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Explaining Trading Volume in Foreign Exchange: Lessons from Tokyo

Richard Lyons

The enormous volume of trading in foreign exchange (FX) markets–almost 100 times the volume on the New York Stock Exchange–has been a puzzle. Economists have turned to a variety of approaches to solve the puzzle–the goods market approach, the asset market approach, and the microstructure approach.

This *Economic Letter* (based on Ito, et al., 1998) focuses on the microstructure approach, with particular attention to the Tokyo market. In 1994, this market made a change in the way it does business, a change that might seem to have nothing to do with explaining trading volume. The market lifted the restriction on trading during the lunch hour (12:00-1:30). This *Letter* shows that, in fact, the shift from a lunchtime break to continuous trading provides a natural experiment on one of the underlying motives for trading. In itself, the *Letter* does not resolve the trading volume puzzle (see, e.g., Lyons 1996 for other microstructure factors that amplify volume). Understanding the motive addressed here does, however, contribute to a resolution.

The three approaches

Until the 1970s the goods market approach was the traditional explanation for exchange rate movements. Under this approach, demand for currencies is determined largely by purchases and sales of goods. For example, an increase in exports increases foreigners' demand for domestic currency to pay for those exports. The FX trading volume this approach produces, however, is limited to the underlying volume of trade in real goods and services. This is grossly inconsistent with the data: trade in

goods and services can account for less than 5% of FX trading.

In the 1970s the asset market approach emerged. It built on the earlier approach by recognizing that the demand for currencies depends not only on purchases and sales of goods, but also on purchases and sales of assets. For example, in order to purchase a Japanese government bond an investor must first purchase the yen needed to make payment. While the asset market approach clarified thinking considerably, empirical work in the 1980s could not confirm it: the macroeconomic variables that move exchange rates under this approach do not have the predicted effect. Moreover, this approach does not explain the enormity of the trading volume. The reason is that, under this approach, macroeconomic information relevant for purchasing and selling assets is publicly available, and everybody agrees on the implications of that information. In this setting, news moves the exchange rate without trading. And people do not trade with one another on the basis of different views because they all hold the same view. Thus, seen from this approach, the enormous trading volume in FX remains a puzzle.

Analyzing the Tokyo experiment–the lifting of the lunchtime trading restriction–illustrates a new approach to exchange rates, the microstructure approach. Like the asset market approach, this approach focuses on the demand for currencies as coming from purchases and sales of assets. It extends the asset market approach by loosening three of its most uncomfortable assumptions. First, microstructure models relax the assumption that all information relevant to exchange rates is publicly available. For example, bank traders, at their trading desks see trades and quotes in the market that are not observable by the public. These quotes and trades may be valuable for forecasting future exchange rate movements, even if only in the short run (e.g., seeing a central bank's intervention trade before the rest of the market). Second, the microstructure models loosen the assumption that all market participants are alike. For example, traders may disagree about the implications of a given piece of information; or they may be trading for different reasons-like hedging versus speculation. Third, this approach models the trading environment more explicitly. For example, microstructure models are explicit about the timing of trades–open versus closed markets–and who can trade with whom at various times.

The Tokyo experiment: description

The Tokyo experiment addresses a key motive for FX trading: informational advantages. The experiment is based on a simple fact: in general, volatility is much higher over periods of continual trading than over otherwise similar periods that contain a closure. Why should this be so? Three possible explanations have been proposed: (1) publicly available information, like a macroeconomic announcement, arrives primarily during trading hours and therefore affects price at that time; (2) errors in pricing may be more likely during trading hours; and (3) some people may be trading on information that is not publicly available, thereby affecting price during trading hours.

To discriminate among these explanations, an insightful paper by French and Roll (1986) examined stock market closures. These closures were special, however: they occurred on what otherwise would have been normal trading days, and the cause of the closures-bookkeeping backlogs-had nothing to do with the rest of the economy. Thus, the flow of publicly available information on these days was the same as on normal trading days (as compared to, say, a holiday). They found that volatility over periods spanning these closures decreases. Since this cannot be due to a changing flow of public information, they turned to the other two possible explanations. After finding only a small role for pricing errors, they concluded that some type of information about equities that is not publicly available is the main source of high trading-time volatility.

