Discussion of

Order Flows and The Exchange Rate Disconnect Puzzle

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Outline

- Overview
- Challenges for all exchange rate papers
- Identification of unobservables
- An alternative model

Overview

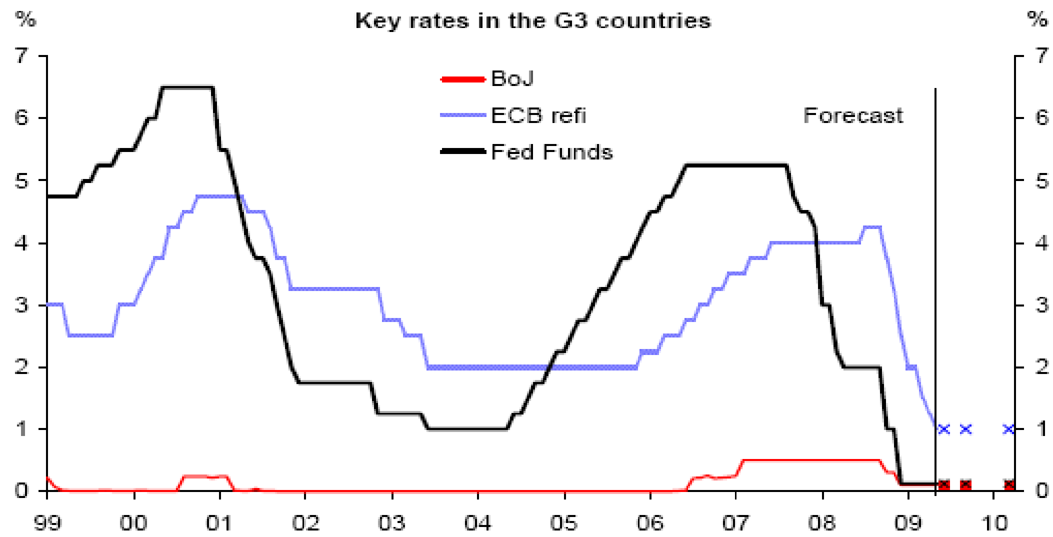
- Macro models vs. microstructure order flow models
- Bringing together the two literatures
- Using unique customer order flow data from Citibank, 1993-99, finds
- Order flow explains ex post excess returns
- Order flow incorporates information about macro variables
- News ➔ order flow ➔ ex rate movement

A challenge to exchange rate models

"Specifically, dealers interest rate expectations incorporate a view on how central banks react to changes in the macroeconomy. The model's focus is on how dealers use order flow to draw inferences about the current state of macroeconomy, which in turn affect their interest-rate forecasts and their foreign currency quotes."

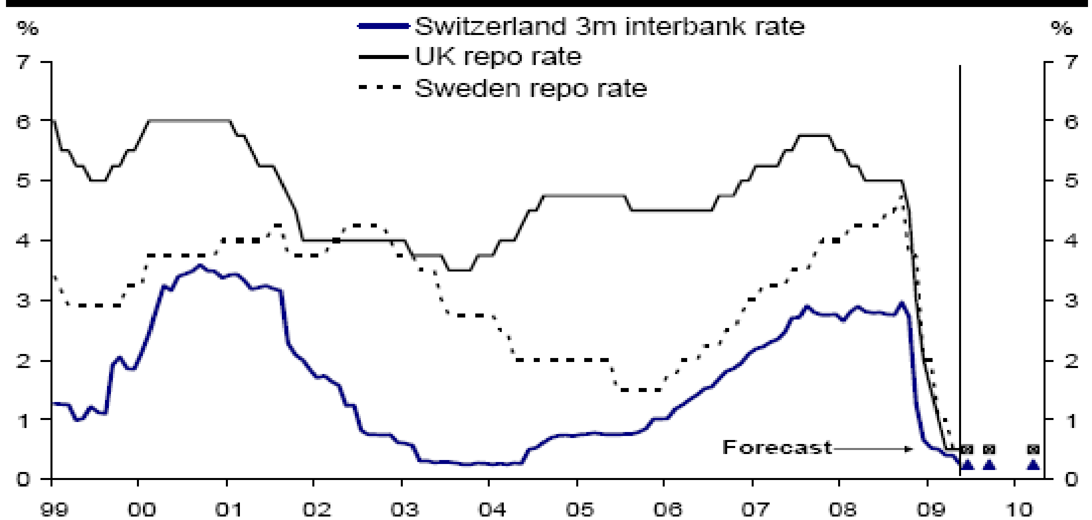
$$\mathbb{E}_t^{\mathrm{D}}(\hat{r}_{t+i} - r_{t+i}) = (1+\gamma_\pi)\mathbb{E}_t^{\mathrm{D}}\left(\Delta\hat{p}_{t+1+i} - \Delta p_{t+1+i}\right) + \gamma_y \mathbb{E}_t^{\mathrm{D}}\left(\hat{y}_{t+i} - y_{t+i}\right) - \gamma_\varepsilon \mathbb{E}_t^{\mathrm{D}} \varepsilon_{t+i},$$

