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Sectoral Price Divergence between Korea and Japan*

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This paper examines the persistent properties of 12 sectoral relative prices between Korea and Japan obtained following the Classification of Individual Consumption according to Purpose (COICOP) over the period of 1985-2016. Applying a new econometric method developed by Pesaran which controls for the cross-section dependence in a panel, we are not able to reject the hypothesis that the sectoral real exchange rates contain a common stochastic trend. On the other hand, the well-known panel unit root tests such as the IPS and LLC tests widely used by previous studies strongly reject the unit root hypothesis. Since the error term of the regression for our panel exhibits significant cross-section dependence, these opposite results justify that the use of the new econometric method is appropriate.

Keywords: PPP, Cross-section Dependence, Panel Unit Root Tests, Real Exchange Rates, Sectoral Price Indices
JEL classification: F31, F41, F42

I. INTRODUCTION

Korea and Japan have been closely linked not only economically but also in many aspects. For example, Japan has been one of the major trading partners of Korea and the volume of trade between the two countries has significantly increased since the development of the Korean economy. Further, there has been a structural transformation in the Korean economy: Korea's capital markets have been extensively integrated to the international financial markets and Korea significantly opened its product markets to the world since the Asian financial crisis in 1997-98 so that the ratios of Korean export and import to its GDP are around 50% as of 2015, respectively. Although all these events point to the direction in favor of a closer integration of product markets, this paper empirically investigates the degree of product market integration between Korea and Japan using a measure

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of sectoral relative consumer price persistence over the period of 1985-2016. In particular, we examine if sectoral relative prices between the two countries converted with the common currency contain a stochastic trend or converge to their equilibrium value in the long run.

We apply a new econometric method for testing the unit root hypothesis of real exchange rates: we use the panel unit root test in the presence of cross-section dependence developed by Pesaran (2007). His method is to augment the cross-sectional averages of lagged levels and first-differences of the individual series in the standard augmented Dickey-Fuller (ADF) regressions to control for cross-section dependence. The use of Pesaran's method has two advantages compared to previous studies.

One advantage is that the method obtains an additional cross-sectional power using panel data and mitigates the well-known shortcoming of univariate unit root tests in terms of their power properties.[1] The other advantage is that the method takes into account of cross-section dependence frequently presented in panel data sets. In particular, panels with sectoral real exchange rates are likely exhibit high cross-section dependence since they are constructed using a common nominal exchange rate. The well-known panel unit root tests such as the LLC test developed by Levin et al. (2002), the IPS test by Im et al. (2003), and the Maddala-Wu test by Maddala and Wu (1999) assume that individual time series in the panel are independently distributed across cross-sections. However, O'Connell (1998) shows that the typical panel unit root tests developed under the cross-sectional independence assumption reject too often the unit root hypothesis in the presence of significant cross-section dependence. Further, recent econometric studies show that the method of demeaning the individual series cross-sectionally does not effectively mitigate the problem of cross-section dependence in a general setting. Pesaran's method overcomes this deficiency of the previous tests. Pesaran (2007) also confirms O'Connell (1998)'s finding applying the new econometric method: he examines if the CPI-based real exchange rates constructed using quarterly consumer price indices of 17 OECD countries contain a stochastic trend for the periods of 1974Q1-1998Q4 and 1988Q1-1998Q4, and finds that the IPS test rejects

[1] The other alternative to solve the problem of low power is to use a very long time series so that the standard univariate unit root tests such as the ADF test can have an effective power (see, for example, Froot and Rogoff (1995) and Lothian and Taylor (1996)).

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the unit root hypothesis for both cases, while his test developed under the assumption of cross-section dependence does not reject it. He also shows that these opposite results are mainly due to the significant cross-section dependence in those panels. As formally and informally discussed in Section III and IV, the error term of the regression for our panel of sectoral real exchange rates exhibits significant cross-section dependence. Therefore, the use of Pesaran (2007)'s method is appropriate for our study.

We find that sectoral relative prices between Korea and Japan do not revert to their equilibrium value in the long run applying Pesaran (2007)'s panel unit root test. We also consider the influence of a potential structural transformation after the Asian financial crisis on the real exchange rate process but find that the conclusion remains unchanged. Conversely, we obtain opposite results using the IPS and LLC tests which assume the cross-section independence: we strongly reject the unit root hypothesis at the conventional significant levels. These opposite results suggest that the IPS and LLC tests could be spurious and demonstrate the advantage of using the new econometric method since there is significant cross-section dependence in our panel. In this sense, our results are consistent with those of O'Connell (1998) and Pesaran (2007), although we use different data sets and sample periods from these studies.

Our study is related to various empirical studies which test purchasing power parity (PPP) in the long run. In general, previous studies have reached two consensuses about the test results. First, studies using univariate unit root tests are not able to reject the hypothesis that the real exchange rate contains a unit root unless a sample has a very long time series of the real exchange rate (see, for example, Glen (1992), Lothian and Taylor (1996), and Rogoff (1996)). For example, Glen (1992) presents evidence that real exchange rates are mean reverting in the long run, using a long time series annual price data for G7 countries for the period of 1900-1987. However, he obtains the opposite result of the divergence of the real exchange rate, using a short time series monthly data for the period of 1973M6-1988M12. Similarly, Lothian and Taylor (1996) obtain strong evidence of mean reversion for US-UK and French-UK real exchange rates, using almost two century time series price and exchange rate data for the period of 1791-1990.

Second, studies based on the panel unit root tests tend to reject the unit root hypothesis but find that the speed of convergence of real exchange rates is very slow. Some of these studies employed the panel unit root tests developed under the

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assumption of cross-section independence. Those studies include Frankel and Rose (1996), Oh (1996), Ceechetti et al. (2002), Mayoral and Gadea (2011), and *etc*. All these studies employ the LLC test, the IPS test, or both for testing the PPP hypothesis and reach the same conclusion of mean reversion of the real exchange rates in the long run, although they have different data sets and sample periods.[2] For example, Frankel and Rose (1996) use a panel of 150 countries and 45 annual observations for the period of 1948-1992 and reject the unit root hypothesis based on the LLC test. However, they find that the speed of convergence is slow: the half-life of convergence of the real exchange rates is about 4 years. This number is within the range of the conventional estimates of 3 to 5 years documented in Rogoff (1996). Ceechetti et al. (2002) use a panel of 19 US city price data from 1918 to 1995 and obtain evidence in favor of price convergence using both the LLC test and the IPS test. However, they find that half-life of convergence is about 9 years, which is extremely slow. Our study differs from these previous studies in that we use the new econometric method which intends to resolve the deficiency of the previous econometric methods of the panel unit root tests developed under the assumption of cross-section independence in the error terms.[3]

[2] As long as the error term of the regression for these panels exhibits strong cross-section dependence, it is possible that the mean reversion results may be turned down, according to O'Connell (1998), Pesaran (2007), and our study. Therefore, reexamining these previous studies may be an interesting task.

