The Effects of Real Exchange Rate Volatility on Thailand's Exports to the United States and Japan under the Recent Float

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Abstract

This paper investigates whether the real exchange rate uncertainty depresses Thailand's exports to the United States and Japan and thus causes the trade balances to deteriorate under the floating exchange rate regime. Monthly data from July 1997 to December 2007 are utilized. Industrial production indexes are used as proxies of real income of the two major trading partners. The results from bounds testing for cointegration show that the variables in the export demand are cointegrated, and the Marshall-Lerner condition still holds in the case of United States. Real exchange rate volatility generated by the ARCH(1) process as a measure of uncertainty has a negative effect on exports to Japan, but has no effect on exports to the United States. However, total exports can be harmed by real exchange rate uncertainty for exports to Japan.

Keywords: *Real Exchange Rate Uncertainty, Exports, Bounds Testing for Cointegration JEL Classification: F31, C22*

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ผลกระทบของความผันผวนของอัตราแลกเปลี่ยนที่แท้จริง ต่อการส่งออกของไทยไปยังสหรัฐอเมริกาและญี่ปุ่น ภายใต้ระบบอัตราแลกเปลี่ยนลอยตัว

โกเมน จิรัญกุล

บทคัดย่อ

บทความนี้เป็นการศึกษาว่าความไม่แน่นอนในอัตราแลกเปลี่ยนที่แท้จริงมีผลทำให้การส่งออกของไทยไปยังสหรัฐอเมริกาและญี่ปุ่นลดลงหรือไม่ และถ้าเป็นเช่นนั้นจะทำให้ดุลการค้าโดยรวมแย่ลงเมื่อประเทศใช้ระบบอัตราแลกเปลี่ยนลอยตัว ข้อมูลที่ใช้ในการวิเคราะห์เป็นข้อมูลรายเดือนในช่วงเดือนกรกฎาคม 2540 ถึงเดือนธันวาคม 2550 เนื่องจากข้อมูลมีลักษณะความถี่เป็นรายเดือนจึงได้ใช้ดัชนีการผลิตในภาคอุตสาหกรรมของสหรัฐอเมริกาและญี่ปุ่นเป็นตัวแทนรายได้แท้จริงจากต่างประเทศ ผลการทดสอบความสัมพันธ์ระยะยาวในสมการการส่งออกพบว่าตัวแปรในสมการมีความสัมพันธ์ระยะยาว จากสมการส่งออกไปยังประเทศคู่ค้ารายใหญ่ทั้งสองประเทศแสดงว่าเงื่อนไขของมาร์แชลล์และเลินเนอร์มีผลในสมการส่งออกไปยังสหรัฐอเมริกา ส่วนความไม่แน่นอนหรือความผันผวนจากอัตราแลกเปลี่ยนที่แท้จริงมีผลในทางลบกับการส่งออกไปยังญี่ปุ่นแต่ไม่มีผลต่อการส่งออกไปยังสหรัฐอเมริกา อย่างไรก็ดี การส่งออกโดยรวมจะถูกกระทบในทางลบจากความไม่แน่นอนของอัตราแลกเปลี่ยนในกรณีการส่งออกไปยังญี่ปุ่น

คำสำคัญ: *ความไม่แน่นอนของอัตราแลกเปลี่ยน การส่งออก การทดสอบความสัมพันธ์ระยะยาว แบบมีขีดจำกัดของค่าวิกฤติ*

Introduction

There exist some arguments concerning the positive and negative effects of exchange rate uncertainty on the trade flows. However, the empirical results are still inconclusive. De Grauwe (1988) and Sereu and Vanhulle (1992) illustrate theoretical models that exchange rate volatility might boost trade by raising the price and volume of exports of exporting firms, but note that the impact of increased exchange rate volatility on the value of trade might be ambiguous. Asseery and Peel (1991) use the error correction framework and confirm a significant positive impact of real exchange rate volatility on exports. On the contrary, Sauer and Bohara (2001) use a large panel of industrialized and developing countries to investigate this relationship, but the results show that exchange rate volatility imposes negative effects for LDC exports from Latin America and Africa, but not for exports from Asian LDCs and Industrialized countries. The European Monetary System (EMS), a system of fixed but adjustable exchange rates, is expected to lead to lower long-run exchange rate volatility. Thus the EMS can have a direct impact on the volume of intra-EU exports. Fountas and Aristolelous (1999) provide the evidence that growth in intra-EU trade seems to be relatively independent of the exchange rate regime. Kihangire (2005) finds that real exchange rate volatility is negatively correlated with exports in Uganda and thus recommends the minimization of excessive volatility under the floating regime. Choudhry (2005) employs cointegration tests to investigate this relationship and finds that this relationship is mostly negative. Fang and Miller (2007) focus on the case of Singapore. Their results show that exchange rate risk significantly depresses exports while depreciation of the Singapore dollar does not significantly increase exports.

