REAL EXCHANGE RATE AND ECONOMIC FUNDAMENTAL: EMPIRICAL STUDY OF ASEAN-5

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Abstract

This paper studies the effect of fundamental economic variables on real exchange rates in Asean-5. The fundamental economic variables are capital mobility, technological progress, terms of trade, opennes index and fiscal policy. The paper applies panel unit root test, panel cointegration test, and Engle-Yoo three-step for short run and long run equilibrium. The result indicates that purchasing power parity holds in the short run. The estimation of equilibrium real exchange rate equation suggests that the direction of the coefficients is in accordance with the theory. It also finds that capital inflow negatively influences equilibrium real exchange rates, and that technological progress affects real exchange rate.

Keywords: Real exchange rate, fundamental economics, ASEAN, panel cointegration
JEL classification numbers: D51, F31

INTRODUCTION

Asian countries have been actively supervising their exchange rate, especially after the crisis 1997-1998. Monetary authorities have been accumulating assets in dollar through the acceleration of domestic product, using export strategy as the activator in the economic growth. The accumulation of foreign exchange reserve in this region increases up to $1.800 billion (or $1,200 excludes Japan) at the end of 2003. The figure is equivalent to 50 percent of world's foreign exchange reserves, or more than ten times of foreign exchange reserves in Latin America (or $ 140 billion). In 2003, central banks in Asia used those reserves to finance almost half of balance of payment.

McKinnon (2003) states that the excess of U.S government spending has trapped the East Asian countries into a surplus balance of payments. Countries in this area are trying to acquire assets in dollar aimed to avoid the exchange rate appreciation and the depreciation. Conventionally it is understood that the government as the owner of the largest reserves are concerned to defend its currency from the speculative attacks in the future. Asia is a regional leader in taking the benefit by maintaining a low rate and high export demand.

Before the crisis attacked some ASEAN countries, real and nominal exchange rates were quite stable. In general, exchange rate in Indonesia was five percent lower if it compared to five other ASEAN countries. In the period before the crisis, Indonesia applied managed exchange rates regime, in which the Central Bank allowed the exchange rates to move around a predetermined boundaries. The intervention rate was from 0,5 percent in 1992 and 8 percent in 1996. The nominal exchange rates fluctuation was around 4 percent per year, indicated that the Central Bank were able to control its exchange rate.

Asia's exchange rate stability has encouraged foreign investment, proven by the significant increase in the capital inflows. Thailand, Malaysia and the Philippines have experienced a high level of capital inflows before the crisis, while Singapore experienced a capital outflow. The increase of capital inflows to Indonesia also

contributed to the improvement of real effective exchange rate in 1996. Furthermore, in 1996, there was a decline in export growth in almost all countries, except the Philippines. Indonesia's export growth declined from the average of 13 percent in 1990-1995 to 10 percent in 1996, smaller than all ASEAN countries. The decline in export growth caused the imbalance trade, which in turn increases all countries' current account deficit, except Singapore. Although there was an appreciation, the emergence of new competitors and the excess supply of export goods made the current account deficit relatively stable between 2,5 percent of GDP in 1990-1996.

Post Asian crisis in 1997, regional liberalization was slowed down by the trend in South East Asian countries to close their markets. However, the Bali Concord II in 2003 restated the commitment to continue the market integration in Asia. ASEAN's Integration Roadmap in the economy has been established since 1967, but only intensified in 1992 by establishing the ASEAN Free Trade Area (AFTA) and was implemented January the first, 2003. Furthermore in the 9th ASEAN Summit in Bali 2003, Bali Concord II has been agreed to establish ASEAN Economic Community (AEC) in 2020 and ASEAN became the production centre. Theoretically, economic integration will lead to trade improvement, economic efficiency improvement, and high competitiveness, which will eventually improve the welfare. ASEAN economic integration facilitates the trade of goods, services and investment, and thus contributing to economic growth in the wider area, namely Asia.

Table 1: Nominal Exchange Rate and Real Exchange Rate, Year 1990-1997

Nations	The Changes of Nominal Exchange Rates toward U.S. Dollar [a] (%)			Real Effective Exchange Rates [b] (1990 =100)		
	Average 1990-95	1996	1997	1995	1996	1997
Indonesia	4	4	24	100	105	62
Thailand	-1	2	24	107	112	76
Malaysia	-1	0	12	102	108	85
Singapore	-5	-1	5	113	118	114
Philippine	3	2	12	110	117	90

Notes: (1) [a] negative sign is appreciation of exchange rate, (2) [b] the improvement states by real effective appreciation exchange rate. Sources: IMF (2000)

Table 2: Macroeconomic Indicators 1990-1997 (%)

Nations	Ratio *Capital Inflows* toward GDP			Export Growth			Ratio Deficit Transaction Berjalan terhadap GDP		
	Average 1990-95	1996	1997	Average 1990-95	1996	1997	Average 1990-95	1996	1997
Indonesia	3	5	-2	13	10	7	-2	-3	-2
Thailand	10	9	-10	19	-1	3	-7	-8	-2
Malaysia	11	7	1	20	6	1	-6	-5	-5
Singapore	-1	-7	-9	18	6	0	12	15	18
Philippine	6	10	2	15	17	23	-4	-5	-5

Sources: IMF (2000); IMF, Direction of Trade Statistic Year Book, some edition.

