

IMF Working Paper

Exchange Rate Fluctuations and International Portfolio Rebalancing in Thailand

Jacob Gyntelberg, Mico Loretan, and Tientip Subhanij

IMF Working Paper

Institute for Capacity Development

Exchange Rate Fluctuations and International Portfolio Rebalancing in Thailand ¹

Prepared by Jacob Gyntelberg, Mico Loretan, and Tientip Subhanij

Authorized for distribution by Marc G. Quintyn

September 2012

This Working Paper should not be reported as representing the views of the IMF. The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

Abstract

We present empirical evidence that the Thai baht's value is driven in part by investors' cross-border equity portfolio rebalancing decisions. Our results are based on comprehensive datasets of FX and stock market transactions undertaken by nonresident investors in Thailand in 2005 and 2006. Higher returns in the stock market relative to a reference stock market are associated with net sales of equities by these investors and a depreciation of the Thai baht. Net purchases of Thai equities lead to an appreciation of the Thai baht. Foreign investors do not appear to hedge the foreign exchange risk related to their stock market positions.

JEL Classification Numbers: F30, F31

Keywords: Foreign exchange market, capital flows, equity market, portfolio rebalancing

Authors' Email Addresses: jacob.gyntelberg@bis.org, mico.loretan@mac.com, tientips@bot.or.th

¹ The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Thailand, the Bank for International Settlements, or the International Monetary Fund. We are grateful for comments by Rabah Arezki, Philippe Bacchetta, Claudio Borio, Mark Carey, Michael King, Jaime Marquez, Robert McCauley, Carol Osler, Pichit Patrawimolpon, Eli Remolona, Lucio Sarno, Martin Schrimpf, Elvira Sojli, Eric van Wincoop, Giorgio Valente, Clara Vega, and Jonathan Wright. We thank the Bank of Thailand's Data Management Group and the Stock Exchange of Thailand's Research Institute for providing most of the data used in this study. All remaining errors are our own. A previous version is available as BIS Working Paper No. 287.

Contents

Page

I.	Introduction	3
II.	Portfolio Rebalancing	4
III.	The Markets and the Data	6
	A. Sample Period and Definition of Nonresident Investors	6
	B. The Onshore FX Market	7
	C. The Equity Market	11
IV.	Empirical Findings	12
	A. Imperfect Hedging	13
	B. Portfolio Rebalancing and the Exchange Rate	14
V.	Concluding Remarks	16
	References	17

Tables

1.	Transactions of nonresident customers in the onshore FX market of Thailand	9
2.	Transactions by nonresident customers on the Stock Exchange of Thailand	12
3.	List of variables used in the regression models	12
4.	Dependence of FX swap order flow on stock market returns and order flow	13
5.	Dependence of FX returns on own-market order flow, stock market order flow, and proxies for macroeconomic conditions	14
6.	Dependence of investors' order flow in the stock market on FX returns, SET returns, and relative performance of the SET index versus the S&P500 index	15

Figure

1.	Thai baht/U.S. dollar exchange rate and SET index in 2005 and 2006	10
----	--	----

I. INTRODUCTION

Understanding the role international capital flows play in determining exchange rates has been a long-standing objective of international finance research. The significant growth of international capital flows over the past few decades has created broad-based interest in this topic. Researchers and policy makers are interested in understanding the forces that drive flows in foreign exchange markets and, more generally, the relationships between external capital flows and developments in the domestic financial system. This relationship affects the stability of the financial system as well as broader economic developments and conditions.

In this paper we examine the influence of equity market related capital flows on the exchange rate for Thailand. We make use of a novel and so far unused dataset for Thailand, a large and important emerging market economy, which contains two years' worth of comprehensive daily-frequency FX market transactions between licensed FX dealers in Thailand and their nonresident customers. In addition, we also use data on capital flows by nonresident investors in the Thai stock market. The datasets were compiled by the Bank of Thailand (BOT) and the Stock Exchange of Thailand (SET) over the period 2005 to 2006.¹

With incomplete markets for hedging of FX risk, assets denominated in various currencies must differ in at least this aspect of risk. Optimizing investors will split their portfolios of stocks, bonds, and other financial assets between domestic-currency and foreign-currency denominated assets in proportions that depend on expected rates of return, risks, and expected risk premia. If expected rates of return or any other component of the portfolio choice problem change, international capital flows should occur as investors rebalance their asset holdings across countries. The approach taken in the studies that formalized this notion is commonly called the portfolio balance approach.²

Portfolio balance models provide plausible scenarios in which capital flows should help explain both the sign and the magnitude of exchange rate fluctuations. Unfortunately, early attempts to verify empirically this implication of the models were generally unsuccessful; see [Frankel \(1983\)](#) for a survey of this literature. The lack of empirical evidence in favor of the portfolio balance hypothesis reflected a number of different factors. First, many of the early studies relied on low-frequency data, such as monthly and quarterly data. Because capital flows can fluctuate considerably from day to day with some evidence of non-zero correlation

¹The data for the Thai stock market have also been used by [Chai-Anant and Ho \(2008\)](#). [Phongpaichit and Baker \(2008\)](#) provide a general overview of developments in the capital markets in Thailand since 1997.

