Trade Balance and Exchange Rate in Thailand & the Implications for Vietnam: An Application using Instrumental Variable and the Heterogeneous Panel Cointegration Methods

VO THE ANH

The Vietnam–Netherland Program, University of Economics HCMC – anh.vt@vnp.edu.vn

VO HONG DUC

Open University of HCMC – duc.vo@erawa.com.au

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ABSTRACT

This study aims to investigate the link of trade balance and exchange rate for the case of Thailand in different aspects by initially attempting to examine what factors determine the trade balance in Thailand and then to test the long-run relationship between the exchange rate and Thailand's trade balance. The empirical findings indicate that the exchange rate and relative growth rate of income play central roles in explaining Thailand's trade balance, and fiscal and monetary policies are beneficial in some cases. Additionally, panel fully modified ordinary least square (FMOLS) estimations illustrate that a devaluation of Thailand Baht offers a significantly positive improvement on its trade balance in the long run, especially for the groups of countries with upper middle and high income in America and Europe. Individual FMOLS regressions of Thailand's trade balance and each of its 62 trading partners suggest that a devaluation of Thailand's currency would stimulate Thailand's trade performance with over 20 trading partners, but hurt its performance with the other 10 countries and be inconclusive to the others.

1. Introduction

Exchange rate has always been one of the most attractive topics among academics, exporters, importers, investors, and policy-makers because of its vitally important role in the international economics. While academics have been concerned to develop theories of disequilibrium and equilibrium real exchange rate, policy-makers concentrate more on exchange rate adjustments and its effects on the economy. Additionally, exchange rate risk is a key element associated directly to the costs and profits for importers, exporters, and foreign investors. Hence, this study aims to investigate the relationship between trade balance and exchange rate for the case of Thailand in different aspects. It initially attempts to examine what factors determine the trade balance in Thailand, and then proceeds to test the long-run relationship between this factor and the exchange rate.

Thailand is opted for as a typical case to study effects of a currency's depreciation on trade balance as it is argued that developing countries have a tendency to devaluate their currency in order to gain the relative competition. Furthermore, according to Bahmani-Oskooee and Kantipong (2001), after the Asian currency crisis during 1997–1998, Thailand was one of the most suffered countries in comparison with others in the Asian region. Consequently, the country lost market shares of many export products and services to China and other ASEAN countries, and it slipped into a severe deficit in its balance of trade. The strategy of devaluation would allow Thailand to increase its regional competitiveness, recover its lost market shares, and improve its trade balance.

This paper provides key advantages in comparison with previous studies. *First*, our analysis utilizes panel data which allow obtaining an individual country's behavior by observing others' performance; the advantages of panel data are not only to take such heterogeneity explicitly into account by controlling for individual variances, but also to provide more information and less collinearity among the variables, more degree of freedom, and more efficiency (Gujarati & Porter, 2009). *Second*, the exchange rate is endogenous to trade balance as previously presented in the earlier researches; thus, this current study exploits the instrumental variable (IV) estimation and FMOLS method to re-examine the link between currency devaluations and trade balances. Neal (2013) asserted that when panel data comprises long T and small to medium N, it is not appropriate to use the standard fixed-effects panel OLS regression. The FMOLS estimation can overcome such an issue to remove nuisance parameters, to correct the regressand, and to make estimation results more reliable by means of the long-run covariance matrix. *Third*, unlike previous studies (such as Onafowara, 2003) which have been conducted for the case of Thailand, this study utilized the disaggregated data of trade and exchange rate to cope with the aggregated bias problem. Obviously, a nation's currency might appreciate against some currencies, but it may depreciate against others. Therefore, taking weighted averaging estimate of the exchange rate would smooth out the fluctuation of real effective exchange rate, leading to an unsustainable connection between the effective exchange rate and the total trade balance (Bahmani-Oskooee & Brooks, 1999).

The paper is constructed as follow. The next part reviews theory and empirical evidence in accordance with trade balance and exchange rate, whereas the following section presents research methodology in terms of econometric techniques and empirical models. Displayed in the two last sections are research findings, conclusions, and implications.

2. Literature review

In theory trade balance is modeled on the ground of three well-known mechanisms, including elasticity, absorption, and monetary approaches. The elasticity approach highlights that exchange rate serves as a main factor of trade balance and proposes depreciation as an effective way to deal with trade deficit. The absorption approach, which was proposed by Alexander (1952, 1959) and mathematically modeled by Johnson (1977), takes into consideration income as a major element in explaining trade performance and suggests that any income-related policy like contractionary fiscal policy could cope with trade deficit. The monetary approach asserts that money supply is highly correlated with trade disequilibrium and favors the use of monetary policy to correct the deficit of balance of payments (Salvatore, 2012). Therefore, exchange rate, income, and money supply are such fundamental determinants of the trade balance. Moreover, it is worth noting that factors associated with fiscal and monetary policy that have been used to correct the trade deficit are of vital importance.

In light of these well-known approaches, a plenty body of research have found fundamental factors leading to a change in trade balance. Furstenberg (1983) proved that the US current account is significantly influenced by domestic factors, such as growth rate of potential output, short- and long-term interest rate, and net foreign investment.

