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Exchange rate determination in Vietnam

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Abstract

This study investigates the determinants of the exchange rate in Vietnam and suggests policy implications. Gregory-Hansen cointegration tests and generalised variance decomposition (VDC) analysis were applied to monthly data from July 2004 to December 2013. The model was built based on the three popular approaches to exchange rate determination, which are purchasing power parity (PPP) approach, balance of payment (BOP) approach, and monetary and portfolio approach. This study finds that the price ratio between Vietnam and the US is an important determinant of Vietnam's exchange rate.

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1. INTRODUCTION

An effective exchange rate policy is critical for a country to control inflation, support export activities, improve balance of payment, and maintain the stability of her domestic budget and currency. The country, Vietnam, has adopted a crawling peg with the US dollar for exchange rate determination, since February 1999. Given that Vietnam is undergoing a transition from a centrally-planned economy to a market-oriented one, studies on exchange rate determination can play a crucial role in guiding towards appropriate exchange rate strategies. There have been only a few rigorous quantitative studies on Vietnam's exchange rate but most of them tested and focused on the impact of exchange rate on key economic variables such as output, inflation, and trade balance (Le and Nguyen, 2011).

Therefore, this study aims to fill the gap in economic literature, by determining the exchange rate in Vietnam in the recent decade (since 2004), as well as suggesting possible policy implications. The study is organized as follows. First, the literature review discusses theories of exchange rate determination while the next section presents the data and methodology. Subsequently, the empirical results are discussed and the study concludes with policy implications.

2. THEORIES OF EXCHANGE RATE DETERMINATION

Theoretically, exchange rate can be explained using three approaches. The Purchasing Power Parity (PPP) approach is perhaps one of the most significant methods of determining exchange rate. The PPP is primarily based on the law of one price. This law implies that the exchange rate of currencies have to compensate for differences in the prices of goods. However, PPP is not a very reliable determinant of exchange rate in the short run. This is because it omits several factors such as transportation costs, barriers to trade, tariffs, and other transaction costs. Further, this law only applies to tradable goods; items like houses, and many local services, are usually not traded between countries. There are two versions of the PPP theory namely: 1) the absolute PPP and 2) the relative PPP. The absolute PPP refers to the equalization of price levels across countries while the relative PPP refers to the rate of change in price levels, i.e., inflation rates. The relative PPP approach continues to be applied till date and it states that the exchange rate has to compensate for the difference in inflation rates.

Stated mathematically,

$$E = \frac{P}{P^*}$$

where E = exchange rate expressed as the price in domestic currency of one unit of the foreign currency; P and P* are the domestic and foreign price levels, respectively.

The second approach is the Balance of Payment (BOP) which determines the exchange rate at the internal and external equilibria. Internal equilibrium reflects a full-employment state in the economy whereas external equilibrium implies equilibrium in the BOP. The supply and demand of both domestic and foreign currencies, which are essential determinants of the exchange rate, are derived from transactions entered in the BOP – flow of goods, as well as financial imports and exports of a country. A BOP surplus shows a stronger demand for the domestic currency compared to the foreign currency. Thus, the exchange rate will decrease following appreciation of the domestic currency. The disadvantage of this approach is that, in the short run, it is difficult to determine the exchange rate that is consistent with the natural rate of unemployment or equilibrium in the BOP.

The third approach is the monetary and portfolio approach which assumes that agents can choose from a portfolio of domestic and foreign assets. The assets (either money or bonds) have an expected return that could be invested. An arbitrage opportunity arises when the expected depreciation does not compensate for the difference in exchange rates. The investment opportunity attached to this return determines the exchange rate.

Stated mathematically, Interest Rate Parity (IRP):

$$\frac{F-S}{S} = i - i^*$$

where F and S are respectively the forward and spot exchange rates expressed as the price in domestic currency of one unit of the foreign currency; i and i* are the domestic and foreign interest rates.

