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Exchange Rate Volatility and International Trade Flows: Evidence from Thailand

Thi Mai Lien Dau[1] and Yuthana Sethapramote [2]

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ABSTRACT

The paper examines the impact of exchange rate volatility on bilateral imports and exports between Thailand and its top-20 trading partners from 1996 to 2018 using the autoregressive distributed lag (ARDL) bounds testing approach. Our empirical results show three main findings. First, exchange rate volatility was found to have a significant effect on Thailand's trade with most countries in the Asia-Pacific region. Secondly, exchange rate volatility mostly had a positive effect on Thailand's bilateral trade in the short run; however, these effects were found to be negative in the long run. Finally, exchange rate volatility generally was seen to have a slightly stronger effect on imports rather than exports in both the short and long run. This implies that Thai imports show a greater response to exchange rate volatility than Thai exports.

Keywords: Exchange Rate Volatility, International Trade, Bounds Testing

Background and Significance of the Research Problem

International trade plays a crucial role in the Thai economy where the sum of imports and exports accounted for approximately 125 percent of gross domestic product (GDP) from 2015 to 2018 (World Bank Development Indicator). Traditionally, real income and real exchange rate are considered the main determinants of international trade flows in the neoclassical model of demand. However, since the collapse of the Bretton Woods system, the impact of exchange rate volatility has been widely discussed as an additional factor affecting international trade flow (Susman, 1983; Thursby and Thursby, 1987; Pozo, 1992), since many developed countries

[1] Lecturer, Martin de Tours School of Management and Economics (MSME Business School) ABAC University
E-mail: dauthimailien@msme.au.edu

[2] Associate Professor, School of Development Economics, National Institute of Development Administration
E-mail: yuthana.s@nida.ac.th

have started to adopt a floating exchange rate regime. In the case of Thailand, as with other emerging economies, the managed-float exchange rate regime has been adopted since July 1997 as a result of the 1997 Asian crisis. Since then, exchange rate fluctuation and its impact on the international trade flows of Thailand has significantly increased.

In the existing literature, a vast number of empirical and theoretical studies examine the relationship between exchange rate volatility and trade flow[3]. However, these studies have drawn contradictory conclusions, i.e., the impact of exchange rate volatility on a country's exports and imports can be either negative, positive, or neutral. Each study offers evidence to support its findings. Firstly, exchange rate volatility may have a negative impact on international trade flows, since it is a measure of the risks which can hinder economic activities and therefore has the potential to reduce international trade flows. Explicitly, in an international transaction, the exchange rate is agreed on and payment made at a different time; therefore, if the exchange rate fluctuates, it will lead to greater uncertainty and increased cost for international risk-averse traders, and this, in turn, may negatively affect a firm's profitability. Additionally, in developing countries such as Thailand, exchange rate risk is generally not hedged due to the underdevelopment of forward markets and limited accessibility to international traders. Even if hedging in forward markets were possible, there are limitations and cost implications (see Ethier (1973) and other economists, e.g., Clark, 1973; Baron, 1976; Cushman, 1983; Gagnon, 1993).

However, another strand of the literature reveals that exchange rate volatility may have a positive effect on trade flows or even no effect at all. De Grauwe (1988) and Sercu (1992) argue that important determinants of the relationship between international trade and exchange rate volatility seem to define exchange rate volatility (using the risk aversion of traders) and the presence or absence of a forward exchange market. They suggested that the effects of exchange rate uncertainty on exports should depend on the degree of risk aversion. According to these researchers, "risk-loving" traders exist who might be willing to make money from exchange rate variability, and hence, they trade even more when there is more risk in the exchange rate. Other researchers (Baldwin and Krugman (1989); Dixit (1989); Froot and Klemperer (1989)) also state that exchange rate uncertainty can affect the amount of trade, either positively or negatively. However, it is difficult to identify how trade will be affected, because other factors are involved, such as market share, market structure, or the sunk costs incurred with international transactions.

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[3] See McKenzie (1999) Bahmani-Oskooee and Hegerty (2007) for extensive literature reviews regarding the impact of exchange rate uncertainty on international trade flows.

In their empirical studies, Franke (1991) and Sercu and Vanhulle (1992) also find evidence to suggest that exchange rate volatility may have a positive or ambiguous impact on the volume of international trade flows, depending on the aggregate exposure to currency risk. In addition, Viaene and de Vries (1992) state that volatility may have a positive effect on either exporters or importers because they are on opposite sides of a risky trading relationship, and therefore, their respective roles are reversed. Furthermore, Dellas and Zilberfarb (1993) use an asset market approach to explain a positive effect. Broll and Eckwert (1999) claim that exchange rate volatility increases the value of a trader's option to export; since this risk increases the potential gains from trade, the volume of trade will increase accordingly.

