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Testing And Identifying Multiple Bubbles In Pak Rupee-Chinese Yuan Exchange Rate

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ABSTRACT

This research investigates the presence of rational bubbles within the time series data of the Pakistani Rupee (Pak Rupee) and Chinese Yuan exchange rate. Its main objectives are to evaluate the efficacy of various econometric tests in identifying explosive behavior and to determine their applicability in assessing exchange rate dynamics. Additionally, the study seeks to elucidate the key drivers contributing to the emergence of explosive behavior in the Pak Rupee-Yuan exchange rate. Employing the Augmented Dickey Fuller (ADF), Sequential Augmented Dickey Fuller (SADF), and Generalized Sequential Augmented Dickey Fuller (GSADF) tests, the research reveals that the ADF test successfully identifies explosive behavior in the exchange rate, while the right-tail ADF test fails to do so for both traded and non-traded goods, leaving the origin of the exchange rate's explosive behavior inconclusive. Similarly, the SADF test mirrors these results, confirming explosive behavior in the exchange rate but not in traded and non-traded goods. However, the GSADF test detects multiple bubbles in the exchange rate and identifies explosive behavior in traded goods. Notably, it fails to identify multiple bubbles in non-traded goods, suggesting that the exchange rate's explosive behavior primarily stems from the non-traded goods sector. In summary, the study concludes that the GSADF test effectively identified the fundamental driver responsible for the explosive behavior in the exchange rate, namely non-traded goods. In contrast, the right-tail ADF and SADF tests were unable to ascertain these underlying drivers.

Keywords: Exchange rate, Bubbles, SADF test, GSADF Test, Explosive Behavior.

Introduction

The timely identification of economic bubbles holds particular significance in the contemporary landscape, where economic elements are intricately interconnected. Notably, the exchange rate (ER) stands out as a prime example of such interconnectivity. Historical episodes of ER bubbles have borne witness to substantial financial crises, with notable instances including the Sterling crisis of 1976, the catastrophic Black Wednesday in the United Kingdom in 1992, the Mexican Peso Disaster spanning 1994-95, and the Asian Crisis in 1997-98. ER, often regarded as the linchpin of economic dynamics, assumes a pivotal role due to its pronounced influence on economic efficiency, as emphasized by Kandil (2006). The debate surrounding the ER of a foreign currency is unceasing, with currency depreciation being postulated by policymakers and economists as a catalyst for enhanced global competitiveness. This shift in currency value is posited to render exports more cost-effective and imports relatively expensive, a phenomenon that stimulates demand for exports while curbing it for imports, thus favorably impacting trade balances as delineated by Baharumshah (2001), Onafowora (2003), and Stucka (2004). Furthermore, currency depreciation exerts a positive influence on remittances and foreign direct investments, thereby fostering economic growth, as evidenced in the works of Di Nino et al. (2011), Rodrik (2008), and Aizenman (1992). However, it is noteworthy that divergent research perspectives indicate that currency depreciation may exert unfavorable effects on trade balances, economic development, and other economic outcomes, as observed in the studies of Hui and Yue (2006), Hall (1999), Upadhyaya and Dhakal (1997), Lizondo and Montiel (1989), Edwards (1989), Diba and Grossman (1988), Evans (1986), and Krugman and Taylor (1978). In addition to the intricate, unidirectional link between ER and various macroeconomic factors, Raza and Afsha (2017) unearth a bidirectional relationship between economic growth and ER. The influence of the United States dollar (USD) on a nation's ER warrants particular attention. Given the USD's status as the preeminent global currency and the pervasive denomination of assets in dollars across international markets, many developing nations align their currencies with the USD to accumulate foreign reserves (Raza et al., 2021) and regulate current account balances. However, this practice exposes financial systems to vulnerabilities, as unanticipated fluctuations in the USD's value can exert far-reaching consequences, as noted by Zhang and Yao (2016).

In the past, bubbles in the ER of several economies have been effectively recognized Hu & Oxley (2017), Jiang et al., (2015), and Van Norden (1996). Nonetheless, prior to this study, there has been a conspicuous absence of substantial efforts to address the specific issue surrounding the exchange rate between the Chinese Yen and Pakistani Rupee. Over the years, Pakistan has undergone a series of adjustments in its exchange rate (ER) policies, transitioning from a fixed ER system that was in place from 1947 to 1981, to the subsequent adoption of a dirty float ER policy from 1981 to 2000. These policy modifications have conferred significant advantages upon the newly established nation, as the fixed ER framework has demonstrated its capacity to stabilize prices and enhance the effectiveness of policy oversight, as highlighted in the work of Barro and Gordon (1983). Similarly, with the dissolution of the Bretton Woods agreement, the implementation of a dirty float ER mechanism, characterized by periodic involvement of a country's central bank in determining the value of its currency, became a commonly employed ER approach during this period, as documented by Garber (1993). In addition to these developments, Pakistan confronted a severe predicament in 1998, marked by harsh international sanctions in response to the country's nuclear testing activities. Pakistan eventually joined the battle on terror, which drastically altered Pakistan's economic, political, and social status (Raza et al., 2020). As Saeed et al. (2012) suggest, variables influencing exchange rates might be economic, political, or psychological. Pakistan established a flexible ER system in 2000, which is still in use today. In other words, Pakistan's ER is currently determined by market forces rather than government interference. As a result, the country underwent significant modifications in ER policies, which may cause its value to vary, De Grauwe and Vansteenkiste (2007). Conversely, past research on exchange rates within the context of Pakistan has shown a tendency to overlook the prospect of ER bubbles, opting instead to concentrate primarily on investigating the root causes and resultant consequences of ER fluctuations. In light of these insights, Pakistan emerges as an enticing and thought-provoking setting for the examination of ER bubbles.