²See [Kouri \(1976\)](#), [Branson \(1977\)](#), [Frankel \(1983\)](#), [Branson and Henderson \(1985\)](#), and [Lewis \(1995\)](#).

at the highest sampling frequencies, the use of lower-frequency data reduces the signal-to-noise, making it more difficult to detect systematic links between capital flows and exchange rates.³ Second, the early portfolio balance models focused mainly on riskless assets, such as bonds. This choice reflected, at least in part, the fact that solution methods for general equilibrium models in which asset prices can fluctuate unpredictably had not yet been developed. However, this also eliminated potentially important asset classes from the empirical analysis. Third, the analysis was mainly concerned with the effects of changes in the *supply* of financial assets. Little was done to explicitly model the demand side of asset markets. Moreover, the asset demand functions used in the early portfolio balance literature were not based explicitly on micro foundations. Finally, portfolio balance models, as well as the earlier “monetary” models of exchange rate determination, performed disappointingly not only “in sample” but even more so out of sample. In fact, their ability to forecast exchange rates was no better—and often worse—than that of the random walk model; see [Meese and Rogoff \(1983\)](#) and [Cheung, Chinn, and Garcia Pascual \(2005\)](#).

However, many of the shortcomings of earlier portfolio balance models—such as their use of low-frequency data, the inability to model risk assets, and a lack of proper micro foundations—have been addressed in the more recent empirical and theoretical literature on portfolio balance effects. Our work builds explicitly on these recent advances. The remainder of this paper is structured as follows. The following section presents the main empirical hypotheses derived from the newer portfolio rebalancing literature. [Section III](#) provides an overview of the foreign exchange and equity markets in Thailand and describes the datasets. [Section IV](#) presents the empirical findings related to our hypotheses. [Section V](#) concludes.

II. PORTFOLIO REBALANCING

To examine the relationships between exchange rate fluctuations and returns on risky financial assets, researchers have recently developed general equilibrium models with multiple assets with uncertain returns. Here we rely on a stylized two-country framework which allows the authors to analyze the joint equilibrium dynamics of equity returns, exchange rate returns, and investors’ portfolio choices developed in [Hau and Rey \(2004, 2006\)](#). The model abstracts from private information effects as well as market microstructure issues to develop the consequences of a “pure” portfolio balance story. In this model, it is assumed—consistent

³The importance of using high frequency data for undertaking empirical studies of the linkages across asset markets is well known. [Dunne, Hau, and Moore \(2010\)](#) and [Ferreira Filipe \(2012\)](#) employ *daily frequency* data to study the linkages between investors’ activity in stock and FX markets.

with the suggestive empirical evidence—that investors do not fully hedge the actual FX price risk contained in their portfolios. This captures the stylized fact that the markets for hedging of foreign exchange risk are incomplete, whereas cross-border equity markets transactions are relatively frictionless. Second, it is assumed that the supply of foreign currency provided by local financial institutions (including the central bank) is less than perfectly elastic. This assumption, which matches the situation in Thailand, rules out the case of a fully-pegged exchange rate system, in which the monetary authority intervenes to offset the effects of any capital in- or outflows on the exchange rate and, in the process, makes the *supply* of foreign currency fully elastic.

We examine the following empirical implications of the stylized framework presented in [Hau and Rey \(2004, 2006\)](#), expressed in terms relevant for nonresident investors in Thailand:

Hypothesis 1. *Net inflows into the Thai stock market by foreign investors should be positively correlated with appreciations of the Thai baht.*

Hypothesis 2. *Higher dollar-denominated SET returns relative to US equity market returns should be associated with net sales of Thai equities by foreign investors.*

This hypothesis was also considered by [Brennan and Cao \(1997\)](#). In their setting, it is obtained as an implication of assumed wealth effects that should influence investors' preferred international portfolio compositions.

Hypothesis 3. *Higher dollar-denominated SET returns relative to US equity market returns should be associated with a depreciation of the Thai baht.*

The third hypothesis runs counter to the conventional intuition that strong home equity market returns should, *ceteris paribus*, be associated with an appreciation of the home currency.

