

FX Option Volume

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Motivation

- ▶ Exponential growth of foreign exchange (FX) option market in past three decades driven by expanding international capital flows
- ▶ One of the largest and most liquid derivative markets, with an average daily volume $\approx$ \$300 billion and outstanding notional close to \$12 trillion (BIS, 2019)
- ▶ Bespoke nature makes options attractive for a diverse range of market participants: hedge funds, asset managers, banks, corporates, etc.
- ▶ Limited knowledge to date about how FX options trading activities affect exchange rates
- ▶ Liquidity and embedded leverage may imply that FX options reflect fundamentals more accurately than spot instruments

This paper

- ▶ Our theoretical model suggests that FX option trading volume can negatively predict future currency returns
- ▶ We then test theoretical predictions using comprehensive, regulatory EMIR Trade Repository (TR) data on trade-level OTC currency options
- ▶ Our sample includes contract characteristics for more than a million transactions:
 - Detailed information on individual trades (date and time stamp, notional, strike, etc.)
 - Identities of both counterparties
 - Data cover 42% of the global trading activity
- ▶ The *granularity* and *completeness* of our data enable us to highlight the unique currency return predictability of FX option volumes

Mechanism: Co-existence of spot and option markets

- ▶ Simple model based on Easley, O'Hara and Srinivas (1998)
 - Informed investors are risk-neutral and choose to trade in option or spot markets Structure of trading
- ▶ We assume that informed investors derive private utility gains from dollar exposures Dollar demand
 - **Convenience yield** (e.g., Krishnamurthy and Vissing-Jorgensen, 2012; Jiang, Krishnamurthy and Lustig, 2021)
 - **'Exorbitant privilege' of the dollar** (e.g., Gourinchas and Rey, 2007; Caballero, Farhi and Gourinchas, 2008; He, Krishnamurthy and Milbradt, 2019)
 - **Dollar demand** (e.g., Shin, 2012; Brauning and Ivashina, 2020; Valentina and Shin, 2017; and Maggiori, Neiman and Schreger, 2020)

Mechanism: Co-existence of spot and option markets

Model's main propositions:

- ▶ **Proposition 1:** When $L \leq \frac{2(1-\mu)q_2}{\mu+2(1-\mu)q_2}$, no informed investors trade options. No association between option volume and the underlying asset payoff, such that $\text{Cov}(e_1 - e_0, V_o) = 0$.
 - L is option leverage, m is utility gain of exposure to US dollar
- ▶ **Proposition 2:** When $L > \frac{2(1-\mu)q_2}{\mu+2(1-\mu)q_2}$, there are two cases:
 1. When $m \leq m^*$, no association between option volume and the underlying asset payoff, i.e. $\text{Cov}(e_1 - e_0, V_o) = 0$
 2. When $m > m^*$, **negative relation** between option volume and the underlying asset payoff, such that $\text{Cov}(e_1 - e_0, V_o) < 0$

Empirical predictions

1. FX option volume is **negatively correlated** with future exchange rate changes (i.e. correlated with a foreign currency depreciation)
2. Return predictability increases with **concentration of informed investors**
3. Return predictability increases with **private utility gains from holding US dollars**
4. Return predictability increases with **option-embedded leverage**

Data

Regulatory DTCC Derivatives Repository data cover all trades in European-style OTC FX options (with at least one UK-regulated counterparty)

- ▶ Sample period: November 2014 to December 2016
- ▶ Detailed information on trades (date, volume, strike, maturity, etc.)
- ▶ Identities of both counterparties (hedge funds, asset managers, banks, corporates, etc.)
- ▶ Data cover **42%** of the global trading activity
- ▶ Clients are grouped into: Real money investors, hedge funds, non-dealer banks, other clients (corporates, central banks, monetary authorities, and unclassified clients)

