POSITION OF NON-COMMERCIAL TRADERS IN FOREIGN CURRENCY FUTURES AND SPOT EXCHANGE RATES IN THE LONG RUN

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ABSTRACT
Microstructure approach to exchange rate determination is a growing phenomenon in exchange rate literature. This approach stresses the significance of buy and sells orders of traders to explain exchange rate movements. Several recent articles have investigated the importance of this approach by testing the long-run relationship between the cumulated order flows and spot exchange rates. This paper examines the cointegration relation between the net position of non-commercial traders in various foreign currency futures and exchange rate movements in the spot market. The results indicate that a stable long-run relationship exists between the cumulated net position of non-commercial traders in foreign currency futures and corresponding spot rates. Moreover, Granger causality tests, produced from error correction models (ECM), point to bidirectional causality in some cases and unidirectional causality in others.

Key words: Exchange Rates, Order Flow, Futures Markets, Cointegration
JEL Codes: F31, F32

I. INTRODUCTION
Traditional analysis of exchange rate behavior in the long-run has been widely dominated by macroeconomic models. However, the failure of these models has led researchers to center on microstructure models of exchange rates. This particular body of literature is concerned with the transmission of information among market participants, the behavior of market agents, the

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importance of order flow, the heterogeneity of agents' expectations, and the implications of such heterogeneity for trading volume and exchange rate volatility (Sarno & Taylor, 2001). The key variable in micro-based models is order flow which is defined as the net of buyer- and seller-initiated transactions, and may be thought of as the net buying pressure (Lyons, 2001). Recent articles have demonstrated a strong statistical relationship between order flow and spot exchange rates. For instance, Evans and Lyons (2002) illustrate that inter-dealer order flow explains more than 60 percent of daily changes in the DEM/USD[2] rate and more than 40 percent of the daily changes in the JPY/USD rate. Order flow is considered to signal private information to market participants and therefore suggests a permanent affect on market prices. Bjønnes and Rime (2005) use cumulative order flow data, over a period of five days in 1998, from Reuters D2000-1 platform and Electronic Broking System (EBS), to test a subset of their exchange rates for cointegration using the Johansen (1988) approach. They find weak evidence of cointegration for the NOK/DEM rate but stronger evidence for the DEM/USD rate. On the other hand, Killen *et al*. (2006) use FF/DEM cumulated order flows from the EBS platform over a period of 4 months in 1998 and find significant evidence of cointegration between cumulative order flow and exchange rates using both the Engle-Granger (1987) and Johansen (1988) approaches. Furthermore, Boyer and Norden (2006) examine nine currencies over a period of 83 business days in 1996 and use daily inter-dealer order flows from the Reuters D2000-1 system. Authors use Johansen (1988) and Johansen and Juselius (1990) methods and find evidence of a stable long-run relationship for only a small number of major currencies and for two currencies that no longer exist – FF and NLG. Lastly, Berger *et al*. (2008) analyze cumulated order flow and exchange rate returns on the EBS platform for the EUR/USD and USD/JPY currency pairs from January 1999 through December 2004 and find out that while the Engle-Granger test fails to reject the null hypothesis of no cointegration for either the euro or the yen, the Johansen trace test rejects for the euro but not for the yen.

Although, the term "order flow" has taken on different meaning in different setting, the common feature of these definitions is a measure of the net trading of some group or the inference of trade direction through components of some mechanism (Locke and Onayev, 2007). In this article, I use the positioning data of traders in currency futures markets to investigate

[2] The following ISO codes for currencies are used in the text: AUD for Australian dollar, GBP for British pound, DEM is Deutsche mark, EUR for Euro, NLG for Dutch guilder, FF is French franc, JPY is Japanese yen, NOK for Norwegian krone, CHF for Swiss franc and USD is US dollar.

the cointegration relationship between the cumulated net position of non-commercial traders and spot exchange rates.

II. DATA AND METHODOLOGY

The following currency futures listed on the Chicago Mercantile Exchange are used in this study: AUD, GBP, EUR, JPY and CHF. The period of time under investigation is from January 5, 1993 to December 30, 2008. In order to keep the sample size consistent across all futures positions, the DEM futures data is merged with the EUR series from January 5, 1993 to December 29, 1998. However, in order to control for the introduction of the official currency of the European Union in January 1, 1999, a dummy variable is generated for the DEM and EUR grouping. The futures positioning data for those currencies are gathered from the Commitment of Traders (COT) report which is calculated from Wednesday to Tuesday and released to the public the following Friday by the Commodity Futures Trading Commission. A net position is defined as the difference between long open interest and short open interest of non-commercial traders, also known as speculators. These net positions are then cumulated to be consistent with prior studies in the literature. Since the net positions represent the outcome of weekly adjustments of trading strategies by traders, the daily exchange rates are averaged over the Wednesday-Tuesday interval to match the COT data. All the spot exchange rates are in the format of foreign currency per USD and are obtained from Bloomberg.