Consistent with both the framework and the empirical findings presented for several other countries in [Hau and Rey \(2004, 2006\)](#), we find the following empirical regularities for Thailand regarding the links between capital flows and exchange rate fluctuations. First, higher returns in the Thai equity market relative to a reference stock market are associated with outflows from Thai equities and a depreciation of the Thai baht. Second, net purchases of Thai equities by nonresident investors lead to an appreciation of the Thai baht. On average, a US\$ 100 million inflow results in a 0.15 percent appreciation of the baht versus the US dollar. Third, foreign investors do not hedge the foreign exchange risk related to their equity market positions, or do so imperfectly. As a result, they bear both equity and currency risk when they

hold Thai stocks. Finally, in contrast to earlier studies which document the presence of momentum trading generated by FX fluctuations, we show that exchange rate movements were not key drivers of nonresident equity investments in Thailand during our sample period.

III. THE MARKETS AND THE DATA

In this section, we provide a brief overview of the onshore FX, stock, and government bond markets in Thailand, while focusing mainly of aspects of the markets and the data that are important for the empirical reported in [Section IV](#). We also note certain regulatory features that induce a relationship between foreign investors' capital market transactions and their FX market transactions that is likely closer in Thailand than in many other economies.

A. Sample Period and Definition of Nonresident Investors

All observations are daily. The sample period however ranges from the beginning of January 2005 through Friday, 15 December 2006. This sample period reflects a severe structural break in the data following the imposition of new capital control measures in mid-December 2006. On Tuesday, 19 December 2006, the Thai authorities imposed additional, stringent capital control measures highlighted by a 30% unremunerated reserve requirement (URR) on nonresident investors' financial holdings apart from stock market holdings. The introduction of these measures caused an abrupt and severe structural break in the behavior of the onshore financial markets in Thailand, and foreign investors' participation in these markets dropped off severely.⁴

Throughout this paper, we focus financial market transactions of *nonresident* investors. Nonresident investors comprise (i) corporations, institutions, funds, financial institutions or juristic persons located outside Thailand; (ii) entities of foreign governments located outside Thailand; (iii) branches and agents of domestic juristic persons located outside Thailand; and (iv) natural persons not of Thai nationalities who do not have alien identity or residence permits. Information from the Bank of Thailand suggest that financial institutions are the dominant group—with a share well in excess of 90% of total transactions among nonresident end-users.

⁴The URR controls were lifted in early March 2008, restoring capital market controls in Thailand roughly to their pre-URR status. See [Abhakorn and Tantisantiwong \(2011\)](#) for a detailed examination of the impact of the URR measures.

In our sample period nonresident market participants accounted for around 20 percent of FX market activity. With the imposition of anti-speculation measures on 19 December 2006, the share of onshore turnover accounted for by nonresident customers declined notably.⁵

Nonresident investors that hold bank balances in Thailand are required to do so by holding so-called nonresident baht accounts (NRBAs). Foreign currencies converted into baht are normally (though not necessarily) deposited in NRBAs before being invested in equities and bond securities, and correspondingly the proceeds of sales of equities and bonds by nonresidents are deposited first in NRBAs before being converted into foreign currencies. During our two-year sample period, regulation meant that balances on NRBAs could not exceed THB 300 million per nonresident at the end of each day. In April 2008, almost two thirds of total NRBA balances were held in current accounts, 26% in savings accounts, and 8% in time deposit accounts. NRBA current accounts are used to settle most capital and FX market transactions of nonresident customers.

If nonresident investors in Thailand wish to build up their positions in long-term baht denominated financial assets such as bonds or shares, they can do so in the short run only in the following three ways: (i) by drawing down their existing baht-denominated bank balances held in NRBAs; (ii) via trading shorter-term fixed income assets (including money market claims) with domestic market participants, or (iii) by engaging in baht-denominated FX transactions.

Because of the limits on allowable balances in NRBAs and because of a general lack of liquidity in the private money markets in Thailand, the most nonresident investors normally acquire the funds involved in the purchase of baht-denominated shares and bonds by transacting in the FX market. This institutional feature is one of the keys to our ability to link foreign customers's transactions across FX and stock markets in Thailand and to trace the effects of portfolio balancing decisions in the equity markets on the exchange rate.

B. The Onshore FX Market

The wholesale onshore FX market in Thailand is an over-the-counter market, where trading services are provided by licensed currency dealers, which can be domestic or foreign-owned banks and brokers. At the beginning of 2005, there were 39 licensed FX dealers; 21 were domestic financial institutions, and 18 were subsidiaries of foreign financial institutions. After a couple of mergers in late 2005, the number of FX dealers in Thailand was 37 during all

⁵Before the introduction of restrictions on foreign exchange activity in September 2003 nonresident end-users accounted for almost 50 percent of activity in the onshore FX market.

of 2006 (20 domestic and 17 foreign). To our knowledge there was no trading in baht outside Bangkok business hours during the sample period.