Table 3: Indicator Macro Economic 5 ASEAN, Members 2006 - 2007

Country	Gross domestic product at current prices US$ million 2007	Gross domestic product per capita at current prices US$ 2007	Gross domestic product per capita at current prices US$ PPP 2007	Merchandise trade Exports US$ million 2006	Merchandise trade Imports US$ million 2006	Merchandise trade Total trade US$ million 2006	Foreign direct investments inflow[7] US$ million 2005	Foreign direct investments inflow[7] US$ million 2006
Indonesia	431,717.7	1,919.6	4,931.0	*100,798.6*	*61,065.5*	*161,864.1*	8,336.0	5,556.2
Malaysia	186,960.7	6,880.2	14,256.4	*157,226.9*	*128,316.1*	*285,543.0*	*3,964.8*	6,059.7
Philippines	146,894.8	1,652.8	5,918.2	*47,410.1*	*51,773.7*	*99,183.8*	1,854.0	2,345.0
Singapore	161,546.6	35,206.1	37,359.9	*271,607.9*	*238,482.0*	*510,089.9*	*15,001.9*	*24,055.4*
Thailand	245,701.9	3,740.1	10,677.7	*121,579.5*	*127,108.8*	*248,688.3*	*8,957.0*	*10,756.1*
ASEAN	**1,281,853.9**	**2,227.3**	**5,961.9**	***750,708.0***	***654,097.8***	***1,404,805.8***	***41,067.8***	**52,379.5**

Sources: ASEAN Finance and Macro -economic Surveillance Unit Database and ASEAN Statistical Yearbook 2006 (compiled/computed from data submission and/or websites of ASEAN Member Countries'

Macroeconomic condition of ASEAN countries vary in terms of capacities and priorities, level of interest, and readiness to form an integrated economy. Those conditions lead the intra-ASEAN trade grow relatively slowly. The trade volume between ASEAN and other countries (80%) are greater than those among ASEAN members (20%). ASEAN economy is concentrated more on maintaining the stability of exchange rates towards U.S. dollar than their own countries. Therefore, it is necessary to set up an exchange rates determination model that could grab the economic fundamental factors which suits recent conditions. Specifically, this research tests exchange rates model towards the fundamental regional economic variable.

METHODS

The methodology in this research includes panel data unit root test, panel data cointegration tests and estimation of short and long-term relationships by applying the Engle-Yoo three steps method. The sample in the study includes ASEAN-5 (Indonesia, Malaysia, Thailand, Philippines and Singapore) that adapts the managed float or free float exchange rates system, from 1970 to 2007.

Panel Data Unit Root Test

Panel unit root test is a test of the behavior of exchange rates and its explanation variables both at level degree and first differences. Following the approach of Levin and Lin (1992), the regression equations for panel unit root test are:

$$\Delta y_{it} = \beta_{y,t-1} + \sum_{i=1}^{p} \phi_i \Delta y_{t-i} + \varepsilon_{i,t} \qquad (1)$$

Equation (1) is the same as the single-series ADF test. In the equation, y_t is the variable that will be tested both at degree level and first differences. Model (1) is estimated by fixed-effect approach. By fixed-effects approach, heterogeneity in the panel can be determined to uncover the constants differences of each individual country. The null hypothesis and alternative hypothesis can be defined as follows:

$$H_0 : \beta = 0, \qquad H_1 : \beta < 0,$$

The null hypothesis states that each series in the panel contains a unit root, and the alternative hypothesis states that every series is individually in the stationary panel. Furthermore, the panel ADF statistic values are compared with critical values of Levin and Lin.

Panel Cointegration Test

Panel Cointegration ADF Test

In exploring the long-term relationship, the regression is conducted by estimating the variable level through using a fixed model. If long-term relationship occurs, then the residual value of panel-based ADF cointegration is used to test whether there is a long term relationship between real exchange rate and economic fundamentals. To determine whether the variables are cointegrated in the panel, the residual value, obtained from long-term estimation, is compared with the ADF for the panel. It can be defined as follows:

$$\Delta ECM_{i,t} = \beta ECM_{i,t-1} + \sum_{i=1}^{p} \varphi_i ECM_{t-1} + \varepsilon_{i,t} \quad (2)$$

If the null hypothesis of no cointegration is rejected, it means that long-term relationship between real exchange rate and economic fundamentals occur. Therefore, the relationship between real exchange rate and economic fundamentals can be investigated further.

Pedroni Panel Cointegration Test

Panel cointegration testing method developed by Pedroni (1995, 1999) is actually almost the same as those developed by McCoskey and Kao (1998). Basically, both approaches are based on the long-term residual (by assuming the panel data of *N* country has *m* regressor and a number of observations *T*).

$$S_{it} = \alpha_i + \beta_{1i} X_{1it} + ... + \beta_{mi} X_{mit} + \varepsilon_{it}$$
$$t=1,....,T,\ i=1,...,N \quad (3)$$

Equation (3) implies that the cointegration vector between countries includes the heterogeneity among individuals in the panel. McCoskey and Kao (1998), Pedroni (1997, 1999) based on OLS estimation by testing the residual ε_{it}, where the null hypothesis states that it is not co-integrated. Pedroni (1997, 1999) established four criteria of the panel cointegration statistics (the dimension statistics are formed by summing up between the numerator and denumerator which pass the dimension of *N*), three groups of averaged statistics panel cointegration (between the statistical dimensions which is formed by dividing the numerator with denumerator to be calculated beyond the dimension of *N*). Pedroni (1997) shows the group ADF and panel ADF statistic can be reliable (robust) for the panel with a relatively short period of time. The standardized distribution of panel and group statistics is formulated as follows:

$$\kappa = \left| K_{NT} - \mu\sqrt{N} \right| / \sqrt{\upsilon} \ \Rightarrow \ N(0,1) \quad (4)$$

K_{NT} is the panel cointegration statistics/group, μ is the expected mean and υ is the variance.