3. THE DATA AND METHODOLOGY

3.1. Data

The basic model in this study was built based on the three approaches to exchange rate determination, as described above. The basic VAR model includes all the variables that could explain the exchange rate (ER), such as interest rate differential, price ratio and BOP between Vietnam and the US. For the exchange rate variable, the VND/USD exchange rate was used. For interest rate differential, price ratio and BOP, the corresponding data of Vietnam and the US were employed, as Vietnam has adopted a crawling peg with the US dollar since February 1999.

Vietnam interbank rate and US Federal fund rate were used as the short-term interest rate for Vietnam and the US, respectively. Consumer price index (CPI) (2005=100) was used to measure the price level in each country. This study was conducted using the monthly time-series data obtained from October 2004 to December 2013, subject to data availability. All the data on country-specific macroeconomic variables including the VND/USD exchange rate, short-term interest rate, CPI and BOP were obtained from the International Financial Statistics. Except for interest rate differential $(i_{VN} - i_{US})$, the other variables including $ER_{VND/USD}$, $\frac{P_{VN}}{P_{US}}$ and BOP were transformed into a logarithmic form, before being entered into the model, to stabilize the variability in data.

3.2. Methodology

This study utilized the unit root test by Zivot and Andrews (1992), which accounts for one endogenous break in the data series, to identify the stationary properties of the variables. To test for a unit root against the alternative of trend stationary process with a structural break, the following regression was used:

$$y_t = \mu + \theta DU_t(\tau_b) + \beta t + \gamma DT_t(\tau_b) + \alpha y_{t-1} + \sum_{i=1}^{k} \varphi_i \, \Delta y_{t-i} + \varepsilon_t \qquad \text{[Eq. 1]}$$

where $DU_t(\tau_b) = 1$ if $t > \tau_b$ and 0 otherwise, and $DT_t(\tau_b) = t - \tau_b$ for $t > \tau_b$ and 0 otherwise. Δ is the first difference operator and ε_t is a white noise disturbance term with variance σ^2. DU_t is a sustained dummy variable that captures a shift in the intercept, and DT_t represents a shift in the trend occurring at time τ_b. The model accommodates the possibility of a change in the intercept, as well as a broken trend. The breakpoint is estimated by the ordinary least squares (OLS) for t = 2, 3 … T-1, and the breakpoint τ_b is selected by the minimum t-stat ($t_{\hat{\alpha}}$) on the coefficient of the autoregressive variable. $t_{\hat{\alpha}}$ is the one-sided t – stat for testing $\alpha = 1$ in the model. The lag length k is determined using the general to specific approach adopted by Perron (1989). The null of a unit root is rejected if $t_{\hat{\alpha}} < k_{inf,\alpha}$ where $k_{inf,\alpha}$ denotes the size α left-tail critical value.

Next, the Gregory and Hansen (1996) tests for cointegration were employed to analyse the long-run relationships between time-series variables. These tests explicitly incorporate a break in the cointegrating relationship. The cointegration procedure consists of two steps. First, as suggested by Gregory and Hansen (1996), the Hansen's (1992) linearity (instability) tests are performed to determine whether the cointegrating relationship has been subject to a structural change. The L_C test is employed to determine whether the long-run relationship between the variables of interest, is subject to a break. As to the second step, cointegration tests are conducted by allowing a break in the long-run equation, following the approach suggested by Gregory and Hansen (1996). The advantage of this test is the ability to treat the issues of an endogenous break and cointegration altogether.

The GH test allows us to assess if cointegration amongst variables of interest holds over a first period of time and then, in an a priori unknown period T_b (the timing of the change point), it shifts to another long run relationship. Three different models were employed in this study corresponding to the three different assumptions concerning the nature of the shift in the cointegrating vector: the level shift model (C), the level shift with trend model (C/T) and the regime shift model (C/S). To model the structural change, the step dummy variable $D_t(T_b)$ is defined as: $D_t(T_b) = 1$ if $t > T_b$ where 1(.) denotes the indicator function, and $D_t(T_b) = 0$ otherwise. The three models: C, C/T and C/S representing the general long-run relationship are respectively defined as follows:

$$y_t = \mu + \theta D_t(T_b) + \alpha' x_t + u_t \qquad \text{[Eq. 2]}$$

$$y_t = \mu + \theta D_t(T_b) + \alpha' x_t + \beta t + u_t \qquad \text{[Eq. 3]}$$

$$y_t = \mu + \theta D_t(T_b) + \alpha' x_t + \delta' x_t D_t(T_b) + u_t \qquad \text{[Eq. 4]}$$

where y_t is a scalar variable, x_t is an m-dimensional vector of explanatory variables (both x_t and y_t are supposed to be I(1)), u_t is the disturbance term, parameters μ and θ measure respectively, the intercept before the break in T_b and the shift occurred after the break, while α are the parameters of the cointegrating vector, β is the trend slope before the shift, and δ is the change in the cointegrating vector after the shift.

The standard methods of testing the null hypothesis of no cointegration are residual-based. OLS were employed to estimate Equations (2), (3), and (4) and then a unit root test was applied to the regression errors (Gregory and Hansen, 1996). The time break was treated as an unknown and was estimated with a data dependent method, i.e. it was computed for each break point in the interval [0.15T, 0.85T] where T denotes the sample size (Zivot and Andrews, 1992). The date of the structural break will correspond to the minimum of the unit root test statistics computed on a trimmed sample.

Finally, based on the cointegration results, this study estimated the basic model and employed the generalized forecast error variance decomposition (VDC) analysis developed by Koop et al. (1996) and Pesaran and Shin (1998) to determine the relative importance of the selected macroeconomic variables, in explaining the volatility of the VND/USD exchange rate. The generalized approach is superior to the traditional approach as the results are not sensitive to the order of the variables in the system. This method is well documented in recent literature, so the specifics are not discussed here.

4. RESULTS AND IMPLICATIONS

The results of ZA unit root tests are reported in Table 1. The finding is that in level, all the variables are non-stationary while in first difference, they are stationary.

Next, this study tests for the stability of the long run relationship between the VND/USD exchange rate and the three selected macroeconomic variables: $i_{VN} - i_{US}$, $log\left(\frac{P_{VN}}{P_{US}}\right)$ and $log(BOP)$. The test statistic L_C is reported in Table 2. The results show that there is not enough evidence to reject the null hypothesis of stability in the long-run equation, since the test statistic is insignificant at all conventional significance levels.

Table 1: Zivot-Andrews Unit Root Test (Intercept and Trend)

	Level			First difference		
	Lag	t-stat	Break point	Lag	t-stat	Break point
$log(ER_{VND/USD})$	1	-3.554	2009M12	0	-9.631***	2011M04
$i_{VN} - i_{US}$	4	-4.150	2008M02	2	-5.442**	2008M09
$log\left(\frac{P_{VN}}{P_{US}}\right)$	3	-4.462	2007M12	1	-4.970*	2008M09
$log(BOP)$	0	-4.783	2009M02	8	-6.741***	2009M12

The critical values for Zivot and Andrew's test (with intercept and trend) are: -5.57, -5.08 and -4.82 at 1%, 5% and 10% significance levels, respectively.

Table 2: Linearity (stability) test

Lc statistic	Stochastic Trends	Deterministic Trends	Excluded Trends	Prob.
0.672	4	1	0	> 0.2

Note: Null hypothesis: Series are cointegrated. Significance implies rejection of the null hypothesis of stability at conventional levels. C and @TREND are used as deterministic regressors, and lags are automatically determined by AIC.

The next step is to conduct the GH cointegration tests which allow for an endogenous structural break in the cointegration. This study computes three modified versions of the ADF cointegration tests of Engle and Granger (1987), as well as the modified Z_t and Z_α tests of Phillips and Ouliaris (1990). The three statistics obtained from different model specifications (C, C/T and C/S) were reported for comparison, where lag *k* was set as in Perron (1997), following a general to specific procedure. The results presented in Table 3, indicate that there is not enough evidence to reject the null hypothesis of no cointegration at the 1% and 5% significance levels. As such, it might be concluded that there is no cointegrating relationship among the VND/USD exchange rate, price ratio, interest rate difference and BOP between Vietnam and the US, during the investigated period.