Thailand has been considered to be one of high economic performance countries in Asia in the last three decades.[1] This can be due to sound measures to liberalize trade and to promote investment in the private sector that has long been implemented in the past. The United Sates and Japan have been major importing countries of Thailand for many years. The country's exports to the

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[1] From World Bank Table.

two major trading partners are of high percentage compared with other trading partners, i.e. the share of exports to the United States accounted for 18.25 percent while that of Japan accounted for 13.91 percent.[2] Figure 1 shows the shares of exports to the two major trading partners.

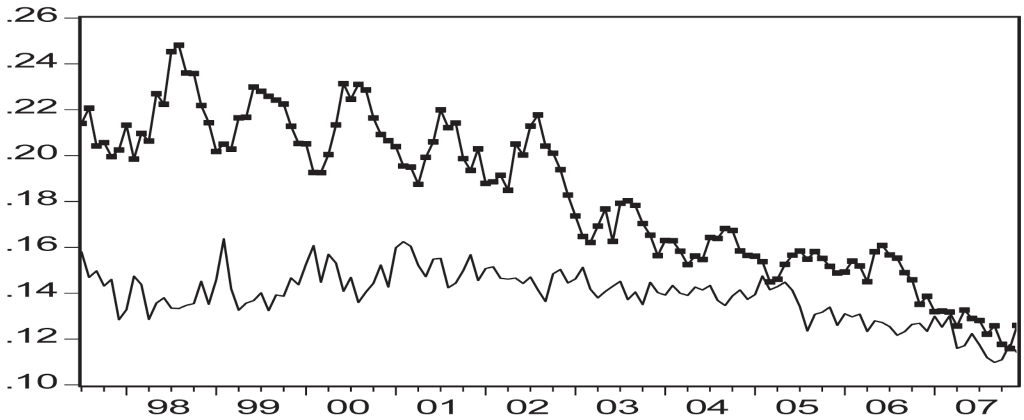

Figure 1: Share of Exports to the United State and Japan

The dotted line shows the share of exports to the United States which was declining over time. The solid line shows the share of exports to Japan which was also declining from 2004 onward. The declining shares of exports to the two major trading partners might be due to a fall in real foreign income and real exchange rate volatility or the decreasing comparative advantage of Thailand compared with its competitors.

After the financial crisis in July 1997, the floating exchange rate regime has been adopted with occasional interventions in the exchange rate market by the Bank of Thailand. This kind of interventions might be necessary due to exchange rate fluctuations that cause uncertainty to both exporters and importers, and thus distort their decision-making. Exchange rate uncertainty can impose an adverse impact on trade flows via the export side.

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[2] The data from the Bank of Thailand show that the monthly average of merchandise exports to the united states and Japan accounted for 18.25 and 13.91 percent of total exports respectively during July 1997 to December 2007. The combined share of exports to two countries is 32.16 percent.

Most empirical studies used aggregate trade data, i.e. total exports of the country. The present study uses bilateral exports data of two major importing partners of Thailand. The benefit of using the bilateral data is that the results might differ in some respects depending on the nature of each trading partner. In this paper, the effects of exchange rate uncertainty (or volatility) on bilateral exports from Thailand to the United States and Japan are analyzed using monthly bilateral data during the recent float. Methodology is presented in Section 2. Empirical results are presented in Section 3. Section 4 provides concluding remarks.

Methodology and Data

This section presents model specification and bounds testing for cointegration, and the measure of real exchange rate uncertainty as well as the sources of data used in the analysis.

