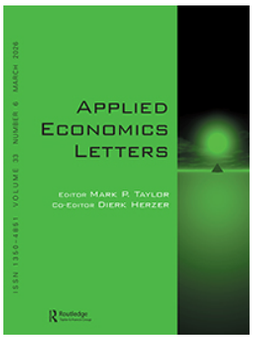

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A quantile panel approach to asymmetric and cross-correlated exchange rate shocks: reassessing Purchasing Power Parity in Asia

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ABSTRACT

This study investigates real exchange rate shocks in thirty Asian economies within the context of the Purchasing Power Parity (PPP) hypothesis using a recently developed quantile panel unit root approach that accounts for asymmetric persistence and cross-correlations. While conventional tests support the PPP, our quantile analysis reveals that shocks are persistent at lower quantiles and transitory at higher quantiles, suggesting that PPP holds primarily at higher quantile conditions. This asymmetry suggests that the standard assumption of a constant unit root process may mask important nuances in how exchange rates adjust over time. Additionally, while the PPP holds robustly in some cases, it fails in others, implying that monetary policy exerts limited long-run influence on exchange rates and that short-run fluctuations are primarily driven by market interventions.

KEYWORDS

Exchange rates; asymmetry; common factor; quantile panel unit root; Asian economies

JEL CLASSIFICATION

C22; F31

I. Introduction

Exchange rate dynamics have long been a central topic in international finance, with the purchasing power parity (PPP) hypothesis serving as a cornerstone theory. PPP posits that bilateral exchange rates adjust to offset differences in price levels between countries, implying that real exchange rates follow a mean-reverting, or stationary, process. This theoretical foundation suggests that deviations from equilibrium are temporary, a notion that has significant empirical implications for assessing equilibrium exchange rates.

Recent research indicates that exchange rates often show asymmetric responses and notable cross-country correlations, especially in diverse Asian economies (Nazlioglu et al. 2024). Structural heterogeneities – such as varied development stages, diverse exchange rate regimes (free-floating, managed floats, currency pegs), differing levels of trade openness, and structural policy changes – significantly influence macroeconomic dynamics in this region. Financial liberalization since the early 1980s, coupled with increased international trade and communication advancements, has further amplified spillovers and cross-country correlations, resulting in heavy-tailed distributions and nonlinear dynamics driven by macroeconomic and financial interdependencies.

Existing empirical studies on PPP in Asian economies typically address asymmetry and cross-sectional correlations separately. Univariate quantile unit root tests indicate asymmetric persistence in exchange rate shocks, supporting PPP (Bahmani-Oskooee et al. 2020; Bahramian and Saliminezhad 2020), while panel unit root tests considering cross-correlations also support PPP (Murad and Hossain 2018; Soon et al. 2017).[1] However, literature integrating both aspects is lacking.

To bridge this gap, this study employs a quantile panel unit root method developed by Yang, Wei, and Cai (2022), accommodating both asymmetric persistence and cross-correlations. Analysing real exchange rate shocks across thirty Asian economies, our findings reveal persistent shocks at lower quantiles and transitory shocks at higher quantiles, indicating PPP validity strengthens at higher quantiles.

This research makes three contributions: introducing a novel quantile-based panel approach

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[1]We refer to Arize and Bahmani-Oskooee (2021) for testing PPP by controlling asymmetric adjustment in relative prices within a cointegration framework.

accounting for cross-correlations; analysing a broader dataset of thirty Asian economies for enhanced generalizability; and providing refined insights into the asymmetric persistence of exchange rate shocks under varying quantile conditions.

II. Quantile panel unit root test

To examine the behaviour of real exchange rates, we apply the quantile panel unit root test developed by Yang, Wei, and Cai (2022), which captures country-specific dynamics, allows for asymmetric responses to shocks (e.g. large depreciations vs. small appreciations), and accounts for common global influences. By analysing differences in the distribution of data, it provides a better understanding of exchange rate behaviour under varying economic conditions.

