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Do speculative traders anticipate or follow USD/EUR exchange rate movements? New evidence on the efficiency of the EUR currency futures market

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Non-technical summary

Research Question

Futures play a central role in financial markets by facilitating risk management and supporting the price discovery mechanism. In addition, standardized, liquid and transparent futures markets send price signals to spot and OTC derivatives markets. In order to fulfill these functions, they need to work in an efficient and robust manner. However, results from recent studies cast doubt on the efficiency of a particular futures market, namely the EUR currency futures market, since a certain type of trader, large speculators, is allegedly able to forecast and profit by trading on expected price (USD/EUR exchange rate) changes.

Contribution

This paper builds on and extends the existing literature in two ways: First, it carefully revisits the empirical evidence about the contemporaneous relationship between the net long position of speculative investors in the EUR futures currency market and the USD/EUR exchange rate. In contrast to earlier studies, different categories of speculative investors are analyzed separately, and non-linear effects are allowed for. Second, the paper provides an analysis of whether the EUR currency futures market is really inefficient. We run a large set of predictive regressions, and check whether changes in the net long position of the different categories of speculators are informative about future exchange rate movements, or whether (temporal) causality tends to run the other way round. In contrast to earlier studies, we thereby explicitly account for the multiple test problem involved.

Results

The results suggest that exchange rate movements lead changes in the net long position on EUR currency futures for all groups of speculative investors. This outcome even holds when adjusting the significance levels to account for the large number of statistical tests conducted. In contrast, the evidence for an indicator role of speculative positions for future exchange rate movements, and therefore an inefficient EUR currency futures market, largely collapses once more conservative significance levels are applied – for all groups of speculators considered, in fact. Earlier contrary results are possibly related to alpha error accumulation.

Nichttechnische Zusammenfassung

Fragestellung

Futures spielen an den Finanzmärkten eine zentrale Rolle, indem sie das Risikomanagement erleichtern und den Preisfindungsprozess unterstützen. Ferner senden standardisierte, liquide und transparente Futures-Märkte Preissignale an die Spot- und OTC (over the counter)-Derivatemärkte. Um diese wünschenswerten Funktionen erfüllen zu können, müssen die Futures-Märkte effizient und robust sein. Allerdings wecken die Ergebnisse jüngerer Studien, wonach große spekulative Anleger in der Lage sind, künftige Wechselkursbewegungen besser zu prognostizieren und durch entsprechende Transaktionen systematisch Gewinne zu erzielen, Zweifel an der Effizienz des EUR Futures-Markt.

Beitrag

Dieser Artikel baut auf diesen Studien auf und erweitert sie in zwei Aspekten: Zum einen wird empirisch der kontemporäre Zusammenhang zwischen der Nettolongposition (NL) spekulativer Anleger am EUR Futures-Währungsmarkt und dem USD/EUR-Wechselkurs untersucht, wobei explizit zwischen verschiedenen Kategorien spekulativer Anleger (kleine und große Spekulanten, bzw. beide zusammen) unterschieden wird. Ferner wird untersucht, ob ein etwaiger Zusammenhang nicht-linearer Natur ist. Zum anderen widmet er sich der Frage, ob die NL eine geeignete Indikatorvariable ist, um künftige Wechselkursbewegungen zu prognostizieren, oder ob es sich andersherum verhält, Positionsänderungen also Wechselkursbewegungen folgen. Im Unterschied zu früheren Studien wird dabei berücksichtigt, dass die Wahrscheinlichkeit steigt, irrtümlich signifikante Testergebnisse zu erhalten, wenn außer Acht gelassen wird, dass eine Vielzahl von Hypothesentests durchgeführt wird ("multiple tests"-Problem).

Ergebnisse

Die Ergebnisse zeigen, dass Veränderungen der NL Wechselkursänderungen folgen, und zwar unabhänig von der betrachteten Gruppe spekulativer Anleger. Dieses Ergebnis bleibt auch dann bestehen, wenn konservativere Signifikanzniveaus betrachtet werden, die berücksichtigen, dass eine Vielzahl von Hypothesentests durchgeführt wird. Dagegen sinkt die Evidenz für eine Vorlaufeigenschaft von Veränderungen der NL für künftige Wechselkursbewegungen und daher einen ineffizienten EUR-Futures Währungsmarkt drastisch, wenn konservativere Signifikanzniveaus verwendet werden. Entgegengesetzte Resultate früherer Studien sind möglicherweise auf alpha-Fehler-Akkumulation zurückzuführen.

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Abstract

We address the question of whether various types of speculative investor correctly anticipate future USD/EUR currency movements or whether they tend rather to react to past exchange rate movements. Throughout the analysis, we differentiate between large and small traders, and an upper bound of total speculation. To account for the large number of testable hypotheses, we contrast results obtained from predictive regressions based on individual significance tests with those based on either controlling the false discovery rate (FDR) or the family-wide error rate (FER). While the statistical evidence in favor of a causal relationship from speculative positions to exchange rate movements, and therefore an inefficient Euro futures market, largely collapses if we account for multiple testing, such a pattern does not emerge in the other direction. In addition, findings based on a contemporaneous analysis point to some notable differences between small and large speculators, and a nonlinear relationship between USD/EUR movements and changes in the open interest position of large speculators.

Keywords: speculative positions, currency futures, exchange rates, predictive regressions, multiple testing.

JEL classification: C32, F31, G15.

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1 Introduction

Futures markets perform several important economic functions, including price discovery and the facilitation of risk management. To perform these functions, futures markets must be efficient and robust. For regulators, understanding the motives of futures traders is central to understanding and to monitoring the functioning of these markets. In the literature on futures markets, market participants are generally classified as either hedgers or speculators. Hedgers use the futures market to manage an existing risk in the spot market. The spot market can therefore be regarded as the hedger's primary market, while the futures market is the hedger's secondary market. Since the objective of the hedger is risk management, and not to take on an outright open position in the futures market, hedgers are generally not suspected to have an adverse impact on the functioning of futures markets. In fact, according to regulators, derivatives markets should first of all serve the needs of hedgers. Academics as well as regulators therefore tend to focus on the speculators, and their potential to forecast and possibly exploit price developments in futures markets (Fishe, Janzen, and Smith (2014); Kim (2015); Sanders, Irwin, and Merrin (2009); Schwarz (2012); Wang (2002)). In contrast to hedgers, speculators do not enter the futures market to manage price risk which originates from a spot business. The futures market is the primary market for the speculator. Therefore, it is fair to assume that speculators are well-informed professionals who focus their attention and resources to study the futures market, and who profit by better forecasting futures prices, as is often described in the literature. From a regulator's perspective, speculators perform an important economic role by providing liquidity to hedgers. However, if speculators can consistently outperform and gain excess returns by forecasting futures prices, then regulators should be concerned about the efficiency and the functioning of these markets.