Miles (1979) established direct relationship between trade balance and other factors, such as exchange rate, income, monetary supply, and ratio of government consumption to output. Using annual data over the 1956–1972 period, the author concluded that exchange rate devaluations improve balance of payments through the capital account instead of the trade balance in most of the 14 selected nations. With the application of Miles's framework, Himarios (1985, 1989) illustrated that devaluation could be a helpful tool for adjusting the trade balance.

The long-run connection between trade balance and exchange rate derived from elasticity approach under partial equilibrium condition has held particular interest for academic researchers. Two kinds of data mainly used in this stream of research are aggregate and bilateral data.

On account of aggregated trade data, Bahmani-Oskooee (1985) introduced an approach of Alan lag structure for the purpose of testing the J-curve phenomenon. Using quarterly data of four countries including Greece, India, Korea, and Thailand, which have differently exchange rate regimes, the author found that the J-curve exists in three former nations (Greece, India, and Korea), except for the case of the other—Thailand. Bahmani-Oskooee and Alse (1994) re-examined effects of devaluation on trade balance with error-correction modeling and Engle-Granger cointegration approach, proposed by Engle and Granger (1987) and developed by Johansen and Juselius (1990). Using quarterly data over the 1971–1990 period for both 19 developed and 22 less developed nations, they indicated that currency's devaluation has positive influence on trade balance of Costa Rica, Brazil, as well as Turkey, and negative impact on that of Ireland, and no conclusion was drawn for the others in the long run. Bahmani-Oskooee (1998) revealed that the devaluation could stimulate the long-run trade balance, and found the evidence of the Marshall-Lerner (ML) condition for the case of Korea, South Africa, and Greece. Boyd et al. (2001) and Lowinger (2002) provided a support for the J-curve phenomenon and the ML condition. Singh (2002) asserted that real exchange rate is statistically related to the balance of trade in India.

In terms of bilateral data for exchange rate and trade balance, Bahmani-Oskooee and Brooks (1999) illustrated that there is no specific influence of exchange adjustment on America's trade balance in the short run, while the real exchange rates have a positive connection with the trade balance toward Canada, France, Germany, Italy, and Japan, except for the UK in the long run. Arora et al. (2003) proved that the devaluation of

India's rupee would stimulate its trade balance with four countries (Australia, Germany, Italy, and Japan) out of seven nations. Similar patterns were found in other studies in different countries, such as Bahmani-Oskooee et al. (2006) for the UK, Bahmani-Oskooee et al. (2005) for Canada, Bahmani-Oskooee and Harvery (2006) for Malaysia; the real exchange rate is positively related to the trade balance in some of the surveyed trading partners.

It should be noticed that results of earlier research may suffer the bias and ineffectiveness owing to the endogenous problem among variables. The fact that the function of trade balance contains macroeconomic variables like output, exchange rate, money supply, and some other indicators may face the problem of potential simultaneity (Rose & Yellen, 1989) and a reverse causal relationship on their own variables (Yol & Baharumshah, 2007). Therefore, to tackle the endogenous problem, some studies employed the instrumental variable (IV) method (Brissimis & Leventankis, 1989; Rose & Yellen, 1989; Rose, 1990), whereas others utilized the fully modified ordinary least squares (FMOLS) approach (Yol & Baharumshah, 2007; Chiu et al., 2010).

As far as empirical studies for Thailand on the issue are concerned, Bahmani-Oskooee and Kantipong (2001) and Onafowara (2003) conducted empirical studies to investigate the link between Thailand's trade balance and bilateral exchange rates. In addition, other empirical analyses used the country of Thailand as a trading partner for their research (Baharumshah, 2001; Bahmani-Oskooee & Harvery, 2010; Chiu et al., 2010). Authors such as Bahmani-Oskooee and Kantipong (2001) and Onafowara (2003) detected the long-run relationship between the exchange rate and the trade balance for two cases (Japan and America) out of five Thailand's major trading partners.

3. Research methodology

3.1. Econometric techniques

3.1.1. Panel unit root test

To avoid spurious regressions associated with the length of time series, the dataset is initially checked to figure out whether it is stationary by virtue of Breitung's (2001) panel-based unit root test. It is argued that this test's performance is more powerful than popular unit root tests performed in individual time series data. Unlike panel-based unit root tests provided by Im et al. (2003), or Maddala and Wu (1999), the method of Breitung (2001) allows individual process to have a common unit root, which is similar to that of Levin et al. (2002). A common unit root assumes that the tests have a common autoregressive (AR) structure for all the series. The prime function form of Breitung's (2001) test could be expressed in regressions:

$$\Delta y_{it} = \alpha_i + \beta y_{it-1} + \sum_{j=1}^{p_i} \theta_{ij}\, \Delta y_{i,t-j} + \varepsilon_{it}\ ; i = 1,2,\dots,n; t = 1,2,\dots,T. \quad (1)$$

where Δ represents the first difference variable, $i = 1,2,\dots, n$, individuals in the panel, and $t = 1,2,\dots,T,$ time periods. The error term ε_{it} is independently distributed normal for all i and t, and have heterogeneous variances across individuals.

