



# Does Economic Policy Uncertainty Affect Exchange Rate in China and Japan? Evidence from Threshold Cointegration with Asymmetric Adjustment

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## ABSTRACT

In this article, we estimate the links between nominal exchange rates (JPY/USD and CNY/USD) and economic policy uncertainty (EPU) in China and Japan by employing monthly data during the period span from January 1997 to September 2020. The threshold cointegration approach focus in TAR, M-TAR, C-TAR and C-MTAR is used. Results indicate the evidence of asymmetric effect in the adjustment process to equilibrium and the M-TAR is the best model to detect threshold effect for the (CNY/USD-CNYEPU) pair and the C-TAR is the best model to detect threshold effect for the (JPY/USD-JPYEPU) pair.

**Keywords:** Foreign Exchange Rate, Economic Policy Uncertainty, Nonlinear Cointegration, Asymmetric ECM

**JEL Classifications:** F22, Q56

## 1. INTRODUCTION

Uncertainty in global economic policy results in sharp market fluctuations. Global events and geopolitical issues are fundamentally the cause of market fluctuations. As markets collapse under fears of shrinking economic policy uncertainty (EPU), the economic machine can also collapse. Currency volatility can affect multinational companies, consumer behavior as well as small and medium-sized businesses.

According to the International Monetary Fund (2020), uncertainty at the global level leads to a sharp reduction in trade between countries and large variations in the exchange rate. The World Trade Organization (2020) says that uncertainty represents an unprecedented upheaval around the world and that global trade has been sharply reduced.

Previous research has investigated the relationship between EPU and exchange rate volatility. Bartsch (2019) finds that uncertainty in economic policy amplifies short-term exchange rate volatility. Chen et al. (2019) asserts that increasing uncertainty in economic policy causes increased levels of exchange rate volatility. Nilavongse et al (2020) add that uncertainty in domestic economic policy affects the response to exchange rate volatility much more than uncertainty in foreign economic policy. On the contrary, Abid and Raul (2020) studied the relationship between policy uncertainty and the exchange rate in emerging markets using a panel VAR model. The results show that the effect of foreign EPU on exchange rate volatility exceeds the contribution of local EPU.

Specifically, Baker et al. (2016) find that uncertainty in economic policy not only affects exchange rate volatility, but it has adverse effects on economic activity. Arouri et al. (2016) show that the

relationship between policy uncertainty and the exchange rate weighs negatively on financial markets.

Benigno et al. (2012) investigated the relationship between EPU and the exchange rate using the autoregressive vector model (VAR). The results show that uncertainty in economic policy has an effect on short-term exchange rates. Colombo (2013) studied the effect of the shock of US EPU on the nominal euro-dollar exchange rate. The results indicate that the exchange rate reaction is more sensitive with an American uncertainty affected the European aggregates than with an uncertainty specific to the euro zone.

Sin (2015) studied the relationship between EPU on exchange rate volatility for China using a structural vector autoregressive model (SVAR). The results indicate that the impact of an uncertainty shock has a significant effect on exchange rate volatility. Krol (2014) finds that EPU affects exchange rate volatility for ten industrial and emerging economies. Therefore, the high volatility of the exchange rate will affect domestic production, consumer behavior and international trade.

The main contribution of this paper is to study the nonlinear cointegration (threshold effect) and asymmetric adjustment between EPU and foreign exchange market considering the China and Japan economies. We employ four threshold models such as TAR, M-TAR, C-TAR and C-MTAR. The symmetric or asymmetric adjustment is analysed by the symmetric ECM or asymmetric ECM.

In this paper, we study the impact of EPU on exchange rates. We employed the nonlinear cointegration such as the threshold effect focus on TAR model, consistent TAR, momentum TAR and consistent momentum TAR. We examine the long-term relationship between foreign exchange rates and economic uncertainty on the China and Japan. We use the Enders and Siklos (2001) asymmetric cointegration model to analyze the long-run asymmetric equilibrium relationship between variables. To be specific, the adjustment coefficient of the error correction term is different when the equilibrium error is positive from when it is negative.

This paper is organized as follows. Section 2 discusses the data and empirical methodology. Section 3 presents the preliminary analysis. Section 4 presents the empirical results and Section 5 concludes the paper.

