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by

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Abstract

Applying the microstructure approach to exchange rates, this paper aims to shed light on the price formation process in the Thai foreign exchange market using a unique supervisory dataset of daily foreign exchange transactions from all licensed dealers in Thailand. We examine the main drivers of different types of order flows and the effect of resident and non-resident customer order flows on the Thai exchange rate. The results suggest that non-resident order flows have an important influence on movements in the Thai baht, while resident order flows do not. Regarding investors' trading behavior, we find that non-resident order flows are driven by both fundamentals and movements of the Thai baht. Specifically, non-resident players appear to be *'trend-followers'* with regard to exchange rate returns, exerting buying pressure when the baht recently appreciated. In contrast, domestic players tend to behave as *'contrarians'*, by buying the Thai baht after it depreciates.

JEL classification: F31, G15

Keywords: FX order flow, FX microstructure, Exchange rate, Thailand

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Introduction

Recent studies from the market microstructure literature strongly suggest that several structural features of the foreign exchange market, such as the transmission of information through order flows and the behavior and interaction of market participants, play an important role in determining exchange rate movements beyond those by explained by macroeconomic fundamentals. Central to microstructure theory is the concept of order flow—a measure of the net of buyer initiated and seller-initiated orders. Existing literature pioneered by Evans and Lyons (2002) has shown that order flow variables exhibit a strongly positive correlation with exchange rate movements and may be more powerful than macroeconomic variables in explaining exchange rate behavior. Non-dealer customer order flow, in particular, has been regarded as an important source of information that influences exchange rates since it represents the underlying demands for currencies in the real economy (Fan and Lyons, 2003).

Applying this microstructure approach, this paper aims to shed light on the price formation process in the Thai foreign exchange market using a supervisory dataset of daily foreign exchange transactions from all licensed dealers over 2012-2016. The data can be segmented by customer type and transaction purpose. Unlike many previous studies that use order flow data from a single market-market (eg. Froot and Ramadorai, 2002; Fan and Lyons, 2003; Marsh and O'Rourke, 2005; Menkhoff et al., 2016), this study benefits from the unique data set that covers virtually all foreign exchange transactions that take place onshore, thus providing a more complete picture of foreign exchange trading activities. The granularity of the data also allows us to address the heterogeneity of different types of order flows, their behaviors and implications on the overall market stability.

Our empirical analyses address two sets of questions:

- First, what is the impact of order flow on the Thai exchange rate? Which type of customer order flows matters more? And how large is the price impact of order flow relative to that of macroeconomic fundamentals?
- Second, what drives order flows? How do different types of order flows react to past exchange rate movements? Is there a clear pattern of trend-following or contrarian trading?

The market microstructure literature posits that order flow can have a non-trivial impact on asset price chiefly because frictions exist in the market, whether they be information frictions (Bagehot, 1971, Glosten and Milgrom, 1985, and Kyle, 1985) or frictions induced by liquidity conditions (Garman, 1976, Stoll, 1978, and Ho and Stoll, 1981). From an empirical standpoint, this view has

been shown to be valid by a number of studies, both at the international level (see, for example, Sarno and Taylor, 2001; Froot and Ramadorai, 2002; Evans and Lyons, 2002; Fan and Lyons, 2003; Marsh and O'Rourke, 2005; Menkhoff et al., 2016) and for Thailand's other markets (for the bond market, see Koosakul, 2016). After all, order flow represents a willingness to back one's beliefs about future macro conditions with real money and hence it plays an important role as a transmission mechanism from information to price (Lyons, 2001).

Nevertheless, not all order flows are equal with regard to their price impact. Evidence has shown that different types of order flows behave differently with varying degree of influence on the exchange rate. Mende and Menkhoff (2003) and Carpenter and Wang (2003) find order flows from financial institutions to have a positive impact on the exchange rate, while non-financial customer either have no influence or a negative impact. They suggest that financial customers tend to possess more information relevant to future exchange rates. Marsh and O'Rourke (2005) also find differential price impact across different customer types. They argue that it is the information content of order flows rather than the dealers' inventory management motive that gives rise to the positive relationship between some particular types of order flows and price, since the inventory-based model would predict the same price reactions across different types of customers. Bjønnes, Rime and Solheim (2004) find evidence to support their argument that financial players are market movers (*'push customers'*) whose order flows are positively correlated with the exchange rate, whereas non-financial customers (*'pull customers'*) take a passive role as liquidity providers in the foreign exchange market.

Closest in spirit to the first part of our paper is the work of Gereben, Gyomai and Kiss M. (2006) which examines the effect of foreign and domestic customer order flows on the Hungarian exchange rate. They find foreign players' order flows to be a main driver of exchange rate movements while domestic players are the source of market liquidity. In our current paper, we aim to investigate not only the differential price impact by different customer groups, but also to compare the relative importance between order flows and macroeconomic fundamentals in explaining exchange rate fluctuations. Several proxies for macroeconomic fundamentals as well as global sentiment factors are included in our regression models.

