E C O N O M I C S B U L L E T I N

Does liquidity in the FX market depend on volatility?

Frank Westerhoff
University of Osnabrueck, Department of Economics

Sebastiano Manzan
University of Amsterdam, CeNDEF, Department of Quantitative Economics

Abstract

We re−examine the relationship between exchange rates and order flow as proposed by Evans and Lyons (2002). Compared to their linear specification, we find that the response of exchange rates to order flow may depend on market historical volatility. If market historical volatility is high, a given order seems to have a lower price impact than in calmer periods. Overall, our simple threshold mechanism has the power to produce higher correlation coefficients.

We gratefully acknowledge the helpful comments of an anonymous referee and of Robert Dekle.
Citation: Westerhoff, Frank and Sebastiano Manzan, (2004) "Does liquidity in the FX market depend on volatility?."
Economics Bulletin, Vol. 6, No. 10 pp. 1−8
Submitted: March 19, 2004. **Accepted:** August 25, 2004.
URL: http://www.economicsbulletin.com/2004/volume6/EB−04F30001A.pdf

1. Introduction

Empirical macro models have difficulties in predicting exchange rates. Meese and Rogoff (1983) find that structural models are not able to outperform a random walk in an out-of-sample forecast. Their conclusions are still valid when a longer time span of data is used (Cheung et al. 2002). A more promising approach to capture the behavior of the exchange rate may be to focus on the microstructure of foreign exchange markets, e.g. Lyons (2001), Evans (2002) and Evans and Lyons (2003). As reported by Evans and Lyons (2002), order flow, i.e. the difference between buyer- and seller-initiated trades, explains a large fraction of the variability of nominal exchange rate changes at short horizons. While structural models may be useful in explaining the long-term dynamics of the exchange rate, order flow seems to be a more appropriate variable in the short run.

In this note, we explore the link between order flow and exchange rates in a novel way. Note that there is now widespread evidence of nonlinear effects in exchange rate dynamics. Hence, we study whether the relationship between order flow and exchange rates may be characterized by a simple piece-wise linear model. As it turns out, the already remarkable fit of Evans and Lyons (2002) may be improved if one incorporates threshold effects: R^2 statistics increase by about 5 to 8 percent. From an economic point of view, the response of exchange rates to order flow seems to respond asymmetrically to the market historical volatility. If market historical volatility is high, an order has a lower price impact than in calmer periods.

The remainder of this note is organized as follow: Section (2) describes the model, Section (3) presents the estimation results and Section (4) concludes.

2. The Setup

Evans and Lyons (2002) propose a microstructural model that leads to the following linear relationship

$$\Delta s_t = \alpha \Delta x_t + \eta_t , \qquad (1)$$

where Δs_t is the change of the log nominal exchange rate at time *t*, Δx_t is the order flow, α is a coefficient and η_t is an *i.i.d.* disturbance term. Estimation results based on daily observations show that the order flow variable significantly and positively causes Δs_t. Overall, Δx_t explains about 64 percent of the variability of USD/DM exchange rates, which stands in sharp contrast to the typically low R^2 achieved by traditional exchange rate models. Although Evans and Lyons (2002) detect weak evidence of nonlinearities, they conclude that a linear specification is appropriate.

Notwithstanding, we explore whether the price impact of order flow may depend on market historical volatility and inspect the following threshold relationship[1]

$$\Delta s_t = \begin{cases} \beta_1 \Delta x_t + \varepsilon_t & \textit{for} \quad y_t = \frac{1}{\mathrm{K}} \sum_{\mathrm{k}=1}^{\mathrm{K}} \left| \Delta s_{t-k} \right| > c \\ \beta_2 \Delta x_t + \varepsilon_t & \textit{otherwise} \end{cases} . \qquad (2)$$

Market historical volatility is measured as the average absolute price change in the last K lag periods. The coefficients β_1 and β_2 are estimated by OLS while the threshold constant *c* is selected by a grid search on the values of the 80% interval of y_t. ε_t is a noise term. Summing up, (2) is a piece-wise linear model with coefficients equal to β_1 if market historical volatility is larger than *c* and β_2 otherwise.

---

[1] According to Easley and O´Hara (1992), such a relationship may result from event uncertainty, the basic idea being that trades are more informative when trading intensity is high. To be precise, their model predicts that the informational content of order flow is positively correlated with volume and volatility.

3. Evidence

Our analysis is based on the dataset of Evans and Lyons (2002). The time series consist of USD/DM and USD/JY rates and order flow observations at daily frequency from May 1 to August 31, 1996. [2] Further details are available in their article. The estimation results of the linear regression are reproduced in Table (1).