A recent study by Tornell and Yuan (2012) suggests that the euro (EUR) futures market might be an interesting case regarding the study of speculators' potential to predict price changes. The authors report that, while there is generally no convincing evidence that traders' positions data is useful for predicting spot exchange rate changes, the euro is a notable exception. Their results support earlier findings by Klitgaard and Weir (2004), who find strong connections between speculators' positions in the EUR futures market and exchange rate movements. In our paper, we build on these earlier findings by analyzing the potential ability of speculators to forecast futures prices in more detail.

More specifically, the contributions of this paper are as follows: First, we provide an update of earlier related studies including the period of the global financial and the sovereign debt crisis in the euro area. Second, we differentiate between different types of trader engaged in the EUR futures market. Third, we check whether previous results suggesting an inefficient EUR currency futures market still hold once we account for the "multiple tests"-problem involved by appropriately adjusting the significance levels.

To anticipate our main result, we find that the evidence for an inefficient EUR currency futures market largely collapses once more conservative significance levels are applied. Earlier contrary findings are therefore possibly due to alpha error accumulation. Once we account for multiple testing by appropriately modifying the significance levels, evidence for a temporal causality from net long position changes to USD/EUR exchange rate movements largely collapses. In contrast, statistical evidence for a causal link from exchange rate movements to changes in the net long position is almost unaffected by the same adjustments.

In section 2, we provide a brief overview of the structure of the EUR futures market and of the types of trader engaged in this market. In section 3, we analyze the contemporaneous relationship between USD/EUR-exchange rate movements and the net long futures position changes of the different types of speculators. In addition, we check whether the relationship is of a non-linear nature. In section 4, we describe the econometric approach followed to assess whether changes in any of the net long positions can be regarded a suitable *leading* indicator for exchange rate movements. In section 5, the estimation results of this exercise are presented. Section 6 concludes and summarizes our main findings.

2 Speculative activity in the EUR currency futures market

The Commodity Futures Trading Commission's (CFTC's) Commitments of Traders (COT) reports provide information on the open interest of hedgers (commercial traders), speculators (non-commercial traders) and small traders (non-reporting). The major limitation of this dataset is that the classification of traders' open interest as either speculation or hedging is shown only for large traders. The problem is how to allocate the small traders' open interest to these speculation and hedging categories. This problem might be negligible if the share of open interest held by small traders were insignificant. In general, however, the small trader component, as a proportion of total open interest, varies significantly over time.

Figures 1 and 2, respectively, show the distribution of open interest in long and short futures contracts in the EUR currency futures market. Visual inspection of the figures suggests that hedgers are generally on the opposite side of the market to speculators and small traders. When hedgers are net long (e.g. between 2011 and 2015), speculators and small traders are generally net short. On the other hand, when hedgers are net short (e.g. between 2000 and 2008), speculators and small traders go long in EUR futures contracts. Economic theory suggests that hedgers and speculators should generally be on opposite sides of the futures market. According to Keynes (1930) and Hicks (1939), the demand by hedgers for protection against specific market risks should lead speculators to enter futures markets on the opposite side. If hedgers are net short, then speculators should be net long in order to restore equilibrium. According to this theory, hedgers play the leading role in futures markets while speculators simply react to hedgers' demand for protection. In turn, speculators should earn a risk premium. However, there is a competing theory presented by Working (1953), where speculators provide liquidity as buyers of gambles in futures markets. Hedgers prefer highly liquid markets, and therefore markets with significant speculative activity. According to this theory, speculators play a leading role in futures markets by providing liquidity to hedgers.

Hence, speculators can be regarded either as buyers of gambles or as sellers of insurance in futures markets.[1] In any case, hedgers and speculators should generally be on opposite

[1] For more information, see Johnson (1960) and the debate between Cootner (1960) and Telser (1960). Röthig (2011) investigates lead-lag relationships between hedging activity and speculation in currency futures markets. The empirical results suggest that speculators generally lead hedgers in these markets.

