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The Relationship Between the Official Exchange Rate and the Parallel Exchange Rate in Vietnam: Evidence from Vecm Model

Van Anh Pham

Australian National University, State Bank of Vietnam. E-mail : phamvaananh@gmail.com

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Abstract: On January 1st 2016, the State Bank of Vietnam has been implementing a new exchange rate policy. This is seen as a significant change in the exchange rate regime to affect various economic factors. In the paper, I focus on analyze and evaluate the relationship between the official exchange rate and the parallel exchange rate. The study answers a question '*Does the official exchange rate drive the parallel exchange rate, or vice versa?*' The paper applies the Vector Error Correction Model and uses data over the span of 2010-2018. Based on these time series, the study investigates the above-mentioned relationship in different sub-periods of 2010-2015 and 2016-2018 following the change of the exchange rate policy. The main results are as follows: (1) The official exchange rate cannot drive the parallel exchange rate in both 2010-2015 and 2016-2018 periods; (2) The parallel exchange rate can drive the official exchange rate over the period of 2010-2015 but this fact does not occur over the period of 2016-2018 as the Government enforces the new exchange rate mechanism. The findings imply that the new exchange rate policy is efficient to prevent the parallel exchange rate affecting on the official exchange rate.

Keywords: Official exchange rate, parallel exchange rate, VECM, Vietnam.

JEL code: C32, F31, F65

1. Introduction

As a sensitive element, the official exchange rate (OEX) could affect to and suffer from other economic factors including the parallel exchange rate (PEX). During the period from 2010 to 2018, the exchange rate policy has a significant change on January 1st 2016. Indeed, over the span of 2010-2015 OEX is pegged to US dollar, while over the span of 2016-2018 OEX is pegged to a basket of foreign currencies. This structural break would lead the relationship between OEX and PEX changing significantly. At the moment, there do not any studies on this fact in Vietnam. This gap motivates me to do my research, wherein the relationship between OEX and PEX is investigated quantitatively in Vietnam over the periods of 2010-2015 and 2016-2018 as well.

Following to the Law on the State Bank of Vietnam (2010), the exchange rate regime is defined as a managed flexible regime. Over the period of 2010-2015, the State Bank of Vietnam (SBV) calculates and announces OEX, namely the average interbank exchange rate. The average interbank exchange rate bases on the foreign exchange demand and supply in the interbank market as the intervention of SBV as well. This OEX accompanied with a specific band is a benchmark, followed by the commercial banks trade foreign exchanges. Although OEX is defined as a managed flexible exchange rate mechanism, it is frequency fixed for a long time and does not really reflect foreign exchange movements (Vo 2000, Nguyen 2009, Nguyen 2010). In countries where OEX does not work well, the black market could be bloomed to fulfil foreign exchange demand of the official market (Phylaktis 1997, Panayiotis and Anastassios 2005). Though there is difficult to measure precisely the black market in Vietnam, this market is not small. Nguyen (2006) estimates that the parallel market occupies about 20% of the total foreign exchange market. Nguyen (2010) indicate that the volume of free market is quite large and still grows given Government's controls of foreign exchanges. PEX would make tensions to OEX by increasing the exchange rate premium level (the difference between PEX and OEX). This raises some doubts that OEX could be affected by PEX. In other words, OEX has to respond to free market shocks. It reveals the inefficiency of the exchange rate policy as policy reactions are led by the unofficial market (Bui, 2018).

Based on the exchange rate analysis, SBV recognizes that the exchange rate should be more flexible to reflect its true value and to adapt to the foreign exchange market as well. On December 31st 2015, SBV issues Decision No. 2730/QD-NHNN, wherein from 2016 onward OEX is the central exchange rate instead of the average interbank exchange rate. The new OEX bases on three elements: (i) the average interbank exchange rate; (ii) foreign currency movements of large trading partners; and (iii) the balance between macroeconomic policies and monetary policy. The central exchange rate accompanied with a specific band is a benchmark for commercial banks' trading. In the new exchange rate regime, the black market of foreign exchanges would reduce its transactions but still existent. The existence of PEX maybe influence OEX. There has not yet studied on this issue, thus understanding the relationship between two exchange rates is necessary to contribute to the existing research. The question I focus on is whether the official exchange rate drives the parallel exchange rate or vice versa, the parallel exchange rate drives the official exchange rate over the periods of 2010-2015 and 2016-2018 as well. In order to answer the question, the paper will test some hypotheses for two exchange rates as follows: (1) whether long-run relationships exist or not; (2) whether short-run relationships exist or not; and (3) whether Granger causalities exist or not. By fulfilling the above-mentioned objectives, the study gives evidences on OEX and PEX relationships. The paper applies the Vector Error Correction Model (VECM), including OEX and PEX variables, over two periods of 2010-2015 and 2016-2018. The findings show that OEX cannot drive PEX over two periods. In contrast, PEX can drive OEX over the period of 2010-2015. During the other period of 2016-2018 when the new exchange rate regime is set up, PEX cannot drive OEX yet. It is clear that the new exchange rate policy has a significant efficiency from 2016 onward. It could prevent PEX affecting and driving OEX.

