Is there Cash Flow Information in Quantities?

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Hayek (AER 1945)

"knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess. The economic problem of society is thus … a problem of the utilization of knowledge not given to anyone in its totality."

$$Y_t = \sum_i Y_{it}$$

Prices?

Money demand?

Interest rates?

Exchange Rate Fundamentals and Order Flow

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The is a good deal of pessimism surrounding attempts to model exchange rate dynamics.

> *"no model based on such standard fundamentals ... will ever succeed in explaining or predicting a high percentage of the variation in the exchange rate, at least at short- or medium-term frequencies." Frankel and Rose (1995)*

Consider the present value relation,

$$s_t = (1-b)\sum_{i=0}^{\infty} b^i \mathbb{E}_t f^{\mathrm{M}}_{t+i} + (1-b)\sum_{i=0}^{\infty} b^i \mathbb{E}_t f^{\mathrm{U}}_{t+i},$$

Empirical analysis must be based on

$$\begin{aligned} s_t &= (1-b)\sum_{i=0}^{\infty} b^i \widehat{\mathbb{E}}_t f^{\mathrm{M}}_{t+i} + \xi_t, \\ \xi_t &= (1-b)\sum_{i=0}^{\infty} b^i \mathbb{E}_t f^{\mathrm{U}}_{t+i} + (1-b)\sum_{i=0}^{\infty} b^i (\mathbb{E}_t - \widehat{\mathbb{E}}_t) f^{\mathrm{M}}_{t+i}. \end{aligned}$$

- Efforts to empirically identify $\mathbb{E}_t f^{\mathrm{U}}_{t+i}$ have been unsuccessful.
- This paper is targets $(\mathbb{E}_t - \widehat{\mathbb{E}}_t) f^{\mathrm{M}}_{t+i}$

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- Transaction flows forecast future excess returns.

Spot rates USD/EUR, and order flows from 6 end-user segments (disaggregated by trade location):

