IFM 2014 Lecture 9

Market Microstructure and Exchange Rates

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Outline of lecture

Lecture 9

- Introduction and motivation

- Key features of market microstructure

- Key concept: order flow

- Empirical evidence on order flow

- Summary

Intro to market microstructure

- Short run exchange rate movements pose fundamental problems for **monetary exchange rate models**

- In the short run, exchange rates are

  1. Disconnected from macro fundamentals

  2. Very volatile

  3. Difficult to predict

- As a result, many researchers have turned to **microstructure models**

- This approach asserts that the structure of FOREX markets is important for understanding the behaviour of exchange rates

Intro to market microstructure cont'd

- The volume of trading in FOREX markets is enormous

- BIS (2013) estimates that in April 2013, global currency trading averaged $5.3 trillion per day!

- Spot trading in currencies accounts for $2 trillion per day – around 40% of the total

- This high volume of transactions is problematic for monetary models of exchange rates, because transactions have no role in those models

- Instead, the exchange rate is presumed to 'jump' to its new level whenever public information on macro fundamentals is released

Intro to market microstructure cont'd

- The market microstructure approach asserts that the path taken by the exchange rate to its new equilibrium will depend on how FOREX markets function

- O'Hara (1995) defines market microstructure as:

    The study of the process and outcomes of exchanging assets under explicit trading rules.

- In a recent book on FOREX market microstructure, Lyons (2001) gives a more detailed definition specific to foreign exchange markets

Key features of market microstructure

- As explained by Lyons, market microstructure models make three key assumptions which are missing from monetary models:

    1. Some information is not publicly available

    2. Different agents have different expectations

    3. The structure of the FOREX market matters

- Let's consider each of these assumptions...

Assumption 1: private information

- FX traders often see trades that are not publicly observable

- **Example 1:** FX traders at banks see demand of central banks before the rest of the market

- **Example 2:** foreign exchange dealers have access to information on trades (order flow)

- It is clear that not all information on the FOREX market is public, but the question is whether this asymmetry is important

- We will have something to say about this later in the lecture

Assumption 2: Heterogeneous expectations

- Heterogeneity is essential for the market microstructure approach

- One approach has been to model different groups of agents:

  1. Chartists – extrapolate exchange rate trends using charts

  2. Fundamentalists – consider prospects for underlying economic fundamentals

- This approach may explain why traders with common information often interpret it differently

- There is also convincing empirical evidence of heterogeneous expectations – see MacDonald Ch. 14.1

- We can use survey data to test whether expectations are unbiased:

$$s = \alpha + \beta s^e + resid$$

- **Unbiasedness:** $\alpha = 0$, $\beta = 1$ and *resid* must be unpredictable

- Ito (1990) rejects unbiasedness for some institutions but not others

- MacDonald (1992): most forecasters have biased expectations, but a minority have unbiased expectations

- Since forecasts vary across survey participants, there is evidence of **heterogeneous expectations**

Assumption 3: FX market structure matters

- There are three main types of agents in currency markets:

    1. Customers (non-bank public)

    2. Dealers

    3. Brokers

- Customers are the original source of the demand for foreign exchange, but they must buy currency from Dealers

- Dealers trade foreign currency and are usually the departments of major financial institutions (eg Lloyds). They supply currency to customers and trade with other dealers, sometimes through brokers.

- Brokers specialize in matching buyers and sellers of each currency pair. They offer a degree of anonymity to the Dealers on each side.

Assumption 3: FX market structure matters cont'd

- The dealers are the key players in the market

- Around one-third of transaction volume is Dealer-Customer. The remainder is split roughly equally between Dealer-Dealer and Dealer-Broker trades (Copeland, p. 366).

- Importance of non-customer trade has implications for exchange rates

- **Example:** the 'hot potato' effect may explain why transaction volumes are so high

- "Hot potato trading is the passing of unwanted positions from dealer to dealer following an initial customer trade." (Lyons, p. 13)

Assumption 3: FX market structure matters cont'd

- As a second example, consider a market where transparency is low – ie individual transaction sizes and prices are not generally observable

- Because Dealers will not observe this data, they will be slower to update their expectations after a demand shock for a currency

- As a result, the exchange rate will change more gradually than if the market were more transparent

  Dealers:

- Make a profit by charging different prices to buyers and sellers

- The total profit depends on this spread and the number of transactions executed

Hallmarks of the microstructure approach

- The microstructure approach focuses on two variables which are crucial to Dealers – quantity and price

- In particular, the two hallmarks of the microstructure approach are

  1. Order flow

  2. Bid-ask spreads

- We discuss order flow in detail in what follows, as this has been the focus of recent developments in the literature

- For more detail on bid-ask spreads, see MacDonald Ch. 14.4.1-2

Order flow

- Order flow is NOT the same thing as transaction volume

- Lyons (2001, p. 6) gives us a simple working definition:

  Order flow is transaction volume that is signed.

