A SIMULTANEOUS-EQUATION MODEL OF THE DETERMINANTS OF THE THAI BAHT/U.S. DOLLAR EXCHANGE RATE

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ABSTRACT

This paper examines short-run determinants of the Thai baht/U.S. dollar (THB/USD) exchange rate based on a simultaneous-equation model. Using a reduced form equation and applying the EGARCH method, the paper finds that the THB/USD exchange rate is positively associated with the real 10-year U.S. government bond yield, real U.S. exports to Thailand, the real U.S. stock price and the expected exchange rate and negatively influenced by the real Thai government bond yield, real U.S. imports from Thailand, and the real Thai stock price. **JEL Classification**: F31

INTRODUCTION

The choice of exchange rate regimes, overvaluation of a currency, and global financial crises may affect the behavior of an exchange rate. Before the Asian financial crisis, the Thai baht was pegged to a basket of major currencies and was substantially over-valued. Due to speculative attacks and running out of foreign reserves, the Thai government gave up pegging of major currencies and announced the adoption of a floating exchange rate regime on July 2, 1997. As a result, the Thai baht had depreciated as much as 108.74% against the U.S. dollar. In the recent global financial crisis, the Thai baht had lost as much as 13.76% of its value versus the U.S. dollar. While a depreciating currency is expected to lead to more exports, it would cause less imports, higher domestic inflation, decreasing international capital inflows, rising costs of foreign debt measured in the domestic currency, and other related negative impacts.

This paper attempts to examine the determinants of the Thai Baht/U.S. dollar (THB/USD) exchange rate based on a simultaneous-equation model of demand and supply. Monetary models of exchange rates are based on the validity of purchasing power parity in the long run and may not hold in the short run. The choice of the Thai baht/U.S. dollar exchange rate as a case study is mainly because the Asian financial crisis originated from substantial depreciation of the Thai baht. A study of the short-run determinants of the Thai baht/U.S. dollar exchange rate would provide policymakers with more insights into the behavior of the exchange rate. The paper is organized in the

following manner. Literature is reviewed in the second section. The theoretical model is described in the third section. Data sources and empirical results are presented in the fourth section. A summary and conclusion is made in the last section.

LITERATURE SURVEY

There have been many studies examining the determinants of exchange rates for Thailand or related countries. Choudhry (2005) indicates that generalized purchasing power parity for five Far East Asian countries including Thailand is not confirmed during the pre-crisis period and is confirmed during and after the crisis period. Baharumshah, Aggarwal and Haw (2007) examine PPP for six Asian countries including Thailand and find support for PPP for all these countries. Ho, Cheng and Hou (2009) reveal that PPP holds for 40 countries including Thailand and that a lower inflation rate and more volatility of the nominal exchange rate increase the validity of PPP. Cavoli and Rajan (2010) find that different exchange rate regimes in 12 Asian countries including Thailand affect exchange rate movements. Exchange rates in countries with inflation targeting or managed float are less affected by the U.S. dollar than countries without inflation targeting or conventional pegging.

Empirical results of the impact of a higher interest rate on the exchange rate for Thailand and related countries are inconclusive. Furman, Stiglitz, Bosworth and Radelet (1998) show that a higher interest rate leads to currency depreciation whereas Basurto and Ghosh (2001) find that a higher interest rate leads to a currency appreciation. Dekle, Hsiao and Wang (2002) reveal that a higher interest rate stabilizes depreciating currencies. Gould and Kamin (2000) Huang, Hueng and Yau (2010) indicate that no significant evidence in favor of the traditional view that a higher interest rate leads to currency appreciation.

Granger, Huang and Yang (2000) examine the relationship between exchange rates and stock prices for 9 East Asian countries including Thailand and find that there is support for a bilateral relationship for Thailand, Hong Kong, Malaysia, Singapore and Taiwan whereas there is lack of evidence of a causal relationship for Indonesia and Japan. Lin (2012) finds that comovements between stock prices and exchange rates in Asian emerging markets are stronger during the crisis period, mostly running from stock price changes to exchange rate changes and are not strong for export-oriented sectors. These findings suggest that comovements are attributable to capital account balance instead of trade. According to Tsai (2012), stock prices and exchange rates in 6 Asian countries including Thailand have a positive relationship (the international trading effect) during normal times and a negative relationship (the portfolio balance effect) during stock market bubbles or financial crises.

THE MODEL

We can express the demand for and supply of the U.S. dollar versus the Thai baht in the foreign exchange market as:

$$D^d = F(\varepsilon, E^{US}, R^{US}, S^{US}, \varepsilon^e) \quad (1)$$
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$$D^s = H(\varepsilon, I^{TH}, R^{TH}, S^{TH}) \quad (2)$$
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where

D^d = demand for the U.S. dollar,
D^s = supply of the U.S. dollar,
ε = the THB/USD (Thai baht/U.S. dollar) exchange rate,
E^{US} = real U.S. exports to Thailand,
R^{US} = the real interest rate in the U.S.,
S^{US} = the real stock price in the U.S.,
ε^e = the expected THB/USD exchange rate,
I^{TH} = real U.S. imports from Thailand,
R^{TH} = the real interest rate in Thailand, and
S^{TH} = the real stock price in Thailand.