Turnover in the FX option market

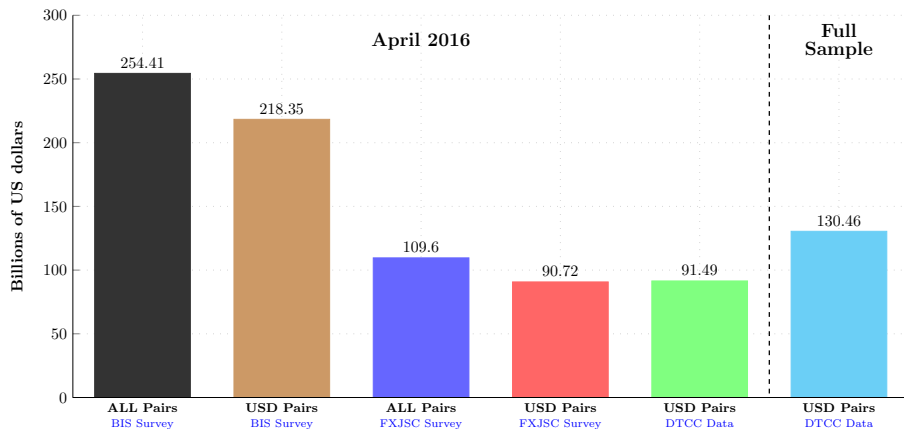


Figure 1 Turnover in the FX option market

FX Option Volume: Currency pairs

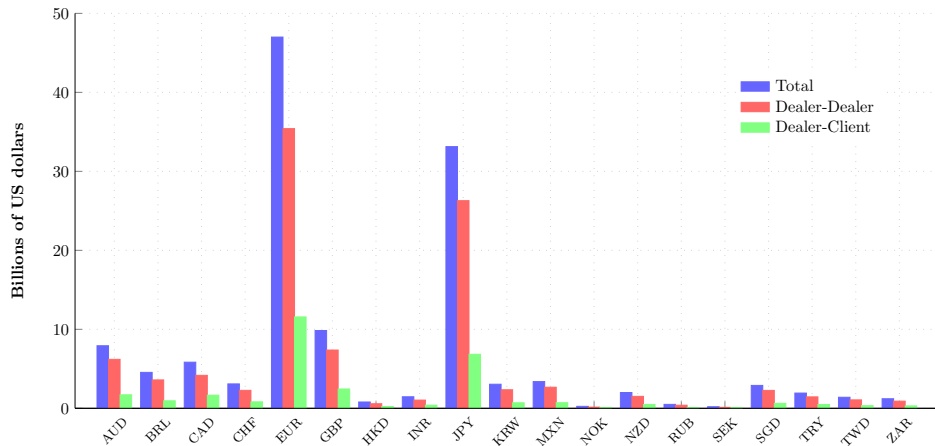


Figure 2 FX option volume: currency pairs

FX Option Volume: Counterparty sectors

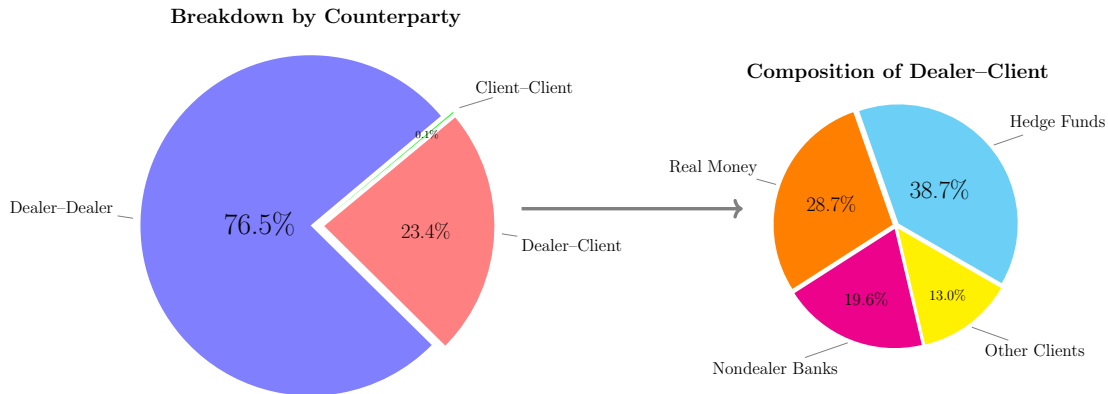


Figure 3 FX option volume: counterparty sectors

Empirical methodology

- ▶ We calculate volume $V_{i,t}^{adj}$ across all options for each currency i on each trading day t
 - Option volume is standardized over a rolling window of 21 trading days prior to the volume signal to account for heteroskedasticity
- ▶ Each day, we sort currencies into four buckets based on FX option trading volume, and then construct equal-weighted portfolios of the currencies within each bucket
 - The portfolio is rebalanced on a daily basis, separately for USD vs. the seven main currencies ("AUD", "CAD", "CHF", "EUR", "GBP", "JPY", and "NZD") and vs. all 20 currencies
- ▶ FX excess returns defined as: $R_{t+1} = s_{t+1} - s_t + (i_t^* - i_t)$, where i_t^* is the foreign interest rate and i_t is the US interest rate

Portfolio sorting approach – major currencies

- G7 FX option volumes strong predictor of future G7 FX excess returns; effect more pronounced for dealer-client volumes:

		P_1	P_2	P_3	P_4	LMH
Total	mean	2.42	-2.67	-6.89	-12.21	14.63
	t-stat	[0.42]	[-0.45]	[-1.22]	[-2.34]	[2.66]
	std	9.06	8.76	10.67	9.85	8.64
	SR	0.27	-0.30	-0.65	-1.24	1.69
Dealer-Dealer	mean	-0.08	-0.79	-5.69	-12.06	11.98
	t-stat	[-0.01]	[-0.14]	[-0.95]	[-2.31]	[1.97]
	std	8.93	8.74	10.88	9.97	8.74
	SR	-0.01	-0.09	-0.52	-1.21	1.37
Dealer-Client	mean	3.51	-1.12	-8.90	-13.28	16.80
	t-stat	[0.59]	[-0.22]	[-1.40]	[-2.31]	[2.71]
	std	9.50	8.49	10.93	9.65	9.04