Key rates in the G3 countries



Source: DB Global Markets Research

Key rates in the peripheral European countries



Source: DB Global Markets Research

Identification of unobservables

$$er_{t+1} = \beta_{er}(x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1}) + \xi_{t+1} \qquad (19)$$

$$\beta_{er} = \frac{\mathbb{E}[er_{t+1}(x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1})]}{\mathbb{E}[(x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1})^2]}$$

Problem: don't observe $x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1}$

But can write *er* as:

$$er_{t+1} = \delta_t + \lambda_u u_{t+1} + \lambda_z(z_t - \mathbb{E}_t^{\mathrm{D}} z_t) - \omega_{t+1} \qquad (18)$$

δ rp, $\lambda_u u_{t+1}$ effects public macro shocks uncorr OF, ω revisions in expected *s*

Decomposing β_{er}

$$\beta_{er} = \sum_{i=1}^{q} \lambda_{z_i} \beta_{z_i} - \beta_{\omega} \tag{20}$$

"price of information"

$$\beta_{z_i} = \frac{\mathbb{E}[(z_{i,t} - \mathbb{E}_t^{\mathrm{D}} z_{i,t})(x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1})]}{\mathbb{E}[(x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1})^2]}$$

$$\beta_{\omega} = \frac{\mathbb{E}[\omega_{t+1}(x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1})]}{\mathbb{E}[(x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1})^2]}$$

$$\beta_{z_i} = \frac{\mathbb{E}[e_{i,t}^z \tilde{x}_{t+1}]}{\mathbb{E}[\tilde{x}_{t+1}^2]} + \frac{\mathbb{E}[(\mathbb{E}[z_{i,t}|\Omega_t] - \mathbb{E}_t^{\mathrm{D}} z_{i,t})\tilde{x}_{t+1}]}{\mathbb{E}[\tilde{x}_{t+1}^2]} = \frac{\mathbb{E}[e_{i,t}^z \tilde{x}_{t+1}]}{\mathbb{E}[\tilde{x}_{t+1}^2]}$$

because $z_{i,t} - \mathbb{E}_t^{\mathrm{D}} z_{i,t} \equiv e_{i,t}^z + \mathbb{E}[z_{i,t}|\Omega_t] - \mathbb{E}_t^{\mathrm{D}} z_{i,t}$ And…

Unobserved key variables (I)

$x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1}$

- "Thus, the requirement of efficient risk-sharing on the dealers choice of risk premium implies that unexpected order flow can be identified from the cumulation of current and past order flows." Or, in algebra…

$\mathbb{E}_t^{\mathrm{D}} \alpha_t = 0$, and $x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1} = \alpha_t - \mathbb{E}_t^{\mathrm{D}} \alpha_t$ because $\alpha_{t-1} \in \Omega_t^{\mathrm{D}}$

$\alpha_t = \alpha_{t-1} + x_{t+1}$, gives $x_{t+1} - \mathbb{E}_t^{\mathrm{D}} x_{t+1} = \sum_{i=0}^{\infty} x_{t+1-i}$

Unobserved key variables? (II)

$$z_{i,t} - \mathbb{E}_t^{\mathrm{D}} z_{i,t}$$

- Proxy using an innovative method for generating real time estimates of data
- do I believe these estimates?