The methodological approach here involves a two-step process. The first is to explore the long-run equilibrium relationship between the cumulated net positions of speculators in currency futures market and corresponding spot exchange rates while the second is to conduct multivariate Granger-causality tests to examine the short-run effects that each variable have on the other.

Cointegration analysis allows us to explore the long-run relationship between exchange rates and cumulative order flows. Testing for cointegration involves two steps: the first is to investigate the unit root behavior of the series. To this end, the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are performed both on the levels and the first differences of the variables. If the variables under investigation are found to be integrated of order one, $I(1)$, then the Johansen (1988) procedure is performed to identify the existence of a long-run relationship. Within the Johansen framework, the following system is estimated:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \ldots + \Gamma_{k-1} \Delta Z_{t-k+1} + \Pi Z_{t-1} + \mu + \Psi D_t + \varepsilon_t$$

Where, Δ is the first difference operator, Z_t is a $p \times 1$ vector of stochastic variables, μ is a constant term, D_t is a vector of nonstochastic variables, such as seasonal or intervention dummies, $\varepsilon_t \sim Niid(0, \Sigma)$ and k is the lag length. In this model, Z_t includes the cumulative net positions of speculators, *CNP*, and exchange rates, *FX*. If the data are *I*(1) then the matrix Π is of reduced rank, *r* and $\Pi = \alpha\beta'$ where α and β are $p \times r$ matrices with β containing the *r* cointegrating relationships and α representing the corresponding adjustment of coefficients in each of the *r* vectors.

Johansen (1988) suggests two test statistics to determine the number of cointegrating vectors, or the rank of Π. The first of these is known as the trace statistic:

$$\lambda_{trace} = -T \sum_{i=r+1}^{p-1} \ln(1 - \hat{\lambda}_i)$$

where $\hat{\lambda}_{r+1}, \ldots, \hat{\lambda}_p$ are the estimated $p - r$ smallest eigenvalues. The null hypothesis being tested here is that there are at most *r* cointegrating vectors. In other words, the number of cointegrating vectors is less than or equal to *r*, where *r* is equal to zero or one. The second test statistic is the maximum eigenvalue test:

$$\lambda_{\max} = -T \ln(1 - \hat{\lambda}_{r+1})$$

This statistic tests the null that the number of cointegrating vectors is *r* against the alternative of *r+1* cointegrating vectors.

According to Engle and Granger (1987), if two variables are integrated of degree one and are cointegrated then either unidirectional or bidirectional Granger causality must exist. They have proposed the ECM as a more comprehensive method to use in the test of causality when the variables are cointegrated. Therefore, if the two series are found to be cointegrated, to test for causality relationship, an error-correction representation of the following form is estimated:

$$\Delta CNP_t = \alpha_{CNP} + \lambda_{CNP}\hat{e}_{t-1} + \sum_{i=1}^{n}\alpha_{11}(i)\Delta CNP_{t-i} + \sum_{i=1}^{n}\alpha_{12}(i)\Delta FX_{t-i} + \varepsilon_{CNP,t}$$

$$\Delta FX_t = \alpha_{FX} + \lambda_{FX}\hat{e}_{t-1} + \sum_{i=1}^{n}\alpha_{21}(i)\Delta CNP_{t-i} + \sum_{i=1}^{n}\alpha_{22}(i)\Delta FX_{t-i} + \varepsilon_{FX,t}$$

where ε_t is the stationary disturbance term, $\hat{e}_{t-1}$ is the error-correction term, *CNP* is cumulative net positions and *FX* is spot exchange rate.

III. EMPIRICAL RESULTS

A. Unit Root Analysis

Table 1 illustrates the unit root behavior of the series. The results suggest that the null hypothesis of a unit root in the time series cannot be rejected at a 1 percent level of significance by both the ADF and PP tests in levels. Thus, neither series appear to be stationary in levels. However, when the series are transformed into first differences, they become stationary and therefore can be characterized as *I*(1). Since it has been determined that the variables under examination are integrated of order 1, we can now test whether the two series are cointegrated over the sample period.