A panel data model to incorporate cross-correlations through a common factor structure, suggested by Pesaran (2007), is specified as

$$y_{it} = \alpha_i + \beta_i t + \rho_i y_{it-1} + \varepsilon_{it} \tag{1}$$

$$\varepsilon_{it} = \gamma_i g_t + e_{it} \tag{2}$$

where $i = 1, \ldots, N$ is cross-section dimension; $t = 1, \ldots, T$is time dimension;g_t is the unobserved common factor to capture the effects of cross-country correlations; γ_i represents the factor loadings; and e_{it} denotes an idiosyncratic component. g_t is estimated by cross-sectional averages of y_{it}, denoted as $\bar{y}_{t-1}$ and $\Delta\bar{y}_t$ where $\bar{y}_t = N^{-1}\sum_{i=1}^{N} y_{it}$ and

$$\Delta\bar{y}_t = N^{-1}\sum_{i=1}^{N}\Delta y_{it} = \bar{y}_t - \bar{y}_{t-1}$$

Yang, Wei, and Cai (2022) recently extends the model in (1)-(2) into quantile framework to account for asymmetry and cross-correlations, given by

$$Qy_{it}(\tau|\Im_{t-1}) = \alpha_i + \beta_i t + \rho_i y_{it-1} + a_i\bar{y}_{t-1} + \sum_{j=0}^{p} b_{ij}\Delta\bar{y}_{t-j} + \sum_{j=1}^{p} c_{ij}\Delta y_{it-j} + F_{e_i}^{-1}(\tau) \tag{3}$$

where Qy_{it} denotes the τth conditional quantile of y_{it} and $\Im_{t-1}$ is information contained in $\{g_1, \ldots, g_t; e_{11}, \ldots, e_{1,t-1}; e_{N1}, \ldots, e_{N,t-1}\}$. Note that $\rho_i(\tau)$ measures the degree of persistence at a given quantile (τ).The null hypothesis of a unit root, is expressed as $H_0 : \rho_i(\tau) = 1$ for all i and τ against the alternative of $H_1 : \rho_i(\tau) < 1 \text{for} i = 1, \ldots, N_1$ and $\rho_i(\tau) = 1 \text{for} i = N_1 + 1, \ldots, N$ for a given τ. To test the null hypothesis, the quantile counterpart of CIPS statistic in Pesaran (2007) is constructed as

$$QCIPS(\tau) = \frac{1}{N}\sum_{i=1}^{N} QCADF_i(\tau) \tag{4}$$

where $QCADF_i(\tau)$ is the quantile counterpart of CADF statistic, based on t-statistic, given by

$$QCADF_i(\tau) = \frac{\hat{f}_{e_i}\left(F_{e_i}^{-1}(\tau)\right)}{\sqrt{\tau(1-\tau)}}\left(Y_{i,-1}' P_x Y_{i,-1}\right)^{1/2}\left(\hat{\rho}_i(\tau) - 1\right) \tag{5}$$

where $Y_{i,-1}$ is vector of lagged dependent variables (y_{it-1}), P_x is projection matrix on space orthogonal to $x = \left(1, t, \bar{y}_{t-1}, \Delta\bar{y}_{t-j}, \Delta y_{t-j}\right)$ and $\hat{f}_{e_i}\left(F_{e_i}^{-1}(\tau)\right)$ is a consistent estimator of $f_{e_i}\left(F_{e_i}^{-1}(\tau)\right)$. Although $QCADF_i(\tau)$ statistic is not independent due to common factor, the truncated version of $QCIPS(\tau)$ has a limiting distribution free from nuisance parameters. We use the simulation procedure in Yang, Wei, and Cai (2022) to approximate distributions of $QCADF_i(\tau)$ and the truncated $QCIPS(\tau)$ statistics.[2]

III. Data and findings

We utilize real effective exchange rates for 30 Asian economies[3] from January-1993 to October-2024, complied from the Bank on International Settlements. As shown in Figure 1, the series exhibits frequent and varied fluctuations, suggesting potential asymmetries in exchange rate behaviour. This observation is statistically supported by the normality test (Jarque and Bera 1987), which confirms non-normal distributions across the region

[2]See Yang, Wei, and Cai (2022) for details of truncated statistic and estimating quantile density function as well, which are omitted here to save space.

[3]Despite the United Nations' classification of 48 countries within the Asian region, it was not possible to include 18 countries due to the unavailability of data necessary to construct a balanced panel. Collecting a balance panel data set is crucial for our research question since we particularly focus on employing an econometric tool which can incorporate the cross-correlations. Due to its transcontinental location, Egypt is included in the study as part of the Asian countries.