## 2. DATA AND EMPIRICAL METHODOLOGY

In this article, we use two variables, namely EPU and nominal exchange rates (CNY/USD and JPY/USD) from two Asian countries such as China and Japan at monthly frequency during the period span from January, 1997 to September, 2020. The main objective is to study the nonlinear cointegration and asymmetric adjustment between variables. The data for the EPU is sourced from [policyuncertainty.com](http://policyuncertainty.com) and for exchange rates were collected from [www.federalreserves.gov](http://www.federalreserves.gov).

The econometric methodology adopted in this research work focuses on three stages: the stationarity test is carried out to verify

the presence or absence of unit root in the series studied. If the variables are stationary in the first difference, the linear and non-linear cointegration methodology is adopted between EPU and foreign exchange market. Subsequently, the long-term asymmetric adjustment between variables is examined using the Asymmetric Error Correction model (AECM).

To study the non-linear interaction between foreign exchange rates and EPU in China and Japan, we have employed the threshold cointegration based on TAR, M-TAR, consistent-TAR and consistent-MTAR, which is developed by Enders and Siklos (2001).

The two methods of cointegration are Johansen and Engle-Granger two-step approaches. Both of them assume symmetric relationship between variables. Balke and Fomby (1997) used a two-step approach for examining threshold cointegration on the basis of the approach developed by Engle and Granger (1987). Enders and Granger (1998) and Enders and Siklos (2001) further generalize the standard Dickey-Fuller test by allowing for the possibility of asymmetric movements in time-series data. This makes it possible to test for cointegration without maintaining the hypothesis of a symmetric adjustment to a long-term equilibrium. Thereafter, the method has been widely applied to analyze asymmetric transmission.

The conventional tests of cointegration such as Engle and Granger (1987) are a residual-based test that analyzes the validity of long-run relationship among EPU and nominal exchange rate by estimating the following model:

$$Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t \quad (1)$$

Where  $Y_t$  is the foreign exchange rates of China and Japan at time  $t$  and  $X_t$  is the EPU in the two countries.  $\varepsilon_t$  is the residual in equation (1) and  $\beta_0$  and  $\beta_1$  are coefficients.

In the next step, for the estimated error term  $\widehat{\varepsilon}_t$ , we can estimate two regime threshold models explained by:

$$\Delta \widehat{\varepsilon}_t = I_t \rho_1 \widehat{\varepsilon}_{t-1} + (1 - I_t) \rho_2 \widehat{\varepsilon}_{t-1} + \sum_{i=1}^P \varphi_i \Delta \widehat{\varepsilon}_{t-1} + \varepsilon_t \quad (2)$$

Where,  $\rho_1$ ,  $\rho_2$  and  $\varphi_i$  are coefficients to be estimated,  $\varepsilon_t$  indicates the white noise error term  $\varepsilon_t$  and  $P$  is the best lag chosen by the AIC.

$$I_t = \begin{cases} 1 & \text{if } \varepsilon_t - 1 \geq \tau \\ 0 & \text{if } \varepsilon_t - 1 < \tau \end{cases} \quad (3)$$

Where  $\tau$  is the parameter of threshold and  $I_t$  is the Heaviside indicator.

Since the exact nature of the nonlinearity may not be known, Enders and Siklos (2001) consider another kind of asymmetric cointegration test methodology that allows the adjustment to be contingent on the change in  $\varepsilon_{t-1}$  (i.e.,  $\Delta \varepsilon_{t-1}$ ) instead of the level of  $\varepsilon_{t-1}$ . In this case, the Heaviside indicator of Eq. (3) becomes.

$$I_t = \begin{cases} 1 & \text{if } \Delta \varepsilon_t - 1 \geq \tau \\ 0 & \text{if } \Delta \varepsilon_t - 1 < \tau \end{cases} \quad (4)$$

Equation (4) represents the momentum TAR (M-TAR), which captures more dynamics than the TAR model if  $\Delta \varepsilon_t - 1$  is

significantly different from zero. The speed of adjustment depends on the increase or decrease of  $\varepsilon_t$ . Thompson (2006) stipulates that if  $|\rho_1| < |\rho_2|$ , then increase in  $\varepsilon_t$  tend to persist, whereas decreases revert back to the threshold quickly.