The second part of the paper investigates the main drivers of different types of order flows, focusing particularly on investors' reaction to lagged exchange rate movements, with the aim of identifying which types of order flows likely act as shock absorbers or shock amplifiers in the foreign exchange market. This draws from the literature on positive and negative feedback trading strategies of market players. Kaniel, Saar, and Titman (2008) studies trading behavior in the equity market and find individual investors to exhibit negative feedback trading pattern,

implicitly providing liquidity for institutional investors. A more recent order flow study by Menkhoff et al. (2016) indicates that the trades of different investor groups indeed react differently to past exchange rate returns. Their result suggests that long-term institutional investors tend to be positive-feedback traders or '*trend followers*', whereas individual investors behave as negative-feedback traders or '*contrarians*', with regard to past returns. They claim this result on heterogeneous trading strategies among different customer groups as an evidence of active risk sharing in the foreign exchange market. Understanding the trading behavior of different customer groups will allow us to better understand the risk sharing aspect as well as to assess the overall stability of the market.

Our key findings are summarized as follows. Based on GMM estimates of the impact of order flows on the USD-Thai baht exchange rate, we find that non-resident order flows have an important influence on movements in the Thai baht, while resident order flows do not. Similar results have been found in Gereben, Gyomai and Kiss M. (2006) for the Hungarian foreign exchange market. One interpretation is that foreign players may possess superior private information about future economic conditions that affect exchange rate, whereas domestic customers play the role of liquidity provider. In terms of economic significance, the price impact of non-resident order flows is on par with other macro fundamental and global sentiment factors, suggesting that order flows are one of the main drivers of short-term exchange rate fluctuations.

Regarding the trading behavior of different customer types, we find that non-resident order flows are driven by both fundamentals and movements of the Thai baht. Specifically, non-resident players appear to be *trend-followers* with regard to exchange rate returns, exerting buying pressure when the baht recently appreciates. In contrast, domestic players tend to behave as *contrarians*, by buying the Thai baht after it depreciates. These results suggest that non-resident players, through their positive feedback trading, may potentially impart a destabilizing force on the exchange rate in the short run. This effect is partly counteracted by the negative feedback trading of domestic players who act as liquidity providers for their foreign counterparts, although their ability to preserve the overall stability of the foreign exchange market could be called into question given some estimation results that we further discuss in the body of the paper.

The rest of the paper is organized as follows. The next section describes the data and provide key stylized facts about the Thai exchange rate market. The main empirical analyses are divided into two parts. The first part studies the impact of customer order flows on the Thai exchange rate. The second part examines the drivers of different types of order flows to capture their trading behaviors. The final section concludes.

Data and Stylized Facts

To construct order flow variables, we employ a unique data set obtained from the Bank of Thailand covering all purchases and sales of foreign exchange with authorized dealers in the Thai jurisdiction. For supervisory and statistical purposes, authorized foreign exchange dealers are required to report to the Bank of Thailand *all* individual transactions of significant size that involve purchasing, selling, depositing, or withdrawing of foreign currencies between the reporting dealers and their counterparties.¹ The report includes details of each individual transaction such as dealer identification, customer identification, contract date, type of foreign exchange instrument, maturity date, sell-buy currencies, transaction amount, the rate of exchange, nationality of customers, as well as purpose of transaction. In this paper, we utilize such data at the daily frequency for the period spanning from January 2012 to December 2016, which totals to around 1,200 observations.

Reporting dealers consist of all commercial banks including branches and subsidiaries of foreign banks in Thailand, and other authorized government banks. End-customers include financial firms, non-financial firms, and individuals, and can be either local resident of Thailand or non-resident.² For the purpose of this study, we focus mainly on the buy and sell transactions between reporting dealers and end-customers, assuming that end-customers are the ones who initiate those foreign exchange transactions. Here end-customers are distinguished into two main types—namely, local customers (residents) and foreign customers (non-residents), with a more detailed breakdown of customer types when we investigate trading behavior at a more disaggregate level. As argued in Fan and Lyons (2003), it is end-customers that matter more for exchange rate movements since they represent underlying demand for currencies for the purposes of real-sector businesses or investment, while interdealer trading is in a sense a derivative, ultimately driven by customer flow. For this reason, interdealer trading activity is excluded from our data set.

Historically, customer trading accounts for around 75-85 percent of total trading volume in the Thai spot market. Out of the total customer trading, Table 1 provides a breakdown of share by customer type. Trading volume by non-resident customers is slightly larger than that of local customers, standing at 56 percent of total volume. Most of non-resident activity is conducted by financial customers, chiefly foreign banks. On the other hand, local customer trading volume is dominated by non-financial customers (19.5%) which are mostly Thai businesses engaging in

¹ All individual transactions in an amount equivalent to USD 50,000 or above must be reported separately. Foreign exchange transactions of value less than USD 50,000 can be reported in aggregate on a daily basis.