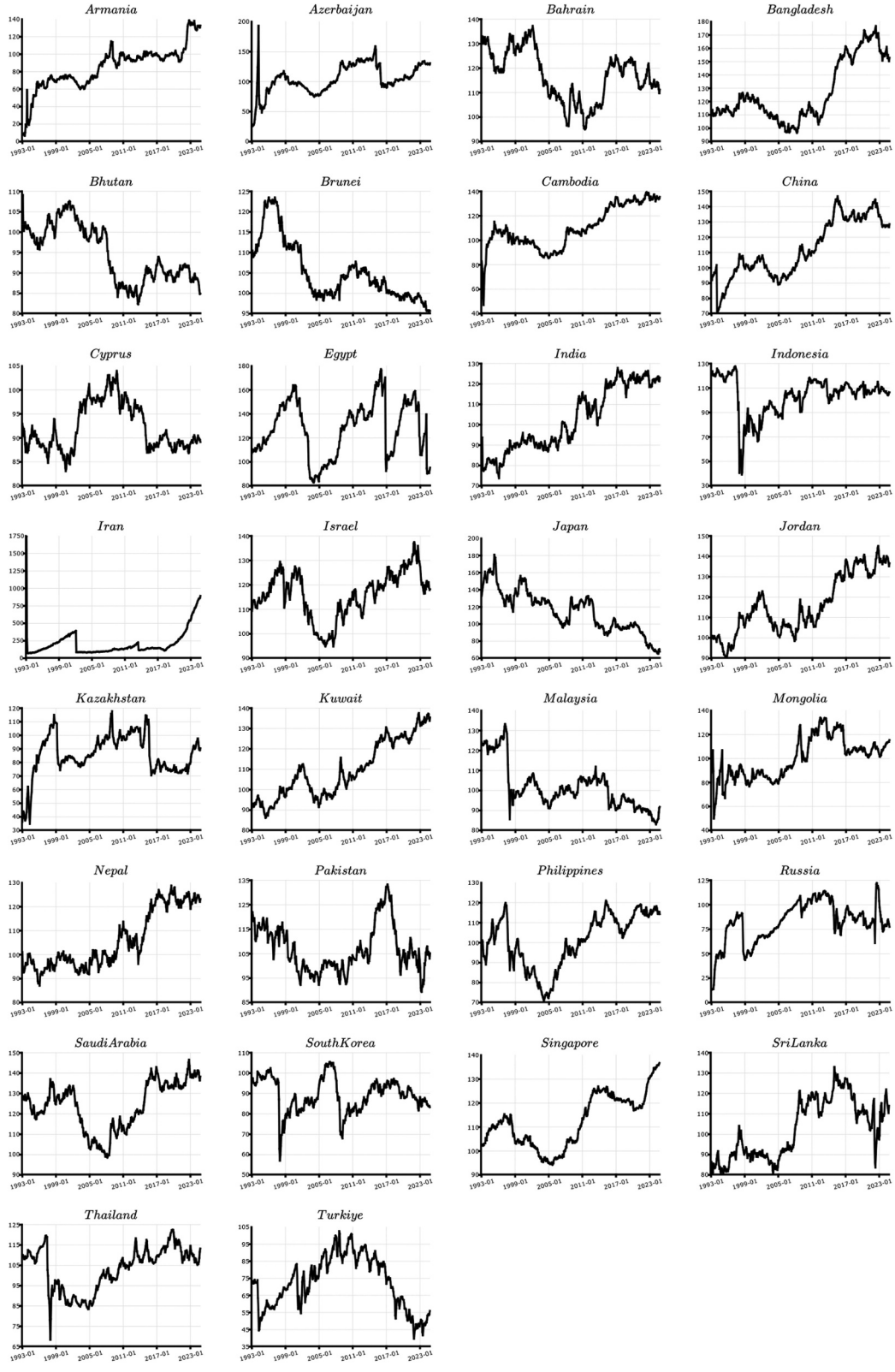

Figure 1. Dynamics of real effective exchange rates.

and underscores the need for a quantile unit root framework. Table 1 reports the results from conventional and quantile panel unit root approaches, including panel statistics, individual statistics, as well as cross-section dependency statistics.[4]

To assess the significance of cross-correlations among the economies, we apply Pesaran's (2021) cross-section dependency (CD) statistic along with its quantile counterpart, denoted as CD(τ). The CD test rejects the null hypothesis of no cross-sectional dependence at the 1% level. The CD(τ) statistic similarly rejects the null at every quantile at the 1% level, reinforcing the importance of employing a quantile unit root testing framework that accounts for cross-correlations.