Considering the equation (2), asymmetric co-integration can be studied through the test of absence of co-integration  $H_0: (\rho_1 = \rho_2 = 0)$ . Rejection of the null hypothesis indicates the evidence of cointegration according to the symmetrical ( $\rho_1 = \rho_2 \neq 0$ ) or asymmetrical context ( $\rho_1 \neq \rho_2$ ). However, the acceptance of  $H_0$  allows evaluating the symmetrical adjustment following the long-term equilibrium and this using the test ( $H_0: \rho_1 = \rho_2$ ). In addition, the presence of threshold co-integration leads us to adopt the asymmetrical ECM model with a particular threshold value (TAR or M-TAR value).

The asymmetric error correction mechanism can be estimated by the following equations:

$$\begin{aligned} \Delta EPU_t &= \theta_{EPU} + \delta_{EPU}^+ Z_{t-1}^+ \\ &+ \delta_{EPU}^- Z_{t-1}^- + \sum_{j=1}^J \alpha_{EPU,j}^+ \Delta EPU_{t-j}^+ \\ &+ \sum_{j=1}^J \alpha_{EPU,j}^- \Delta EPU_{t-j}^- + \sum_{j=1}^J \beta_{ER,j}^+ \Delta ER_{t-j}^+ \\ &+ \sum_{j=1}^J \beta_{ER,j}^- \Delta ER_{t-j}^- + v_{EPU,t} \end{aligned} \tag{5}$$

And

$$\begin{aligned} \Delta ER_t &= \theta_{ER} + \delta_{ER}^+ Z_{t-1}^+ + \delta_{ER}^- Z_{t-1}^- + \sum_{j=1}^J \alpha_{ER,j}^+ \\ \Delta ER_{t-j}^+ &+ \sum_{j=1}^J \alpha_{ER,j}^- \Delta ER_{t-j}^- \\ &+ \sum_{j=1}^J \beta_{EPU,j}^+ \Delta EPU_{t-j}^+ + \sum_{j=1}^J \beta_{EPU,j}^- \\ \Delta EPU_{t-j}^- &+ v_{EPU,t} \end{aligned} \tag{6}$$

Where ER is the exchange rate, EPU is the EPU,  $Z_{t-1}^+ = I_t \widehat{\varepsilon}_{t-1}$  and  $Z_{t-1}^- = (1 - I_t) \widehat{\varepsilon}_{t-1}$ ,  $\delta^+$  and  $\delta^-$  indicates the positive and negative speed of adjustment coefficient. In addition, the constant is  $\theta$ .  $\alpha$  and  $\beta$  represent the coefficients of the lagged difference of ER and EPU, respectively. Also, J is the number of lag and  $V_t$  denotes a white noise error term.

In this context, many hypothesis can be used such as F-tests to detect the Granger causality, distributed asymmetric lag effect, cumulative asymmetric effect, and equilibrium-adjustment path asymmetric effect between nominal exchange rates and EPU. The Granger causality test is tested from the two hypothesis: ( $H_{01} : \alpha^+ = \alpha^- = 0$  and  $H_{02} : \beta^+ = \beta^- = 0$ ). In the next step,

we employ the hypothesis ( $H_{03} : \alpha^+ = \alpha^-$ ) to detect the presence of the distributed lag asymmetric effect of EPU on its own. The hypothesis ( $H_{04} : \alpha^+ = \alpha^-$ ) can be adopted for each lag and both variables. For the cumulative asymmetric effect, we employed two hypothesis such as: ( $H_{05} : \sum_{(j=1)}^J \alpha_j^+ = \sum_{(j=1)}^J \alpha_j^-$ ) for EPU and ( $H_{06} : \sum_{(j=1)}^J \beta_j^+ = \sum_{(j=1)}^J \beta_j^-$ ) for ER. Finally, we use the hypothesis ( $H_{07} : \delta^+ = \delta^-$ ).

### 3. EMPIRICAL RESULTS

#### 3.1. Preliminary Analysis

Table 1 reports summary statistics of JPY/USD and CNY/USD exchange rates and EPU (JPYEPU and CNYEPU). The highest mean and standard deviation are observed for CNYEPU during the period. Asymmetry is measured by the values of skewness and kurtosis is a measurement for flatted distribution. We see that the two exchange rates have a negative skewness. However, EPU is characterized by a positive skewness. The Jarque-Bera test statistics which rejects the null hypothesis of normality.