Engle and Yoo Method (Three Steps)

Based on the Granger representation theorem, if there are cointegration relationships between variables, it can be specified as an error correction model (ECM). The advantage of this model is its ability to obtain the relationship in the short and long term. In addition, it can also be shown the speed of model adjustment towards the long-term equilibrium. Estimation method which was used in this study was the ECM of Engle-Yoo three-steps. This approach is an improved version of the ECM of two-step Engle-Granger. The enhancement is neces-

sary because the result of the estimated parameters in the static regression (first step) is bias and it is not normally distributed so the significance test of parameters becomes invalid.

Assuming that the cointegration vector and weak exogeneity of the variables on the right of the sign is equal to the short-term equation of ECM, thus, the third step will be to correct the estimated value of $\hat{\beta}$ in the first step and ensure the normally distributed. The three-steps approach sequence of Engle-Granger-Yoo can be described as follows (Harris, 1995; Rangasamy, 2003).

After estimating the static models (PPP model and exchange rate equilibrium model), this next step is to produce a value of $\hat{\beta}$ or it is symbolized as $\hat{\beta}^1$. Residual from the static model represents the estimated value of the imbalance $(\hat{\varepsilon}_{t-1} = y_{t-1} - \hat{\beta}x_{t-1})$ where the value is then inserted into the second steps of the short term EMC equation. ECM short-term equation can be written as:

$$\Delta y_t = \gamma_0 \Delta x_t - (1-\alpha)\hat{\varepsilon}_{t-1} + u_t \text{ or}$$
$$A(L)\Delta y_t = B(L)\Delta x_t - (1-\pi)\hat{\varepsilon}_{t-1} + u_t \quad (5)$$

From the estimated equation (5) above, it will be obtained the speed of adjustment parameters namely $-(1-\hat{\alpha})$ and residual $\hat{u}_t$, and it is subsequently used for regression in three steps as follows:

$$\hat{\beta}^3 = \hat{\beta}^1 + \hat{\delta} \quad (6)$$

Thus, the value of $\hat{\beta}^3$ is a long-term elasticity. To obtain the *t* ratio of long-term elasticity, it uses standard deviation (SE) from the third steps which has not been bias.

Hausman Test: Fixed Effects versus Random Effects

The first thing to do in the estimation with panel data is the selection between fixed effects (FE) and random effects (RE). The difference between both effects is whether there is a correlation between individual effects and the independent variable. Suppose there is a panel data regression equation as follows:

$$y = \propto + \beta X' + u_{it} \quad i=1,\ldots,N;\ t=1,\ldots,T. \quad (7)$$

The *errors* of the equation above can be expressed as:

$$u_{it} = \mu_i + v_{it} \quad (8)$$

μ_i is a non-observable individual effect which is not affected by time (time-invariant), whereas v_{it} is an error which is influenced by individual and time or error as in the general regression.

If there are individual effects that are not correlated with the independent variable $E(\mu_i | X_{it}) = 0$ so the *RE* model is more appropriate to be used, otherwise if there is a correlation $[E(\mu_i \mid X_{it}) \neq 0]$ so the *FE* model is more appropriate to be used.

Hausman test aims to determine whether there is a correlation as mentioned above or not. His null hypothesis is that there is no correlation between individual effects and independent variables. Without that correlation, the RE estimator is consistent and efficient, while the FE estimator is consistent but it is not efficient. If there is a correlation, FE estimator is consistent and efficient but the estimator of RE becomes inconsistent (Johston and DiNardo, 1997).

Hypothesis Tests of Purchasing Power Parity

PPP hypothesis testing is aimed to analyze the long-term balance between the nominal exchange rate and the difference of domestic and foreign prices. In conditions of absolute PPP (APPP) is obtained $e_{it} = (P_{it} / P_{*t})$, which can mean that the market price standard of the bundle of

goods in different currencies is equal. If APPP is applicable, it means the nominal exchange rate is deviated from parity stationary. In other words, the real exchange rate of currency of country *i*,