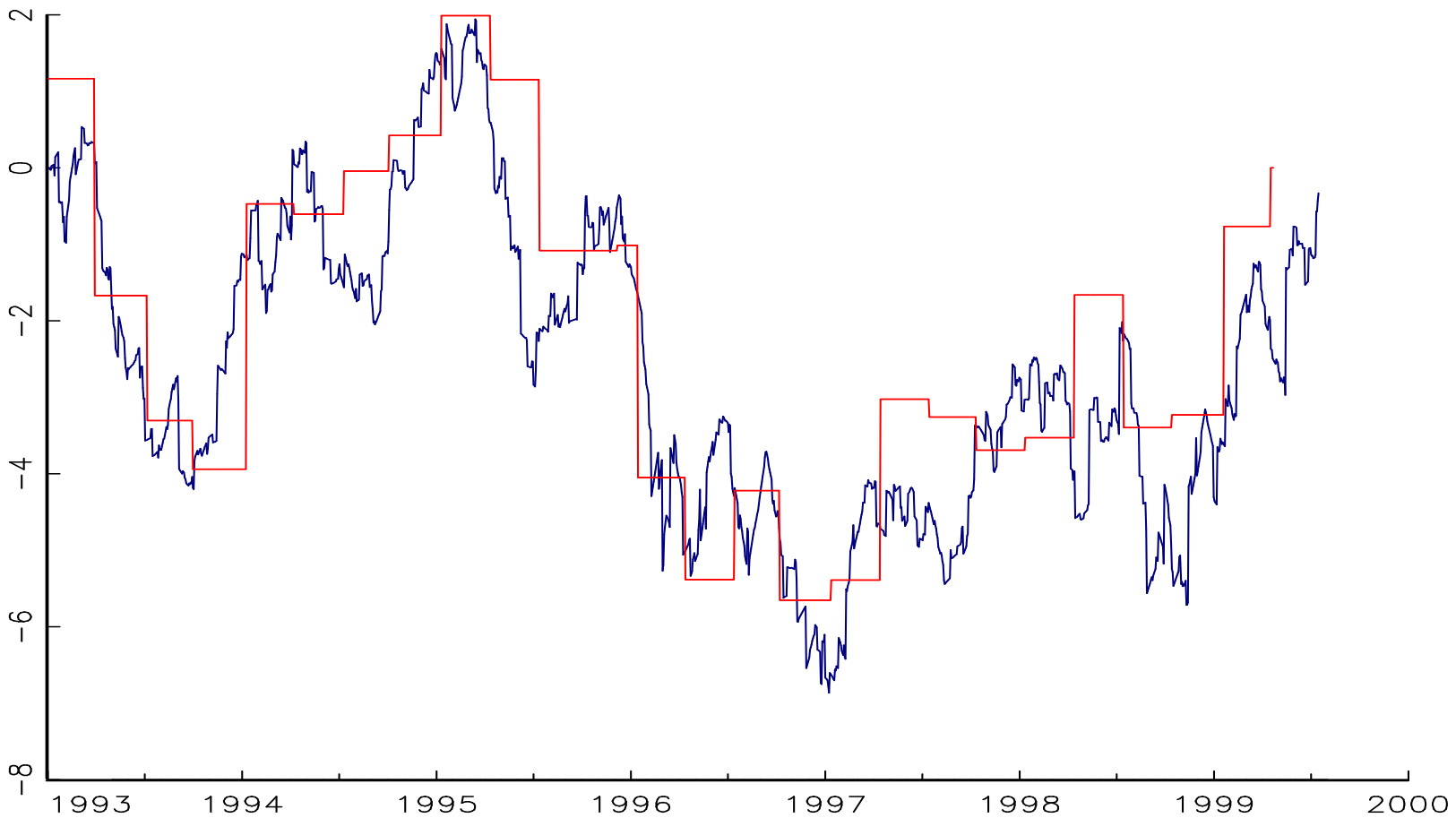
- US and non-US based non-financial corporations,
- US non-US based investors (such as mutual funds and pension funds)
- US non-US based leveraged traders (such as hedge funds and proprietary traders).
- Source: Citibank. Span: January 1993 to June 1999:

We compute real-time estimates of the following variables:

- GDP (US and German)
- CPI Inflation (US and German),
- M1 Monetary Growth, (US and German)
- Source Money Market Services (MMS)

The real-time estimate of variable $\varkappa_t$ is $\mathbb{E}\left[\varkappa_t | \Omega_t^P\right]$ where Ω_t^P is an information set that comprises the history of macro data releases up to date t.

- For US variables, Ω_t^P comprises the history of 21 data releases at the quarterly and monthly frequency.
- For German variables. Ω_t^P comprises 14 monthly data releases.
- Not the same as "real-time data".
- Methodology: MLE + Kalman Filtering with "bells and whistles", see Evans "Where Are We Now?: Real-Time Estimates of the Macro Economy" IJCB, 2005



Real-time estimates and ex post realiazations of GDP

Under Proposition 1 and 3, changes in future fundamentals are related to spot rates and order flows by

$$\Delta f_{t+h} = \beta_s \left(s_t - \mathbb{E}_t^{\mathrm{D}} f_t \right) + \beta_x \left(x_t - \mathbb{E}_t^{\mathrm{D}} x_t \right) + \epsilon_{t+h},$$

where

$$\beta_x = \frac{\phi \pi \kappa \mathbb{V} \left(\nabla \mathbb{E}_t^{\mathrm{H}} \mathbf{y}_{t+1} \right) \left(A^{h-1} \right)' C' \iota_2'}{\mathbb{V} \left(x_t - \mathbb{E}_t^{\mathrm{D}} x_t \right)} + \frac{\phi^* \pi \kappa^* \mathbb{V} \left(\nabla \mathbb{E}_t^{\mathrm{H}^*} \mathbf{y}_{t+1} \right) \left(A^{h-1} \right)}{\mathbb{V} \left(x_t - \mathbb{E}_t^{\mathrm{D}} x_t \right)} + \frac{\mathbb{CV} \left(o_t, \Delta f_{t+h} \right)}{\mathbb{V} \left(x_t - \mathbb{E}_t^{\mathrm{D}} x_t \right)}.$$