The onshore FX market in Thailand is closely monitored by the BOT. Onshore commercial banks are required by the BOT to limit their net FX positions in any one currency to no more than 15% of capital (individual currency limit) and to maintain a net overall FX position across all foreign currencies of no more than 20% of capital (aggregate currency limit) at the end of each day. Dealers usually manage to adhere to these limits by conducting transactions in the FX swaps markets. The position limits tend to be particularly important for the branches of foreign banks that operate in Thailand. The BOT discourages nondeliverable forward (NDF) trading activity involving Thai baht and has asked onshore financial institutions not to participate in the offshore NDF market. All licensed FX dealers submit detailed daily reports of their FX transactions to the Bank of Thailand (BoT). For each transaction banks report the counterparty, its type (other dealer, domestic customer, nonresident customer, and BOT), the volume (in dollar equivalent), the currencies involved (by far the majority of all transactions are in Thai baht vs. U.S. dollars), the applicable exchange rate, and the type of transaction. The five types of transactions are spot (separated further into same-day, “tomorrow” or next-day, and “next” or $T + 2$ transactions), outright forwards ($T \geq 3$, with settlement date), and FX swaps.

We calculate daily-frequency *gross* buy and sell capital flow series involving dealers and non-residents for all 5 types of FX contracts by aggregating the data across reporters, and we take the difference between aggregate buys and sells to obtain the net buy or order flow series. Based on conversations we had with FX market participants, “tomorrow” ($T + 1$) and “next” ($T + 2$) spot transactions, as well as forward transactions between dealers and their foreign customers, are initiated mostly by the customers. Hence, our net capital flow series should match the theoretical concept of order flow very well for these types of transactions. In contrast, FX swaps are initiated by either the reporting banks or end-users, suggesting that in the case of FX swaps our net capital flow measure may not be a good proxy for order flow.

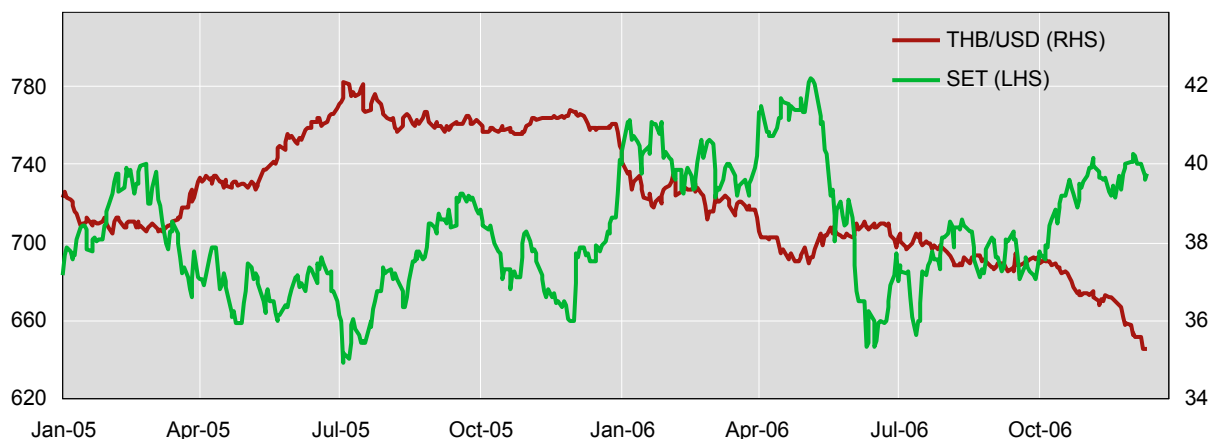
In 2005 and 2006, all three spot FX daily net flow series were positive on average, as non-resident customers were net buyers of baht in both years. Conversely, in 2005 and 2006 non-resident customers were net sellers of baht through outright forwards and through FX swap contracts. The daily overall transaction volume between dealers and nonresident end-users averaged US\$ 780 million in 2005 and US\$ 1,155 million in 2006. [Table 1](#) provides summary statistics on volume and order flow in the onshore FX market. In both 2005 and 2006, spot-

Table 1. Transactions of nonresident customers in the onshore FX market of Thailand

Daily volume and order flow, in millions of US dollars.