[3] Like us, studies such as Chen and Engel (2005), Imbs et al. (2005), Gadea and Mayoral (2009), Crucini and Shintani (2008), and Mayoral and Gadea (2011) examine the persistent behavior of disaggregate real exchange rates using sectoral price data or micro level price data. One key issue among these studies is related to an aggregation bias. For example, using the Eurostat data, Imbs et al. (2005) estimate that half-life of convergence for aggregate real exchange rates constructed using the consumer price indices is in the range of 3 to 5 years, while half-life for sectoral real exchange rates is about 1 year. Based on these results, they argue that the aggregation bias may significantly affect the PPP puzzle. On the other hand, Gadea and Mayoral (2009) using the same data as Imbs et al. (2005) obtain that half-lives for both aggregate and sectoral real exchange rates are in the range of 3 to 5 years, suggesting the aggregation bias is not a robust feature. Crucini and Shintani (2008) also obtain a similar result using micro price data for OECD countries. One criticism about these studies except for Crucini and Shintani (2008) is that they take for granted that the sectoral real exchange rates are mean-reverting in the long run. Note that the cross-section dependence in the panel is likely higher for sectoral real exchange rates than for CPI-based real exchange rates since the former contains a common nominal exchange rate whose variance is in general much greater than those of the price indices. Therefore, appropriate tests should be first used to test the PPP hypothesis before they examine a possibility of an aggregation bias.

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Our paper is also related to the studies that use Korean price data. Using various econometric methods, several studies examine the persistent behavior of the real exchange rates constructed using the price indices of Korea and its trading partners. Those studies include Kim (1998), Kim (2000), Kim (2001), Kang and Joo (2004), Oh and Park (2004), Rhee (2006), Lee and Yoon (2008), Oh and Hong (2010), Bang (2010), and etc. All these studies except for Bang (2010) apply various univariate unit root tests for the PPP hypothesis. For example, Kim (2000) and Kang and Joo (2004) employ both the ADF test and the Phillips-Perron (PP) test to examine the persistent behavior of Korean real effective exchange rates and find that those exchange rates are not mean reverting in the long run. Kim(1998), Kim (2001), Rhee (2006), and Lee and Yoon (2008) employ Johansen cointegration test to investigate if PPP holds in the long run using consumer, core consumer, wholesale, and producer price indices of Korea and its major trading partners as well as bilateral nominal exchange rates. In general, they find that PPP does not hold. However, Lee and Yoon (2008) present evidence that PPP tends to hold when core consumer price indices are considered. As an alternative to the standard unit root tests, Oh and Park (2004) apply sign test developed by Campbell and Dufour (1995) using consumer and wholesale price indices and find that PPP does not hold.

On the other hand, Bang (2010) constructs a panel with industrial real effective exchange rates for Korea and rejects the unit root hypothesis using the LLC and IPS tests. Our study is similar to Bang (2010) in that we also construct a panel with sectoral real exchange rates between Korea and Japan for testing the PPP hypothesis. However, our study differs from his study in that we use the method which controls for the cross section dependence more effectively than the two panel unit root tests used by him. In fact, we confirm the concern of O'Connell (1998) and Pesaran (2007): the IPS test could be spurious in the presence of significant cross-section dependence.

The remainder of the paper is organized as follows. We present the procedure of implementing the panel unit root test in the presence of cross section dependence developed by Pesaran (2007) in Section II. Section III displays the time series pattern of Korean and Japanese sectoral price indices as well as sectoral real exchange rates. We present our empirical results on the test for the presence of a common stochastic trend in the sectoral real exchange rates using Pesaran (2007)'s method in Section IV. We also provide the results from the IPS and LLC tests for comparison. Conclusions follow.

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II. EMPIRICAL METHOD

This section presents our empirical method for the examination of the time series properties of sectoral prices of Korea relative to Japan.

1. PPP

Let P_t denote the Korean consumer price index at time t, P_t^* denote the Japanese price index, and S_t denote the price of the Korean won in term of the Japanese yen (the yen-won nominal exchange rate). Then, $y_t = \ln(P_t S_t / P_t^*)$ is the log of the relative price of the Korean (KO) commodity basket in terms of the Japanese (JP) basket (or the log of the KO-JP real exchange rate). If the law of one price holds for the goods in the basket individually, then $y_t = 0$. That is, PPP holds. However, the basket includes not only traded goods but also non-traded goods. Further, there are various trade barriers in real world which cause the law of one price to be violated at least in the short run. Considering this, empirical studies have mainly investigated if PPP is violated in the short run but holds in the long run.

One popular empirical examination for PPP in the literature is to test if the real exchange rate contains a stochastic trend using univariate unit root tests. However, univariate unit root tests suffer from a low power when sample size is relatively small. One way to overcome this short-coming is to gain additional cross-sectional power using panel data. For this, we construct a panel using sectoral price indices to test the PPP hypothesis. Investigating the persistent properties of those price indices are directly related to the test of the PPP hypothesis since the consumer price index is constructed based on the weighted average of those sectoral price indices.

Let P_{it} denote the Korean price index in sector i at time t and P_{it}^* denote the Japanese price index in sector i. Then, $y_{it} = \ln(P_{it} S_t / P_{it}^*)$ is the log of the relative price of the Korean commodity basket in terms of the Japanese basket in sector i (or the log of the KO-JP real exchange rate in sector i). We then examine if sectoral real exchange rates are mean reverting in the long run allowing

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heterogeneity of the speed of convergence to the long run value as well as cross-section dependence of those sectoral real exchange rates in the panel.

2. An Empirical Model for Cross-section Dependence

Consider the following specification of persistence of sectoral real exchange rates in a panel with N cross-sectional units:

$$\Delta y_{it} = \beta_i y_{i,t-1} + \alpha_i + \gamma_i f_t + \varepsilon_{it}, \text{ for } i = 1, 2, \cdots, N \text{ and } t = 1, 2, \cdots, T \quad (1)$$

where y_{it} is the log of the real exchange rate in sector i at time t and $\Delta y_{it} = y_{it} - y_{i,t-1}$. If $\beta_i = 0$ then y_{it} follows a unit root process. If the value of β_i is negative then y_{it} is stationary. In this case, β_i governs the speed of convergence of y_{it} to its long run value. Note that this specification allows the speed of convergence to be different across sectors. This assumption is reasonable since some sectors mainly include non-traded goods and other sectors mainly include traded goods. The error term contains three components: α_i is a sector specific time-invariant constant, f_t is the unobserved time-varying common effect which is serially uncorrelated with mean zero and a constant variance, and ε_{it} is a sector-specific (idiosyncratic) $i.i.d.$ innovation with mean zero, a constant variance, and independently distributed both across i and t. The sector specific constant α_i controls for the influence of time-invariant heterogeneity across sectors. The unobserved common factor f_t captures the influence of cross-sectional dependence in the sectoral real exchange rates possibly induced by macroeconomic shocks.

