11th session

28th November 2017

The Microstructure of the Foreign Exchange Market

- Evans (2005)
- Lyons (2001)

- Alternative to traditional approaches.
- The equilibrium spot exchange rate does not come out of a "black box". Instead, it is solely a function of the foreign currency prices quoted by dealers at a point in time.
- Information about the current and future state of the economy will only impact on exchange rates when, and if, it affects dealer quotes.
- The importance of ORDER FLOW; the importance of PRIVATE INFORMATION

Evans, 2005, Foreign Exchange Market Microstructure, mimeo

What is private information in the FOREX?

- There are no rules about the information that must be revealed in the foreign exchange market.
- Fundamentals are mostly publicly announced. But there is a delay between a fundamental variable's realization in the economy and its public announcement – opportunity for private information.
- Evidence that aggregate Citibank customer order flow helps predict future GDP and inflation rates (Evans and Lyons 2007); that interdealer order flow carries information about upcoming macro statistical releases (Rime et al. 2010) – trading contains information about upcoming macro statistical releases.
- Heterogeneous interpretations of macro news - source of private information. Order flow aggregates heterogeneous interpretations in response to news for days following a news release - Evans and Lyons (2005)
- Non-fundamental information about activity that involves large exchange trades – at high frequencies.

Who are the informed traders in the FOREX?

- To identify whether participants are typically informed, examine whether their trades anticipate FX returns. If an agent consistently tends to buy (sell) before prices rise (fall) one concludes he is informed.
- *Dealers* receive information concerning their clients' order flow, which is not observed by other *dealers*. They also receive information that is not public related with the transactions with other *dealers*. Brokers publicize information: the direction of the last transaction and the change in the available quantity on the side of the last transaction.
- Central Banks - Intervention in most liquid currencies is infrequent – only a small fraction of the influence of order flow on foreign exchange returns.

- Do order flows from different market participants affect the exchange rate in the same way?
  - Some studies find different effects of order flow on exchange rates from financial and non-financial traders [Carpenter & Wang (2003) , Mende & Menkhoff (2003), Marsh & O'Rourke (2005), Bjonnes et al (2004)], from important financial centres and the rest [Menkhoff & Schmeling (2008)].
  - The order flow from financial customers is positively associated with the exchange rate; the order flow from non-financial customers is either uncorrelated or negatively correlated with the exchange rate.
  - The financial institutions are dominant influencing the exchange rates. Non-financial institutions basically provide liquidity.
  - Financial institutions (hedge funds, insurance companies, pension funds, etc) get smaller bid-ask spreads. To extract private information, dealers are willing to give them better conditions.

The explanatory power of order flow

- Exchange rates adjust to make net customer currency demand close to zero on most trading days.

Interdealer Market

- Liquidity demand from:
  - Those placing market orders;
  - Those calling other dealers.
- Order flow =
  - market buy orders – market sell orders;
  - dealer initiated buy trades – dealer initiated sell trades

The explanatory power of order flow

- Evans and Lyons (2002) Order Flow and Exchange Rate Dynamics

$$\Delta s_{t+1} = \beta_i \, \Delta(i_t - i^*_t) + \beta_z \, z_t$$

Δs_{t+1} : first difference in log of daily foreign exchange rate

$\Delta(i_t - i^*_t)$: first difference in interest rate differential (public information)

Z_t : difference between nr of buyer-initiated trades and seller-initiated trades during the day.

- Later models: Z_t is signed trade size
- Not the first to analyse relationship between exchange rates and order flow, but the first to use data covering a relatively long period – 4 months

- **Evans-Lyons model**
  - Private information is not assigned to a single participant, it is scattered among individuals.
  - Both dealers and customers are risk averse.
  - Each dealer observes the order flow from his own customers.
  - After trading with their customers, dealers are left with open foreign exchange positions. Beacuse they are risk-averse, they want to close their exposures and they trade with other dealers.
  - Dealers pass their open positions among them and meanwhile, they learn from the order flow.
  - Knowing the aggregate order flow, dealers adjust their quotes in a manner that induces customers to absorb the accumulated open positions.

