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Article

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Are the current accounts of Asian-5 economies mean-reverting? New evidence from Fourier panel stationarity tests

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Abstract: This study offers a novel examination of the mean-reversion properties of the current account balances, expressed as a percentage of GDP, for the Asian-5 economies: Indonesia, Korea, Malaysia, the Philippines, and Thailand. While prior studies mainly employed traditional unit-root tests, our research stands out for its use of novel panel stationarity tests that account for cross-sectional dependence and incorporate both sharp and smooth structural breaks via a Fourier function. Our findings robustly indicate the sustainability of the current accounts of the Asian-5 nations. The emphasis on the significance of structural breaks with a Fourier component sets this research apart, offering fresh perspectives on the intricacies of current account mean-reversion dynamics and the long-term sustainability implications for these economies.

Subjects: International Finance; Econometrics; Finance

Keywords: stationarity; nonlinearity; Fourier function; current account

JEL Classification: C22; F32

1. Introduction

A significant body of empirical research has been dedicated to examining the mean-reverting dynamics of the current-account balance in the Asian-5 economies (Indonesia, Korea, Malaysia, Philippines, and Thailand) affected by the 1997 crisis. However, most of these studies have relied on conventional univariate unit-root tests or first-generation panel tests, resulting in a lack of consensus regarding the mean-reversion of the current account balances in the Asian-5. Furthermore, the application of standard unit root and cointegration techniques has led some researchers to assert that the CA deficits in Asian countries were not only unsustainable but also contributed to the 1997 financial crisis.[1]

This study presents a fresh examination of the current account sustainability issue in the Asian-5 economies. It introduces novel panel stationarity tests proposed by Nazlioglu and Karul (2017) and complementary panel stationarity tests developed by Nazlioglu et al. (2021) to evaluate the mean-reverting properties of the current account to GDP ratio (cay_t) over the period of 1981–2021. These panel stationarity tests consider important factors such as cross-sectional dependence (CSD), heterogeneity across cross-sections in the panel, and gradual structural breaks using a Fourier approximation. Additionally, for completeness and comparison, we incorporate the panel

stationarity test by Carrion-I-Silvestre et al. (2005) to handle sharp breaks, as well as the no-break panel stationarity test proposed by Hadri and Kurozumi (2011).[2]

In examining the stationary properties of the Asian-5 current accounts, our study builds on and substantially refines earlier efforts in several significant ways.

(1) Moving Beyond Univariate Unit-root Tests: Many previous studies relied on univariate unit-root testing methods. However, these methods, which often have low power in finite samples, can be ambiguous. Notably, as pointed out by Herwartz et al. (2019), "it is not clear if the failure to reject the null of a unit-root is an evidence of a truly I(1) series". We have adopted a different approach to avoid this issue.

(2) Moving beyond First-Generation PURTs: While prior research frequently employed first-generation panel unit-root tests (PURTs) with an implicit assumption of cross-sectional independence among panel units, this study mitigates the shortcomings of such an approach. Especially in cross-country analyses, ignoring cross-sectional dependence can lead to considerable size distortions.

(3) Addressing Nonlinearities and Structural Breaks: Some studies have moved towards second-generation PURTs, which do account for cross-sectional dependence. However, many still overlook extant breaks and other nonlinearities in the data-generating process (DGP). As highlighted by Perron (1989, 1990) and Leybourne et al. (1998), neglecting these breaks can result in notable size distortions, even if the series are stationary around evolving trends.

(4) Enhanced Insights from PURTs: While conventional PURTs provide a somewhat constrained perspective—failing to identify which cross-sectional units are stationary as opposed to those that aren't—our study addresses this gap. The utilized panel stationarity tests offer a more thorough comprehension, a detail we expand upon in our methodology section.

Using the new tests from Nazlioglu and Karul (2017) and Nazlioglu et al. (2021) and the latest available data, we aim to better understand the mean-reverting properties of the current accounts in the Asian-5 nations.

2. Theoretical background

Experts often study the current account's sustainability. In simple terms, it is about whether an economy can meet its long-run budget constraints (LRBC) without big changes in policy or private sector actions. We view sustainability as an economy's ability to stick to this budget, much like previous studies by Taylor (2002) and Christopoulos and León-Ledesma (2010).[3]

A common method to gauge this sustainability is by checking how persistent a current account deficit is through unit root and/or stationarity tests. If disturbances to the current account are short-lived, then it's stable or mean-reverting, and external debt will not grow indefinitely after a shock. This stability is a necessary condition for a country's financial health, as noted by Trehan and Walsh (1991) and Husted (1992).

