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A Cointegration Analysis of Purchasing Power Parity and Country Risk

Su-Yin Cheng
Department of Finance, National Chung Cheng University, Taiwan

Jong-Shin Wei
Department of International Business, Wenzao Ursuline College of Languages, Taiwan

Han Hou*
Department of Finance, National Chung Cheng University, Taiwan

Abstract

This paper examines purchasing power parity (PPP) for 61 countries using the panel cointegration method developed by Westerlund (2007). After controlling for cross-sectional dependence, the results show that weak PPP is stronger for Latin American countries and for countries with moderate country risk, defined in terms of political, economic, and financial components, with direct or indirect implications for the validity of PPP. Compared with a single country characteristic that might affect PPP as suggested in the literature, country risk captures more information for explaining the validity of the PPP hypothesis.

Key words: purchasing power parity; country risk; panel cointegration; cross-sectional dependence

JEL classification: C23; F31; O57

1. Introduction

The purchasing power parity (PPP) hypothesis asserts that exchange rates between two currencies are determined by relative national aggregate price levels. Testing for PPP is usually done using unit root tests of real exchange rates or employing a cointegration approach to test for cointegration between nominal exchange rates and domestic and foreign prices. According to Froot and Rogoff

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*Correspondence to: Department of Finance, National Chung Cheng University, 168, University Rd., Min-Hsiung, Chia-Yi 621, Taiwan. E-mail: hans.hou0503@msa.hinet.net. We would like to thank Professor Westerlund for his valuable guidance on how to correctly implement the error-correction-based panel cointegration model and for providing GAUSS code. A referee's constructive comments are also gratefully acknowledged.

(1995), the empirical results from a time series unit root test or a cointegration test, such as the augmented Dickey-Fuller (ADF) test or Johansen's maximum likelihood methods, provide little support for PPP. The common explanation for failing to reject the null of unit root or the null of no cointegration is attributed to the small sample size. Consequently, a growing body of the literature, such as Froot and Rogoff (1995) and O'Connell (1998), suggest that panel data should be applied instead to increase the power of the test. MacDonald (1996), Oh (1996), Papell (1997), and Im et al. (2003) use more powerful panel unit roots of real exchange rates, yet the results are conflicting.

One implication of unit root tests is that the restrictive conditions of proportionality and symmetry restrictions are satisfied in PPP. That is, nominal exchange rates and aggregate price ratios move together in a one-to-one fashion in the long run. However, transportation costs, measurement errors, and differences in the composition of price indexes may each lead to violations of proportionality and symmetry in PPP, leading to the looser definition of so-called "weak" PPP (Taylor, 1988; Cheung and Lai, 1993; Pippenger, 1993). The weak version of the PPP hypothesis states that nominal exchange rates and aggregate price ratios may move together in equilibrium, but the relationship need not necessarily be one-to-one. Testing for weak PPP is typically facilitated by the techniques of cointegration. One advantage of the cointegration test for PPP is that it relaxes the restriction of symmetry or proportionality imposed by unit root tests of real exchange rates. McCoskey and Kao (1998), Larsson et al. (2001), and Pedroni (2004) use panel cointegration tests to support the weak PPP hypothesis for developed countries.

Although the panel approach is more powerful and increasingly popular, some studies, e.g., O'Connell (1998), Wu and Wu (2001), and Im et al. (2003), indicate that the traditional hypothesis of cross-independent cross-sectional units in panel data is implausible. The phenomenon of inter-economy linkages around the world or across a region suggests cross-section dependence. To overcome the problem of cross-section dependence, Maddala and Wu (1999) and Chang (2004) recommend using bootstrapping procedures to draw statistical inference.

In addition to improving the low power of the statistical tests of PPP, some studies address the role of structural characteristics across countries on PPP. Cheung and Lai (2000) using a time series approach find that PPP is stronger for developing countries. They also indicate that inflation and persistence in PPP deviations are negatively correlated, suggesting that PPP is more likely to hold for countries with high inflation. In contrast with Cheung and Lai (2000), Holmes (2001) using the IPS panel unit root test finds that PPP does not hold for countries with high inflation. Alba and Papell (2007) using a panel unit root test developed by Levin et al. (2002) find that PPP holds for European and Latin American countries. Furthermore, they find that PPP is stronger for countries which are more open to trade, are closer to the US, have lower inflation rates, have growth rates of per capita real GDP more similar to the US, and have moderate nominal exchange rate volatility.