According to previous study, researchers are divided on the specific causes influencing ER. Furthermore, whether the link among fundamentals and ER is linear or nonlinear, there is belief divergence. According to the notion of purchasing power parity (PPP), ER is the ratio of two nations' price levels for products. Traded products and non-traded products are both possible (Raza et al., 2021; Raza et al., 2021). Similarly, nominal exchange rate (NER) is only affected by price levels in two nations if PPP holds. As economic foundations of NER, the only variables that remain are the components of ER, specifically non-traded products price differential and traded products price difference abroad and inside the country, Bettendorf and Chen (2013); Jiang et al., (2015). According to different research, in order to realize the advantages of the nominal devaluation policy, NER should be modified for fluctuations in both regional and global prices. Further, it is observed that inflation rate disparity in underdeveloped nations is inversely connected with ER. Based on the purchasing power parity (PPP) theoretical framework, much research regarding ER forecasting is being undertaken in the Pakistani setting. In one of the research, it showed empirically that higher inflation rates contribute to the devaluation of Pakistani currency using data from 1979 to 2008. Furthermore, in another study it was observed that inflation reduces Pakistan's ER. According to Obstfeld and Rogoff (1986), the NER should be treated as an asset value. Campbell and Shiller (1987), frequently utilized the present value approach to assess an asset's real worth. Using the same theoretical framework, first hypothesize ER, and then measure the key elements.

There are relatively few studies in Pakistan that focus on spotting economic bubbles in various financial markets, especially for Pak Rupee-Yuan exchange rate. For Pak Rupee-Yuan exchange rate, no one study has been conducted to test bubbles. The current study takes control and tackles this critical problem. Furthermore, based on the most recent available monthly time series data from January 2010 to July 2022, this study assists researchers in determining whether traded or non-traded products, the basic driving force, are the primary reason in the explosive trend of the exchange rate. The identification of bubbles is made feasible by Phillips et al. (2015)'s recently developed Generalise Supremum ADF (GSADF) technique, which has various advantages over conventional competing approaches, including the ability to identify numerous bubbles, which was previously not conceivable.

Data and Basic Model

To identify potential bubbles in Pakistan's exchange rate (ER), the study focuses on quoting the Rupee in terms of the Yuan, which is considered one of the most influential currencies in the global economy, especially with respect to the China-Pakistan Economic Corridor (CPEC). This research exclusively relies on monthly data pertaining to the nominal Pak-Yuan exchange rate retrieved from the International Monetary Fund (IMF) website, covering the period from January 2010 to May 2022.

As stated by Obstfeld et al. (1996, p. 529), NER should be perceived as a representation of asset values, influenced by both current and anticipated underlying factors. In line with the perspectives of Engel and West (2005), we, therefore, employ the subsequent model to assess the present value of exchange rates:

$$S_t = (1-\gamma)\sum_{j=0}^{k} \gamma^j E_t[fr_{t+j}] + \gamma^{k+1} E_t[S_{t+k+1}], \quad (1)$$

Here S_t represents NER, while fr_t denotes the market fundamental at 't' time period. The parameter γ represents the discount factor. Thus by employing the transversally condition as a criterion,

$$\lim_{k\to\infty} \gamma^k E_t[S_{t+1}] = 0 ,$$

We ensure that, from a long-term perspective, the exchange rate will be solely influenced by anticipated future factors. Nevertheless, in the event that the transversally criterion is not satisfied, there is potential for the ER to exhibit an explosive bubble. When examining a bubble that follows an AR (1) process, its expression may take the following form:

$$bb_t = \frac{1}{\gamma} bb_{t-1} + \varepsilon_t \quad , \tag{2}$$

In this context, S_t^{fr} indicates the discounted aggregate of forthcoming economic fundamentals, while b_t signifies the bubble element. Further, S_t^{fr} is linearly connected to the economic fundamental $'fr_t'$. This perspective aligns with the analysis presented by Engel and West (2005), which also accounts for the I(1) nature of fr_t.

According to the PPP model, the price discrepancy is the economic fundamental underlying the nominal exchange rate:

$$fr_t = pr_t - pr_t^* , \tag{4}$$

In this context pr_t represents the home pricing index log level, denoted by an asterisk, representing international counterparts. According to Engel (1999), a nation's price index can be stated as a weighted average of prices for non-traded and traded goods, allowing it to be deconstructed into separate indexes for non-traded and traded goods, as follows: $pr_t = (1-\alpha)pr_t^T + \alpha pr_t^N$. Where pr_t^T and pr_t^N represent the log of the traded and non-traded goods price indexes respectively, and α is the share of the nontraded products component. One can also write to a foreign nation. $pr_t^* = (1-\beta)pr_t^* + \beta pr_t^{N*}$. As a result, the price disparity (fr_t) may be divided into two parts: the non-traded goods element (fr_t^N) and the traded products element (fr_t^T).

Where if $\frac{1}{\gamma} > 1$, the bubble is an explosive process.

A more detailed discussion on this autoregressive coefficient can be found in Hussan et al. (2019), Akbar et al. (2019). Errors are detected by $\varepsilon_t \sim NID(0,\sigma^2)$. Hence, the formulation of ER can be articulated as follows:

$$S_t = S_t^{fr} + bb_t \text{ Or } S_t - S_t^{fr} = bb_t \tag{3}$$

$$(pr_t - pr_t^*) = (pr_t^T - p^{T*}_t) + \alpha(pr_t^N - pr_t^T) - \beta(pr_t^{N*} - pr_t^{T*}). \tag{5}$$

The producer price index (PPI) is the preeminent and extensively utilized index for depicting the price level of traded commodities. PPI computations are conducted at the production site, effectively excluding marketing and various non-traded consumer services, even though some producer goods may not be involved in trade. Consequently, we derive the segment pertaining to traded goods by adopting the PPI methodology outlined by Engel (1999).