On the other hand, if disturbances have long-term effects, then debt does not revert back to equilibrium after a shock. Over time, continuous deficits grow, requiring significant economic changes to avoid severe debt issues or tough adjustments.[4]

We measure current account sustainability using the ratio of the current account to GDP, $cay_t = \frac{CA_t}{Y_t}$. We also utilize recent stationarity panel testing methods by Nazlioglu and Karul (2017), and Nazlioglu et al. (2021) for our analysis. While the current account adjustment isn't strictly linear, and considering the expansive range of nonlinear model possibilities, the tests we employ help address this complexity as they mitigate the problem of selecting the appropriate functional form.

The rest of this paper is organized as follows. The next section presents a brief review of recent literature, Section 4 introduces the data and the econometric methodologies employed. Section 5 presents the empirical results, and Section 6 presents the conclusions.

3. Literature review

The sustainability of the current account in the Asian-5 economies has been a focal point of numerous studies. These countries' current account behaviors have been examined in different periods, using various methodological approaches. However, the question that remains is: Do the results converge on a consensus or is there room for further exploration? Up next is a succinct comparison of recent studies on current account sustainability that focused on one or more of the Asian-5 nations

For instance, studies like Baharumshah et al. (2003) and Baharumshah et al. (2005) are aligned in their findings. Both studies suggest that prior to the financial crisis, current account imbalances for several Asian countries were not in the long-run steady state. The former specifically highlighted that except for Malaysia, the current account imbalances were indeed not sustainable for countries such as Indonesia, the Philippines, and Thailand. These findings underscore the potential of current account deficits as indicators of looming financial crises.

Interestingly, when delving deeper into specific testing methodologies, the conclusions shift. Lau and Baharumshah (2005) and Lau et al. (2006) employ unit-root tests but arrive at different interpretations. While Lau and Baharumshah (2005) couldn't reject the unit-root null hypothesis for several countries, Lau et al. (2006), by using first-generation panel unit-root tests, found evidence suggesting current account mean-reversion properties. The divergence is mainly attributed to the consideration of factors like cross-sectional dependence and structural breaks in the latter's analysis.

This divergence is even more pronounced when we bring nonlinear methods into the picture. For example, Kim (2005) used Park and Shintani's (2005) nonlinear unit-root test, finding mean-reverting current accounts in some countries but not in others. Specifically, Kim's analysis for Korea and Thailand contradicts that of Indonesia, Malaysia, and the Philippines for the pre-crisis period. Interestingly, when extended to the full sample, his findings suggest mean-reversion for almost all countries barring Thailand. This is somewhat in line with Kim et al. (2009) findings, which supports mean-reversion for all the Asian-5 except Thailand.

However, the findings of Andreosso O'Callaghan and Kan (2007) deviate from the aforementioned studies. By utilizing standard unit-root and cointegration tests, they found no evidence of a long-term relationship between imports and exports for all the Asian-5 countries, implying an unsustainable current account during their study period.

Another dimension brought forth by Hamizun and Baharumshah (2008) focused on Malaysia's external solvency. They provided an optimistic outlook, suggesting that Malaysia's actual current account path aligns closely with its optimal consumption-smoothed path, implying a satisfaction of the external solvency condition.

In summary, while a majority of studies converge on certain findings, particularly the unsustainability of current account balances prior to the financial crisis, there is a palpable divergence when methodological nuances are brought into the frame. The Asian-5's current account sustainability remains a topic ripe for further exploration, especially when considering the intricacies of data generation processes and nonlinearities.

4. Data and econometric methodology

The dataset used in this study consists of yearly observations of the cay_t (current account balance as a percentage of GDP). Table 1 presents summary statistics of the cay_t for three distinct periods.