Model Specification and Methods

In this subsection, the export demand function and the methods used to test the effect of real exchange rate volatility are described.

a. Model Specification

To investigate the impact of exchange rate uncertainty on trade flows, most studies have employed the export and import demand models by adding exchange rate volatility as a measure of uncertainty or risk into the models. In this study, the export demand model is used.[3] The equation to be estimated takes the following form:

$$LX_{it} = \alpha_0 + \alpha_1 LY_{it} + \alpha_2 LR_{it} + \alpha_3 VR_{it} + \varepsilon_{it} \quad (1)$$

[3] This model is used by Kenen and Rodrik (1986).

where LX_i denotes the log of real exports from Thailand to country i (the United States or Japan), Y_i denotes the log of real income of country i proxied by its industrial production index, LR_i denotes the log of bilateral real exchange rate between Thailand and country i (baht/US dollar or baht/Japanese Yen), and VR_i denotes the real exchange rate volatility of bilateral real exchange rate between Thailand and county i, which is obtained from estimation of the ARCH-type process.

To distinguish the short-run effects from the long-run effects, one needs to incorporate the short-run adjustment mechanism into Equation (1) by specifying it in the format of error-correction mechanism. Following the specification of Pesaran, et al. (2001), the bounds testing procedure is specified as:

$$\Delta LX_{i,t} = \mu + \sum_{i=1}^{p1} \beta_i \Delta LX_{i,t-i} + \sum_{j=0}^{p2} \gamma_i \Delta LY_{i,t-j} + \sum_{k=0}^{p3} \phi_k \Delta LR_{i,t-k} + \sum_{l=0}^{p4} \varphi_l \Delta VR_{i,t-l} + \delta_1 LX_{i,t-1} + \delta_2 LY_{i,t-1} + \delta_3 LR_{i,t-1} + \delta_4 VR_{i,t-1} + \eta_t \qquad (2)$$

In the bounds testing for cointegration, the F test for joint significance of the lagged level variables is used for testing for cointegration. If all variables are integrated of order one (I(1)), the upper bound critical value is compared with the calculated F-statistic of adding lagged variables in to the autoregressive distributed lag (ARDL) model. Cointegration exists when the calculated F-statistic is greater the the upper bound critical value. This also applied to the case of mixed between I(0), integrated of order zero, and I(1) variables. The volatility of real exchange rate can be stationary, or I(0) while other variables may not. However, there is no need to test for unit root before testing for cointegration. This is the main advantage of this procedure. In addition, equation (2) provides the estimates of both short-run and long-run effects at the same time.

A significant F test shows cointegration among variables, but does not show whether the adjustment is toward long-run equilibrium or disequilibrium. Therefore, it is necessary to estimates the coefficient of lagged level variables and used them to form the error-correction term, ECT. Replacing the lagged level variable by the lagged residual in equation (2) will get the ECT, which tells whether the adjustment is toward equilibrium or not.

b. Real Exchange Rate Volatility

Bollerslev (1986) develops a generalized ARCH (or GARCH) model in which the time-varying estimates of the conditional variance also include past variances. The approach by Bolerslev (1986) can be used to calculate real exchange rate uncertainty. The GARCH (p,q) process allows lagged conditional variances to enter into the model.

The GARCH(p,q) process is specified as:

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j} \qquad (3)$$

The simplest form of this model is the GARCH (1, 1) process suggested by Bollerslev (1986) and can be expressed as,

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \qquad (4)$$

where $\alpha_0 \geq 0$, $\alpha_1 \geq 0$, and $\beta_1 \geq 0$, h_t is the conditional variance (σ_t^2). The left-hand-side term is the time-varying residual variance representing a series of real exchange rate uncertainty estimates. Equation (4) is GARCH (1, 1). If β_1 = 0, then equation (4) will collapse to an ARCH model (Engle, 1982 and 1983).

The standard time-series model is usually specified as ARMA(p,q) process in the following form:

$$\Delta LR_{i,t} = a_0 + \sum_{i=1}^{p} a_i \Delta LR_{i,t-i} + \sum_{j=1}^{q} b_j \varepsilon_{i,t-1} + \varepsilon_{it} , \qquad (5)$$

where ΔLR_i is the first difference of log of each real exchange rate, which is usually a stationary series. The autoregressive variables take the order of p while the moving average variables take the order of q. Equation (5) is an autoregressive-moving average representation that can be used to estimate the conditional mean of real exchange rate changes.