Table 1 shows the results of the stationarity test based on ADF. The observation of the results indicates that all the series are stationary in first difference. We conclude that EPU and exchange rates are integrated processes of order one I (1), or unit root processes.

#### 3.2. Results of the Threshold Cointegration Analysis

This work focuses on four threshold cointegration models: the TAR, C-TAR, M-TAR and C-MTAR models. Table 2 reports the results of the estimates by focusing on the non-linear cointegration (threshold effect). Considering the pair (CNY/USD-CNYEPU), the results indicate that the threshold value is zero for the TAR and MTAR models. However, the values of C-TAR and C-MTAR are 0.074 and -0.028 respectively. Based on the reported results, the M-TAR model is the best performed because it has the minimum information criterion (AIC and SBIC). L-Jung-Box's statistics at order 4 show the absence of auto-correction problem.

Through the four nonlinear models, the results indicate the rejection of the null hypothesis of threshold cointegration ( $\rho_1 = \rho_2 = 0$ ) for the CNY/USD-CNYEPU pair by considering the M-TAR model. This result confirms the evidence of a cointegrating relationship between exchange rate and EPU. In this case we can examine whether their adjustment coefficients are different across positive and negative errors. This procedure serves to verify the evidence of an asymmetric cointegration through the hypothesis  $H_0: \rho_1 = \rho_2$ . If the two previous tests reject the null assumption, so asymmetry test makes sense. Based on information criterion AIC and SBIC and L-Jung Box statistics, we observed that the M-TAR is the most applicable model for variables' adjustment to long-run equilibrium for the pair CNY/USD-CNYEPU.

Considering the CNY/USD-CNYEPU pair, we observe for the M-TAR model that the F test relating to the null hypothesis of absence of cointegration admits a statistic of 2.582 which is significant at a level of 10%. This result indicates that EPU and

**Table 1: Descriptive statistics and unit root test**

Statistics	CNY/USD	CNYEPU	JPY/USD	JPYEPU
Mean	1.9856	4.7778	4.6789	4.6615
Median	1.9487	4.6985	4.6976	4.6409
Maximum	2.1193	6.7476	4.9745	5.4682
Minimum	1.8002	2.1217	4.3391	3.8829
Std-dev	0.1152	0.7818	0.1320	0.3086
Skewness	-0.0530	0.1832	-0.8820	0.3039
Kurtosis	1.3639	3.3718	3.3939	2.9228
Jarque-Bera	31.9179***	5.2253*	38.7955***	4.4598*
Prob	0.0000	0.0810	0.0000	0.0975

Stationarity	ADF-Level	ADF-first diff	ADF-Level	ADF-first diff	ADF-Level	ADF-first diff
t-statistics	-1.2403	-9.4844***	-1.9375	-18.1149***	-2.1538	-12.9403***
Prob	0.8995	0.0000	0.6321	0.0000	0.5130	0.6709

\*, \*\* and \*\*\*Denote the significance at 10%, 5% and 1% levels

**Table 2: Engle-Granger and threshold cointegration result tests**

Pairs of variables	CNY/USD-CNYEPU				JPY/USD-JPYEPU				
	TAR	C-TAR	M-TAR	C-MTAR	Engle and Granger	TAR	C-TAR	M-TAR	C-MTAR
lags (p)	8	8	8	8		14	14	14	14
Threshold ( $\tau$ )	0	0.074	0	-0.028		0	-0.07	0	0.011
rho1	-0.033 (-0.991)	-0.056 (-1.531)	0.01 (0.339)	-0.018 (-0.768)		-0.061*** (-3.098)	-0.066*** (-3.368)	-0.033** (-1.996)	-0.061*** (-3.158)
rho2	-0.027 (-0.966)	-0.016 (-0.615)	-0.065** (-2.224)	-0.107* (-1.915)		-0.019 (-1.402)	-0.017 (-1.215)	-0.031** (-1.982)	-0.017 (-1.222)
total obs	285	285	285	285		285	285	285	285
coint obs	276	276	276	276		270	270	270	270
AIC	-1099.476	-1100.317	-1102.908	-1101.813		-1253.598	-1254.959	-1250.067	-1253.829
BIC	-1059.651	-1060.493	-1063.083	-1061.989		-1192.425	-1193.786	-1188.894	-1192.656
LB (4)	0.87	0.882	0.809	0.799		0.996	0.992	1	0.987
No CI	0.906	1.315	2.582*	2.045		5.422***	6.092***	3.702	5.536***
H0:	0.4053	0.2702	0.0775	0.1314		0.0049	0.0026	0.0260**	0.0044
No APT	0.024	0.836	3.353*	2.287		3.346**	4.647**	0.003	3.567*
H0: rho 1=rho2	0.877	0.361	0.068	0.132		0.069	0.032	0.954	0.06