Table 1. Summary statistics for the current account to GDP ratio

Country	Mean	SD	Skewness	Kurtosis	J-B
1981 – 1997					
Indonesia	−2.922	1.832	−1.314	4.238	0.050
Korea	−1.178	3.901	0.184	3.106	0.949
Malaysia	−4.270	5.673	0.488	2.809	0.705
Philippines	−3.237	2.630	0.369	3.007	0.825
Thailand	−4.880	2.752	0.370	2.089	0.614
1998 – 2006					
Indonesia	3.189	1.698	−1.033	2.495	0.428
Korea	2.718	3.238	1.672	4.739	0.070
Malaysia	11.935	3.297	−0.211	1.729	0.714
Philippines	0.317	2.807	0.329	2.308	0.843
Thailand	4.350	4.962	0.096	2.453	0.939
2007 – 2021					
Indonesia	−0.991	1.862	0.421	1.926	0.559
Korea	3.958	2.033	−0.388	2.306	0.713
Malaysia	6.908	5.349	0.913	2.178	0.285
Philippines	1.707	2.489	−0.293	1.726	0.541
Thailand	4.079	4.069	−0.143	1.935	0.684
1981 – 2021					
Indonesia	−0.874	2.939	0.265	2.732	0.740
Korea	1.556	3.908	−0.365	3.276	0.595
Malaysia	3.377	8.430	−0.144	2.073	0.447
Philippines	−0.648	3.413	−0.037	2.177	0.558
Thailand	0.424	5.847	0.222	2.012	0.367

Note: JB is the *p*. value for the Jarque-Bera test.[5]

The first period spans from 1981 until the 1997 Asian financial crisis, the second period covers the years 1998 to 2006, and the third period encompasses the onset of the global financial crisis in 2007 until 2021. The entire sample period, from 1981 to 2021, is also included for analysis.

The table indicates that before the 1997 Asian financial crisis, all the countries had significant and prolonged current account deficits. However, during the period from 1998 to 2006, there was a shift towards surpluses in their current accounts. Following the 2007 global recession, both Indonesia and the Philippines entered a period of deficits. Regarding the distribution of the data, all countries in the sample exhibit a slight left-skewness, except for Indonesia, which demonstrates a slight right-skewness. The Jarque-Bera test results indicate that the data follows a normal distribution for each individual country. The study sourced its data from the World Bank (WDI, 2022).

4.1. Preliminary analysis

Prior to examining the series' integration properties, we assess if disturbances in the panel exhibit cross-sectional independence, as neglecting CSD could lead to notable size distortions. The CSD tests of Pesaran (2015), Baltagi et al. (2012), and Pesaran (2004) are utilized.[6]

4.2. Panel stationarity tests

Stationarity can be invalid when structural breaks in the DGP are improperly specified (Perron, 1989). Furthermore, a majority of macroeconomic time-series data possess numerous structural breaks, the number and nature of which are often unknown. Considering the possibility of smooth

structural shifts in the DGP, the specific form of these breaks is typically unknown. Finally, if the presumption is that a macroeconomic series such as cay_t is a stationary process, then according to Carrion-I-Silvestre et al. (2005) it is more natural to utilize a test "that has the null hypothesis of stationarity and the alternative of unit-root".

Combining temporal and cross-sectional dimensions enhances the power in unit root and stationarity tests. To that end, we utilize a novel panel stationarity test proposed by Nazlioglu and Karul (2017). This test considers gradual structural breaks, cross-sectional dependencies, and heterogeneity across cross sections. In our employed approach, the panel stationarity test captures structural breaks and nonlinearities in the DGP through a Fourier approximation, accommodating CSD using Pesaran's (2007) cross-section average augmented (*ca*) method. The testing regression's deterministic component, $d_i(t)$,as a function of time is described as:

$$d_i(t) = a_i + b_{it} + \gamma_{1i}\sin\left(\frac{2\pi kt}{T}\right) + \gamma_{2i}\cos\left(\frac{2\pi kt}{T}\right) \quad (1)$$

where k is the single Fourier frequency component. When $b_{it} = 0$,equation 1 provides a time-varying intercept term influenced by nonzero values of γ_{1i} and γ_{2i}, which represent gradual shifts in the intercept (also referred to as the level shift model). We construct the Fourier panel stationarity test statistic, $W(k)$, by averaging the individual test statistics. Moreover, given that the current account series might exhibit pronounced breaks, we also delve into their stochastic behaviors through the KPSS-based multiple sharp breaks panel stationarity test proposed by Carrion-I-Silvestre et al. (2005).