The paper starts with the introduction, and then followed by Sections 2-6. Section 2 describes the literature review. Section 3 discusses the methodology and data to build up models. Section 4 provides models' results. Section 5 mentions discussion and suggests policy implication. Section 6 gives conclusion.

2. Literature Review

According to Love and Chandra (2007), there are three theoretical models to explain the OEX and PEX relationship. First, this is the trade model (e.g. smuggling model). The foreign exchange demand arises to purchase illegal import goods and the foreign exchange supply is derived from illegal export goods. In other words, there appears the diversion of foreign exchanges in the official market to the free market. Second, there is the monetary approach model. Black market dollars seem as valuable portfolio. The increase of the foreign exchange demand is for asset diversifications needed, and it is not for current account transactions assumed to be satisfied by the official market. Third, this is the portfolio balance model, which combines characteristics of two above-said models. The 'flow' characteristic from the trade model mixes with the 'asset' characteristic from the monetary approach model, which helps the portfolio balance model overcoming the limitation of two former models that only stress on one factor. These models, especially the portfolio balance model developed by Dornbusch (1983) and Phylaktis (1992), imply the relationship between OEX and PEX. Firstly, models have an implication related to the equilibrium spread existence between two exchange rates. Secondly, models imply that OEX depreciates or appreciates in the same proportion with PEX. In other words, the black market premium is constant in the long term. Thirdly, models suggest that the error-correction term is negative and significant in VECM, whereby two exchange rates could converge in the long-run. Fourthly, models investigate whether the market is efficient. If future OEX depends on its past values, the official market is efficient. However, if future OEX depends on other information, the official market is inefficient. In order to evaluate foreign exchange market, VECM is one of the most useful methods. If the error-correction term exists significantly, it implies inefficient market. Additionally, VECM exploits the speed of adjustment under the long-run disequilibrium. If the error-correction term is small, it takes longer time to return to a long-run equilibrium. Finally, VECM reveals the causality between two exchange rates.

There are also various empirical studies to examine the relationship between OEX and PEX. Booth and Mustafa (1991) evaluate this relationship in Turkey in the mid-1980s. They find that two exchange rates are cointegrated and adjust toward the equilibrium; however, the speed of adjustment of PEX is higher than OEX. Baghestani and Noer (1993) based on quarterly data from 1973 to 1990 in India show that two exchange rates have a long-run relationship. PEX is more sensitive to shocks and adjust more quickly towards the long-run equilibrium. Apergis (2000) find that in Armenia during the span of 1993-1997, there are three causality directions between two exchange rates. PEX has Granger-caused OEX from November 1993 to May 1994, OEX has Granger-caused PEX from November 1994 to January 1997, and bilateral causality relationship appears from June 1994 to October 1994. Kouretas and Zarangas (2001) study the relationship between two exchange rates in Greece from 1975 to 1993. They find the long-run relationship and the unique adjustment of PEX. Love and Chandra (2007) use data from 1953 to 1993 to examine OEX and PEX relationship in India. Both exchange rates are cointegrated, wherein PEX is weakly exogenous and OEX converges to the equilibrium. Baliamoune-Lutz and Lutz (2008) uses Granger causality tests for Tunisia over the span of 1972-1998. Their results show that PEX causes OEX in the short-run, and PEX adjusts to the long-run equilibrium. Balianoune-Lutz (2010) indicates that between 1974 and 1992 in Morocco, two exchange rates have long-run relationships, whereby PEX has Granger-caused OEX. This suggests that PEX would predict changes in OEX.

Among the cross-country research, Agenor and Taylor (1993) evaluate the OEX and PEX relationship through a sample of 19 emerging countries. They use 13-year data to test cointegration and Granger causality and then conclude no clear causality evidences. Noorbakhsh and Shahrokhi (1993) investigate the causality of two exchange rates in 12 countries. They reveal that PEX has Granger-caused OEX in seven countries, whereas there are no causality between two exchange rates in remainders. Phylaktis and Kassimatis (1994) study 7 Pacific Basin countries over 1974-1989 period to show a constant long-run black market premium and the speed of adjustments of PEX. The speed of adjustments vary and depend on the development of finance market in each country. Yunus (1997) pays attention on 5 South Asian countries to estimate dynamics between OEX and PEX. While the evidence shows a strong long-run relationship, it reveals a weak direct causality between two exchange rates. Diamandis and Drakos (2005) focus on 4 Latin America countries to analyze the long-run dynamic between two exchange rates. Their findings indicate that in each country, the free market premium is constant to support to long-run equilibrium. Kula et al (2014) concentrate on 13 Northern African and Middle East countries over the span of 1970-1998 to find that the long-run relationship between two exchange rates exists but the short-run relationship remain heterogeneous.