The conventional CIPS test rejects the null hypothesis of a unit root, thereby supporting the PPP hypothesis for Asian countries in a general sense. However, it assumes a constant speed of adjustment and does not capture the full dynamics of shock persistence. In contrast, the QCIPS(τ) test reveals a more nuanced picture: while it does not reject the unit root hypothesis from low to median quantiles (between 10% and 50%), it does so at the higher quantiles at the 1% significance level. This pattern indicates that negative shocks (captured at the lower quantiles) tend to be more persistent, whereas positive shocks (captured at the higher quantiles) are more transitory. Such asymmetric behaviour suggests that conventional tests may oversimplify the dynamics of exchange rate adjustments under PPP.

Recognizing that rejecting the null hypothesis does not imply a stationary process for all countries at a given quantile – since the alternative hypothesis allows for some cross-sections to retain a unit root – we also examine country-specific results (see Table 2). For clarity, we note that p-values below 0.1, 0.05, and 0.01 indicate rejection of the unit root hypothesis at the 10%, 5%, and 1% significance levels, respectively, thereby supporting PPP for a country. While the CADF test supports PPP in seven countries, the QCADF(τ) statistic increases this number substantially, rejecting the null hypothesis in 12 to 20 cases at the lowest (0.1) and highest (0.9) quantiles. This finding highlights that assuming a constant unit root process can lead to misleading inferences at the country level and that quantile-based inference provides deeper insights into exchange rate dynamics.

Our analysis further identifies that negative and positive shocks exhibit asymmetric effects in 20 countries (including Armenia, Azerbaijan, Bahrain, Bangladesh, Bhutan, Cambodia, China, Cyprus, Indonesia, Kazakhstan, Kuwait, Malaysia, Pakistan, Philippines, Russia, Singapore, South Korea, Sri Lanka, Thailand, and Türkiye), while the effects appear symmetric in the remaining 10 countries (Brunei, Egypt, India, Iran, Israel, Japan, Jordan, Mongolia, Nepal, and Saudi Arabia). Among these, PPP is strongly supported at almost all quantiles in six countries (Egypt, India, Israel, Mongolia, Nepal, and Saudi Arabia) but does not hold in four (Brunei, Iran, Japan, and Jordan). Table 2 presents a summary of these findings, along with the differences in economic characteristics of the countries that have different degrees of openness and levels of economic growth as well as exchange rate regime.

Finally, we interpret $\rho_i(\tau)$from Equation (3) as the degree of persistence at a given quantile τ, effectively capturing a regime-switching process of asymmetric persistence across different shock magnitudes. Figure 2 illustrates $\rho_i(\tau)$ over the entire conditional distribution (τ = 0.01, 0.02, . . . , 0.99). When $\rho_i(\tau)$reaches 1, it signals that shocks are fully persistent. The figure clearly shows that shocks close to the mean of distribution, or of a smaller magnitude, tend to be persistent, thereby reinforcing the evidence of asymmetric exchange rate dynamics in Asian economies.

This finding appears to be economically intuitive and relevant. Moderate shocks may not trigger strong policy responses – particularly in regimes with (implicit or explicit) intervention bands; and thus, central banks may tolerate fluctuations within a such band. Such shocks may not attract immediate market correction if they are perceived as transitory or within expected volatility. This may lead to an inertia in error correction process, making such shocks more persistent in practice. Thus, the persistence of near-mean shocks may arise from a combination of policy design and market expectations, which

[4]We would like to thank Saban Nazlioglu for sharing GAUSS codes for Payne et al. (2024) to conduct conventional and quantile panel unit root tests.

Table 1. Results from quantile panel unit root test.