$$x_{it} = \left(\frac{e_{it}.P_{*t}}{P_{it}} \right) \tag{9}$$

does not contain unit roots. APPP has many limitations due to several things. First, these types of PPP empirical studies usually use a constant price data which are better than price-level data (to be in force). The constant price contains the base period (base year) in which the nominal exchange rate will be equal to the ratio of established price. Therefore, in fact the unit root test on x_{it} is the unit root test of the base period changes. This is a test commonly used in long-term PPP with the argument that the percentage change in the nominal exchange rate *spot* will tend to be similar to inflation differences between countries *i* and *partner* countries (Crownover et al., 1996). Second, the actual exchange rate may be deviated from the parity value; that is the constant price data series is less perfect in its publications (for example, in reality the constant of across countries does not reflect the basket of goods). Third, the deviations from APPP can occur due to transport costs, tariffs, and the difference of speed adjustment in goods and foreign exchange markets. While the testing of the relative PPP requires constant proportion of the factors that are determined between P_{it} and $e_{it}P_{*t}$. Here is the application of t-bar test in more detail. Assume that x_{it} is determined by the autoregressive process of degree one,

$$x_{it} = \alpha_i + \beta_i x_{i,t-1} + \varepsilon_{it}, \tag{10}$$

It can be rewritten as:

$$\Delta x_{it} = \alpha_i + \phi_i x_{i,t-1} + \varepsilon_{it} \tag{11}$$

where $\phi_i = (\beta_i - 1)$. The null hypothesis is expressed as $H_0 : \phi_i = 0 \ \forall i$ and alternative hypothesis is expressed as

$$H_1 : \varphi_i < 0, i = 1,2,...., N_1, \varphi_i = 0, i = N_1 + 1, N_1 + 2,...., N.$$

The formulation of alternative hypotheses is determined for ϕ_i of the difference between series and it is fewer restrictions if it is compared with Levin and Lin approach that defines $H_1 : \phi_i = \phi < 0 \forall i$. This allows for the occurrence of residual correlation between the panels. Furthermore, to explore the correlation between the panels, assume that

$$\varepsilon_{it} = \theta_t + u_{it} \tag{12}$$

where θ_t is the specific time for the common effect which is for the dependence level between the series and U_{it} is a random effect which includes the independence distribution of inter group. To eliminate the impact of components ϕ_t, we can add the average value of *cross-section* on both sides of equation (12) and it is obtained the following regression equation:

$$\Delta \tilde{x}_{it} = \tilde{\alpha}_i + \tilde{\phi}_\tau \tilde{x}_{i,t-1} + \tilde{\xi}_{it}, \tag{13}$$

where

$\tilde{x}_{it} = x_{it} - N^{-1} \sum_{j=1}^{n} x_{jt}$ and $\tilde{\phi}_i = (\tilde{\beta}_i - 1)$.

Next, it can be determined the heterogeneity of the panel with the serial correlation error through rewriting equation (10) as (Pappel, 1997):

$$\Delta \tilde{x}_{it} = \tilde{\alpha}_i + \tilde{\phi}_i \tilde{x}_{i,t-1} + \sum_{k=1}^{q_i} \rho_{it} \Delta \tilde{x}_{i,t-k} + \tilde{\xi}_{it} \tag{14}$$

Equation (11) is the basic form of *t*-bar test for testing of the relative PPP. By using

data exchange rate of five ASEAN countries and t-bar test, it is calculated by an average value of the individual ADF statistics based on each value of $\tilde{\phi}_i$.

Tests of Real Exchange Rates and Economic Fundamentals

After going through testing stages of stationary of the variables which are used, the next step is to test the long-term relationship between the exchange rate and the domestic prices and foreign prices, also the exchange rate and the economic fundamentals. Long-term model in this study included the real exchange rate and economic fundamental variables. Thus, the long-term equations can be written as follows (in log form):

$$e_{it} = \beta_{0it} + \beta_3 Fundamentals + \varepsilon_{it} \qquad (15)$$

The equation (15) about the equilibrium real exchange rate which was developed by Edwards (1989). Economic fundamental variables in this study included the flow of incoming capital, technological progress, terms of trade, the openness index and fiscal variables.

This research will be tested on foreign direct investment (FDI) per GDP as a measure of capital inflows, and real GDP growth as a proxy for technological progress. Term of trade is calculated by the export unit value ratio of import unit value. Openness index becomes a proxy with the amount of exports and imports per GDP, and government expenditures per GDP are as a proxy for fiscal variables.

A capital inflow in developing countries (generally in ASEAN) is needed to increase investment and capital formation, and facilitate productivity growth. One of issue that is consistently related to capital flows is that capital flows can push the appreciated exchange rate. If the capital flows are exogenous and the income elasticity of demand for *non-tradable goods* is not equal to zero, the capital inflows will encourage increased absorption and real appreciation. Next, the appreciation of real exchange rate will cause a loss of *external competitiveness*, and the consequence is the decrease in exports and manufacturing production. This became known as "Dutch disease" (Edward and van Wijnbergen, 1989).

RESULTS DISCUSSION

Research Variable Chart

Before moving to quantitative analysis, it is important to look at the connection among research variables to understand the connection among variables in general. These charts below are the movements of nominal exchange rates and real exchange rates.