According to Breitung's (2001) panel-based unit root test, the null hypothesis is that all panels contain a unit root, meaning that H_0: $\beta = 0$. The alternative hypothesis is that not all of the individual series have a unit root, that is, H_A: $\beta < 0$.

3.1.2. Panel cointegration test

3.1.2.1. Kao's cointegration test

Kao (1999) constructed the residual-based cointegration test on the basis of DF and ADF tests. The estimation model is as follows:

$$y_{it} = \alpha_i + \beta_i y_{it} + e_{it};\ i = 1,\dots,N; t = 1,\dots,T. \quad (2)$$

where the error term e_{it} is I(1).

The function of DF test applied to the residuals takes the following form:

$$\widehat{e_{it}} = p\,\widehat{e_{it-1}} + v_{it}, \quad (3)$$

The ADF test uses an extension of the DF function, adding lag changes in the equation to correct serial correlation: $\widehat{e_{it}} = p\,\widehat{e_{it-1}} + \sum_{j=1}^{k} \varphi_j\, \Delta\hat{e}_{it-j} + v_{itp}$. The null hypothesis of no cointegration is tested through $p = 1$, and the alternative hypothesis is cointegrated with $p < 1$.

3.1.2.2. Pedroni cointegration test

The general estimation for Pedroni cointegration test is expressed as follows:

$$y_{it} = \alpha_i + \sum_{m=1}^{M} \beta_{mi}\, x_{m\,i\,t} + \varepsilon_{it}\ ; i = 1,2,\dots,N; t = 1,2,\dots,T. \quad (4)$$

where M, N, and T represent the number of independent variables, the number of individuals, and the time periods respectively; the parameter α_i denotes the unit-specific fixed effect.

Pedroni (1999, 2001, 2004) proposed seven test statistics[1] for the variable's cointegration. These test statistics are calculated as follows:

Panel v-statistic:

$$\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{\varepsilon}_{i,t-1}^{2}\right)^{-1}.$$

Panel rho statistic:

$$\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{\varepsilon}_{i,t-1}^{2}\right)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,(\hat{\varepsilon}_{i,t-1}^{2}\,\Delta\hat{\varepsilon}_{it}-\hat{\lambda}_{i}).$$

Panel PP statistic:

$$\left(\tilde{\sigma}_{NT}^{2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{\varepsilon}_{i,t-1}^{2}\right)^{\frac{-1}{2}}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,(\hat{\varepsilon}_{i,t-1}^{2}\,\Delta\hat{\varepsilon}_{it}-\hat{\lambda}_{i}).$$

Panel ADF statistic:

$$\left(\tilde{s}_{NT}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{\varepsilon}_{i,t-1}^{*2}\right)^{\frac{-1}{2}}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{\varepsilon}_{i,t-1}^{*2}\,\Delta\hat{\varepsilon}_{i,t-1}^{*}.$$

Group rho statistic:

$$\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{\varepsilon}_{i,t-1}^{2}\right)^{-1}\sum_{t=1}^{T}(\hat{\varepsilon}_{i,t-1}^{2}\Delta\hat{\varepsilon}_{it}-\hat{\lambda}_{i}).$$

Group PP statistic:

$$\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{\sigma}_{i}^{2}\,\hat{\varepsilon}_{i,t-1}^{2}\right)^{\frac{-1}{2}}\sum_{t=1}^{T}(\hat{\varepsilon}_{i,t-1}^{2}\Delta\hat{\varepsilon}_{it}-\hat{\lambda}_{i}).$$

Group ADF statistic:

$$\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{s}_{i}^{*2}\,\hat{\varepsilon}_{i,t-1}^{*2}\right)^{\frac{-1}{2}}\sum_{t=1}^{T}\hat{\varepsilon}_{i,t-1}^{*}\Delta\,\hat{\varepsilon}_{it}^{*}.$$

The null hypothesis of those seven tests is that there exists no cointegration among variables. If the null hypothesis is rejected, a conclusion of the existence of long-run relationship among the variables could be drawn. In contrast, the null hypothesis cannot be rejected; there is no long-run relationship among the variables.

3.1.3. FMOLS approach

The FMOLS technique was proposed initially by Phillips and Hansen (1990) and extended by Pedroni (2000). The cointegrated system of equations is considered as follows:

$$y_{it} = \alpha_i + \beta y_{it} + \mu_{it}\ ; i = 1, \ldots, N\ ; t = 1, \ldots, T. \tag{5}$$

and

$$x_{it} = x_{it-1} + \varepsilon_{it}. \tag{6}$$

where y_{it} and x_{it} are nonstationary variable and vector error terms respectively.