Despite extensive studies on this topic, limited studies focus on Thailand. Caballero and Corbo (1989) find that exchange rate uncertainty has a significantly adverse effect on Thailand's exports, while Arize, Osang, and Slottje (2000) apply Johansen's cointegration technique to aggregate export demand models for 13 developing countries, including Thailand, finding a significantly negative effect of exchange rate uncertainty on the aggregate exports of every country, including Thailand. However, Poon, Choong, and Habibullah (2005) reveal that exchange rate volatility has a significantly positive effect on Thailand's exports, while Sauer and Bohara (2001) reveal that exchange rate volatility has an insignificant effect on the exports of Asian countries, including Thailand. Moreover, Bahmani-Oskooee et al. (2012) investigate the impact of exchange rate uncertainty on the trade flows of 118 US exporting industries to Thailand and 41 US importing industries from Thailand, finding that exchange rate uncertainty has a short-run effect on the trade flows of most industries. In the long run, the main determinant of trade flows is the level of economic activity in both countries. Hayakawa and Kimura (2009) empirically investigate the relationship between exchange rate volatility and international trade, focusing on East Asia, including Thailand. The results show that exchange rate volatility seems to have a more serious negative impact on intra-East Asian trade than trade in other regions. Additionally, volatility has a greater negative effect than tariffs but less than distance-related costs in East Asia. Jiranyakul (2013) investigates the impact of real exchange rate uncertainty on the import demand of Thailand, finding no short-run impact, although the long-run negative impact of real exchange rate uncertainty on Thai real imports is large and highly significant under the floating exchange rate regime. Bahmani-Oskooee et al. (2015) examine the impact of exchange rate uncertainty on trade flows between Japan and Thailand at the industrial level, finding that exchange rate volatility has a short-run effect on the trade flows of most industries. In the long run, this effect is mixed.

To date, no study comprehensively investigates the impact of exchange rate volatility on trade flows between Thailand and its major trading partners. As previously mentioned, the importance of international trade for the Thai economy is undeniable. With the introduction of the floating exchange rate regime, exchange rate volatility probably becomes an important determinant of Thai trade flows. Furthermore, the degree of exchange rate volatility is different among trading partners and the intervention of the Bank of Thailand to stabilize uncertainly is required, focusing on some of the major currencies.

Research Objective

The main objective of this study is to examine the impact of exchange rate volatility on the bilateral imports and exports between Thailand and its top 20 trading partners from 1996 to 2018. Accomplishment of the objective allows us to obtain a comprehensive understanding of the direction and magnitude concerning the impact of exchange rate fluctuations on the international trade flows of Thailand. The information obtained is critical not only for policymakers in making both exchange rate and trade policies but also international businesses in preparing for the impact of exchange rate volatility on their export sales, import costs and profitability.

Scope of the Research

In this paper, we use quarterly data on bilateral trade between Thailand and its trading partners only from 1996 to 2018 due to the availability of datasets from creditable sources. Data on exchange rates and bilateral trade value (in US dollars) are obtained from the Bank of Thailand. The unit value of imports, exports, and GDP data are extracted from the CEIC database. Finally, CPI data is obtained from the OECD and IMF databases.

The scope of this study consists of Thailand's top 20 trading partners from the following countries and regions.

1. ASEAN member states: Indonesia, Malaysia, the Philippines, Singapore, and Vietnam.
2. East and South Asian countries: China, Hong Kong, Japan, Korea, Taiwan, and India.
3. EU and OECD countries: France, Germany, the Netherlands, Switzerland, the United Kingdom, the United States, and Australia.
4. Other regions: Saudi Arabia and South Africa.

Finally, the demand model for international trade is used to analyze the relationship between exchange rate volatility and international trade flow, i.e., import or export demand depends on real income, real exchange rate and exchange rate volatility, defined as follows:

- VX is defined as the (ln) volume of Thai exports to foreign countries calculated from export value data deflated by the export unit value index.

- VM is defined as the (ln) volume of Thai imports from foreign countries calculated from import value data deflated by the import unit value index.

- REX is the bilateral exchange rate between the Thai baht and foreign currency, defined as $(\frac{CPI_{Thai}*NEX}{CPI_{foreign}})$.