In this paper, we adopt a panel cointegration method recently developed by Westerlund (2007) to investigate whether PPP varies with country risk defined in terms of political, economic, and financial factors. As indicated by previous studies, PPP may not hold for many reasons, such as barriers to trade and sticky nominal exchange rates. The factors that prevent prices or nominal exchange rates from adjusting might impede PPP from being achieved or maintained. However, there are limitations to focusing on a single indicator. It is unknown which individual indicator is most important or whether the most important indicator explains most of the deviation. To the best of our knowledge, no one has suggested that inflation rates or trading conditions can completely explain PPP deviations across countries. In contrast, a composite measure of risk can be constructed to simultaneously consider political, economic, and financial factors that impact prices and nominal exchange rate which in turn support or prevent PPP.

Oetzel et al. (2001) suggest that one measure of country risk is the stability of a country's currency. The political environment and government attitude have a crucial effect on the degree of intervention in foreign trade and currency markets. A government which prefers to actively manage nominal exchange rates could prevent PPP from being achieved. On the other hand, Alba and Papell (2007) indicate that stability of nominal exchange in developed countries may support PPP. In addition to these factors, economic risk, reflecting inflation rates and productivity growth differentials across countries, may be important. Financial risk, reflecting import, export, and current account conditions, may also play a role. In summary, political, economic, and financial risk factors have all been noted in the literature as possibly contributing to deviations from PPP. This composite view of the risk components suggests inquiring into whether PPP varies with country risk.

2. Methodology and Data

2.1 Unit root tests

Pesaran (2007) provides an individual cross-sectional ADF (CADF) test to examine stationarity of variables under investigation. His idea can be summarized using the following specification:

$$\Delta y_{it} = \alpha_i + \kappa_i t + \beta_i y_{it-1} + \sum_{j=1}^{p} \gamma_{ij} \Delta y_{it-j} + \sum_{j=1}^{p} \delta_{ij} \Delta \bar{y}_{t-j} + \phi_i \Delta \bar{y}_{t-1} + \rho_i \Delta \bar{y}_t + \varepsilon_{it} , \quad (1)$$

where $t = 1, \dots, T$, $i = 1, \dots, N$, y_{it} is the response variable under investigation, $\bar{y} = N^{-1} \sum_{j=1}^{N} y_{jt}$ is the cross-sectional mean of y_{it} , and p_i is the lag order of the model. The reason for augmenting the cross-sectional mean in (1) is to control for contemporaneous correlation among y_{it} . The null hypothesis of the test can be expressed as $H_0 : \beta_i = 0$ for all i against the alternative hypothesis $H_0 : \beta_i < 0$ for some i . The test statistic provided by Pesaran (2007) is given by:

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

where $t_i(N,T)$ is the t-statistic of β_i in (1). In addition, Pesaran (2007) constructs a truncated version of the $CIPS$, denoted $CIPS^*$, to avoid the problem of an extreme statistic caused by a small sample.

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

where

$$t_i^*(N,T) = \begin{cases} t_i(N,T) & -K_1 < t_i(N,T) < K_2 \\ -K_1 & t_i(N,T) \le K_1 \\ -K_2 & t_i(N,T) \ge K_2 \end{cases}$$

The parameters K_1 and K_2 are positive constants based on simulations. Based on Pesaran (2007), $K_1 \approx 6.42$ and $K_2 \approx 1.70$. The critical values of $CIPS(N,T)$ and $CIPS^*(N,T)$ tests are given in Table II(c) of Pesaran (2007).

2.2 Error-correction-based panel cointegration

Let P_{it} denote the price level in country i, where $i = 1,\ldots,N$, P_f be the base country price level, and S_{it} be the bilateral nominal exchange rate between country i and the base country. The absolute PPP relationship is $S_{it} = P_{it}/P_f$, which states that the prices of a standard market basket of goods in the two countries expressed in a common currency should be the same. However, transportation costs and measurement errors may introduce persistent deviations from PPP. As noted above, this motivates the definition of the weak version of PPP, which states that while nominal exchange rates (S_{it}) and aggregate price ratios (P_{it}/P_f) may move together in equilibrium, the relationship need not necessarily be one-to-one.