		τ =0.1	τ =0.2	τ =0.3	τ =0.4	τ =0.5	τ =0.6	τ =0.7	τ =0.8	τ =0.9
Panel results	*CIPS*	*QCIPS*(τ)								
	−2.869***	−0.955	−0.992	−1.114	−1.487	−1.923	−2.352***	−2.332***	−2.519***	−2.780***
	(0.000)	(0.999)	(1.000)	(1.000)	(0.998)	(0.112)	(0.000)	(0.000)	(0.000)	(0.000)
Individual results	*CADF*$_i$	*QCADF*$_i$(τ)								
Armenia	−6.420***	0.406	−0.083	−2.222**	−3.295***	−4.669***	−6.165***	−5.373***	−6.712***	−6.986***
	(0.000)	(0.937)	(0.648)	(0.030)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Azerbaijan	−4.721***	−0.026	−0.361	−1.578*	−2.718***	−2.254**	−3.807***	−3.409***	−3.450***	−4.316***
	(0.002)	(0.665)	(0.458)	(0.089)	(0.006)	(0.023)	(0.000)	(0.001)	(0.001)	(0.000)
Bahrain	−1.161	0.089	−0.085	−0.278	0.071	−1.208	−1.740*	−1.713*	−0.855	−1.794*
	(0.926)	(0.621)	(0.550)	(0.487)	(0.623)	(0.168)	(0.072)	(0.068)	(0.271)	(0.059)
Bangladesh	−1.989	−0.983	−0.879	0.102	−1.399	−1.896**	−2.818***	−2.697***	−3.050***	−3.559***
	(0.676)	(0.228)	(0.255)	(0.633)	(0.123)	(0.046)	(0.004)	(0.006)	(0.002)	(0.000)
Bhutan	−1.036	1.150	1.853	−0.007	−1.293	−1.649*	−1.745*	−1.814*	−1.926**	−3.180***
	(0.946)	(0.917)	(0.981)	(0.588)	(0.143)	(0.073)	(0.066)	(0.058)	(0.046)	(0.002)
Brunei	−1.260	−0.256	0.040	−1.220	−0.987	−1.082	−1.094	−0.969	−1.284	−2.223**
	(0.910)	(0.484)	(0.604)	(0.160)	(0.224)	(0.198)	(0.196)	(0.232)	(0.143)	(0.023)
Cambodia	−2.416	−3.892***	−2.919***	−1.061	−0.461	0.114	−0.739	−1.105	−1.872*	−1.220
	(0.469)	(0.000)	(0.004)	(0.206)	(0.417)	(0.633)	(0.304)	(0.195)	(0.053)	(0.159)
China	−6.420***	−4.165***	−3.866***	−3.613***	−3.074***	−1.179	−0.689	−0.029	−1.062	−1.159
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.172)	(0.320)	(0.590)	(0.205)	(0.174)
Cyprus	−1.985	−2.613***	−2.289**	−2.207**	−2.392**	−3.438***	−1.946**	−1.696*	−0.868	−0.740
	(0.678)	(0.008)	(0.018)	(0.026)	(0.016)	(0.002)	(0.042)	(0.071)	(0.255)	(0.315)
Egypt	−3.327	−2.171**	−4.500***	−2.430**	−2.250**	−2.536**	−1.956**	−2.562***	−2.499**	−2.868***
	(0.118)	(0.029)	(0.000)	(0.013)	(0.021)	(0.011)	(0.045)	(0.009)	(0.011)	(0.004)
India	−3.687*	−2.653***	−2.520**	−2.293**	−3.494***	−3.576***	−2.554**	−2.774***	−2.921***	−2.765***
	(0.055)	(0.007)	(0.011)	(0.019)	(0.001)	(0.001)	(0.011)	(0.006)	(0.004)	(0.005)
Indonesia	−4.597***	2.188	5.119	1.167	−0.207	−3.111***	−6.371***	−7.895***	−11.474***	−10.884***
	(0.004)	(1.000)	(1.000)	(0.919)	(0.513)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Iran	−0.862	3.111	5.258	5.335	3.916	2.890	2.450	2.645	0.854	0.163
	(0.964)	(0.999)	(1.000)	(1.000)	(1.000)	(0.999)	(0.996)	(0.998)	(0.858)	(0.652)
Israel	−3.205	−1.933**	−3.314***	−2.210**	−1.602*	−1.917**	−3.114***	−2.386**	−2.692***	−2.451***
	(0.149)	(0.044)	(0.001)	(0.022)	(0.086)	(0.044)	(0.002)	(0.015)	(0.006)	(0.012)
Japan	−2.010	−1.272	−1.174	−0.089	−0.325	−0.483	−0.841	−0.846	−1.280	−1.418
	(0.666)	(0.148)	(0.175)	(0.558)	(0.450)	(0.403)	(0.275)	(0.273)	(0.147)	(0.113)
Jordan	−1.820	0.923	0.025	−0.707	−1.262	−1.156	−1.282	−1.367	−1.618*	−1.401
	(0.752)	(0.884)	(0.604)	(0.308)	(0.148)	(0.181)	(0.148)	(0.123)	(0.084)	(0.125)
Kazakhstan	−3.811**	0.012	−0.755	−1.778*	−2.859***	−4.053***	−4.816***	−3.619***	−4.232***	−4.938***