One key issue in the literature of the panel unit root tests is how to deal with cross-sectional dependence in panel data. Previous panel unit root tests such as Levin et al. (2002) and Im et al. (2003) assumed that the error term is independent across cross-sectional units ($f_t = 0$). However, this assumption is restrictive for our study in that sectoral real exchange rates in the panel contain the common yen-won nominal exchange rate. Therefore, the error terms are not likely to be cross-

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sectionally independently distributed. One may assume $\gamma_i = 1$ for all i so that pair-wise cross-sectional covariance of the error terms is the same across sectors. Under this assumption, one can remove the common time effect using the deviation from the cross-sectional average as the basic unit of analysis before applying the panel unit root test. However, this cross-sectional de-meaning may not work in general specifications where the pair-wise covariances differ across sectors. And there is no prior reason why $\gamma_i = 1$ for all i in our dataset.[4] For example, the influence of the yen-won exchange rate can be different across sectors. In our study, we allow the sensitivity to the common component in the error term to be different across sectors and thus the pair-wise cross-sectional covariance of the error terms to be different.

3. A Panel Unit Root Test in the Presence of Cross-sectional Dependence

Our main interest is to examine if KO-JP sectoral real exchange rates contain a unit root, based on specification (1). For this, we express the null hypothesis as

$$H_0 : \beta_1 = \cdots = \beta_N = 0, \tag{2}$$

against the heterogeneous alternative,

$$H_a : \beta_1 < 0 \cup \beta_2 < 0 \cdots \cup \beta_N < 0. \tag{3}$$

To test the above unit root hypothesis based on specification (1), we use Pesaran (2007)'s method. Pesaran assumes that the common factor, f_t, is serially uncorrelated and has mean zero and a constant variance. He also assumes that ε_{it}, f_t, and γ_i are independent for all i and t. Under these assumptions as well as other usual assumptions mentioned in Pesaran(2007), he shows that the unobserved common factor can be proxied by the cross-sectional mean of the

[4] Imbs et al. (2005) also emphasize the potential effect of heterogeneity in price adjustment dynamics in panel data.

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lagged value and of the first order difference [see Pesaran (2007) for the detail]. Then, we can test the unit root hypothesis (2), based on the t-value of the OLS estimate, b_i, in the following cross-sectionally augmented DF (CADF) regression:

$$\Delta y_{it} = \alpha_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + e_{it}, \tag{4}$$

where $\bar{y}_t = \frac{1}{N}\sum_{i=1}^{N} y_{it}$ is the cross-sectional mean and e_{it} is a residual. Note that the sum of two terms, $c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t$, filters out the effects of the unobserved common factor f_t. This is the key difference from the well-known panel unit root tests that use the deviation from the cross-sectional average to mitigate the effects of cross-sectional dependence.

The t-value of the estimate b_i in regression (4) is defined by

$$t_i(N,T) = \frac{\Delta y_i' \bar{M}_w y_{i,-1}}{\hat{\sigma}_i (y_{i,-1}' \bar{M}_w y_{i,-1})^{1/2}} \tag{5}$$

where

$$\Delta y_i = (\Delta y_{i,1}, \cdots, \Delta y_{i,T})', y_{i,-1} = (y_{i,0}, \cdots, y_{i,T-1})'$$

$$\bar{M}_w = I_T - \bar{W}(\bar{W}'\bar{W})^{-1}\bar{W}', \bar{W} = (\tau, \Delta\bar{y}, \bar{y}_{-1})$$

$$\tau = (1,1,\cdots,1)', \Delta\bar{y} = (\Delta\bar{y}_1, \cdots, \Delta\bar{y}_T)', \bar{y}_{-1} = (\bar{y}_0, \cdots, \bar{y}_{,T-1})'$$

$$\hat{\sigma}_i^2 = \frac{\Delta y_i' M_{i,w} \Delta y_i}{T-4} \quad \text{and} \quad M_{i,w} = I_T - G_i (G_i' G_i)^{-1} G_i', G_i = (\bar{W}, y_{i,-1}).$$

Note that $t_i(N,T)$ can be compared with the standard DF t-statistic. The main difference between the two t-values is that $t_i(N,T)$ takes into account of cross-sectional dependence. That is, $t_i(N,T)$ can be interpreted as the *cross-sectionally* augmented DF statistic for sector i since the standard DF regression does not include $c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t$. In principle, $t_i(N,T)$ should have more power than the DF test when there is a significant degree of cross-section dependence in data because the former eliminates the effect of the common factor on the persistence of the real exchange rate.

Pesaran (2007) proposes several methods to aggregate the individual CADF statistics $t_i(N,T)$ so that one can test for the panel unit root hypothesis in the presence of cross-section dependence more powerfully, while allowing heterogeneity of the speed of convergence across cross-section units [see Pesaran (2007, pp. 276-277) for the detail]. We consider the most representative one among his methods: based on the idea of Im et al. (2003)'s aggregation method (also known as the IPS test), the method takes the average of individual t-values:

$$CIPS(N,T) = \frac{1}{N}\sum_{i=1}^{N} t_i(N,T). \tag{6}$$

He also provides critical values for various pairs of N,T under each of the standard three model specifications by simulations [see Pesaran (2007, Table II(a)-(c))]: one model specification is that regression (4) does not include intercept and time trend terms; another is that it includes only an intercept term; and the other is that it includes both intercept and time trend terms.

Pesaran also relaxes the assumptions of the serially uncorrelated error term in specification (1) so that both y_{it} and the common factor f_t follow an AR(p) process. Then, the corresponding CADF regression is followed by:

$$\Delta y_{it} = \alpha_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + \sum_{j=1}^{p} (\phi_{ij} \Delta y_{i,t-j} + d_{ij} \Delta \bar{y}_{t-j}) + e_{it}, \tag{7}$$

where the term $\sum_{j=1}^{p} (\phi_{ij} \Delta y_{i,t-j} + d_{ij} \Delta \bar{y}_{t-j})$ is augmented to capture residual serial correlation and the lagged levels of the cross-sectional means of the processes. Nevertheless, the formula for the calculation of t-value is the same as equation (5) except for the term $\bar{W}$. It is now modified in the following way:

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$\bar{W} = (\tau, \Delta\bar{y}, \bar{y}_{-1}, \Delta y_{i,-1}, \ldots, \Delta y_{i,-p}, \Delta\bar{y}_{-1}, \ldots, \Delta\bar{y}_{-p})$. This modification takes into account of the inclusion of the term $\sum_{j=1}^{p}(\phi_{ij}\Delta y_{i,t-j} + d_{ij}\Delta\bar{y}_{t-j})$ in the regression. We use $CIPS(N,T)$ obtained from regression (7) and its critical values for our empirical study of testing the panel unit root hypothesis (2).

Table 1. COICOP Divisions of Consumer Prices

	Title of Group
G1	Food and non-Alcoholic beverages
G2	Alcoholic beverages, tobacco and narcotics
G3	Clothing and footwear
G4	Housing, water, electricity, gas and other fuels
G5	Furnishings, household equipment and routine, household maintenance
G6	Health
G7	Transport
G8	Communication
G9	Recreation and culture
G10	Education
G11	Restaurants and hotels
G12	Miscellaneous goods and services

Data Source: OECD Statistics (accessed September 15th, 2016).