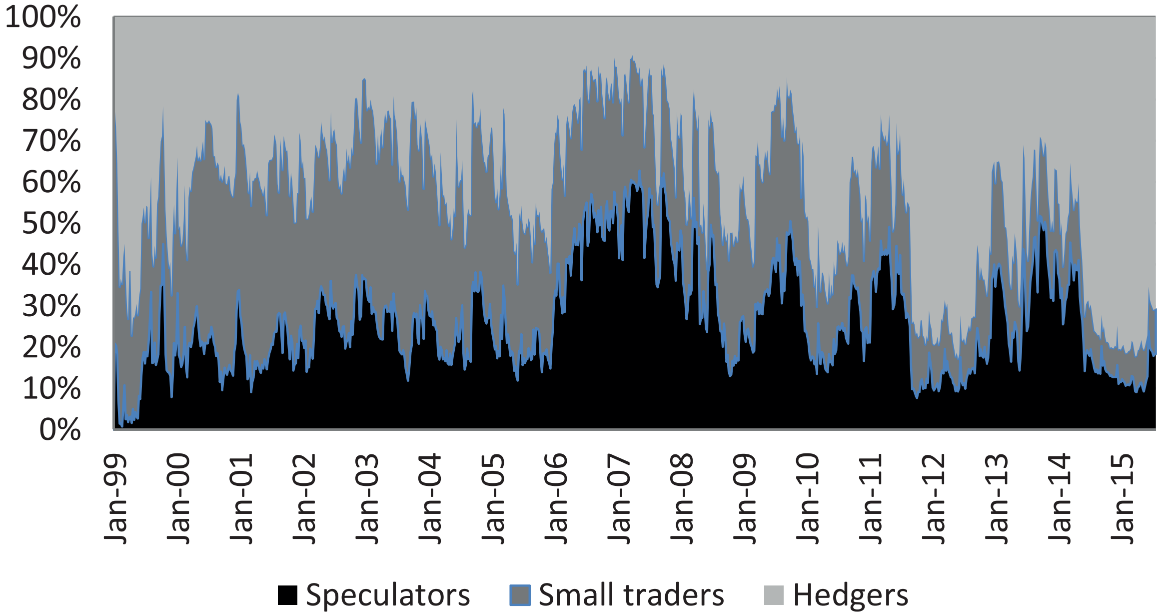


Figure 1: Long position of various types of trader on EUR currency futures

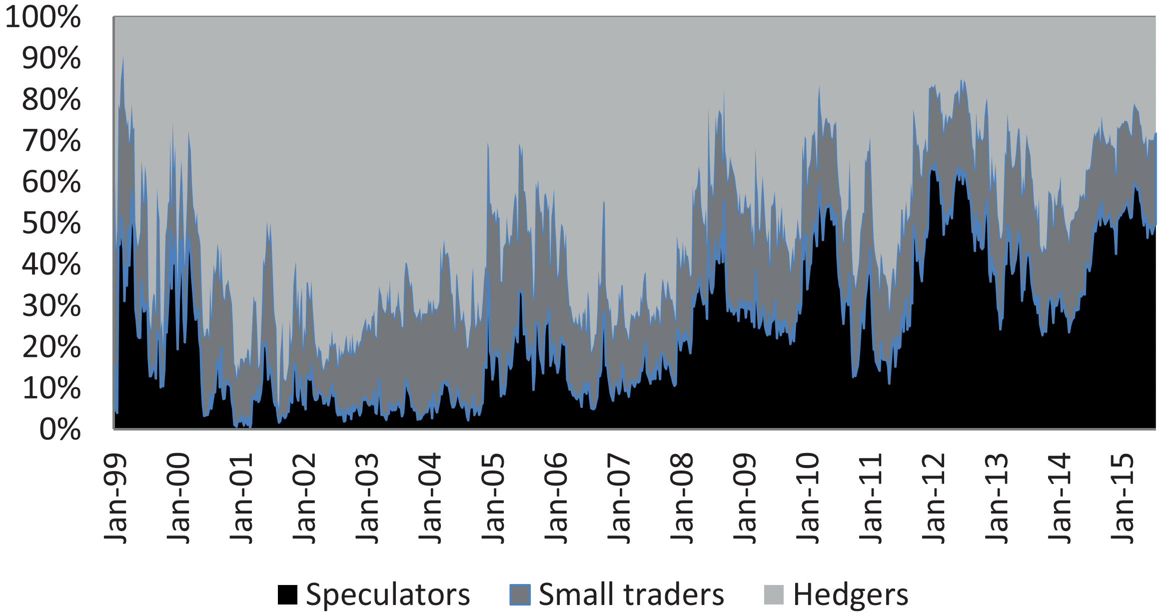


Figure 2: Short position of various types of trader on EUR currency futures

sides of the futures market. In contrast, the role of small traders (i.e. non-reporting traders) is not clear. Figure 1 shows that the market share of the small traders can be quite large. Between 2000 and 2005 small traders appear to dominate the long side of the EUR futures markets. Their overall long positions during that period are larger than the long positions of speculators or hedgers. In addition, the small traders, like the speculators, are net long when hedgers are net short (e.g. between 2000 and 2008) and vice versa. This suggests that the small traders are, in fact, small speculators.[2] If small traders can be regarded as small speculators, then total speculative activity (small plus large speculators) could play a dominant role in the EUR futures market, with about 70% of total short positions in mid-2015.

Because of the significant involvement of small traders in the EUR futures market, as shown in Figure 1, analyzing the open positions of large speculators in isolation may lead to biased results regarding the overall activities of speculators in this market. The assumption that small traders are speculators is, according to Peck (1982), common and useful, because it provides an upper bound of speculative activity in the futures market.[3] However, since this upper bound could overestimate the speculative activity, small traders' and large speculators' open interest will be investigated separately in the following sections as well. Hence, three estimates of speculative activity will be analyzed in this study: the open interest of small speculators, of large speculators, and total speculation (i.e. small plus large).

Table 1: Descriptive summary statistics

	Mean	Stdev	Min	Max	No. of obs.
E (USD/EUR)	1.222	0.181	0.836	1.599	860
$100\Delta(lnE)$	−0.006	1.406	−4.371	7.988	859
NL_{large}	−5.488	62.104	−226.560	119.538	860
NL_{small}	4.179	21.339	−59.518	39.644	860
NL_{all}	−1.321	81.037	−274.469	141.542	860
ΔNL_{large}	−0.104	11.745	−40.222	54.121	859
ΔNL_{small}	−0.040	4.310	−19.341	15.809	859
ΔNL_{all}	−0.155	14.115	−57.336	58.203	859

Note: The sample period is January 5, 1999 to June 23, 2015. Net long positions (NL) are measured in 1,000 contracts. E denotes the exchange rate (in USD per EUR).

Speculative activity therefore appears to be a decisive factor in currency futures markets.

[2] Röthig and Chiarella (2011) show that small traders' open interest in currency futures markets is closely related to the dynamics of open interest of large speculators. From now on, we will use these two terms interchangeably. Furthermore, small traders and speculators react similarly to price changes. While they both appear to be positive feedback traders, hedgers are contrarians. In addition, Wang (2002) finds that volatility in currency futures markets is positively related to shocks in net positions of speculators and small traders, and negatively associated with shocks in net positions of hedgers. Overall, these findings suggest that small traders in currency futures markets are small speculators.

[3] For more information see Working (1960), Larson (1961) and Rutledge (1977).

