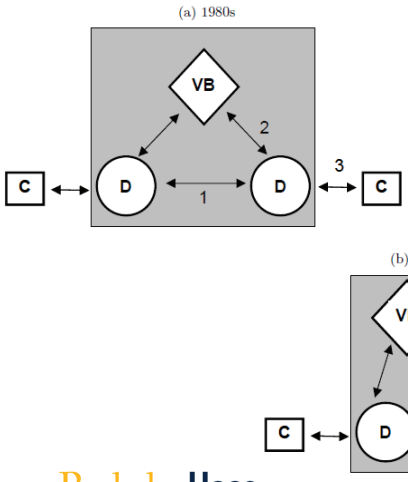
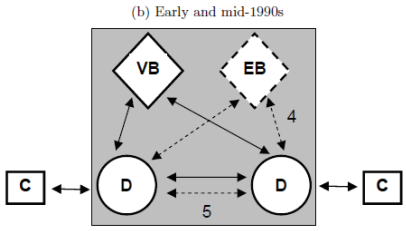
Explaining exchange rates with order flow

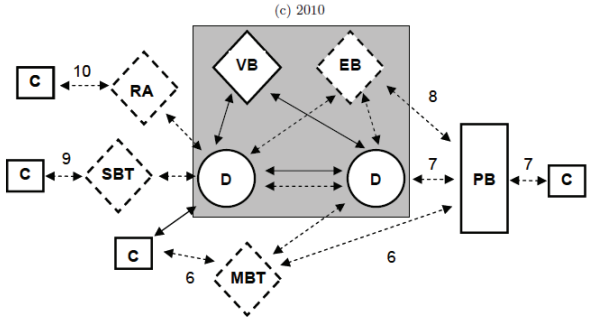
Microstructure approach incorporates

- Information: microstructure models recognize that some information relevant to exchange rates is not publicly available.
- Players: microstructure models recognize that market participants differ in ways that affect prices.
- Institutions: microstructure models recognize that trading mechanisms differ in ways that affect prices.
  - See Microstructure of FX markets by Evans and Rime 2019

Evolution of FX Market Structure

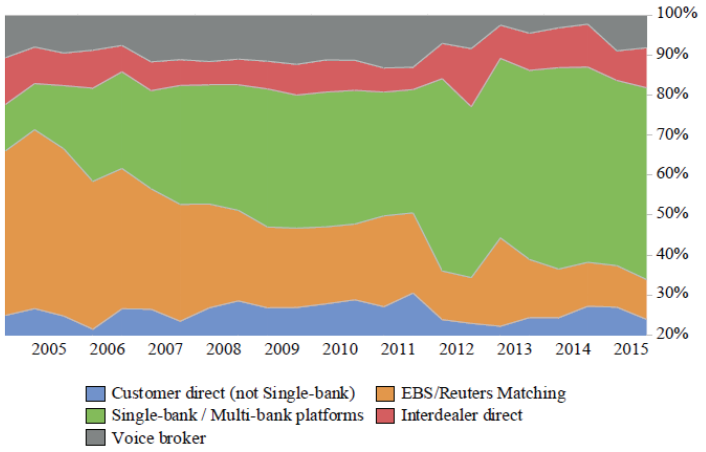






Notes: D=dealer, C=client, VB=voice broker, EB=electronic broker, PB=prime broker, MBT = multi-bank trading system, SBT=single-bank trading system, RA=retail aggregator. Solid lines represent voice execution methods. Dashed lines represent electronic execution methods. Source: King, Osler, and Rime (2012)

Spot FX Share of Execution Method for US Market



Note: Graph show distribution of FX spot volumes in U.S. market on different execution methods. Source: Bi-annual survey by New York Fed FX Committee.