- To put a number on order flow, we must attach a sign to all transactions over a given period of time

- This leads us to a more precise definition:

  Order flow is the difference between buyer-initiated and seller-initiated orders of currency over a given period of time.

Order flow cont'd

- Suppose we are interested in measuring order flow for a currency over the next 10 days

- We would use the equation:

$$X = \sum_{j=1}^{10} x_j$$

where x_j = difference between buy and sell orders on day j

- By convention, we attach a positive sign to all buy orders and a negative sign to all sell orders

- Therefore, negative order flow means net selling pressure

Order flow: a simple example

- Suppose there are two different individuals and one dealer

- Individuals 1 and 2 approach the dealer:

    1. Individual 1 decides to sell 100 Dollars

    2. Individual 2 decides to buy 200 Dollars

- Order flow is given by

$$X = 200 - 100 = +100$$

- In practice, there are multiple dealers, so we must sum across dealers to get a meaningful measure of order flow
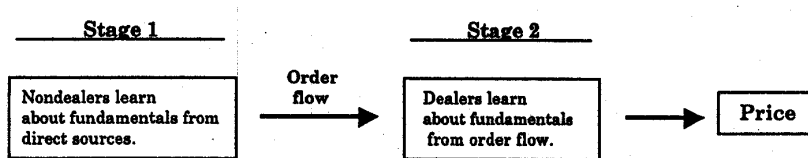
Order flow: key concept

- We are interested in order flow because it is similar to the concept of 'excess demand'

- **Eg:** positive order flow indicates that buy orders exceed sell orders

- Order flow differs from excess demand because

  1. Order flow need not be zero in equilibrium

  2. Order flow measures actual transactions

- The market microstructure approach asserts that

  Order flow is an indicator of market sentiment. (Copeland, p. 370)

Order flow: key concept cont'd

- More specifically, order flow is interpreted as the consensus view about what is going to happen to exchange rates

- Order flow should contain useful information about fundamentals, because it contains the trades of those who analyze fundamentals

Fig 1 – Two stages of information processing (Lyons, Fig 1.1)

Order flow: key concept cont'd

- Crucially, non-dealers may learn about fundamentals before they become public knowledge:

  1. Central bank intervention in FOREX markets

  2. Some non-dealers may have *private information*

  3. Indirectly relevant variables help to predict future fundamentals

- Moreover, the 'macro fundamentals' in monetary models of exchange rates are quantities like GDPs and money supplies

- But info on fundamentals cannot always be quantified – eg speeches, news. This info will be reflected in exchange rates via order flow.

Order flow: key concept cont'd

- In principle, there are good reasons to think that order flow will help to explain and predict spot exchange rates

- But ultimately, order flow is an empirical approach to exchange rates

- Let's look at some empirical studies to decide if order flow is useful...

Evans and Lyons (2002): Order flow and ER dynamics

- **Data:** all bilateral transactions among FX dealers from

  1. Reuters Dealing 2000-1 electronic trading system

  2. Spot US/DM and USD/JPY markets

  3. May 1 to 31 Aug 1996

- The data is summed to give a daily measure of order flow X

- They also have data on:

  1. Daily change in the foreign spot rate, Δs

  2. Daily change in the nominal interest differential, $\Delta i - \Delta i^*$

Fig 2: Exchange rates and order flow, May 1 – Aug 31 1996
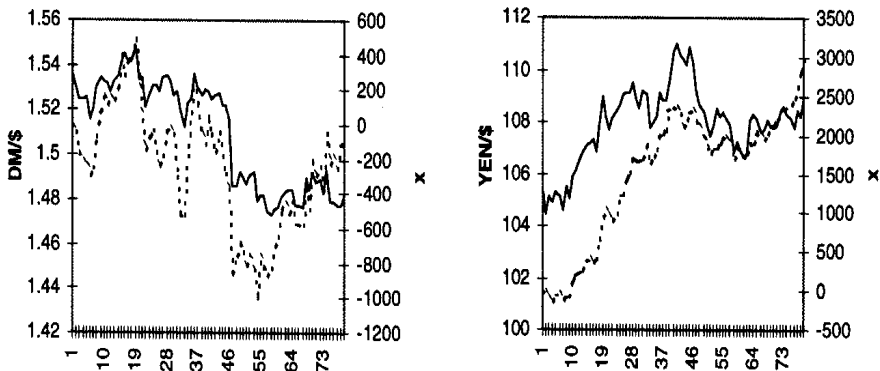
Source: Fig 1, Evans and Lyons (2002)

- EL run a regression of the form:

$$\Delta s = \beta_1(\Delta i - \Delta i^*) + \beta_2 X + resid$$

- If β_2 is statistically significant, order flow matters for exchange rates

- We would expect β_2 to be positive, since order flow is defined as the difference between buy and sell orders for Dollars

- The regression R^2 value will give us an indication of whether order flow has explanatory power for exchange rates

Table 1 – Regression results

Currency pair	β_1	β_2	R^2
DM per Dollar	0.51	2.47	0.64
Yen per Dollar	2.14	2.86	0.46

Source: Evans and Lyons (2002), Table 1

- All coefficients are statistically significant with the expected signs

- Explanatory power of the regressions is impressive

- EL show that this explanatory power comes from order flow – omitting the interest differential variable leaves R^2 essentially unchanged

Evans and Lyons (2002): Summary and caveats

- EL's results suggest that order flow is an important determinant of exchange rate changes at short horizons

- Indeed, it appears to be much more important than interest rates

- They conclude that the common information assumption of standard macro models is incorrect – order flow does convey information that affects exchange rates

- **Caveat:** the results could arise due to reverse causality from exchange rates to order flow. This would be a problem if exchange rate changes have a positive feedback effect on order flow.