Table 3: Summary Statistics: Real-Time Estimation Errors

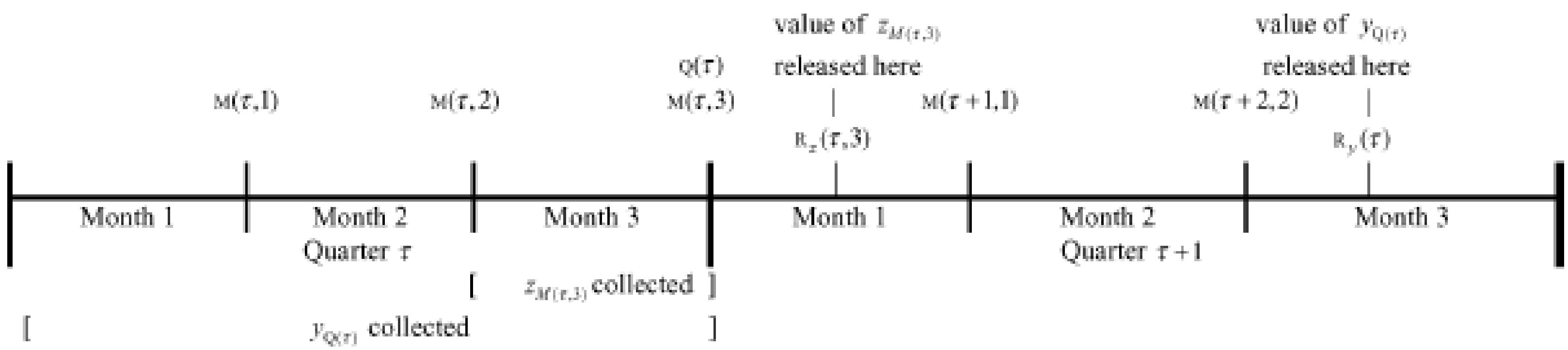
	Mean Std.	Max Min	Skewness Kurtosis	Autocorrelations ρ_1	 ρ_2	 ρ_4	 ρ_8
A:							
(i) US GDP	0.165	3.166	0.133	0.903	0.807	0.616	0.372
	1.341	-3.637	2.566				
(ii) US CPI	-0.064	0.379	0.265	0.749	0.528	0.528	0.520
	0.125	-0.369	3.196				
(iii) US M1	0.292	14.349	0.037	0.495	0.103	0.171	0.112
	3.921	-11.495	3.753				
(iv) German GDP	-1.255	8.406	0.001	0.922	0.843	0.701	0.387
	3.295	-11.742	4.412				
(v) German CPI	1.871	15.026	0.127	0.935	0.862	0.752	0.660
	5.536	-12.906	2.934				
(vi) German M1	-3.694	8.363	-1.288	0.795	0.585	0.393	0.237
	5.567	-29.020	7.284				

B: Cross-Correlations	(i)	(ii)	(iii)	(iv)	(v)
(i) US GDP					
(ii) US CPI	-0.417*				
(iii) US M1	0.239*	-0.120*			
(iv) German GDP	0.100	-0.024	0.043		
(v) German CPI	-0.093	-0.109	0.043	0.105	
(vi) German M1	-0.098	-0.004	0.092	-0.049	-0.055

C: Forecast Comparisons	M.M.S. Mean	 M.S.E	Real-Time Mean	 M.S.E
(i) US GDP	0.729	1.310	0.190	1.407
(ii) US CPI	-0.327	1.797	0.054	2.357
(iii) US M1	0.399	11.807	0.033	11.932
(iv) German GDP	0.132	6.981	-0.416	6.954
(v) German CPI	-0.136	1.687	-0.035	1.906
(vi) German M1	4.778	42.363	-0.159	20.561