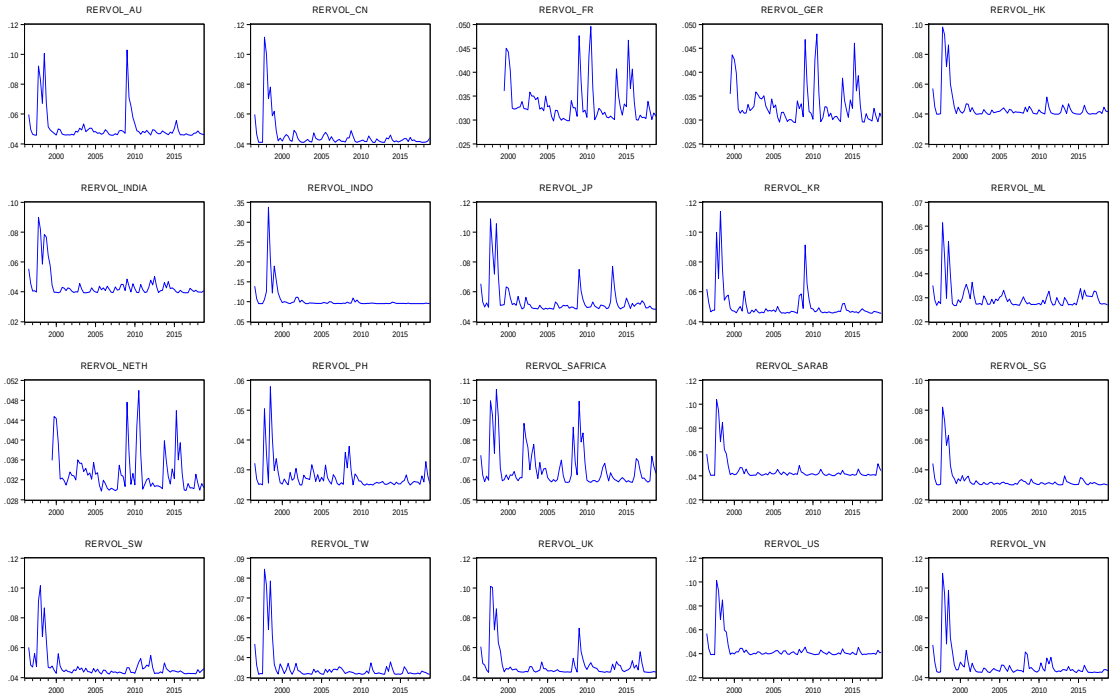
Where CPI is the Consumer Price Index; NEX is the nominal bilateral exchange rate defined as the number of baht units per one unit of foreign currency. Thus, an increase in REX reflects a real depreciation in Thai currency.

- VOL is the volatility measure of the real bilateral exchange rate (REX).

Various methods are proposed in previous literature for measuring the volatility of exchange rates. However, no clearly dominant measure is appointed as the best approximation for exchange rate volatility. The most common measure relates to variance, but its exact construction differs from study to study.

In this study, we use the ARCH(2) model (Autoregressive Conditional Heteroskedasticity), developed by Engle and Granger (1987) to generate the exchange rate volatility variable. Conceptually, ARCH is a measure of volatility in time-series errors. This procedure models the variance in each period's disturbance term as a function of the errors in the previous period(s).

The ARCH(2) model is applied to calculate series of conditional volatility for each real exchange rate, as shown in Figure 1. It shows high volatility in the real exchange of Thailand and its major trading partners during the period from 1997 to 1999 when Thailand and other Asian countries were impacted by the Asian financial crisis. The volatility also increased from 2008 to 2010 during the global financial crisis. Specifically, the Thai baht exchange rate with the eurozone and other European countries, i.e., France, Germany, the Netherlands, Switzerland, and the United Kingdom tended to experience increased volatility due to the effect of the Euro debt crisis. In the long term, the conditional volatility conversely moved toward its long-run level, representing the characteristics of a stationary series.



Source: Author's calculation using the *ARCH*(2) model.

Figure 1 Volatility of the Real Exchange Rate by Country

Research Methodology

To study the relationship between exchange rate volatility and trade flows, we built a model based on the determinants of trade proposed by neoclassical international trade theory. Specifically, trade is a function of domestic and foreign real income, the level of the real exchange rate and its volatility. However, data on these variables have both stationary and non-stationary characteristics (as showed in Table 1). Consequently, in this paper we estimate the short-run and long-run relationship by applying a bounds testing approach to cointegrate and equilibrium-correct the models proposed by Pesaran et al. (2001). This method is able to analyze cointegration and error-correction in the equation with a mixture of stationary and I(1) variables. It applies a standard F-test for the joint significance of lagged level variables. However, the F-test has new critical values as tabulated by Pesaran et al. (2001). By assuming all variables are I(1), they tabulate an upper bound critical value and, by assuming they are all I(0), a lower-bound critical value. For the joint significance of lagged level variables that support cointegration among them, the calculated F statistics should be higher than the upper bound critical value. If the F-statistic is above the upper bound critical value, then a long-run relationship exists among the variables. If it is below the lower-bound value, then the variables are not cointegrated.