To perform a French-Roll type analysis on the foreign exchange market one needs an experiment like theirs, namely, open and closed periods that do not differ in the flow of public information. The lifting of the trading restriction in Tokyo is just such an experiment. Three key facts support the possibility that the flow of public information remained unchanged. First, abolishing the trading restriction was not part

of a broader policy reform, nor was it the work of the Ministry of Finance; rather, it was an isolated change in regime, unlikely to be correlated with Ministry of Finance policy more generally. Second, reviewing the schedule of relevant macroeconomic announcements in the subsequent months shows that no change over the lunch hour occurred. Third, the timing of some public information is endogenous and may be affected by trading rules (an issue that arises in the French-Roll paper as well since their closures were known in advance). However, an examination of the flow of news reports on the Money Market Headline News screen, a measure of public information flow commonly used by analysts, suggests that the number did not increase after lifting the restriction. Thus, the usual measures indicate that the flow of public information remained unchanged.

The Tokyo experiment: results

Now, what happened to lunch-hour volatility after the trading restriction was lifted? *Lunch return volatility doubled.* This increase is statistically significant and is illustrated in Figure1, which is based on three 90-minute periods. Even though this result is similar to that of French and Roll, it is perhaps more striking since most people believe that in the FX market the flow of public information is even more important for understanding volatility than in the equity market.

So what's going on? Because we have controlled for public information, the volatility increase must be coming from one of the other two explanations cited above — non-public information and pricing errors. To discriminate between them, we can look to relevant theory for testable implications. Specifically, we can look to work on volatility patterns. It is a stylized fact that within a trading day, volatility in most financial markets is relatively high in the morning, lower midday, and then high again in the afternoon. This is typically referred to as the intraday volatility "U-shape." From Figure 1 it is clear that this holds for the foreign exchange market as well. Theory explains the volatility U-shape using non-public information. We can use this theory to provide testable implications of the presence of non-public information, for example, how the U-shape should change when lunch-hour trading is introduced. Specifically, theory predicts the U-shape will flatten: more information can be revealed through trading over the lunch period, leaving a smaller share for the morning and afternoon. Clearly, this implication of non-public information is borne out in Figure 1 as well.

There is another testable implication provided by models with non-public information. This implication relates to trading over the morning period: if non-public information is indeed driving the U-shape, then in the period with closure over lunch we should find a morning U-shape. Moreover, after the restriction is lifted we should find that the morning U-shape disappears as a full-day U-shape emerges. Figure 2 verifies that this is the case, using higher resolution hourly intervals from 9:00AM-1:00PM. The data behave just as the models based on non-public information predict.

Now the question must be confronted: What is this information that is not publicly available but clearly moves exchange rates? Of the many examples, I describe just two. First, actual FX traders, for example, often cite the fact that not all market participants have the same information about real-time trading activity. Traders at big commercial banks have a lot more customers placing large trades directly through them. This non-public information about demands allows them to forecast how the market will react when it learns about these big trades (that is, it is a motive for speculative trading). Another example, cited above, is advance knowledge of the trades of central banks during intervention operations: a dealer who first receives a central bank's order has superior information for forecasting exchange rate movements.

Conclusion

The Tokyo experiment provides four facts that support the presence of information that both is not publicly available and is important for exchange rate movements. First, the volatility of the yen/dollar rate over the lunch hour increases significantly when the trading restriction is lifted. This volatility

increase cannot be due to public information since there was no change in the timing of macroeconomic announcements. Second, allowing trade over lunch produces a more even volatility pattern over the full day. This is a natural consequence of informative trades being redirected toward the lunch hour. Third, when Tokyo took a lunch break there was a significant increase in volatility just before the break. Models based on non-public information predict this: traders with superior information will choose to trade before the break to ensure that prices cannot adjust before they have opened a position. Finally, allowing trade over lunch causes the increase in pre-lunch volatility to disappear. Models based on non-public information also predict this: since there is no longer a break, traders with superior information do not face the same pressure to trade in the pre-lunch period. In sum, non-public information provides a powerful driver of trading volume, one that plays no role under the traditional macro-oriented asset market approach to exchange rates.

Richard K. Lyons
Associate Professor of Economics and Finance
U.C. Berkeley and Visiting Scholar, FRBSF

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