	SR	0.37	-0.13	-0.81	-1.38	1.86

Portfolio sorting approach – all currencies

- Weak return predictability when using all 20 currencies:

		P_1	P_2	P_3	P_4	LMH
Total	mean	-3.42	1.45	-8.97	-9.33	5.91
	t-stat	[-0.54]	[0.28]	[-1.66]	[-1.63]	[1.11]
	std	9.13	8.51	8.65	9.17	8.37
	SR	-0.37	0.17	-1.04	-1.02	0.71
Dealer-Dealer	mean	-2.53	1.09	-9.66	-9.15	6.62
	t-stat	[-0.37]	[0.22]	[-2.06]	[-1.54]	[1.11]
	std	9.22	8.45	8.73	9.23	8.51
	SR	-0.27	0.13	-1.11	-0.99	0.78
Dealer-Client	mean	3.37	-1.34	-13.66	-7.40	10.76
	t-stat	[0.57]	[-0.22]	[-2.29]	[-1.39]	[1.99]
	std	9.05	8.63	8.95	8.90	7.88
	SR	0.37	-0.16	-1.53	-0.83	1.37

- Results unchanged when using exchange rate returns instead of excess returns [Go](#)

Panel regressions

- We run additional panel regressions to corroborate results from portfolio sorting approach:

$$R_{i,t+1} = \alpha + \beta \cdot \text{Option Volume}_{i,t} + \gamma' \cdot X_{i,t} + FE + \epsilon_{i,t+1},$$

- where $R_{i,t+1}$ is currency i 's excess return on day $t + 1$
- $\text{Option Volume}_{i,t}$ is currency i 's quartile rank of the standardized option volume on day t
- Vector X includes currency-level characteristics: realized volatility, bid-ask spread, and forward premium
- We include day and currency fixed effects

Panel regressions

	Excess Returns					
Total Volume	-1.968** (0.796)					
Dealer-Dealer Volume	-1.677** (0.813)		-0.753 (0.848)	-0.778 (0.849)	-0.776 (0.950)	
Dealer-Client Volume	-2.396*** (0.823)		-2.057** (0.861)	-2.088** (0.859)	-2.119** (1.002)	
<i>AdjR² (%)</i>	42.3	42.3	42.3	42.3	42.3	42.3
<i># Observations</i>	3,552	3,552	3,552	3,552	3,552	3,552
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Currency FE</i>	No	No	No	No	No	Yes
<i>Controls</i>	No	No	No	No	Yes	Yes