	(0.041)	(0.665)	(0.296)	(0.061)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Kuwait	−2.497	−3.351***	−2.016**	−1.467	−1.109	−1.141	−1.319	−0.063	0.387	−0.360
	(0.432)	(0.002)	(0.038)	(0.108)	(0.188)	(0.181)	(0.135)	(0.572)	(0.727)	(0.449)
Malaysia	−3.274	−1.804*	−1.509*	−1.473	−1.147	−1.675*	−1.568*	−1.978**	−1.332	−1.503
	(0.131)	(0.069)	(0.099)	(0.106)	(0.180)	(0.078)	(0.097)	(0.038)	(0.137)	(0.100)
Mongolia	−2.886	−3.180***	−2.041**	−2.530**	−2.470**	−2.786***	−2.319**	−1.962**	−1.860**	−0.464
	(0.258)	(0.002)	(0.038)	(0.012)	(0.014)	(0.005)	(0.018)	(0.043)	(0.049)	(0.408)
Nepal	−3.053	−1.387	−1.882**	−2.982***	−2.510***	−3.467***	−3.551***	−2.756***	−2.536**	−2.835***
	(0.198)	(0.118)	(0.047)	(0.002)	(0.009)	(0.001)	(0.001)	(0.007)	(0.012)	(0.005)
Pakistan	−2.987	−1.417	−1.154	−1.365	−1.919**	−2.439***	−2.696***	−2.202**	−2.269**	−4.414***
	(0.221)	(0.119)	(0.178)	(0.127)	(0.047)	(0.014)	(0.007)	(0.024)	(0.022)	(0.000)
Philippines	−1.980	−2.380**	−1.252	−0.771	−0.551	−0.022	0.137	−0.330	−1.764*	−2.493**
	(0.680)	(0.017)	(0.154)	(0.292)	(0.378)	(0.595)	(0.641)	(0.464)	(0.062)	(0.012)
Russia	−3.725*	1.334	1.701	−0.071	−0.902	−2.961***	−5.018***	−5.211***	−5.770***	−5.839***
	(0.051)	(0.994)	(0.977)	(0.563)	(0.259)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)
Saudi Arabia	−2.854	−2.431**	−2.224**	−2.002**	−1.792*	−2.174**	−1.385	−1.677*	−1.685*	−1.958**
	(0.272)	(0.013)	(0.023)	(0.041)	(0.061)	(0.027)	(0.122)	(0.076)	(0.072)	(0.044)
Singapore	−1.487	−1.513*	−1.345	−0.200	−1.044	−0.857	−0.574	−1.152	−0.626	−1.291
	(0.864)	(0.097)	(0.138)	(0.510)	(0.213)	(0.268)	(0.370)	(0.175)	(0.343)	(0.144)
South Korea	−3.363	0.362	0.183	−1.272	−3.254***	−3.398***	−5.124***	−6.575***	−6.355***	−5.405***
	(0.108)	(0.732)	(0.656)	(0.145)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sri Lanka	−2.289	0.892	0.321	0.174	−0.082	−0.981	−2.966***	−3.594***	−3.044***	−3.568***
	(0.531)	(0.869)	(0.707)	(0.652)	(0.560)	(0.229)	(0.003)	(0.000)	(0.003)	(0.001)
Thailand	−3.341	−0.735	−0.648	−0.464	−0.402	−1.510	−2.541***	−3.861***	−4.413***	−4.518***
	(0.114)	(0.332)	(0.343)	(0.415)	(0.444)	(0.104)	(0.009)	(0.000)	(0.000)	(0.000)
Türkiye	−1.604	0.938	−0.313	−0.285	−1.582*	−1.890**	−1.661*	−1.667*	−2.716***	−2.050***
	(0.830)	(0.956)	(0.462)	(0.477)	(0.087)	(0.053)	(0.081)	(0.074)	(0.005)	(0.034)
#cases (PPP)	7	12	10	11	13	18	20	21	21	20
CD	29.096***	29.838***	28.116***	27.897***	27.684***	27.502***	27.649***	27.791***	28.100***	29.435***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: CIPS and QCIPS(τ) are truncated panel statistics. CADF and QCADF(τ) are individual statistics, which are based on the t-statistic from ADF-type linear and quantile regressions, including lags (p) with integer value of $4(T/100)^{1/4}$.p-values in parenthesis are based on simulated statistics with 1,000 Monte Carlo replications. CD (cross-section dependency) test is based on residuals from OLS estimation of y_{it} on $(1, t, y_{it-1}, \Delta y_{it})'$. CD($\tau$), the quantile counterpart of CD test, is based on residuals from quantile regression estimation. p-values for CD tests are based on standard normal distribution. ***(1%, p-value < 0.01), ** (5%, p-value < 0.05), *(10%, p-value < 0.1).