Table 3: Granger Causality Significance Levels

Variable to be Forecast	Forecasting Variable	
	Order Flows	Exchange Rate
Money Growth—US	0.00	0.72
Output Growth—US	0.00	0.01
Inflation—US	0.47	0.09
Money Growth—Germany	0.79	0.72
Output Growth—Germany	0.44	0.96
Inflation—Germany	0.00	0.71

Notes: Table presents marginal significance levels of tests whether end-user flows Granger cause three macro variables: output growth, money growth, and inflation. The tests are based on a monthly-frequency VAR for money and inflation, and a quarterly-frequency VAR for output growth. All the VARs include one lag of each of the following: the rate of exchange-rate depreciation, the macro variable, and the 6 end-user flow segments.

Consider forecasting regressions of the form:

$$\Delta^h y_{t+h} = a_1 \Delta^k y_t + a_2 \Delta^k s_t + \sum_{n=1}^{6} \omega_j x_{j,t}^k + \eta_{t+h}, \qquad (1)$$

- $\Delta^h y_{j+h}$ denotes the $h-$period change in the macro variable y ending at $t+h$,
- $\Delta^k s_t$ is the rate of depreciation between $t-k$ and t, and
- $x_{j,t}^k$ is the order flow from segment j in periods $t-k$ to t.
- We estimate this equation in weekly data using the real-time estimates of GDP, M1 and prices as the macro variables.

Table 4: Forecasting Fundamentals

	US Output Growth				German Output Growth			
Forecasting Variables	1 month	2 months	1 quarter	2 quarters	1 month	2 months	1 quarter	2 quarters
Output	0.002	0.003	0.022	0.092	0.004	0.063	0.089	0.006
	(0.607)	(0.555)	(0.130)	(0.087)	(0.295)	(0.006)	(0.009)	(0.614)
Spot Rate	0.001	0.005	0.005	0.007	0.058	0.029	0.003	0.024
	(0.730)	(0.508)	(0.644)	(0.650)	(0.002)	(0.081)	(0.625)	(0.536)
Output and Spot Rates	0.003	0.007	0.031	0.096	0.059	0.083	0.099	0.033
	(0.802)	(0.710)	(0.287)	(0.224)	(0.007)	(0.021)	(0.024)	(0.709)
Order Flows	0.032	0.080	0.189	0.246	0.012	0.085	0.075	0.306
	(0.357)	(0.145)	(0.002)	(0.000)	(0.806)	(0.227)	(0.299)	(0.000)
All	0.052	0.086	0.199	0.420	0.087	0.165	0.156	0.324
	(0.383)	(0.195)	(0.011)	(0.000)	(0.021)	(0.037)	(0.130)	(0.000)
	US Inflation				German Inflation			
Forecasting Variables	1 month	2 months	1 quarter	2 quarters	1 month	2 months	1 quarter	2 quarters
Inflation	0.003	0.024	0.005	0.053	0.007	0.037	0.053	0.024
	(0.461)	(0.146)	(0.487)	(0.213)	(0.402)	(0.067)	(0.040)	(0.232)
Spot Rate	0.005	0.007	0.013	0.016	0.081	0.000	0.000	0.033
	(0.351)	(0.419)	(0.391)	(0.457)	(0.000)	(0.962)	(0.858)	(0.305)
Inflation and Spot Rates	0.007	0.028	0.015	0.060	0.088	0.038	0.053	0.051
	(0.505)	(0.352)	(0.636)	(0.441)	(0.002)	(0.214)	(0.112)	(0.364)
Order Flows	0.025	0.050	0.116	0.212	0.050	0.116	0.178	0.271
	(0.773)	(0.629)	(0.052)	(0.000)	(0.429)	(0.010)	(0.025)	(0.000)
All	0.031	0.082	0.124	0.240	0.127	0.158	0.258	0.511
	(0.788)	(0.151)	(0.010)	(0.000)	(0.005)	(0.021)	(0.005)	(0.000)