Table 3: Gregory-Hansen cointegration test (Dependent Variable: $log(ER_{VND/USD})$:)

	Level shift C	Level shift with trend C/T	Regime shift C/S
ADF*	-4.721 (0)	-4.748 (0)	-6.392** (1)
	[2007M12]	[2009M12]	[2010M01]
Z_α^*	-38.245	-38.200	-64.822*
	[2007M12]	[2009M12]	[2009M12]
Z_t^*	-4.742	-4.769	-6.558***
	[2007M12]	[2009M12]	[2009M12]

Note: VAR consists of $log(ER_{VND/USD})$, $(i_{VN} - i_{US})$, $log(BOP)$ and $log\left(\frac{P_{VN}}{P_{US}}\right)$ so m=3. *, ** and *** denote significance, i.e. rejection of the null hypothesis of no cointegration at 10%, 5% and 1% levels, respectively. Numbers in (.) are lag orders to include in equations. Time breaks are in [.] Approximate asymptotic critical values for C, C/T and C/S respectively: m=3: -5.77, -6.05 -6.51 for ADF* and Z_t^* and -63.64, -70.27, -80.15 for Z_α^* (at 1% level); -5.28, -5.57, -6.00 for ADF* and Z_t^* and -53.58, -59.76, -68.94 for Z_α^* (at 5% level); -5.02, -5.33, -5.75 for ADF* and Z_t^* and -48.65, -54.94, -63.42 for Z_α^* (at 10% level).

No cointegrating relationship was found for the case of C model and C/T model, suggesting that the variables did not move together in the long run. However, with the C/S model, the test statistics are 6.392 for ADF* and -6.558 for Zt*, implying that the null can be rejected at 5% level of significance. As such, it can be thought that there is cointegration with the C/S model: the model considered regime shift (possible break in both constant and trend).

After having determined the cointegration with the C/S model, the next step is to estimate the corresponding cointegration vector in order to attain the long-run relationship. As suggested by the GH results reported in Table 3, this study estimated the regime shift model, as follows:

$$log(ER_{VND/USD})_t = \alpha + \beta\varphi_{t,\tau} + \gamma_1 log(BOP)_t + \gamma_2(i_{VN} - i_{US})_t + \gamma_3 log\left(\frac{P_{VN}}{P_{US}}\right)_t + \delta_1 log(BOP)_t\varphi_{t,\tau} + \delta_2(i_{VN} - i_{US})_t\varphi_{t,\tau} + \delta_3 log\left(\frac{P_{VN}}{P_{US}}\right)_t \varphi_{t,\tau} + \varepsilon_t \quad \text{[Eq. 5]}$$

where ε_t is the error term and $\varphi_{t,\tau}$ is a dummy variable such that: $\varphi_{t,\tau} = 0$ if $t \le \tau$ and $\varphi_{t,\tau} = 1$ if $t > \tau$. τ denotes the structural break date, i.e. December 2009 as indicated in Table 3. This is to account for a regime shift in the cointegrating relationship because since January 2010, the State Bank of Vietnam (SBV) has implemented a number of measures to deal with the exchange rate fluctuations, including its continuous adjustments of the interbank exchange rate and policy interest rates. The results are reported in Table 4.