$$fr_t^T = \ln(PPI_t) - \ln(PPI_t^*). \tag{6}$$

To get the non-traded goods component, the ratio between aggregate consumer price indexes (CPI) and aggregate PPI is calculated:

$$fr_t^N = \ln(CPI_t) - \ln(PPI_t) - \ln(CPI_t^*) - \ln(PPI_t^*) . \tag{7}$$

Right tail Augmented Dickey-Fuller (ADF) Test

In econometrics, there are numerous tests available to evaluate the occurrence of a unit root. Among these tests, the ADF unit root test is the most frequently employed. The primary objective of the ADF test is to evaluate the existence of unit root within a given time series dataset. The specific alternative hypothesis, indicating non-unit root behavior, varies depending on the version of the test applied but typically suggests either stationarity or trend-stationarity. However, the alternative hypothesis regarding explosiveness is employed to recognize the behavior of the series as explosive during the investigation. In view of this alternative hypothesis a right tail ADF test was introduced in the literature on the basis of the following ADF model,

$$y_t = \tau + \delta y_{t-1} + \sum_{i=1}^{q} \vartheta_i \Delta y_{t-i} + \varepsilon_t,$$

Where y_t is the series under investigation (e.g., the price of a stock), τ represents drift, q shows the maximum number of lags, ϑ_i for i = 1,…, q are the coefficients differenced lags and ε_t is the error term. The assessment for a potential bubble (explosive behavior) relies on a right-tailed variation of the standard ADF unit root test. In this case, the null hypothesis assumes a unit root, while the alternative hypothesis indicates a mildly explosive autoregressive coefficient. Formally, we test for

$$H_0{:}\delta=1,$$
$$H_1{:}\delta>1.$$

Sequential Augmented Dickey-Fuller (SADF) test

The global financial crises of 2007-08 prompted concerns about the existing methodologies for detecting bubbles. It is difficult to identify bubbles. In this sector, several tests have been developed. However, as we mentioned in the second part, each has restrictions. Phillips et al. (2011) proposed Sequential Augmented Dickey-Fuller (SADF) test, which was designed to examine price bubbles and determine the specific timing of their occurrence.

$$SADF(r_0) = \sup_{r_2 \in [r_0, 1]} \{ADF_0^{r_2}\}$$

Phillips and Yu (2011), along with subsequent works by Phillips et al. (2011, 2015), introduced innovative techniques for bubble detection. Their research operates on the premise that differentiating random walk behavior from explosive activity is crucial, and it aims to identify speculative bubbles before they burst. They devised a unique recursive algorithm tailored for bubble detection, which accommodates explosive unit roots. In contrast to the standard test that confines itself to autoregressive process with $\delta \leq 1$. However, Phillips and Yu (2011) test accommodates the possibility of δ exceeding unity while remaining in close proximity to it. This flexibility enables the assessment of the right-tailed unit root test (RT-UR) repeatedly, a crucial tool for evaluating all potential bubbles. It is essential to highlight that the concept of stationarity distinguishes the right-tailed test from its left-tailed counterpart. As suggested by Homm and Breitung (2012), SADF test is widely acknowledged for its effectiveness in bubble detection. However, the SADF test is not without limitations. Its initial observation phase, characterized by a constant pattern, poses a challenge. In scenarios where results indicate the presence of two bubbles, with one being dominant, the SADF test may fail to identify the second and will provide misleading results.

Generalized Sequential Augmented-Dickey Fuller (GSADF) test

Phillips et al. (2011) developed a dynamic version of the SADF test to address the difficulties of distinguishing many bubbles. This adaptive approach features a window that is not fixed in advance but moves through the dataset, maintaining a consistent window size. Phillips et al. (2015) then combined the SADF and rolling SADF tests inside the framework of the GSADF test, thereby solving the difficulty of finding many bubbles.

$$GSADF(r_0) = \sup_{r_2 \in [r_0, 1],\, r_1 \in [0, r_2 - r_0]} \{ADF_{r_1}^{r_2}\}$$

Here, $_2$ denotes the endpoint of the range, spanning from $_0$ (minimum window dimension) to 1. Likewise, $_1$ ranges from 0 to $_2 - _0$. As a result, the GSADF data analysis change between $_2 - _0$. According to Phillips et al. (2015), The GSASDF dispersion is dependent upon the smallest window dimension r_0. If r_0 is excessively small, prediction is impossible; if it is too high, then risk missing an early bubble. As a result, following Hu and Oxley (2017), and Phillips et al. (2015) the researchers employ the following

equation for r_0: $r_0 = 0.01+^{1}\sqrt{T}^{8}$, in this context, T represents the total number of observations. According to Phillips et al. (2015), this criterion ensures an adequate window dimension. Researchers contend that an excessively specified lag order can lead to significant size distortion. Consequently, for this investigation, lag duration of zero is selected. To establish bounded values, Monte Carlo analyses comprising one thousand replications are employed. Following the methodology outlined by Phillips et al. (2015), we performed an econometric study of explosive bubbles with an intercept. Their study evaluated the model under various regression parameters, including models with and without intercepts, trend-related and non-trend-related models. Their analysis of actual data revealed that the model with an intercept term outperforms the one without. It's important to note that introducing an intercept can occasionally result in misleading (positive) bubbles, especially during a period of collapse or collapse and recovery as discussed by Hu and Oxley (2017). This problem can be effectively addressed through visual inspection. The problem is being further investigated using backward SADF statistics at a 95% significance level.

Results and Discussion

This section assesses the study's findings in light of the methodology used to achieve the objectives. The descriptive statistics and correlation matrix of the variables under consideration are shown in Tables 1 and 2.

Table 3 presents the outcomes of the right-tail ADF test conducted on ER. The analysis reveals that ER exhibits a high degree of statistical significance. In simpler terms, In favor of the alternative hypothesis, it strongly rejects the null hypothesis of a unit root, signifying explosive behavior.