What does data reveal?

- Some empirical success.
- The order flow has explicative power with relation to the foreign exchange rate changes. It explains approximately 0,5 of the variation, whereas *fundamentals* typically explain no more than 0,1 (even with only inter-dealer order flows).
- Evans and Lyons (2002): Aggregate interdealer order flow in the spot dollar/DMark on day *d* accounts for 64% of the variation in the depreciation rate between the start of days *d* and *d*+1. Macro models can account for less than 1% of daily depreciation rates.
- The impact of order flow on price is a function of the order size, of the time of day and of the horizon.
- There is some persistency in the price impact of order flow: this impact declines gradually but remains significant even at one month.
- The order flow of a currency pair may affect the exchange rate of different currency-pairs.

- Empirical Evidence
  - In traditional macro models, the order flow has no role. The expectations about the foreign exchange rate are influenced by the arrival of information and the price is automatically adjusted with no need for transactions.
  - However, about 2/3 of the influence of news on the foreign exchange rates and on volatility runs through the order flow.
  - Difficulties
    - Availability of order flow data for considerable time spans and covering several dealers.
    - Availability of data for customer order flow.
    - Customer trading: decentralized, no electronic platform, confidential data.
    - Possibility of reverse causality: returns driving order flow. Some studies have controlled for this feedback (Evans and Lyons 2005, Daniélsson and Love 2005)

- Empirical Evidence
  - Potential explanation of the better explanatory power of the order flow models compared to the ones based on macro variables:
    - In Exchange rate models expectations of macro variables cannot be measured accurately. The order flow may be a better translation of the expectations.

VOLUME

- Event-uncertainty view-
  - Some probability *p* that new information exists;
  - If there is new information, with probability *q*, the informed trader knows the price will increase; with probability (1-*q*) it will decrease.
  - If there is no trade at time *t*, the dealer decreases the probability of news having occurred. → times of low trading intensity – less likely that trades signal news – smaller adjustment in prices
  - times of high trading intensity (HIGH VOLUME) – trades are MORE informative

If agents trade currencies as new information arrives to the market, and if this trading changes exchange rates, exchange rate volatility should be positively related to trading volume

VOLUME

- Hot Potato Model (Lyons 1997) – justification of the high trading volumes in the foreign exchange market, not justified by Exports and Imports.

A trader trades a large size (block)

Contacts a dealer

Dealer departs significantly from the desired position

High risk that prices move adversely

In order to reduce that risk, the dealer breaks the order trading using the other dealer's quotes

The block is passed on, creating a volume of transactions that is larger than the initial order

- Hot potato view – If most trades are motivated only by interdealer risk-sharing, a large volume can be a result of a sequence of reactions to an initial piece of news.

- Is there information in Volume?

Not clear.

Returns and volatility

Osler 2008 http://people.brandeis.edu/~cosler/

- Excessive volatility: the foreign exchange rate is much more volatile than the fundamentals.
- Similar fundamentals correspond to a higher volatility in floating exchange rates. Dornbusch overshooting.
- Exchange rates are frequently described as following a random walk at the daily horizon. The unconditional autocorrelation of daily returns is approximately null. At the highest frequencies (5 mins, for e.g) not a random walk.

- $s_t = s_{t-1} + u_t$

$$u_t \sim N(0, \sigma_u^2)$$

The autocorrelation of returns is null, on average: the level of the returns is not predictable.

However, the square of returns exhibits autocorrelation – volatility clustering

- Strong autocorrelation of volatiliy: volatility is clustered in time (ARCH/GARCH) – Large changes tend to be followed by large changes of either sign. Periods of high volatility alternate with periods of tranquility.
  - Baillie and Bollerslev (1991) : The patterns of hourly volatility are similar among countries and are associated with the opening and closing of time zones of foreign exchange markets.
  - Trading interdealer volume and volatility move together
    - Asia opens – volume and volatility rise modestly from overnight lows
    - U – shape during Asian trading hours
    - Another U-shape during London morning
    - Both peak at the closing of London
    - Decline monotonically after that until Asian trading opens.