In Vietnam, there are several qualitative research on the relationship between OEX and PEX. These studies show that PEX challenges the implementation of the exchange rate policy (Nguyen 2009, International Monetary Fund 2010, Nguyen 2010). Nguyen (2009) mentions that the change of PEX could predict the change of OEX as SBV aims to reduce the gap between two exchange rates in certain times. The International Monetary Fund (2010) points out the OEX and PEX relationship when domestic currency depreciates at the end of 2009. Nguyen (2010) analyzes depreciation causes of OEX over the span of 2008-2009. They argue that under the shortage of foreign exchanges in the official market, the increase of foreign exchange demand leads firms and individuals making transactions in the black market. Consequently, PEX significantly depreciates, and then causes the increase of the black market premium. SBV thus has to depreciate OEX to eliminate the gap. In the recent times, there are some quantitative studies on the relationship between OEX and PEX in Vietnam. Bui (2014) uses the two-stage least square method to investigate this relationship during the period of 1995-2007. He finds the impact of OEX on PEX, wherein the depreciation of OEX by 1% causes PEX depreciating by 1.33%. Do and Goujon (2018) apply VECM to analyze the cointegration between OEX and PEX over the span of 2000-2015. The results reveal the long-run equilibrium. However, only OEX changes to correct disequilibria meanwhile PEX seems weakly exogenous. The findings argue that the depreciation of PEX leads the Government adjusting OEX to unify both exchange rates in the long term. PEX only is affected by short-run shocks from OEX but in complex ways. Bui (2018) uses VECM and Granger tests to evaluate the OEX and PEX relationship from 2005 to 2011. The empirical evidences suggest the long-run equilibrium, while the short-run dynamics only occur from OEX to PEX.

3. Methodology and data

3.1. Methodology

According to Bahmani-Oskooee and Tanku (2006), it could rely either the Engle-Granger test (1987) or Johansen test (1988) to establish cointegration between OEX and PEX. Both tests require that variables are integrated in the same order k and the linear combination is integrated in order less than k. Look at equation (1):

$$\text{LogOEX}_t = \alpha + \alpha\text{logPEX}_t + \varepsilon_t \tag{1}$$

In which:

logOEX: logarithm of the official exchange rate

logPEX: logarithm of the parallel exchange rate

ε: error term

α and β: parameters.

In equation (1), assuming both logOEX and logPEX are integrated in the same order one I(1). If there exists the cointegration between variables, their linear combination (e.g. residual ε_t) must be stationary or I(0). Yet, the cointegration would be set up in another channel. The short-run dynamics in equation (1) needs incorporating and expressing as an error-correction pattern. Look at equation (2):

$$\Delta LogOEX_t = a + \Sigma_{n=1}^{n1} b_i \Delta LogOEX_{t-1} + \Sigma_{n=1}^{n2} c_i \Delta LogPEX_{t-1} + \lambda\varepsilon_{t-1} + \mu_t \tag{2}$$

In this way, logOEX and logPEX are seen as cointegration if the coefficient λ is negative and statistically significant.

Then there are two channels, wherein PEX makes causality with OEX (Bahmani-Oskooee and Payesteh 1993). One is that the c_i are jointly significant; other is that λ is negative and significant.

Persaran *et al.* (2001) modify equation (2). They replace ε_{t-1} by variables' linear combination lagged by one period. Look at equation (3):

$$\Delta LogOEX_t = a + \sum_{n=1}^{n1} b_i \, \Delta LogOEX_{t-1} + \sum_{n=1}^{n2} c_i \Delta LogPEX_{t-1} + dLogOEX_{t-1} + eLogPEX_{t-1} + \mu_t \tag{3}$$

Now logOEX and logPEX are integrated if variables' lagged level is jointly significant, based on F test (Persaran *et al*, 2001). In equation (3), the sizes and signs of the c_i infer to the short-run causality, meanwhile the size and sign of *e* standardized on d infer to the long-run causality.

To determine whether long-run effects exist, it should use estimate of *d* and *e* to formulate the error-correction pattern:

$$EC_{t-1} = \hat{a} + \hat{d}\log OEX_{t-1} + \hat{e}\log PEX_{t-1}. \quad (4)$$

After variables' lagged level is replaced by the error-correction term EC_{t-1}, it requires to re-estimate the equation (3) that uses the optimum lags. According to Bahmani-Oskooee and Brooks (1999) and Bahmani-Oskooee and Ratha (2004), if the coefficient of EC_{t-1} is negative and significant, this supports not only the cointegration but also the long-run impacts from logPEX to logOEX.