Table 1. Descriptive Statistics of the Variables

	ER	Non-Traded Goods	Traded Goods
Mean	2.871504	-0.400039	0.670143
Median	2.796272	-0.503637	0.730607
Maximum	3.483770	0.180059	0.928971
Minimum	2.509900	-0.738686	0.251523
SD	0.237244	0.288257	0.167461
Skewness	0.637569	0.995711	-1.231383
Kurtosis	2.512218	2.465782	3.499002
Jarque-Bera	11.80477	26.92396	39.99008
Probability	0.002733	0.000001	0.000000
n	152	152	152

Table 2. Correlation Matrix of the Variables

	ER	Non-Traded Goods	Traded Goods
ER	1.000000	0.866790	-0.511159
Non-Traded Goods	0.866790	1.000000	-0.851397
Traded Goods	-0.511159	-0.851397	1.000000

Table 3. ADF Right tail test results for Exchange Rate (Pak Rupee-Chinese Yuan)

		t-Stat	P-value
ADF		1.340855	0.0010
Test CVs**:	90% level	-0.412782	
	95% level	-0.049505	
	99% level	0.706422	

Table 4. ADF Right tail test results for traded goods

		t-Stat	P-value
ADF		-2.263367	0.8050
Test CVs**:**:	90% level	-0.412782	
	95% level	-0.049505	
	99% level	0.706422	

Table 5. ADF Right tail test results for non-traded goods

		t-Stat	P-value
ADF		-1.096819	0.2810
Test CVs**:	90% level	-0.412782	
	95% level	-0.049505	
	99% level	0.706422	

Table 6. SADF test results for Exchange Rate (Pak Rupee-Chinese Yuan)

		t-Stat	P-value
SADF		2.492018	0.0040
Test CVs**:	90% level	1.056194	

95% level	1.434442
99% level	1.952200

The estimated right-tail ADF value exceeds the critical values at the 1%, 5%, and 10% levels of significance, leading to this result. This suggests that ER has an explosive trend.

Table 4 elucidates the outcomes of the right-tail ADF test applied to traded goods. The test reveals that the test statistic for traded goods is below the critical values at the 10%, 5%, and 1% levels of significance so implying that traded goods do not exhibit explosive behavior. Table 5 provides an exposition of the outcomes derived from the right-tail ADF test applied to non-traded goods. The test results indicate that the test statistic for non-traded goods falls below the critical values at the levels of significance (10%, 5%, and 1%). Consequently, we infer that traded goods do not exhibit explosive behavior.

The explosive behavior in ER was recognized using the right tail ADF test. but unable to identify whether traded or non-traded goods are the driven fundamentals of ER. To solve this issue, we employ the SADF and GSADF tests to validate the result of explosive behavior obtained by the right tail ADF test and to determine whether traded or non-traded factors are driving explosive behavior in ER. Table 6 provides an overview of the findings from the SADF test applied to the ER. The results reveal statistical significance, implying the presence of explosive behavior in ER. This indicates that ER has explosive behavior and this explosive behavior is detected in early 3rd quarter of 2011 which remained till the mid of 1st quarter of 2014. Similarly the explosive behavior is identified at the middle of 2nd quarter 0f 2019 which remained explosive behavior till the mid of 3rd quarter of 2019, after that in the 1st quarter of 2020 an explosive behavior again identified and it remained with the random fluctuations till the 1st quarter of 2021 and after that an continue explosive behavior identified up to date and this explosive behavior till continue.

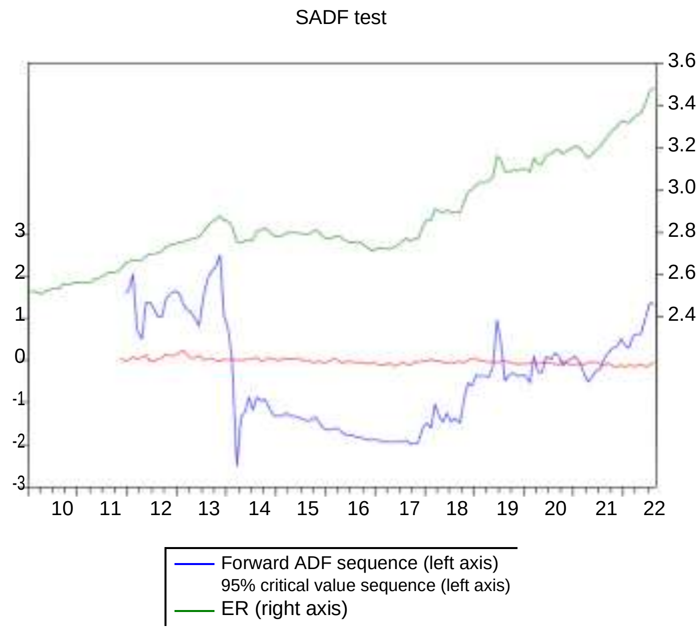

Figure 1. SADF Test for Bubbles Date Stamping for ER

Tables 7 and Table 8 present the outcomes of the SADF test for traded and non-traded goods, respectively. Both tables reveal that neither the non-traded goods nor the traded goods exhibit explosive behavior and this finding is also depicted from the Figure 2 and Figure 3 of SADF test over the time.

Both ADF right tail test and SADF test have same results. However ADF right tail test and SADF test were unable to identify explosive behavior in traded and non-traded goods.

In order to identify explosive behavior in fundamental traded and non-traded by using SADF test, but SADF tests were unable to identify explosive behavior in fundamental traded and non-traded goods, in order to solve this issue we use GSADF test to verify the result of explosive behavior.