Spot FX Share of Execution Method for US Market

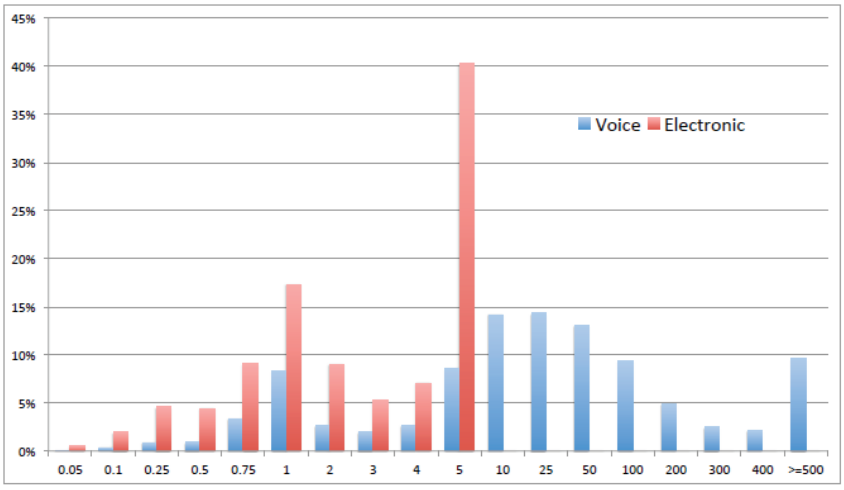
Table 1: Execution Method and End-User Groups

	Major banks	Medium banks	Real Money	Leveraged Investors	Large Corporates	Small Corporates	Brokers	Small banks	Total
Direct	0	0	14	2	25	69	0	2	1
SBT	5	22	33	1	18	30	14	65	12
MBT	51	21	53	46	57	1	25	14	39
Prime brokered	2	30	0	50	0	1	60	3	21
Interbank	42	27	0	0	1	0	0	16	26
Total	53	10	1	5	1	0	24	5	

Note: Table shows the distribution of trading volume for a large bank in 2012 across venues and customer type. Columns shows how the different customer types have traded across venues, while the Total at bottom shows the relative importance of each counter-party group with this bank. The rightmost column marked total split the bank's total volume across the venues. SBT and MBT is short for Single-bank and Multi-bank trading platforms. Source: (Bjønnes and Kathiziotis, 2016).

Spot Trade Size Distribution

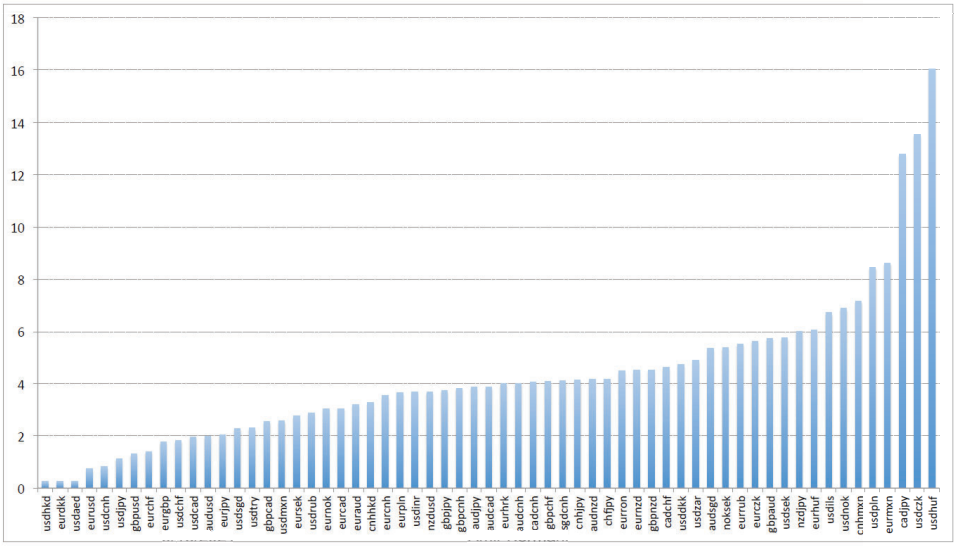
- Is there any economic rational for the smaller relative size of electronic trades?



Notes: The figure plots the faction of spot voice and electronic trading volume in five major currency pairs (EURUSD, GBPUSD, USDJPY, USDCAD and USDAUD) across different trade sizes, ranging from USD 0.05 million, to at least USD 500 million.

There is a very significant variation in cross-currency spreads

- What factors can explain this huge difference in cross-currency spreads?