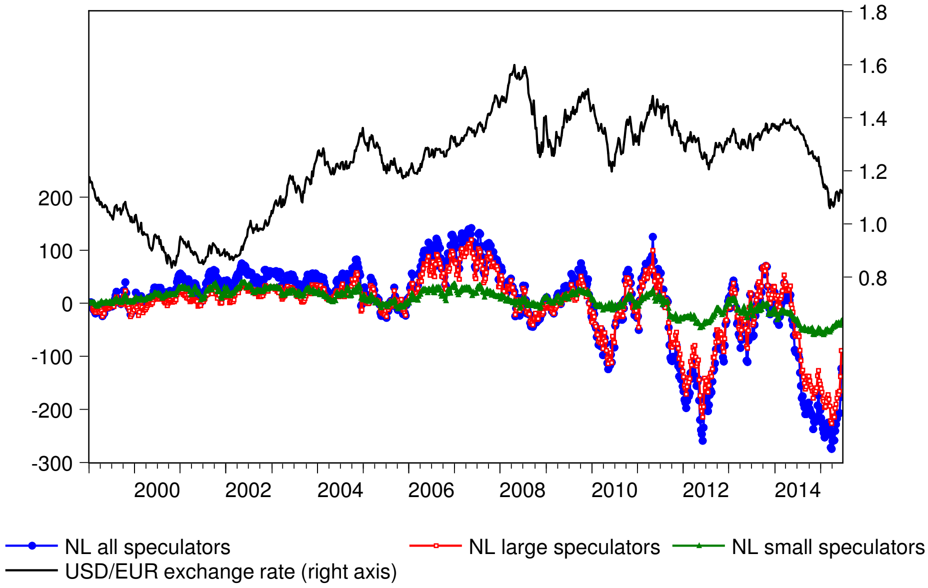


Figure 3: USD/EUR exchange rate and net long position by type of speculative investor

3 On the contemporaneous relationship between the USD/EUR exchange rate and the net long futures position

The following empirical analysis is based on weekly data, because net long position data is provided by the CFTC each Tuesday only. Correspondingly, we also use Tuesday's USD/EUR exchange rates (ECB fixing rates). The sample period is January 5, 1999 to June 23, 2015 (860 observations).

Before analyzing the quality of net long position changes of the various types of speculator as indicator variables for *future* USD/EUR movements (or vice versa) in the next section, we empirically assess their *contemporaneous* relationship. To start with, Figure 3 depicts the USD/EUR exchange rate and the net long position of the different types of speculator. Table 1 shows the descriptive summary statistics. In addition, Figure 4 provides a scatterplot of USD/EUR exchange rate changes (in %) against absolute changes in the net long position of large speculators. It can be observed that a) the net long position of small and large speculators broadly move together[4], that b) these position changes seem to be related to USD/EUR exchange rate movements, that c) peaks and troughs in the net long position occur closely to peaks and troughs of the USD/EUR exchange rate, and that d) visual inspection of the series does not show a clear pattern as to whether one of the net long positions lead exchange rate movements temporally or vice versa.

Since all variables are non-stationary in levels but stationary in first differences based on simple ADF-tests, we model the contemporaneous relationship between Δe_t and $\Delta NL_{g,t}$, where e_t is the natural log of the exchange rate E (in USD per EUR) and $NL_{t,g}$ the net

[4]The corresponding Pearson correlation coefficient is about 0.85.

long position (i.e. the number of long minus the number of short contracts) of the respective group of investors g (large, small, or all speculators). First, we run simple OLS regressions of the form

$$\Delta e_t = \delta_{0,g} + \delta_{1,g}\Delta NL_{g,t} + \kappa_{g,t}, \tag{1}$$

where $\kappa_{g,t}$ is a (group-specific) random error. The regression results (with Newey–West serial correlation consistent standard errors) are presented in table 2.

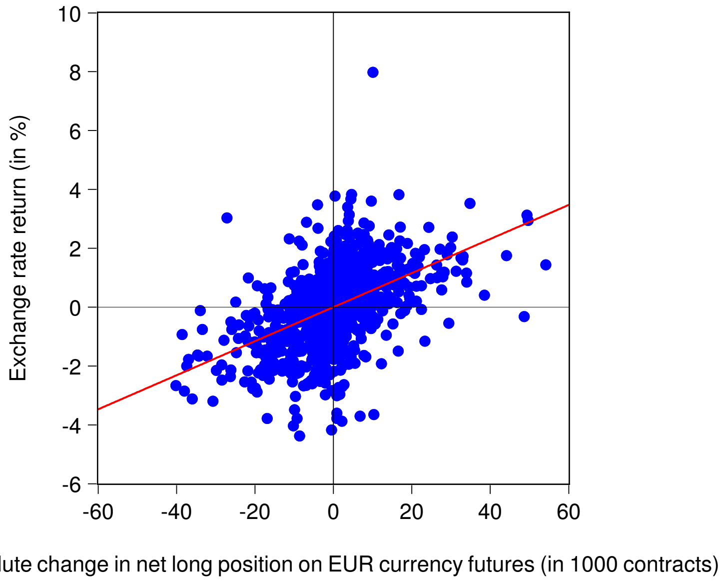


Figure 4: USD/EUR exchange rate return vs. absolute change in the net long position on EUR currency futures of large speculators

Table 2: Results of contemporaneous regressions

	$\hat{\delta}_{1,g}$	$SE\left(\hat{\delta}_{1,g}\right)$	R^2
Large speculators	0.579***	0.035	0.241
Small speculators	0.934***	0.126	0.082
All speculators	0.489***	0.029	0.241

Note: ***,**, and * denotes significance at the 1%, 5%, or 10% level, respectively, based on Newey West standard errors. Estimated coefficient values have been multiplied by 10,000 (no. of contracts) and by 100 (due to the log-linear nature of the model), i.e. by a factor of 1M in total. Constants have been included in the regressions but are not reported here.

According to the estimation results, an increase in the net long position by 10,000 contracts is contemporaneously associated with a 0.58% (large speculators), 0.94% (small speculators), and 0.49% (all speculators) appreciation of the EUR against the USD, respectively.[5] However, the fit of the regressions differs considerably across the groups. For

[5] We consider an increase of 10,000 contracts because this value is relatively close to the mean absolute

the group of large speculators, the share of explained variation is about three times as large as for the group of small speculators. One possible explanation for this finding is that large traders observe and respond to the release of public information in a more timely manner than small traders.[6]

So far, we have assumed – in line with the existing literature – that the marginal impact of position changes is constant. However, it may well be that it depends on the absolute level of the net long position in *t-1*. To test for this possibility, we augment the above model by adding the cross-term $(\Delta NL_{t,g} \cdot |NL_{t-1,g}|)$. The augmented model thus can be written as

$$\Delta e_t = \phi_{0,g} + \phi_{1,g}\Delta NL_{t,g} + \phi_{2,g}\Delta NL_{t,g} \cdot |NL_{t-1,g}| + \eta_{t,g} \tag{2}$$

According to the estimation results, we find a significant impact of this cross-term at the 1% level for the category of large speculators. All four information criteria (adjusted R^2, AIC, HQC, and SIC) suggest that this augmented model is to be preferred. The results imply that if the net long position was zero in the previous week, an increase of the net long position of 10,000 contracts is associated with a 0.75% increase in the USD/EUR exchange rate (which is about 0.17 pp higher than in the previous model), while, for example, the same absolute increase leads only to a 0.48% appreciation if the level of the net long position was 100,000 contracts in the previous week. This means that equally large speculative position changes are contemporaneously associated with smaller exchange rate movements if the absolute level of the net long position was higher.