Table 7. SADF test results for traded goods

		t-Stat	P-value
SADF		-0.321640	0.7080
Test CVs**:	90% level	1.056194	
	95% level	1.434442	
	99% level	1.952200	

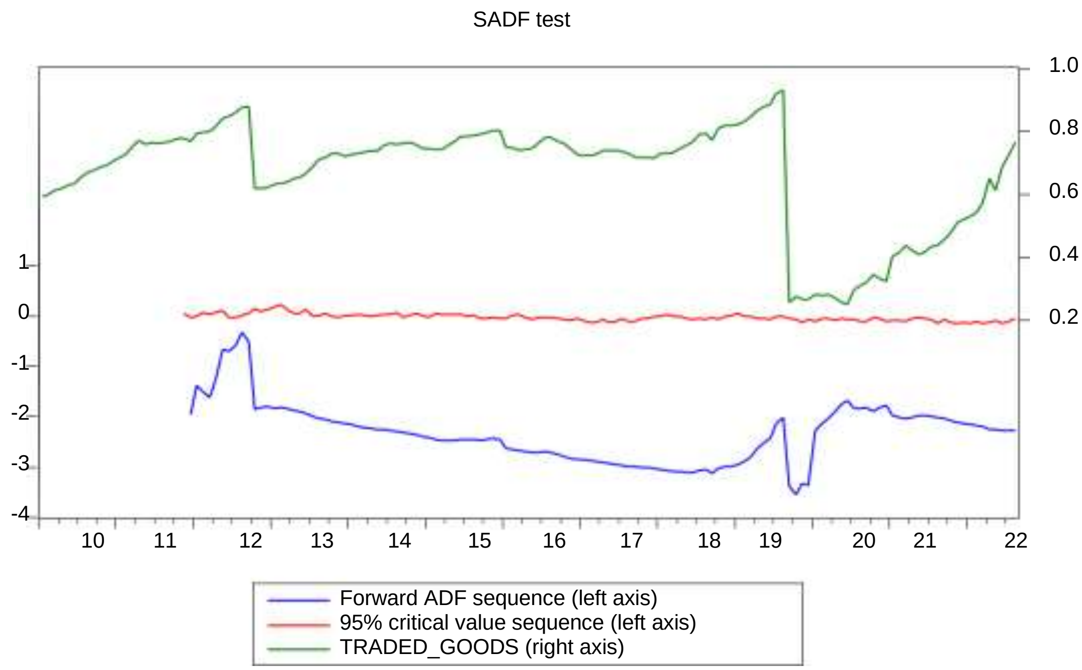

Figure 2. SADF Test Bubbles Date Stamping for ER to traded goods price differential

Table 8. SADF test results for non-traded goods

		t-Stat	P-value
SADF		-0.302741	0.6990
Test CVs**:	90% level	1.056194	
	95% level	1.434442	
	99% level	1.952200	

It is evident from Table 9 that ER is statistically significant, suggesting the presence of explosive behavior. This conclusion is also supported by the GSADF test. This signifies that ER exhibits explosive behavior. The explosive behavior was initially detected in the first quarter of 2012 and persisted until the first quarter of 2014. Subsequently, another episode of explosive behavior was identified in the fourth quarter of 2016, which continued until the middle of the first quarter of 2017. Then, in the first quarter of 2018, another instance of explosive behavior was observed, which extended until the second quarter of 2018. In the fourth quarter of 2018, yet another episode of explosive behavior was identified, which persisted until the first quarter of 2020. Subsequently, in the first quarter of 2020, another episode of explosive behavior was observed, and it continued with intermittent fluctuations until the first quarter of 2021. In the third quarter of 2021, another instance of explosive behavior was once again identified, and it has persisted to the present day, indicating its ongoing nature.

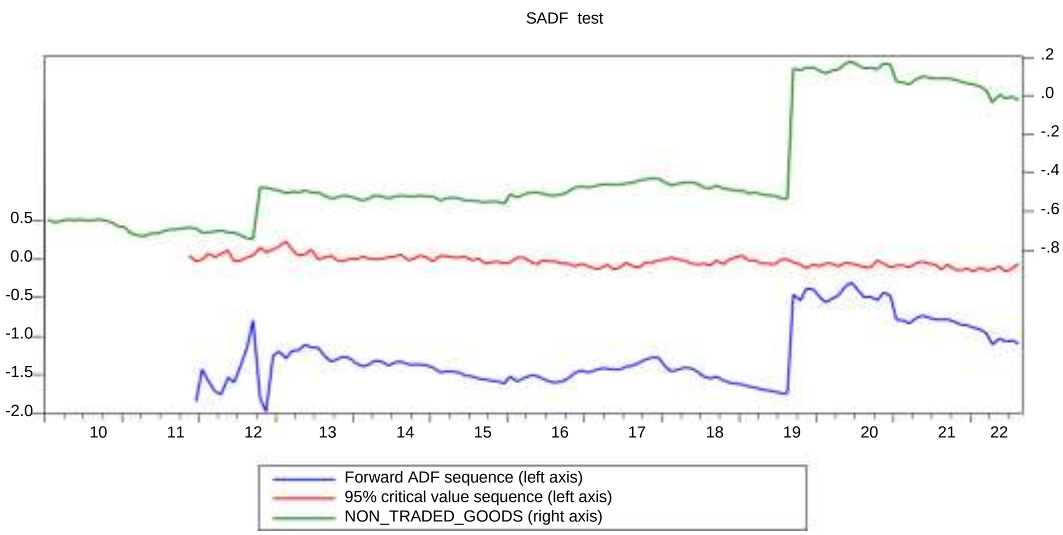

Figure 3. SADF Test Bubbles Date Stamping for ER to non-traded goods price differential

Table 9. GSADF test results for Exchange Rate (Pak Rupee-Chinese Yuan)

		t-Stat	P-value
GSADF		3.045530	0.0040
Test CVs**:	90% level	1.819000	
	95% level	2.108136	
	99% level	2.763722	