Notes: The plot shows median relative inside spread, in basis points, on the EBS/Reuters platforms during April of 2013

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Spread and trading volumes

Rank	Currency Pair	Share	Spread	Rank	Currency Pair	Share	Spread
1	EURUSD	24.12	0.754	16	USDTRY	1.17	2.296
2	USDJPY	18.30	1.132	17	USDSEK	1.03	5.758
3	GBPUSD	8.82	1.308	18	USDZAR	0.96	4.894
4	AUDUSD	6.80	1.979	19	USDINR	0.93	3.675
5	USDCAD	3.73	1.965	20	USDNOK	0.91	6.875
6	USDCHF	3.44	1.813	21	EURSEK	0.52	2.773
7	EURJPY	2.77	2.051	22	USDPLN	0.41	8.445
8	USDMXN	2.39	2.574	23	EURAUD	0.39	3.189
9	USDCNH	2.10	0.822	24	EURNOK	0.37	3.027
10	EURGBP	1.90	1.772	25	EURCAD	0.28	3.046
11	NZDUSD	1.54	3.680	26	EURPLN	0.26	3.664
12	USDRUB	1.48	2.879	27	EURDKK	0.23	0.269
13	EURCHF	1.33	1.405	28	EURHUF	0.18	6.063
14	USDHKD	1.28	0.257	29	EURCNH	0.02	3.535
15	USDSGD	1.22	2.295				

Notes: The table reports the percentage share of trading volume for each currency pair reported in the BIS 2013 survey, and the median spread in basis points between the best limit bid and offer prices on the EBS/Reuters platforms during April 2013.

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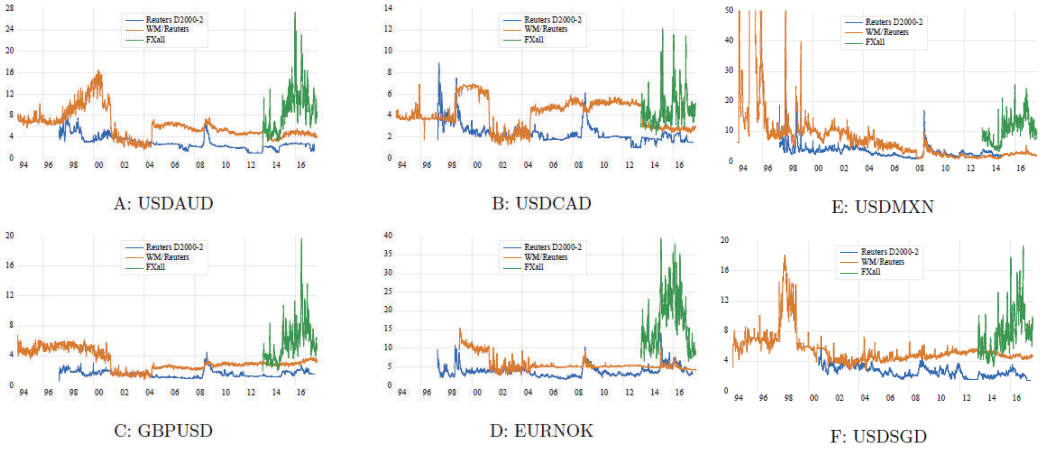
There is also a lot of variation in time-series of spreads and across different platforms