The group-mean FMOLS estimator for the coefficient β is given by:

$$\hat{\beta}^*_{NT} = \frac{1}{N}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)^2\right)^{-1}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)\, y^*_{it} - T\hat{\gamma}_i\right). \tag{7}$$

where $y^*_{it} = (y_{it} - \bar{y}_i) - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\Delta x_{it}$ and $\hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}^0_{21i} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\left(\hat{\Gamma}_{22i} + \hat{\Omega}^0_{22i}\right)$,

$$L_{11i} = (\Omega_{11i} - \Omega^2_{21i}/\Omega_{22i})^{1/2}\ ; L_{12i} = 0;\ L_{21i} = \frac{\Omega_{21i}}{\Omega^{\frac{1}{2}}_{22i}};\ L_{22i} = \Omega^{\frac{1}{2}}_{22i}\ .$$

The t-statistic for $\hat{\beta}^*_{NT}$ is defined as follows:

$$\bar{t}_{\hat{\beta}^*_{NT}} = \frac{1}{\sqrt{N}}\sum_{i=1}^{N}\hat{L}^{-1}_{11i}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)^2\right)^{-1/2}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)\, y^*_{it} - T\hat{\gamma}_i\right). \tag{8}$$

As N-> ∞ and T-> ∞, the t-statistic converges to the standard normal distribution.

3.2. Empirical models

In this paper the trade model is constructed as follows:

$$TB_{it} = \Delta\frac{lnX_{it}}{lnM_{it}} = \beta_1\Delta lnRER_{it} + \beta_2\Delta\, ln\frac{GDP_{Thai}}{GDP_{it}} + \beta_3\Delta\, ln\left(\frac{(\frac{M2}{GDP})_{Thai}}{(\frac{M2}{GDP})_{it}}\right) +$$
$$\beta_4\Delta\ln\left(\frac{\left(\frac{GOV}{GDP}\right)_{Thai}}{\left(\frac{GOV}{GDP}\right)_{it}}\right) + \beta_5\Delta ln\left(\frac{IR_{Thai}}{IR_{it}}\right) + \varepsilon_{it}\ . \tag{9}$$

where TB_{it} represents the trade balance between Thailand and its country partner *i* at year *t*.

The dependent variable, *bilateral trade balance*, is expressed as the ratio of the value of total exports to that of total imports. This calculation is more favorable because of the following reasons:

Firstly, the trade balance could be presented in term of logarithm and its negative value with regard to trade deficit (Arora et al., 2003; Brada et al., 1997; Chiu et al., 2010).

Secondly, the measurement could allow trade balance to interpret both in real and nominal terms (Bahmani-Oskoee & Brooks, 1999).

Thirdly, the ratio is not sensitive to the unit of value (Bahmani-Oskoee & Alse, 1994).

The independent variables appear in the right hand-side of the estimation equation. Real bilateral real exchange rate (RER_{it}) is defined as the nominal bilateral exchange rate adjusted by ratio of the consumer price index of country i to that of Thailand. *Relative income* is the ratio of Thailand's GDP to GDP of a trading partner i (GDP_{Thai}/GDP_i). *Relative money supply* is the ratio of Thailand money supply to GDP in proportion to ratio of money supply to GDP of country i ($(M2/GDP)_{Thai}/(M2/GDP)_i$). *Relative interest rate* is the ratio of Thailand interest rate to interest rate of country i (IR_{Thai}/IR_i). *Fiscal variable* is the ratio of Thai government expenditure to GDP in proportion to ratio of government expenditure to GDP of country i ($(GOV/GDP)_{Thai}/(GOV/GDP)_i$). Like other studies (Bahmani-Oskooee, 1993; Miles, 1979), both dependent and independent variables are first differentiated in order to be interpreted in terms of the growth rate. Furthermore, it is necessary for us to take first differences for the variables, make them stationary, and avoid spurious estimation as Rose and Yellen (1989) stated that the use of variables in terms of logs of level could be inappropriate owing to misleading statistic test with the presence of non-stationary variables.

This study will apply OLS and IV techniques to the nexus between Thailand's trade balance and its determinants. The IV method is employed to tackle the endogenous problem mentioned in the literature review. Following the previous studies' approaches (Rose & Yellen, 1989; Rose, 1991; Willson, 2001), instrument variables for exchange rate in this study comprise money supply, interest rate, and foreign exchange reserve in terms of foreign and domestic data.

It should be noted that various trading partners with different per capital income may have a diversity of their capability in export supply and import demand (Chiu et al., 2010). Moreover, such factors as geographic distance, trade barriers, and political and economic relationships are highly likely to influence the trade structure of Thailand with its trading partners. Hence, the study separates the entire data into seven sub-samples[2] to further investigate whether the geographic structure and income level affect the relationship between Thailand's trade balance and its determinants.

The coefficient of exchange rate variable is expected to be positive in order that the depreciation could provide a stimulus for trade balance. In contrast, the expectation of the relative income's coefficient is negative so that a reduction in relative growth rate leads to an improvement in the balance of trade. Meanwhile, an expectation is that the relative growth of money supply is negatively related to Thailand's trade balance. The effect of interest rate on consumption is unclear because of the switch between income and substitution effects, causing its impact on trade performance to be ambiguous also. The coefficient of the variable of government spending is expected to be negative.

The model for investigating the long-run connection between bilateral real exchange rate and balance of trade comprises four variables: (i) bilateral trade balance *(TB_{it})*, (ii) bilateral real exchange rates *(RER_{it}),* (iii) Thai domestic income (GDP_t^{Thai}), and (iv) foreign income (GDP_{it}). The data are presented in terms of natural logarithm and in the real term. Another estimation equation can be described as follows:

$$ln\, TB_{it} = \alpha_i + \beta_1\, RER_{it} + \beta_2\, ln\, GDP_{it} + \beta_3\, ln\, GDP_{t\_Thai} + \varepsilon_{it}\,. \quad (9)$$

The panel FMOLS regressions are carried out for both the entire sample and seven sub-groups categorized by countries' income and regions. As affirmed by Marquez (1990), sole reliance on multilateral elasticities could conceal valuable information for both policy applications and empirical analyses of international trade. Hence, individual estimations of FMOLS will also be conducted to further grasp the relationship.