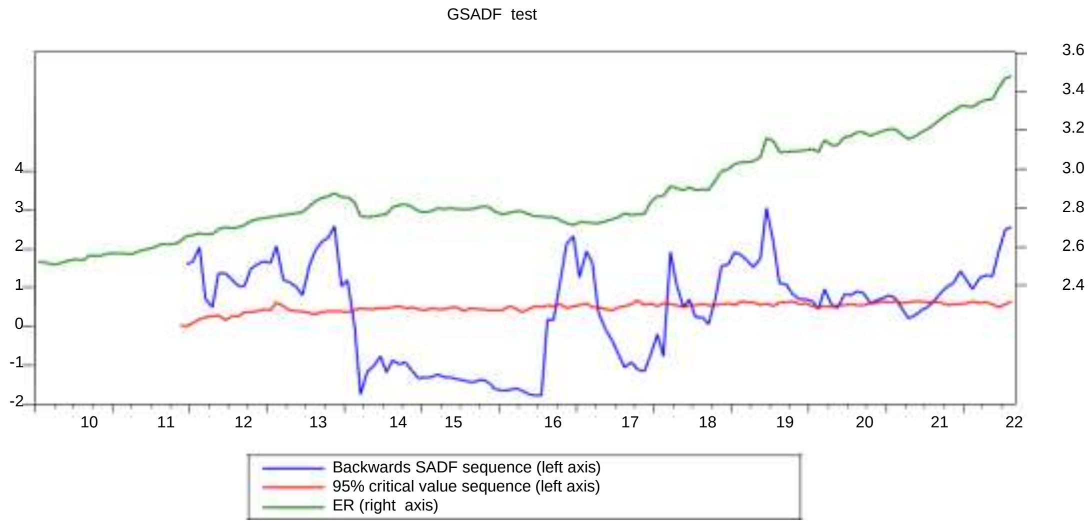

Figure 4. GSADF Test Bubbles Date Stamping for ER

Table 10 details the findings of the GSADF test conducted for traded goods. The results indicate that traded goods exhibit statistical significance, suggesting the presence of explosive behavior. This reveals that traded goods exhibit explosive behavior, which was initially detected in the first quarter of 2019 and persisted until the third quarter of 2019. Subsequently, another episode of explosive behavior was identified at the end of the first quarter of 2022, which has continued through the end of the second quarter of 2022. Furthermore, explosive behavior was once again observed at the end of the second quarter of 2022 and has persisted to the present day.

As right tail ADF and SADF tests were unable to identify explosive behavior in traded goods however GSADF test identified the multiple bubbles in traded goods.

Table 11 provides an overview of the findings derived from the GSADF test conducted for non-traded goods. According to output results, we deduce that non-traded goods do not exhibit explosive behavior.

These findings contradict the speculative bubble idea of the Rupee-Yuan exchange rate. This is owing to the finding that the exchange rate's explosive behavior might be attributable to the relative pricing of non-traded items.

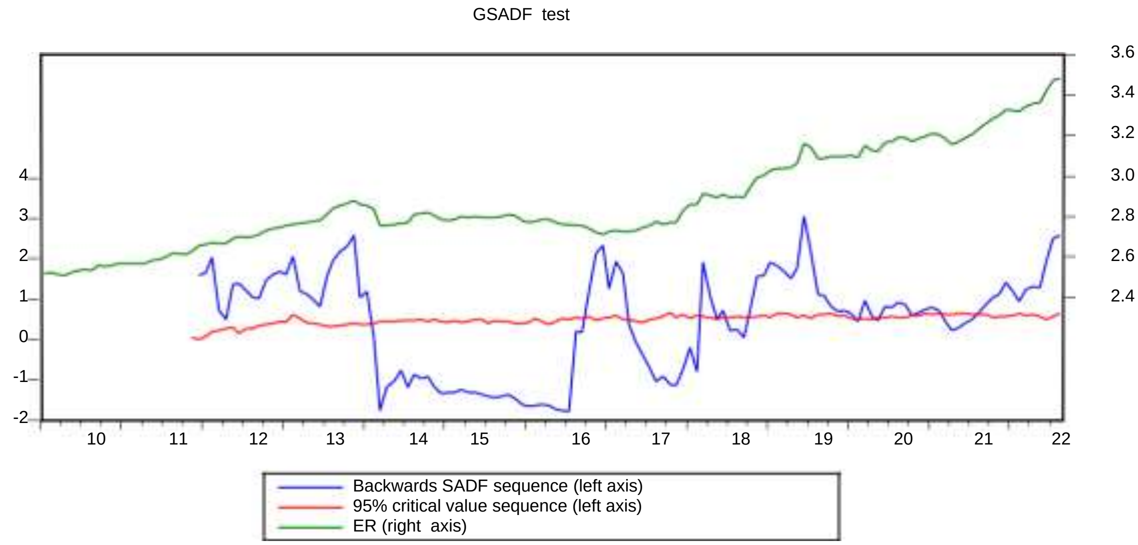

Figure 5. GSADF Test Bubbles Date Stamping for nominal ER

Table 10. GSADF test results for traded goods

		t-Stat	P-value
GSADF		2.592287	0.0160
Test CVs**:	90% level	1.819000	
	95% level	2.108136	
	99% level	2.763722	

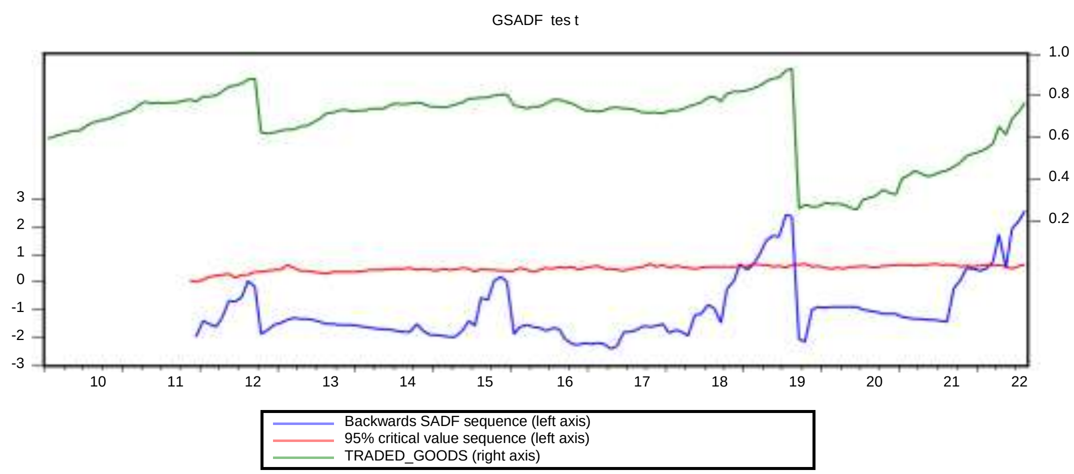

Figure 6. GSADF Test Bubbles Date Stamping for ER to traded goods price differential