For GARCH estimation, equation (5) is the mean equation while equation (4) is the variance equation. When $\alpha_i \geq 0$ and $\alpha_1 + \beta_1 < 1$, these conditions ensure nonnegativity and stationarity of the conditional variance.

Data

All data used in the analysis are monthly during July 1997 to December 2007 and come from two sources: (1) International Financial Statistics of IMF, (2) Bank of Thailand.

Real exports are defined as nominal exports divided by domestic producer price index. Real exchange rate is bilateral exchange rate multiplied by the ratio of foreign and domestic producer price indexes. Industrial production index is used as a proxy of real income of each importing country from Thailand. Nominal exports in terms of baht are from the Bank of Thailand. Whole sale price indexes and U.S. and Japanese industrial production indexes are from IMF International Financial Statistic. All series are seasonally adjusted by the author.

Real exchange rate volatility is estimated by an ARCH-type model explained in 2.2(b).

Empirical Results

In what follows, the results from estimates of the variance series, and the long-run relationship in equation (1) are presented.

Results of Real Exchange Rate Uncertainty

The volatility of real exchange rates is obtained from eqautions (4) and (5). Since the variable in the mean equation must be a stationary series, the PP test proposed by Phillips and Perron (1988) is used to test for unit root. The results are reported in Table 1.

The results of PP test for unit root in Table 1 show that both real exchange rate series are integrated of order one, I(1), and thus they are stationary in first difference. The estimates of an ARMA process use the first differences of each series.

Table 1: PP Test for Stationarity Property of Real Exchange Rate

Series	Constant	Constant and Trend
Log of real exchange rate	-1.534 [6]	-2.036 [6]
(baht/US dollar)	(0.513)	(0.576)
ΔLog of real exchange rate	-10.626 [6]	-10.863 [7]
(baht/US dollar)	(0.000)	(0.000)
Log of real exchange rate	-0.482 [4]	-2.067 [3]
(baht/JP yen)	(0.890)	(0.558)
ΔLog of real exchange rate	-9.082 [5]	-9.162 [6]
(baht/JP yen)	(0.000)	(0.000)

Note: The number in bracket is the optimal bandwidth, and the number in parenthesis is the probability of accepting the null hypothesis of unit root provided by MacKinnon (1996).

Using the mean equations as ARMA(2,3) process for the baht/US dollar and ARMA(3,3) for the baht/yen, and GARCH(1,1) type as variance equations are estimated. The estimates of various types of GARCH model fail by diagnostic tests. The ARCH(1) process is appropriate when applied to the data set. Therefore, the conditional variance series are obtained by the estimates reported in Table 2.

The estimated ARCH model is adequate to model real exchange rate uncertainty of the two exchange rate series. Almost all coefficient estimates are significant at the 1% level of significance. Based upon the estimated coefficients of the variance equation, the conditional variance series can be estimated and used as a measure of real exchange rate volatility or uncertainty. The Ljung-Box Q statistics for the standardized residuals and the squared standardized residuals are lower than the 5% critical value. These two residual tests show no further first or second-order serial dependence and no further evidence of ARCH effects.

The graphical presentation of real exchange rate uncertainty (or volatility) generated from ARCH model is shown in Figures 2 and 3.

Table 2 Estimates of the ARCH(1) model of Real Exchange Rate Series

	Baht/US dollar	Baht/Yen
Mean Equation:		
$\Delta LR_{i,t-1}$	3.111 (0.002)	-2.218 (0.005)
$\Delta LR_{i,t-2}$	8.326 (0.000)	0.503 (0.000)
$\Delta LR_{i,t-3}$		- 0.432 (0.000)
ε_{t-1}	-5.597 (0.000)	0.187 (0.087)
ε_{t-2}	-72.646 (0.000)	-0.844 (0.000)
ε_{t-3}	3.459 (0.000)	-0.633 (0.000)
Constant	-0.001 (0.001)	-0.001 (0.004)
Variance Equation:		
α_1	0.001 (0.000)	0.001 (0.000)
α_2	0.442 (0.004)	0.283 (0.029)
Residual Tests:		
Q(4)	1.926 (0.165)	0.641 (0.423)
Q(8)	3.459 (0.630)	6.239 (0.284)
Q2(4)	3.108 (0.078)	0.351 (0.554)
Q2(8)	6.445 (0.265)	5.223 (0.389)
Log Likelihood	-273.864	-257.212
AIC	-4.323	-4.069
SC	-4.140	-3.862

Note: ΔR denotes first difference of real exchange rate, ε denote the moving average term, and ARMA(p,q) is an autoregressive moving average at lags of p and q. The number in parenthesis is probability.