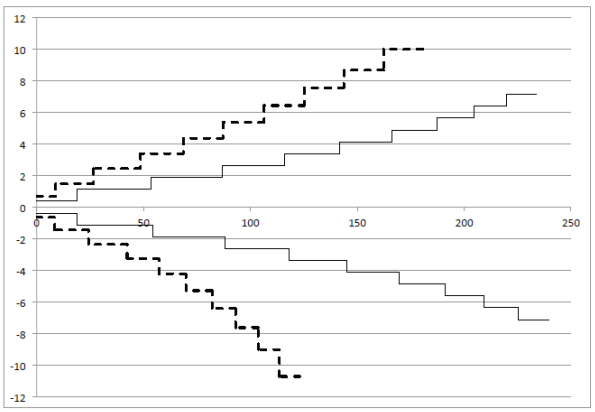


A: USDAUD B: USDCAD E: USDMXN

C: GBPUSD D: EURNOK F: USDSGD

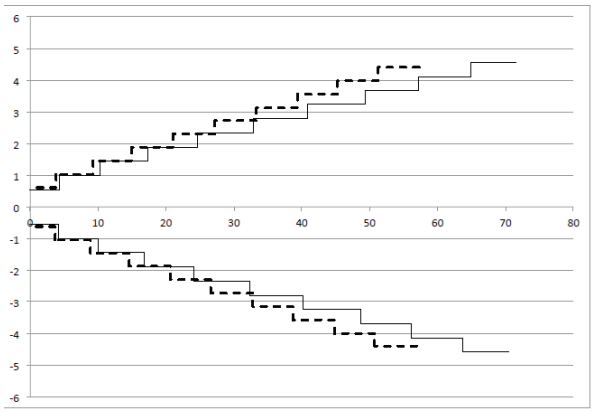
Transaction cost is more than one number for bid-ask spread

Figure 7: EBS Limit Prices, April 2007



Notes: Average ask and bid limit prices in basis points (relative to mid-point between the best bid and ask prices) against the average volume of limit orders, in millions of USD for EURUSD (solid) and USDJPY (dashed).

Figure 8: EBS Limit Prices, April 2015



Notes: Average ask and bid limit prices in basis points (relative to mid-point between the best bid and ask prices) against the average volume of limit orders, in millions of USD for EURUSD (solid) and USDJPY (dashed).

Probability of execution also falls with size

	A: Market Purchase				B : Market Sales			
Trade Size (million USD)	Execution Percentage	VWAP Percentiles 10	50	90	Execution Percentage	VWAP Percentiles 10	50	90
EURUSD								
10	100.00	0.613	0.912	1.227	100.00	-1.226	-0.917	-0.618
20	99.96	0.905	1.270	1.658	99.93	-1.657	-1.274	-0.917
30	99.71	1.163	1.603	2.048	99.63	-2.046	-1.607	-1.181
40	98.50	1.401	1.915	2.396	98.50	-2.399	-1.917	-1.429
50	91.31	1.603	2.182	2.650	91.03	-2.650	-2.184	-1.640
60	66.10	1.689	2.332	2.766	65.77	-2.763	-2.338	-1.750
70	37.20	1.659	2.368	2.840	37.31	-2.844	-2.389	-1.754
80	21.51	1.613	2.363	2.935	20.33	-2.921	-2.393	-1.703
90	13.66	1.604	2.359	3.038	12.45	-3.021	-2.406	-1.651
100	9.26	1.587	2.387	3.129	8.26	-3.101	-2.439	-1.640

Notes: The table reports the execution percentage for market purchase and market sales orders with sizes ranging from 10 to USD 100 million based on existing limit orders on EBS during April 2013. The table also shows the 10th, 50th and 90th percentiles of the VWAP distribution for executed orders, where the VWAP is measured in basis points relative to the mid-point of the best limit bid and ask prices.

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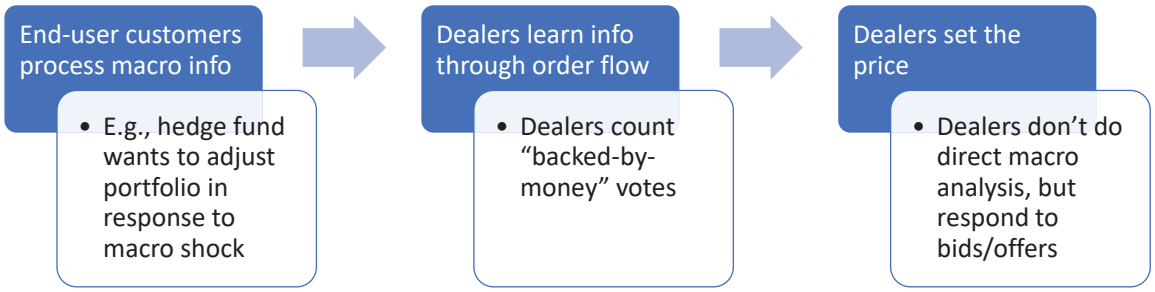
Order flow