Tangent: Methodology for RT Estimates

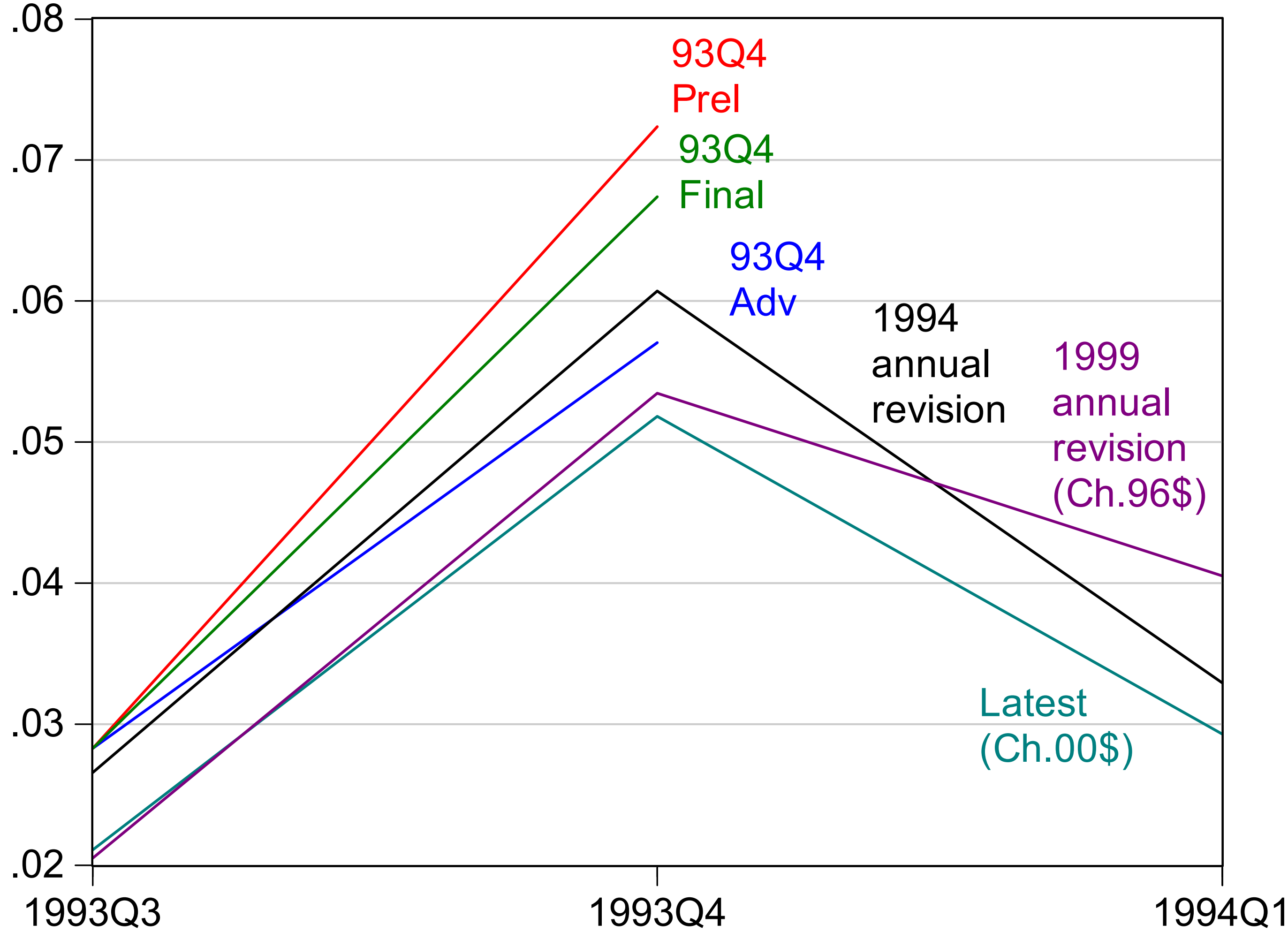
Figure 1. Data Collection Periods and Release Times for Quarterly and Monthly Variables



Note: The reporting lag for "final" GDP growth in quarter τ, $y_{Q(\tau)}$, is $R_y(\tau) - Q(\tau)$. The reporting lag for the monthly series $z_{M(\tau,j)}$ is $R_z(\tau,j) - M(\tau,j)$ for $j = 1, 2, 3$.

Evans, "Where are we now," *IJCB*, Sept. 2005

How Many Revisions Are There?
For GDP, many



RT estimation error /order flow regression

- Key regression:

$$e^z_{i,t} = \sum_{j=1}^{6} b_j x_{j,t} + v_t. \tag{23}$$

where

$$e^z_{i,t} = z_{i,t} - \mathbb{E}[z_{i,t}|\Omega_t],$$

b’s should be approximately zero if order flow contains no information

Table 5: Real-Time Estimation Errors and Order Flows

Real-Time Error	Corporate		Hedge		Investor		R^2	χ^2
	US	Non-US	US	Non-US	US	Non-US		(p-value)
A: US								
GDP	-0.530**	0.010	0.133**	0.109	0.428**	-0.256**	0.197	89.430
	(0.137)	(0.059)	(0.049)	(0.098)	(0.100)	(0.043)		(<0.001)
CPI	0.296	0.252**	-0.112**	-0.153	-0.572**	0.255**	0.157	197.056
	(0.181)	(0.054)	(0.048)	(0.098)	(0.107)	(0.046)		(<0.001)
M1	-0.243	-0.090	0.052	0.178*	0.255**	-0.242**	0.128	54.024
	(0.133)	(0.061)	(0.042)	(0.089)	(0.118)	(0.051)		(<0.001)
B: Germany								
GDP	0.106	0.100	0.120**	-0.147	-0.092	-0.065	0.029	19.873
	(0.175)	(0.064)	(0.058)	(0.093)	(0.143)	(0.052)		(0.003)
CPI	-0.380**	-0.188**	0.048	0.045	-0.131	-0.068	0.018	33.917
	(0.144)	(0.049)	(0.047)	(0.109)	(0.106)	(0.048)		(<0.001)
M1	1.081**	0.146**	-0.122**	-0.043	0.101	0.182**	0.145	96.927
	(0.242)	(0.057)	(0.055)	(0.132)	(0.125)	(0.048)		(<0.001)
C: Difference								
GDP	0.636**	0.090	-0.013	-0.256**	-0.520**	0.191**	0.068	59.258
	(0.213)	(0.092)	(0.071)	(0.126)	(0 .159)	(0.060)		(<0.001)
CPI	-0.676**	-0.440**	0.160**	0.198	0.441**	-0.324**	0.082	131.419
	(0.247)	(0.067)	(0.069)	(0.163)	(0.162)	(0.078)		(<0.001)
M1	1.324**	0.237**	-0.174**	-0.221	-0.154	0.424**	0.163	149.297
	(0.256)	(0.077)	(0.065)	(0.150)	(0.158)	(0.073)		(<0.001)

Notes: The table reports coefficients and standard errors from regression (23). The estimated coefficients on the order flows are multiplied by 1000. The right hand column reports χ^2 statistics for the null that all the coefficients on order flows are zero. Estimates are calculated at the weekly frequency. The standard errors correct for heteroskedasticity. Statistical significance at the 5% and 1% level is denoted by * and **.

Econometric quibbles

- Serial correlation?
- Cumulated order flow has a trend?
- GDP real time error highly persistent
- Standard errors correct for heteroskedasticity, not serial correlation?

Point of Agreement

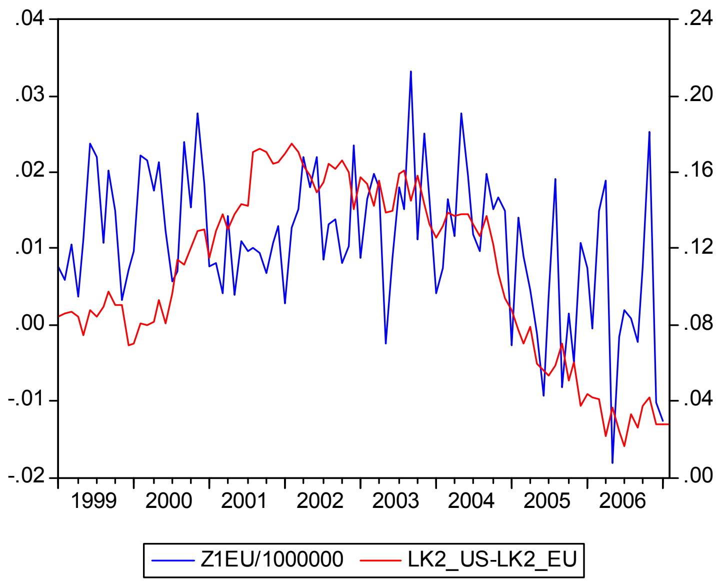
"For example, Mark (2005) and Engel and West (2006) that the correlation between the log level of the real exchange rate implied by their models and the actual rate is approximately 0.3, but this encouraging result does not carry over to changes in log spot rates (i.e. depreciation rates)."