Tables (2) displays the findings for the threshold model. Due to the rather short sample, we consider only up to K=5 lags. In the USD/DM case, both β_1 and β_2 are always statistically significant and different from each other. Moreover, for all lags, the R^2 statistic improves. This is also confirmed by the Akaike Information Criteria that is larger for all values of K considered. All in all, there exists clear support for the threshold mechanism.

For K=4, for instance, the threshold regression is able to explain about 69.3 percent of the variability of the changes in the exchange rates, compared to the 63.6 percent explained by the linear regression.[3] The interpretation is quite simple. When the 4-day moving average of absolute exchange rate changes is higher than 0.00191, the coefficient of the order flow is close to 1.7, otherwise it is around to 2.9. Hence, when market historical volatility is high, the order flow causes a smaller change of the USD/DM rate compared to the case when it is low. In the misspecified linear model, the price adjustment is about 2.2.

Similar results are obtained for the USD/JY market. The threshold variable with the highest R^2 statistic is the one-period lagged absolute price change, i.e. $y_t = |\Delta s_{t-1}|$. The coefficients in the regression are significantly different from each other but the coefficient

[2] We thank the authors for making available their data.

[3] The grid search procedure indicates that the optimal value of the threshold is quite close to its median value.

in the regime for $y_t > c$ is not significantly different from zero. The fraction of variability of the exchange rate explained by the regression increases from 0.392 (for the linear case) to 0.478. Again, the response of exchange rate changes to order flow is asymmetric: The coefficient is equal to 3.075 if the last absolute change in the exchange rate is below 0.45 percent, but it is statistically insignificant otherwise. Put differently, if volatility is low, order flow has a stronger effect on exchange rates than predicted by the linear model.

4. Conclusion

We investigate whether there exist nonlinearities in the relation between order flow and changes in exchange rates. In fact, estimation of a piece-wise linear model reveals clear evidence for asymmetric effects in the data: In one regime, characterized by high exchange rate volatility, the impact of order flow on exchange rate changes is rather modest while in the other regime it is large (and larger than predicted by the linear model).

Although this is an empirical note, the question arises what is driving our finding. As pointed out by the referee, high volatility periods may be followed by periods more heavily weighted toward (uninformative) inventory adjustment trading, which translates into high liquidity, due to the increased share of uninformed trades in the order flow mix.

To sum up, the linear specification proposed in the seminal work of Evans and Lyons (2002) may be improved by considering piece-wise linear models. Given such a strong relationship, the question of the determinants of order flow becomes even more challenging.

References

Cheung Y.-W., M.D. Chinn and A. Garcia Pascual (2002). Empirical Exchange Rate Models of the Nineties: Are Any Fit to Survive?, *NBER Working Paper Series*, No. 9393.

Easley, D. and M. O'Hara (1992): Time and the Process of Security Price Adjustment. *Journal of Finance*, 47, 577-605.

Evans (2002), FX Trading and Exchange Rate Dynamics. *Journal of Finance*, 57(6), 2405-2447.

Evans M. and R. Lyons (2002). Order Flow and Exchange Rate Dynamics. *Journal of Political Economy*, 110, 170-180.

Evans, M. and Lyons, R. (2003). How is Macro News Transmitted to Exchange Rates?, *NBER Working Paper Series*, No. 9433.

Lyons, R. (2001). *The Microstructure Approach to Exchange Rates.* MIT Press: Cambridge.

Meese R.A. and K. Rogoff (1983). Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?, *Journal of International Economics*, 14, 3-24.

Table 1: Linear Model

USD/DM			USD/JY		
α	R^2	AIC	α	R^2	AIC
2.156 (11.7)	0.636	-2.818	2.538 (7.13)	0.392	-4.273

Estimation of Equation (1). The t-values are given in parentheses.

Table 2: Threshold Model

	USD/DM					USD/JY				
K	β^1	β^2	c	R^2	AIC	β^1	β^2	c	R^2	AIC
1	1.558 (5.78)	2.666 (11.3)	0.00210	0.681	-2.594	0.500 (0.64)	3.075 (8.32)	0.00450	0.478	-3.951
2	1.769 (8.29)	3.037 (9.88)	0.00160	0.688	-2.589	1.939 (3.54)	3.060 (6.74)	0.00310	0.436	-4.174
3	1.789 (8.02)	2.889 (9.72)	0.00200	0.682	-2.593	0.067 (0.49)	2.763 (7.55)	0.0055	0.436	-4.174
4	1.677 (7.22)	2.893 (10.6)	0.00191	0.693	-2.572	2.054 (5.15)	4.147 (6.22)	0.0019	0.472	-3.960
5	1.809 (6.75)	2.538 (9.80)	0.00225	0.663	-2.633	2.268 (5.80)	4.082 (4.82)	0.0019	0.441	-4.123

Estimation of Equation (2). The t-values are given in parentheses.