- Signing each trade (+ or -) depending on the direction of the "aggressor."
- Is a transaction a buy or sell-side trade?
- Aggregating over flow can give a bigger picture of trading over a period.

$$T_t = \begin{cases} +1 & \text{if } z_t > 0 \\ 0 & \text{if } z_t = 0 \\ -1 & \text{if } z_t < 0 \end{cases},$$

Two-Stages Information Processing



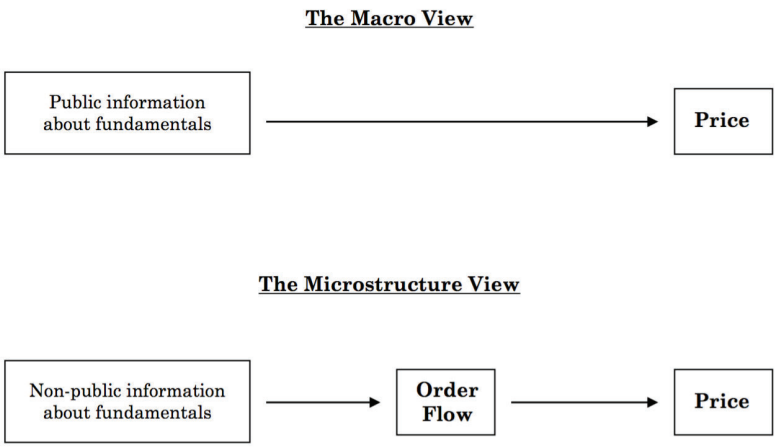
Two-Stages Information Processing cont.

- Order flow may contain uninformative information.
- Because some information is private, learning order flow is important.
- Aggregated order flows are highly correlated with changes in exchange rates.
  - The Two-Stages of Information Processing model suggests this is causal.

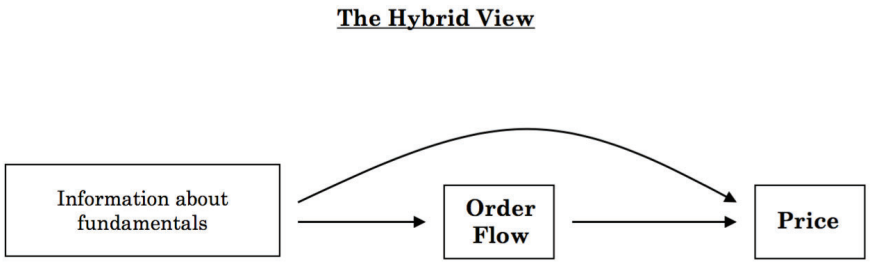
Order flow

- Order flow – executed transactions that indicate whether transaction is buyer/seller initiated.
- Sell $50 million, coded as -$50 million.
  - Volume coded as $50 million.
- Order flows affect prices.
  - Dealers decide whether an order is important, i.e. affects price, or not important, i.e. does not affect price.

Spanning macro and microstructure



Spanning macro and microstructure



Estimates of the Evans-Lyons model

Estimates of the Evans-Lyons model

$$\Delta p_t = \beta_1 \Delta(i_t - i_t^*) + \beta_2 X_t + \eta_t$$

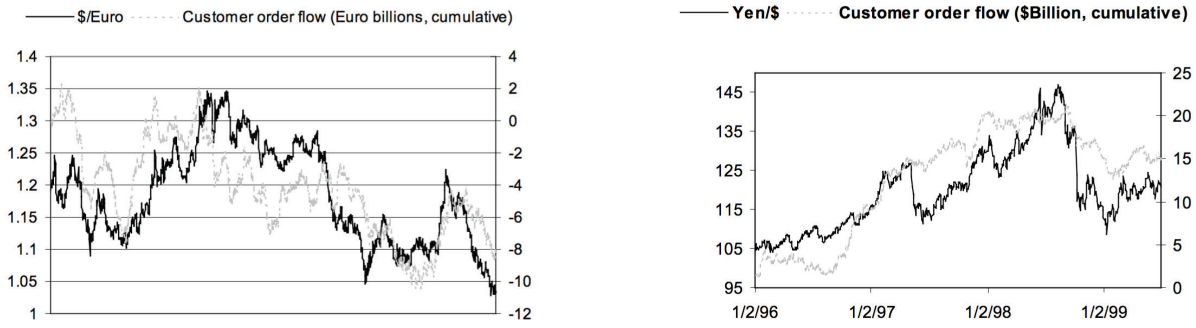
	β_1	β_2	R^2
DM	0.52 (1.5)	2.10 (10.5)	0.64
Yen	2.48 (2.7)	2.90 (6.3)	0.45