III. DATA

We obtain monthly "National Consumer Price Indices by COICOP Divisions" from the OECD database (stats.oecd.org) for the period of 1985M01-2016M07. For each month, OECD joint with IMF publishes prices of 12 groups divided by the purpose of individual consumption. These groups are presented in Table 1. We use these 12 sectoral price indices for Korea and Japan as well as the yen-won nominal exchange rate to construct a panel of 12 sectoral KO-JP real exchange rates.[5]

[5] All price indices are seasonally adjusted using the software package of "X-12-ARIMA" provided by the US Census Bureau.

Table 2. Summary statistics

	$corr(\Delta y_{it}, \Delta s_t)$	$sd(\Delta y_{it}) / sd(\Delta s_t)$	$corr(y_{it}, y_{i,t-1})$	$corr(\Delta y_{it}, \Delta y_{i,t-1})$
G1	0.95	1.05	0.98	0.34
G2	0.85	1.18	0.98	0.29
G3	0.99	1.02	0.98	0.39
G4	0.99	0.97	0.98	0.38
G5	0.99	1.00	0.98	0.40
G6	0.98	1.02	0.98	0.39
G7	0.96	0.94	0.99	0.34
G8	0.95	1.06	0.99	0.37
G9	0.99	1.00	0.99	0.37
G10	0.98	1.02	0.98	0.36
G11	0.99	0.99	0.98	0.39
G12	0.98	0.98	0.98	0.36

Data Source: OECD Statistics (accessed September 15th, 2016). $corr(\Delta y_{it}, \Delta s_t)$ is the cross correlation between the change in the log of the sectoral real exchange rate and the change in the log of the nominal exchange rate; $sd(\Delta y_{it}) / sd(\Delta s_t)$ is the ratio of the standard deviation of the change in the log of the sectoral real exchange rate to that of the change in the log of the nominal exchange rate change; $corr(y_{it}, y_{i,t-1})$ is the first order autocorrelation of the log of the sectoral real exchange rate; and $corr(\Delta y_{it}, \Delta y_{i,t-1})$ is the first order autocorrelation of the change in the log of the sectoral real exchange rate.

Table 2 presents summary statistics of time series properties of logs of the sectoral KO-JP real exchange rates and of the yen-won nominal exchange rate. First, the contemporaneous cross correlations between the sectoral real exchange rate changes and the yen-won nominal exchange rate changes are close to one for all sectors except for "Alcoholic beverages, tobacco, and narcotics" (G2). For example, the contemporary cross correlation between the real and nominal exchange rate changes for the sector of "Clothing and footwear" (G3) is 0.99. This suggests that the sectoral real exchange rates move very closely together with the nominal exchange rate. Second, the ratios of the standard deviation of the sectoral real exchange rate changes to that of the nominal exchange rate changes are close to one for all sectors except for "Alcoholic beverages, tobacco, and narcotics". This suggests that the volatility of the nominal exchange rate changes mainly determines the volatility of the sectoral real exchange rate changes. Third, the first order autocorrelations of the sectoral real exchange rates are close to one for all sectors. We also find that the first order autocorrelation of the nominal exchange

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rate is about 0.98, implying that both the sectoral real exchange rates and the nominal exchange rate are very persistent.

Figure 1-1. Yearly Japanese Sectoral Consumer Prices

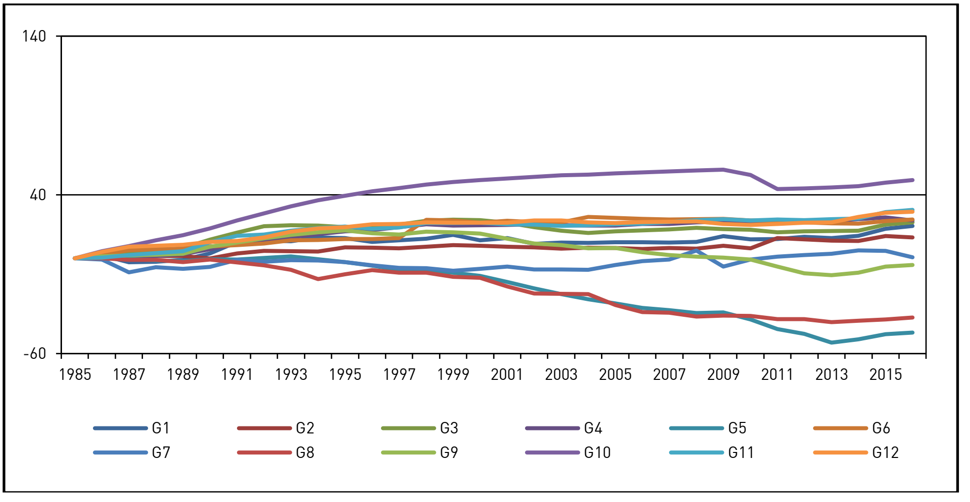
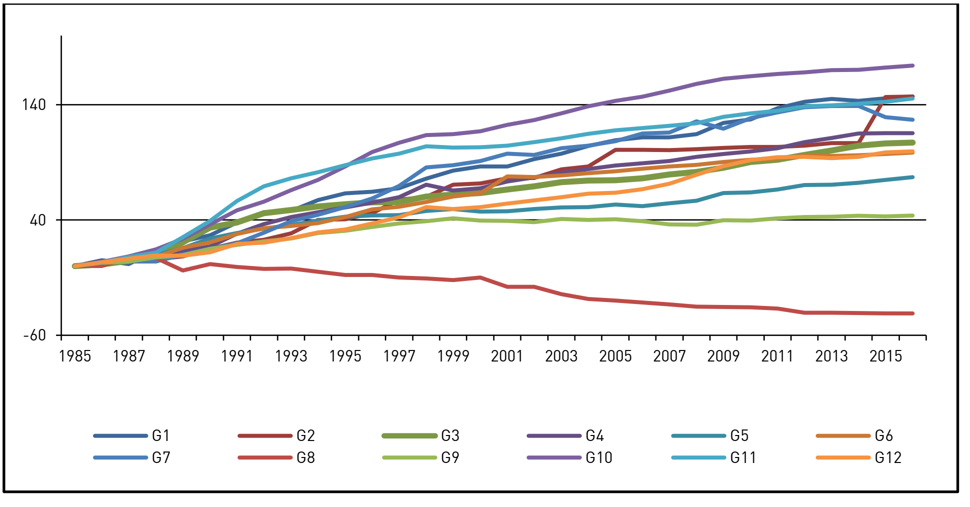


Figure 1-2. Yearly Korean Sectoral Consumer Prices



Data Source: OECD Statistics (accessed September 15th, 2016). We multiply 100 by logs of each series normalized by its 1985M1 value.