	Mean	Standard Deviation	Minimum	Maximum
Volume (Buy+Sell)				
2005: 4 Jan–30 Dec				
Foreign exchange market, overall	780.1	236.2	181.2	1714.9
Spot, today	34.4	19.8	14.7	299.8
Spot, tomorrow	82.4	62.3	1.3	439.9
Spot, next ($T + 2$)	354.1	132.6	23.2	869.1
Forwards	38.1	49.9	0.0	309.0
FX Swaps	271.1	110.7	0.7	686.4
2006: 3 Jan–15 Dec				
Foreign exchange market, overall	1155.4	433.5	342.1	4015.6
Spot, today	45.8	64.3	22.0	980.5
Spot, tomorrow	152.3	101.8	5.4	622.9
Spot, next ($T + 2$)	525.4	226.4	70.2	1634.7
Forwards	47.4	83.9	0.0	744.9
FX Swaps	384.2	179.1	36.2	858.8
Order flow (Buy–Sell)				
2005: 4 Jan–30 Dec				
Foreign exchange market, overall	–56.2	200.1	–888.6	576.3
Spot, today	18.9	19.3	–8.1	289.2
Spot, tomorrow	20.0	50.9	–193.7	219.6
Spot, next ($T + 2$)	24.4	116.7	–486.7	349.6
Forwards	–21.1	48.6	–250.5	114.6
FX Swaps	–98.3	113.3	–483.5	271.8
2006: 3 Jan–15 Dec				
Foreign exchange market, overall	–78.8	264.6	–1712.9	671.1
Spot, today	20.4	20.3	–192.3	56.4
Spot, tomorrow	22.9	98.0	–257.8	342.0
Spot, next ($T + 2$)	19.6	181.4	–766.2	659.5
Forwards	–17.5	78.6	–591.8	447.6
FX Swaps	–124.3	138.7	–564.5	363.8

next transactions (which settle on a $T + 2$ basis) made up roughly 45 percent of the nonresident end-user total, FX swaps accounted for an additional 33 to 35 percent, spot-tomorrow ($T + 1$) transactions contributed 11 to 13 percent to the total, and spot-today (same day settlement) and outright forwards each accounted for less than 5 percent of the total. Average

Figure 1. Thai baht/U.S. dollar exchange rate and SET index in 2005 and 2006

Sources: Bloomberg, BIS.

daily volume in 2006 was higher than in 2005 in part because of two periods of market turmoil, the first occurring in May and June 2006, during a period of heightened global equity market volatility, the second in September 2006, during a brief period of political turmoil in Thailand. The single most active day in our sample, in terms of overall nonresident customer FX market transaction volume, occurred on 21 Sept. 2006, after then-Prime Minister Thaksin was unseated in a coup. Gross and net capital flows were both exceptionally large that day. Nonresident customers were net sellers of baht of US\$ 1.713 billion. Nonresident customers' net capital flows in spot, forward, and FX swaps contracts were all negative that day.

The bilateral THB/USD spot exchange rate used in this study is collected by the BIS as of 7:15 pm Bangkok time. This choice of collection time—shortly after equity, bond and onshore FX trading has ended in Bangkok—should allow the daily FX returns to reflect all relevant intraday information without being affected by global market developments that occur after the close of business in the onshore markets. The baht depreciated against the dollar in the first half of 2005, reaching a low of about 42 THB/USD in July 2005; see [Figure 1](#).

Over the subsequent six quarter the baht appreciated sharply against the dollar, reaching the 35 THB/USD mark by mid-December 2006. Over the sample period as a whole, the average daily return on THB/USD was very close to zero, and the standard deviation of daily returns was 0.33%. The minimum and maximum values of daily returns in the sample were -1.54% and $+1.26\%$, respectively.

The dollar's major currencies index, which measures its trade-weighted exchange value against some of the major foreign currencies, was obtained from the Federal Reserve Board. This index is calculated daily by the Federal Reserve and measures the dollar's trade-weighted exchange value—listed by descending magnitude of the weights—against the euro, the Canadian dollar, the yen, pound sterling, the Swiss franc, the Australian dollar, and the Swedish krona.

C. The Equity Market

The main share price indicator in Thailand is the SET index, which is a composite index calculated based on stock prices of companies listed on the main board of the Stock Exchange of Thailand (SET). It is a market capitalization-weighted price index which compares the current market value of all listed common stock against the base date value. Our stock market dataset contains the daily closing values of the SET index and the daily gross buy and sell transaction volumes, as well as the net buy volumes, by nonresident investors. As with the FX dataset, we terminate the sample on Friday, 15 December 2006, because the government's URR measures were announced and went into effect the following week. Settlement for equities is performed on a $T + 3$ basis. Investors can trade securities on the SET through any of 39 brokerage houses, many of which are foreign-owned. As [Figure 1](#) shows, stock prices in Thailand experienced bouts of elevated volatility in 2006 during the same two periods as the onshore FX market did.

Average daily gross transaction volume (buys+sells) on the SET by nonresident investors in 2005 and 2006 was the equivalent of US\$ 229 million and US\$ 286 million, respectively, or less than a third of average daily gross capital flows between FX dealers and nonresident customers. The mean daily return of the SET was 0.01% in 2005 and 0.07% in 2006. The standard deviation of daily returns was about 0.65% in both 2005 and 2006. The single largest negative and positive daily moves during the sample period were -1.9% and $+2.1\%$, respectively. [Table 2](#) provides summary statistics for nonresident investors' transaction volumes and net capital flows.