² A detailed description of the Thai foreign exchange market microstructure including stylized facts on their trading activities can be found in Civilize and Ananchotikul (2018).

international trade of goods and services, followed by state-owned enterprises (8.8%) and funds (8.8%).

Table 1: Share of customer trading volume in the Thai spot market, by customer type

Customer type		Share	Total
Resident	Non-financial businesses	19.5	41.5
	State-owned enterprises	8.8	
	Funds	8.8	
	Other financial entities	2.0	
	Government	1.7	
	Individuals	0.6	
Non-resident	Financial	46.6	56.0
	Individuals	5.0	
	Non-financial	4.4	
Others (unclassified)		2.6	2.6

Note: The calculation period is from 4 January 2012 to 30 December 2016.

Source: Bank of Thailand, authors' calculations.

Order flow construction

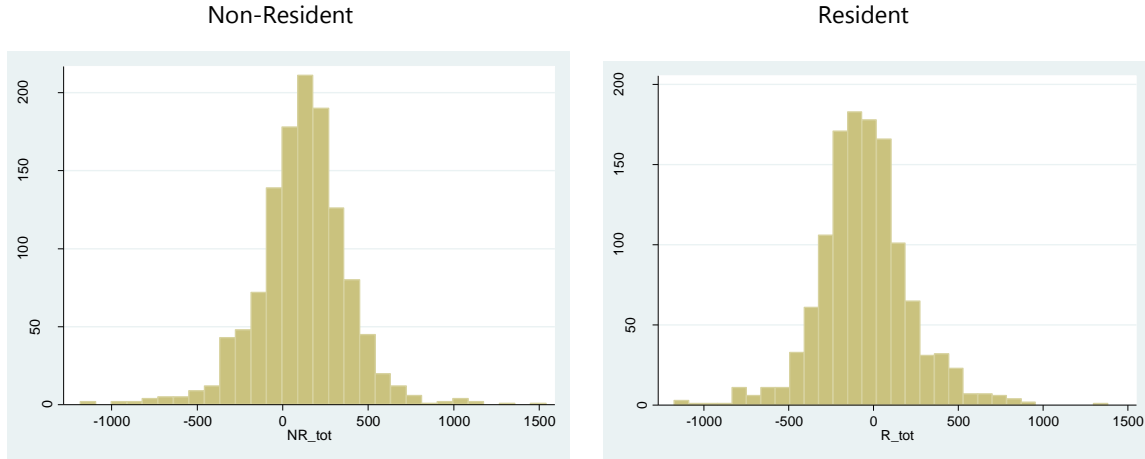
As is standard in the order flow literature, we construct order flow variables as a signed net purchase of Thai baht against the US dollar in the spot and forward market.³ Thus, a positive sign of order flow represents a net buying pressure on Thai baht vis-à-vis US dollar, and vice versa. Figure 1 presents the distribution of the two types of order flows (spot and forward transactions combined). Non-resident daily order flow distribution is slightly skewed to the left, with positive mean and median, while resident order flow appears almost as a mirror image. Their standard deviations are also roughly equal.

Table 2 calculates correlations between daily order flows of different types, namely, (1) non-resident spot, (2) non-resident forward, (3) resident spot, and (4) resident forward order flows. We observe strong negative correlations between non-resident and resident order flows, particularly between the non-resident spot and resident forward activities. Taken together, this may suggest that the foreign and local end-customers are likely the ultimate counterparts in the foreign exchange market, whose demand and supply for currencies are matched by the dealers. However, based on these statistics alone we cannot infer which group is an active trader and which group is

³ We focus on order flow between the Thai baht and the US dollar only and ignore trading with other foreign currencies since the US dollar is the most traded foreign currency in the Thai foreign exchange market, representing nearly 90 percent of daily trading volume.

more of a liquidity provider. Further investigation is needed which will be carried out in the empirical analysis section.

Figure 1: Distribution of non-resident and resident order flows



Source: Bank of Thailand, authors' calculations.

Table 2: Correlation among different types of order flows

	NR spot	NR fwd	R spot	R fwd
NR spot	1			
NR fwd	-0.0277	1		
R spot	-0.3887*	-0.0665	1	
R fwd	-0.6804*	-0.1917*	-0.0596	1

Note: NR = non-resident, R = resident, spot = spot order flow, fwd = forward order flow. * denotes the significance level of the correlation coefficient at 1%. The calculation period is from 4 January 2012 to 30 December 2016.

Source: Bank of Thailand, authors' calculations.