Firstly, a reduced form model is established in which each trade flow is a function of the purchasing country's income, the real exchange rate Thai baht/foreign currency, and a measure of exchange rate volatility. We assume that the trade flows of each country pair, namely *i* (between Thailand and another foreign country) are assumed to depend upon real GDP, the real exchange rate, and volatility of the real exchange rate. These models are formulated from Thailand's perspective. This single-equation method is established based on a traditional ARDL model. The long-run relationship equations for exports and imports can be expressed as follows.

$$\ln VX_t = \alpha_{x0} + \alpha_{x1} \ln Y_t^F + \alpha_{x2} \ln REX_t + \alpha_{x3} \ln VOL_t + \varepsilon_t \quad (1)$$

$$\ln VM_t = \alpha_{m0} + \alpha_{m1} \ln Y_t^{TH} + \alpha_{m2} \ln REX_t + \alpha_{m3} \ln VOL_t + \varepsilon_t \quad (2)$$

where VX is the export volume of Thailand compared to foreign countries, which theoretically depends on the foreign country's income (Y^F), the real exchange rate (REX), and volatility of REX (VOL). Likewise, in Equation 2, VM is the import volume of a commodity for Thailand from foreign countries assumed to depend on Thailand's income (Y^{TH}), in similarity to REX and VOL.

Hypothesis

1. Since an increase in the economic activity of a country results in increased imports, we expect the estimate of α_{x1} and α_{m1} to be positive.

2. Given the definition of REX, an increase reflects a real depreciation in the baht against foreign currencies and if real depreciation encourages Thai exports and discourages Thai imports, we expect the estimate of α_{x2} to be positive and α_{m2} to be negative.

3. Finally, the impact of exchange rate volatility on trade is inclusive in literature, and hence the estimates of α_{x3} and α_{m3} can be in either direction.

From these ADRL equations, error-correction models are estimated

$$\Delta \ln VX_{i,t} = \alpha_{x0} + \sum_{k=0}^{n1} \beta_{1k} \Delta \ln VX_{i,t-k} + \sum_{k=0}^{n2} \beta_{2k} \Delta \ln Y_{t-k}^{f} + \sum_{k=0}^{n3} \beta_{3t} \Delta \ln REX_{i,t-k} + \sum_{k=0}^{n4} \beta_{4t} \Delta \ln VOL_{i,t-k} + \theta_1 \ln VX_{i,t-1} + \theta_2 \ln Y_{t-1}^{f} + \theta_3 \ln REX_{i,t-1} + \theta_4 \ln VOL_{i,t-1} + \varepsilon_t \quad (3)$$

$$\Delta \ln VM_{i,t} = \alpha_{m0} + \sum_{k=0}^{n5} \beta_{5k} \Delta \ln VM_{i,t-k} + \sum_{k=0}^{n6} \beta_{6k} \Delta \ln Y_{t-k}^{TH} + \sum_{k=0}^{n7} \beta_{7t} \Delta \ln REX_{i,t-k} + \sum_{k=0}^{n8} \beta_{8t} \Delta \ln VOL_{i,t-k} + \theta_5 \ln VM_{i,t-1} + \theta_6 \ln Y_{t-1}^{TH} + \theta_7 \ln REX_{i,t-1} + \theta_8 \ln VOL_{i,t-1} + \varepsilon_t \quad (4)$$

In Equations 3 and 4, short-run dynamics are included to estimate the long-run effects. The short-run effects are reflected in the estimates of the coefficients attached to first-differenced variables. The long-run effects are obtained by the estimates of θ_2, θ_3, and θ_4

normalized on θ_1 in Equation (3) and the estimates of θ_6, θ_7, and θ_8 normalized on θ_5 in Equation (4).

In this study, Thailand's exports to its major trading partner are expected to respond positively to an increase in foreign income and baht depreciation (an increase in REX, based on the number of Thai baht units per foreign currency unit). At the same time, Thailand's imports should increase with both Thai income and baht appreciation. Based on the literature, the anticipated sign for VOL is ambiguous.

Results

To check for the stationary property of data, we first apply the ADF test, the results of which are reported in Table 1. By testing for unit root and the stationary of variables based on the available dataset, our findings reveal that the majority of real exchange rate volatility series are stationary at level, while most of the real exchange rate and real GDP series are stationary at the first difference, with mixed results for export volume and import volume series. In short, the variables included in our study are integrated with different levels. Hence, the bound testing approach proposed by Pesaran et al. (2001) is applied since it allows for testing the long-run relationship between variables, integrated in the order of one I(1) or zero I(0), or any combination of the two.

The error-correction models (3) and (4) are then subjected to empirical testing based on quarterly bilateral trade data between Thailand and its top 20 trading partners. To estimate the optimum lags for each optimum model, Akaike's Information Criterion (AIC) is used with a maximum of four lags. Therefore, all the results reported belong to the optimum models.