According to the weak PPP, the cointegration among variables with error-correction-based panel cointegration tests provided by Westerlund (2007) can be expressed as follows:

$$\Delta ls_{it} = \delta_t' d_t + \alpha_i (ls_{it-1} - \beta_i' lp_{it-1}) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta ls_{it-j} + \sum_{j=0}^{p_i} \gamma_{ij} \Delta lp_{it-j} + \varepsilon_{it}, \tag{2}$$

where ls_{it} is the log bilateral US nominal exchange rate, lp_{it} is the log aggregate price ratio in terms of the consumer price index (CPI) between two countries, $d_t = (1,t)'$ is a vector including a constant term and time trend, and p_i is the lag order of the model. The parameter β_i denotes the cointegrating coefficient between ls_{it} and lp_{it}. The coefficients $\gamma_{ij}s$ are corresponding short-run adjustment coefficients of Δls_{it}. The linear combination of ls_{it-1} and lp_{it-1}, i.e., $ls_{it-1} - \beta_i' lp_{it-1}$, is assumed to be stationary, and α_i contains the associated error-correction parameters. If $-2 < \alpha_i < 0$, then (2) can be justified as an error-correction model, implying that ls_{it} and lp_{it} are cointegrated, taked as evidence in favor of weak PPP. Equation (2) can be reparameterized as:

$$\Delta ls_{it} = \delta_t' d_t + \alpha_i (ls_{it-1} + \lambda_i' lp_{it-1}) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta ls_{it-j} + \sum_{j=0}^{p_i} \gamma_{ij} \Delta lp_{it-j} + \varepsilon_{it} \,, \tag{3}$$

where $\lambda_i = -\alpha_i \beta_i$. The parameter α_i is unaffected by imposing an arbitrary β_i, suggesting that the estimate of α_i can be used to provide a valid test for the null hypothesis of no cointegration against the hypothesis of cointegration. Westerlund (2007) proposes two group and panel mean statistics, respectively, to test cointegration between ls_{it} and lp_{it} based on the estimate of α_i in (3).

The two group mean statistics are:

$$G_r = \frac{1}{N} \sum_{i=1}^{N} \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)}$$

$$G_\alpha = \frac{1}{N} \sum_{i=1}^{N} \frac{T\hat{\alpha}_i}{\hat{\alpha}_i(1)} \,,$$

where $\hat{\alpha}_i(1) = 1 - \sum_{j=1}^{p_i} \hat{\alpha}_{ij}$ and $SE(\hat{\alpha}_i)$ is the conventional standard error of $\hat{\alpha}_i$. The two panel mean statistics are:

$$P_r = \frac{\hat{\alpha}}{SE(\hat{\alpha})}$$

$$P_\alpha = T\hat{\alpha} \,,$$

where $\hat{\alpha} = (\sum_{i=1}^{N} \sum_{t=2}^{T} \tilde{e}_{it-1}^2)^{-1} \sum_{i=1}^{N} \sum_{t=2}^{T} [1/\hat{\alpha}_i(1)] \tilde{e}_{it-1} \Delta \tilde{e}_{it}$, $SE(\hat{\alpha}) = [(\bar{S}_N^2)^{-1} \sum_{i=1}^{N} \sum_{t=2}^{T} e_{it-1}^2]^{-1/2}$, and the other terms are defined in Westerlund (2007). The advantage of this method is its greater power than existing popular residual-based panel cointegration tests. The error-correction-based panel cointegration test is carried out under circumstances that allow differences between the long-run cointegrating vector and the short-run adjustment process. Moreover, the model allows heterogeneity across individual units of the panel. To control for cross-sectional dependence across agents in the panel, we follow Westerlund (2007) and simulate the finite sample distribution of each estimator via the bootstrap procedure.

2.3 Data

We use monthly, end-of-period nominal exchange rates and CPI data for 61 countries obtained from the International Monetary Fund's International Financial Statistics, except that data for Taiwan are from the Central Bank of Taiwan, and CPI data for Ireland and Iceland are from the official website of the Organization for Economic Cooperation and Development statistics portal. The data reflect the post-Bretton Woods period from January 1976 to December 2005. We assume nominal exchange rates of European Union members changed by the same proportion as the Euro since January 1999, and we impute missing observations.

3. Empirical Investigation

3.1 Grouping by geographical regions

As a preliminary step, we apply the panel unit root test provided by Pesaran (2007), which controls contemporaneous correlation across individuals, to examine nominal exchange rates and CPI. The model used to test the unit root hypothesis is the one with intercept and trend. Because our data are monthly, lag lengths are set to 12. We aggregate 61 countries into Africa, Europe, Latin America, and Asia. Among Asian countries, we further classify the panel of Asian countries into high income and low income. Results from Table 1 reveal that average contemporaneous correlation coefficients among 61 countries are 0.195 and 0.068 for nominal exchange rates and CPI respectively. The cross-sectional dependence (CD) test statistics reject the null hypothesis of cross-sectional independence at the 1% level for both nominal exchange rates and CPI. Furthermore, the unit root hypothesis is not rejected at the conventional level of significance for nominal exchange rates or CPI based on the $CIPS$ and $CIPS^*$ statistics. These results indicate that variables under investigation are integrated of order 1. Similar results are obtained when we divide the samples according to geographical regions.