Empirical Methodology

A. Impact of FX Order Flow on the Thai Exchange Rate

To explore the influence of order flows on the Thai exchange rate, the following econometric specification is employed.

$$\Delta USDTHB_t = \alpha + \delta \mathbf{OF}_t + \beta \Delta \mathbf{D}_t + \eta \Delta \mathbf{X}_{t-1} + e_{it} \quad (1)$$

where $USDTHB_t$ denotes the bilateral spot exchange rate between the Thai baht and the US dollar (Thai baht per US dollar), \mathbf{OF}_t is a vector containing order flow variables, and \mathbf{D}_t and \mathbf{X}_t , are vectors containing domestic and regional/global control variables, respectively.

To ensure stationarity, all domestic and regional/global variables are modeled in first-differences.

In contrast, order flow variables are already stationary and are thus left in their original level form. For the dependent and independent domestic and order flow variables, Δ denotes the changes in their values from working day $t-1$ to working day t . In contrast, for global variables, the changes are from working day $t-2$ to working day $t-1$. This reflects the timing differences between Thailand and other international markets, whereby events occurring in the latter on working day $t-1$ will not affect events in the former until working day t .⁴

The set of variables contained in \mathbf{D}_t and \mathbf{X}_t is consistent with the literature and includes both fundamental and financial markets variables.⁵ Specifically, the \mathbf{D}_t vector includes the following variables: economic growth (as proxied by the Stock Exchange of Thailand (SET) index), country credit risk (reflected by changes in 5-year CDS for Thailand), short term interest rate differentials (gap between Thai and US Treasury 1-month yields) and long-term interest rate differential (gap between Thai and US Treasury 10-year yields).⁶ Additionally, the \mathbf{X}_t vector includes FX market sentiment in the region (reflected by the Asian dollar index), market sentiment at the emerging markets level (CITI Group Economic Surprise Index), market sentiment at the global level (Dollar Index), and the global investors' degree of risk aversion (as reflected by GFSI and gold price).⁷

As for the order flow variables, we distinguish between two types of order flows – namely (1) resident end-customer order flow and (2) non-resident end-customer order flow. Missing from our coverage due to data limitation is inter-dealer order flows, although, as argued by Girardin and Lyons (2008), information on end-user trades is more important as it reflects the underlying sources of currency demands in the economy. Our order flow variables include both spot and forward transactions.

A few econometric challenges arise in estimating Equation 1. Firstly, there appear to be high correlations among several independent variables, namely between SET, CDS, Asian dollar index and the main dollar index. To overcome the potential multicollinearity problem, we adopt the following procedure. We first determine which variable in the explanatory variable set is likely to be more exogenous (for example, the dollar index is likely to be more exogenous than the Asian

⁴ For example, changes in U.S. Treasury yield on Thursday US time will not be relevant in determining the Thai exchange rates until Friday Thai time, as the Thai market will already have closed on Thursday Thai time when such an event occurs in the U.S.

⁵ Because the objective of this paper is to examine the high-frequency dynamics of USDTHB movements, some standard fundamental variables important to exchange rate determination such as economic growth and debt-to-GDP ratio cannot be used due to their low-frequency reporting. This paper utilizes financial markets variables to proxy for these standard determinants.

⁶ To construct the last two variables, the US Treasury component is lagged by one period just like the regional/global variables.

⁷ Strictly speaking, the Asian dollar index is reconstructed to exclude USDTHB, which is our dependent variable, in order to truly capture changes in regional sentiment excluding movements in USDTHB themselves.

dollar index). We then use a simple orthogonalization method by regressing the less exogenous variable on the exogenous variable and use the residual from the regression to represent the less exogenous variable in estimating Equation 1.⁸

Second and perhaps more importantly, there is potential simultaneity bias in estimating the effect of order flows on USDTHB using OLS. This is because it is possible that order flows are themselves driven by changes in the exchange rate. This occurs if investors follow a feedback trading strategy—an issue we investigate next in the second part of this paper. To overcome this problem, Equation 1 is estimated using generalized method of moments (GMM), where each order flow variable is instrumented for by its first lag. Lastly, to account for potential autocorrelation and heteroscedasticity in the data, HAC standard errors are used.

B. Investors' Trading Behaviors

To study investors' trading behaviors, we now have the order flow variables as the dependent variables and movements of USDTHB as independent variables:

$$Order\ Flow_{i,t} = \alpha + \delta \Delta USDTHB_{t-1} + \beta \Delta D_t + \eta \Delta X_{t-1} + e_{it} \quad (2)$$

where $Order\ Flow_{i,t}$ is the order flow of investor type i , $USDTHB_{t-1}$ is a vector containing USDTHB movements of four horizons, namely, daily, weekly, fortnightly, and monthly, and D_t and X_t are the same vectors of variables used in Equation 1. Because of the same simultaneity problem discussed in Part A, the exchange rate variables are lagged by one day, such that they could not have been affected by order flows taking place in the same day.