By switching logOEX and logPEX in equations (1), (2), (3) and (4), it could establish the cointegration and the long-run causality from logOEX to logPEX.

$$\text{LogPEX}_t = \alpha' + \beta'\text{logOEX}_t + \varepsilon_t' \quad (1')$$

$$\Delta LogPEX_t = a' + \Sigma_{n=1}^{n1} b_i' \Delta LogPEX_{t-1} + \Sigma_{n=1}^{n2} c_i' \Delta LogOEX_{t-1} + \lambda' \varepsilon_{t-1} + \mu_t' \quad (2')$$

$$\begin{aligned} \Delta LogPEX_t = a' + \sum_{n=1}^{n1} b_i' \Delta LogPEX_{t-1} \\ + \sum_{n=1}^{n2} c_i' \Delta LogOEX_{t-1} + d' LogPEX_{t-1} + e' LogOEX_{t-1} + \mu_t' \end{aligned} \quad (3')$$

$$EC_{t-1} = \hat{a}' + \hat{d}'\log PEX_{t-1} + \hat{e}'\log OEX_{t-1}. \quad (4')$$

The said-above process establishes VECM that the paper applies to investigate the relationship between OEX and PEX in Vietnam.

3.2. Data

The paper uses monthly data of OEX and PEX from SBV to test hypotheses and analyze results. OEX published by SBV is the average interbank exchange rate before 2016 and the central exchange rate after 2016. Regarding to PEX, the price of foreign exchanges is quoted at major gold shops where SBV collects data. Monthly data of two exchange rates are derived from 2010 to 2018 to perform the analysis. These data thus are divided into two sub-periods 2010-2015 and 2016-2018 as SBV changes the exchange rate policy at the end of 2015 and implements it in the beginning of 2016.

All variables take logarithm form. The table 1 below shows statistical descriptions of the data set. It comprises periods of 2010-2015 and 2016-2018.

Table 1: Statistic descriptions

	2010-2015		*2016-2018*	
	Log(OEX)	*Log(PEX)*	*Log(OEX)*	*Log(PEX)*
Mean	9.933714	9.951554	10.01303	10.03244
Median	9.944054	9.957502	10.01807	10.03166
Maximum	9.993785	10.02571	10.03561	10.06390
Minimum	9.794844	9.849031	9.991590	10.01100
Std.Dev	0.049703	0.039413	0.013641	0.016237
Observation	72	72	36	36

Source: Author's estimation

4. Empirical Results

4.1. Unit Root test

The Augmented Dickey Fuller (ADF) is used to check stationarity of two variables. Table 2 below provides stationary results, whereby OEX and PEX in logarithm form contain unit roots. However, taking first-difference leads two exchange rates being stationary at 1 percent significant level. This means that two variables are stationary in the same order one, which satisfies the condition of VECM.

Table 2: ADF tests

Variables	*2010-2015 period*		*2016-2018 period*	
	T-statistics	*P_value*	*T-statistics*	*P_value*
		Level		
LogOEX	-2.858734	0.1821	-3.134511	0.1139
LogPEX	-4.312633	0.0054	-3.441638	0.0616
		First-diffirence		
D(LogOEX)	-9.056765*	0.0000	-4.937809*	0.0016
D(LogPEX)	-5.024057*	0.0006	-4.337943*	0.0077

Source: Author's estimation

4.2. Lag length

The table 3 below provides criteria to determine the lag length for VECM analysis as choosing the lag length is essential in VECM.

Regarding to the period of 2010-2015, all AIC, SC, and HQ criteria choose four lags for the model. Moving onto the period of 2016-2018, based on AIC, SC, and HQ criteria, there are two choice of lag length such as one lag or two lags. As the number of observations is restrained, the lag length should be as small as possible. If the lag length increases, it makes the degree of freedom decreasing and leads estimates being bias. Thus, the quality of results is not credible. This explanation suggests one lag for the model over the span of 2016-2018. However if the lag length is too small, it could make the

Table 3: Lag length criteria

Lag	*2010-2015 period*			*2016-2018 period*		
	AIC	*SC*	*HQ*	*AIC*	*SC*	*HQ*
0	-8.697600	-8.631247	-8.671381	-12.63502	-12.54705	-12.60432
1	-12.27129	-12.07223	-12.19264	-17.30534	-17.04142*	-17.21322
2	-12.46219	-12.13042	-12.33109	-17.36776*	-16.92789	-17.21423*
3	-12.73107	-12.26660	-12.54754	-17.18193	-16.56611	-16.96699
4	-13.12947*	-12.53229*	-12.89350*	-17.24607	-16.45431	-16.96972
5	-13.08403	-12.35414	-12.79561	-17.13286	-16.16516	-16.79511
6	-13.00726	-12.14467	-12.66641	-17.10827	-15.96461	-16.70910

Source: Author's estimation

autocorrelation, and then causes estimation results being bias as well. It then is necessary to choose suitable lag length to avoid any incredible results. Ivanov and Kilian (2005) point out that HQ criterion is more accrurate to large and quarterly data (more than 120 observations), SC criterion is more accrurate to small and quarterly data (less than 120 observations), and AIC criterion is more accrurate to monthly data. These arguments suggest two lags for the model in 2016-2018 period. As there are different views to choose lag length for the period of 2016-2018, the paper runs and compares empirical results from models with different lags to finally determine the appropriate lag length. As a consequence, empirical results in the two-lagged model are rational and cridible, which leads the paper using two lags for the period of 2016-2018. Overall, the paper uses four lags for the model in 2010-2015 period and two lags for the model in 2016-2018 period.