Finally, we also employ Hadri and Kurozumi (2011) second-generation test, (W_{ca}), alongside three additional panel tests introduced by Nazlioglu et al. (2021): P_{ca}, $P_{m,ca}$, and Z_{ca}. Due to space constraints, we avoid extensive descriptions of each testing method and direct readers to the original studies for details.[7]

5. Empirical results

5.1. CSD test results

The findings from the CSD tests, presented in Table 2, clearly indicate a rejection of the null hypothesis for each specific test in favor of the CSD alternative. These findings underscore a joint interdependence among the Asian-5 economies and emphasize the need for a testing approach that accounts for cross-correlations in innovations across the panels such as the ones we utilized in this study.

5.2. Panel stationarity test results

The findings from panel stationarity tests for the level stationary model can be found in Table 3. The W_{ca} test of Hadri and Kurozumi (2011) and the Nazlioglu et al. (2021) P_{ca}, $P_{m,ca}$, and Z_{ca}, tests show that the stationarity null hypothesis of is not rejected by all four tests.

Table 2. Results of CSD tests

Test	Statistic	p-value.
Bias-corrected Scaled LM	28.75***	0.00
CD_P	11.44***	0.00
CD_{NT}	10.19***	0.00

Notes: *** 1% significance. The Bias-corrected scaled LM, *CSD* test, and the CD_P are Baltagi et al. (2012), Pesaran (2004), and Pesaran (2015) *CSD* tests, respectively.

Table 3. Panel stationarity test results

	Test	Constant	*p*-value
2nd-generation no-break tests			
Hadri and Kurozumi (2011)	W_{ca}	−0.798	0.788
Nazlioglu et al. (2021)	P_{ca}	6.013	0.814
	$P_{m,ca}$	−0.892	0.814
	Z_{ca}	0.444	0.671
2nd-generation structural break tests			
Carrion-I-Silvestre et al. (2005)	$W(\lambda)$	0.525	0.752
Nazlioglu and Karul (2017)	$W(k=1)$	1.432	0.076
	$W(k=2)$	1.115	0.124
	$W(k=3)$	0.273	0.392
Nazlioglu et al. (2021)	$P(k=1)$	16.18	0.095
	$P(k=2)$	14.72	0.143
	$P(k=3)$	10.80	0.373
	$P_m(k=1)$	1.382	0.083
	$P_m(k=2)$	1.050	0.146
	$P_m(k=3)$	0.179	0.429
	$Z(k=1)$	−1.726	0.042
	$Z(k=2)$	−1.539	0.062
	$Z(k=3)$	−0.873	0.191

Notes: The W, P_m, and Z tests have p-values that are derived from the Z distribution while the P test uses the chi-square distribution.

The lower panel of Table 3 presents the structural break stationarity tests for the panel. For the level stationarity model, both the sharp-breaks test of Carrion-I-Silvestre et al. (2005), W(λ), and the Nazlioglu and Karul (2017) gradual break test, $W(k)$, fail to reject the stationarity null hypothesis, the latter for all frequencies at 5% level of significance. Similarly, all new complimentary tests of panel stationarity, $P(k)$, $P_m(k)$, and $Z(k)$, fail to reject the stationarity null hypothesis for all k with the sole exception of $Z(k=1)$ test. To sum it up, the battery of tests robustly validates the mean reversion in current account for the Asian-5.

Because of the strict nature of the null hypothesis that is imposed on the above panel stationarity tests which implies that if the null hypothesis is not rejected, then stationarity holds for all cross-section units, we report in Table 4, the individual test results based on Hadri and Kurozumi (2011), Carrion-I-Silvestre et al. (2005), and Nazlioglu and Karul (2017) panel stationarity tests. The individual test results show that the null hypothesis of stationarity is not rejected for the five countries by all tests and for all frequencies.

Having established that the cay_t series for the Asian-5 economies are stationary based on a battery of panel stationarity tests, we then explore the breaks that are pinpointed by the Bai and Perron (2003) approach as presented in Table 4. The modified Schwarz criterion (LWZ) selected three breaks for Indonesia, two breaks for Malaysia, and one break for Korea, the Philippines, and Thailand. The breaks occur in 1997, 2003, and 2011 for Indonesia; 1997 and 2011 for Malaysia; 2001 for the Philippines; and 1997 for Korea and Thailand.[8]

Table 4. Results for individual countries based on Hadri and Kurozumi (2011), Carrion-I-Silvestre et al. (2005), and Nazlioglu and Karul (2017)