Prior to running FMOLS estimations, variables are checked to see whether they are stationary, and then whether they are cointegrated. The FMOLS is a type of cointegration estimations, so it is essential to make sure that the variables are cointegrated. Therefore, two well-known kinds of the panel cointegration tests of Kao (1999) and Pedroni (1999, 2001, 2004) are employed in the study.

4. Research findings

4.1. Determinants of Thailand's trade balance

Table 1 presents the results of the OLS and IV estimations for Thailand's trade balance and its determinants. Generally, two regressions provide consistent results in expectation with the exception of bilateral real exchange rate. The coefficient of exchange rate is positive and significant at 1% level as for the OLS result. In contrast, this coefficient in the IV regression carries a negative value, and is statistically insignificant, implying that the exchange rate might not be an element of Thailand's trade. The coefficients of the relative growth rate of income are negative and statistically significant, but those of the growth rate of money supply and interest rate are insignificant in both the estimations.

Table 1

Results of OLS and IV estimations for determinants of Thai trade balance

Dependent variable: D.Trade		
	OLS estimation	IV estimation
D.realer	0.879***	-0.107
	(4.00)	(-0.12)
D.gdpr	-0.930**	-1.733**
	(-2.06)	(-2.57)
D.m2gdpr	-0.268	-0.128
	(-1.48)	(-0.46)
D.govgdpr	-0.145	-0.536*
	(-0.68)	(-1.89)
D.rir	0.0372	0.0528
	(0.90)	(1.13)
Constant	0.0292***	0.0520**
	(2.83)	(2.60)
Observation	1275	1201
Endogenity test		3.879
p-value		0.0489

Note: t-statistics in parentheses; *, **, and *** indicate 10%, 5%, and 1% significance levels respectively; *D* represents first difference of the data

Table 2 presents estimation results for seven sub-groups characterized by incomes and regions. The empirical results point out that the coefficients of exchange rate are statistically significant at least at 10% significance and carry correct signs for groups with low and middle income and in Asia, Oceania, and Europe. Thus, this implies that the exchange rate plays an important role in explaining Thailand's trade balance with trading partners with low and middle income, and in Asia, Oceania, and Europe. The largest exchange rate's coefficient (2.223) belongs to the upper middle-income group, meaning that the reaction of the trade balance to exchange rate would be the most sensitive to this group.

All coefficients of income variable holds negatively expected signs, but solely are some of the coefficients statistically significant for groups of high income, in Africa and Western Asia. The coefficients of monetary variable (the relative growth rate of money supply over GDP) are statistically significant at 5% level with expected negative signs in cases of lower middle income and low income, in Africa and Western Asia, and Asia and Oceania. In other words, a reduction in the relative growth rate of Thailand's money supply over GDP would improve its trade balance with the partners in these groups.

Table 2

Estimation results for countries within each of the seven sub-samples

Dependent variable: D.Trade

	High income	Upper middle income	Lower middle and low income	Asia and Oceania	Europe	Africa and Western Asia	America
D.realer	0.421	2.223***	0.441*	0.238*	1.345***	0.398	-2.96
	(-1.68)	(-4.43)	(-1.94)	(-1.88)	(-3.38)	(-1.44)	(-0.97)
D.gdpr	-1.32***	-0.396	-0.801	-0.262	-1.23	-2.360***	-2.432
	(-1.73)	(-0.43)	(-1.28)	(-0.60)	(-1.27)	(-3.44)	(-0.96)
D.m2gdpr	0.019	-0.178	-1.33****	-0.510**	-0.0374	-1.047**	0.783
	(-0.09)	(-0.55)	(-5.22)	(-2.16)	(-0.14)	(-2.67)	(-0.98)
D.govgdpr	-0.052	-0.122	-0.2	-0.0841	-0.144	-0.203	-0.259
	(-0.09)	(-0.40)	(-0.69)	(-0.22)	(-0.39)	(-0.60)	(-0.19)
D.rir	-0.004	0.067	0.040	-0.024	0.087	0.117	0.041

Dependent variable: D.Trade							
	High income	Upper middle income	Lower middle and low income	Asia and Oceania	Europe	Africa and Western Asia	America
	(-0.11)	(-0.96)	(-0.34)	(-0.76)	(-1.07)	(-0.72)	(-0.22)
Constant	0.047**	0.021	0.005	0.027**	0.028	0.038	0.116
	(-2.4)	(-0.77)	(-0.22)	(-2.66)	(-0.87)	(-1.36)	(-1.08)
Observation	658	312	305	448	445	198	176
Endogenity test	0.028	0.031	0.044	2.466	1.143	0.206	4.231
p-value	0.8676	0.8604	0.8345	0.1163	0.2851	0.6502	0.0379

Note: t-statistics in parentheses; *, **, and *** indicate 10%, 5%, and 1% significance levels respectively; the America group is estimated using the IV regression, other groups with OLS regressions.