The test results of cointegration for export and import models are reported in Table 2. For export models, we find evidence of cointegration among the dependent and independent variables in most country-pairs. Explicitly, 16 out of 20 cases have a higher calculated F-statistic than the upper bound critical value of 3.35 (significant at the 10% level). For import models, 17 models have a higher calculated F-statistic than the upper bound critical value of 3.35 (significant at the 10% level).

Table 1 Unit Root Tests (ADF Test)

	I(0)					I(1)				
	LVX	LVM	LRER	RERVOL	LY	LVX	LVM	LRER	RERVOL	LY
Thailand					0.26					-9.42***
ASEAN countries										
Indonesia	-2.06	-2.5	-4.34***	-5.33***	0.98	-11.97***	-13.18***			-6.25***
Malaysia	-3.22**	-1.57	0.49	-6.22***	-0.63		-11.98***	-7.80***		-6.72***
Philippines	-1.82	-2.71*	-1.04	-6.84***	2.88	-11.27***		-7.006***		-8.18***
Singapore	-2.96**	-2.22	-1.49	-4.18***	-0.55		-12.76***	-6.293***		-7.55***
Vietnam	-1.68	-3.29**	0.05	-5.03***	0.52	-9.01***		-6.40***		-14.63***
East and South Asian countries										
China	-4.53***	-2.24	-2.3	-4.38***	-3.15**		-10.31***	-5.72***		
Hong Kong	-2.71*	-3.75***	-1.27	-5.36***	-0.29			-7.02***		-7.07***
Japan	-2.80*	-2.21	-3.60***	-5.27***	-0.67		-10.27***			-8.12***
S. Korea	-2.32	-2.18	-1.11	-5.57***	-3.58***	-10.85***	-8.08***	-9.06***		
Taiwan	-3.24**	-1.94	-1.57	-4.51***	-1.89		-8.31***	-7.28***		-7.60***
India	-2.69*	-1.42	0.89	-4.07***	0.44		-12.59***	-6.03***		-10.58***
EU and OECD countries										
France	-2.80*	-3.03**	0.16	-5.31***	-2.25			-6.46***		-4.80***
Germany	-2.23	-1.7	0.27	-5.36***	-0.4	-9.39***	-9.12***	-6.50***		-7.09***
Netherlands	-3.14**	-4.83***	0.29	-5.35***	-2.095			-6.40***		-5.06***
Switzerland	-2.43	-1.62	-3.40***	-4.21***	-1.079	-7.908***	-8.275***			-5.454***
United Kingdom	-3.31**	-2.61*	-0.5	-4.45***	-2.016			-6.022***		-4.283***
United States	-3.14**	-2.59*	-1.17	-4.18***	-1.887			-6.616***		-6.013***
Australia	-3.11**	-1.94	-0.79	-5.20***	-2.714*		-9.390***	-7.718***		
Others regions										
Saudi Arabia	-1.56	-2.31	-1.02	-4.26***	-0.38	-10.51***	-15.80***	-6.54***		-11.75***
South Africa	-2.16	-3.62***	-0.14	-5.36***	-1.41	-10.07***		-6.77***		-4.47***

Note: Unit root test results are reported for all the series at level. At the first difference, the unit root tests are performed when the null hypothesis of non-stationary cannot be rejected in the tests of the series at level.

Source: Authors' Calculation

Table 2 Results of the Cointegration Test

Country	Export Models		Import Models	
	F-statistic	Cointegration	F-statistic	Cointegration
ASEAN countries				
Indonesia	7.560***	Yes	5.472***	Yes
Malaysia	4.469**	Yes	2.103	No
Philippines	5.787***	Yes	4.907***	Yes
Singapore	6.568***	Yes	4.505**	Yes
Vietnam	5.7379***	Yes	12.46***	Yes
East and South Asian countries				
China	9.115***	Yes	9.115***	Yes
Hong Kong	14.96***	Yes	4.262**	Yes
Japan	2.876	No	4.458**	Yes
South Korea	5.648***	Yes	6.077***	Yes
Taiwan	11.19***	Yes	12.53***	Yes
India	3.631*	Yes	7.098***	Yes
EU and OECD countries				
France	1.682	No	3.629*	Yes
Germany	1.815	No	3.642*	Yes
Netherlands	5.699***	Yes	3.789*	Yes
Switzerland	8.483***	Yes	3.309	No
United Kingdom	3.962**	Yes	3.767*	Yes
United States	7.810***	Yes	2.030	No
Australia	5.632***	Yes	3.975**	Yes
Others Regions				
Saudi Arabia	1.074	No	4.310**	Yes
South Africa	11.58***	Yes	6.262***	Yes

Note: *** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level.
Source: Authors' Calculation

Hence, all countries' short-run volatility coefficients are analyzed and the long-run coefficients only for the 16 export and 17 import models for which evidence of cointegration exists among the dependent and independent variables.