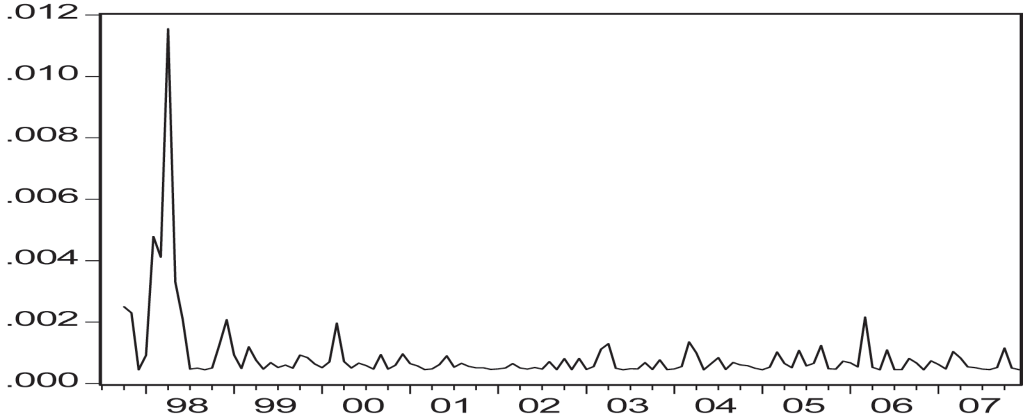

Figure 2: The baht/US dollar real exchange rate volatility

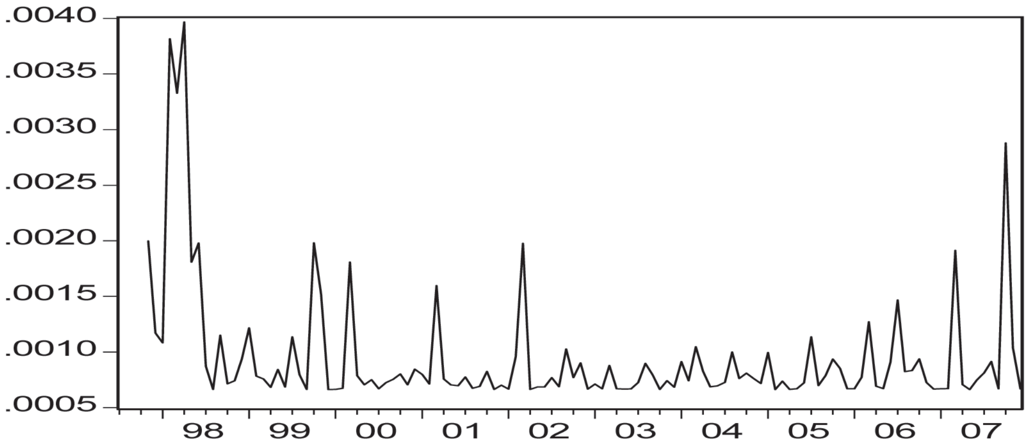

Figure 3: The baht/Yen real exchange rate volatility

The patterns of volatility are different for the two real exchange rate series, i.e., the volatility of the dollar exchange rate seems to subside after the financial crisis while the yen exchange rate fluctuates during the whole period but with lesser degree of volatility. Therefore, the impacts of real exchange rate volatility on real exports are expected to be different.

Results from Bounds Testing for Cointegration

The estimates of equation (2) give the calculated F-statistic as shown in Table 3. The lag length selection is based the serial correlation LM test. The optimal lag length of the ARDL is thus chosen by reducing the number of lags from the maximum of eight. For the United States the ARDL order is (5, 2, 5, 4), and for Japan it is (7, 6, 5, 5).