Table 1. Panel Unit Root tests (Pesaran, 2007)

Country Group	N	$\bar{\hat{\rho}}$	CD	$CIPS$	$CIPS^*$
Log bilateral US nominal exchange rate					
All countries	61	0.195	158.28***	−2.296	−2.296
Africa	13	0.248	41.55***	−2.243	−2.243
Europe	20	0.746	195.16***	−2.315	−2.315
Latin America	14	0.018	3.29***	−2.359	−2.359
Asia	12	0.170	26.20***	−2.377	−2.377
High Asia	6	0.306	22.47***	−2.565	−2.565
Low Asia	6	0.060	4.41***	−2.568	−2.568
Log aggregate price ratio in terms of the CPI between the two countries					
All countries	61	0.068	55.55***	−1.926	−1.975
Africa	13	0.029	4.88***	−1.722	−1.722
Europe	20	0.203	53.11***	−1.439	−1.439
Latin America	14	0.038	6.86***	−1.754	−1.754
Asia	12	0.089	13.77***	−2.230	−2.230
High Asia	6	0.140	10.32***	−2.706	−2.706
Low Asia	6	0.067	4.91***	−1.968	−1.968

Notes: Africa includes Botswana, Burkina Faso, Cameroon, Ethiopia, Ghana, Kenya, Madagascar, Malta, Morocco, Niger, Nigeria, Senegal, and South Africa. Europe includes Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Latin America includes Chile, Colombia, and Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Paraguay, Trinidad and Tobago, and Venezuela. High Asia include Japan, Korea, Malaysia, Singapore, Taiwan, and Thailand. Low Asia includes India, Indonesia, Myanmar, Pakistan, Philippines, and Sri Lanka. All countries includes Canada and Jordan. $\hat{\rho}$ is the average of correlation coefficients across all the pairs and CD denotes cross-sectional dependence test statistics. *** denotes significance at the 1% level.

Given that nominal exchange rates and CPI have unit roots, we perform panel cointegration tests for (3). Results are reported in Table 2. Since Papell and Theodoridis (2001) indicate that a test model without a time trend is more theoretically consistent with long-run PPP, the tests are implemented with a constant only in the test regression. All tests are constructed with the bandwidth and the number of lags chosen according to $4(T/100)^{2/9}$, as suggested by Newey and West (1994). The existence of a cointegration relationship between ls_{it} and lp_{it} can be examined by testing whether $\alpha_i = 0$ in (3). Rejecting the hypothesis $\alpha_i = 0$ implies rejecting no long-run cointegration relationship among variables.

The last two columns in Table 2 report statistics and p-values after controlling for cross-sectional dependence. Table 2 shows that we can reject the null hypothesis of no cointegration at a 10% level for the panel of 61 countries, suggesting that weak PPP holds for some of these countries. Table 2 also presents test results for 6 subset panels organized by geographical regions. It shows that we can only reject the null hypothesis of no cointegration for the panel of Latin American countries at the 1% level. Consistent with our findings, Alba and Papell (2007) also find that PPP holds for Latin American countries under panel unit root tests of real exchange rates.

3.2 Grouping by country risk

Here we examine the evidence of whether PPP varies with country risk and then look into the risk characteristics in each panel subset grouped by country risk. The International Country Risk Guide (ICRG) is a unique resource for evaluating political, economic, and financial risks, as well as composite risk (country risk) for 140 countries. The system is based on a set of 22 parameters in three categories: political (12 parameters), economic (5), and financial (5). For each parameter, countries are assigned a numerical rating within a specified range. For all parameters, a high score represents low risk. The specific factors taken into account for each parameter are described in Panel A of Table 3. The composite rating is a linear combination of political, economic, and financial risks. The political risk rating contributes 50% to the composite rating, while the economic and financial risks each contribute 25%. Panel B of Table 3 reveals ordinal risk categories of ICRG composite scores for comparison of country scores.