Table 11. GSADF test results for non-traded goods

	t-Stat	P-value

GSADF		0.570624	0.7210
Test CVs**:	90% level	1.819000	
	95% level	2.108136	
	99% level	2.763722	

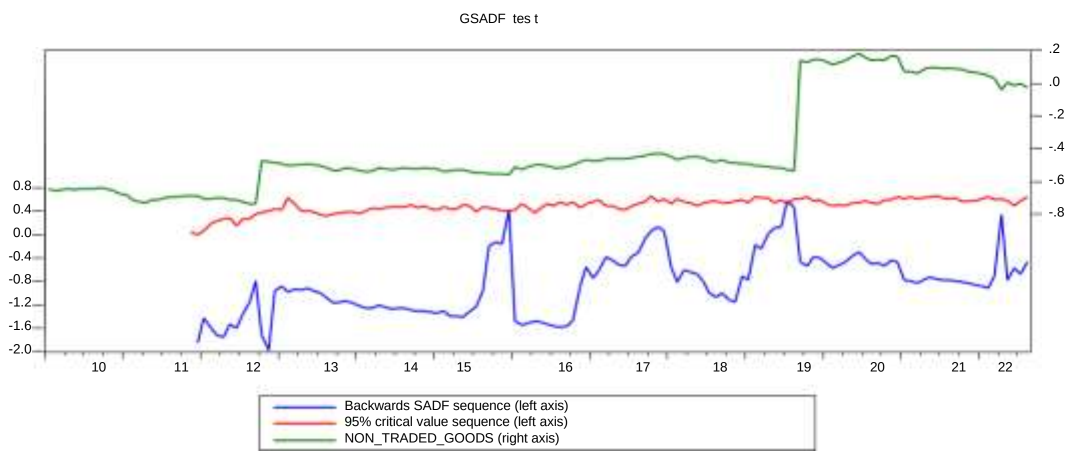

Figure 7. GSADF Test Bubbles Date Stamping for ER to non-traded goods price differential

Conclusion and Recommendations

This study undertook an examination of explosive behavior in the ER, employing various econometric methods, specifically the right tail ADF test, SADF test, and GSADF test. Furthermore, we explored whether the explosive behavior in the ER was predominantly attributable to fundamental factors associated with traded or non-traded goods. All of the conducted tests identified an occurrence of explosive behavior in the ER. The right tail ADF test demonstrated the presence of explosive behavior in the ER, albeit it could not pinpoint the specific source of this explosiveness within either non-traded goods or traded goods series. Similarly, the SADF test yielded consistent results, highlighting explosive behavior in the ER while revealing non-explosive behavior in both non-traded and traded goods. However, upon utilizing the GSADF test, a method adept at identifying multiple explosive patterns, not only was explosive behavior identified in the ER, but it was also detected in traded goods. Consequently, we can conclude that the right tail ADF test and SADF test failed to identify the underlying fundamental factor contributing to the explosive behavior in the ER, whereas the GSADF test pinpointed non-traded goods as the primary driver of this explosive behavior.

Our findings contradict those of Jiang et al. (2015), Bettendorf and Chen (2013), and Kehoe (2006, 2008) and as they propose that price differentials in traded products significantly influence exchange rate fluctuations while downplaying the impact of non-traded product price differentials. This information is of paramount importance for policymakers to consider. Preventing bubbles demands thorough monitoring and multifaceted monetary considerations. It is evident that asset price volatility alone is an insufficient indicator for detecting rational bubbles. Future research should incorporate essential key characteristics into their analyses. Hence, our study underscores the critical need to account for underlying fundamentals when identifying rational asset price bubbles. This understanding has far-reaching ramifications for policymakers and practitioners alike.