These three findings are consistent with empirical evidence obtained using CPI-based real exchange rates in developed countries [see for example Mussa (1986), Engel (1999), and Chari et al. (2002)]. Fourth, the first order autocorrelations of the sectoral real exchange rate changes are strictly positive and in the range of 0.29 to 0.4. The first order autocorrelation of the nominal exchange rate changes is about 0.40, suggesting that both the sectoral real exchange rates and the nominal exchange rate do not behave like a random walk.[6] The fourth fact is not consistent with the so-called Messe and Rogoff (1983) puzzle: no exchange rate models can outperform the random walk in out of sample forecasting. The first three facts are apparently consistent with the so-called PPP puzzle: both high volatility and strong persistence of real exchange rates cannot be solely explained by either real shocks or monetary (financial) shocks. In addition, the significant positive autocorrelations of sectoral real exchange rate changes suggest that real exchange rates are not likely mean-reverting in the long run. In the next section, we will conduct more rigorous analysis to examine if these sectoral real exchange rates converge to their long run value.

We now discuss the time series properties of sectoral consumer prices for Korea and Japan as well as sectoral real exchange rates. Figure 1 draws the logs of yearly consumer prices: we normalize the series by its value in 1985M1 and multiply the logs of normalized values by 100 so that the series can be interpreted as a percentage deviation of its initial value.[7] Although we use monthly data for our main analysis, yearly data are used here to make visualization clear. One distinct feature is that the time series of yearly Japanese sectoral consumer prices reflect the influence of the so-called deflation era in Japan. In general, the price increase is about 4 to 8 times greater in Korea than in Japan. For example, the price of "Food and non-Alcoholic beverages"(G1) has increased about 20% in Japan but 147% in Korea during the last 30 years since 1985 [see Figure 1.1 and 1.2]. In addition, four sectoral prices in Japan have been even decreased or changed very little. Those price indices include "Furnishings, household equipment and routine, household maintenance" (G5), "Communication" (G8), "Transport" (G7), and "Recreation

[6] Although we do not report the standard errors for the estimates of autocorrelations for the sectoral real exchange rate changes and the nominal exchange rate changes for simplicity, they are statistically significant at the usual conventional levels.

[7] We use January price indices to construct yearly series.

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and culture" (G9). During the same period, the price indices except for the price index of "Communication" have significantly increased in Korea. For example, the price of "Transport" has increased about 137% in Korea but only about 0.7% in Japan. Furthermore, the Japanese sectoral prices have increased very little since the mid-1990s, consistent with the so-called deflation era. Of the 12 price indices, the magnitude of the highest price increase is about 10% during the last 20 years in Japan, while it is about 76% in Korea. Exceptionally, the price index of "Communication" has steadily decreased both in Korea and Japan. The price change between 1985 and 2015 is about -38.6% in Japan and -40.9% in Korea. In summary, some price indices have increased both in Korea and Japan, although the magnitude of the price change is quite different between the two countries. On the other hand, some price indices have increased only in Korea and have not changed much in Japan. Finally, the price index of "Communication" has decreased in a similar amount both in Korea and Japan. The divergence of price changes across sectors between the two countries suggests that the adjustment of the yen-won nominal exchange rate alone may not be enough in order for PPP to hold in the long run.

Figure 2 draws the logs of yearly yen-won nominal exchange rate and KO-JP sectoral real exchange rates. One key feature is that the Korean won has been continuously depreciated relative to its 1985M1 value. This pattern reflects the fact that the Japanese inflation rate has been much lower than the Korean inflation rate, holding other things constant. By comparing the time series of the nominal exchange rate with that of sectoral real exchange rates, we confirm that the two series move very closely and the movement of the nominal exchange rate is critically related to that of the real exchange rates, consistent with empirical facts in Table 2. Further, there is a tendency that all sectoral real exchange rates move closely together over time. This co-movement suggests that a common factor, likely the movement of the nominal exchange rate, may govern the movement of sectoral real exchange rates. This co-movement also illustrates that there is a significant degree of cross-section dependence and suggests that empirical methods for testing PPP should take into account of it.

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Figure 2-1. Yearly Yen-Won Nominal Exchange Rate

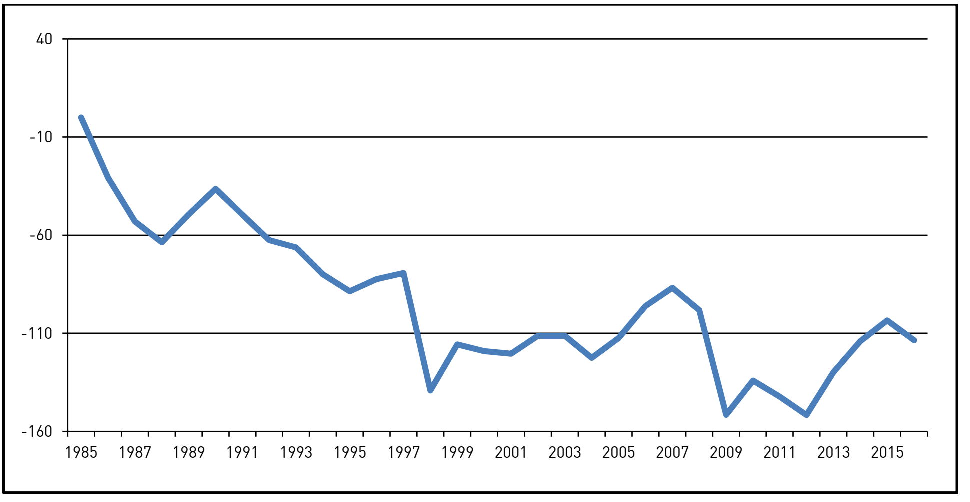
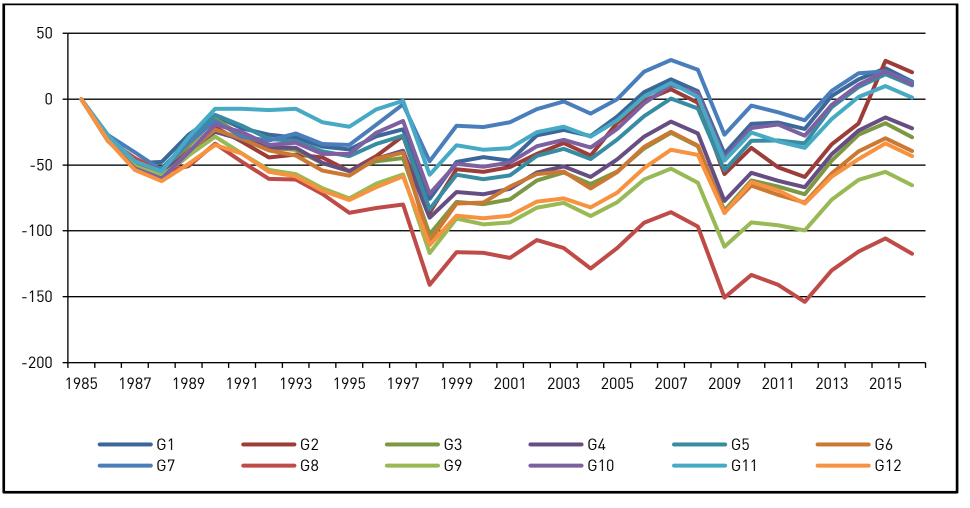


Figure 2-2. Yearly KO-JP Sectoral Real Exchange Rates



Data Source: OECD Statistics (accessed September 15th, 2016) and ECOSYS of the Bank of Korea. We multiply 100 by logs of each series normalized by its 1985M1 value.