In contrast, for the category of small speculators, the cross-term does not differ from zero significantly, implying that the marginal impact of an increase in the net long position is not affected by the former absolute level of the net long position. Due to the dominant influence of the group of large traders on the overall net long position, it is not surprising that the evidence points towards a level dependency of the marginal impact if all speculators are treated as one group again.[7] In this case, we see a moderate increase of the estimated impact of a 10,000 unit increase from 0.48% to 0.59% for a balanced net long position. If the former absolute level of the net long position was 100,000 contracts in the previous week, the marginal impact decreases to 0,45%.[8]

Summarizing, these results suggest that a) the net long position and the USD/EUR exchange rate largely move in the same direction, that b) the marginal impact of position changes is lower for the group of large speculators if the absolute value of the former net long position was higher, and c) that the explanatory power of the regressions differs notably between large and small speculators. However, the fact that speculative positions and the USD/EUR exchange rate mostly move in tandem does not imply an inefficient

change of the net long position of large traders, which amounts to 7,437 contracts.

[6]In the appendix, we exemplary show the results of a formal stability analysis for the regression of large speculators. In addition, we show how the fit of the model has developed over time.

[7]The Pearson correlation coefficient for the change in the net long position of the group of large speculators (small speculators) and the change of the total speculative net position is 0.96 (0.66).

[8]In the appendix, we exemplary provide an alternative model specification for the group of large traders, in which the marginal impact is allowed to differ once certain net long position (negative or positive) threshold levels have been surpassed. In short, the results of this threshold regression approach suggest that a) such a threshold level of the absolute net long position does indeed exist, b) the estimated threshold level is 28,409 contracts, and that c) the marginal impact of the net long position changes of large speculators is higher below the threshold level than above (consistent with the above results).

EUR futures currency market. The positive correlation could equally be due to the fact that the spot and the futures market react simultaneously to the release of public information (see Klitgaard and Weir (2004) and Schwarz (2012) for this and other possible explanations). A real "knock out"-criterion for an efficient EUR currency future market would be the case, in which some group of traders were able to forecast *future* price (exchange rate) movements. We address this issue in the following section.

4 Econometric methodology

Below we address the question of whether the net long positions of different groups of investors are a leading indicator for exchange rate movements or whether (temporal) causality rather tends to run in the opposite direction. To this end, we estimate a large number of predictive regressions in which either future exchange rate changes over certain horizons are to be predicted by changes in the net long position or vice versa.

The models are specified as

$$(NL_{g,t+h} - NL_{g,t}) = \alpha_{0,g,hj} + \alpha_{1,g,hj}\left(e_t - e_{t-j}\right) + \varepsilon_{g,t,hj} \tag{3}$$

$$(e_{t+h} - e_t) = \beta_{0,g,hj} + \beta_{1,g,hj}\left(NL_{g,t} - NL_{g,t-j}\right) + \upsilon_{g,t,hj} \tag{4}$$

Lead lengths are determined by h = 1,2,3,4,8,12,16,20, lag lengths by j = 1,2,3,4,8, 12,16,20. In total, for each direction ($\Delta e \rightarrow \Delta NL$, respectively $\Delta NL \rightarrow \Delta e$) and each group of investors g (*large*, *small*, or *all*, i.e. the sum of *large* and *small*) 64 models are estimated. Subsequently, the significance of the slope parameter is tested with a simple t-test. When performing a single t-test for significance of an individual coefficient, the probability of a type 1-error, ie in our case erroneously concluding that x causes/leads y, is equal to $\alpha = 5\%$. When performing 64 t-tests and maintaining $\alpha = 5\%$, the probability of at least one type 1-error rises to $100 - (1-\alpha)^{64} = 96.2\%$. This simple calculation illustrates the importance of appropriately accounting for the number of tests conducted when assessing statistical significance, primarily if a topic easily allows the researcher to make use of data-mining techniques to come up with a significant result.[9] Therefore, we use two alternative adjustments for multiple testing: the well-known Bonferroni adjustment as well as the less conservative Benjamini-Höchberg adjustment. In the former case, α is divided by the number of tests conducted (in our case 64) in order to control the family-wide error rate at 5%. However, this adjustment has been criticized as being too conservative because the probability of no type 2-error, ie not rejecting any false null hypothesis, is too high. To overcome this deficiency, the Benjamini-Höchberg adjustment is applied as an alternative. In this approach, the false error rate is set to 5%, ie in at most 5% of the cases we would mistakenly reject a true null hypothesis in the $n = 64$ tests conducted. The approach proceeds in three steps: First, the p-values based on the individual t-statistics are sorted in ascending order. Second, these sorted p-values are compared with rank-specific indexes, which are calculated as $BH_i = d \cdot i/n$, where d is the selected false discovery rate (in our case 5%) and i the rank (from 1 to 64) of the relevant

[9] A well-known related quote associated with Ronald Coase and cited in Varian (2010) is that "If you torture the data long enough it will confess to anything".

p-value. Third, for all tests, where the sorted p-values are smaller than the corresponding index, the null hypothesis of no influence is rejected. Therefore, the Benjamini-Höchberg adjustment is more conservative than individual significance tests but less conservative than the Bonferroni adjustment.[10]

5 Estimation results

First, we comment on the results obtained for the group of large speculators. Then we will compare these to the ones obtained for small speculators, and, finally, to all speculative (ie non-commercial plus non-reporting) traders. In table 3, the *individual* marginal significance levels of the estimated slope coefficients (ie $\hat{\alpha}_{1,large,hj}$, respectively $\hat{\beta}_{1,large,hj}$) based on eqs. (3) and (4) are presented.[11] Coefficients which significantly differ from zero at $\alpha = 5\%$ are printed in bold.