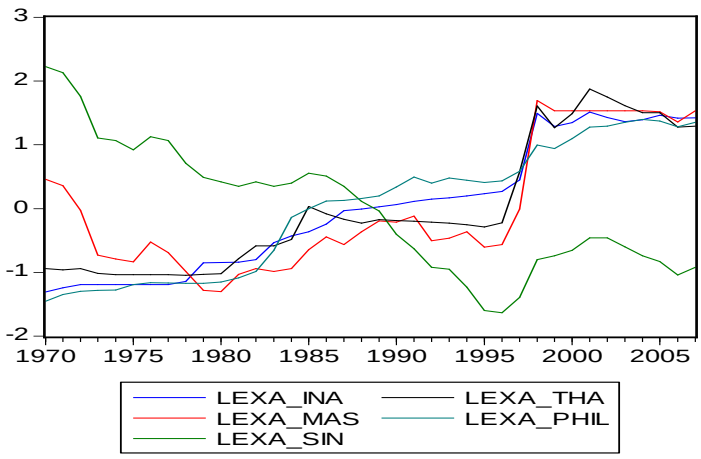

Figure 1: Quarterly Nominal Exchange Rates

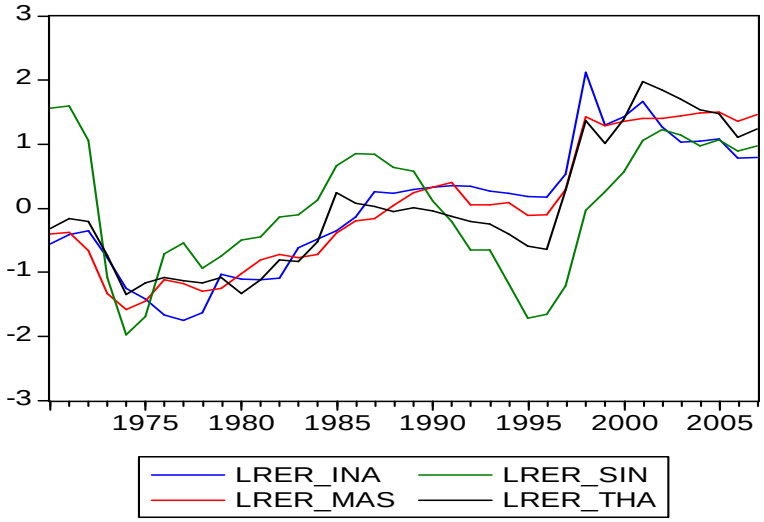

Figure 2: Quarterly Real Exchange Rates

Based on the picture above, at first glance it seems that from the five countries only Singapore that its nominal exchange rate tends to have an appreciation, and the other four relatively depreciated especially after a period in 1997. While the Figure 2 shows that the real exchange rate in the region during the period of observation moves quite volatile.

Panel Data Unit Root Test

Based on test results, both LLC and IPS methods give the same conclusion that the variables in the equation of the PPP are not stationary and they contained a unit root. Panel unit root test results (method LLC) on the variables in the equation of real exchange rates and economic fundamentals showed that there are differences in the result on LCAP variable if intercept and trend are used. However, testing without the use of intercept and trend give the same result (IPS test without intercept and trend) that LCAP variable is not stationary and it contain one unit root. With the basis that the IPS test has a better power (the probability of not rejecting wrong H_0), these variables are inferred not stationary at the level of limit. (Table 6 – 7).

Data Panel Cointegration Test

Cointegration test for PPP equation is done by using equations with intercept and without intercept and trend. Equation without intercept and trend is used in the testing of cointegration because the nominal exchange rate can only have a random walk behavior. For the panel statistics, the rejection of H_0 signifies that all members of the panel are co-integrated. While for the statistics group, the rejection of H_0 signifies that there is a cointegration relationship for at least one individual panel. From the test results, most statistical values manage to reject the hypothesis that states there is no cointegration.

Panel cointegration test variables in the equation of real exchange rates and economic fundamentals signify that all members of the panel are co-integrated and there is a co-integrated relationship for at least one individual variable. In the differentiation of outcome (statistics panel-V, Rho and Rho statistics and PP group), Pedroni shows that the ADF- Statistics Panel and ADF-Statistics Group generally give a better result (Kelly and Mavrotas, 2003). With these results, it can be concluded that there are co-integrated relationships between the dependent and independent variables. So it can be asserted that if the exchange rate of the

non-stationary is co-integrated with a number of non-stationary economic variables, then the real exchange rate can not be said to be deviated from the long-term equilibrium (Kawai and Ohara, 1997).

Table 4: Pedroni Conitegration Test of Purchasing Power Parity

Lag max= 1	Statistics Panel				Statistics Group		
	V-stat	Rho	PP	ADF	Rho	PP	ADF
H0 = No cointegration							
Intercept	1.1320	-0.7639	-1.7210**	-1.7196**	0.2833	-0.5822	-1.9275**
No Intercept + trend	-1.6742	1.7796	4.1845***	3.0252***	3.2232***	5.7333***	4.2393***

Source: Data analysis.

Table 5: Pedroni Cointegration Test of Real Exchange Rate and Economic Fundamental

Lag max = 1	Statistic Panel				Statistic Group		
	V-stat	Rho	PP	ADF	Rho	PP	ADF
H0 = No cointegration							
Intercept	- 1.9015	2.5401**	2.5878**	1.0777**	2.8870**	2.5203**	1.9313**
Intercept + trend	-1.6421*	1.8252**	1.0170	1.4210**	2.6377**	1.5943	1.9948**

Source: Data analysis.