In our baseline results, we distinguish between resident and non-resident investors. However, in this section we can be more granular than this, since there is no need to find a strong instrument for each of the investor type's order flow. We therefore also break down order flow further into the following: non-financial businesses, state-owned enterprises (SOEs), government sectors, individuals, funds, and other financials for resident investors; and financial, non-financial, and individual investors for non-resident investors.

⁸ More specifically, the dollar index is used as is since it is deemed to be exogenous. The Asian dollar index is orthogonalized by removing the effect of the dollar index. SET and CDS are orthogonalized by removing the effects of both the Asian dollar index and the dollar index.

Estimation Results

A. Influence of Order Flow on the Thai Exchange Rate

The regression results for Equation 1 are reported in Table 3, with Figure 2 shows the degree of economic significance of the main results. Column (1) contains results from an OLS regression including only fundamental and financial market variables in the explanatory variables as a baseline regression. The next two columns report results based on GMM estimates which include order flow variables in the set of regressors. The adjusted R-squares are between 0.33-0.55, indicating high explanatory power and is consistent with those reported in the existing literature.

Across all specifications, the results on the set of fundamental and financial market variables overall are statistically significant with expected signs, implying that the day-to-day USDTHB movements are indeed influenced by these domestic, regional, and global factors. These factors are not only statistically significant, but also economically so; as shown in Figure 2, a one standard deviation change in each of these factors would result in a change ranging from 2% to 35% of the usual standard deviation of USDTHB movements. On a relative basis, regional and global factors appear to be more important than domestic factors, at least during the sample period considered, with their influence on USDTHB movements being between 5% to 35% of USDTHB standard deviation, as opposed to 2% to 13% for domestic factors. This becomes less surprising if we consider the small-open-economy nature of Thailand.

Turning to the effects of order flows, results from Table 3 Column (2) and (3) suggest that market-microstructure features are indeed important in determining USDTHB movements. Non-resident and resident order flows are included separately because of a potential multi-collinearity issue. From Column (2), non-resident order flow is statistically significant in affecting USDTHB movements. It is also highly economically significant, with a one standard deviation increase in order flow (i.e. buying pressures on the baht) leading to an appreciation of USDTHB by approximately 28% of its usual (one standard deviation) movement. This is on par with the effects of regional and global factors, again highlighting the strong influence on USDTHB movements from external factors.

The coefficient on resident flow is also statistically significant (Column 3). However, it has an unexpected positive sign, which implies that an increase in net resident buying pressure on the baht appears to lead to a baht *depreciation*. While counterintuitive at a first glance, it is clear upon further deliberation why this is the case. For technical reason, to avoid multicollinearity, we enter non-resident and resident order flow in separate regressions when estimating Equation 1.

Because the two types of order flows are strongly negatively correlated, and each of them separately is expected to have a negative correlation with the USDTHB movement (i.e. net buying pressure leading to a baht appreciation), technically there should be an upward bias in the estimated coefficients. By not including the non-resident order flow in Column (3), the positive coefficient on resident order flow can thus be seen as a result of this bias. Because of this complication, we are not able to conclude whether resident order flows have significant effects on USDTHB movements. While suffering from the very bias, the fact that the coefficient on non-resident flows remains negative means that they are indeed important in determining baht movements, because an upward bias would have resulted in the coefficient being more *positive* than it should be.

Our finding that non-resident order flow has a stronger positive impact on the exchange rate than resident order flow is consistent with the findings in previous literature. One potential explanation is that foreign players possess superior private information about future economic conditions driven by both domestic and external factors that affect exchange rate. Also, most of the non-resident participants in the Thai foreign exchange market are *financial* players such as foreign banks and institutional investors, while resident end-user participants are mostly *non-financial* entities such as exporters and importers of goods and services. This fact lends further support to the notion that the non-resident players tend to be more aggressive traders seeking profits from foreign exchange trade, while the local non-financial players are more passive liquidity providers thus having limited price impact. And the resident order flow's negative correlation with the exchange rate could be viewed as simply reflecting their trades in the opposite direction of the non-resident trades.

B. Investors' Trading Behavior

The regression results for Equation 2 are presented in Table 4, where the dependent variables in Column (1) and (2) are non-resident and resident order flow, respectively. Overall, there is ample evidence that both resident and non-resident investors engage in feedback trading. In addition, both investor types employ very different strategies; in the short-horizons, the negative coefficients on the exchange rate variables in Column (1) suggest that non-resident investors are trend followers (positive feedback traders), while the positive coefficients in the third row indicate that residents act as contrarians (negative feedback).