Based on these individual significance tests, a larger percentage of coefficients can be considered to be significantly different from zero in the direction $\Delta e \rightarrow \Delta NL$ than in the opposite direction $\Delta NL \rightarrow \Delta e$ (76.6% compared to 32.8%). Notwithstanding this difference, 32.8% still seems a sizable percentage, and it might be tempting for a researcher to conclude that the empirical evidence is strong enough to say that changes in the net long position of large speculators indeed lead future exchange rate movements - if not for all, than at least for a sizable percentage of lead-lag-length combinations. However, as explained in the previous section, a non-negligible part of these seemingly significant results may indeed be due to α-error accumulation. To check for this possibility, we apply the previously described multiple test-corrections proposed by Benjamini-Höchberg and Bonferroni. In table 4, the shares of rejected null hypotheses are compared for three cases: in column 2, the fractions are based on the individual significance tests of the estimated coefficients, in which we set α=5%, in column 3, the fractions are based on the Benjamini-Höchberg adjustment, in which we set the false discovery rate at 5%, in column 4, the fractions are based on the Bonferroni-adjustment, in which we set the false error rate at 5%. The results are striking.
While we observe no or only a very moderate drop in the fraction of rejected null hypotheses in the direction $\Delta e \rightarrow \Delta NL$ (individual: 76.6%, BH: 76.6%, Bonferroni: 62.5%), the share of rejected null hypotheses drops notably in the other direction. While close to a third of the null hypotheses could be rejected based on the individual tests, their share drops to 12.5% if the moderate BH-adjustment is applied, and as low as to 6.25% in the case of the Bonferroni-adjustment. Based on a comparison of these results, we therefore conclude that the evidence clearly suggests EUR/USD movements to be a leading indicator for changes in the net long position of large speculators, while the evidence does not support a leading indicator role in the other direction.

It turns out that this result does not depend on the particular group of traders analyzed. For small speculators as well as for both groups of traders together (upper bound of speculative activities) we observe very similar patterns (see table 4). Results are particularly impressive for the group of small traders. In this case, the percentage of rejected null

[10] A careful exposition of different approaches to controlling the FDR and the FER is provided by Glickman, Rao, and Schultz (2014).

[11] The depicted p-values are calculated based on Newey–West serial correlation consistent standard errors.

hypothesis declines from 32.8% (individual tests) to 15.6% (BH) to 0.00% (Bonferroni) in the direction $\Delta NL \rightarrow \Delta e$, while we see only a very moderate decline in the opposite direction (from 68.8% to 67.2% to 46.9%).[12] This shows once again that the evidence in favor of a temporal causality running from exchange rate movements to changes of the net long position is much stronger than it is in the opposite direction. This outcome – standing in contrast to previous results – provides evidence that the EUR currency futures market is indeed efficient.

Table 3: Large speculators: Marginal significance levels based on predictive regressions

Direction: $\Delta e \rightarrow \Delta NL$								
	h=1	**h=2**	**h=3**	**h=4**	**h=8**	**h=12**	**h=16**	**h=20**
j=1	**0.0000**	**0.0005**	**0.0103**	0.3983	0.0878	0.0740	**0.0038**	0.0565
j=2	**0.0002**	**0.0250**	0.6776	0.4220	**0.0019**	**0.0057**	**0.0002**	**0.0079**
j=3	**0.0058**	0.5671	0.3081	0.0590	**0.0001**	**0.0003**	**0.0000**	**0.0014**
j=4	0.2476	0.4903	0.0563	**0.0069**	**0.0000**	**0.0000**	**0.0000**	**0.0003**
j=8	0.1612	**0.0079**	**0.0003**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=12	0.1749	**0.0169**	**0.0007**	**0.0001**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=16	**0.0160**	**0.0020**	**0.0004**	**0.0002**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=20	**0.0321**	**0.0313**	**0.0306**	**0.0333**	**0.0272**	**0.0130**	**0.0222**	0.0621
Direction: $\Delta NL \rightarrow \Delta e$								
	h=1	**h=2**	**h=3**	**h=4**	**h=8**	**h=12**	**h=16**	**h=20**
j=1	0.6394	0.8349	0.5888	0.9628	0.1774	0.2176	0.1786	0.0952
j=2	0.7969	0.7051	0.8248	0.8128	0.0923	0.2016	0.1248	0.0999
j=3	0.5536	0.8140	0.9793	0.8472	0.0593	0.1681	0.0898	0.1008
j=4	0.9171	0.8260	0.8427	0.4647	**0.0377**	0.1193	**0.0458**	0.0921
j=8	0.1826	0.0740	**0.0444**	**0.0286**	**0.0227**	**0.0168**	**0.0167**	**0.0118**
j=12	0.2186	0.1714	0.1360	0.1013	**0.0146**	**0.0147**	**0.0029**	**0.0010**
j=16	0.1789	0.1049	0.0651	**0.0294**	**0.0146**	**0.0033**	**0.0001**	**0.0002**
j=20	0.0763	0.0818	0.0801	0.0729	**0.0093**	**0.0012**	**0.0001**	**0.0001**

[12]The individual marginal significance levels for these two groups are presented in tables 5 and 6.

Table 4: Individual, Benjamini-Höchberg- and Bonferroni-corrected tests (n=64)

	Percentage of rejected null hypotheses		
	$\alpha = 5\%$	**FDR** = **5%**	**FER** = **5%**
Large speculators			
$\Delta e \rightarrow \Delta NL$	76.60	76.60	62.50
$\Delta NL \rightarrow \Delta e$	32.81	12.50	6.25
Small speculators			
$\Delta e \rightarrow \Delta NL$	68.75	67.19	46.88
$\Delta NL \rightarrow \Delta e$	32.81	15.63	0.00
All speculators			
$\Delta e \rightarrow \Delta NL$	81.25	71.88	50.00
$\Delta NL \rightarrow \Delta e$	29.69	20.31	6.25

Note: The table shows the percentage of rejected null hypotheses for each group of traders if the individual significance level is set to 5%, the false discovery rate (FDR) is set to 5% (Benjamini-Höchberg adjustment), or the family-wise error rate (FER) is set to 5% (Bonferroni adjustment), respectively. In total, 64 tests based on the estimations of models 3 and 4 were conducted for each group of traders and direction.