4.3. Johansen's tests

Johansen's framework is used to determine the rank of cointegration. This test investigates whether there exist a cointegration between OEX and PEX. Table 4 below provides the test results. It finds that there is at least one cointegration between two exchange rates over the periods of 2010-2015

Table 4: Johansen's tests

Maximum Rank	*Eigen-value*	*Trace statistic*	*Critical value (5% level)*	*P-value*
		2010-2015 period		
None*	0.375315	34.53975	12.32090	0.0000
At least 1	0.044013	3.015739	4.129906	0.0976
		2016-2018 period		
None*	0.257824	14.64338	12.32090	0.0201
At least 1	0.102903	3.909301	4.129906	0.0570

Source: Author's estimation

and 2016-2018. In these cases, it is able to identify long-run dynamics as short-run dynamic between two exchange rates as well.

4.4. Vector Error Correction Model over the period of 2010-2015

4.4.1. Long-run dynamics

Table 5 below summarizes estimations of VECM and cointegrating equations to show the long-run relationships between LogOEX and LogPEX over the span of 2010-2015. The table mentions two dynamic equations: one equation is used for dependent variable D(logOEX) and another equation is used for dependent variable D(logPEX). Negative numbers in parentheses represent the number of lags.

Table 5: Error-correction and Cointegration equations 2010-2015

Vector Error Correction Model				
Independent variables	*Dependent variables*			
	D(logOEX)		*D(logPEX)*	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*
Error-Correction(-4) (rate of adjustment)	-0.394609 *	0.06694	0.193706	0.10535
D(logOEX) (-1)	-0.051487	0.10737	-0.462330	0.16898
D(logOEX) (-2)	0.116321	0.10143	-0.017446	0.15963
D(logOEX) (-3)	-0.497980	0.10174	-0.135853	0.16012
D(logOEX) (-4)	-0.180496	0.11647	-0.016474	0.18330
D(logPEX) (-1)	-0.298101	0.10897	0.120075	0.17150
D(logPEX) (-2)	-0.699759	0.10884	-0.440865	0.17129
D(logPEX) (-3)	0.146238	0.12385	0.268076	0.19492
D(logPEX) (-4)	-0.029908	0.09696	-0.187109	0.15260
Cointegrating equations				
LogOEX (-1)	1.000000		-1.000016	0.00027
LogPEX (-1)	-0.999984 *	0.00027	1.000000	

Source: Author's estimation

Cointegrating equations appear at the bottom of the table 5.

$$\log OEX_{t-1} = 0.999984 \log PEX_{t-1} \quad (1)$$

$$\log PEX_{t-1} = 1.000016 \log OEX_{t-1} \quad (2)$$

From the cointegrating equations, the model extracts residuals lagged one period to estimate error-correction terms. The top of the table 5 gives estimates of error-correction patterns, wherein error-correction terms reflect the rate of adjustments to long-run equilibrium from deviations.

Regarding to the equation (1) where LogOEX is the dependent variable, the error-correction term is negative (-0.3946) and statistically significant

(P-value = 0.0000). The significantly negative sign of the error-correction pattern implies that each exchange rate converges to the long-run equilibrium from their past deviations. In other words, the long-run equilibrium exists in the equation (1). The magnitude is 0.3946; it suggests that the rate of adjustment is around 39.46% within one month. This means that it takes about 2 months and half to return to the long-run equilibrium.

VECM estimates:

$D(logOEX_t) = -0.395ECT_{t-1} - 0.051D(logOEX_{t-1}) + 0.116D(logOEX_{t-2}) - 0.498D(logOEX_{t-3}) - 0.180D(logOEX_{t-4}) - 0.298D(logPEX_{t-1}) - 0.700D(logPEX_{t-2}) + 0.146D(logPEX_{t-3}) - 0.030D(logPEX_{t-4})$

Error-correction estimates: $ECT_{t-1} = 1.000logOEX_{t-1} + 0.999logPEX_{t-1}$

Moving onto the equation (2) where LogPEX is the dependent variable, the error-correction term is negative but not significant (P-value = 0.0711). This means that long-run equilibrium does not exist in the equation (2).

VECM estimates:

$D(logOEX_t) = 0.194ECT_{t-1} - 0.462D(logOEX_{t-1}) - 0.017D(logOEX_{t-2}) - 0.136D(logOEX_{t-3}) - 0.016D(logOEX_{t-4}) + 0.120D(logPEX_{t-1}) - 0.441D(logPEX_{t-2}) + 0.268D(logPEX_{t-3}) - 0.187D(logPEX_{t-4})$

Error-correction estimates: $ECT_{t-1} = 1.000logPEX_{t-1} + 1.000logOEX_{t-1}$

In general, the long-run equilibrium only appears in the equation (1) where D(logOEX) is the dependent variable, but does not appear in the equation (2) where D(logPEX) is the dependent variable.