Number in parentheses are the t-value. \*, \*\* and \*\*\* denote the significance at 10%, 5% and 1% levels

exchange rate are cointegrated with an adjustment threshold. In addition, the F statistic for the null hypothesis of symmetric transmission has a value of 3.353 and it is significant at the 10% level. Therefore, the adjustment process is asymmetric when exchange rate and EPU adjust to achieve the long-term equilibrium.

If we observe the pair (JPY/USD-JPYEPU), the results indicate that the threshold value is zero for the TAR and MTAR models. However, the values of C-TAR and C-MTAR are -0.07 and 0.011 respectively. Based on the reported results, the C-TAR model is the best performed because it has the minimum information criterion (AIC and SBIC). L-Jung-Box's statistics at order 4 show the absence of auto-correction problem.

Focused on four nonlinear models, the results indicate the rejection of the null hypothesis of threshold cointegration ( $\rho_1 = \rho_2 = 0$ ) for the JPY/USD-JPYEPU pair. This result confirms the evidence of a cointegrating relationship between exchange rate and EPU in Japan. In this case we can examine whether their adjustment coefficients are different across positive and negative errors. This procedure serves to verify the evidence of an asymmetric cointegration through the hypothesis  $H_0: \rho_1 = \rho_2$ . If the two previous tests reject the null assumption, so asymmetry test makes sense. Based on information criterion AIC and SBIC and L-Jung Box statistics, we observed that the C-TAR is the most applicable model for variables' adjustment to long-run equilibrium for the pair JPY/USD-JPYEPU.

Considering the JPY/USD-JPYEPU pair, we observe for the C-TAR model that the F test relating to the null hypothesis of absence of cointegration admits a statistic of 6.092 which is significant at a level of 1%. This result indicates that EPU and Japan exchange

rate are cointegrated with an adjustment threshold. In addition, the F statistic for the null hypothesis of symmetric transmission has a value of 4.647 and it is significant at the 5% level. Therefore, the adjustment process is asymmetric when exchange rate and EPU in Japan adjust to achieve the long-term equilibrium.

Figure 1 illustrate the variations of the SSE for the M-TAR model considering a lag of 8. By observing the CNY/USD-CNYEPU pair, we see that the lowest SSE for the momentum-TAR model is 0.389 at the threshold value of zero. The M-TAR model is the best model characterized by the lowest AIC statistic of -1102.908 and BIC statistic of -1063.083.