	US Money Growth				German Money Growth			
Forecasting Variables	1 month	2 months	1 quarter	2 quarters	1 month	2 months	1 quarter	2 quarters
Money Growth	0.071 (0.009)	0.219 (0.000)	0.253 (0.000)	0.329 (0.000)	0.050 (0.023)	0.111 (0.005)	0.122 (0.017)	0.041 (0.252)
Spot Rate	0.021 (0.054)	0.001 (0.778)	0.003 (0.732)	0.005 (0.619)	0.002 (0.558)	0.044 (0.031)	0.036 (0.123)	0.065 (0.343)
M Growth and Spot Rates	0.086 (0.002)	0.220 (0.000)	0.267 (0.000)	0.333 (0.000)	0.050 (0.075)	0.130 (0.004)	0.129 (0.040)	0.080 (0.403)
Order Flows	0.034 (0.466)	0.119 (0.239)	0.280 (0.026)	0.424 (0.000)	0.026 (0.491)	0.082 (0.147)	0.152 (0.037)	0.578 (0.000)
All	0.096 (0.056)	0.282 (0.000)	0.417 (0.000)	0.540 (0.000)	0.074 (0.244)	0.175 (0.020)	0.284 (0.001)	0.624 (0.000)

Table 5A: Forecasting Contributions, US Fundamentals

Forecasting Variable	hor.	Spot Rate Fundamental		Corporate		Traders		Investors		All Flows
				US	Non-US	US	Non-US	US	Non-US	
GDP	1	-0.013	-0.111	1.476	0.329	-0.235	0.283	-0.099	-0.116	
		0.230	1.689	8.797**	3.579	2.946	0.483	0.684	1.575	18.064**
	2	-0.109	-0.449	0.709	0.283	0.607	-0.218	-0.662	0.281	
		-2.332***	13.544	6.300	2.763	15.921**	0.458	3.600	1.839	30.882**
Inflation	1	0.005	0.048	-0.144	0.040	0.037	-0.068	-0.072	0.020	
		0.987**	0.330	1.874	1.829	2.406	1.955	1.301	1.695	11.06**
	2	-0.006	0.184	0.141	-0.010	-0.045	0.083	-0.020	0.100	
		-1.247**	4.150	0.664	-0.602	1.027	1.525	0.993	17.236*	20.842**
M. Growth	1	0.360	0.425	0.919	-0.957	2.129	-5.184	-9.573	-2.477	
		0.577***	21.427**	0.633	-0.826	-0.045	3.020	14.798**	2.160	19.74**
	2	-1.039	0.439	1.391	-3.944	5.292	-1.806	-10.537	-0.056	
		1.962***	30.842**	1.259	-2.929	1.657**	0.855	19.764*	0.009	20.615*

Notes: The upper entry in each cell is the OLS coefficient in the forecasting equation computed at either the 1 or 2 quarter horizon. The lower entry is the percentage contribution to the variance of the forecast variable. Marginal significance levels for the null hypothesis that there is no forecasting power in spot rates or order flows are denoted by *, **, and *** for 10%, 5% and 1%. All marginal significance levels are computed from the finite sample bootstrap distribution.