	Hadri and Kurozumi (2011)	Carrion-I-Silvestre et al. (2005)				Nazlioglu and Karul (2017)		
Country	W_{ca}	W(λ)	*TB1*	*TB2*	*TB3*	*k=1*	*k=2*	*k=3*
Indonesia	0.14 (0.427)	0.14	1997	2003	2011	0.07 (0.300)	0.21 (0.219)	0.20 (0.258)
Korea	0.08 (0.694)	0.11	1997	-	-	0.17 (0.052)	0.12 (0.426)	0.17 (0.337)
Malaysia	0.17 (0.333)	0.05	1997	2011	-	0.11 (0.136)	0.27 (0.137)	0.21 (0.243)
Philippines	0.07 (0.739)	0.06	2001	-	-	0.06 (0.391)	0.29 (0.119)	0.12 (0.501)
Thailand	0.08 (0.676)	0.03	1997	-	-	0.06 (0.367)	0.13 (0.415)	0.14 (0.420)

Notes: See Table 3 footnote. *P*-values are in parentheses. TB is the time of the break based on Bai and Perron (2003).

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In Figure 1a, the twin solid lines showcase the actual current account to GDP ratio (cay_t) and the corresponding fitted Fourier curve (the smooth line). The dashed lines pinpoint the breakpoints and the mean of the cay_t series during specific sub-periods: there are four distinct sub-periods for Indonesia, three for Malaysia, and two each for Korea, the Philippines, and Thailand. Notably, while the sharp breaks are somewhat analogous to the Fourier intercept, the latter exhibits a smoother nature. To sum up, by incorporating structural breaks in the CA to GDP ratios and a Fourier element, our panel stationarity tests provide compelling evidence supporting the sustainability of cay_t in the Asian-5 countries.