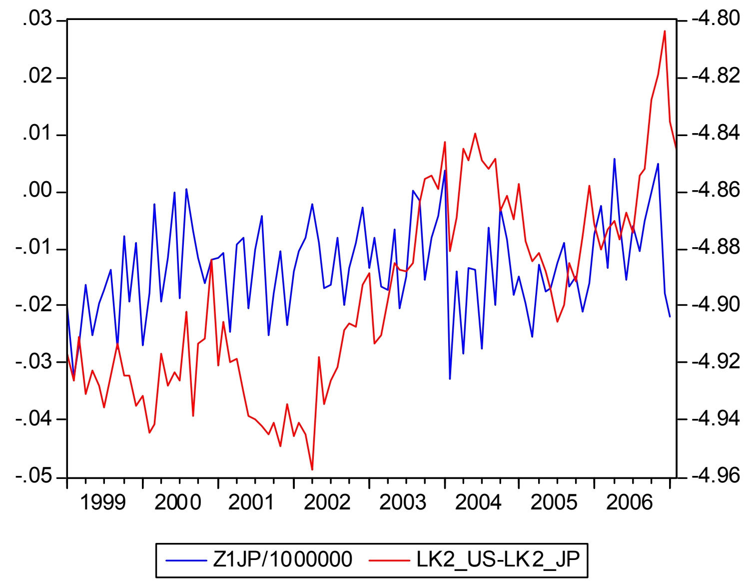
A Simpler Model

- Chinn-Moore (2009) imbeds order flow in monetary model
- Order flow proxies for velocity shocks
- Estimated of 1999m04-07m02
- Achieves adjusted R^2's of up to 0.57
- Outperforms a random walk

$$\Delta s_t = \Delta X_{t-1}\Gamma + \rho_1 \Delta s_{t-1} + \rho_2 \Delta s_{t-1} + \varphi(s_{t-1} - X_{t-1}B) + v_t$$

Velocity Shocks and Order Flow





Adj. R^2=0.17

Adj. R^2=0.03

USD/EUR 99m04-07m02

coefficient	[1]	[2]	[3]	[4]
Error correction term	**-0.0652**	**-0.0522**	**-0.0875**	**-0.0859**
	(0.0385)	(0.0299)	(0.0341)	(0.0363)
lag money	**-4.4418**	**-9.8273**	-3.5667	**-6.4155**
	(1.9166)	(4.3574)	(2.5037)	(3.4498)
lag income	0.2010	-9.1941	-3.0104	-7.4858
	(6.8814)	(11.2760)	(5.7884)	(8.1076)
lag int rate	-9.5746	-1.9370	0.1355	2.1832
	(7.4101)	(7.7748)	(5.0111)	(6.1952)
lag infl rate	1.0621	1.4740	0.5515	0.7311
	(2.0818)	(1.7263)	(1.0373)	(1.0612)
OF		**1.8578**	**1.8222**	**1.7748**
		(0.3604)	(0.3519)	(0.3358)
lag OF				0.6498
				(0.4285)
2nd lag OF				0.5241
				(0.2946)
lag cumulative OF			**0.3124**	0.2539
			(0.1690)	(0.1854)
adj.R sq.	0.015	0.331	0.339	0.367
N	94	94	94	94

USD/JPY 99m04-07m02

coefficient	[1]	[2]	[3]	[4]
Error correction term	**-0.201**	**-0.154**	**-0.154**	**-0.155**
	(0.057)	(0.045)	(0.046)	(0.047)
lag money	**-0.452**	**-0.772**	0.096	0.399
	(0.173)	(0.191)	(2.180)	(2.292)
lag income	**-1.127**	**-2.104**	**-2.022**	**-1.963**
	(0.675)	(0.541)	(0.572)	(0.568)
lag int rate	**-1.914**	**-3.469**	**-2.982**	-2.644
	(0.867)	(1.159)	(1.522)	(1.873)
lag infl rate	-0.448	0.102	0.117	0.135
	(0.450)	(0.364)	(0.386)	(0.373)
OF		**2.099**	**2.090**	**2.107**
		(0.269)	(0.271)	(0.275)
lag OF				-0.047
				(0.324)
2nd lag OF				-0.136
				(0.428)
lag cumulative OF			0.216	0.279
			(0.543)	(0.563)
adj.R sq.	0.167	0.570	0.565	0.554
N	94	94	94	94

Parting Comments

- I’m a believer
- Order flow provides information about the macroeconomy
- Order flow is able to increase explanatory power far above what standard macro variables can achieve
- But maybe I need a little more to be a “true” believer