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IV. RESULTS ON PANEL UNIT ROOT TESTS FOR SECTORAL REAL EXCHANGE RATES

In this section, we use two generations of panel unit root tests to examine the long run convergence of the sectoral real exchange rates: the first one includes the IPS test developed by Im et al. (2003) and the LLC test developed by Levin et al. (2002); the second one includes the CIPS test developed by Pesaran (2007). The main difference among these tests is that the latter takes into account of the effect of cross-section dependence more effectively than the former. For example, O'Connell (1998) and Pesaran (2007) show that the former tests have severe size distortions in the presence of high cross-sectional dependence in panel data.

Table 3. IPS and LLC Tests for Sectoral KO-JP Real Exchange Rates

Sample Period	Intercept Only	Lag	Intercept and Trend	Lag	Obs
Panel A. IPS Tests					
1985M1-2016M7	-5.79***	1 to 2	-5.92***	1	4548
1985M1-1997M10	-5.14***	1	-3.01***	1	1848
1997M11-2016M7	-3.15***	1 to 2	-4.68***	1	2700
Panel B. LLC Tests					
1985M1-2016M7	-4.19***	1 to 2	-6.80***	1 to 2	4548
1985M1-1997M10	-5.31***	1	-4.58***	1	1848
1997M11-2016M7	-1.51*	1 to 2	-3.64***	1	2700

Data Source: OECD Statistics (accessed September 15th, 2016). The statistics in Panel A of the table are Im et al. (2003)'s w-statistics which are the standardized t-statistics. The statistics in Panel B of the table are Levin et al. (2002)'s t-statistics. The lag length is selected based on BIC. The number of cross-section units in the panel is 12. "obs" represents the number of observations in each sample. *, **, and *** represent statistical significance at 10, 5, and 1% level, respectively.

We consider two model specifications for testing the unit root hypothesis (2): the first specification includes an intercept term in the regressions and the second one includes both intercept and trend terms. The second specification with a deterministic trend is not consistent with the PPP hypothesis since there are no economic theories predicting that the real exchange rate trends over long time periods. However, as presented in Section III, the Korean won relative to the Japanese yen has continuously depreciated during our sample period and appears to follow a trend. Therefore, based on the model specification with a deterministic

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trend, we intend to investigate if the so-called deflation error in Japan has influenced the process of the real exchange rate process.

To examine the persistent properties of KO-JP sectoral real exchange rates, we mainly consider the entire sample period of 1985M1-2016M7 since having longer time series data as much as possible would help the unit root tests to be more powerful. In addition, we divide the entire sample period into two to investigate if macroeconomic events may have influenced a structural change in the process of the real exchange rate: one is the sample period of 1985M1:1997M10; the other is the period of 1997M11:2016M7. The second sub-period includes the periods of the Asian financial crisis in 1997-1998 and of the global financial crisis in 2008-2009. Several studies argue that the Korean economy has experienced a structural transformation after the Asian financial crisis [see for example Chang (2003) and Moon (2015)]. Therefore, we intend to investigate that the crisis shocks may have a permanent effect on the process of the real exchange rate.

1. The IPS and LLC Tests

As a starting point, we consider the IPS and LLC tests for the hypothesis that KO-JP sectoral real exchange rates contain a stochastic trend. These tests have been widely used in the literature to test the nonstationary behavior of time series in panel datasets under the assumption of no cross-section dependence and thus can be compared to the CIPS test which is our main method.

The key difference between the IPS and LLC tests is that the LLC test sets the unit root null hypothesis against the alternative hypothesis where all sectoral real exchange rates are stationary, while the IPS test relaxes these homogeneity restrictions under the alternative hypothesis. Table 3 displays the results of the IPS and LLC tests for the unit root hypothesis for the three sample periods and for the two model specifications. In Panel A, we present the test results from the IPS test by reporting Im et al. (2003)'s w-statistics which are the standardized t-statistics. In Panel B, we present the results from the LLC test by reporting Levin et al. (2002)'s t-statistics. We set lag length based on the Bayesian information criteria (BIC). Overall, we find that the IPS test strongly rejects the unit root hypothesis for all the three sample periods and the two model specifications we considered. The w-statistics are statistically significant at the 1% level for all cases. We also find that the LLC test strongly rejects the null hypothesis for all the cases

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considered. Levin et al. (2002)'s t-statistics are statistically significant at the 1% level for all cases. There is one exception: the LLC test rejects the unit root hypothesis at the 10% level for the sample period of 1997M11-2016M7 and for the model specification with only intercept term. We also find that these results are robust to the selection of lag length: We consider different lag lengths from 0 to 15 for robustness check and find that the conclusion in general remains unchanged.

However, there is one important concern regarding the robustness of the results from the IPS and LLC tests in the presence of significant cross-section dependence. That is, O'Connell (1998) and others show that the panel unit root tests developed under the assumption of cross-section independence are spurious in that the tests tends to over-reject the unit root hypothesis for real exchange rates in the presence of significant cross-sectional dependence. As visually displayed in Section 3, KO-JP sectoral real exchange rates move closely together suggesting that there is significant degree of cross-sectional dependence in our panel dataset. To formally measure cross section dependence of these sectoral real exchange rates, we also compute pair-wise correlations using residuals from typical individual ADF regressions. As reported in Table 4, the average of those correlations for each sample period is very high. For example, for the entire sample period the average cross correlations are around 0.91 for both model specifications. These strong correlations are also observed in the two subsample periods, suggesting that a different panel unit root test should be considered.

Table 4. Cross-sectional Correlations of Residuals in the ADF Regressions of Sectoral Real Exchange Rates

Sample Period	Intercept Only	Intercept and Trend	Obs
1985M1-2016M7	0.91	0.91	4548
1985M1-1997M10	0.89	0.90	1848
1997M11-2016M7	0.90	0.91	2700

Data Source: OECD Statistics (accessed September 15th, 2016). All the numbers in the table are the average of pair-wise correlations using residuals from typical individual ADF regressions. The lag length is set at 1 to be consistent with the models in Table 3. The number of cross-section units in the panel is 12. "obs" represents the number of observations in each sample.

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2. The CIPS Test

We obtained supporting evidence that the sectoral real exchange rates revert to their long run value based on the IPS and LLC tests. However, our conclusion might not be safe, considering the fact that the significant degree of cross-section dependence in the sectoral real exchange rates is documented in Table 4. Therefore, we now consider the CIPS test which controls for the influence of cross-section dependence in the error term.