Table 6: Data Panel Unit Root Test of PPP

Method	**Variable**	**Exogenous Vaı able**	***statistic***	**Conclusion**
H0 = *unit root* [assumption: ρ homogeneous / *common unit root process*]				
Levin-Lin-Chu (LLC)	LEXA	Intercept	- 0.36209	I(1)
	LEXA	Trend & Intercept	-0.53289	I(1)
	d(LEXA)	Intercept	- 9.29347	I(1)
	d(LEXA)	Trend & Intercept	-8.65743	I(1)
	LRP	Intercept	- 1.57991	I(1)
	LRP	Trend & Intercept	-0.56106	I(1)
	d(LRP)	Intercept	- 8.56113	I(1)
	d(LRP)	Trend & Intercept	-7.55167	I(1)
H0 = *unit root* [assumption: ρ heterogeneous / *individual unit root process*]				
Im-Pesaran-Shin WStat. (IPS)	LEXA	Intercept	1.60067	I(1)
	LEXA	Trend & Intercept	-0.89173	I(1)
	d(LEXA)	Intercept	-8.21986	I(1)
	d(LEXA)	Trend & Intercept	-7.21622	I(1)
	LRP	Intercept	0.51722	I(1)
	LRP	Trend & Intercept	-0.66537	I(1)
	d(LRP)	Intercept	-6.98061	I(1)
	d(LRP)	Trend & Intercept	-5.66123	I(1)

Table 7: Data Panel Unit Root Test for Real Exchange Rate and Fundamental Economic

Method	Variable	Exogenous Variable	*statistic*	Conclusion
H_0 = *unit root* [assumption: ρ homogeneous / *common unit root process*]				
Levin-Lin-Chu (LLC)	LRER	Intercept	0.78989	I(1)
	LRER	Trend & Intercept	-1.22639	I(1)
	d(LRER)	Intercept	-6.70396	I(1)
	d(LRER)	Trend & Intercept	-5.68922	I(1)
	LCAP	Intercept	-2.25935	I(0)
	LCAP	Trend & Intercept	-2.40233	I(1)
	d(LCAP)	Intercept	-9.97826	I(1)
	d(LCAP)	Trend & Intercept	-2.95316	I(1)
	LRGDP	Intercept	-3.92470	I(0)
	LRGDP	Trend & Intercept	0.40235	I(1)
	d(LRGDP)	Intercept	-7.77745	I(1)
	d(LRGDP)	Trend & Intercept	-7.37312	I(1)
	TOT	Intercept	-1.88132	I(1)
	TOT	Trend & Intercept	-1.08423	I(1)
	d(TOT)	Intercept	-9.77714	I(1)
	d(TOT)	Trend & Intercept	-9.65771	I(1)
H_0 = *unit root* [assumption: ρ heterogeneous / *individual unit root process*]				
Im-Pesaran-Shin $W_{Stat.}$ (IPS)	LRER	Intercept	0.56529	I(1)
	LRER	Trend & Intercept	-2.73619	I(0)
	d(LRER)	Intercept	-7.75194	I(1)
	d(LRER)	Trend & Intercept	-6.45913	I(1)
	LCAP	Intercept	-0.82458	I(1)
	LCAP	Trend & Intercept	-2.78227	I(0)
	d(LCAP)	Intercept	-11.4605	I(1)
	d(LCAP)	Trend & Intercept	-9.11687	I(1)
	LRGDP	Intercept	0.07248	I(1)
	LRGDP	Trend & Intercept	1.03469	I(1)
	D(LRGDP)	Intercept	-7.16534	I(1)
	D(LRGDP)	Trend & Intercept	-6.46449	I(1)
	TOT	Intercept	-1.88989	I(1)
	TOT	Trend & Intercept	-0.48887	I(1)
	d(TOT)	Intercept	-10.0567	I(1)
	d(TOT)	Trend & Intercept	-9.62265	I(1)
H_0 = *unit root* [assumption: ρ homogeneous / *common unit root process*]				
Levin-Lin-Chu (LLC)	OP	Intercept	0.99674	I(1)
	OP	Trend & Intercept	-1.15518	I(1)
	d(OP)	Intercept	-11.9177	I(1)
	d(OP)	Trend & Intercept	-10.8412	I(1)
	FIS	Intercept	-1.80088	I(0)
	FIS	Trend & Intercept	-2.43486	I(0)
	d(FIS)	Intercept	-14.2106	I(1)
	d(FIS)	Trend & Intercept	-12.6856	I(1)
H_0 = *unit root* [assumption: ρ heterogeneous / *individual unit root process*]				
Im-Pesaran-Shin $W_{Stat.}$ (IPS)	OP	Intercept	-0.55623	I(1)
	OP	Trend & Intercept	1.35679	I(1)
	d(OP)	Intercept	-10.6955	I(1)
	d(OP)	Trend & Intercept	-9.69518	I(1)
	FIS	Intercept	-1.46739	I(1)
	FIS	Trend & Intercept	-1.31244	I(1)
	d(FIS)	Intercept	-13.3396	I(1)
	d(FIS)	Trend & Intercept	-12.3784	I(1)

Regression Analysis

After conducting a series of pre-estimation tests, with results that support the use of error correction model (ECM), this section presents the results of the estimation of the model as a basis in research and decision making related to the research hypothesis.