Table 2. Summary of results and some economic characteristics.

Country	PPP	Trade Openness	Economic Growth	Exchange Rate Regime
Armenia	Asymmetric	80.78	5.63	Floating
Azerbaijan	Asymmetric	86.11	4.85	Stabilized arrangement
Bahrain	Asymmetric	142.37	4.19	Conventional peg
Bangladesh	Asymmetric	33.12	5.67	Crawl-like arrangement
Bhutan	Asymmetric	86.12	5.73	Conventional peg
Brunei	Fail	94.98	0.66	Currency board
Cambodia	Asymmetric	113.08	5.86	Stabilized arrangement
China	Asymmetric	42.43	8.68	Crawl-like arrangement
Cyprus	Asymmetric	133.63	3.37	Free floating
Egypt	Hold	45.45	4.40	Stabilized arrangement
India	Hold	38.49	6.31	Floating
Indonesia	Asymmetric	51.94	4.52	Floating
Iran	Fail	44.78	2.85	Stabilized arrangement
Israel	Hold	63.26	3.97	Floating
Japan	Fail	28.02	0.73	Free floating
Jordan	Fail	111.88	3.96	Conventional peg
Kazakhstan	Asymmetric	76.47	3.70	Floating
Kuwait	Asymmetric	92.21	3.93	Managed arrangement
Malaysia	Asymmetric	166.98	5.05	Floating
Mongolia	Hold	114.23	5.33	Stabilized arrangement
Nepal	Hold	47.42	4.30	Conventional peg
Pakistan	Asymmetric	30.07	3.82	Floating
Philippines	Asymmetric	69.05	4.67	Floating
Russia	Asymmetric	52.11	1.83	Free floating
S. Arabia	Hold	68.72	3.35	Conventional peg
Singapore	Asymmetric	351.48	5.27	Stabilized arrangement
S. Korea	Asymmetric	74.45	4.39	Floating
Sri Lanka	Asymmetric	64.14	4.23	Crawl-like arrangement
Thailand	Asymmetric	117.79	3.32	Floating
Türkiye	Asymmetric	51.64	4.71	Floating

Notes: Trade openness: exports plus imports as a percentage of GDP. The numbers for trade openness and economic growth are the 1993–2024 averages, based on the data retrieved from World Development Indicators. Exchange rate regimes (as of 2022) and their definitions are available at https://www.elibrary-areaer.imf.org/Pages/ExchangeRegimes.aspx.

both contribute to underlying asymmetric persistence.

Overall, these results provide compelling evidence that incorporating both asymmetric persistence and cross-sectional correlations into unit root testing offers a more refined understanding of the PPP hypothesis in Asian financial systems.

IV. Conclusion

This study employs a quantile panel unit root approach to examine exchange rate shocks in thirty Asian economies, capturing asymmetric persistence and cross-sectional correlations. Unlike traditional tests broadly supporting PPP, our analysis identifies persistent negative shocks at lower quantiles and transitory positive shocks at higher quantiles. There is symmetric adjustment in ten countries, with PPP robustly holding in Egypt, India, Israel, Mongolia, Nepal, and Saudi Arabia, but failing in Brunei, Iran, Japan, and Jordan. For twenty countries, adjustments to shocks are asymmetric, suggesting limited long-term monetary policy effectiveness on exchange rates.

These findings provide practical relevance for policymakers, enabling them to adapt exchange rate and monetary policy responses to asymmetric shocks. Recognizing asymmetric persistence, policymakers can design targeted policies for macroeconomic and financial stability and resilience to external shocks. Persistent depreciations in real exchange rates require active policy responses for stabilizing goods and financial markets, pivotal for international portfolio diversification, risk management, and sustainable competitiveness. In contrast, transient appreciations may not necessitate prompt interventions to avoid unnecessary disruptions to inflation targeting or external balance.