The estimate coefficients are reported in Tables 3 and 4 for export and import models, respectively.

Firstly, the estimated results of the export models are analyzed (as shown in Table 3). The findings reveal that exchange rate volatility has a significant impact on Thai exports to certain countries in both the short and long run. In the short run, the effect of exchange rate volatility is significant with a 5% critical value in nine country-pair export models, namely Malaysia, Singapore, Vietnam, China, Hong Kong, the United Kingdom, South Africa, and Saudi Arabia. In most cases, the significant coefficients of exchange rate volatility generally show positive signs. This implies that exchange rate volatility has a positive impact on Thailand's exports in the short run. However, evidence to support the long-run impact of exchange rate volatility on export volume is only found in five country-pair export models, namely Malaysia, Singapore, Vietnam, China, and the United States. In all cases, exchange rate volatility has a negative impact on Thai exports to these trading partners. Moreover, while analyzing the coefficients of traditional variables in export models, we also find that Thailand's exports to Indonesia, the Philippines, Singapore, Vietnam, China, India, Hong Kong, Taiwan, South Korea, Switzerland, the United Kingdom, the United States, and Australia are positively affected by foreign country income. Additionally, baht depreciation has a significantly positive effect on Thai exports in the case of Singapore, Vietnam, Hong Kong, South Korea, Taiwan, India, the United Kingdom, the United States, and Australia. These findings are consistent with the related theories.

Table 3 Coefficient Estimates of the Thai Export Model

Country	Short-run Coefficient Estimate of Volatility				Long-run Coefficient Estimates			
	ΔVOL_t	ΔVOL_{t-1}	ΔVOL_{t-2}	ΔVOL_{t-3}	Constant	ln Y^f	ln RER	VOL
ASEAN countries								
Indonesia	0.635	-0.549	1.178	-1.185	-0.247	2.038**	0.479	7.479
	(0.795)	(-0.579)	(1.446)	(-1.646)	(-0.050)	(2.531)	(1.164)	(0.895)
Malaysia	-1.416	8.285***	5.346**	2.713	6.662	0.447	0.120	-41.05***
	(-0.786)	(2.814)	(2.325)	(1.495)	(1.007)	(1.137)	(0.162)	(-2.303)
Philippines	1.887	3.832	-3.401		-10.393	1.440**	0.363	-11.585
	(0.825)	(1.356)	(-1.479)		(-1.047)	(2.064)	(0.500)	(-0.591)
Singapore	-1.494	4.080**			3.422	0.275**	1.765***	-13.09***
	(-0.680)	(2.003)			(1.429)	(2.253)	(4.773)	(-4.199)
Vietnam	-2.426	4.189*	0.895		9.289***	0.322*	-0.369**	-69.53***
	(-0.668)	(1.719)	(0.492)		(3.572)	(1.786)	(-2.015)	(-2.791)

Table 3 (Continued)

Country	Short-run Coefficient Estimate of Volatility				Long-run Coefficient Estimates			
	ΔVOL_t	ΔVOL_{t-1}	ΔVOL_{t-2}	ΔVOL_{t-3}	Constant	ln Y^f	ln RER	VOL
East and South Asian countries								
China	-0.238	7.468***	3.150**	1.820	6.431**	1.520***	-0.204	-21.16***
	(-0.186)	(4.735)	(2.124)	(1.341)	(2.255)	(3.044)	(-0.571)	(-3.148)
Hong Kong	1.486	4.187***	2.578**		-13.44***	1.822***	0.886***	-3.041
	(1.296)	(2.812)	(2.195)		(-7.605)	(15.011)	(8.472)	(-1.430)
Japan	-0.083	1.074						
	(-0.136)	(1.659)						
South Korea					-25.51***	1.978***	0.878**	1.457
					(-3.981)	(5.262)	(2.508)	(0.254)
Taiwan					-10.88***	1.419***	2.905***	-0.330
					(-4.464)	(8.780)	(10.241)	(-0.099)
India	2.563				-5.276*	3.604***	1.232***	-3.846
	(1.118)				(-1.872)	(5.458)	(2.966)	(-0.490)
EU and OECD countries								
France								
Germany								
Netherlands					8.174***	0.530	-0.005	-5.888
					(3.075)	(1.191)	(-0.028)	(-1.076)
Switzerland					-36.87***	3.757***	0.488	7.297
					(-3.661)	(3.815)	(0.556)	(0.776)
United Kingdom	-1.230	1.031***	0.569	1.842*	-3.063	0.898	0.570**	-6.331
	(-1.166)	(5.705)	(0.516)	(1.686)	(-0.308)	(1.286)	(2.446)	(-1.074)
United States	-0.628	1.106	-1.764**		-29.17***	2.439***	1.303***	-4.757**
	(-0.848)	(1.339)	(-2.334)		(-8.839)	(12.417)	(13.443)	(-2.538)
Australia	3.040**				-38.30***	3.484***	1.587**	2.054
	(2.283)				(-4.891)	(6.773)	(2.529)	(0.288)
Others regions								
Saudi Arabia	0.800	5.572***						
	(0.380)	(2.778)						
South Africa	3.039*	6.467***	3.485*	4.087**				
	(1.794)	(3.224)	(1.922)	(2.496)				

Note: *** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level.