6 Conclusions

In this paper, we analyze the relationship between the net long position of various types of speculative traders and the USD/EUR exchange rate. Throughout the analysis, we differentiate between large and small traders, and an upper bound of total speculation (the sum of the net long position of large and small traders). In line with the existing literature, the empirical evidence points to a significant *contemporaneous* co-movement between changes in each of the considered net long positions and USD/EUR exchange rate movements. However, for the group of small traders, the explanatory power of the corresponding regression is about two-thirds smaller than for the group of large speculators. We attribute this finding to large speculators observing the release of public information in a more timely manner. Furthermore, we find that changes in the net long position of large speculators are associated with smaller changes in the USD/EUR exchange rate if the previous absolute level of the net long position was higher. For the group of small speculators, we do not detect such a state-dependent response.

Based on a large number of predictive regressions and by appropriately accounting for the multiple test problem involved, we observe that the, at first, seemingly significant effect of net long position changes of the different types of speculator on *future* exchange rate changes, and therefore an inefficient EUR currency futures market, largely collapses once significance levels are adjusted accordingly. In contrast, in the opposite direction, the statistical evidence for exchange rate movements serving as a suitable indicator variable for future speculative position changes does not vanish if more conservative significance levels are considered.

References

Bai, J. and P. Perron (2003). Critical values for multiple structural change tests. *The Econometrics Journal 6*(1), 72–78.

Cootner, P. H. (1960). Returns to speculators: Telser versus Keynes. *The Journal of Political Economy*, 396–404.

Fishe, R. P., J. P. Janzen, and A. Smith (2014). Hedging and speculative trading in agricultural futures markets. *American Journal of Agricultural Economics 96*(2), 542–556.

Glickman, M. E., S. R. Rao, and M. R. Schultz (2014). False discovery rate control is a recommended alternative to Bonferroni-type adjustments in health studies. *Journal of clinical epidemiology 67*(8), 850–857.

Hansen, B. E. (2000). Sample splitting and threshold estimation. *Econometrica*, 575–603.

Hicks, V. (1939). Value and capital. pp. 270–2.

Johnson, L. L. (1960). The theory of hedging and speculation in commodity futures. *Review of Economic Studies 27*(3), 139–151.

Keynes, J. M. (1930). A treatise on money: The applied theory of money, vol. 2.

Kim, A. (2015). Does futures speculation destabilize commodity markets? *Journal of Futures Markets*.

Klitgaard, T. and L. Weir (2004). Exchange rate changes and net positions of speculators in the futures market. *Economic Policy Review 10*(1).

Larson, A. B. (1961). Estimation of hedging and speculative positions in futures markets. *Food Research Institute Studies 2*(3), 203–212.

Peck, A. E. (1982). Estimation of hedging and speculative positions in futures markets revisited. *Food Research Institute Studies 18*(2), 181–195.

Röthig, A. (2011). On speculators and hedgers in currency futures markets: who leads whom? *International Journal of Finance and Economics 16*(1), 63–69.

Röthig, A. and C. Chiarella (2011). Small traders in currency futures markets. *Journal of Futures Markets 31*(9), 898–913.

Rutledge, D. J. S. (1977). Estimation of hedging and speculative positions in futures markets: an alternative approach. *Food Research Institute Studies 16*(3), 205–211.

Sanders, D. R., S. H. Irwin, and R. P. Merrin (2009). Smart money: The forecasting ability of cftc large traders in agricultural futures markets. *Journal of Agricultural and Resource Economics*, 276–296.

Schwarz, K. (2012). Are speculators informed? *Journal of Futures Markets 32*(1), 1–23.

Telser, L. G. (1960). Returns to speculators: reply. *Journal of Political Economy 68*(4), 404–415.

Tornell, A. and C. Yuan (2012). Speculation and hedging in the currency futures markets: Are they informative to the spot exchange rates. *Journal of Futures Markets 32*(2), 122–151.

Varian, H. R. (2010). Computer mediated transactions. *The American Economic Review*, 1–10.

Wang, C. (2002). The effect of net positions by type of trader on volatility in foreign currency futures markets. *Journal of Futures Markets 22*(5), 427–450.

Working, H. (1953). Futures trading and hedging. *The American Economic Review 43*(3), 314–343.

Working, H. (1960). Speculation on hedging markets. *Food Research Institute Studies 1*(2), 185–220.

A Appendix

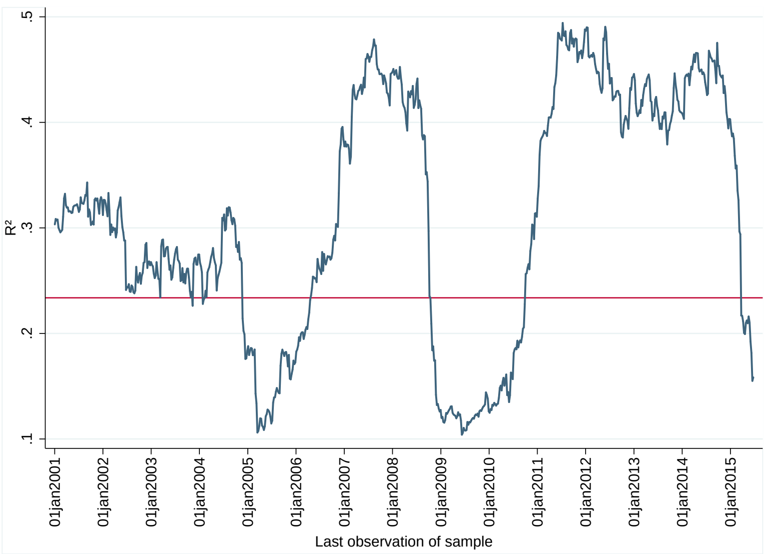
A.1 Stability of estimated coefficients in contemporaneous regressions for large speculators

To check the stability of this relationship, we conduct, as an example, the sequential Bai and Perron (2003) multiple break test for the specification of large speculators. When conducting the test, we allow for up to five breaks. According to the test results, the null hypotheses of 0 vs. 1 break has to be rejected, while the null hypothesis of 1 vs. 2 breaks cannot be rejected at the 5% level.[13] The (only) identified break date is April 20, 2004. Consequently, we split the sample into the two sub-samples January 5, 1999 - April 13, 2004 (276 obs.), and April 20, 2004 - June 23, 2015 (584 obs.) and reestimate the econometric model for these two sub-samples. According to the sample-specific estimation results, the estimated coefficient is almost three times as large in the first sub-sample (1.461***) as in the second sub-sample (0.518***). However, it has to be borne in mind that the absolute size of the net long position as well as its standard deviation have clearly increased over time.