We expect that the demand for the U.S. dollar has a negative relationship with the THB/USD exchange rate and a positive relationship with real exports from the U.S. to Thailand, the real interest rate in the U.S., the real stock price in the U.S., and the expected THB/USD exchange rate. The supply of the U.S. dollar is expected to be positively associated with the THB/USD exchange rate, real U.S. imports from Thailand, the real interest rate in Thailand, and the real stock price in Thailand. More U.S. exports to Thailand increase the demand for the U.S. dollar. A higher real interest rate or stock price in the U.S. tends to attract Thai people to invest in U.S. financial assets and to increase the demand for the U.S. dollar. More U.S. imports from Thailand increase the supply of the U.S. dollar. A higher real interest rate or stock price in Thailand tends to attract American investors to buy Thai financial assets and increase the supply of the U.S. dollar in exchange for the Thai baht.

Solving for the equilibrium values of the two endogenous variables simultaneously, we can express the equilibrium exchange rate as a function of all the exogenous variables:

$$\bar{\varepsilon} = X(R^{US}, R^{TH}, E^{US}, I^{TH}, S^{US}, S^{TH}, \varepsilon^e) \quad (3)$$

According to comparative static analysis, a change in any one of the exogenous variables is expected to have an impact on the equilibrium THB/USD exchange rate:

$$\partial\bar{\varepsilon}/\partial R^{US} = -F_{R^{US}}/|J| > or < 0 \quad (4)$$

$$\partial\bar{\varepsilon}/\partial R^{TH} = -H_{R^{TH}}/|J| < or < \quad (5)$$

$$\partial\bar{\varepsilon}/\partial E^{US} = -H_{E^{US}}/|J| > 0 \quad (6)$$

$$\partial\bar{\varepsilon}/\partial I^{TH} = -F_{I^{TH}}/|J| < 0 \quad (7)$$

$$\partial \bar{\varepsilon} / \partial S^{US} = -F_{S^{US}} / |J| > 0 \quad (8)$$

$$\partial \bar{\varepsilon} / \partial S^{TH} = -H_{S^{TH}} / |J| < 0 \quad (9)$$

$$\partial \bar{\varepsilon} / \partial \varepsilon^{e} = -F_{\varepsilon^{e}} / |J| > 0 \quad (10)$$

where $|J| = (F_{\varepsilon} - H_{\varepsilon}) < 0$ is the Jacobian for the endogenous variables. The sign in equation (4) or (5) is unclear. The traditional view suggests that an increase in the interest rate would cause a currency to appreciate due to capital inflows for higher returns on domestic assets whereas the revisionist view argues that a higher interest rate would cause a currency to depreciate due to a higher default probability, a weaker financial position and a higher exchange rate risk premium (Dekle, Hsiao, and Wang, 2002; Huang, Hueng and Yau, 2010).

EMPIRICAL RESULTS

Bilateral trade data for U.S. exports to Thailand and U.S. imports from Thailand came from U.S. Department of Commerce. Other data were collected from IMF's *International Financial Statistics*. The THB/USD exchange rate measures units of the Thai baht per U.S. dollar. Hence, an increase means a depreciation of the Thai baht and an appreciation of the U.S. dollar. The real interest rate in the U.S. is represented by the 10-year U.S. government bond yield minus the inflation rate in the U.S. The real interest rate in Thailand is represented by the Thai government bond yield minus the inflation rate in Thailand. U.S. exports to Thailand and U.S. imports from Thailand are measured in billions of U.S. dollars and divided by the U.S. export and import price indexes to derive real values. The expected exchange rate is represented by the average THB/USD exchange rate of past four quarters. The stock price in the U.S. or Thailand is represented by the share price index with 2005 as the base year and divided by the CPI to derive the real value. The sample consists of quarterly data ranging from 1997.Q3 to 2013.Q3 and has a total of 65 observations. Before the Asian financial crisis, the Thai government pegged the Thai baht to a basket of major currencies, and the THB/USD exchange rate changed little. Due to the Asian financial crisis, the Thai government announced the adoption of a floating exchange rate regime on July 2, 1977. Hence, the sample begins in 1997.Q3 in order to have a consistent exchange rate regime.

The DF-GLS test on the regression residuals is employed to determine whether these time series variables in equation (3) are cointgegrated. The value of the test statistic is estimated to be -4.5287, which is greater than the critical value of -2.6028 in absolute values at the 1% level. Therefore, these variables have a long-term stable relationship.