Table 1. Unit Root Test

	Augmented Dickey-Fuller		Phillips-Perron	
Variables	Level	First Difference	Level	First Difference
CNP ^{AUD}	2.087	-4.095***	5.585	-3.742***
CNP ^{GBP}	-0.020	-5.926***	0.747	-5.056***
CNP $^{(DEM)EUR}$	1.580	-5.058***	2.949	-4.429***
CNP ^{JPY}	-1.218	-5.770***	-1.114	-5.197***
CNP ^{CHF}	-0.365	-7.193***	-0.206	-6.715***
ln(FX $^{AUD/USD}$)	-1.621	-22.826***	-1.628	-22.945***
ln(FX $^{GBP/USD}$)	-1.591	-23.787***	-1.595	-23.760***
ln(FX $^{(DEM)EUR/USD}$)	-1.066	-28.255***	-1.066	-28.255***
ln(FX $^{JPY/USD}$)	-2.049	-24.019***	-2.107	-24.104***
ln(FX $^{CHF/USD}$)	-1.282	-21.886***	-1.034	-21.682***

Note: ***H_o of a unit root is rejected at the 1%. MacKinnon (1996) critical value is -3.437 for 1%. *CNP* denotes net cumulative order flow of speculators in currency futures and *FX* stands for spot exchange rate.

B. Cointegration Analysis

Cointegration of the series is checked with the Johansen Maximum Likelihood (ML) Test procedure. Table 2 shows that the null hypothesis of no cointegration is rejected at 5% level by both the maximum eigenvalue and trace statistic tests. The test results point to one cointegrated relation, which shows that cumulated net position of speculators in currency futures and spot exchange rates are linked in the long run.

Table 2. Johansen Cointegration Test Results

AUSTRALIAN DOLLAR

Hypothesized No. of Vectors	Eigenvalue	Trace Test	Maximum Eigenvalue	Critical Value 95% (Trace)	Critical Value 95% (λ-max)
$r = 0$	0.031	29.489*	26.092*	15.494	14.264
$r \leq 1$	0.004	3.397	3.397	3.384	3.384

BRITISH POUND

Hypothesized no. of Vectors	Eigenvalue	Trace Test	Maximum Eigenvalue	Critical Value 95% (Trace)	Critical Value 95% (λ-max)
$r = 0$	0.018	15.708*	15.185*	15.494	14.264
$r \leq 1$	0.000	0.522	0.522	3.841	3.841

GERMAN MARK – EURO

Hypothesized no. of Vectors	Eigenvalue	Trace Test	Maximum Eigenvalue	Critical Value 95% (Trace)	Critical Value 95% (λ-max)
$r = 0$	0.025	22.307*	21.278*	15.494	14.264
$r \leq 1$	0.001	1.028	1.028	3.841	3.841

JAPANESE YEN

Hypothesized no. of Vectors	Eigenvalue	Trace Test	Maximum Eigenvalue	Critical Value 95% (Trace)	Critical Value 95% (λ-max)
$r = 0$	0.018	20.916*	15.910*	20.261	15.892
$r \leq 1$	0.005	5.005	5.005	9.164	9.164

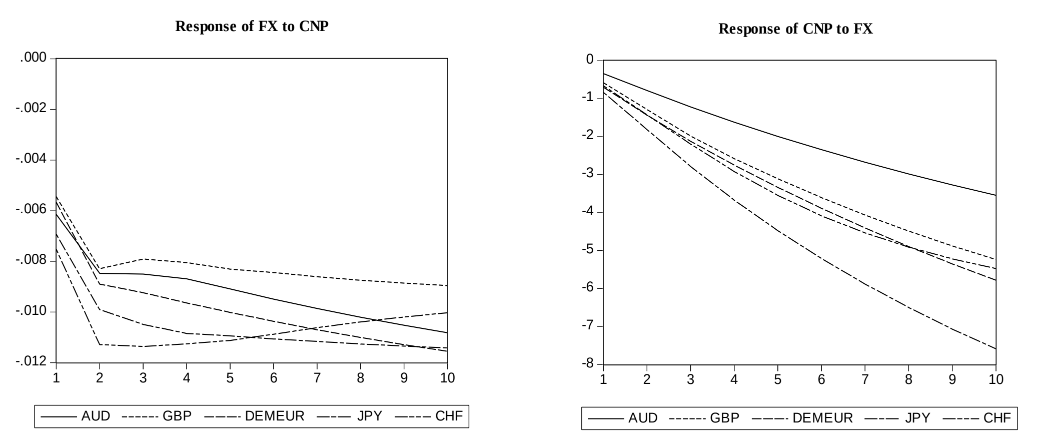
SWISS FRANC

Hypothesized no. of Vectors	Eigenvalue	Trace Test	Maximum Eigenvalue	Critical Value 95% (Trace)	Critical Value 95% (λ-max)
$r = 0$	0.023	22.198*	19.825*	20.261	15.892
$r \leq 1$	0.002	2.373	2.373	9.164	9.164