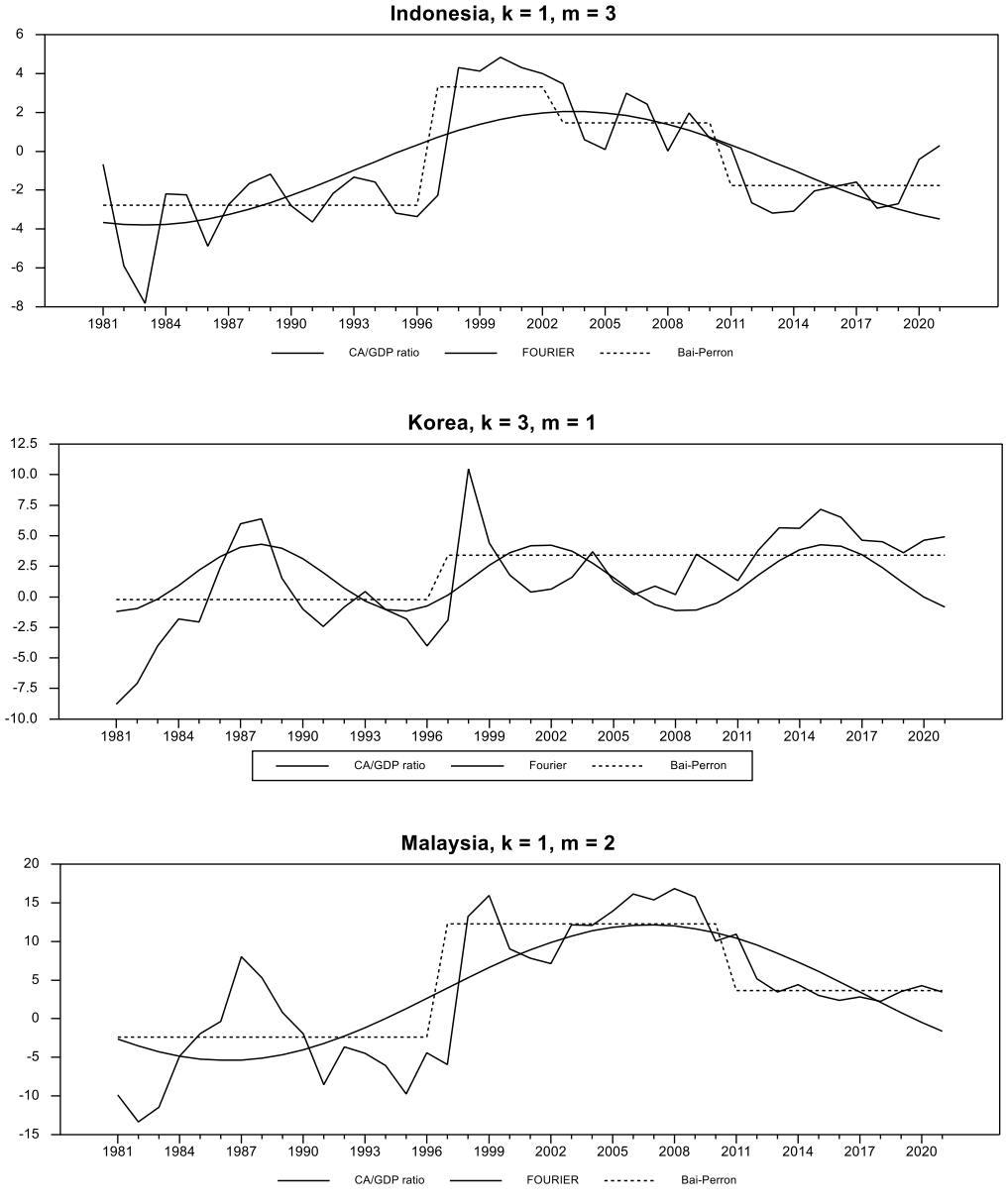
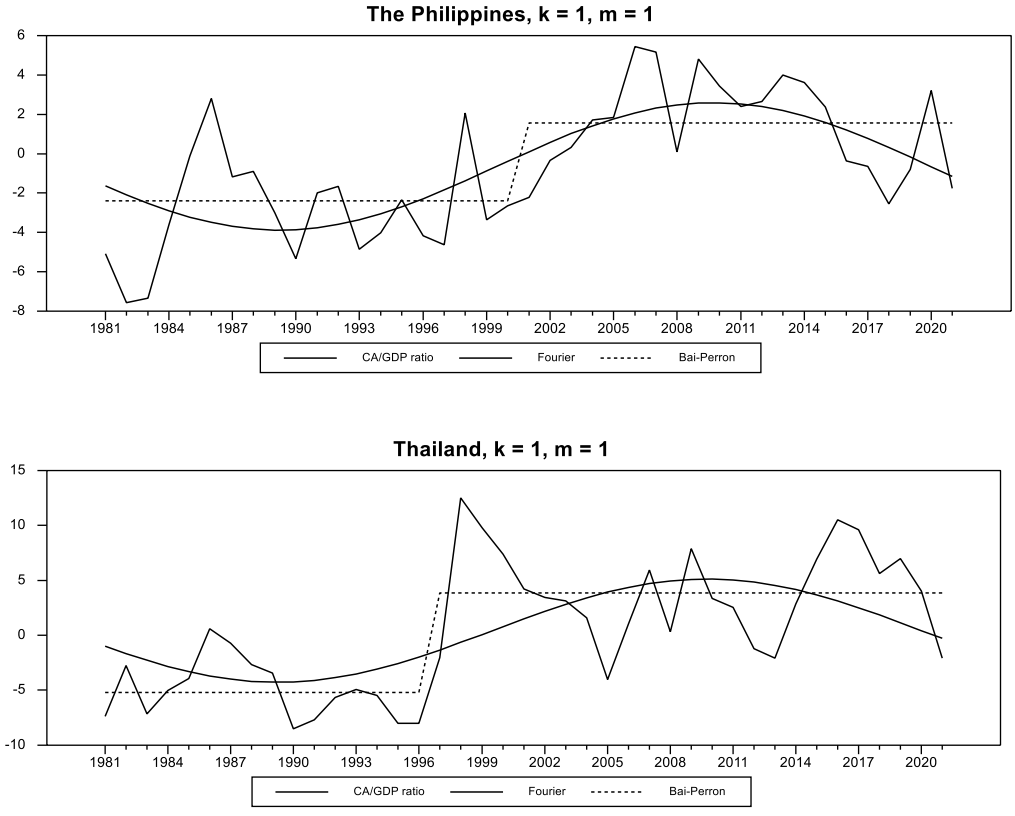


Figure 1a. The fitted nonlinearities (smooth line), Bai and Perron (2003) intercepts, and current account balance as a percentage of GDP.

Figure 1a. (Continued).



6. Conclusions

In this study, our focus was on re-examining the mean-reversion properties of the current account balances as a percentage of GDP for Indonesia, Korea, Malaysia, the Philippines, and Thailand. To accomplish this, we employed various tests.