Table 2. Transactions by nonresident customers on the Stock Exchange of Thailand

Daily volume and order flow, in millions of US dollars.

	Mean	Standard Deviation	Minimum	Maximum
Volume (Buy+Sell)				
2005: 4 Jan–30 Dec	228.7	82.8	36.5	588.8
2006: 3 Jan–15 Dec	285.5	140.3	87.7	1121.6
Order flow (Buy–Sell)				
2005: 4 Jan–30 Dec	12.1	39.4	–109.9	169.1
2006: 3 Jan–15 Dec	12.7	60.1	–147.5	388.8

Sources: Bank of Thailand, CEIC, authors' calculations.

IV. EMPIRICAL FINDINGS

We now turn to examining the empirical evidence for the hypotheses. All variables used in the regression models are listed in [Table 3](#). All regression equations were estimated by OLS with Newey–West correction of standard errors and covariances. Standard tests for misspecification of the regression relationships were performed for all models and were not statisti-

Table 3. List of variables used in the regression models

Variable	Description	Units
THB	THB/USD spot exchange rate	Log first diff.
SET	SET index, expressed in US dollars	Log first diff.
SPX	S&P 500 index	Log first diff.
SET_SPX	Excess return of SET index, expressed in US dollars, over 1-day-lagged S&P 500 index	Log first diff.
OF_SET	Net purchases of shares on SET by nonresidents (NRs), i.e., gross share purchases – gross share sales by NRs	USD million
OF_FX_NOSWAP	Net baht purchases by NRs except via FX swaps	USD million
OF_FX_SWAP	Net baht purchases by NRs via FX swaps	USD million
USD_MCI	Major currencies index of US dollar	Log first diff.
VIX	VIX index	First diff.
THB_IRS_1Y	1-year Thai baht interest rate swap rate	First diff., pct. points
D_IRS_1Y	Differential between 1-year Thai baht and 1-year US dollar interest rate swaps	First diff., pct. points

Table 4. Dependence of FX swap order flow on stock market returns and order flow

Dependent variable: OF_SWAP. Estimation method: OLS.

Regressor	Coefficient	Std. error	t-stat.	Prob.
C	-119.850	10.575	-11.333	0.000
SET	87.471	632.960	0.138	0.890
SET(-1)	477.911	826.056	0.579	0.563
SET(-2)	393.414	693.947	0.567	0.571
SET(-3)	705.264	559.723	1.260	0.209
OF_SET	0.279	0.292	0.954	0.341
OF_SET(-1)	0.233	0.225	1.036	0.301
OF_SET(-2)	0.096	0.286	0.334	0.739
OF_SET(-3)	0.136	0.192	0.710	0.478
	R ²	0.075	F-stat	3.668
	Adj. R ²	0.054	Prob. (F-stat)	0.000

Sources: Bank of Thailand; CEIC; BIS; authors' calculations.

cally significant. We also tested whether additional lags of the regressors should be included. The corresponding F -statistics did not indicate the presence of higher-term lagged relationships between the regressors and the dependent variable.

A. Imperfect Hedging

One of the key assumptions of the [Hau and Rey \(2006\)](#) framework is that foreign exchange risk is imperfectly hedged. For Thailand, we find that this assumption is highly plausible when it comes to foreign investors' equity market positions. [Table 4](#) reports the results of a regression of nonresident investors' FX swap transactions—the standard instrument used to hedge FX price risk—on current and lagged values of stock market flows and returns. The results clearly indicate that FX swap market activity is not driven by either equity market transactions or equity market returns: None of the individual slope coefficients in this regression are statistically significant, and the adjusted R^2 of the regression is 0.05. This is consistent with imperfect or perhaps even no hedging of foreign exchange risk embedded in equity market positions.

Table 5. Dependence of FX returns on own-market order flow, stock market order flow, and proxies for macroeconomic conditions

Dependent variable: THB. Estimation method: OLS.