- Time patterns of volatility
  - Lunch time and week-ends (lower volumes) - lower volatility. 1st hour of trading on Monday –highest volatility
- Positive association between volume and volatility interpreted as a common influence. Larger nr of *traders* - higher probability of disagreement about the right prices. Frankel & Froot (1990) find evidence that a measure of dispersion that quantifies the forecasts disagreement with survey data obtained by asking *traders* causes (Granger causality) both volume, and volatility.
  - If the common influence is news, volatility should move together with unexpected trading volumes.

- Announcements usually increase volatility, but not always. Ex: FED announcements decrease volatility – reduction of uncertainty.

Incorporation of market microstructure findings into traditional models (hybrid)

- More realistic.
- Capable of performing tasks typical of general macro models: simulations, forecasts, welfare analysis.
- Example: Bacchetta & Wincoop (2004): Monetary model [money market equilibrium, ppp, uncovered interest parity] but with heterogeneous economic agents [asymmetric information]
  - No strong co-movement between short run exchange rates and fundamentals.
  - The exchange rates and the order flow move close.
  - In the Long run fundamentals determine the exchange rate.

- King et al. (2010) - adding financial order flow to a forecasting model that already includes macroeconomic fundamentals and commodity prices improves the model's ability to predict movements in the Canadian dollar.

Final remarks- What role for the Macro Approach?

- Macro fundamentals as a means of "setting the parameters" within which microstructural models may be constructed.
- Even though the nominal exchange rate is hard to distinguish from a random walk even at the 1-year horizon, a simple macro fundamentals-based model outperforms the random walk at horizons 5 years+.
- The process by which information is obtained and disseminated in the FOREX is only analysed in the microstructural approach.

- Time-of-day complicate the relation between order flow and returns, with unstable coefficients across different time intervals.

- Relationship between order flows and fundamentals.
  - If the dealers set prices taking into account the expectations regarding future fundamentals based on information, current exchange rates must have predictive power for fundamentals. There is some evidence to that effect, although the predictive power is limited.
  - Although verifying that dispersed information is impounded into prices via interdealer order flow is important, it does not provide evidence on the "ultimate source of exchange rate dynamics".

- References

  - Dominguez and Frankel, 1993, Foreign exchange intervention: an empirical assessment. *in* On Exchange Rates, Frankel JA (ed.). Mit Press: Cambridge, MA.
  - Evans and Lyons, 2004, A new Micro Model of exchange rate dynamics, NBER WP 10379
  - Evans and Lyons, 2005 Do currency markets absorb news quickly? Journal of International Money and Finance 24 (6), 197–217.
  - Flood and Taylor, 1996, Exchange rate Economics: what's wrong with the conventional macro approach? *In* Frankel et al. (eds) The Microstructure of Foreign Exchange Markets, The University of Chicago Press, p.261-294
  - King, Sarno and Sojli, 2010. Timing exchange rates using order flow: the case of the Loonie. Journal of Banking and Finance 34 (12), 2917–2928
  - Lyons, 2001, The Microstructure Approach to Exchange Rates, MIT Press: Cambridge, MA.

- Neely, C., 2000, The practice of CB intervention: looking under the hood, Fed Res Bank StLouis WP 2000-028
- Osler, 2008, Foreign Exchange Microstructure: a survey of the empirical literature, http://www.rpi.edu/~tealj2/Osler2008.pdf
- Rime, Sarno, Sojli, 2010. Exchange rate forecasting, order flow and macroeconomic information. Journal of International Economics 80 (1), 72–88.
- Sager & Taylor, 2006, Under the microscope: the structure of the foreign exchange market, International Journal of Finance and Economics, 11, 81-95
- Sarno & Taylor, 2002, The Economics of Exchange Rates, Cap. 9, Cambridge University Press.