Source: Authors' Calculation

Next, we analyze the import models, with the estimated results presented in Table 4. We find evidence of cointegration in 17 country-pair models. In similarity to export models, the findings reveal that exchange rate volatility also has a significant impact on Thai imports from some countries in both the short and long run. The short-run impact of exchange rate volatility is found to be significant at the 5% level in seven country-pair models, namely Malaysia, the Philippines, Vietnam, China, Japan, the Netherlands, and Saudi Arabia. The results indicate that the impact of exchange rate volatility on the import volume of Thailand from these partner countries is positive in most cases. However, the findings reveal a negative impact for Vietnam, and a significantly negative impact for Japan in the contemporary period, although it has a positive impact in lagged periods. In the long run, there is more evidence to support the long-run impact of exchange rate volatility in country-pair import models in comparison to export models, namely nine country-pair import models such as Indonesia, Vietnam, China, Japan, South Korea, Hong Kong, India, Australia, and the United Kingdom. In similarity to the export models, negative signs are also found for all cases. Furthermore, by analyzing the coefficients of traditional variables in the import models, the findings also reveal that Thai income has a significantly positive impact on the country's imports from Indonesia, Singapore, Vietnam, China, Hong Kong, Japan, South Korea, India, the United Kingdom, Australia, and Saudi Arabia. Finally, the real exchange rate is found to have a significantly positive impact on Thai imports from Malaysia, Singapore, Hong Kong, Taiwan, and Australia. Only Thai imports from Indonesia have a negative impact on the real exchange rate.

Table 4 Coefficient Estimates of the Thai Import Model

Country	Short-run Coefficient Estimate of Volatility				Long-run Coefficient Estimates			
	ΔVOL_t	ΔVOL_{t-1}	ΔVOL_{t-2}	ΔVOL_{t-3}	Constant	ln Y^{TH}	ln REX	VOL
ASEAN countries								
Indonesia	0.251	2.259			1.533	0.682**	-0.337***	-6.752**
	(0.334)	(3.083)			(0.325)	(2.229)	(-3.729)	(-3.302)
Malaysia	3.043	7.589**	7.991***	3.579				
	(1.370)	(2.187)	(2.854)	(1.664)				
Philippines	0.853	11.445***	10.495***	9.413***	-0.106	0.745	0.409	-31.185
	(0.297)	(2.744)	(2.905)	(3.318)	(-0.006)	(0.612)	(0.471)	(-1.486)
Singapore					-11.81***	1.167***	1.884***	-2.325
					(-3.786)	(7.679)	(5.458)	(-0.692)
Vietnam	-0.160	-6.916**	-5.421**		-58.76***	4.591***	0.213	18.532**
	(-0.088)	(-2.486)	(-2.619)		(-4.963)	(5.668)	(0.905)	(2.568)

Table 4 (Continued)

Country	Short-run Coefficient Estimate of Volatility				Long-run Coefficient Estimates			
	ΔVOL_t	ΔVOL_{t-1}	ΔVOL_{t-2}	ΔVOL_{t-3}	Constant	ln Y^{TH}	ln REX	VOL
East and South Asian countries								
China	-0.238	7.468***	3.150**	1.820	6.431**	1.520***	-0.204	-21.16***
	(-0.186)	(4.735)	(2.124)	(1.341)	(2.255)	(3.044)	(-0.571)	(-3.148)
Hong Kong					-7.423	1.049***	1.123***	3.491
					(-1.242)	(2.816)	(2.903)	(0.531)
Japan	-1.708*	1.663	2.012*	2.523***	7.250***	0.328***	0.321	-12.273***
	(-1.761)	(1.230)	(1.821)	(2.663)	(3.340)	(2.926)	(1.528)	(-3.289)
South Korea					-9.076***	1.443***	0.306	-5.218*
					(-2.999)	(5.848)	(1.345)	(-1.764)
Taiwan					-11.01***	1.485***	1.540***	0.610
					(-7.915)	(15.846)	(9.423)	(0.370)
India	-1.263	4.318	0.711	7.379***	-19.27***	2.013***	0.153	-13.621**
	(-0.604)	(1.642)	(0.319)	(3.523)	(-2.659)	(4.153)	(0.947)	(-2.585)
EU and OECD countries								
France	2.636							
	(0.310)							
Germany								
Netherlands	1.308***	-3.512	-5.238		5.583	0.192	0.167	0.187
	(3.749)	(-1.029)	(-1.643)		(1.570)	(1.024)	(0.719)	(0.021)
Switzerland								
United Kingdom					0.852	0.650**	-0.137	-3.777
					(0.165)	(2.226)	(-0.556)	(-0.836)
United States								
Australia					-20.87***	1.833***	1.571***	-13.845*
					(-3.095)	(5.026)	(2.724)	(-1.853)
Others regions								
Saudi Arabia	-2.767	14.993***	12.904***	8.319**	-9.084	1.383*	0.162	-27.87***
	(-0.810)	(3.443)	(3.072)	(2.495)	(-0.721)	(1.815)	(0.306)	(-2.826)
South Africa					-4.844	1.005	-0.058	-19.65**
					(-0.331)	(1.059)	(-0.172)	(-2.219)

