A STUDY ON PURCHASING POWER PARITY IN VIETNAM AND UNITED STATES

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ABSTRACT

The objective of this research is to investigate the relationship of Purchasing Power Parity (PPP) between Vietnam and United States (U.S). Conducted were unit root test; Johansen Co-integration test; Vector Error Correction Model, and monthly time series data spans from January 2010 to December 2015. The results support the theory of PPP holding between Vietnam and U.S. Based on this result, policy makers can calculate the real exchange rate, and find out the effect of exchange rate on trade balance in order to set suitable policies to improve trade balance. The managers of MNCs can forecast the bilateral exchange rate to find the best options to reduce risk or maximize profit.

Keywords: *PPP, real exchange rate, VECM, Johansen Cointegration test*

TÓM TẮT

Nghiên cứu về ngang giá sức mua giữa Việt Nam và Hoa Kỳ

Bài nghiên cứu này nhằm khám phá mối quan hệ giữa ngang giá sức mua (PPP) của Việt Nam và Hoa kỳ. Các kiểm định đơn vị, đồng liên kết Johansen, Mô hình tự hồi quy (VECM) cùng với dữ liệu chuỗi thời gian được thực hiện theo tháng từ tháng 1 năm 2010 đến tháng 12 năm 2015. Kết quả nghiên cứu chỉ ra lý thuyết PPP tồn tại giữa Việt Nam và Hoa Kỳ. Dựa trên kết quả này, các nhà hoạch định chính sách có thể tính tỷ giá hối đoái thật, tìm mối quan hệ giữa tỷ giá hối đoái và cán cân thương mại để có chính sách thích hợp nhằm cải thiện cán cân thương mại giữa hai nước. Các nhà quản lý của các công ty đa quốc gia (MNCs) có thể dự báo tỷ giá giữa hai nước, đưa ra lựa chọn tốt nhất nhằm giảm rủi ro hoặc tối đa hóa lợi nhuận.

Từ khóa: *PPP, tỷ giá hối đoái thực, VECM, đồng liên kết Johansen*

1. Introduction

Purchasing Power Parity (PPP) exerts a cr cial efficiency on the economy. First, using PPP, economists are able to forecast the exchange rate in the long-term and short-term because exchange rate tends to move in the same direction of PPP. The valuation of real exchange rate is very important for Vietnam. Kaminsky et al., (1998) and Chinn (2000) state that appreciation of the exchange rate can lead to a crisis for emerging economies. It affects the international commodity markets and international finance through exchange rates; therefore, the policy makers must have plans to react to exchange rate volatility, and enterprise managers needs suitable strategies to deal with the same. Furthermore, the exchange rate is very important to mana ing a country's trade balance and balance of payments. Finally, PPP helps countries compare the position and economic performance through adjusting Gross Domestic Product. As a result, PPP has become one of the most discussed topics in the world. In short, PPP is a good indicator for policy makers, multinational enterprises and participants in exchange markets.

The presence of PPP is mixed. Tastan (2005) finds that PPP does not exist between Turkey and US or between Turkey and England in the long run. Nevertheless, Baharumshah, et al., (2010) finds the relationship between six Asian c tries and the United States.

The computation of PPP depends on countries and currencies used. In this paper, the a thors aim to determine the existence of PPP between Vietnam and United States.

2. Literature review

The PPP was first presented by the Salamanca School in Spanish in the 16th century. At that time, PPP basically meant that when we changed to the common currency, the price level of every country would be the same (Rogoff, 1996).

Cassel introduced the term purchasing power

parity (PPP) in 1918. After that, PPP became the benchmark for a center bank to set exchange rates and for scholars to study determinants of exchange rates. The model of PPP of Cassel came the inspiration for Balassa and Samuelson to set up their models in 1964. They worked independently and gave the final explanation why absolute PPP formed a good theory of exchange rate (Asea and Corden, 1994). The reason they gave is that the relative price of each good in different countries should be equal to the same price after exchanging into another currency.

The PPP has two versions, absolute PPP and relative PPP (Balassa, 1964). According to the first version, Krugman et al., (2012), says that absolute PPP sets the exchange rate of a pair of countries equal to the ratio of the price level of these countries. This means: st = pt/pt* (1)

Shapiro (1983) states that the relative PPP sets the ratio of domestic to foreign prices equal to the ratio change in the equilibrium exchange rate. This states that there is a constant k which is the relationship between price level and the equilibrium exchange rate.

st = k*pt/pt*

In empirical studies, checking the validity of PPP by unit root test was popular in 1980's, based on the Dickey and Fuller approach, never theless, this approach has low predictive power (Ender and Granger, 1998).

Later, Johansen (1988) developed a method of conducting VECM, which has become the benchmark model for many authors testing the PPP approach.

Studies of PPP use two popular models, linear and nonlinear. Employing the linear model, most papers use a cointegration test called the Vector Error Correction Model (VECM), or test the unit root to check whether all variables move along together or revert to the mean. In contrast, using the nonlinear model, most papers apply the STAR-family (Smooth Transition Auto Regressive) model, and then test the unit root of real ex change rate in the nonlinear model framework.