Table 5 presents the results of Pesaran (2007)'s CIPS test for the panel of 12 sectoral KO-JP real exchange rates. Analogous to the cases of the IPS and LLC tests, we provide the results from not only the three sample periods but also the two model specifications. Again, we set lag length based on the BIC. For each case, we report $CIPS(N,T)$ in (6). Overall, we find that there is little evidence of long run convergence of sectoral real exchange rates. For a robustness check, we use different lag lengths from 0 to 24 and find that the conclusion in general remains unchanged.[8] These results contradict to those from the IPS and LLC tests and suggest that the apparent support for the PPP hypothesis based on the IPS and LLC tests could be spurious since the CIPS test is robust to the presence of cross-section dependence.

Table 5. CIPS Tests for Sectoral KO-JP Real Exchange Rates

Sample Period	Intercept Only	Lag	Intercept and Trend	Lag	Obs.
1985M1-2016M7	-1.54	0	-1.87	0	4548
1985M1-1997M10	-0.67	0	-1.65	0	1848
1997M11-2016M7	-1.52	0	-2.49	0	2700

Data Source: OECD Statistics (accessed September 15th, 2016). All the numbers in the table are the CIPS statistics defined in equation (6). The lag length is selected based on BIC. The number of cross-section units in the panel is 12. "obs" represents the number of observations in each sample. *, **, and *** represent statistical significance at 10, 5, and 1% level, respectively.

Specifically, the CIPS test does not reject the unit root hypothesis at the standard conventional levels. These results hold true for the entire sample period as well as for the two subsample periods. We also consider different dates for the division of

[8] For the sake of space, we do not report the results for different lag lengths. But the results are available upon request.

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subsample periods and find that the conclusion remains intact. One would expect that product markets between Korea and Japan are more integrated in the second subsample period than in the first subsample period. However, the data do not show a clear picture and rather suggest that capital market liberalization and high openness of product markets after the Asian financial crisis do not much affect the process of the real exchange rate. Second, the long run divergence of sectoral real exchange rates appears in both model specifications, suggesting that the nonstationary behavior of the real exchange rates is not much related to their time trend component.

Overall, we are not able to reject the unit root hypothesis for sectoral real exchange rates using the CIPS test. That is, we do not find enough evidence that the deviations of sectoral real exchange rates from PPP are stationary.

3. Traded Goods Versus Non-traded Goods

In this subsection, we look into a reason for the non-stationary behavior of the KO-JP sectoral real exchange rates. Our sample of sectoral price indices includes both traded and non-traded goods. Therefore, one may argue that the presence of the price indices for non-traded goods may derive the divergence of the sectoral real exchange rates. To examine the role of non-traded goods, we divide our sample of 12 sectoral real exchange rates into two. One includes those real exchange rates constructed using price indices of traded goods and the other includes those real exchange rates constructed using price indices of non-traded goods. The former includes the following 4 sectors: “Food and non-Alcoholic beverages” (G1), “Alcoholic beverages, tobacco and narcotics” (G2), “Clothing and footwear” (G3), and “Housing, water, electricity, gas and other fuels” (G4). And the latter includes the other 8 sectors. We admit that our classification of traded and non-traded goods is not perfect since our sample does not have more detailed price data.

Table 6 presents the results of Pesaran (2007)’s CIPS test for the panels of traded and nontraded sectoral KO-JP real exchange rates. For the non-traded sectoral KO-JP real exchange rates, the CIPS test does not reject the unit root hypothesis for all the three sample periods considered, consistent with the results from the sample with both traded and non-traded sectoral real exchange rates. However, for the traded sectoral real exchange rates, the CIPS test now rejects the

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unit root hypothesis at the 10% significant level for the period of 1997M11-2016M7, while it does not reject it for the period of 1985M1-1997M10. This result can be interpreted as the traded goods markets between Korea and Japan have been more integrated after the Asian financial crisis, although the statistical significance is marginal. This result is also in favor with the fact that both Korean financial and product markets have been significantly open to the world markets after the Asian financial crisis.[9]

Table 6. CIPS Tests for Traded and Non-traded Sectoral KO-JP Real Exchange Rates

Sample Period	Intercept Only	Lag	Intercept and Trend	Lag	Obs.
Panel A. Traded Sectoral KO-JP Real Exchange Rates					
1985M1-2016M7	-1.57	0	-2.54	0	1516
1985M1-1997M10	-1.06	0	-1.78	0	616
1997M11-2016M7	-2.31*	0	-2.62	0	900
Panel B. Non-traded Sectoral KO-JP Real Exchange Rates					
1985M1-2016M7	-1.51	0	-1.49	0	3032
1985M1-1997M10	-0.41	0	-1.60	0	1232
1997M11-2016M7	-1.52	0	-2.49	0	1800

Data Source: OECD Statistics (accessed September 15th, 2016). All the numbers in the table are the CIPS statistics defined in equation (6). The lag length is selected based on BIC. "obs" represents the number of observations in each sample. *, **, and *** represent statistical significance at 10, 5, and 1% level, respectively.

V. CONCLUSION

This paper investigates the degree of product market integration between Korea and Japan. In particular, we examine if sectoral KO-JP real exchange rates revert to their mean value in the long run. Implementing the new panel unit root test in the presence of cross-section dependence, we do not find enough evidence that a deviation of the sectoral real exchange rates from PPP converges in the long run.

[9] Since our stationary alternative hypothesis allows heterogeneity in sectoral persistence, it is possible that a few sectors may derive the result of nonstationary sectoral real exchange rates. Hence, we reconstruct panels taking out either the maximum or minimum sectoral real exchange rate and apply the CIPS test. But we find that the conclusion remains unchanged.

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However, for the traded sectoral real exchange rates, we marginally reject the hypothesis that a deviation from PPP diverges in the long run. These two pieces of evidence suggest that further analysis using more detailed price data or micro level price data is needed to understand better the degree of product market integration between Korean and Japan. We leave this issue for a future study.

Our paper has two innovations in the related literature. One is technical. We apply the new panel unit root test for the study of PPP. This method improves the power properties of univariate unit root tests which have been widely applied to the real exchange rate data. In addition, the method overcomes the deficiency of the well-known panel unit root tests such as the IPS and LLC tests. The other is economical. Previous studies using the Korean price data mainly apply univariate unit root tests for the PPP hypothesis. Implementing the new panel econometric technique, future studies may examine more thoroughly issues related to the integration of product markets between the Korean and world economy.

REFERENCES

Bang, H. 2010. "Estimating Real Effective Exchange Rate by Industry in Korea and Panel Unit-root Tests," *Economic Analysis*, vol. 16, no. 4, pp. 150-171. (in Korean)

Campbell, B. and J.-M. Dufour. 1995. "Exact Nonparametric Orthogonality and Random Walk Tests," *Review of Economics and Statistics*, vol. 77, no. 1, pp. 1-16.

Cecchetti, S. G., Mark, N. C. and R. J. Sonora. 2002. "Price Index Convergence Among United States Cities," *International Economic Review*, vol. 43, no. 4, pp. 1081-1099.