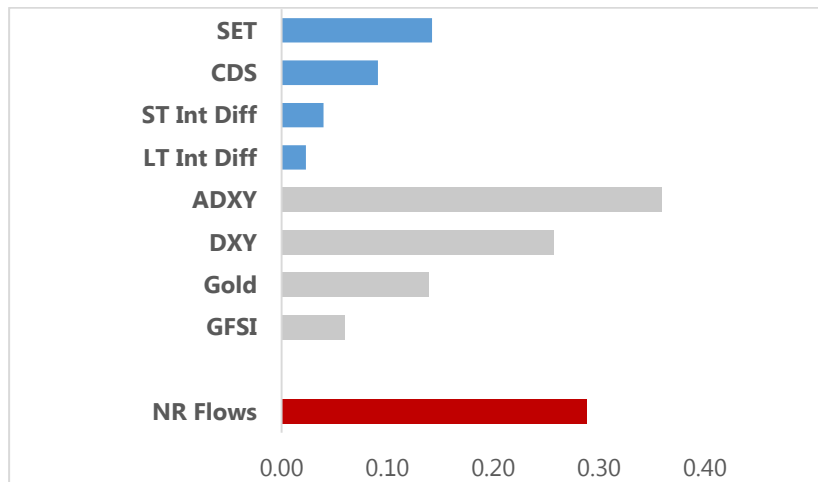
Table 3: Impact of order flows on Thai exchange rate

Variable	(1) OLS	(2) GMM	(3) GMM
<i>Domestic variables:</i>			
Δ SET Index	-0.0557***	-0.0490***	-0.0510***
Δ CDS	0.0199***	0.0114**	0.0148***
Δ ST Int Diff (1M)	-0.0136**	-0.0087*	-0.0119**
Δ LT Int Diff (10Y)	-2.75E-05***	-2.89E-05***	-3.33E-05***
<i>Regional/global variables:</i>			
Δ ADXY	-0.3618***	-0.3879***	-0.3601***
Δ CESI - EM	0.0043	0.0036	0.0041
Δ Dollar Index	0.2034***	0.1761***	0.1765***
Δ Gold Price	-0.0502***	-0.0444***	-0.0488***
GFSI	-0.5274**	-0.5200**	-0.5246**
<i>Order flow variables:</i>			
NR Flows (ex BOT)		-3.38E-04***	
R Flows			2.46E-04**
Obs	1,222	1,222	1,222
Adj R-squared	0.3	0.503	0.431

Note: *, **, *** indicate significance level at 10%, 5% and 1% respectively.

Figure 2: Economic significance of the results

(USDTHB movements in terms of S.D. per one S.D. of the X variable)



The above observation implies that non-resident investors are those whose trading activities could potentially 'destabilize' the market, by trading in a direction that further amplifies the currency movements. On the other hand, residents' activities appear to be 'stabilizers', in that they trade in such a way that prevents further changes in the currency values.

The finding that resident investors act as contrarians in the Thai market is quite comforting, since it implies that there are market participants ready to provide 'liquidity' to the market, thereby preventing further asset price changes. However, one point is worth noting. From the regression results, the coefficients on control variables of the non-resident specification have the expected signs⁹, while those of the resident specification do not. This suggests that non-resident investors are the ones who actively trade in response to news, while the control variables in the resident specification are statistically significant simply because resident order flows are highly (negatively) correlated with non-resident order flows. It is therefore possible that the significant positive coefficients on the short-term exchange rate variables for the resident specification are significant because of the same reason, rather than because they really act as *active* contrarians in the market. Stated differently, resident investors simply trade for reasons unrelated to news, changing their positions purely for liquidity and opportunistic reasons and when market timing allows (i.e. sell when non-resident wish to buy and buy when non-residents wish to sell). This observation is consistent with our prior knowledge that in the Thai case non-resident investors are mainly financial entities, while resident investor are real-sector entities such as exporting and importing firms.

The fact that resident investors' contrarian behaviors tend not to be active ones, however, may limit their role as a market stabilizer in times of extreme baht movements. Specifically, when economic fundamentals or market sentiments—especially external factors that are found in Part A to have a strong influence on the baht—cause the baht to move rapidly, such as the episode witnessed during the 2013 Taper Tantrum period, and non-resident investors engage in positive feedback trading, residents' ability or willingness to counteract such moves may be limited—because they trade for non-profit driven reasons to begin with.

Notwithstanding the above results in relation to daily and weekly baht movements, at the monthly horizon non-resident investors' behaviors change to contrarian ones. Specifically, the coefficient on the 1-month exchange rate variable is statistically significant and positive. This suggests that when the baht moves in the same direction for extended periods, these investors close their positions to realize profits, thereby lessening the effects of their previous positive feedback trading activities. Therefore, it may be said that while foreign presence may be causing market volatility in the very short run, there is evidence of market corrections over longer horizons.

⁹ for example, an increase in the SET index (CDS), which signals positive (negative) news that could also potentially cause a simultaneous appreciation (depreciation) of the baht, appears to induce non-residents to buy (sell) more baht.