Regression Analysis of the Validity of PPP Relative

Stage of testing the existence of a correlation between individual effects of independent variables is done through Hausman test. Based on test results, it obtains a Hausman statistics of 13.2145 with a p-value 0.0003 which can be interpreted that the random effects model (RE) is not appropriate for use. RE estimator is unbiased only if the null hypothesis of Hausman test is true. Meanwhile, FE estimator still produces unbiased estimates without even considering the null hypothesis because the Hausman test has included a dummy for the individual (intercept). So the next step is to test the fixed effect model which states that all individual dummy equals zero. Based on the test of fixed effects, it can be concluded that the use of dummy for more individuals is advised, so the FE model will be more appropriate to use. With that basis, the chosen technique to estimate the PPP model is the FE technique. The estimation results of the PPP model with the basic FE models are as follows:

Lung-run Equation:
Log_exa = 3,45 + 1,32 Log_price_ratio
$t_{\text{-stat}}$ (167,42) (34,71)
R^2 = 0,98;
$F_{\text{-stat}}$(*p-value*)= 4049,1 (0.0000);
DW = 0,20 (15)

Short-run:
Δ(Log_exa) = 0,006+1,078 Δ(Log_price_ratio)
$t_{\text{-stat}}$ (0,75) (7,31)
– 0,091 ECT(-1)
(-2,75)
R^2 = 0.98;
$F_{\text{-stat}}$ (*p-value*) = 4049.100 (0.0000);
DW = 1,84 (16)

Adjusted Coefficient:
Log_exa= 3.4567 + 1.3958 Log_price_ratio*
$t_{\text{-stat}}$ (382.85) (7.36)
(17)

The theory of PPP is valid in the long term only if the coefficient of the price ratio has a positive direction and a non-zero, and t-$_{\text{stat}}$ significant (Ramirez and Khan, 1999). From the estimation results above, it can be informed that the PPP applies only in the short term. Thus, at least in the short-term nominal exchange rate movements can be predicted by domestic and overseas prices. Real exchange rate would move steadily in the long term, and the changes in the nominal exchange rate are apt to equate with changes in relative prices. Exchange rate is moved as a mean reverting stochastic process (Krugman, 1989; Dixit 1989).

This finding was consistent with Johnson's research (1990) and Kim (1990), which stated that the PPP was effective. However, Kim (1990) also noted that the nominal exchange rate is co-integrated stronger to WPI ratio than to CPI ratio. More consistent results are found in the study Jacobson, et.al (2002), using multivariate cointegration technique and maximum likelihood panel cointegration panel data covering France, Germany, Italy and United Kingdom in post-Bretton Woods period. It is found that for each characteristic, there is one form of panel cointegration relationship (exactly one cointegration) between the nominal exchange rate and price, so that PPP can be regarded as weak or at least sufficient to fulfill the requirements for validity of PPP.

In the short-term regression, there is a variable speed adjustment (ECT), and the result is -0.091. This figure shows that as much as 9.1 percent imbalances of ex-

change rate that occur in the short term as a result of changes in the price ratio, are adjusted to balance the long term in the next period. In other words the fluctuation in prices will affect the nominal exchange rate in both the short and long term.

Regression Analysis of Real Exchange Rates and Economic Fundamentals

Similar to the PPP model estimation stage, on the model of real exchange rates and economic fundamentals, Hausman test and fixed effects test is implemented. Hausman test results statistics value of 0.6185 (p-value 0.8921), and testing of fixed effect F-statistic results of 2840.40 (p-value 0.000). This can be interpreted that the estimation of real exchange rates model and fundamental economy are more advisable to use a dummy for individuals or a FE model. The results of the estimation model of real exchange rates are expressed as follows:

Long- run Equation:

Log_rer = 3,15 – 0,05 Log_cap
$t_{\text{-stat}}$ (17,39) (-3,90)
– 2,29 Log_RGDP
(-4,93)
– 0,0045 TOT + 0,15 Open
(-0,06) (2,33)
– 1,27 Fiscal
(-2,58)

R^2 = 0.9935;
$F_{\text{-stat}}$ (*p-value*) = 3006.366 (0.0000);
$DW_{\text{-stat}}$= 0.3076 (18)

Short- run Equation:

Δ(Log_rer) = 0.07 – 0,01Δ (Log_cap)
(6,01) (-2,50)
– 1,23Δ(Log_RGDP)
(-6,51)
– 0,01Δ(ToT) + 0.09Δ(Open)
(-0,27) (1,98)
+ 0,0013Δ(Fiscal)
(0,0043)
– 0,12 ECT(-1)
(-4,06) (19)

Adjusted Coefficient:

Log_rer = 3,03 – 0,06 Log_cap*
$t_{\text{-stat}}$ (40,85) (-11,34)
– 2,28 Log_RGDP*
(-12,52)
– 0,041 TOT*
(-1,31)
+ 0,14 Open*
(5,51)
– 1,11 Fiscal*
(-5,71) (20)

Capital inflow (CAP) have a significant role in affecting the equilibrium real exchange rate. In the long-term capital flows have a negative (appreciation) to real exchange rate, which indicated that this area received substantial capital inflows but not evenly among others. This finding is consistent with the research of Calvo et al., (1993) and Edwards (1998). Furthermore, with the consideration that the real exchange rate appreciation tends to cause a decline in product competitiveness in world markets, thus capital inflows in the form of FDI was more beneficial for countries with good economic growth performance compared to other types of capital flows. In addition, FDI capital inflows also bring the aspects of technological progress.