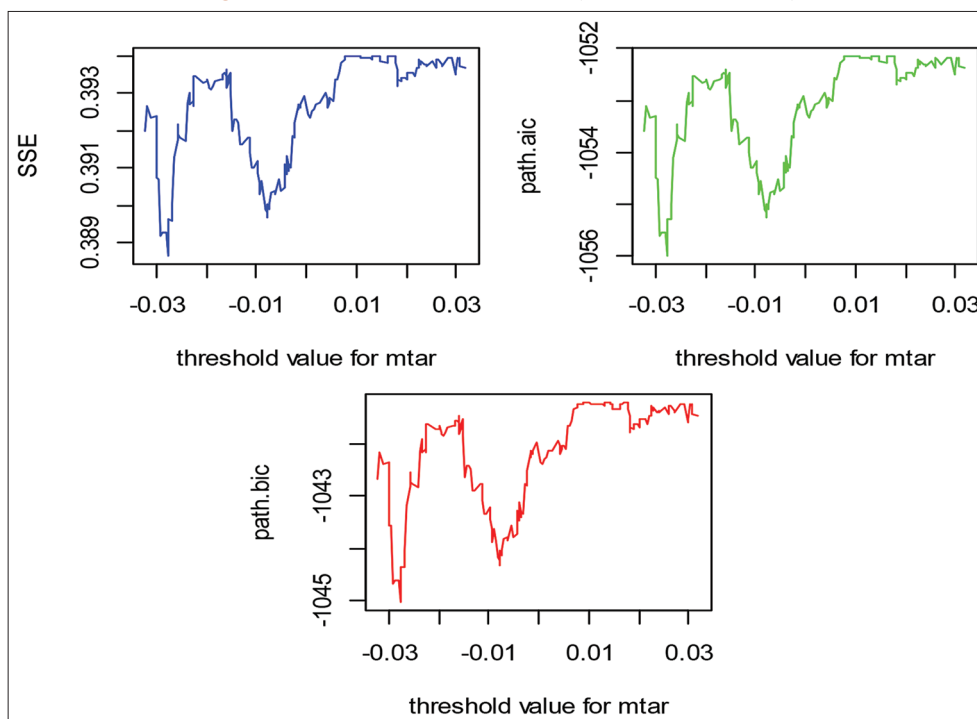
Figure 2 illustrate the variations of the SSE for the C-TAR model considering a lag of 14. By observing the JPY/USD-JPYEPU pair, we see that the lowest SSE for the consistent-TAR model is 0.183 at the threshold value of -0.066. The C-TAR model is the best model characterized by the lowest AIC statistic of -1254.959 and BIC statistic of -1193.786.

### 3.3. Results of the Asymmetric Error-correction Model

In order to investigate the movement of the foreign exchange markets such as CNY/USD and JPY/USD and EPU series in a long-run equilibrium relationship, we analyze the asymmetric error correction model. Empirical results justify the evidence of the long-run equilibrium relationship between EPU and exchanges rates in the two countries with asymmetric behavior. The results of the M-TAR model are reported in Table 3 (CNY/USD-CNYEPU pair). Based on AIC, a maximum of up to three lags has selected for estimation of the asymmetric ECM.

For regimes with positive and negative shocks (CNYEPU is higher than CNY/USD), which means that, in the next period, CNYEPU

Figure 1: Threshold value for M-TAR (CNY/USD-CNYEPU)



**Table 3: Results of the A-ECM with threshold cointegration**

Variable	Coefficients	CNY/ USD	t-statistic	M-TAR (lag=3)	Coefficients	CNYEPU	t-statistic	Coefficients	JPY/ USD	t-statistic	C-TAR (lag=3)	Coefficients	JPYEPU	t-statistic
$\theta$	-0.001		-0.731		-0.0858		-1.693	-0.0024		-0.653		0.0694**		2.307
$\alpha_1^+$	0.002		1.047		-0.2986**		-2.514	0.0162		1.214		-0.2992**		-2.804
$\alpha_2^+$	0.001		0.546		-0.2795**		-2.389	-0.0294**		-2.115		-0.1619		-1.459
$\alpha_3^+$	0.001		0.546		-0.3514***		-3.879	0.0130		0.932		-0.3840***		-3.439
$\alpha_1^-$	-0.002		-1.229		-0.8281***		-8.948	-0.0056		-0.413		-0.1765		-1.614
$\alpha_2^-$	0.002		0.940		-0.3854***		-3.317	0.0226		1.680		-0.1035		-0.963
$\alpha_3^-$	0.001		0.800		-0.1155		-0.989	-0.0222		-1.717		-0.0844		-0.818
$\beta_1^+$	0.561***		6.371		9.7087		1.716	0.3333**		2.838		1.0253		1.096
$\beta_2^+$	-0.172		-1.769		-1.4382		-0.230	-0.0075		-0.063		-0.1313		-0.138
$\beta_3^+$	0.071		0.807		4.0058		0.704	0.1043		0.902		-1.3570		-1.472
$\beta_1^-$	0.462***		4.275		2.5782		0.372	0.2617**		2.528		0.5616		0.681
$\beta_2^-$	0.219		1.838		-4.8719		-0.635	0.0791		0.758		1.6235		1.953
$\beta_3^-$	-0.171		-1.571		-7.1124		-1.015	-0.1199		-1.145		0.6889		0.826
$\delta^+$	-0.004		-0.909		-0.2771		-1.049	-0.0512**		-2.769		-0.0496		-0.337
$\delta^-$	-0.005		-0.548		-0.4341		-0.678	-0.0126		-0.952		0.0611		0.577
Diagnostic														
R-squared	0.2756				0.3567			0.1371					0.1497	
Adjusted	0.2375				0.3229			0.0916					0.105	
R-squared														
F-Stat	7.23				10.54			3.018					3.346	
AIC	-2099.958				239.380			-1305.418					-139.473	
BIC	-2041.744				297.594			-1247.204					-81.259	
Q (4)	0.976				0.415			0.971					0.703	