REFERENCES

1. Akbar, S., Raza, A., & Riaz, Y. (2019). A Monte Carlo Simulation Analysis of Panel Stationarity Tests under a Single Framework. European Online Journal of Natural and Social Sciences: Proceedings, 8(1 (s)), pp-34.
2. Bettendorf, T., & Chen, W. (2013). Are there bubbles in the Sterling-dollar exchange rate? New evidence from sequential ADF tests. Economics Letters, 120(2), 350-353.
3. Diba, B. T., & Grossman, H. I. (1988). Explosive rational bubbles in stock prices? The American Economic Review, 78(3), 520-530.
4. Engel, C. (1999). Accounting for US real exchange rate changes. Journal of Political Economy, 107(3), 507-538.
5. Engel, C., & West, K. D. (2005). Exchange rates and fundamentals. Journal of political Economy, 113(3), 485-517.
6. Evans, G. W. (1986). A test for speculative bubbles in the sterling-dollar exchange rate: 1981-84. The American Economic Review, 621-636.
7. Hall, S. G., Psaradakis, Z., & Sola, M. (1999). Detecting periodically collapsing bubbles: a Markov‐switching unit root test. Journal of Applied Econometrics, 14(2), 143-154.
8. Homm, U., & Breitung, J. (2012). Testing for speculative bubbles in stock markets: a comparison of alternative methods. Journal of Financial Econometrics, 10(1), 198-231.
9. Hu, Y., & Oxley, L. (2017). Are there bubbles in exchange rates? Some new evidence from G10 and emerging market economies. Economic Modelling, 64, 419-442.
10. Hui, E. C., & Yue, S. (2006). Housing price bubbles in Hong Kong, Beijing and Shanghai: a comparative study. The Journal of Real Estate Finance and Economics, 33(4), 299-327.
11. Hussan, M., & Akbar, S. (2019). A Monte Carlo Comparative Simulation Study for Identification of the Best Performing Panel Cointegration Tests. European Online Journal of Natural and Social Sciences, 8(2), pp-366.
12. Jiang, C., Wang, Y., Chang, T., & Su, C.-W. (2015). Are there bubbles in Chinese RMB–dollar exchange rate? Evidence from generalized sup ADF tests. Applied Economics, 47(56), 6120-6135.
13. Obstfeld, M., & Rogoff, K. (1986). Ruling out divergent speculative bubbles. Journal of Monetary Economics, 17(3), 349-362.
14. Obstfeld, M., Rogoff, K. S., & Wren-lewis, S. (1996). Foundations of international macroeconomics (Vol. 30): MIT press Cambridge, MA.
15. Phillips, P. C., Shi, S., & Yu, J. (2015). Testing for multiple bubbles: Historical episodes of exuberance and collapse in the S&P 500. International Economic Review, 56(4), 1043-1078.
16. Phillips, P. C., Wu, Y., & Yu, J. (2011). Explosive behavior in the 1990s Nasdaq: When did exuberance escalate asset values? International economic review, 52(1), 201-226.
17. Phillips, P. C., & Yu, J. (2011). Dating the timeline of financial bubbles during the subprime crisis. Quantitative Economics, 2(3), 455-491.
18. Zhang, Y.J., & Yao, T. (2016). Interpreting the movement of oil prices:

driven by fundamentals or bubbles? Economic Modelling, 55, 226-240.

19. Kandil, M. (2006). The growth of government spending and the money supply: Evidence and implications within and across industrial countries. Journal of Economic Studies.
20. Baharumshah, A. Z. (2001). The effect of exchange rate on bilateral trade balance: new evidence from Malaysia and Thailand. Asian Economic Journal, 15(3), 291-312.
21. Onafowora, O. (2003). Exchange rate and trade balance in East Asia: is there a J-curve. Economics bulletin, 5(18), 1-13.
22. Stucka, T. (2004). The effects of exchange rate change on the trade balance in Croatia (No. 4-65). Washington: International Monetary Fund.
23. Aizenman, J. (1992). Exchange rate flexibility, volatility, and domestic and foreign direct investment. Staff Papers, 39(4), 890-922.
24. Rodrik, D. (2008). The real exchange rate and economic growth. Brookings papers on economic activity, 2008(2), 365-412.
25. Di Nino, V., Eichengreen, B., & Sbracia, M. (2011). Real exchange rates, trade, and growth: Italy 1861-2011. Bank of Italy Economic History Working Paper, (10).
26. Upadhyaya, K. P., & Dhakal, D. (1997). Devaluation and the trade balance: estimating the long run effect. Applied Economics Letters, 4(6), 343-345.
27. Krugman, P., & Taylor, L. (1978). Contractionary effects of devaluation. Journal of international economics, 8(3), 445-456.
28. Edwards, S. (1989). Exchange rate misalignmentindeveloping countries. The World Bank Research Observer, 4(1), 3-21.
29. Lizondo, J. S., & Montiel, P. J. (1989). Contractionary devaluation in developing countries: an analytical overview. Staff Papers, 36(1), 182-227.
30. Raza, S. A., & Afshan, S. (2017). Determinants of exchange rate in Pakistan: Revisited with structural break testing. Global Business Review, 18(4), 825-848.
31. Van Norden, S. (1996). Regime switching as a test for exchange rate bubbles. Journal of Applied Econometrics, 11(3), 219-251.
32. Barro, R. J., & Gordon, D. B. (1983). Rules, discretion and reputation in a model of monetary policy. Journal of monetary economics, 12(1), 101-121.
33. Saeed, N., Khan, M. R., & Shabbir, M. (2012). Antioxidant activity, total phenolic and total flavonoid contents of whole plant extracts Torilis leptophylla L. BMC complementary and alternative medicine, 12, 1-12.
34. De Grauwe, P., & Vansteenkiste, I. (2007).Exchangeratesand fundamentals: a non-linear relationship? International Journal of Finance & Economics, 12(1), 37-54.
35. Campbell, J. Y., & Shiller, R. J. (1987). Cointegration and tests of present value models. Journal of political economy, 95(5), 1062-1088.
36. Raza, A., Akbar, S. & Raza, Z. (2021). "Does Greenfield-foreign direct investment inflow contribute in socioeconomic development? Empirical evidence from developing countries". Pakistan Journal of Humanities and social sciences, 9(3), 469-481. DOI: https://doi.org/10.52131/pjhss.2021.0903

37. Raza, A., Azam, K, & Tariq, M. (2020). "The Impact of Greenfield-FDI on Socio-Economic Development of Pakistan". HSE Economic Journal, 24(3): 415-433. DOI: 10.17323/1813-8691-2020-24-3-415-433

38. Raza, A., Tariq, M., & Sadiqa, B. A. (2021). "An Empirical data investigation of the Greenfield investment: Welfare nexus from low-income countries". International Journal of Innovation, Creativity and Change, 15(8), 820-835.

39. Raza, A., Iqbal, M. & Hussain, N. (2021). "Is Greenfield investment greener for the welfare of lower-middle incomecountries?Market-based empirical analysis with GMM approach". Journal of Marketing Strategies, 3(3), 194-206. DOI: https://doi.org/10.52633/jms.v3i3.111

40. Raza, A., Akbar, S., & Sadiqa, B. A. (2021) "Relationship among Economic Growth, Health, Education, Economic Development and Greenfield Investment as Mode of FDI: Evidence from MENA Countries." International Review of Social Sciences, 9(5), 271-280.