4.2. Devaluation and Thailand's trade balance

Table 3 shows t-statistics of the Breitung's (2001) panel-based unit root test both at the level and first difference. The bilateral real exchange rates are mixture of I(0) and I(1). The null hypothesis of a unit root cannot be rejected for the GDP and Thai's GDP variables at levels, but this hypothesis is strongly rejected at first difference at 1% significance level, showing that two variables are integrated of I(1).

Table 3

Results of Breitung's (2001) unit root test with level and first difference

	Level				First difference			
	Trade	RER	GDP	GDP_Thai	Trade	RER	GDP	GDP_Thai
1980–2013	-4.94***	-8.31***	8.40	4.06	-12.26***	-8.31***	-8.33***	-22.45***
High income	-2.92***	0.34	2.13	3.21	-10.15***	-3.38***	-4.97***	-17.03***

	Level				First difference			
	Trade	RER	GDP	GDP_Thai	Trade	RER	GDP	GDP_Thai
Upper middle income	-3.35***	-3.02***	0.50	1.77	-4.19***	-7.78***	-6.69***	-10.22***
Lower middle and low income	-2.67***	-3.41	6.66	1.74	-5.95***	-8.56***	-5.58***	-10.45***
Asia and Oceania	-3.63***	-1.02	6.38	2.34	-6.48***	-7.14***	-6.56***	-12.49***
Europe	-3.49***	-2.38**	3.99	2.56	-8.16***	-5.51***	-3.51***	-14.23***
Africa and Western Asia	-0.94	-3.25***	1.89	1.42	-4.62***	-6.98***	-3.64***	-8.84***
America	-1.77**	1.20	0.49	1.55	-4.62***	1.49	-7.60***	-8.17***

Note: ** and *** indicate 5% and 1% significance levels respectively.

Table 4 presents two types of cointergration tests by Pedroni (1999, 2001, 2004) and Kao (1999). Most t-statistics from Kao's (1999) test reveal that the null hypothesis could be strongly rejected at 1% level, apart from the high-income group. Seven t-statistics from Pedroni (1999, 2001, 2004) provide weaker evidence of long-run relationship owing to some insignificant statistics. However, all the panel ADF and group ADF statistics are statistically significant at 1% level. As stated by Pedroni (1999), such two statistics are superior to others statistics, so the results of long-run relationship would be reliable. In conclusion, there is an existence of long-run relationships among trade balance, bilateral real exchange rate, Thailand's GDP, and foreign GDP.

Table 4
Results of cointegration test

	Pedroni							Kao
	Panel v	Panel rho	Panel PP	Panel ADF	Group rho	Group PP	Group ADF	t-statistic
1980-2013	-0.37	-3.11***	-9.89***	-10.3***	-1.12***	-13.30	-11.1***	1.90***
High income	0.70	-4.07***	-8.51***	-4.51***	-1.4*	-10.1***	-7.79***	0.06
Upper middle income	-0.96	-1.18	-5.14***	-7.38***	-0.36	-7.69	-6.89***	8.45***
Lower middle and low income	0.36	-0.94	-3.48***	-3.99***	0.12	-4.62***	-4.41***	4.55***
Asia and Oceania	1.49*	-2.41***	-4.86***	-5.45***	-0.90***	-5.68***	-6.71***	3.07***
Europe	-0.36	-3.32***	-7.12***	-3.08***	-1.3*	-10.1***	-6.05***	5.18***
Africa and Western Asia	0.15	-0.33	-4.00***	-3.57***	0.51	-6.15***	-2.72***	12.07***
America	-1.25	-1.13	-3.67***	-7.44***	0.06	-3.56***	-6.81***	8.05***

Note: *, **, and *** indicate 10%, 5%, and 1% significant levels respectively.

Depicted in Table 5 are panel FMOLS estimations for the entire sample and seven sub-samples. For the case of 1980–2013 period the coefficient of exchange rate is highly significant at 1% level. The figure of 0.61 shows that when Thailand's currency depreciates by 1% on average, its trade performance would grow by approximately 0.6% in the long run. The coefficient of foreign income is significantly positive. The value of 1.23 suggests that if the total income of all surveyed countries increases by 1%, the Thailand's trade would rise by nearly 1.23%. The coefficient of Thailand's income is significantly negative. When Thailand income rises, its trade balance would be worsened because of its higher imports. Particularly, an increase by 1% in Thailand's income would lead to a decrease by approximately 0.61% in its trade balance.

As far as three income groups are concerned, the empirical results indicate that the depreciation of Thailand currency offers a positive influence on its trade balance with countries having high and upper middle income, whereas the lower middle and low income might not be suffered from Thailand's depreciation. The coefficients of foreign income are positive and significant for the cases of high income, lower middle-income, and low-income groups; countries in such groups have a higher tendency to import or use Thailand's products and services, thus improving its trade balance. The coefficients of domestic income for three income groups are negative and significant at 5% level, showing that Thailand may suffer a distortion of its trade balance when Thailand's output rises owing to higher demand for importing goods and services.