Table 5 presents the regression results of Equation 2, focusing only on the order flow response to USDTHB movements, at a more granular level. Resident investors are categorized further into and non-resident investors into non-financial businesses, state-owned enterprises, government sectors, individuals, funds, and other financial institutions; and non-residents into financial, non-financial, and individual investors. The green and red boxes indicate the coefficients on USDTHB movements that are statistically significant, with the green box indicating a positive coefficient (i.e. contrarian) and the red box indicating a negative coefficient (i.e. trend follower) with respect to the relevant exchange rate variables. Overall, the disaggregate results for resident investors are consistent with the aggregate one, with investors being contrarians in the short run and trend followers in the long run. The results for non-resident appear to be slightly more heterogeneous, with financial institutions acting in manners that are reflected in the aggregate result. Conversely, non-financial businesses and individuals do not appear to switch strategies; the former appear to be trend followers in the horizons that are statistically significant, while the latter are uniformly contrarians throughout the horizons.

Table 4: Determinants of non-resident and resident order flows

Variable	(1) NR order flow	(2) R order flow
<i>Lagged ΔUSDTHB</i>		
Overnight	-158.447***	188.034***
Weekly	-81.485***	82.316***
Fortnightly	-7.343	-8.726
Monthly	32.294***	-31.193***
<i>Domestic variables:</i>		
Δ SET Index	18.347*	-17.127*
Δ CDS	-8.451**	6.724*
Δ ST Int Diff (1M)	13.845**	-4.814
Δ LT Int Diff (10Y)	-0.001	0.020**
<i>Regional/global variables:</i>		
Δ ADXY	323.965***	-323.445***
Δ CESI - EM	-3.769	2.944
Δ Dollar Index	-85.141***	103.968***
Δ Gold Price	4.323	9.436
GFSI	396.68	-388.863*
Obs	1,212	1,212
R-squared	0.259	0.269

Note: *, **, *** indicate significance level at 10%, 5% and 1% respectively.

Table 5: Summary of results on the influence of lagged changes in exchange rate for different types of disaggregated non-resident and resident order flows

		1 day	1 week	2 weeks	1 month
R	Non-financial firms	Contrarian	Contrarian	Not statistically significant	Trend follower
	SOEs	Not statistically significant	Contrarian	Not statistically significant	Not statistically significant
	Government	Contrarian	Not statistically significant	Not statistically significant	Trend follower
	Individuals	Contrarian	Contrarian	Not statistically significant	Not statistically significant
	Funds	Not statistically significant	Not statistically significant	Not statistically significant	Trend follower
	Other financial	Not statistically significant	Contrarian	Not statistically significant	Not statistically significant
NR	Financial	Trend follower	Trend follower	Not statistically significant	Contrarian
	Non-financial	Not statistically significant	Trend follower	Trend follower	Not statistically significant
	Individuals	Contrarian	Contrarian	Contrarian	Contrarian

Contrarian
 Trend follower
 Not statistically significant

Conclusion

In this paper we apply the FX microstructure approach with an aim to shed light on the price formation process in the Thai foreign exchange market using a unique supervisory dataset of daily foreign exchange transactions from all licensed dealers. We examine the effect of resident and non-resident customer order flows on the Thai exchange rate as well as investigate the main drivers of different types of order flow in order to understand investors' trading behavior particularly with regard to past exchange rate movements.

Our key findings can be summarized as follows. We find that *non-resident* order flows have an important influence on movements in the Thai baht, while *resident* order flows do not. In terms of economic significance, the size of the impact of non-resident order flows is on par with other macro fundamental and global sentiment factors. This result suggests that foreign (mostly financial) players may possess, or they are perceived by other market players to possess, private information that affect the future value of the exchange rate. Thus, their trades instigate a strong price impact. On the other hand, domestic (mostly non-financial) players appear to be uninformed traders, but play an important role as liquidity providers in the Thai foreign exchange market.

Regarding investors' trading behavior, we find that non-resident order flows are driven by both fundamentals and movements of the Thai baht. Specifically, non-resident players appear to be *'trend-followers'* with regard to exchange rate returns, exerting buying pressure when the baht recently appreciated. In contrast, domestic players tend to behave as *'contrarians'*, by buying the Thai baht after it depreciates.

Overall, the results suggest that non-resident players, through their strong price impact and their positive feedback trading, may potentially impart a destabilizing force on the exchange rate in the short run. This effect is partly counteracted by the negative feedback trading of domestic players who act as liquidity providers for their foreign counterparts, hence preserving the overall stability of the foreign exchange market. In addition, while foreign trading may cause market volatility and destabilizing in the very short run (daily and weekly), there is evidence of market corrections over longer horizons (monthly).