Table 3: Results of Bounds Testing for Cointegrtion

Export to	Calculated F-Statistic	Chi-Sqaure
The United States	7.312	1.067
		(0.359)
Japan	3.984	1.468
		(0.433)

Note: The p-value of serial correlation test in parenthesis gives the Chi-square test statistic that accepts the null hypothesis of no serial correlation in the estimated equation

The upper bound critical value provided by Pesaran, et. al. (2001) is 3.770 at the 10% level and 4.350 at the 5% level.[4] Therefore, it can be concluded that there exists cointegration in both cases. In the case of the United States, the calculated F-statistic is greater than the upper bound critical value at the 5% level, while that of Japan is greater than the upper bound critical value at the 10% level.

The estimate of equation (1) for the United States and Japan are reported in Table 4.

[4] Table CI(iii) Case III Unrestricted intercept and no trend.

Table 4: Estimates of Long-run Coefficients for Export Demand Equation: LX = Dependent Variable

	The United States	**Japan**
LY_i	1.313 (0.000)	1.140 (0.000)
LR_i	0.956 (0.000)	-0.097 (0.253)
VR_i	-2.165 (0.760)	-79.078 (0.001)
Intercept	1.727 (0.291)	6.740 (0.000)
R^2	0.463	0.341
F-Statistic	34.134	20.331

Note: The p-value of t-statistic is in parenthesis.

The results in Table 4 show that foreign real income still play a crucial role the export demand from both trading partners with the income elasticity of 1.313 and 1.140 respectively. This implies that a decline in foreign real income by one percent will causes a decline in real exports of the country by more than one percent. The Marshall-Lerner condition holds in the case of the United States, i.e., a real depreciation raises the value of exports, but it does not hold in the case of Japan. In the case of exports to Japan, the coefficient with the unexpected sign is not significant. There is the enormous impact of real exchange rate uncertainty on the exports to Japan that substantially dominates the real exchange rate effect. It can be said that real exchange rate volatility significantly depresses exports to Japan, but does not have the impact on exports to the United States.

For short-run dynamics of the estimated equations, the error-correction terms (ETCs) are obtained by replacing the lag level of independent variables in equation (2) by the one period lag of residual series generated by the long-run equation.[5] The ECT for the United States is -0.747 with the p-value of t-statistic of 0.000. This indicates that there is a short-run adjustment to the long-run equilibrium. In the case of Japan, the ECT is -0.041 with the p-value of t-statistic

[5] The results of short-run relationship are reported in Tables A1 and A2 in the appendix.

of 0.291, which is insignificant, and indicates no short-run adjustment to the long-run equilibrium.

4. Concluding Remarks

Most studies on the impact of exchange rate volatility on trade flows use quarterly or annual data. This analysis is one of few studies that use monthly data to shed light on the notion that volatility in real exchange rate depresses trade flows via exports. The usual practice in measuring uncertainty in real exchange rate is to use the variance of the exchange rate. However, this study uses the conditional variance from the ARCH-type process. The main advantage of ARCH process is that it provides time-varying estimates of the conditional variance of real exchange rate, specified as a linear function of current and past squared forecast errors. The important results from this study show that volatility in the real exchange rates under the recent floating exchange rate regime affects major trading partners differently.

Even though the floating exchange rate regime can enhance more flexibility in the implementation of monetary policy, uncertainty in bilateral real exchange rates with major trading partners caused by the floating regime hampers the country's exports. The impact of real exchange rate volatility is apparent in the case of exports to Japan, but does not appear in the case of exports to the United States. However, the patterns of volatility are different as can be seen in Figures 2 and 3. The baht/dollar real exchange rate volatility is less severe right after the financial crisis compared to that of the baht/yen. Nevertheless, the evidence from this study indicates the potential of a negative impact of real exchange rate uncertainty on overall exports of the country. In other words, exports to one of the two major importing countries, namely Japan, will be depressed, and this effect will cause the country's exports to deteriorate. Hence, it is compulsory for policymakers to stabilize the baht/yen real exchange rate so as to reduce real exchange rate volatility if the main target is to improve or maintain the country's trade balance. Finding the sources of baht/yen real exchange rate volatility is crucial because one can know the causes and how to alleviate such a volatility or uncertainty.

Appendix

The following two tables show the short-run dynamics of the estimated long-run equations.