Regarding the regional aspect, America group reveals a largest elasticity of real exchange rate and reverse signs expected for the coefficients of domestic and foreign income. This implies that a Thai depreciation considerably improves its trade balance with America rather than other regional groups. The coefficient of foreign income is statistically significantly negative, implying that when the real income rises in American countries, the demand for Thailand's goods and services reduces. On the contrary, the coefficient of domestic income is significantly positive, implying that an increase in Thailand's output results in an improvement in its trade balance due to a growth in producing import substitutes from such regions, as stated in international trade theory. An explanation for the most striking feature of the America group may be transportation costs with the furthest distance as compared to that of Thailand and other regions. Moreover, the coefficients of real exchange rate, foreign income, and domestic income for Africa and Western Asia, Asia and Oceania, and Europe carry expected signs, but a few of them are not statistically significant.

Table 5
Panel results of FMOLS estimation

Dependent variable: Trade balance in terms of natural logarithms						
	Ln RER		Ln GDP		Ln GDP Thai	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
1980–2013	0.61***	3.94	1.23***	5.22	-0.61***	-3.20
High income	0.44***	3.42	1.01***	3.86	-0.36**	-2.16
Upper middle income	1.41***	4.04	0.49	1.14	-0.09	-0.22
Lower middle and low income	0.31	0.60	2.45***	3.48	-1.74***	-2.73
Asia and Oceania	0.01	0.03	0.81*	1.89	-1.17***	-2.61
Europe	1.26***	7.69	0.96***	2.70	-0.34	-1.50
Africa and Western Asia	-0.43	-1.29	4.53***	6.70	-2.20***	-6.16
America	1.31*	2.61	-1.08*	-1.90	1.85***	3.09

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

The FMOLS results for each individual country are displayed in Table 6. The coefficients of bilateral real exchange rates are statistically significant in 30 out of 62 cases (countries), and 20 of them holds correctly expected signs. A depreciation of Thailand Baht would stimulate its bilateral trade performance with over 20 countries, but hurt its trade balance to 10 nations. Many of the 10 countries are fossil fuel exporters, so Thailand should have proper substitute plans when depreciating its currency. The coefficients of foreign income are statistically significant for 37 cases out of the total of 62 countries. The number of cases carrying expected positive signs is 26, meaning that an increase in foreign income of these 26 countries is matched by an improvement in Thailand's trade balance in the long run. Similar patterns are also witnessed for the coefficients of domestic income. The estimated coefficients being statistically significant and carrying correctly expected signs are 36 and 26 respectively.

Table 6

Individual results of FMOLS estimation

Dependent variable: Trade balance in terms of logarithms

Partners	RER		GDP		GDP_Thai	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Australia	-0.92*	-1.79	3.23***	5.03	-1.05***	-3.24
Austria	1.91***	4.88	1.06	0.98	-0.68	-1.35
Bangladesh	-3.22***	-4.46	3.53***	3.71	-3.99***	-3.74
Belgium	0.93	1.62	3.14*	1.87	-0.84	-1.27
Benin	1.23	0.92	-2.00	-0.86	6.15**	2.59
Brazil	0.58	1.43	4.88***	2.81	-2.82*	-1.87
Brunei Darussalam	-2.50*	-1.74	-2.83	-1.10	2.90***	3.37
Bulgaria	0.78*	1.80	2.71	1.68	-3.31**	-2.35
Cambodia	-6.90	-1.68	10.30***	4.33	-21.61***	-4.18
Canada	2.77***	3.78	-3.37**	-2.95	2.10***	4.32
Colombia	0.99***	2.87	-5.71***	-6.77	7.84***	14.65
Coted' Ivoire	2.54	1.16	23.82***	4.14	-5.49***	-3.13
Cyprus	1.77	1.36	3.96	1.67	-2.23	-1.39
Czech Republic	1.19	1.35	3.94	1.11	-0.61	-0.26
Chile	0.00	-0.03	4.40***	3.53	-2.61***	-2.13
China	0.11	0.37	0.36	0.97	-0.50	-0.67
Denmark	-0.34	-0.59	3.71	2.33	-0.45	-0.86
Egypt	-0.75**	-2.22	1.77**	2.02	-0.84	-1.12
Finland	0.50	0.93	5.06***	5.63	-1.72***	-4.35
France	1.14***	3.14	0.84	0.71	-0.63	-1.49

