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An Empirical Analysis of Exchange Rates Cointergrating System

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Abstract

This paper analyzes whether the system of exchange rate time series of the Japanese yen and the South Korean won is cointegrated by using Engle and Granger's two-step approach to modeling cointegrated processes. The first step involves fitting the long-run relationship in levels by least squares. At a second step, the residuals from the static regression are employed as an error correction term in the dynamic, first-difference regression. Because the hypothesis of cointegration cannot be rejected, the estimated parameters can be considered as elements of the cointegrating vector of this system.
The conclusion of this paper can provide some insights to investors who are interested in foreign exchange markets.

Keywords: Cointegration, Time series, Japanese yen, South Korean won, Stationary
JEL Classification: C12, C13, C22, F31

1. Introduction

This paper attempts to analyze whether the system of exchange rate time series of the Japanese yen and the South Korean won is cointegrated by using Engle and Granger's two-step approach to modeling cointegrated processes. The first step involves fitting the long-run relationship in levels by least squares. The hypothesis of cointegration can then be tested by applying the Dickey-Fuller test to the residuals from the regression. If the residuals fail the test, the series are taken not to be cointegrated, and the specification would have to be reconsidered. Otherwise, at a second step, we could employ the residuals from the static regression as an error correction term in the dynamic, first-difference regression, and then "test down" to find a parsimonious structure. If the hypothesis of cointegration cannot be rejected, then the estimated parameters can be considered as elements of the cointegrating vector of this system. The conclusion of this paper can provide some clues to investors interested in foreign exchange markets.

2. Econometric Methodology

2.1. The definition of cointegration

X_t and Y_t are said to be cointegrated, if

(i) X_t and Y_t are I(1);

(ii) there exists a vector α $(\alpha \neq 0)$, such that $Z_t = \alpha' \begin{bmatrix} Yt \\ Xt \end{bmatrix}$ is I(0).

The vector α is called the cointegrating vector.

2.2. Engle and Granger's two-step approach to modeling cointegrated processes.

This method is based on assessing whether single-equation estimates of the equilibriumerrors appear to be stationary.

Step 1. CRDW (Cointegrating Regression Durbin -Waston statistic)

After running the cointegrating regression, the Durbin Waston statistic is tested to see if the residuals appear stationary. If they are nonstationary, the Durbin Waston will approach zero. If DW is too big, then the test rejects non-cointegration (finds cointegration).This was proposed recently by Bhargava (1984) for the case where the series is observed and the null and alternativeare first order models.

Put in a simple way, the Cointegrating Regression Durbin – Waston:

$$Y_t = a X_t + b + U_t$$

ξ_1 = DW. The null is DW = 0.

Step 2. DF (Dickey Fuller Regression test statistic)

This tests the residuals from the cointegrating regression by running an auxiliaryregression as described by Dickey and Fuller. It also assumes that the first order model is correct.
In other words, Dickey Fuller Regression:

$$\Delta U_t = - \phi U_{t-1} + \varepsilon_t$$

$\xi_2 = T_\phi$: the t statistic for ϕ.

2.3. Find the cointegrating vector

If the system is coinegrated, then the estimated parameters can be considered as elementsof the cointegrating vector of this system.
Therefore, the cointegrating vector is $\begin{bmatrix} 1 \\ -a \end{bmatrix}$ in which the first element of the cointegrating vector is already normalized.

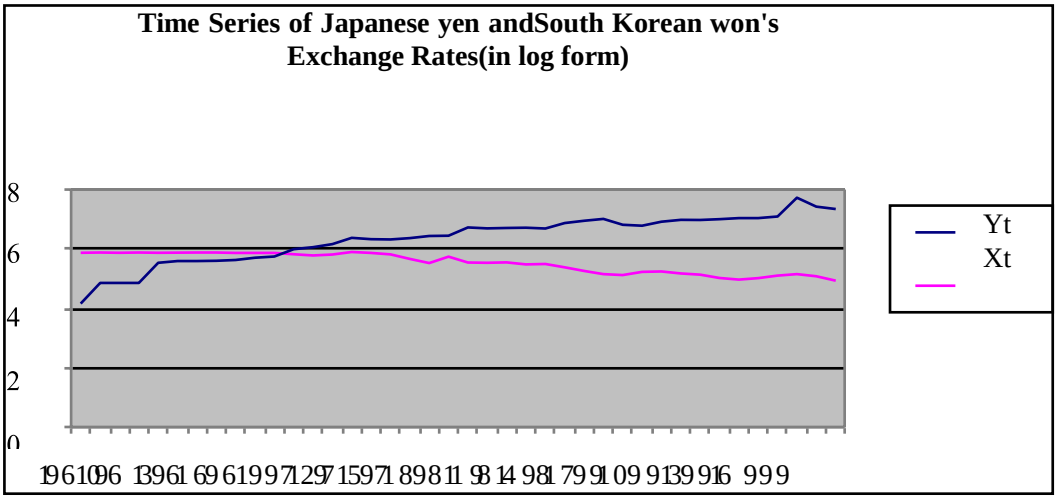
3. The Description of Data

These annual market exchange rates are from 1960 to 1999, and are all measured by 1 unitUS dollar = ? units of national currency .

Let :

Y_t donates log of South Korean won's exchange rate,
X_t donates log of Japanese yen's exchange rate

An ADF test for unit roots was conducted for Y_t and X_t and confirmed that both timeseries are I(1).



Data Resources: IMF International Financial Statistic

4. Estimation and Analysis

4.1.1 The cointegrating regression of Y_t on X_t and a constant was run.

For the regression in levels, the estimation is as follow

$$Y_t = \underset{(\ 0.214\ )}{- 1.928\ X_t} + \underset{(\ 1.189\ )}{17.042} + U_t$$

R^2 = 0.681
T statistic (for slope) = - 9.001
D-W = 0.336

The Dickey-Fuller test for the residuals is based on the following regression:

$$U_t - U_{t-1} = - 0.552\ U_{t-1} + \varepsilon_t \quad (0.079)$$

$$T_\phi = - 5.671$$

4.1.2. Analyze the estimation

The coefficient of X_t is - 1.928 (with a t statistic of – 9.001 and an $R^2$of 0.681). The DW was 0.336 indicating that accepts cointegration at least at a level of 10 percent and almost approaching 5 percent level of significance. The Dick Fuller regression gave a test statistic of - 5.671 which is significant at 1 percent level(Compare DW d statistic and DF t statistic with the critical values given by Engle and Granger,1987).

4.1.2 The cointegrating regression of X_t on Y_t and a constant was run.

$$X_t = \underset{(0.039)}{- 0.353\ Y_t} + \underset{(0.252)}{7.787} + u_t$$

R^2 = 0.681
T statistic (for slope) = - 9.001D-W = 0.323

The Dickey-Fuller test for the residuals is based on the regression:

$$u_t - u_{t-1} = - 0.371\ u_{t-1} + \eta_t \quad (0.089)$$

$$T_\phi = - 7.067$$

4.2.2. Analyze the estimation

The coefficient of Y_t is - 0.353.The DW was 0.323 indicating that accepts cointegration atleast at 10 percent level of significance. The Dick Fuller regression gave a test statistic of - 7.067 which is significant at a level of 1%.

5. Conclusion

The above estimation and testing confirm that the exchange rate time series of the Japanese yen and the South Korean won are very likely to be cointegrated processes. The economic implication of this result is that the system of Japan and Korea's exchange rates is in equilibrium in the long run. The linear combination of these two time series is stationary. This conclusion can help investors interested in foreign exchange markets to find some opportunities of making money.

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