Table 4: Estimated coefficients of the cointegration vector

Parameter	Estimate	t-statistics
α	-9.690***	-13.450
β	0.151*	1.798
γ_1	0.002	0.371
γ_2	-0.001*	-2.250
γ_3	0.214***	11.848
δ_1	-0.003	-0.249
δ_2	-0.006***	-7.917
δ_3	-0.345***	-11.415

Note: *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

The estimated results suggest that at the 10% level, the interest rate differential and price ratio significantly affected the VND/USD exchange rate. All the statistically significant impacts had signs as expected in theory. However, at the 1% level, the price ratio was the only factor that had a significant influence on the VND/USD exchange rate. The coefficient of the shift dummy is significantly positive at 10% level. This implies that the VND/USD exchange rate in the years where the regime shift occurred is significantly higher than the VND/USD exchange rate in the years in which there was no regime shift, with controlling for other considered factors in the study. As such, it may be concluded that the effectiveness of SBV's measures to deal with the exchange rate fluctuations was low. Further, the results also indicate that with considering the structural break of December 2009, the coefficients of the interest rate differential and the price ratio between Vietnam and the US have decreased in later years. It thus suggest that, the implementation of several measures by SBV to deal with the exchange rate fluctuations has significantly reduce the impact of interest rate differential and the price ratio between Vietnam and the US on the VND/USD exchange rate.

Finally, the results from estimating the generalized VDC are reported in Table 5. The 10-month horizon is presented as the figures became stable afterwards. Among the three variables, the price ratio between Vietnam and the US appears to play the most significant role in explaining volatilities in the VND/USD exchange rate. This finding is consistent with Vietnam's poor ability to control inflation, as the country has often been faced with high inflation rates during the recent decade. The higher inflation in Vietnam makes domestic goods more expensive, compared to US goods. Thus, the demand for US goods increases, leading to an increase in demand for the US dollar and decreased demand for the Vietnamese Dong. As a result, the VND/USD exchange rate increases, i.e., the Vietnamese Dong depreciates comparatively to the US dollar. The interest rate difference between both countries is the second most important factor in explaining the fluctuations in VND/USD exchange rate while BOP between both countries is the least important determinant. The relative contributions of the variables in the system, in accounting for variations in exchange rate, remained stable during the whole 10-month horizon. It may thus be concluded that the impacts of macroeconomic shocks on exchange rate are transitory.

Table 5: Generalized variance decomposition of Exchange rate in Vietnam (in percentage)

Horizon	BOP	Price Ratio	Interest rate difference
1	0.380	20.567	5.445
2	0.911	20.768	5.806
3	1.544	21.813	6.040
4	1.541	22.078	6.058
5	1.552	22.584	6.385
6	1.568	22.614	6.659
7	1.663	22.686	6.779
8	1.662	22.699	6.835
9	1.662	22.711	6.847
10	1.663	22.721	6.875

Finally, this study conducted robustness checks using the VND/USD exchange rate in real terms (2005=100). The objective of the robustness checks was to determine if there is any significant difference in results. Since the results in all cases are not significantly different, the use of VND/USD exchange rate in nominal terms was retained in the analysis of this study[1].

5. CONCLUDING REMARKS

This study suggests that the price ratio between Vietnam and the US is an important determinant of the exchange rate in Vietnam. Following this conclusion, the depreciation of the VND to the USD during recent periods could be explained by the high inflation in Vietnam and the low inflation in the US, in the past decade. As such, to maintain a strong exchange rate policy, the government of Vietnam should put priority on ensuring stability, instead of continuously trying to achieve a high rate of economic growth. Possible policy measures include tightening monetary policy, stabilising the foreign exchange market, and implementing inflation control plans, to keep an eye on the prices of essential products such as milk and medicine.

Further, despite the privilege of the US dollar in the Foreign Exchange market, Vietnam should not peg its domestic currency only to the US dollar. This is because fluctuations of the US dollar in the world market will affect the VND/USD exchange rate, which generally brings unfavourable outcomes. In addition, since becoming a member of the World Trade Organisation (WTO), Vietnam has become more closely linked with other countries in the region, as well as in the world such as Japan, China, and in Europe. Thus, a multilateral

[1] As space is limited, detailed results on robustness checks will be provided upon request.

exchange rate system based on a currency basket is possibly the most appropriate exchange rate regime for Vietnam. This currency basket should include the currencies of all the key trading partners of Vietnam. This new exchange rate regime would help to increase the stability of Vietnam's exchange rate system.

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