Table A1: Estimate of Short-Run Relationship (U.S.A) Dependent Variable: ΔLX_t

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004662	0.004733	-0.985016	0.3271
ΔLX_{t-1}	0.041257	0.110812	0.372317	0.7105
ΔLX_{t-2}	0.489991	0.090019	5.443207	0.0000
ΔLX_{t-3}	0.434646	0.113784	3.819931	0.0002
ΔLX_{t-4}	0.228020	0.116313	1.960404	0.0528
ΔLX_{t-5}	-0.125321	0.110013	-1.139148	0.2574
ΔLY_t	1.859212	0.415914	4.470180	0.0000
ΔLY_{t-1}	1.151315	0.490656	2.346481	0.0210
ΔLY_{t-2}	0.493397	0.436975	1.129120	0.2616
ΔLR_t	0.687415	0.190154	3.615041	0.0005
ΔLR_{t-1}	-0.872797	0.222924	-3.915216	0.0002
ΔLR_{t-2}	1.108694	0.245036	4.524616	0.0000
ΔLR_{t-3}	-0.444224	0.231417	-1.919580	0.0578
ΔLR_{t-4}	0.062445	0.220072	0.283747	0.7772
ΔLR_{t-5}	-0.508081	0.199973	-2.540740	0.0126
ΔVR_t	-24.14613	6.754190	-3.574985	0.0005
ΔVR_{t-1}	-6.916948	7.168016	-0.964974	0.3370
ΔVR_{t-2}	-10.22351	7.074677	-1.445086	0.1517
ΔVR_{t-3}	4.487901	7.266875	0.617583	0.5383
ΔVR_{t-4}	18.18709	5.429526	3.349664	0.0012
ECT	-0.746970	0.147956	-5.048594	0.0000
R^2 = 0.756				
F = 15.052				

In Table A1, both negative and positive impacts of baht/dollar real exchange rate volatility on real exports are observed for different lags. The coefficient of the error correction term (ECT) is negative with the absolute value of less than one, and is highly significant.

Table A2: Estimate of Short-Run Relationship (Japan) Dependent Variable: ΔLX_t

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004610	0.004528	1.018130	0.3114
ΔLX_{t-1}	-0.530011	0.109458	-4.842156	0.0000
ΔLX_{t-2}	0.089181	0.127319	0.700454	0.4855
ΔLX_{t-3}	0.223029	0.130385	1.710548	0.0907
ΔLX_{t-4}	-0.111878	0.139590	-0.801476	0.4250
ΔLX_{t-5}	0.198667	0.125442	1.583733	0.1168
ΔLX_{t-6}	-0.106688	0.113491	-0.940053	0.3498
ΔLX_{t-7}	-0.169946	0.096371	-1.763461	0.0813
ΔLY_t	0.890975	0.139879	6.369623	0.0000
ΔLY_{t-1}	-0.137448	0.167437	-0.820893	0.4139
ΔLY_{t-2}	0.124852	0.180655	0.691105	0.4913
ΔLY_{t-3}	0.080996	0.161405	0.501820	0.6170
ΔLY_{t-4}	0.201611	0.162780	1.238548	0.2188
ΔLY_{t-5}	-0.032581	0.145836	-0.223406	0.8237
ΔLY_{t-6}	-0.065578	0.130722	-0.501662	0.6172
ΔLR_t	0.189474	0.176595	1.072928	0.2862
ΔLR_{t-1}	0.178781	0.176477	1.013060	0.3138
ΔLR_{t-2}	0.282413	0.159071	1.775392	0.0793
ΔLR_{t-3}	-0.326501	0.156650	-2.084280	0.0400
ΔLR_{t-4}	0.346862	0.162304	2.137106	0.0354
ΔLR_{t-5}	-0.348608	0.159616	-2.184040	0.0316
ΔVR_t	6.592188	10.82806	0.608806	0.5442
ΔVR_{t-1}	15.31994	12.72102	1.204302	0.2317
ΔVR_{t-2}	3.193468	13.13878	0.243057	0.8085
ΔVR_{t-3}	7.841090	12.05530	0.650427	0.5171
ΔVR_{t-4}	8.077155	11.26420	0.717064	0.4752
ΔVR_{t-5}	21.79712	10.45027	2.085795	0.0399
ECT	-0.04062	10.038260	-1.061698	0.2913

R^2 = 0.802

F = 13.228

The results in Table A2 show that most of the lagged volatilities do not affect exports to Japan, except for the lag of five with a large coefficient and a 5% level of significance. However, the expected sign of the ECT is correct but not significant.

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