading hours. These higher exchange cross-rate variance ratios are consistent with the higher probability that relevant European macroeconomic news is released during European trading hours. The result that the U.S. dollar exchange rates are more volatile during U.S. trading hours is consistent with the importance of public information. It appears that U.S. news is more important for the U.S. dollar contracts than news from other countries. Correspondingly, an analysis of exchange cross-rates indicates that European news disclosures are at least as important as the U.S. news releases since European exchange cross-rates exhibit higher volatility during European trading hours.

5. Private Information Trading

In general, volatility induced by trading on the basis of private information cannot be ruled out, and it is tempting to interpret the variance rate ratios in terms of private information trading. FRENCH and ROLL (1986) exploit the structural feature of market closure in U.S. equity market to argue that trading based on private information leads to higher volatility when the market is open compared to when the market is closed. However, the FX market is not characterized by this special type of market closure. In the currency markets, U.S. investors have the ability to trade in many markets 24 hours a day. Still, the dollar volatility may occur when the U.S. markets are open because most of the private information about the value of the dollar is revealed by U.S. investors at times when they face the lowest transactional impediments to trade. However, trading during U.S. business hours does not necessarily guarantee lower transaction costs. Indeed, the most liquid market for foreign exchange is not in the U.S. but in London, where the trading volume is twice that of New York [5]. Therefore, the ability to trade around the clock and the high liquidity in non-U.S. markets suggest that the concentration of volatility for the U.S. exchange rates during U.S. trading hours is probably driven by public rather than private information-based trading.

While it is not possible to directly test the relative importance of private information versus macroeconomic information-based trading on volatility, the FX markets permit the study of the relation between market volatility and a specific source of private information. Generally, the study of the relation between private information trading and volatility is encumbered by the difficulty of identifying informed trades. In the FX markets, the determinants of FX rates are generally publicly available information so that the definition of private information and informed traders is unclear. However, HARVEY and HUANG (1991b) have identified an important informed trader in financial markets. This is the New York Federal Reserve Bank whose trading desk implements the monetary targets of the Federal Open Market Committee. Given the close link between interest rates and exchange rates, the New York Fed potentially exerts a powerful influence on U.S. dollar exchange rates by influencing interest rates through open market operations. Fortunately, following a daily routine of gathering information from various sources, the trading desk of the New York Fed conducts its trading regularly between 10:35 and 11:15 am CT that is known as "Fed time." If private information induces increased trading volatility, "Fed time" should probably provide the strongest evidence.

Figures 1 to 5 document that for Monday through Thursday, the volatilities exhibit an inverse U-shaped pattern that peaks between 9:30 to 11:30 am

CT. This pattern is most apparent for the U.S.-European exchange rates, less apparent for the dollar-yen rate, and absent in the dollar-Canadian dollar currency futures. During the first three days of the week, volatilities are low at the Open-8:30 period and the 8:30-9:30 period, higher during midday, and lower at the close. Thursday is different in that it displays a high opening volatility. The pattern on Fridays is quite different from that on the other weekdays and seems to be at odds with the Fed trading behavior. On Friday, high volatilities are observed in the first hour of exchange trading, but the volatilities drop off sharply in the next hour and remain moderately flat for the next five hours.

Thus, the evidence of volatility in FX futures induced by informed trading is mixed. The intraday volatility pattern of U.S.-European exchange rates from Monday through Thursday appears to be consistent with trading based on private information. However, it remains unclear as to why a similar effect is absent on Fridays and is mitigated for U.S.-Canadian dollar futures.

6. Conclusion

What have we learned about the relation between information trading and volatility in the FX markets? First, the intraday volatility on the IMM may vary by day of the week because of public and private information trading. The opening volatilities on Thursday and Friday are sharply higher than other days of the week. These high opening volatilities may be explained by increased public information announcements since the most important day for U.S. macroeconomic announcements is Friday followed by Thursday. In addition, from Monday to Thursday, the intraday volatilities display a humped pattern that crests about the time the trading desk at the New York Federal Reserve Bank starts conducting its open market operations. This result provides evidence compatible with private information trading. However, no such pattern is observed for Friday.

Second, the volatility is highest when the trading hours coincide with the business hours of the countries whose currencies are being traded. For the U.S. dollar, the volatility is higher during Chicago trading hours even when the other currency is European. For European exchange cross-rates, they show higher volatility during European trading hours. These results may also be explained in terms of volatility generated by the release of public information.

Footnotes

[1] See, for example, the works of HAKKIO and PEARCE (1985) and ITO and ROLEY (1987).

[2] At the level of individual transactions, FX volatility may also be induced by pricing errors. However, it is difficult in practice to separate volatility induced by information from volatility due to noise trading.

[3] A listing of the announcements and their release dates may be found in HARVEY and HUANG (1991a).

[4] A variance rate is calculated by deflating the measured total variance by the number of hours in the interval.

[5] The market with the largest spot and forward volumes is London, followed by Tokyo and then New York (KRUGMAN and OBSTFELD (1988)).

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