4.4.2. Short-run dynamics

The paper applies Wald test to check whether there are short-run relationships between two exchange rates. Regarding to the equation that D(logOEX) is the dependent variable (table 5), it should investigate whether coefficients of D(logPEX) with respect to its number of lags joined could affect D(logOEX). Moving onto the equation that D(logPEX) is the dependent variable (table 5), it also should investigate whether coefficients of D(logOEX) with respect to its number of lags joined could affect D(logPEX). The table 6 below shows short-run dynamic results of two exchange rates.

Table 6: Wald test

D(logOEX)		*D(logPEX)*	
χ^2-statistics	*P-value*	*χ^2-statistics*	*P-value*
65.35616*	0.0000	11.35296*	0.0229

Source: Author's estimatio

Regarding to the equation that D(logOEX) is the dependent variable (table 6), based on Wald test results, it can reject the null hypothesis of no short-run dynamics. This means that there are short-run effects from PEX to OEX. Holding all factors constant, if PEX depreciates by 1%, it could cause OEX appreciating by 0.298% on average after one month, appreciating by 0.670% on average after two months, depreciating by 0.146% on average after three months, or appreciating by 0.030% on average after four months (table 5). Moving onto the equation that D(logPEX) is the dependent variable (table 6), based on Wald test results, it can reject the null hypothesis of no short-run dynamics. This means that there are short-run effects from OEX to PEX. Holding all factors constant, if OEX depreciates by 1%, it could cause PEX appreciating by 0.462% on average after one month, by 0.017% on average after two months, by 0.013% on average after three months, or by 0.016% on average after four months (table 5).

This concludes that there are short-run effects from PEX to OEX, and vice versa, there are short-run effects from OEX to PEX.

4.4.3. Granger causality

The above-mentioned causality conclusion between two exchange rates could be tested by Granger causality. As short-run dynamics play an important role, first-differences of variables that exclude long-run dynamics are used in Granger causality test. Results are showed in Table 7 below.

Table 7: Granger causality

Independent variables	*Dependent variables*			
	D(logOEX)		*D(logPEX)*	
	χ^2*-statistics*	*P-value*	χ^2*-statistics*	*P-value*
D(logOEX)	-	-	11.38198 *	0.0226
D(logPEX)	65.35616*	0.0000	-	-

Source: Author's estimation

Based on the Chi-square statistics and their P-values, it can reject hypothesizes of weak exogeneity. It means that D(logPEX) is not weak exogeneity to D(logOEX) and D(logOEX) is not weak exogeneity to D(logPEX) as well. In other words, PEX has Granger-caused OEX and OEX has Granger-caused PEX as well.

Overall, empirical results from different approaches such as VECM and Granger causality give the same conclusion. There are short-run effects from PEX to OEX, and vice versa, there are short-run effects from OEX to PEX.

4.4.4. Diagnostic checking

In diagnostic checking, it is necessary to check serial correlation and heteroskedascity of residuals from VECM regressions. The paper applies Breusch-Godfrey Serial Correlation LM test to check serial correlation and Autoregressive Conditional Heteroskedasticity (ARCH) test to check heteroskedascity. The table 8 below shows the test results.

Table 8: Diagnostic checking

	F-statistic	*Prob. F*	*Obs*R-squared*	*Prob.* χ^2
Breusch-Godfrey	0.541182	0.7061	2.577356	0.6308
ARCH	0.617172	0.6520	2.572030	0.6318

Source: Author's estimation

Based on Breusch-Godfrey and ARCH tests' results, it cannot reject hypothesizes. To be more exact, it cannot reject the hypothesis of no serial correlation for Breusch-Godfrey test. It also cannot reject the hypothesis of homoskedasticity for ARCH test. This means that there are no serial correlation and no heteroscedasticity for residual of regression. Therefore, the model specification is plausible.

4.5. Vector Error Correction Model over the period of 2016-2018

4.5.1. Long-run dynamics

Table 9 below summarizes estimations of VECM and cointegrating equations to show the long-run relationships between LogOEX and LogPEX over the span of 2016-2018.

Table 9: Error-correction and Cointegration equations 2016-2018

Vector Error Correction Model				
Independent variables	*Dependent variables*			
	D(logOEX)		*D(logPEX)*	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*
Error-Correction(-2) (rate of adjustment)	-0.063607	0.03614	-0.188292	0.09880
D(logOEX) (-1)	0.288314	0.18533	1.000346	0.50715
D(logOEX) (-2)	0.098614	0.19358	0.709315	0.52974
D(logPEX) (-1)	-0.056177	0.06178	0.228530	0.16905
D(logPEX) (-2)	-0.012145	0.06218	-0.166244	0.17016
Cointegrating equations				
LogOEX (-1)	1.000000		-1.001088	0.00035
LogPEX (-1)	-0.998913	0.00035	1.000000	

Source: Author's estimation

Cointegrating equations appear at the bottom of the table 9. From the cointegrating equations, the model extracts residuals lagged one period in order to estimate error-correction terms. The top of the table 9 gives estimates of error-correction patterns, wherein error-correction terms reflect the rate of adjustments to long-run equilibrium from deviations. Both error-correction terms are negative (-0.0636 and -0.1883 respectively) but are not statistically significant (P-value = 0.0883 and P-value = 0.0635 respectively). This means that long-run equilibrium does not exist in the model over the period of 2016-2018.