- Interdealer volume insignificant when incl. dealer-client volume

Cumulative returns based on dealer-client volume

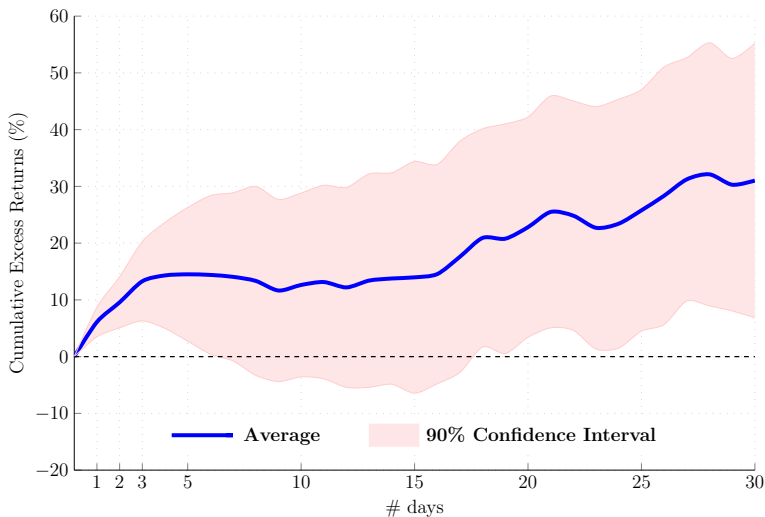


Figure 4 Long-short portfolio excess returns

Informed trading: Client sectors

- Prediction 2: Return predictability increases with **concentration of informed investors**:

		P_1	P_2	P_3	P_4	LMH
Hedge Funds	mean	0.50	-1.86	1.21	-13.76	14.26
	t-stat	[0.08]	[-0.28]	[0.17]	[-2.09]	[2.60]
Real Money	mean	2.27	-5.48	-9.35	-12.79	15.06
	t-stat	[0.38]	[-0.79]	[-1.27]	[-1.92]	[2.45]
Non-dealer Banks	mean	2.95	-12.03	-7.34	-5.47	8.42
	t-stat	[0.45]	[-2.02]	[-1.05]	[-0.83]	[1.43]
Other Clients	mean	-3.63	-5.57	-1.21	-7.33	3.70
	t-stat	[-0.56]	[-0.89]	[-0.17]	[-1.12]	[0.58]

Dollar demand

- Prediction 3: Return predictability increases with utility gains from holding US dollars
- Valuation of dollar utility gains m can be proxied by empirical measures:

		Panel A: High Dollar Demand					Panel B: Low Dollar Demand				
		P_1	P_2	P_3	P_4	LMH	P_1	P_2	P_3	P_4	LMH
Proxied by Treasury Premium	mean	10.32	-5.48	-4.14	-16.17	26.49	-5.80	-0.05	-10.00	-8.56	2.77
	t-stat	[1.20]	[-0.71]	[-0.45]	[-1.61]	[3.19]	[-0.67]	[-0.01]	[-0.95]	[-0.92]	[0.30]
Proxied by VXY Index	mean	15.79	7.52	0.35	-3.29	19.09	-11.89	-13.02	-14.35	-21.71	9.82
	t-stat	[1.85]	[0.91]	[0.05]	[-0.44]	[2.82]	[-1.83]	[-1.48]	[-1.44]	[-3.00]	[1.44]

Informed trading: Moneyness

- Prediction 4: Return predictability increases with **option-embedded leverage**:

		P_1	P_2	P_3	P_4	LMH
Deep out of the money	mean	7.09	-6.90	-14.48	-15.86	22.95
	<i>t</i> -stat	[1.29]	[-1.01]	[-2.34]	[-2.62]	[3.02]
Out of the money	mean	2.78	-3.44	-4.70	-8.52	11.30
	<i>t</i> -stat	[0.46]	[-0.55]	[-0.91]	[-1.44]	[2.13]
Near the money	mean	-1.40	-1.02	-11.48	-7.95	6.55
	<i>t</i> -stat	[-0.26]	[-0.15]	[-1.77]	[-1.36]	[1.13]
In the money	mean	0.93	-10.06	-2.45	-5.58	6.52
	<i>t</i> -stat	[0.15]	[-1.63]	[-0.37]	[-0.90]	[1.05]
Deep in the money	mean	-2.59	-9.79	-3.71	-2.39	-0.20
	<i>t</i> -stat	[-0.41]	[-1.40]	[-0.61]	[-0.39]	[-0.03]