* t-statistics are shown in parentheses. (In the case of the DM equation, the t-statistics are corrected for heteroskedasticity; there is no evidence of heteroskedasticity in the Yen equation, and no evidence of serial correlation in either equation.) The dependent variable Δp_t is the change in the log spot exchange rate from 4 pm GMT on day t-1 to 4 pm GMT on day t (DM/$ or ¥/$). The regressor $\Delta(i_t - i_t^*)$ is the change in the one-day interest differential from day t-1 to day t (* denotes DM or ¥, annual basis). The regressor X_t is interdealer order flow between 4 pm GMT on day t-1 and 4 pm GMT on day t (negative for net dollar sales, in thousands of transactions). Estimated using OLS. The sample spans four months (May 1 to August 31, 1996), which is 89 trading days. (Saturday and Sunday order flow—of which there is little—is included in Monday.)

Estimates of the Evans-Lyons model

- β_1 insignificant (could be considered a control).
- β_2 significant, indicating that order flow provides the explanatory power.
- R^2 is super high relative to R^2 from macro models.

Cumulative customer order flow and exchange rates



The plots show the spot exchange rate and cumulative customer order flow received by the source bank. The sample for the $/euro plot is January 1993 to June 1999. The sample for the yen/$ plot is January 1996 to June 1999 (the January 1993 to December 1995 period is not included due to the lack of Tokyo-office data). The spot exchange rate is expressed on the left-hand scale. The cumulative customer order flow is expressed on the right-hand scale (in billions of euros for the $/euro plot and in billions of dollars for the yen/$ plot).

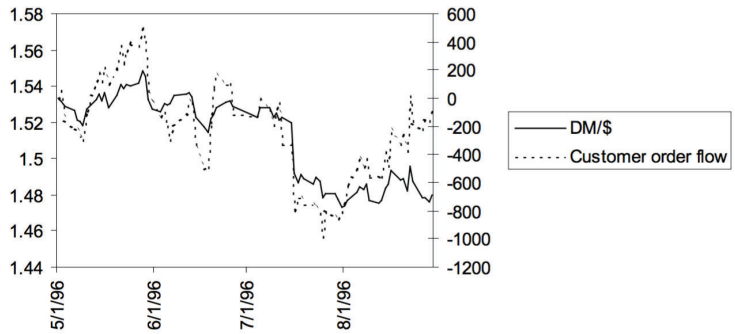
Price impact of disaggregated customer orders

$$\Delta p_t = \beta_0 + \beta_1(\text{Unlev. Fin. Flow})_t + \beta_2(\text{Lev. Fin. Flow})_t + \beta_3(\text{Non-fin. Corp. Flow})_t + \varepsilon_t$$

	β_1	β_2	β_3	R^2
Monthly Data				
Euro	1.5 (4.3)	0.6 (1.9)	-0.2 (-0.39)	0.27
Yen	1.1 (2.6)	1.8 (4.5)	-2.3 (-2.8)	0.34

* t-statistics are shown in parentheses. The dependent variable Δp_t is the monthly change in the log spot exchange rate. The three order-flow regressors are the order flows from unleveraged financial institutions, leveraged financial institutions, and non-financial corporations. Order flows are measured over the concurrent month (in billions of euros for the euro equation and billions of dollars in the yen equation). Estimated using OLS (standard errors corrected for heteroskedasticity). The sample is January 1993 to June 1999. Constants (not reported) are insignificant in both equations.

Cumulative customer order flow and exchange rates from Evans-Lyons sample



The plot shows the cumulative customer order flow in the USD/EURO market received by the source bank from May 1 to August 31, 1996, and the spot exchange rate over the same period. The spot rate is expressed in DM/$ on the left-hand scale. The cumulative customer order flow is expressed in millions of euros on the right-hand scale (positive for net dollar purchases).