4.5.2. Short-run dynamics

The paper applies Wald test to check whether there are short-run relationships between two exchange rates. Regarding to the equation that D(logOEX) is the dependent variable (table 9), it should investigate whether coefficients of D(logPEX) with respect to its number of lags joined could affect D(logOEX). By switching D(logOEX) and D(logPEX), it could establish Wald test for the equation that D(logPEX) is the dependent variable. The table 10 below shows the results of short-run dynamics of two exchange rates.

Table 10: Wald test

D(logOEX)		*D(logPEX)*	
χ^2-statistics	*P-value*	*χ^2-statistics*	*P-value*
0.914310	0.6331	7.097387*	0.0288

Source: Author's estimation

Regarding to the equation that D(logOEX) is the dependent variable (table 10), it cannot reject the null hypothesis of no short-run dynamics based on Wald test results. This means that there are not short-run effects from PEX to OEX. In contrast, in the equation that D(logPEX) is the dependent variable, it can reject the null hypothesis of no short-run dynamics based on Wald test results. This means that there are short-run effects from OEX to PEX. Holding all factors constant, if OEX depreciates by 1%, it could cause PEX depreciating by 1.000% on average after one month or by 0.709% on average after two months (table 9). Overall, this concludes that there are no short-run effects from PEX to OEX, but there are short-run effects from OEX to PEX.

4.5.3. Granger causality

The above-mentioned causality conclusion between two exchange rates could be tested by Granger causality. Results are showed in Table 11 below.

Table 11: Granger causality

Independent variables	*Dependent variables*			
	D(logOEX)		*D(logPEX)*	
	χ^2-statistics	*P-value*	*χ^2-statistics*	*P-value*
D(logOEX)	-	-	7.097387*	0.0288
D(logPEX)	0.914310	0.6331	-	-

Source: Author's estimation

Regarding to the equation that D(logOEX) is the dependent variable, it cannot reject the hypothesis of weak exogeneity based on the Chi-square statistic and its P-value. Meaning that PEX is weak exogeneity, or PEX does not have Granger-caused OEX. Moving onto the equation that D(logPEX) is the dependent variable, it can reject the hypothesis of weak exogeneity. This means that OEX is not weak exogeneity, or OEX has Granger-caused PEX.

In genral, empirical results from different approaches such as VECM and Granger causality give the same conclusion. There are not short-run effects from PEX to OEX, but there are short-run effects from OEX to PEX.

4.5.4. Diagnostic checking

In diagnostic checking, it is necessary to check serial correlation and heteroskedascity of residuals from VECM regressions. The paper applies Breusch-Godfrey Serial Correlation LM test to check serial correlation and Autoregressive Conditional Heteroskedasticity (ARCH) test to check heteroskedascity. The table 12 below shows the test results.

Table 12: Diagnostic checking

	F-statistic	*Prob. F*	*Obs*R-squared*	*Prob.*
Breusch-Godfrey	0.496718	0.6136	0.474572	0.7888
ARCH	0.364088	0.6978	0.780315	0.6770

Source: Author's estimation

Based on Breusch-Godfrey and ARCH tests' results, it cannot reject the hypothesizes. To be more exact, it cannot reject the hypothesis of no serial correlation for Breusch-Godfrey test. It also cannot reject the hypothesis of homoskedasticity for ARCH test. This means that there are no serial correlation and no heteroscedasticity for residual of regression. Therefore, the model specification is plausible.

5. Discussion and policy implication

The paper applies VECM approach to investigate the relationship between OEX and PEX over different periods of 2010-2015 and 2015-2018 following the significant change of the exchange rate policy.

Over the span of 2010-2015, the finding shows that there are both long-run and short-run dynamics from PEX to OEX while there are only short-run dynamics from OEX to PEX. Meaning that PEX could drive OEX in this period. The paper's empirical evidences could be explained by analyzing the exchange rate regime in the period of 2010-2015. To be more exact, Vietnam Dong is usually pegged to US dollar for a long time. Therefore, OEX does not reflect its true value, whereby speculations raise in foreign exchange markets. This leads the foreign exchange demand increasing under the shortage of foreign exchange supply. Consequently, PEX rises and causes the exchange rate premium level increasing. In this context, SBV has to intervene by selling US dollars from Foreign Exchange Reserves into the foreign exchange market. However, Foreign Exchange Reserves are limited, if SBV intervenes into the market but it does not work well, SBV must to depreciate OEX to reduce the exchange rate premium level. This is a reason why PEX could drive OEX in short and long terms. Furthermore, when OEX depreciates, it could affect PEX in the short term. However, as OEX then continues fixing in the next time, it cannot influence PEX in the long term.