Regressor	Coefficient	Std. error	t-stat.	Prob.
C	0.000	0.000	1.581	0.115
THB(-1)	-0.067	0.072	-0.930	0.353
THB(-2)	-0.055	0.056	-0.988	0.324
OF_FX_NOSWAP	-485.22×10^{-6}	38.94×10^{-6}	-12.462	0.000
OF_FX_NOSWAP(-1)	90.73×10^{-6}	48.69×10^{-6}	1.864	0.063
OF_FX_SWAP	-1.17×10^{-6}	1.25×10^{-6}	-0.940	0.349
OF_FX_SWAP(-1)	3.03×10^{-6}	1.49×10^{-6}	2.029	0.043
OF_SET	-9.02×10^{-6}	4.37×10^{-6}	-2.063	0.040
OF_SET(-1)	-2.38×10^{-6}	4.76×10^{-6}	-0.499	0.618
VIX(-1)	330.52×10^{-6}	0.000	1.298	0.195
VIX(-2)	136.90×10^{-6}	0.000	0.731	0.465
USD_MCI(-1)	0.087	0.035	2.484	0.014
USD_MCI(-2)	-0.003	0.042	-0.081	0.936
SET_SPX(-1)	0.029	0.022	1.310	0.191
SET_SPX(-2)	0.008	0.016	0.499	0.618
THB_IRS_1Y(-1)	0.009	0.005	1.657	0.099
THB_IRS_1Y(-2)	0.014	0.005	2.755	0.006
D_IRS_1Y(-1)	-0.008	0.005	-1.727	0.085
D_IRS_1Y(-2)	-0.014	0.005	-3.187	0.002
	R ²	0.495	F-stat	16.739
	Adj. R ²	0.466	Prob. (F-stat)	0.000

Sources: Bank of Thailand; CEIC; BIS; authors' calculations.

B. Portfolio Rebalancing and the Exchange Rate

Net inflows into the Thai stock market by foreign investors should be positively correlated with appreciations of the baht according to [Hypothesis 1](#). In our regressions an *appreciation* effect for the baht requires a *negative* value for the coefficient(s).

The regression results in [Table 5](#) show that daily-frequency baht returns do indeed depend significantly and with the “correct,” i.e., negative sign on net purchases of shares by nonresident investors OF_SET. The total effect of this variable on FX returns is computed as the sum of the coefficients for the same-day and one-day lagged regressors. On average, a US\$ 100

Table 6. Dependence of investors' order flow in the stock market on FX returns, SET returns, and relative performance of the SET index versus the S&P500 index

Dependent variable: OF_SET. Estimation method: OLS.

Regressor	Coefficient	Std. error	t-stat.	Prob.
C	7.161	2.743	2.611	0.010
THB(-1)	367.286	844.844	0.435	0.664
THB(-2)	535.898	866.263	0.619	0.537
THB(-3)	302.797	626.522	0.483	0.629
THB(-4)	-79.554	678.096	-0.117	0.907
SET(-1)	3408.581	485.428	7.022	0.000
SET(-2)	1343.184	403.642	3.328	0.001
SET(-3)	245.841	450.560	0.546	0.586
SET(-4)	877.060	335.860	2.611	0.010
SET_SPX(-1)	-1574.131	333.231	-4.724	0.000
SET_SPX(-2)	-245.799	313.795	-0.783	0.434
SET_SPX(-3)	295.213	407.140	0.725	0.469
SET_SPX(-4)	-251.593	301.247	-0.835	0.404
	R ²	0.359	F-stat	13.083
	Adj. R ²	0.332	Prob.(F-stat)	0.000

Sources: Bank of Thailand, CEIC, BIS, authors' calculations.

million inflow results in a 0.15 percent appreciation of the baht versus the US dollar. [Hypothesis 1](#) is thus supported by the data contained in our sample period.

The regression results in [Table 6](#) show similar to what is found in many other markets, there is also “return chasing” (i.e., there is positive dependence of investors' net share purchases on lagged returns) in the Thai equity market. The coefficients on the lagged SET variables are all but one statistically significant. Our results also show that baht returns depend significantly—and with the “correct,” i.e., negative sign—on nonresident investors' net purchases of baht via spot-tomorrow, spot-next, and outright forward FX contracts.

[Hypothesis 2](#) states that higher returns on the SET index than on the S&P500 index should predict a decrease in foreigners' net purchases of Thai equities. The empirical results we report in [Table 6](#) are consistent with this prediction: the coefficient of the first lag of SET_SPX, the variable that captures relative SET/S&P500 returns, is negative and statistically significant. Thus, foreign investors' net flows in the Thai equity market are explained *both* by return chasing and by portfolio rebalancing.

According to [Hypothesis 3](#) the baht should depreciate if the SET outperforms other stock markets, and vice versa. This follows since when nonresident investors in Thailand are net sellers of shares on the SET, they are generally also net sellers of baht in the FX market in order to comply with regulations on permissible balances held in NRBA bank accounts. Our regression analysis shows that this relationship holds statistically. In [Table 5](#), the coefficient of the first lag of SET_SPX, the variable that measures the outperformance of the SET relative to the S&P500, implies a depreciation of the baht (as its sign is positive) and statistically significant. This particular portfolio balance effect is, however, not large numerically: A 1% higher return of the SET relative to the S&P500 is, on average, associated with a subsequent 0.03% depreciation of the baht.