Taken together, the findings from this study shed light on some of the microstructure the Thai foreign exchange market and its influence on the exchange rate. The results suggest that, in order to understand the market and exchange rate dynamics, we need to pay closer attention to the various dimensions of heterogeneity across different types of market participants, whether they be their information superiority, trading strategies, trading motives, or risk exposures. We regard this analysis as a first step of understanding the microstructure of the Thai baht market and investor's trading behavior. Future research is needed to gain further insights from observing the transactions and interaction among different groups of market players at a more granular level. Knowledge on the nature and the impact of different types of order flow will be valuable for policymakers in monitoring and designing policy to safeguard the overall financial market stability.

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DATA APPENDIX

Table A1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
NR flow, total	1,222	115.47	266.95	-1183.69	1538.96
R flow, total	1,222	-50.22	266.76	-1175.02	1382.72
Δ USDTHB, daily	1,222	0.01	0.31	-2.25	1.49
Δ USDTHB, weekly	1,222	0.05	0.65	-2.88	2.91
Δ USDTHB, fortnightly	1,222	0.11	1.00	-4.41	3.88
Δ USDTHB, monthly	1,222	0.23	1.46	-3.46	4.48
Δ SET Index*	1,222	0.00	0.91	-5.28	4.48
Δ CDS*	1,222	0.00	2.48	-15.01	14.92
Δ ST Int Diff (1M)	1,222	-0.07	1.43	-9.58	9.56
Δ ST Int Diff (10Y)	1,222	-0.14	9.97	-47.87	42.93
GFSI	1,222	0.00	0.04	-0.14	0.23
Δ Gold Price**	1,222	0.00	0.98	-12.97	6.50
Δ Dollar Index	1,222	0.02	0.46	-2.37	2.20
Δ Asian Dollar Index**	1,222	0.00	0.29	-1.47	1.13
Δ CESI-EM	1,222	0.02	2.46	-25.20	18.10

** Δ SET and Δ CDS here are residual changes after removing the effects of both Asian dollar index and the dollar index, to mitigate the multicollinearity problem among the highly correlated variables. ** Δ Gold Price and Δ Asian Dollar Index are residuals changes after removing the effects of the dollar index.*

Table A2: Correlations among variables

	NR flow, total	R flow, total	ΔUSDTHB, daily	ΔUSDTHB, weekly	ΔUSDTHB, fortnightly	ΔUSDTHB, monthly	Δ SET Index*	Δ CDS*	Δ ST Int Diff (1M)	Δ ST Int Diff (10Y)	GFSI	Δ Gold Price**	Δ Dollar Index	Δ Asian Dollar Index**
NR flow, total	1													
R flow, total	-0.8359*	1												
ΔUSDTHB, daily	-0.5912*	0.5372*	1											
ΔUSDTHB, weekly	-0.2109*	0.2094*	0.0428	1										
ΔUSDTHB, fortnightly	-0.1203*	0.0874*	0.023	0.6854*	1									
ΔUSDTHB, monthly	0.0106	-0.022	0.0461	0.4664*	0.6877*	1								
Δ SET Index*	0.0839*	-0.0820*	-0.1744*	-0.0431	-0.0474	-0.0418	1							
Δ CDS*	-0.2166*	0.2118*	0.2691*	0.0890*	0.0399	0.0888*	0.000	1						
Δ ST Int Diff (1M)	0.0790*	-0.0376	-0.0723	0.013	0.0259	0.0228	-0.004	0.017	1					
Δ ST Int Diff (10Y)	0.0053	0.0385	0.0201	0.066	0.0604	0.0567	-0.0262	0.0868*	0.1137*	1				
GFSI	-0.0592	0.0628	0.0273	0.1357*	0.0639	0.0752*	-0.1162*	0.2664*	0.0001	0.1630*	1			
Δ Gold Price**	0.0643	-0.0268	-0.1911*	-0.0097	-0.0272	-0.0162	0.0096	-0.0132	0.0403	0.0637	0.0772*	1		
Δ Dollar Index	-0.1713*	0.2112*	0.3011*	0.0311	0.0105	-0.0048	-0.0923*	0.0793*	-0.029	-0.0357	0.0384	0.000	1	
Δ Asian Dollar Index**	0.3698*	-0.3670*	-0.5435*	-0.02	-0.0005	-0.0475	0.00	-0.3934*	0.0322	-0.0119	-0.1056*	0.0995*	0.000	1
Δ CESI-EM	-0.008	0.0044	0.0258	-0.0264	0.0052	0.0609	-0.0227	-0.045	0.0572	0.0221	-0.0628	0.0079	0.0071	0.0071

*ΔSET and ΔCDS are residual changes after removing the effects of both Asian dollar index and the dollar index, to mitigate the multicollinearity problem among the highly correlated variables.

**Δ Gold Price and Δ Asian Dollar Index are residuals changes after removing the effects of the dollar index.