Asymmetric Information Risk in FX Markets

Angelo Ranaldo Fabricius Somogyi

Dataset from CLS group

FX Order Flow Data:

- **CLS** operates the world's largest multi-currency cash settlement system handling **50-60%** of global FX trading volume
- **Disaggregated hourly** FX **spot order flow**
- Customer groups include **price taker banks (BA)**, **corporates (CO)**, **funds (FD)**, **non-bank financial firms (NB)**, total **buy-side** (price takers) and **sell-side** (market makers)
- **Number of transactions** (trade count) and equivalent value in the **base currency** (trade volume)
- Unique dataset on high-frequency **disaggregated order flow** that has *not* been used for academic purposes before

Methodological Approach

Estimate a **bivariate VAR** model that picks up order flow dependence of up to 10 lags:

$$r_t = \zeta_{1,I} D_{I,t} + \sum_{i=1}^{10} \rho_i r_{t-i} + \sum_{j \in C} \left(\sum_{i=0}^{10} \beta_i^j T_{t-i}^j + \sum_{i=0}^{10} \phi_i^j \tilde{S}_{t-i}^j \right) + \quad (1)$$
$$+ \eta_1 \Delta s_{t;t-\tau} + \eta_2 \Delta s_{t;t-5\tau} + \epsilon_{r,t},$$

$$T_t = \zeta_{2,I} D_{I,t} + \sum_{i=1}^{10} \gamma_i r_{t-i} + \sum_{j \in C} \left(\sum_{i=1}^{10} \delta_i^j T_{t-i}^j + \sum_{i=1}^{10} \omega_i^j \tilde{S}_{t-i}^j \right) + \quad (2)$$
$$+ \epsilon_{T,t},$$

where $C = \{CO, FD, NB, BA\}$. Eqs. (1) and (2) are based on Hasbrouck (1988, 1991a) and Hendershott et al. (2011) and **decompose** the price moves into **trade-related** and **trade-unrelated** components

Measuring Asymmetric Information

- Following Hasbrouck (1988) and Payne (2003), the permanent price impact of agent j, in currency pair k, is equal to the **sum of** the **asymmetric information coefficients** in Eq. (1)

$$\alpha_m^{j,k} = \sum_{t=0}^{m} \beta_t^{j,k}, \quad (3)$$

  where $m = 10$ indicates the number of lags.

- The **average permanent price impact** across agents captures **systematic superior information**

$$\bar{\alpha}_m^k = \frac{1}{|C|} \sum_{j \in C} \sum_{t=0}^{m} \beta_t^{j,k} = \frac{1}{|C|} \sum_{j \in C} \alpha_m^{j,k}. \quad (4)$$

Heterogeneous Asymmetric Information

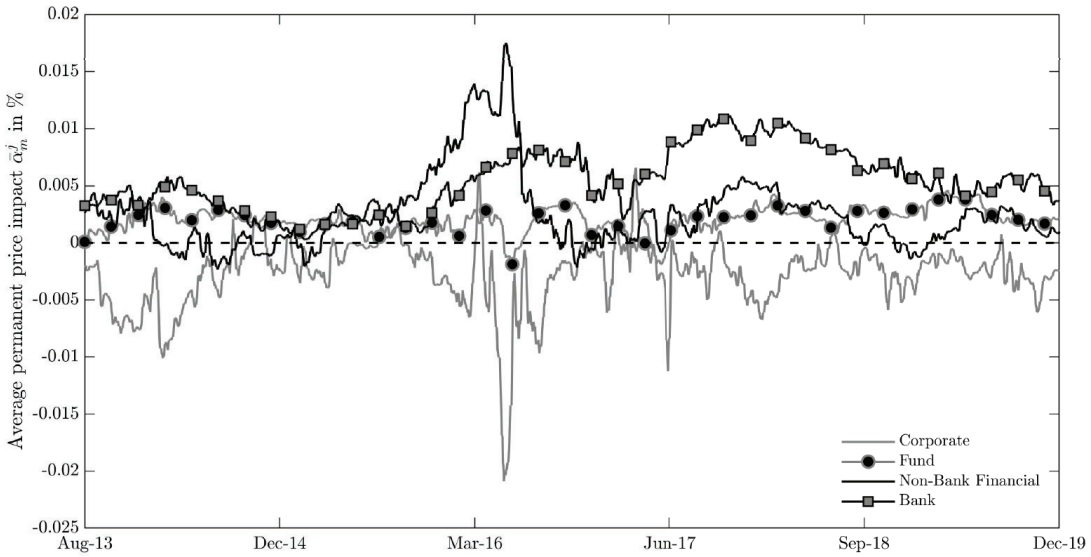
Permanent Price Impact Measures Asymmetric Information