A.2 R^2 based on moving window regressions

To see how the model's fit has developed over time, we estimate moving window regressions with a window size of two years (104 obs.). Figure 5 plots the obtained coefficients of determination (R^2) over time for the group of large speculators. It can be observed that the value of R^2 varies considerably (ranging from about 10% to almost 50%). The graph also suggests that the very high R^2-value obtained by Klitgaard and Weir (2004) may be largely sample-specific.

Figure 5: Time-varying R^2 based on moving window regressions (window size = 104 obs.)



[13] The evidence also points to one sample-split based on the values of the Schwartz information criterion for various numbers of breaks (up to 5).

A.3 Evidence for threshold effects in contemporaneous regressions

In order to test for a threshold effect depending on the absolute level of the net long position of large speculators in the previous week, we implement the threshold regression approach by Hansen (2000), and estimate the following threshold regression model:

$$\Delta e_t = \varpi_{r,0} + \varpi_{r,1} \Delta NL_t + \tau_t, \tag{5}$$

where

$$r = \begin{cases} l \text{ if } |\text{NL}_{t-1}| \leq & \gamma \\ h \text{ if } |\text{NL}_{t-1}| > & \gamma \end{cases}$$

$\varpi_{r,g,i}$ denotes the (possibly) regime-specific parameters, γ the threshold value (in our case the absolute value of the net long position of large traders from the previous week), which splits the sample into two regimes, l and h are acronyms (l=lower, h=higher) used to denote the specific regime, r. $\hat{\gamma}$ is the value of the absolute value of NL_{t-1} which minimizes the sum of squared errors function across both regimes. Once the threshold value has been determined, the coefficients are estimated by OLS. The significance of the threshold is then tested with the help of a likelihood ratio test.

According to the results, we indeed find strong evidence for a threshold effect (the respective bootstrapped p-value is 0.00). The threshold estimate is 28,409. The coefficient estimates for $\varpi_{r,g,1}$ below or above that threshold are 0.79, respectively 0.47. This suggests that the marginal impact of changes in the net long position is considerably lower once the absolute level of the net long position of the previous week surpasses the level of 28,409 (which is about double as much as mean absolute level of the net long position).

A.4 Further speculator group-specific results

Table 5: Small speculators: Marginal significance levels based on predictive regressions

Direction: $\Delta e \rightarrow \Delta NL$								
	h=1	**h=2**	**h=3**	**h=4**	**h=8**	**h=12**	**h=16**	**h=20**
j=1	**0.0000**	**0.0000**	**0.0109**	0.2937	0.1126	**0.0289**	**0.0105**	**0.0030**
j=2	**0.0000**	**0.0075**	0.8092	0.2261	**0.0003**	**0.0000**	**0.0000**	**0.0000**
j=3	**0.0073**	0.8446	**0.0296**	**0.0028**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=4	0.2442	0.2521	**0.0032**	**0.0001**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=8	0.1648	**0.0015**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=12	0.0872	**0.0007**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=16	**0.0354**	**0.0003**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=20	0.2740	0.2156	0.2319	0.2571	0.5242	0.8226	0.6135	0.2674
Direction: $\Delta NL \rightarrow \Delta e$								
	h=1	**h=2**	**h=3**	**h=4**	**h=8**	**h=12**	**h=16**	**h=20**
j=1	0.6329	0.9376	0.8491	0.8837	0.5792	0.3977	0.3303	0.1318
j=2	0.9491	0.9106	0.8959	0.7727	0.3496	0.3522	0.1828	0.1124
j=3	0.8349	0.8998	0.8966	0.9866	0.3750	0.3433	0.1019	0.1066
j=4	0.9098	0.7761	0.9905	0.9903	0.3025	0.3809	0.0602	0.0873
j=8	0.5711	0.3127	0.3321	0.2544	0.1370	**0.0276**	**0.0078**	**0.0094**
j=12	0.3159	0.2431	0.2351	0.2759	**0.0239**	**0.0063**	**0.0014**	**0.0049**
j=16	0.2162	0.1030	**0.0462**	**0.0234**	**0.0046**	**0.0010**	**0.0008**	**0.0040**
j=20	**0.0490**	**0.0406**	**0.0431**	**0.0402**	**0.0062**	**0.0044**	**0.0033**	**0.0047**

Table 6: All speculators: Marginal significance levels based on predictive regressions

Direction: $\Delta e \rightarrow \Delta NL$								
	h=1	**h=2**	**h=3**	**h=4**	**h=8**	**h=12**	**h=16**	**h=20**
j=1	**0.0000**	**0.0000**	**0.0049**	0.2983	0.0576	**0.0429**	**0.0026**	**0.0254**
j=2	**0.0000**	**0.0088**	0.7690	0.3250	**0.0003**	**0.0009**	**0.0001**	**0.0018**
j=3	**0.0023**	0.6631	0.1475	**0.0161**	**0.0000**	**0.0000**	**0.0000**	**0.0002**
j=4	0.1731	0.3593	**0.0138**	**0.0008**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=8	0.0900	**0.0011**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=12	0.0932	**0.0026**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=16	**0.0068**	**0.0003**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
j=20	**0.0412**	**0.0380**	**0.0389**	**0.0432**	**0.0485**	**0.0347**	0.0738	0.1897

Direction: $\Delta NL \rightarrow \Delta e$								
	h=1	**h=2**	**h=3**	**h=4**	**h=8**	**h=12**	**h=16**	**h=20**
j=1	0.5903	0.8637	0.6117	0.9887	0.2115	0.2213	0.1796	0.0792
j=2	0.8285	0.7611	0.8675	0.8008	0.1096	0.2057	0.1148	0.0813
j=3	0.5797	0.8579	0.9649	0.8786	0.0795	0.1752	0.0744	0.0816
j=4	0.9445	0.8140	0.8768	0.5570	0.0521	0.1373	**0.0370**	0.0729
j=8	0.2264	0.0935	0.0634	**0.0398**	**0.0260**	**0.0131**	**0.0097**	**0.0079**
j=12	0.2153	0.1665	0.1361	0.1105	**0.0115**	**0.0083**	**0.0015**	**0.0008**
j=16	0.1699	0.0920	0.0505	**0.0215**	**0.0083**	**0.0017**	**0.0001**	**0.0002**
j=20	0.0596	0.0627	0.0621	0.0568	**0.0064**	**0.0010**	**0.0001**	**0.0002**