Tastan (2005) and Narayan (2005) test the stationary of real exchange rate by using a unit root test. Tastan (2005) attempted to find the stationary of the real exchange rate between Turkey and four other partners: US, England, German and Italian. From 1982 to 2003, the empirical result remained non-stationary in the long run between Turkey and the US, and between Turkey and England as well. While Tastan (2005) used a single country, Narayan examined PPP for 17 OECD countries. The results of his research are mixed. If he uses currency based on the US dollar, three countries, France, Portugal, and Den mark are satisfied. If the used currency is the Deutschmark, seven countries are satisfied. The authors used a univariate technique to find out the equilibrium of the real exchange rate ever, Kremers et al. (1992) states that this technique (univariate approach) suffers low power against a multivariate approach because of the deception of improper common factor limitation implicit in the ADF test.

After Johansen (1988) developed a method of conducting VECM, there have been various papers applying it to test PPP. Thereby, Chinn (2000) estimated East Asian currencies ov valued or undervalued with VECM. Chinn es mated that the currencies of Hong Kong, Indone sian, Thai, Malaysian, Philippines and Singapore were overvalued.

Many authors besides Chinn have used the VECM technique to test the PPP theory. Papers finding empirical validity were published by Yazgan (2003), Doğanlar et al.(2009), Kim (2011), Kim and Jei (2013), Jovita (2016), and papers not finding validity were published by Basher et al. (2004), and Doğanlar (2006).

3. Research Methods

3.1. Data collection

The nominal exchange rate, the CPI (Consumer Price Index) of Vietnam and the CPI of the U.S, are given in terms of logarithmic form. All data spanned monthly from January 2010 to December 2015 (Table 1).

3.2. Data analysis

Take log from the equation (1) we have:

$\text{Log}(s_t) = \log(p^t) - \log(p_t^*)$

So when we run regression, the formula is:

$s_t = c + \alpha_1 p_t + \alpha_2 p_t^* + \varepsilon_t$

Where: s is the natural log exchange rate of VN, p_t and p_t^* is the natural log CPI of VN and CPI of US respectively.

Because it uses time series data, the most importance issue is that s, p, and p* are stationary or nonstationary. If the variable is nonstationary, there will be spurious results when running the model.

Step 1: Testing s, p, and p* stationary or non-

Table 1. Variables definition and data source

Variables	Variables definition	Sources
S	The nominal exchange rate is defined as the number of units of domestic currency per unit of foreign currency.	ERIC indicator
CPIVN	Consumer price index of Vietnam, year 2010 = 100	IFS and GSO
CPIUS	Consumer price index of U.S, year 2010 = 100	OECD

stationary by using Augmented Dickey Fuller test. A time series is

An Augmented Dickey Fuller test based on the equation:

$$\Delta Y_t = \beta_1 + \beta_2 t + \beta_3 Y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-1} + \varepsilon_t$$

Where: is a pure white noise error term and n is maximum length of lagged dependent variables.

Null hypothesis: Ho: $\beta_3 = 0$

Alternative hypothesis: H1: $\beta_3 \neq 0$

If the absolute value t* exceeds ADF critical value, the null hypothesis could not be rejected, this result implies that the variable is nonstationary.

If the absolute value t* is smaller than ADF critical value, the null hypothesis fails to reject, this result suggests variable stationary.

Step 2: Test of cointegration.

Johansen (1988) used the following VAR system to analyze the relationship among variables nostationary or stationary.

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \cdots + \Gamma_{k-1} \Delta X_{t-(k-1)} + \Pi X_{t-k} + \mu + \varepsilon_t$$

Where X (q, 1) vector of observation of q variables at time t, μ is a (q, 1) vector of constant terms in each equation, ε_t is a (q,1) vector of error terms. Γi (q,q), Π (q,q) are matrices of coefficients.

Johansen (1988) procedure has two tests, Trace test and Maximum Eigenvalue, to check whether vectors cointegration.

Trace test is calculated following the formula:

$$LRtr(r/k) = -T\sum_{i=r+1}^{k} \log(1 - \lambda i)$$

Where r is the number of cointegrated equation r = 0,1,…k-1 and k is number of endogenous variables.

Null hypothesis: r is the number of cointegrated equations.

Alternative hypothesis: k is the number coi tegrated equations

The maximum Eigenvalue test is calculated following the formula:

$$LRmax(r/k+1) = -Tlog(1 - \lambda)$$

Null hypothesis: r is the number cointegrated equations

Alternative hypothesis: r + 1 is the number cointegrated equations

After using Johansen (1988) procedure, variables are tested cointegration or not. If three variables are cointegration, the conclusion is that three variables have long run relationship or one or three variables come back to the mean.

Step 3: Vector Error Correction Model (VECM)

If there are the cointegrated among the series, the long term relationship happen; therefore VECM can be applied.