1. Measures **adverse selection** and **asymmetric information risk**
2. Captures heterogeneity in **asymmetric** and **private information** on currency values (e.g. Evans and Lyons, 2006)
3. Accounts for the persistence in order flow and **feedback trading**

Strong Evidence of Asymmetric Information Dispersion

- **Traders**: banks and funds exhibit large permanent price impacts
- **Currencies**: market fragmentation
- **Time**: time variation based on rolling window estimation

Figure 3: Twelve Months Rolling Window Regression for $\bar{\alpha}_m^j$



Asymmetric Information Premium II

4. *Signal Generation*:
   - Estimate Eq. (1) in a **twelve months** rolling window fashion at daily frequency based on **order flows** and **mid-quotes**
   - Extract the permanent price impact $\alpha_m^{j,k}$
   - **Sort** the systematic price impact $(\frac{1}{|C|}\sum_{j\in C}\alpha_m^{j,k})$ across currency pairs
   - Use yesterday's trading signals to create portfolio weights today
   - Form **tertile portfolios** and derive AIP_{HML} as $Q_3 - Q_1$
5. *Excess Returns*:
   - **Net** log excess return for going **long** in foreign currency X:

$$rx_{t+1}^{X/Y} = f_{t,t+1}^{USD/Y,b} - s_{t+1}^{USD/Y,a} - (f_{t,t+1}^{USD/X,a} - s_{t+1}^{USD/X,b}), \qquad (5)$$

   - f_t and s_t are both in units of the foreign currency per USD.

Exposure Regression

Table 2: Exposure Regression Based on Monthly ***Gross*** *Excess Returns*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept (α) in %	***4.05	***4.22	**4.20	***4.14	**4.29	***4.39	**4.47	**4.11	***4.66
	[3.09]	[2.65]	[2.55]	[2.68]	[2.57]	[2.99]	[2.55]	[2.52]	[2.79]
DOL		−0.13	−0.13	0.03	−0.12	−0.08	−0.13	0.00	0.09
		[1.03]	[0.96]	[0.25]	[1.07]	[0.67]	[1.02]	[0.01]	[0.73]
RER_{HML}			−0.02						
			[0.15]						
RER				**−0.31					**−0.33
				[2.27]					[2.41]
MOM_{HML}					0.16				
					[1.28]				
CAR_{HML}						**−0.34			**−0.35
						[1.96]			[2.11]
BMS							−0.07		−0.10
							[0.50]		[0.81]
VOL_{LMH}								−0.15	
								[0.92]	
R^2 in %	N/A	12.97	12.99	19.35	15.46	22.47	13.41	13.50	29.90
IR	0.24	0.27	0.27	0.27	0.28	0.30	0.28	0.26	0.33
#Obs	75	75	75	75	75	75	75	75	75

Note: The intercept (α) has been annualised ($\times 12$). The t-stats are based on HAC errors and stars (*/ **/ ***) denote significance at the 90%/ 95%/ 99% levels, respectively. All results hold after controlling for relative changes in the VIX index, the North American credit default swap index (CDX), the TED spread as well as risk aversion (Bekaert et al., 2013).

Asymmetric Information Risk in FX Markets

Summary

- **Asymmetric information** is **systematically** present in the global FX market, where **some agents** are **always more informed** than others
- Empirical evidence of **asymmetric information risk** being deep-rooted across **market participants**, **time** and **currencies**
- A **new asymmetric information risk factor** generates significant returns and is not subsumed by existing FX risk factors