In the last column of Table 3, we present country characteristics affecting PPP against the components of country risk to reveal relationships between them. As shown in Panel A, components of political risk are directly or indirectly related with country characteristics that might affect PPP. For example, government stability could have a large influence on a country's exchange rates, and it also affects a country's international trade, inflation, and economic growth. Internal and external conflict significantly impacts on a country's trade conditions and exchange rates. In addition, the components of economic risks, such as annual inflation rate, GDP per head, and real GDP growth, are country characteristics affecting PPP suggested by the literature. Last, components of financial risk, such as exports, imports, and exchange rate stability, are also country characteristics affecting PPP identified in the literature.

Table 2. Panel Cointegration Organized by Geographic Region

Country Group	N	Test	Value	P-value
All countries	61	G_r	−3.358	0.052*
		G_α	−3.406	0.089*
		P_r	−5.684	0.008***
		P_α	−8.270	0.002***
Africa	13	G_r	2.753	0.970
		G_α	3.214	0.998
		P_r	1.923	0.924
		P_α	2.637	0.992
Europe	20	G_r	−1.847	0.296
		G_α	−1.742	0.288
		P_r	−2.954	0.208
		P_α	−4.707	0.140
Latin America	14	G_r	−4.870	0.000***
		G_α	−5.003	0.000***
		P_r	−5.240	0.000***
		P_α	−7.562	0.000***
Asia	12	G_r	−0.142	0.476
		G_α	−0.142	0.488
		P_r	−1.506	0.198
		P_α	−2.370	0.136
High Asia	6	G_r	−0.062	0.482
		G_α	0.370	0.594
		P_r	−0.581	0.424
		P_α	−0.918	0.332
Low Asia	6	G_r	−0.139	0.456
		G_α	−0.570	0.296
		P_r	−1.504	0.162
		P_α	−2.436	0.110

Notes: Africa includes Botswana, Burkina Faso, Cameroon, Ethiopia, Ghana, Kenya, Madagascar, Malta, Morocco, Niger, Nigeria, Senegal, and South Africa. Europe includes Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Latin America includes Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Paraguay, Trinidad and Tobago, and Venezuela. High Asia includes Japan, Korea, Malaysia, Singapore, Taiwan, and Thailand. Low Asia includes India, Indonesia, Myanmar, Pakistan, Philippines, and Sri Lanka. All countries includes Canada and Jordan. The p-values are for a one-sided test based on the bootstrap distribution. We use 500 bootstrap replications. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 3. Critical Components in the ICRG Rating System and Risk Categories

Panel A: Critical Components in the ICRG Rating System				
Components	**Max points**	**Percentage of individual index**	**Percentage of composite**	**Country characteristics**
Political Risk				
Government Stability	12	12	6	Nominal exchange rate volatility Inflation rate Trade openness Growth rate
Socioeconomic Conditions	12	12	6	
Investment Profile	12	12	6	
Internal Conflict	12	12	6	
External Conflict	12	12	6	
Corruption	6	6	3	
Military in Politics	6	6	3	
Religious Tensions	6	6	3	
Law and Order	6	6	3	
Ethnic Tensions	6	6	3	
Democratic Accountability	6	6	3	
Bureaucracy Quality	4	4	2	
Total	100	100	50	
Economic Risk				
Annual Inflation Rate	10	20	5	Nominal exchange rate volatility Inflation rate Trade openness Growth rate
Budget Balance as a Percentage of GDP	10	20	5	
Current Account as a Percentage of GDP	15	30	7.5	
GDP per Head	5	10	2.5	
Real GDP Growth	10	20	5	
Total	50	100	25	
Financial Risk				
Foreign Debt as a Percentage of GDP	10	20	5	Nominal exchange rate volatility Inflation rate Trade openness Growth rate
Foreign Debt Services as a Percentage of Exports of Goods and Services	10	20	5	
Current Account as a Percentage of Exports of Goods and Services	15	30	7.5	
Net International Liquidity as Month of Import Cover	5	10	2.5	
Exchange Rate Stability	10	20	5	
Total	50	100	25	
Overall points	200		100	
Panel B: ICRG Risk Categories				
Risk Category	Composite Score Range			
Very High	00.0 to 49.5 points			
High	50.0 to 59.5 points			
Moderate	60.0 to 69.5 points			
Low	70.0 to 79.5 points			
Very Low	80.0 to 100 points			

Accordingly, the components of country risk have direct or indirect effects on the validity of PPP, and it is interesting to investigate whether PPP varies with country risk. To perform our tests, we divide 61 countries into 3 panel subsets according to mean ICRG country risk scores for 1984–2000. It is well known that the power of panel tests is affected by the panel size. To guarantee similar panel sizes in each subset, we choose threshold values for the ICRG risk categories such that each subset has a similar size. Risk ranges are classified into 5 categories according to ICRG as shown in Panel B of Table 3. We do not exactly follow the 5-category organization by ICRG because it would generate extreme panel sizes. For example, there are only 3 countries that would be classified in the highest risk category and only 8 countries that would be classified in the low risk category.