The regression of VECM has the form as follow:

$$\Delta e_t = \delta + \pi e_{t-1} + \sum_{i=1}^{\rho-1} \Gamma_i \Delta e_{t-1} + \varepsilon_t$$

where

e_t : n× 1 the exchange rates matrix,

π = αβ: α is n × r and β is r × n matrices of the error correction term

Γ_i: n× n the short-term coefficient matrix

ε_t :n× 1 vector of iid errors

If the Error Correction Term is negative, and significant in sign, there will be a steady long term relative among variables.

4. Results and Discussion

4.1. Unit root test

The Augmented Dickey Fuller test is used to check the stationary of consumer price index of Vietnam (CPIVN), consumer price index of U.S (CPIUS) and nominal exchange rate (S) between Vietnam and U.S. All variables have log form. Mackinon (1996) which is available in Eview 8.1 package software is used as the critical value.

The table 2 reports the results of unit root test for time series of consumer price index of Vietnam (CPIVN), consumer price index of U.S (CPIUS) and nominal exchange rate (S) between Vietnam and U.S. All variables have t-statistic greater than the critical value at level. As the consequence, all variables have unit root or n stationary at level.

Table 2. Unit root test for variables

Variables	ADF			
	At level		At first different	
	t – statistic	p-value	t - statistic	p-value
CPIUS	0.324043	0.9780	-5.544508	0.0000**
CPIVN	1.674693	0.9995	-3.303306	0.0184*
S	0.662047	0.9905	-6.379588	0.0000 **

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

On the contrary, at first, difference S and CPIUS have the t-statistic smaller than criti cal value at 1%. Therefore, S and CPIUS have not unit root or stationary at the first difference. Similarly, CPIVN has t-statistic smaller than the critical value at 5% so that it is stationary at the first difference.

As being analyzed above, all variables are nonstationary at level and stationary at first difference, therefore they cointegrated at I(1) or same order. As a result, Johansen (1988) procedure is examined to investigate the cointegration among these time series.

4.2. Optimal lag

Optimal lag must be chosen before conduct ing Johansen (1988) procedure. In view package, there are five lags length criteria which have the same power. Therefore, if one lag is dominated by many criterions, this lag will be selected. Unless, every lag is used for every case in VECM.

LR: sequential modified LR test statistic
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 3 illustrates three the criterion such as LR, FPE and AIC choose lag 3. In other words, 3-lag was chosen for conducting Johansen (1988) procedure or testing cointegration of three variables.

Table 3. Lag criteria

Criterion	LR	FPE	AIC	SC	HQ
Lag	**3**	**3**	**3**	2	**3**

4.3. Johansen (1988) procedure for cointegration test

For the reason all variables are cointegrated at the first order I(1), Johansen (1988) cointegr tion with 3 lags is conducted to test the long run relationship among variables.

Table 4 presents the Johansen (19 gration test. The results indicate both Trace test and Eigenvalue test are statistically significant at 5% because the statistic is greater than the criti cal value of 5% or P-valued less than 5%. In consequence, the null hypothesis of r = 0 is rejected. R = 0 implies one cointegration equation in the long run. That is the reason why VECM can be used for further investigation of variables.

Table 4. Johansen (1988) cointegration equation

Number of Ces	Cointegration equation			
	Trace test		Eigenvalue test	
	Statistic	P - valued	Statistic	P - valued
None*	30.34429	0.0432	23.52728	0.0226
At most 1	6.817003	0.5990	6.649302	0.5314
At most 2	0.167701	0.6822	0.167701	0.6822

4.4. Vector Error Correction Model

The table 5 suggests the long run relationship of PPP between two countries. C(1) has negative in value (-0.133) and significant in sign (Prob = 0.0011), is error correction term. This implies that the variables move along together or have mean reverting. As consequence, PPP exists between Vietnam and U.S.

Table 5. The speed of adjustment coefficient of long run

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.133156	0.038557	-3.453503	0.0011

In conclusion, ADF, Johansen Cointegration and Vector Error Correction Model prove that PPP hold between Vietnam and U.S. This is the good indicator for policy makers, multinational firms and exchange rate market members to set their plans for future activities.

5. Conclusion

Based on the theory of long run equilibrium real exchange rate, the aim of this paper was to contribute to the analysis of whether the long run PPP hypothesis hold for Vietnam and the United States. To the end, various methods such as Johansen cointegration and VECM frameworks, which are the better methodologies than univar ate method were conducted. General, the results seem to indicate that the PPP hypothesis hold strongly for the VND and USD based on the real exchange rate. This conclusion is the same as the results of Doğanlar et al.(2009), Kim (2011), Kim and Jei (2013), Jovita (2016).

Nevertheless, this paper has just proved the PPP between Vietnam and U.S hold. It is rec ommended that further researches should be conducted such as finding out the misalignment, forecasting the real exchange rate and investigating on the impact of real exchange rate on trade balance.

Conflicts of Interest:

The authors declare no conflict of interest

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