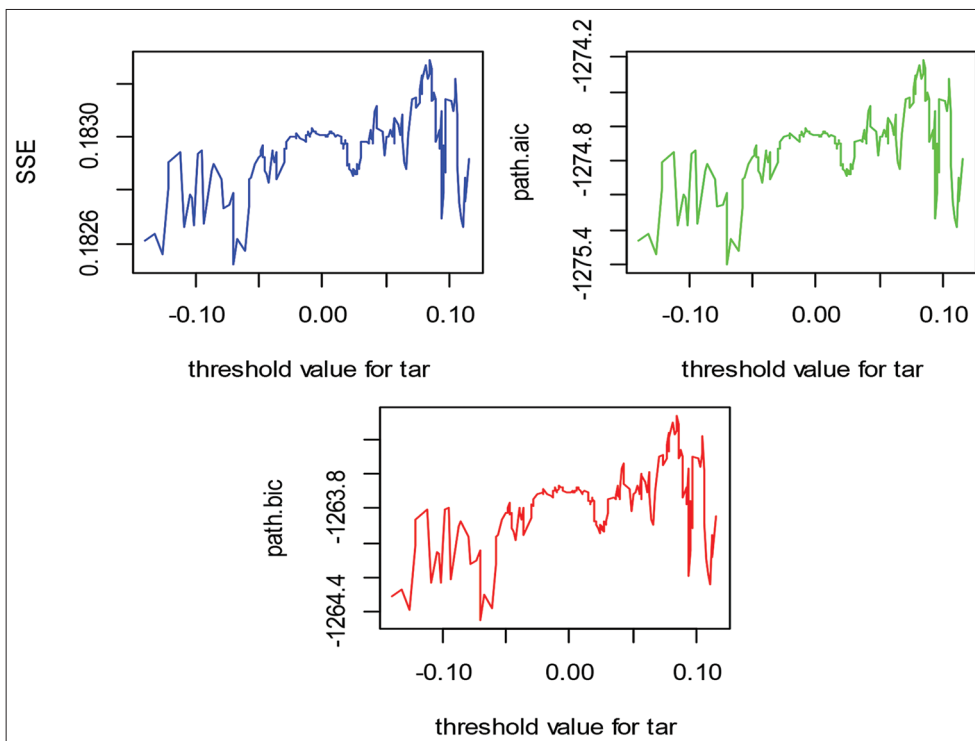
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**Table 3: (Continued)**

Hypothesis descriptions	F-statistics	CNY/USD	p-value	F-statistics	CNY/EPU	p-value	F-statistics	JPY/USD	p-value	F-statistics	JPY/EPU	p-value
Granger causality test												
$H_{01} : \alpha_{yj}^+ = \alpha_{yj}^-$	0.537		0.780	19.845***		0.000	1.596		0.148	5.421***		0.000
$H_{02} : \beta_{xy}^+ = \beta_{xy}^-$	15.839***		0.000	1.044		0.397	4.870***		0.000	1.871*		0.086
Distributed lag asymmetric effects												
$H_{03} : \alpha_1^+ = \alpha_1^- = 0$	1.944		0.164	9.613***		0.002	0.947		0.331	0.467		0.495
$H_{03} : \alpha_2^+ = \alpha_2^- = 0$	0.061		0.804	0.334		0.564	5.317**		0.022	0.105		0.746
$H_{03} : \alpha_3^+ = \alpha_3^- = 0$	0.290		0.591	1.928		0.166	2.470		0.117	2.805*		0.095
$H_{04} : \beta_1^+ = \beta_1^- = 0$	0.425		0.515	0.532		0.466	0.151		0.698	0.099		0.753
$H_{04} : \beta_2^+ = \beta_2^- = 0$	5.591**		0.019	0.104		0.747	0.218		0.641	1.412		0.236
$H_{04} : \beta_3^+ = \beta_3^- = 0$	2.531		0.113	1.286		0.258	1.481		0.225	1.944		0.164
Cumulative asymmetric effects												
$H_{05} : \sum_{(j=1)}^J \alpha_j^+ = \sum_{(j=1)}^J \alpha_j^-$	0.218		0.641	3.400*		0.066	0.020		0.887	2.867*		0.092
$H_{06} : \sum_{(j=1)}^J \alpha_j^+ = \alpha_{(j=1)}^J \alpha_j^-$	0.075		0.785	3.403*		0.066	0.551		0.459	2.210		0.138
Equilibrium adjustment path asymmetry												
$H_{07} : \delta^+ = \delta^-$	0.027		0.871	0.053		0.818	2.902*		0.090	0.378		0.539