We classify a country as low risk if its country risk score is higher than 80 (the ICRG threshold for very low risk), as high risk if its risk score is lower than 59.5 (the ICRG threshold for high or very high risk), and as moderate risk if its risk score is between 60 and 80 (the ICRG thresholds for moderate and low risks). This classification generates 18, 22, and 21 observations in the three subsets respectively.

Table 4 presents the cointegration test results for groups of countries organized by country risk scores. The results indicate that we can reject the null hypothesis of no cointegration at the 1% level for the moderate risk country panel, suggesting that weak PPP hold for countries with moderate country risk. We can also reject the null hypothesis of no cointegration at the 10% level using the P_α statistic for the high country risk panel. However, Westerlund (2007) indicates that since P_α is normalized by T, this may cause the test statistic to reject the null hypothesis too frequently. His simulation results also show that P_r is quite robust to cross-sectional correlations. Therefore, we should rely more on the P_r statistic and question whether our test results are strong enough to reject the null hypothesis for the high country risk panel.

Finally, we examine whether the political, economic, and financial risk components of country risk differ in countries where weak PPP holds. Table 5 shows that countries with higher country risk have higher political, economic, and financial risk. This pattern is significant at the 1% level across the three subsets, suggesting that moderate risk countries where weak PPP holds have significantly different risk characteristics from low risk countries and high risk countries. The reason that PPP does not hold in countries with extreme risk characteristics could be that countries that are overly protectionist or overly open in their political, economic, and financial policies can dampen or amplify variation in prices and nominal exchange rates, which can in turn prevent them from adjusting to parity. The results in Table 5 suggest that country risk seems to support PPP. This is consistent with the motivation for using a composite indicator: a single indicator cannot explain PPP deviations across countries but and the composite country risk measure appears to support the weak PPP hypothesis.

Table 4. Panel Cointegration Organized by Country Risk

Country Group	N	Test	Value	P-value
Low risk	18	G_τ	−1.851	0.214
		G_α	−1.447	0.254
		P_τ	−2.732	0.172
		P_α	−4.268	0.122
Moderate risk	22	G_τ	−2.066	0.072*
		G_α	−1.932	0.094*
		P_τ	−3.812	0.008***
		P_α	−5.344	0.004***
High risk	21	G_τ	1.108	0.810
		G_α	−0.303	0.420
		P_τ	−2.155	0.152
		P_α	−3.785	0.056*

Notes: The low risk group includes countries with composite risk score higher than 80, the moderate risk group includes countries with composite risk score between 60 and 79.5, and the high risk group includes countries with composite risk score less than 49.5. P-values are for a one-sided test based on the bootstrap distribution. We use 500 bootstrap replications. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Table 5. Country-Specific Characteristics Organized by Country Risk

Characteristics	Country Risk Group			Difference	
	Low	Moderate	High	Moderate-Low	Moderate-High
Political Risk	84.635	67.195	50.867	−17.44*** (−10.717)	16.328*** (8.979)
Economic risk	40.149	35.048	30.017	−5.101*** (−4.903)	5.031*** (4.873)
Financial Risk	44.621	35.851	26.588	−8.77*** (−8.890)	9.263*** (8.752)
Country Risk	87.769	69.021	53.624	−18.748*** (−10.604)	15.397*** (9.584)
Number of countries	18	22	21		

Notes: Numbers in parentheses are *t*-statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

4. Conclusion

Using the panel cointegration approach developed by Westerlund (2007), we investigate the validity of the weak version of PPP for 61 developed and developing countries. After controlling for cross-sectional dependence, the empirical results suggest that weak PPP is stronger for a panel of Latin American countries and for a panel of countries with moderate country risk. These latter countries have significantly higher (lower) political, economic, and financial risk than countries with low (high) country risk. In contrast with using a single country characteristic to explain deviations from PPP, the composite measure of country risk appears to contain important information for explaining of the validity of the PPP hypothesis.

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