Payne (2003): Informed trade in spot FOREX markets

- Payne wanted to see if EL's result still held after controlling for feedback effects

- He considers all inter-dealer trades from

  1. Reuters Dealing 2000-2 system

  2. Spot US/DM market

  3. 6 Oct to 10 Oct 1997 (30,000 transactions)

- In addition, he obtained data on exchange rate changes and constructed an order flow variable

- The data are not summed like in EL(2002) – each transaction is a different data point

Payne (2003): Methodology

- To deal with the reverse causality issue, Payne estimates a 2-equation vector autoregression (VAR) with P lags:

$$\Delta s = \sum_{i=1}^{P} \beta_{si} \Delta s_{-i} + \sum_{i=0}^{P} \beta_{zi} X_{-i} + resid_1 \qquad (1)$$

$$X = \sum_{i=1}^{P} \alpha_{si} \Delta s_{-i} + \sum_{i=1}^{P} \alpha_{zi} X_{-i} + resid_2 \qquad (2)$$

- **1st equation:** similar to the one estimated by EL (2002), but it also includes lags of X and Δs

- **2nd equation:** allows for the possibility that past exchange rate changes drive order flow

- The focus is on the estimated coefficients on order flow and R^2

Payne (2003): Results

Table 2 – VAR results (P = 8 lags)

Equation	Sum of coeffs on X	R^2
Δs	0.0067	0.22
X	NA	0.08

Source: Payne (2003), Table 2

- The sum of the estimated order flow coefficients in (1) is positive, and each individual coefficient is positive and statistically significant

- R^2 values are respectable – and explanatory power of (1) is higher

- These results suggest that the positive impact of order flow on exchange rates found by EL (2002) is NOT spurious

Evans and Lyons (2005): Meese-Rogoff redux

- One obvious question to ask of market microstructure models is whether they can overturn the influential Meese-Rogoff result

- MR (1983) showed that traditional economic models of exchange rates could not beat a random walk out-of-sample at short horizons

- EL (2005) ask whether the microstructure approach fares any better

- To do so, they compare a market microstructure model of the Euro/USD spot rate against a random walk

- The data set runs from Jan 1993 to June 1999

Evans and Lyons (2005): Methodology

- In contast to MR (1983), a true out-of-sample forecast test is conducted – time t info is used to forecast exchange rates in $t + 1$

- **Microstructure model:**

$$\Delta s = \beta_1 + \beta_2 X + resid$$

- In Model 1, aggregate order flow is used, whereas Model 2 uses disaggregated order flow

- Regressions are estimated from Jan 1993 to May 1996, and June 1996 onwards is used for out-of-sample forecasting

- Forecast results for 1 trading day, 10 trading days and 1 month

Table 3 – RMSE ratios (Euro-Dollar)

Horizon	$\frac{RMSE^{MM(1)}}{RMSE^{RW}}$	$\frac{RMSE^{MM(2)}}{RMSE^{RW}}$
1 day	1.026	0.961
10 days	1.001	0.848
1 month	0.896	0.806

Source: Evans and Lyons (2005), Table 1

- There is a significant reduction in forecast error for the microstructure models at the 1-month horizon

- The disaggregated order flow model performs better and clearly beats a random walk – even for 1-day ahead forecasts

- The market microstructure models overturn the Meese-Rogoff result at the 1-month horizon!

Evans and Lyons (2005): Summary and caveats

- EL show that market microstructure models can help to predict nominal exchange rates **out-of-sample**

- The models improve substantially upon the predictions of a random walk. These results confirm that **order flow** is a useful predictor of exchange rates.

- EL note that forecasts from the microstructure model can explain 16% of monthly exchange rate volatility

- **Caveat:** 16% is excellent compared to other models, but it still leaves most volatility unexplained

Market microstructure: a summary

- The literature is at an early stage, but it has shown that order flow can explain and forecast short run movements in exchange rates

- There is also convincing evidence of heterogeneous expectations

- It remains to be seen whether these models are useful at medium and long run horizons, but it seems unlikely that they will outperform models based on macro fundamentals

- **Reason:** info in order flow will eventually become public when published as macro fundamentals (see Copeland pp. 375-6)

- It therefore seems likely that the main uses of market microstructure models will be short run forecasting and analysis

After Easter...

- Revision lecture

- Advance reading:

    1. Lecture slides

    2. Past exam papers on Moodle