Informed trading: Time-to-expiration

- Prediction 4: Return predictability increases with [option-embedded leverage](#):

		P_1	P_2	P_3	P_4	LMH
Maturity ≤ 1 month	mean	4.29	-8.77	-8.65	-8.97	13.26
	t -stat	[0.68]	[-1.40]	[-1.16]	[-1.35]	[2.41]
1 month < Maturity ≤ 3 months	mean	1.68	-3.78	-7.32	-10.25	11.93
	t -stat	[0.27]	[-0.58]	[-1.13]	[-1.59]	[2.11]
3 months < Maturity ≤ 6 months	mean	0.47	-3.02	-9.69	-8.35	8.83
	t -stat	[0.08]	[-0.45]	[-1.33]	[-1.25]	[1.66]
Maturity > 6 months	mean	-7.40	-3.42	0.90	-9.04	1.64
	t -stat	[-1.20]	[-0.47]	[0.14]	[-1.37]	[0.28]

Additional analyses and robustness checks

- ▶ LMH portfolios generate higher returns during [macro-announcement periods](#) (including FOMC, non-farm payrolls, PMI, PPI, CPI, GDP), particularly for hedge funds [Go](#)
- ▶ Consistent results when using clients' [signed option volumes](#) (e.g. clients' sell volumes of put options) [Go](#)
- ▶ Results also robust to using [alternative windows](#) to standardize option volumes ($M = 5$, $M = 21$ and $M = 63$) and formation periods ($N = 3$) [Go](#)
- ▶ Important cross-check: No return predictability of [FX forward volumes](#) [Go](#)
- ▶ Results also hold when using [publicly-available option volume data](#) from Bloomberg [Go](#)

Conclusion

- ▶ We examine the [informational content of FX option volumes](#) for future exchange rate movements
- ▶ We use [regulatory transaction data](#) to analyze when and in which instruments informed investors trade on their information advantage
- ▶ We find a [unique currency return predictability](#) of FX option volumes, particularly for trading by sophisticated investors
- ▶ Return predictability increases with [option leverage](#), and is more pronounced in periods of [high dollar demand](#) or on [macro-announcements days](#),
- ▶ Results consistent with an [asymmetric information model](#) in which informed traders trade either in FX option or spot markets, based on Easley, O'Hara and Srinivas (1998)

Appendix

Structure of trading

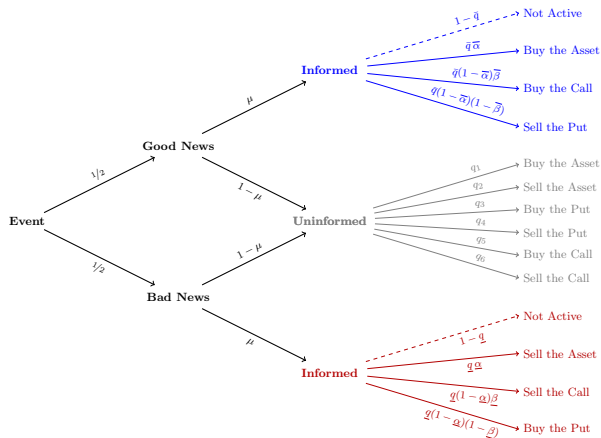


Figure 5 Structure of trading

Portfolio sorting approach with FX returns – major currencies

- G7 FX option volumes strong predictor of future G7 FX exchange rate returns:

		P_1	P_2	P_3	P_4	LMH
Total	mean	2.26	-2.77	-7.07	-12.37	14.63
	t-stat	[0.39]	[-0.46]	[-1.25]	[-2.38]	[2.67]
	std	9.06	8.76	10.66	9.85	8.64
	SR	0.25	-0.32	-0.66	-1.26	1.69
Total	mean	-0.24	-0.89	-5.82	-12.24	12.00
	t-stat	[-0.04]	[-0.15]	[-0.98]	[-2.35]	[1.98]
	std	8.93	8.74	10.88	9.97	8.73
	SR	-0.03	-0.10	-0.54	-1.23	1.37
Total	mean	3.38	-1.25	-9.06	-13.45	16.83
	t-stat	[0.56]	[-0.24]	[-1.42]	[-2.35]	[2.72]
	std	9.49	8.50	10.93	9.65	9.03
	SR	0.36	-0.15	-0.83	-1.39	1.86

Portfolio sorting approach with FX returns – all currencies

- Weak exchange rate return predictability when using all 20 currencies:

		P_1	P_2	P_3	P_4	LMH
Total	mean	-5.42	-0.29	-10.69	-11.30	5.88
	t-stat	[-0.86]	[-0.06]	[-1.98]	[-1.98]	[1.10]
	std	9.14	8.50	8.66	9.17	8.37
	SR	-0.59	-0.03	-1.23	-1.23	0.70
Total	mean	-4.65	-0.53	-11.39	-11.17	6.53
	t-stat	[-0.69]	[-0.11]	[-2.43]	[-1.87]	[1.09]
	std	9.21	8.45	8.73	9.23	8.50
	SR	-0.50	-0.06	-1.30	-1.21	0.77
Total	mean	1.45	-3.19	-15.54	-9.32	10.76
	t-stat	[0.24]	[-0.52]	[-2.60]	[-1.75]	[1.99]
	std	9.05	8.63	8.95	8.90	7.89
	SR	0.16	-0.37	-1.74	-1.05	1.36

Macro-announcement days

- Strong return predictability on macro-announcement days for informed investors:

		Panel A: Announcement days					Panel B: Non-announcement days				
		P_1	P_2	P_3	P_4	LMH	P_1	P_2	P_3	P_4	LMH
Hedge Funds	mean	-1.47	-4.60	-22.06	-25.94	24.47	1.43	-1.04	8.32	-9.98	11.41
	t-stat	[-0.09]	[-0.34]	[-1.35]	[-1.77]	[2.80]	[0.21]	[-0.15]	[0.99]	[-1.33]	[1.71]
Real Money	mean	-7.05	-14.77	-9.77	-19.81	12.76	5.22	-2.71	-9.04	-10.51	15.73
	t-stat	[-0.45]	[-0.99]	[-0.84]	[-1.17]	[1.04]	[0.76]	[-0.36]	[-1.10]	[-1.39]	[2.05]
Non-dealer Banks	mean	1.57	-24.51	-16.12	-16.26	17.82	3.36	-8.34	-4.75	-2.27	5.64
	t-stat	[0.12]	[-1.72]	[-1.00]	[-1.00]	[1.33]	[0.49]	[-1.33]	[-0.58]	[-0.31]	[0.86]
Other Clients	mean	-8.42	-20.97	-30.34	-19.54	11.12	1.71	-10.84	-1.89	-2.71	4.42
	t-stat	[-0.60]	[-1.42]	[-1.95]	[-1.51]	[0.81]	[0.27]	[-1.31]	[-0.23]	[-0.37]	[0.60]