Dependent variable: Trade balance in terms of logarithms						
Partners	RER		GDP		GDP_Thai	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Germany	0.04	0.29	4.77***	4.38	-1.60***	-4.13
Greece	2.25**	2.01	1.32	1.04	-0.36	-0.75
Hong Kong	-0.20	-0.88	0.29	0.38	0.30	0.44
Hungary	4.26***	4.81	-5.72***	-4.84	0.75	1.30
India	0.47	0.59	3.27***	4.41	-3.22***	-3.45
Indonesia	1.59***	2.08	0.11	0.06	0.01	0.01
Iran	0.20	1.03	7.91***	8.22	-6.51***	-9.58
Ireland	1.78***	6.20	-0.07	-0.28	1.18***	5.27
Israel	0.63	1.66	1.03**	2.02	-0.34	-0.76
Italy	-0.05	-0.11	6.15***	3.24	-1.79***	-3.80
Japan	0.77***	3.27	-2.02**	-1.96	0.76**	2.34
Korea	-0.31	-0.68	2.75***	3.91	-3.29***	-3.92
Kuwait	-4.66***	-48.58	6.62***	37.05	-8.27***	-35.45
Lao PDR	-0.33	-0.28	0.66	1.24	-2.84***	-2.76
Malaysia	-0.94	-1.63	1.72***	5.15	-1.95***	-4.95
Malta	2.74	1.14	-19.19***	-4.45	10.55***	3.52
Mexico	2.66***	6.77	-4.15***	-3.76	4.13***	8.09
Nepal	1.66	0.41	-5.57***	-0.89	3.76***	0.68
Netherlands	-0.58***	-2.41	3.33***	6.23	-1.70***	-6.93
New Zealand	0.80***	2.58	3.33***	8.24	-0.58***	-2.70
Nigeria	0.33	0.73	1.61*	1.89	-4.81***	-5.83
Norway	1.28***	4.69	1.24**	2.36	-0.30	-1.17
Oman	-2.10***	-5.79	5.29***	6.40	-2.62**	-2.50
Pakistan	8.03***	3.80	-1.06	-0.52	3.82*	1.95

Dependent variable: Trade balance in terms of logarithms						
Partners	RER		GDP		GDP_Thai	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Panama	2.13	0.81	-3.06**	-2.16	3.16**	2.49
Peru	0.16	0.05	-1.05	-0.32	2.37	0.58
Poland	-0.64	-0.65	-0.24	-0.10	1.63	0.68
Portugal	2.80**	2.28	-3.92	-1.48	1.53	1.59
Philippines	0.08	0.06	1.68***	2.79	-0.66	-1.59
Romania	1.72***	16.87	7.10***	13.74	-4.04***	-8.44
Russian	0.16	0.54	1.64	2.28	-2.26	-2.37
Saudi Arabia	-4.39***	-3.34	-2.28***	-2.95	0.10	0.16
Singapore	2.45***	4.61	-0.51	-1.42	0.48	1.07
South Africa	2.64*	1.79	1.54	0.85	0.57	0.70
Spain	2.59***	8.27	-1.21*	-1.88	0.67**	2.06
Sri Lanka	1.40	0.83	-1.39	-1.10	1.56*	1.72
Sweden	1.31***	3.74	3.01***	4.65	-0.88***	-3.07
Switzerland	1.11*	1.71	-0.53	-0.32	-0.44	-0.71
Turkey	3.07**	2.56	-0.13	-0.06	-0.86	-0.58
United Kingdom	-0.12	-1.67	2.06**	2.52	-0.09	-0.21
United States	1.1***	6.17	-0.59	-1.31	0.65***	2.87
Vietnam	-1.80***	-3.22	-2.41***	-4.44	3.75***	3.77

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

5. Conclusions and implications for Vietnam

The study is conducted to examine the relationship of trade balance and exchange rate in Thailand. This objective could be achieved by the two procedures. The first one is to analyze how changes in the exchange rate policy, fiscal policy, and monetary policy affect Thailand's trade balance with respect to various scenarios: (i) the entire sample of

62 countries who are trading partners with Thailand; (ii) different geography (between regions and regions of countries); and (iii) different income levels. The second one is to examine the long-run relationship between a devaluation of Thailand's currency and trade balance in terms of panel and individual country.

The empirical findings indicate that the exchange rate policy and relative growth rate of income play central roles in explaining Thailand's trade balance, while the fiscal and monetary policies are beneficial in some cases. Moreover, the panel FMOLS estimations illustrate that a devaluation of Thailand Baht could produce positive effects on trade balance in the long run, especially for: (i) the group of countries with high income, (ii) the group of countries with upper middle income, (iii) countries in America, and (iv) countries in Europe. The individual FMOLS regressions between Thailand and each of its 62 trading partners confirm that the devaluation of Thailand's currency would stimulate Thailand's trade performance with over 20 trading partners, but hurt its performance with the other 10 countries and be inconclusive to the others.

Thailand and Vietnam are very similar in many aspects including both social and economic characteristics. This study is not conducted for the case of Vietnam alone because of the data constraints. Given similarities between Thailand and Vietnam, we argue that implications from the findings of this empirical study can be drawn for the Government of Vietnam and also for the Government of Thailand. *First,* the government should focus on the money supply rather than on interest rate. According to the empirical findings, the money supply may have a more significant effect on trade balance in comparison with the interest rate. While an overall money supply is determined by the central bank (which then implies a basis interest rate), individual interest rates may be left with commercial banks to determine within a reasonable band. *Second,* a policy on currency devaluation should be strictly considered and adopted with the purpose of improving the national trade balance (and possibly encouraging economic growth) occasionally. However, it is cautious that this policy should be constantly reviewed to ensure that prevailing market conditions still allows for the existence of such a devaluation policy■

Notes

[1] Of these seven statistics four are based on the within-dimension approach, and three referred to group-mean panel or between-dimension approach.

[2] Due to space constraints, the countries belonging to sub-samples are not displayed but will be further detailed if required.

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