Note: * denotes rejection of the hypothesis at the 0.05 level. The lag selection is based on Log Likelihood, Final Prediction Error, Akaike, Schwarz and Hannan-Quinn information criteria and a lag structure is selected by at least three out of the five criteria chosen for each model. Based on this criterion, the optimum lag length is determined as three for all the cases.

Figure 1 displays the generalized impulse responses (Pesaran and Shin, 1998) to one standard error shock. The results show that a positive shock in cumulative net position of speculators in a particular foreign currency futures market results in an instantaneous appreciation of that same foreign currency in the spot market against the USD. This outcome is observed in all the cases. After an instantaneous appreciation, the foreign currency continues to gain strength in a gradual manner for two periods into the future after which the currency lends on a steady path of appreciation. Furthermore, it is clear that the net position of speculators react to shocks in the spot market. A positive shock in the spot market, which indicates a sudden depreciation of the foreign currency against the USD, leads to a decrease in the futures positions.

Figure 1. Generalized Impulse Responses to One Standard Error Shock in Error Correction Equations



C. Granger Causality Tests

Finally, I conduct Granger-causality tests & test the null hypothesis $H_o : \alpha_{21}(i) = 0$ for all *i*, i.e. lagged cumulative net position of traders do not cause the spot exchange rates. Table 3 shows the results of the Granger causality tests. It appears that there is unidirectional causality running from the cumulative net position of speculators in the DEM – EUR and Swiss franc futures to the spot DEM-EUR and CHF rates against the USD, respectively. Although, the causality running from the cumulative net position of non-commercial traders in the British pound and Japanese yen futures to the spot GBP and JPY exchange rates, respectively, is significant at the 1% level, the presence of reverse causality cannot be overlooked. Thus, there seems to be bidirectional causality between the cumulative net position of speculators in the GBP futures and GBP/USD rate as well as between the net position of speculators in the JPY futures and JPY/USD rate. Although, we observe causality running from the futures position of speculators in the Australian dollar to the spot rate of AUD per USD, the causality running from the opposite direction is much more significant.

Table 3. Wald Test-Granger-Causality

Null Hypothesis	Chi – Square Statistic	Probability
AUSTRALIAN DOLLAR		
$\Delta CNP \Rightarrow \Delta \ln(FX)$	10.5815	0.0142
$\Delta \ln(FX) \Rightarrow \Delta CNP$	24.2665	0.0000***
BRITISH POUND		
$\Delta CNP \Rightarrow \Delta \ln(FX)$	43.8581	0.0000***
$\Delta \ln(FX) \Rightarrow \Delta CNP$	15.5116	0.0014
GERMAN MARK – EURO		
$\Delta CNP \Rightarrow \Delta \ln(FX)$	79.8734	0.0000***
$\Delta \ln(FX) \Rightarrow \Delta CNP$	0.8609	0.8348
JAPANESE YEN		
$\Delta CNP \Rightarrow \Delta \ln(FX)$	24.3207	0.0000***
$\Delta \ln(FX) \Rightarrow \Delta CNP$	6.6393	0.0843
SWISS FRANC		
$\Delta CNP \Rightarrow \Delta \ln(FX)$	28.8640	0.0000***
$\Delta \ln(FX) \Rightarrow \Delta CNP$	4.1845	0.2422

Note: The arrow "$\Rightarrow$" denotes no Granger causality and *** denotes significance at the 1% level.

VI. CONCLUSION

The microstructure approach to exchange rate behavior is relatively a recent phenomenon in the exchange rate literature. The most important variable in the microstructure model is order flow. In this article, the net cumulative position of speculators in various foreign currency futures were treated as order flow since these positions reveal the buying and selling pressure in the currency futures market. The objective of this study was to investigate the long-run relationship between the cumulated net position of speculators and spot exchange rates. Johansen Maximum Likelihood Test procedures rejected the null hypothesis of no cointegration between the series and pointed to one cointegrating relation in each and every case. An ECM model was estimated to infer causal linkages between the positions of speculators and spot exchange rates. The Granger causality tests found bidirectional causality in some cases and unidirectional causality in others.

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