Dollar demand: Put and call volumes

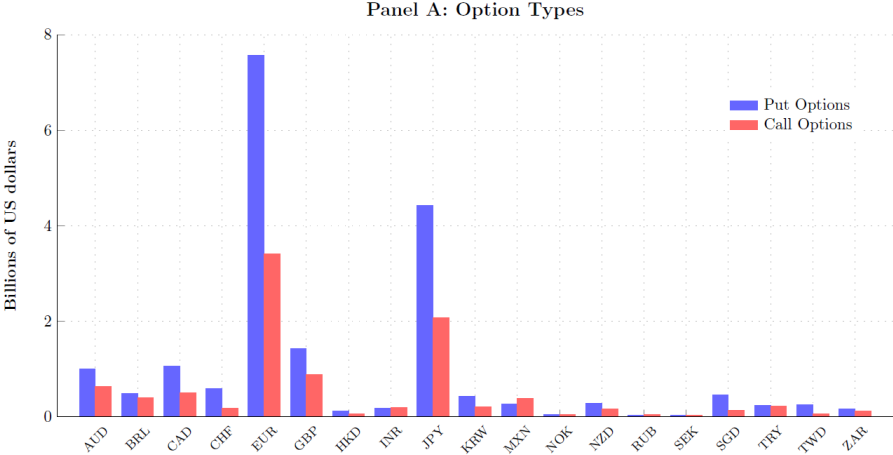


Figure 6 FX option volume: puts vs. calls

Signed order flow

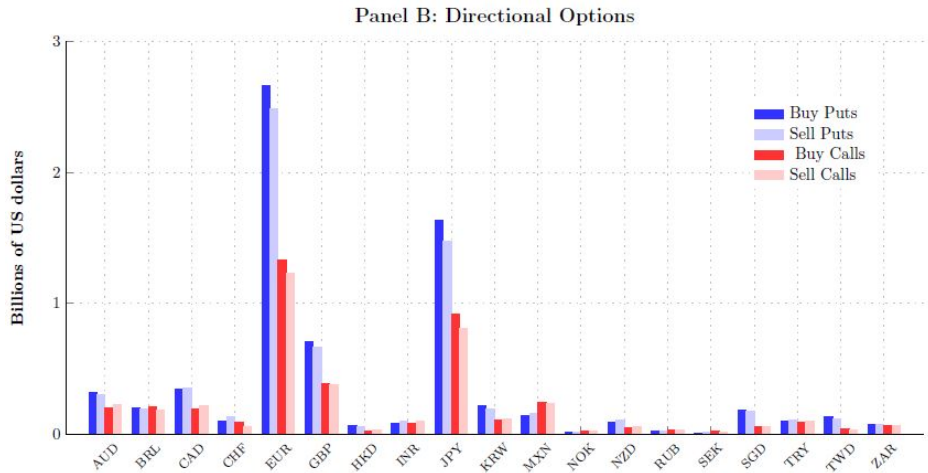


Figure 7 Signed order flow

Signed order flow

- Net demand of put (call) options negatively (positively) predicts future FX returns:

		Panel A: Put option net demand					Panel B: Call option net demand				
		P_1	P_2	P_3	P_4	LMH	P_1	P_2	P_3	P_4	LMH
Hedge Funds	mean	11.16	-1.28	-3.19	-6.85	18.01	-5.66	3.46	-6.40	11.46	-17.12
	t-stat	[1.29]	[-0.15]	[-0.42]	[-0.96]	[2.38]	[-0.76]	[0.43]	[-0.62]	[1.63]	[-2.68]
Real Money	mean	10.59	0.85	-18.76	-6.90	17.49	-1.97	7.14	1.21	13.92	-15.89
	t-stat	[1.61]	[0.09]	[-2.52]	[-0.74]	[1.76]	[-0.27]	[0.58]	[0.12]	[1.36]	[-1.28]
Non-dealer Banks	mean	1.61	4.05	-1.52	-3.99	5.60	-1.81	9.99	0.23	-1.54	-0.27
	t-stat	[0.23]	[0.51]	[-0.16]	[-0.56]	[0.86]	[-0.29]	[1.40]	[0.02]	[-0.28]	[-0.04]
Other Clients	mean	3.22	-1.26	-0.69	0.57	2.64	0.20	-9.12	-2.86	10.60	-10.40
	t-stat	[0.39]	[-0.19]	[-0.08]	[0.06]	[0.26]	[0.03]	[-1.05]	[-0.31]	[1.43]	[-1.49]

FX forward volume

- No return predictability when using FX forward volumes:

		Panel A: Major currencies					Panel B: All currencies				
		P_1	P_2	P_3	P_4	LMH	P_1	P_2	P_3	P_4	LMH
Hedge Funds	mean	-0.56	1.31	-6.37	-4.58	4.01	-1.95	-2.85	-3.92	-3.38	1.43
	t-stat	[-0.12]	[0.31]	[-1.17]	[-1.05]	[0.95]	[-0.41]	[-0.74]	[-0.88]	[-0.91]	[0.43]
Real Money	mean	-1.95	-1.85	-2.13	-1.22	-0.73	-1.19	-2.75	-6.94	-1.03	-0.16
	t-stat	[-0.43]	[-0.39]	[-0.41]	[-0.26]	[-0.16]	[-0.27]	[-0.64]	[-1.38]	[-0.24]	[-0.04]
Non-dealer Banks	mean	-2.12	-4.65	1.25	-0.46	-1.66	-2.80	-3.05	-2.36	-3.24	0.44
	t-stat	[-0.52]	[-1.11]	[0.20]	[-0.11]	[-0.40]	[-0.68]	[-0.79]	[-0.63]	[-0.70]	[0.13]
Other Clients	mean	-0.43	-1.81	-6.63	-2.00	1.57	-5.99	-0.40	-3.00	-3.51	-2.48
	t-stat	[-0.11]	[-0.37]	[-1.20]	[-0.40]	[0.40]	[-1.34]	[-0.10]	[-0.60]	[-0.88]	[-0.76]

Controlling for common currency factors

- Long-short portfolio persistently generates significant alphas:

Alpha	6.888** (2.846)	6.646** (2.651)	7.025** (2.688)	7.006*** (2.561)
DOL	0.022 (0.075)	0.041 (0.067)	0.048 (0.063)	0.042 (0.064)
CAR		0.004 (0.054)	0.017 (0.053)	0.049 (0.061)
VAL		0.064 (0.061)	0.088 (0.060)	0.082 (0.063)
MOM		0.036 (0.065)	0.046 (0.067)	0.043 (0.066)
VOL			-0.028 (0.071)	-0.004 (0.072)
LIQ			-0.094** (0.043)	-0.060 (0.045)
R25				-0.062 (0.065)
VRP				0.127* (0.069)
<i>AdjR² (%)</i>	-0.2	0.1	1.0	2.5
<i># Observations</i>	512	512	512	512

Alternative volume scaling windows

- Return predictability robust to alternative volume scaling windows:

		Panel A: Currency Excess Returns					Panel B: Exchange Rate Returns				
		P_1	P_2	P_3	P_4	LMH	P_1	P_2	P_3	P_4	LMH
$M = 5$ and $N = 1$	mean	4.57	-0.43	-11.79	-10.49	15.06	4.40	-0.50	-11.96	-10.64	15.04
	t-stat	[0.76]	[-0.07]	[-1.76]	[-2.20]	[2.61]	[0.73]	[-0.08]	[-1.78]	[-2.24]	[2.61]
$M = 63$ and $N = 1$	mean	7.23	-2.03	-6.19	-10.35	17.57	7.17	-2.12	-6.30	-10.47	17.64
	t-stat	[1.23]	[-0.36]	[-0.79]	[-2.09]	[2.88]	[1.23]	[-0.38]	[-0.80]	[-2.11]	[2.90]
$M = 21$ and $N = 3$	mean	-6.82	-2.24	-10.24	-11.93	18.75	6.68	-2.35	-10.34	-12.09	18.78
	t-stat	1.13	-0.41	-1.40	-2.17	2.79	1.11	-0.43	-1.41	-2.21	2.80

Alternative data source: Bloomberg

- Return predictability robust to using publicly-available option volume data from Bloomberg:

		Panel A: Major currencies					Panel B: All currencies				
		P_1	P_2	P_3	P_4	LMH	P_1	P_2	P_3	P_4	LMH
Major Currencies	mean	4.57	-1.45	-1.46	-4.79	9.37	4.82	-1.21	-1.16	-4.53	9.34
	t-stat	[1.48]	[-0.57]	[-0.59]	[-1.71]	[2.86]	[1.56]	[-0.48]	[-0.47]	[-1.61]	[2.86]
All Currencies	mean	-1.89	-0.07	-3.20	-3.30	1.41	-3.29	-1.37	-4.47	-4.75	1.46
	t-stat	[-0.78]	[-0.03]	[-1.19]	[-1.26]	[0.69]	[-1.36]	[-0.50]	[-1.66]	[-1.80]	[0.71]