Depreciation of real exchange rates enhances price competitiveness, stimulating exports and import substitution in export-oriented Asian economies. However, depreciation driven by weakening domestic currency may distort inflation expectations through higher import prices, complicating monetary policy. Such depreciation also increases foreign-denominated debt servicing costs, necessitating effective hedging strategies. Exchange rate trends influence asset allocation

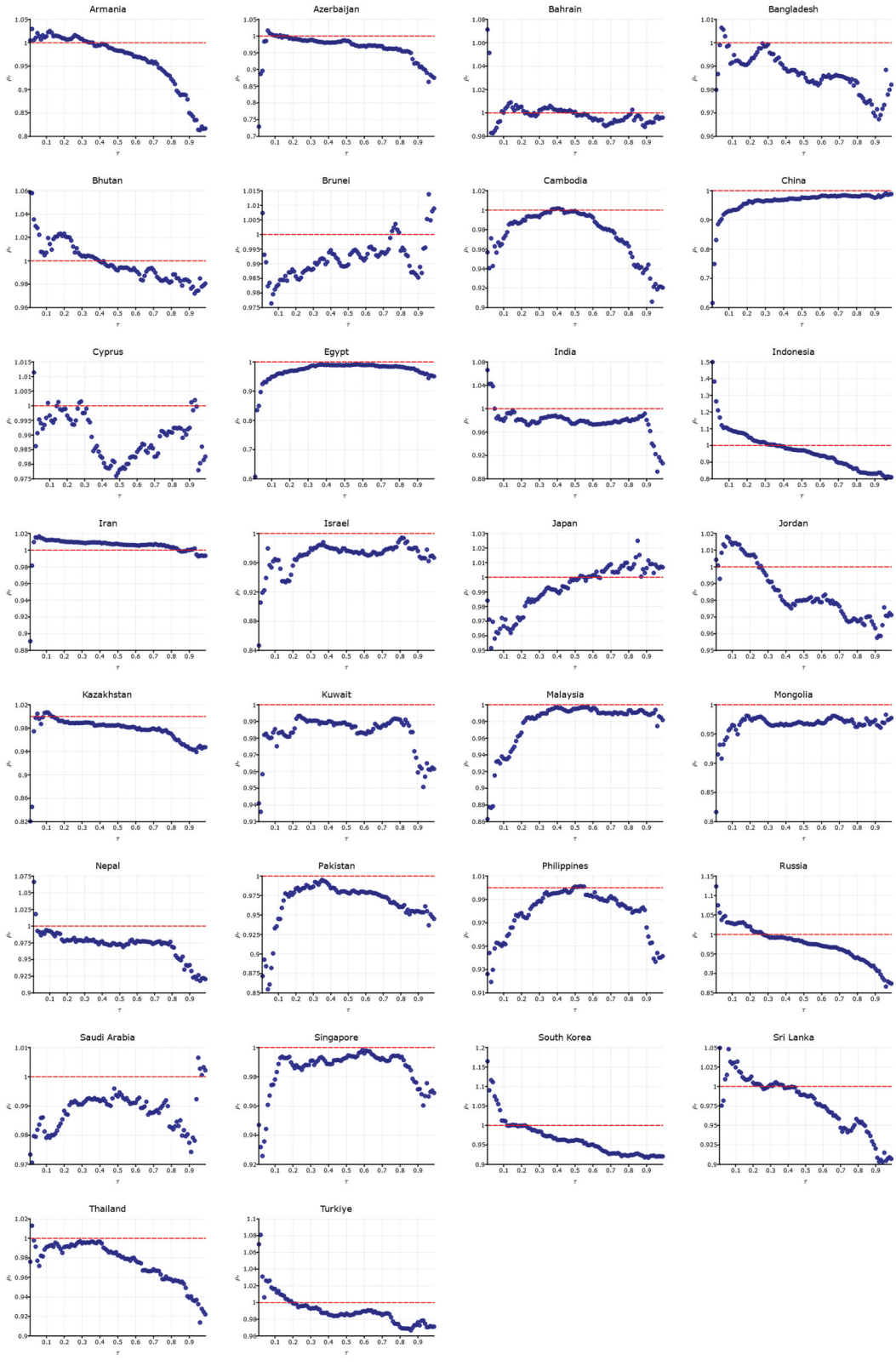

Figure 2. Dynamic asymmetric persistence degree.

decisions by affecting currency risk and foreign investment returns.

In summary, by integrating asymmetric persistence and cross-sectional correlations, this study reinforces PPP relevance in Asian economies, providing deeper insights into heterogeneous exchange rate adjustments. Future research may explore similar dynamics in other regions and economic conditions.

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Author contributions

CRediT: **Elif Hilal Nazlioglu:** Conceptualization, Data curation, Investigation, Writing – original draft; **Turker Batmaz:** Conceptualization, Formal analysis, Writing – original draft; **Alper Gormus:** Conceptualization, Investigation, Writing – original draft.

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