Initially, we conducted a series of linear unit-root tests, which did not provide substantial evidence in support of current account sustainability. To further explore the issue, we applied well-known nonlinear unit-root tests, namely the ESTAR (exponential smooth transition autoregressive) tests proposed by Kapetanios et al. (2003), Sollis (2009), and Kruse (2011). The empirical results from these tests indicated that the CA balance was sustainable for two out of the five countries, namely Indonesia and Korea.

To bolster our analysis, we utilized advanced panel stationarity tests that account for smooth structural breaks in the DGP through a Fourier function. We also incorporated a panel stationarity test that interprets structural breaks as abrupt shifts. The robust empirical results derived from these panel stationarity tests confirmed that the current accounts of the Asian-5 countries were on a sustainable path.

Our investigation into the mean-reverting properties of the current account balance in the Asian-5 economies yields significant insights. Our findings contribute to the ongoing debate in economic literature regarding the behavior of current accounts. The fact that all Asian-5 economies exhibit mean-reverting properties, especially when incorporating nonlinear dynamics, suggests that these economies inherently lean towards equilibrium in the long-run.

While previous literature predominantly identified mean-reverting properties for only Indonesia and Korea using univariate linear and widely-used nonlinear unit-root tests, our application of the Fourier panel stationarity test provides a nuanced understanding. It accentuates the need for

embracing sophisticated methodologies that account for nonlinearities and gradual breaks to derive accurate insights in macroeconomic studies. This study, thus, not only underlines the significance of the Fourier panel stationarity test but also challenges and refines our understanding of current account behavior in the Asian-5 context.

For policymakers in the Asian-5, the evidence of mean-reverting properties suggests that while short-term imbalances may occur, the current accounts inherently tend towards equilibrium. This provides some reassurance against prolonged current-account deficits and informs fiscal and trade policy decisions. While the Asian-5 economies collectively seem to adhere to their long-run budget constraint, this does not preclude individual countries from experiencing unsustainable current account deficits at certain times. Such anomalies, though temporary, underscore the dynamic nature of economies and their susceptibilities to external and internal shocks. The implication is that any deficits or shocks were temporary or of limited duration to cause non-stationarity of debt in the Ponzi scheme sense.

Investors, particularly those with long-term horizons in the Asian-5 markets, can derive valuable insights from this study. The mean-reverting nature of the current-account s imply an inherent stability, which, combined with the economic dynamism of these economies, might present lucrative opportunities.

In conclusion, this study, while empirically grounded, offers broad ramifications, bridging the gap between nuanced economic theories and real-world implications.

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Notes

1. Earlier studies utilized first-generation panel unit-root tests that assume cross-section independence in the panel, i.e., Lau et al. (2006); Andreosso O'Callaghan and Kan (2007), while other studies accounted for cross-section dependence but ignored the presence of structural breaks i.e., Lau and Baharumshah (2005).
2. We also computed a battery of linear tests (i.e., ADF, and Ng & Perron, 2001) and the nonlinear tests of Kruse (2011), Sollis (2009), and Kapetanios et al. (2003). The results of these tests, not reported for space considerations and are available upon request, confirm stationarity only for Indonesia and Korea.
3. For a detailed description of the model, we refer the reader to Taylor (2002) and Christopoulos and León-Ledesma (2010).
4. Consistent and sizeable current account deficits have historically been linked to the onset of currency crises. For instance, such trends were observed in countries like Chile and Mexico during the early 1980s, the UK and Nordic regions in the late 1980s, and again in Mexico along with Argentina in the mid-1990s. Research, including studies by Baharumshah et al. (2003) and Lau and Baharumshah (2005), suggests that these protracted deficits in Asian nations weren't merely unsustainable but also catalytic to their financial downturns.
5. Some values of Skewness and Kurtosis might seem inconsistent with JB results. However, when the sensitivity of the JB test to sample size is considered, it can be understood to have slight deviations in skewness and kurtosis from a perfect normal distribution yet not be statistically significant enough to reject normality.
6. We refer the reader to the associated study for the details of the testing methodology in order to conserve space.
7. The panel tests apply Pesaran's (2007) cross-section average augmented (*ca*) method to accommodate for CSD.
8. Note that one break coincides with the onset of the Asian financial crisis for all countries except the Philippines. Three breaks are allowed at maximum.

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