\*\*\*, \*\*, \* indicates significant at the 1%, 5%, 10% level, respectively. Numbers in brackets () are P values

**Figure 2:** Threshold value for TAR (JPY/USD-JPYEPU)



will go up and the deviation will increase. The adjusted R-squared value is 0.2375 for the CNY/USD and 0.3229 for CNYEPU. In the other hand, the statistic Q of Ljung-Box indicates the absence of problem of autocorrelation. From causality analysis, we observe that the CNY/USD cause the CNYEPU in the short run (F-stat=15.839 and p = 0.0000) and CNYEPU cause CNY/USD in the long run (F-stat=19.845 and p = 0.0000).

The null hypothesis of the absence of a distributed lag asymmetric effect from EPU (CNYEPU) to CNY/USD is not rejected at the significance level. In addition, the study does not find evidence of a significant cumulative asymmetric effect from CNY/USD to EPU in China. The F-statistics of adjustment path asymmetric effect are respectively 0.027 for CNY/USD (statistically not significant) and 0.053 for CNYEPU (not significant). This result indicates that there is an absence of equilibrium adjustment path asymmetric effect between EPU and CNY/USD.

The empirical results of the C-TAR model are reported in Table 3 (JPY/USD-JPYEPU pair). Based on AIC, a maximum of up to three lags has selected for estimation of the asymmetric ECM.

For regimes with positive and negative shocks (JPYEPU is higher than JPY/USD), which means that, in the next period, JPYEPU will go up and the deviation will increase. The adjusted R-squared value is 0.0916 for the JPY/USD and 0.105 for JPYEPU. In the other hand, the statistic Q of Ljung-Box indicates the absence of problem of autocorrelation. From causality analysis, we observe that the JPY/USD cause the JPYEPU in the short run and JPYEPU cause JPY/USD in the short and long.

The F-statistics of adjustment path asymmetric effect are respectively 2.902 for JPY/USD (statistically significant) and

0.378 for JPYEPU (not significant). This result indicates that there is a presence and absence of equilibrium adjustment path asymmetric effect between EPU and JPY/USD.

#### 4. CONCLUSION

In this article, we study the dynamic interaction between foreign exchange rate and EPU by considering two Asian countries such as China and Japan. Specifically, we focused on the linkages between variables in both the short-run and long-run horizons under the nonlinear threshold cointegration framework. We employ the methodology developed by Enders and Siklos (2001), focused on a nonlinear (threshold) cointegration model allowing for nonlinear adjustment to long-run equilibrium. From the nonlinear cointegration approaches, we can reject the null hypothesis of no cointegration for the pair (CNY/USD-CNYEPU) by considering the M-TAR. From the pair (JPY/USD-JPYEPU), we can reject the null hypothesis of no cointegration by considering four threshold models. In addition, we found evidence of asymmetry in the adjustment process to equilibrium. Our finding indicates the presence of asymmetric effect between nominal exchange rate and EPU.

Policymakers must pick sound economic policies to promote prosperity. The clarity in economic policy making, especially in the period of high volatility, can lead to more stable markets. Additionally, our findings are also of great relevance for policymakers on managing exchange rate fluctuations and on prevention of potential risks that may arise due to significant dependence among different markets. They should further control over risks at markets of significant dependence and properly decide on the timing and extent of foreign exchange rate intervention.



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