Finally, we also find that during our sample period exchange rate fluctuations did not drive foreign investors' equity investment flows in Thailand. This is reflected in the uniformly insignificant coefficients on the lagged values of the variable THB in [Table 6](#).

V. CONCLUDING REMARKS

We provide clear empirical evidence for Thailand on the importance for the exchange rate of portfolio rebalancing by foreign investors. We find: (i) that net inflows are positively correlated with an appreciation of the exchange rate; (ii) periods of higher returns in the Thai equity market relative to the US equity market are followed by net sales of Thai equities for foreign investors as they rebalance their portfolios and (iii) such a rebalancing of portfolio holdings by foreign investors is associated with a depreciation of the exchange rate. The numerical magnitude of this effect is, however, quite small.

We also find, perhaps surprisingly, that foreign investors do not hedge the foreign exchange risk related to their equity market positions, perhaps because they can only do so imperfectly. As a result, they bear both equity and currency risk when they hold Thai stocks. Finally, we find that exchange rate movements were not key drivers of nonresident equity investments in Thailand during our sample period.

REFERENCES

- Abhakorn, Pongrapeeporn, and Nongnuch Tantisantiwong, 2011, "A Reexamination of Capital Controls' Effectiveness: Recent Experience of Thailand," *Journal of Asian Economics*, Vol. 23, No. 1, pp. 26–38.
- Branson, William H., 1977, "Asset Markets and Relative Prices in Exchange Rate Determination," *Sozialwissenschaftliche Annalen*, Vol. 1, No. 1, pp. 69–89.
- Branson, William H., and Dale W. Henderson, 1985, "The Specification and Influence of Asset Markets," in Ronald W. Jones and Peter B. Kenen (eds.), *Handbook of International Economics, Volume 2: International Monetary Economics and Finance*, chap. 15, pp. 749–805 (Amsterdam: Elsevier).
- Brennan, Michael J., and H. Henry Cao, 1997, "International Portfolio Investment Flows," *Journal of Finance*, Vol. 52, No. 5, pp. 1851–1880.
- Chai-Anant, Chayawadee, and Corrinne Ho, 2008, "Understanding Asian Equity Flows, Market Returns, and Exchange Rates," Working Paper 245, Bank for International Settlements, Basel.
- Cheung, Yin-Wong, Menzie David Chinn, and Antonio I. Garcia Pascual, 2005, "Empirical Exchange Rate Models of the Nineties: Are any Fit to Survive?" *Journal of International Money and Finance*, Vol. 24, No. 7, pp. 1150–1175.
- Dunne, Peter G., Harald Hau, and Michael J. Moore, 2010, "International Order Flows: Explaining Equity and Exchange Rate Returns," *Journal of International Money and Finance*, Vol. 29, No. 2, pp. 358–386.
- Ferreira Filipe, Sara, 2012, "Equity Order Flow and Exchange Rate Dynamics," *Journal of Empirical Finance*, Vol. 19, No. 3, pp. 359–381.
- Frankel, Jeffrey A., 1983, "Monetary and Portfolio-Balance Models of Exchange Rate Determination," in Jagdeep S. Bhandari, Bluford H. Putnam, and Jay H. Levin (eds.), *Economic Interdependence and Flexible Exchange Rates*, chap. 3, pp. 84–115 (Cambridge: MIT Press).
- Hau, Harald, and H el ene Rey, 2004, "Can Portfolio Rebalancing Explain the Dynamics of Equity Returns, Equity Flows, and Exchange Rates?" *American Economic Review*, Vol. 94, No. 2, pp. 126–133.
- , 2006, "Exchange Rates, Equity Prices, and Capital Flows," *Review of Financial Studies*, Vol. 19, No. 1, pp. 273–317.
- Kouri, Pentti J. K., 1976, "The Exchange Rate and the Balance of Payments in the Short Run and in the Long Run: A Monetary Approach," *Scandinavian Journal of Economics*, Vol. 78, No. 2, pp. 280–304.
- Lewis, Karen K., 1995, "Puzzles in International Financial Markets," in Gene M. Grossman and Kenneth S. Rogoff (eds.), *Handbook of International Economics, Volume 3*, chap. 37, pp. 1913–1971 (Amsterdam: Elsevier).

Meese, Richard A., and Kenneth S. Rogoff, 1983, "Empirical Exchange Rate Models of the Seventies: Do They Fit out of Sample?" *Journal of International Economics*, Vol. 14, No. 1–2, pp. 3–24.

Phongpaichit, Pasuk, and Chris Baker (eds.), 2008, *Thai Capital after the 1997 Crisis* (Chiang Mai: Silkworm Books).