Variable of technological progress (RGDP) is also able to explain the change in equilibrium real exchange rate, both in the long term and short term. Advances in technology stimulated the real exchange rate appreciation. These findings both supported the validity of Balassa-Samuelson hypothesis, which stated that countries (regions) with rapid economic growth will tend to appreciate its currency. More information that can be raised about the Balassa-Samuelson hypothesis (1964) is that differences in productivity growth between countries systematically have an impact on real exchange rate through the interaction between tradable sector and non-tradable in the economy (see Bahmani-Oskooee and Rhee (1996) for the case of

Korean won). Furthermore, regarding opposition to the Balassa-Samuelson hypothesis, this research is not in line with the study of Edwards (1989, 1994) in the case of panel data and study of twelve countries Feyzioglu (1997) who finds that increased productivity will encourage experienced real exchange rate appreciation for Finnish case.

Movement of terms of trade (TOT) reflects changes in supply and demand for commodities in world markets or changes in the productivity of tradable sector, both domestic and foreign, which in turn will affect the real exchange rate. The variable terms of trade (TOT) has a negative impact on the real exchange rate in both the short and long term. Although not significant but the coefficient is consistent with previous findings such as Elbadawi (1994), Edwards (1989, 1994), Feyzioglu (1997). In theory TOT variable coefficient sign of the real equilibrium exchange rate is ambiguous, so the sign (direction) negative on the outcome of long and short-term estimation proves the existence of income effect which is more dominant than the substitution effect.

Furthermore, the variables of openness (open) produce the same sign, in both short and long term. Result of estimation is in line with the study of Elbadawi (1994) and reveals that a more open a regime will be followed by real exchange rate depreciation. It can be also understood that economic openness will bring greater consequences to the depreciating exchange rate. Government consumption growth (fiscal) stimulates the real exchange rate appreciation that supports the hypothesis that government expenditure biases towards domestic product (thus it will cause difficulties for macroeconomic management).

COUNCLUSION

Based on the aforementioned analysis, this paper makes four conclusions. *First*, variables unit root test in the equation and the balance of the PPP real exchange rate shows that the LLC and IPS give the same conclusion that all the variables are not stationary and contain a unit root. Pedroni panel cointegration test on the variables in the equation of the PPP shows that all panel members is co-integrated and there is cointegration relationship for at least one individual variable. It is also the same on the panel cointegration test equilibrium real exchange rate equation, so that the real exchange rate can not be said to deviate from the long-term balance.

Second, The result indicates that the PPP is applied in the short term; in the short term nominal exchange rate movements can be predicted by the ratio of domestic and overseas prices. In the long run, the consistency of the findings can be seen from the direction of the coefficient (positive) ratio of domestic and foreign prices to exchange rates. Thus it can be said that volatility in prices will affect the nominal exchange rate in both the short and long term.

Third, Results of estimation on equilibrium real exchange rate show that generally the direction of the coefficient of the variables that are estimated is in accordance with the theoretical expectations. In the short-term estimation, despite the conformity of the direction of coefficient with the theory, TOT and Fiscal variable have a value that is not statistically significant. Or in the short term it can be said that the changes in the TOT and government consumption (Fiscal) does not affect the equilibrium real exchange rate. The confotmityof the direction off the coefficients is also fulfilled in the long-term equation, with different levels of significance.

Fourth, Variable of capital inflow (CAP) negatively affect the equilibrium real exchange rate, which indicates that FDI that moves into the region in the long term encourage the exchange rate to appreciate. Technological progress (RGDP) is also negatively affect the real

equilibrium exchange rate, as well as supporting the validity of the Balassa-Samuelson hypothesis.

Based on the analysis, the paper made some suggestions. *First*, the experience exchange rate crisis (1998) should bring the ASEAN region monetary authorities placing priority on exchange rate fluctuations through the control of macroeconomic variables (economic fundamentals). Exchange rate uncertainty can negatively affect investment decisions both domestic and foreign investment. Real exchange rate uncertainty would lead to reallocation of resources between sectors, between countries and create a climate of uncertainty for investment decisions. In addition, it is necessary to create an alignment of the projected rate of economic actors in determining the appropriate exchange rate policy.

Second, as an increasingly integrated area of macro-economic aspects and intra-ASEAN trade itself, it is necessary to have an economic policy scheme that can ensure the adjustment process can be run automatically. A policy that is responsive to the event of exchange rate fluctuations and the impact of contagion (contagion effect), particularly in the sectors of international trade and foreign investment.

Third, Management of a conducive climate for the entry of foreign capital flows in the form of FDI. Foreign capital in the form of FDI will bring more benefits to countries with good economic growth performance compared to other types of capital flows. In addition, foreign investment and technology and other economic assets that come into the area can be used as capitals for the countries in the region to get a larger share and continue to increase in world production.

Fourth, The process of regional market integration will encourage the continuation of the liberalization process in Indonesia, Malaysia, Singapore, Thailand and the Philippines. Therefore, the cooperation of the area is necessary to enlarge each country's opportunities in facing global challenges. Alternative policies which can be implemented such as opening the market for others (intra-ASEAN) so that it will form a greater confidence to open up markets for other.

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