Table 5B: Forecasting Contributions, German Fundamentals

Forecasting Variable	hor.	Spot Rate	Fundamental	Corporate		Traders		Investors		All Flows
				US	Non-US	US	Non-US	US	Non-US	
GDP	1	0.095	-0.281	-0.983	-0.712	0.302	-0.997	-0.726	-0.426	
		0.617***	8.814*	0.257	2.108	0.409	2.646	0.368	0.394	6.181*
	2	-0.042	-0.106	-1.677	0.260	0.024	-0.845	1.402	1.170	
		-0.859	0.837	2.630	-0.730	0.095	3.026	6.511	19.995	31.527*
Inflation	1	-0.192	-0.286	2.315	0.167	-0.068	-3.479	-2.701	1.027	
		-0.307***	6.483*	2.485	0.065	0.052	9.421**	5.384	2.171	19.578**
	2	-0.531	-0.491	1.764	0.714	0.104	-3.242	-4.703	1.394	
		7.156***	7.040*	2.263	3.142	-0.327	3.287	25.076*	3.355	36.797**
M. Growth	1	0.724	0.396	-3.224	2.408	-0.233	3.210	5.180	-5.215	
		-3.982***	13.880**	0.443	1.928	0.154	1.046	1.749	13.150**	18.469***
	2	1.143	0.243	5.670	-3.091	0.203	8.813	-4.129	-11.436	
		-6.683***	4.935	0.938	0.349	-0.067	10.483*	1.530	50.605***	63.838***

Notes: The upper entry in each cell is the OLS coefficient in the forecasting equation computed at either the 1 or 2 quarter horizon. The lower entry is the percentage contribution to the variance of the forecast variable. Marginal significance levels for the null hypothesis that there is no forecasting power in spot rates or order flows are denoted by *, **, and *** for 10%, 5% and 1%. All marginal significance levels are computed from the finite sample bootstrap distribution.

If information aggregation takes time, order flows should have forecasting power for future changes in spot rates over the corresponding learning period. Consider then

$$\Delta^h s_{t+h} + i_t^{*h} - i_t^h = \delta_0 + \sum_{j=1}^{6} \delta_j x_{j,t}^h + \omega_{t+h}.$$

Table 6: Forecasting Regressions for Excess Returns

Horizon	Corporate		Traders		Investors			
	US	Non-US	US	Non-US	US	Non-US		(p-value)
1 week	1.119	-0.061					0.027	10.243
	(0.365)	(0.170)						(0.006)
			0.045	0.205			0.003	0.983
			(0.162)	(0.225)				(0.612)
					-0.652	0.222	0.015	6.003
					(0.304)	(0.183)		(0.050)
	1.074	-0.008	-0.071	0.039	-0.421	0.247	0.037	16.207
	(0.363)	(0.189)	(0.161)	(0.228)	(0.309)	(0.196)		(0.013)
1 month	1.179	-0.051					0.119	18.041
	(0.306)	(0.133)						(0.000)
			0.090	0.135			0.010	1.116
			(0.160)	(0.173)				(0.572)
					-0.965	0.131	0.110	15.434
					(0.264)	(0.109)		(0.000)
	0.985	-0.008	0.001	-0.038	-0.762	0.146	0.185	33.629
	(0.259)	(0.137)	(0.136)	(0.182)	(0.242)	(0.128)		(0.000)

- These findings are not inconsistent with standard definitions of market efficiency: Only dealers observe order flows.
- The heterogeneity in coefficients is accounted for in Evans and Lyons (2006, IJFE).

Forecasting ability of order flows holds out-of-sample as well.

Model	Horizon h (trading days)	1	5	10	15	20
Micro II	MSE Ratio	0.961	0.876	0.848	0.810	0.806
	p-value	(0.062)	(0.012)	(0.046)	(0.023)	(0.027)
	var contrb.	0.027	0.057	0.102	0.122	0.157
	p-value	(0.005)	(0.018)	(0.005)	(0.007)	(0.002)

Source: Evans and Lyons (2005 AER P&P).

Conclusion

Transaction flows in the FX market convey information about the PV of fundamentals that is not captured in macro - econometric measures.
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- though flows convey new information about future fundamentals, much of this information is still not impounded in the spot rate one quarter later.

Implications

- Many people have viewed past micro-empirical findings linking transaction flows and exchange rates as reflecting a high-frequency, non-fundamental part of exchange rate determination.
- Our findings suggest that transaction flows are central to the process by which expectations of future macro variables are impounded in price.