Chang, S.-J. 2003. *Financial Crisis and Transformation of Korean Business Groups*. Cambridge: Cambridge University Press.

Chari, V. V., Kehoe, P. J. and E. R. McGrattan. 2002. "Can Sticky Price Models Generate Volatile and Persistent Real Exchange Rates?," *Review of Economic Studies*, vol. 69, no. 3, pp. 533-563.

Chen, S.-S. and C. Engel. 2005. "Does 'Aggregation Bias' Explain the PPP Puzzle," *Pacific Economic Review*, vol. 10, no. 1, pp. 49-72.

Choi, C.-Y., Mark, N. C. and D. Sul. 2006. "Unbiased Estimation of the Half-life to PPP Convergence in Panel Data," *Journal of Money, Credit and Banking*, vol. 38, no. 4, pp. 921-938.

Crucini, M. J. and M. Shintani. 2008. "Persistence in Law of One Price Deviations: Evidence from Micro-data," *Journal of Monetary Economics*, vol. 55, no. 3, pp. 629-644.

Engel, C. 1999. "Accounting for U.S. Real Exchange Rate Changes," *Journal of Political Economy*, vol. 107, no. 3, pp. 507-538.

ⓒ 2016 East Asian Economic Review

Frankel, J. A. and A. K. Rose. 1996. “A Panel Project on Purchasing Power Parity: Mean Reversion Within and Between Countries,” *Journal of International Economics*, vol. 40, no. 1-2, pp. 209-224.

Froot, K. A. and K. Rogoff. 1995. Perspectives on PPP and Long-run Real Exchange Rates. In Grossman, G. M. and K. Rogoff. (eds.) *Handbook of International Economics*. Vol. 3, Amsterdam: North-Holland.

Gadea, M. D. and L. Mayoral. 2009. “Aggregation is not the Solution: The PPP Puzzle Strikes Back,” J*ournal of Applied Econometrics*, vol. 24, no. 6, pp. 875-894.

Glen, J. D. 1992. “Real Exchange Rates in Short, Medium, and Long Run,” *Journal of International Economics*, vol. 33, no. 1-2, pp. 147-166.

Im, K. S., Pesaran, M. H. and Y. Shin. 2003. “Testing for Unit Roots in Heterogeneous Panels,” *Journal of Econometrics*, vol. 115, no. 1, pp. 53-74.

Imbs, J., Mumtaz, H., Ravn, M. O. and H. Rey. 2005. “PPP Strikes Back: Aggregation and the Real Exchange Rate,” *Quarterly Journal of Economics*, vol. 120, no. 1, pp. 1-43.

Kang, S. and S. Y. Joo. 2004. “Real Exchange Rate Misalignment in Korea, Singapore and Thailand,” *Journal of Money & Finance*, vol. 18, no. 2, pp. 1-28. (in Korean).

Kim, B. 2007. “Forecasting Analysis of Real Won/Dollar Exchange Rates,” *Journal of Korean Economic Development*, vol. 13, no. 1, pp. 95-112. (in Korean)

Kim, C.-H. 2000. “Decomposition of the Won Real Effective Exchange Rate with a Consideration of Heteroscedasticity,” *Kukje Kyungje Yongu*, vol. 6, no. 2, pp. 33-60. (in Korean)

Kim, J.-O. 2001. “Purchasing Power Parity: Two Nations Versus Multi-Nation Model,” *Korean Journal of Money & Finance*, vol. 6, no. 2, pp. 101-119. (in Korean)

Kim, J. S. 1998. “An Empirical Test of Purchasing Power Parity Hypothesis: The Long-run Behavior of Korean Won/Dollar Exchange Rate,” *Kukje Kyungje Yongu*, vol. 4, no. 3, pp. 189-205. (in Korean)

Lee, H. H. and K.-S. Yoon. 2008. “A Re-examination of Purchasing Power Parity Hypothesis by Using Core Consumer Price Index,” *Kukje Kyungje Yongu*, vol. 14, no. 2, pp. 53-75. (in Korean)

Levin, A., Lin, C.-F. and C.-S. J. Chu. 2002. “Unit Root Tests in Panel Data: Asymptotic and Finite-sample Properties,” *Journal of Econometrics*, vol. 108, no. 1, pp. 1-24.

Lothian, J. R. and M. P. Taylor. 1996. “Real Exchange Rate Behavior: The Recent Float from the Perspective of the Past Two Centuries,” *Journal of Political Economy*, vol. 104, no. 3, pp. 488-509.

Maddala, G. S. and S. Wu. 1999. “A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test,” *Oxford Bulletin of Economics and Statistics*, vol. 61, Issue, S1, pp. 631-652.

Mayoral, L. and M. D. Gadea. 2011. “Aggregate Real Exchange Rate Persistence through the Lens of Sectoral Data,” *Journal of Monetary Economics*, vol. 58, no. 3, pp. 290-304.

Meese, R. A. and K. Rogoff. 1983. “Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?,” *Journal of International Economics*, vol. 14, no. 1-2, pp. 3-24.

Moon, S. 2015. “Decrease in the Growth of Domestic Demand in Korea,” *Journal of East Asian Economic Integration*, vol. 19, no. 4, pp. 381-408.

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Murray, C. J. and D. H. Papell. 2005. "Do Panels Help Solve the Purchasing Power Parity Puzzle?," *Journal of Business and Economic Statistics*, vol. 23, no. 4 , pp. 410-415.
Mussa, M. 1986. "Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications," *Carnegie-Rochester Conference Series on Public Policy*, vol. 25, no. 1, pp. 117-214.
O'Connell, P. G. J. 1998. "The Overvaluation of Purchasing Power Parity," *Journal of International Economics*, vol. 44, no. 1, pp. 1-19.
Oh, D. and K. Hong. 2010. "Balassa-Samuelson Effect in Won/Dollar and Won/Yen Exchange Rates," *Journal of East Asian Economic Integration*, vol. 14, no. 1, pp. 263-307. (in Korean)
Oh, K.-Y. 1996. "Purchasing Power Parity and Unit Root Tests Using Panel Data," *Journal of International Money and Finance*, vol. 15, no.3, pp. 405-418.
Oh, Y. and B. Park. 2004. "Test of Purchasing Power Parity for Korean Exchange Rate: Sign Unit Root Test," *Kukje Kyungje Yongu*, vol. 10, no. 2, pp. 87-104. (in Korean)
Pesaran, M. H. 2007. "A Simple Unit Root Test in the Presence of Cross-section Dependence," *Journal of Applied Econometrics*, vol. 22, no. 2, pp. 265-312.
Rhee, H.-J. 2006. "Evaluation of Korean Won Exchange Rates Implemented by Non-tradable Goods and Purchasing Power Parity Frameworks," *International Area Studies Review*, vol. 10, no. 2, pp. 564-581. (in Korean)
Rogoff, K. 1996. "The Purchasing Power Parity Puzzle," *Journal of Economic Literature*, vol. 34, no. 2, pp. 647-668.

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