Note: *** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level.

Source: Authors' Calculation

In summary, the results show evidence that exchange rate volatility generally has a positive impact on Thai trade with some countries in the short run but a negative impact in the long run. Compared to the impact of traditional variables on Thai international trade which is significant in most models, the impact of exchange rate volatility can only be found in some country-pair models. Interestingly, exchange rate volatility is found to have a more significant impact on Thailand's trade with countries in the Asia-Pacific region.

Discussion

Applying the bounds testing approach proposed by Pesaran et al. (2001), in this study we investigate the impact of exchange rate volatility on international trade in Thailand using a quarterly dataset for the period from 1996 to 2018. As a result, we are able to capture the effects of volatility on trade in both the short and long run.

Our main findings are presented as follows:

Firstly, most countries in which exchange rate volatility is found to have a significant effect on Thailand's trade flow are in the Asia-Pacific region, namely, Malaysia, Singapore, Vietnam, China, Japan, South Korea, Hong Kong, India, and Australia. This indicates that regional trade flow is more sensitive to exchange rate volatility than trade flow with countries outside the region. This finding is consistent with the study by Hayakawa and Kimura (2009) who report that exchange rate volatility seems to have a more serious negative impact on intra-East Asian trade than trade in other regions. This emphasizes the need for regional collaboration to minimize the negative effect of exchange rate volatility, especially in the context of rapidly increasing international trade between countries in the region following the Asian financial crisis.

Secondly, our findings reveal that less than half the country-pair models experience a significant impact from exchange rate volatility, since it mostly has a positive effect on trade flows in the short run. However, there is evidence to support the negative impact of exchange rate volatility on export volume in the long run. This finding is also consistent with some other studies, such as Arize, Osang, and Slottje (2000) who report the significantly negative effect of exchange rate uncertainty on the aggregate exports of every country in the long run, and Jiranyakul (2013) who reveals an extensive, highly significant long-run negative impact from real exchange rate uncertainty on the real imports of Thailand under the floating exchange rate regime.

Thirdly, exchange rate volatility generally has a slightly stronger effect on imports compared to exports in both the short and long run. This implies that Thai imports seem to demonstrate a greater response to exchange rate volatility compared to Thai exports.

Finally, traditional variables (i.e., national income and foreign exchange rate) are shown to have a more significant impact than exchange rate volatility.

Suggestions

The findings of this study have several policy implications. Since exchange rate volatility between Thailand and countries in the Asia-Pacific region has a negative impact on Thai trade in the long run, this emphasizes the need for collaboration to achieve exchange rate stabilization among countries in the region. For example, central bankers in the region could schedule meetings on a regular basis to provide the opportunity for discussion on regional monetary policies, to decrease exchange volatility among currencies. Moreover, exchange rate volatility usually increases during periods of global crisis due to the spillover effect and capital outflows. Hence, a regional safeguards policy, such as the multilateral Chiang Mai Initiative (CMI) could provide a useful tool, not only for financial stability but also to promote the long-term growth of international trade in Asia. At country level, ever since Thailand implemented the managed floating exchange rate regime "the policymakers have been giving significant consideration to keeping exchange rate volatility moderate through active exchange rate interventions" (Ananchotikul et al., 2010). However, exchange rate intervention is costly in many aspects and such costs must be efficiently utilized. International traders should take steps to actively participate in hedging the risk of exchange rate volatility. In the case of Thailand, intra-regional traders who mostly trade in intermediate goods are more affected by exchange rate volatility and will benefit considerably from a reduction in such volatility.

The scope of this research only focuses on Thai imports and exports at aggregate level. Therefore, further investigation could extend to the impact of exchange rate volatility on the import and export demands of individual industries and different products. Moreover, recent interesting developments in the panel dynamic cointegration models of Pesaran and Smith (1995) and Pesaran et al. (1999) could be applied to further research in this area.

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