Over the period of 2016-2018, the findings show that there are not long-run and short-run dynamics from PEX to OEX while there still are short-run dynamics from OEX to PEX. Meaning that PEX could not drive OEX in this period. This fact also could be explained when analyzing the significant change of the exchange rate regime in this period. At the beginning of 2016, SBV enforces the new exchange rate regime, whereby OEX swiftes from pegging to US dollar to pegging to a basket of foreign currencies. This leads OEX fluctuates in two directions (upward and downward) to reflect foreign exchange market movements. Consequently, OEX is more flexible, which constraints the exchange rate premium level. This is a reason why PEX cannot drive OEX over the span of 2016-2018. Instead, the fluctuation of OEX still influences PEX in the short term. This result suggests the efficiency of the new exchange rate policy to prevent negative impacts from the free market.

Based on empirical results, if OEX is fixed, PEX could drive the official market. Therefore, it negatively impacts the foreign exchange market. However, if OEX is more flexible, PEX cannot drive the official market. In the current time, the exchange rate regime in Vietnam is gradually flexible. It bases on three factors, namely the average interbank exchange rate, foreign currency movements of large trading partners, and the balance between macroeconomic policies and monetary policy. The first two factors reflect the foreign exchange market movements; however, the last factor still represents the powerful control of SBV. It could be understood that the foreign exchange market in Vietnam is still developing; it thus still contains a number of risky. Consequently, SBV needs to intervene into the foreign exchange market if it is necessary. This act could hinder the efficiency of flexible exchange rate regime. This is a reason why the paper's results show that OEX only affects PEX shortly in the current time (2016-2018 period), but it cannot influence the black market in the long term. In order to drive PEX in the long term, it is essential to let the exchange rate mechanism being more flexible. To achieve this target, on one hand SBV should increase Foreign Exchange Reserves to guarantee the stability of the exchange rate, which reduces speculations in the foreign exchange market. On the other hand, SBV should improve the foreign exchange market by diversifying and improving participants in the market, as well as developing and diversifying transaction tools to reduce market risky.

Regarding to Foreign Exchange Reserves, SBV should purchase foreign exchanges from the Treasury and credit institutions to increase its reserves. Besides, SBV also must set up an efficient monetary policy to guaranty interests of holding domestic currency against foreign currency, which encourage individuals and businesses selling their foreign currency from their remittances and export revenues. Additionally, SBV has to manage its foreign exchange trading in international markets to get profits and raise its reserves. Moving onto the foreign exchange market, SBV might require commercial banks improving their trading capacity and risk management. At the same time, SBV should build up a framework of foreign exchange tools, wherein it is necessary to develop derivative transactions such as option, forward and future transactions beside spot transactions. Such derivative means could help participants in the foreign exchange market hedging their risk. If the foreign exchange market could reduce financial risky, SBV thus could let OEX being more flexible. As a result, OEX would drive both official and black markets in short and long terms as well.

6. Conclusion

The paper analyzes the relationship between OEX and PEX following the significant change of the exchange rate policy. The study applies VECM approach and uses monthly data from 2010 to 2018 to conclude the above-mentioned relationship. Over the span of 2010-2015, the finding shows that there are long-run and short-run dynamics from PEX to OEX. This means that the black market could drive the official market in that time. In contrast, there are only short-run dynamics and are not long-run dynamics from OEX to PEX. This means that the official market only affects the free market in the short term; however, the former cannot influence the latter in the long term. In other words, the official market cannot drive the black market over the span of 2010-2015. During the period of 2016-2018, the empirical evidences show that there are not long-run and short-run dynamics from PEX to OEX. This means that the free market now cannot drive the official market. On the contrary, although there are not long-run dynamics from OEX to PEX, there still are short-run dynamics. Even though the official market cannot affects the black market in long term, the former could still influence the latter in short term during the period of 2016-2018. These findings imply the efficiency of the new exchange rate policy, implemented at the beginning of 2016, so the parallel exchange rate now cannot negatively affect the official exchange rate.

The study also provides reasons to explain empirical results, based on analyses of exchange rate regimes in each period. This reflects the significant change in the exchange rate policy, which swifts from the fixed exchange rate mechanism to the flexible exchange rate mechanism. From these findings and their explanations, the paper suggests some recommendations that SBV could implement to manage the exchange rate regime. SBV then needs increasing the Foreign Exchange Reserves and improving the foreign exchange market to reduce market risky and stabilize exchange rates. Therefore, the exchange rate could be absolutely flexible, and then drive both official and black markets.

To sum up, investigating the relationship between two exchange rates and proposing relevant policy are the way that the study contributes to the existing studies.

Future work: As mentioned above, there is a significant change in the exchange rate policy in 2016. This implies that there exist structural breaks in the model. In one hand, it would apply VECM method and devide data from 2010 to 2018 into two different periods of 2010-2015 and 2016-2018 as the paper did. In other hand, it would use Threshold VECM instead of VECM to run the model. In the next study, the author will apply Threshold VECM and compare results from this method with results from the paper to have better assessments on the relationship between OEX and PEX in Vietnam.

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