Table 1 reports the estimated regression and related statistics. The EGARCH method is applied in empirical work in order not to place any restriction on the parameters and to yield a positive conditional variance. As shown, approximately 74.90% of the change in the equilibrium THB/USD exchange rate can be explained

by the seven right-hand side variables. The forecast error of 4.5116% is relatively small. All the coefficients are significant at the 1% level. The equilibrium THB/USD exchange rate is positively associated with the real 10-year U.S. government bond yield, real U.S. exports to Thailand, the real U.S. stock price, and the expected THB/USD exchange rate. It is negatively affected by the real Thai government bond yield, real U.S. imports from Thailand, and the real stock price in Thailand.

Specifically, a 1 percentage-point increase in the real 10-year U.S. government bond yield would raise the THB/USD exchange rate by 0.3197 whereas a 1 percentage-point increase in the real Thai government bond yield would reduce the THB/USD exchange rate by 0.1737. According to the Wald test, the null hypothesis that the coefficients of the real 10-year U.S. government bond yield and the real Thai government bond yield are the same can be rejected at the 1% level. It suggests that in absolute values, the impact of a change in the real 10-year U.S. government bond yield on the exchange rate is greater than the impact of a change in the real Thai government bond yield on the exchange rate.

A $1 billion increase in real U.S. exports to Thailand would raise the THB/USD exchange rate by 4.5593 whereas a $1 billion increase in real U.S. imports from Thailand would reduce the THB/USD exchange rate by 4.5226. According to the Wald test, the null hypothesis that the coefficients for real U.S. exports to Thailand and real U.S. imports from Thailand are the same cannot be rejected at the 1% or 5% level.

A one unit increase in the real U.S. stock price would increase the THB/USD exchange rate by 0.0116 whereas a one unit increase in the real Thai stock price would reduce the THB/USD exchange rate by 0.0539. The null hypothesis that the coefficients of the real U.S. stock price and the real Thai stock price are the same can be rejected at the 1% level. It implies that in absolute values, the effect of a change in the real U.S. stock price on the exchange rate is less than the effect of a change in the real Thai stock price on the exchange rate. If the expected exchange rate rises by 1, the actual exchange rate would increase by 0.5681.

SUMMARY AND CONCLUSION

This paper has examined the determinants of the THB/USD exchange rate in the short run based on a simultaneous-equation model consisting of the demand for and supply of the U.S. dollar versus the Thai baht. A reduced-form equation is estimated by the EGARCH method. The paper finds that a higher real 10-year U.S. government bond yield, more real U.S. exports to Thailand, a higher real stock price in the U.S., and a higher expected exchange rate would raise the THB/USD exchange rate whereas a higher real Thai government bond yield, more real U.S. imports from Thailand, and a higher real stock price in Thailand would reduce the THB/USD exchange rate.

There are several policy implications. It seems that demand and supply analysis appears to apply to the THB/USD exchange rate in the short run because it can explain approximately 74.90% of exchange rate movements and the forecast error of 4.5116% is relatively small. Interest rates, exports, imports, stock prices and the expected exchange rate in the U.S. and Thailand play important roles in exchange rate movements in the short run. Holding other factors constant, the recent rise of the 10-year U.S. government bond yield from a low of 1.53% in July 2012 to 2.56% in May 2014 and the rising trend of U.S. stock market indexes since March 2009 would cause

the THB/USD exchange rate to rise. The recent decline of the Thai stock price partly due to domestic political developments would contribute to the increase in the THB/USD exchange rate. The rising trend of bilateral trade deficits between the U.S. and Thailand is expected to reduce the THB/USD exchange rate. Other policy measures to prevent currency from depreciation are to avoid huge fiscal and current account deficits and to maintain low inflation, low interest rates and large foreign exchange reserves (Witte, 2010). The use of the differential form such as the interest rate differential between two countries may not be appropriate because the null hypothesis that the two coefficients are the same may be rejected.

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TABLE 1. ESTIMATED REGRESSION OF THE THB/USD EXCHANGE RATE

Dependent variable: the THB/USD exchange rate	Coefficient	z-statistic
Constant	24.1688	25.9061
Real 10-year U.S. government bond yield	0.3197	6.1410
Real Thai government bond yield	-0.1737	-6.2296
Real U.S. exports to Thailand	4.5593	5.3003
Real U.S. imports from Thailand	-4.5226	-8.3384
Real U.S. stock price	0.0116	31.3266
Real Thai stock price	-0.0539	-1068.231
Expected THB/USD exchange rate	0.5681	28.6928
R^2	0.7490	
Sample period	1997.Q3-2013.Q3	
Sample size	65	
Mean absolute percent error (MAPE)	4.5116%	

Notes: The THB/USD exchange rate refers to the units of Thai baht per U.S. dollar. All the coefficients are significant at the 1% level.