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Nexus between monetary policy shock and financial imbalance in India

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ABSTRACT

During the 1990s and early 2000s, it was a widely adopted global practice to utilize interest rates as a means to stabilize inflation and output, with the aim of addressing financial imbalances. However, the Global Financial Crisis and the recent pandemic challenged this consensus, leading to a heated debate over the appropriate role of monetary policy. This motivated us to hypothesis the nexus between monetary policy shocks and financial imbalances against the backdrop of economic policy uncertainty (EPU) in India. We have used the principal component analysis method to construct a financial index using critical financial variables. The index is further used to derive financial imbalances. The relation between financial imbalance and monetary policy shock is found to be negative and statistically significant during 2008-2012, generally marked as a period of high EPU caused by the great depression of 2008. Afterwards, the phase of moderation persists until 2019 and the arrival of recent pandemic. However, during the pandemic, the EPU has escalated and strengthened the positive relationship between financial imbalance and monetary policy. Overall, the findings of this study indicate that EPU plays a significant role in the interplay between monetary policy and financial imbalance. In terms of policy implications, our findings suggest that monetary policy is ineffective in preserving financial stability during periods of high uncertainty, and hence policymakers should focus on alternative measures.

Contribution/ Originality: This work is a contribution to the existing literature because of its novel empirical attempt to assess the nexus between financial imbalances and monetary policy against the backdrop of EPU in emerging economies like India.

1. INTRODUCTION

Financial stability is a precursor to a healthy economy. Prior to the Great Financial Crisis (GFC) of 2008, it was widely believed that monetary policy was an ineffective instrument and that tackling cumulative financial imbalances may lead to cascading effects on the economy. According to pre-crisis studies, the impact of monetary policy shocks on the stock market was found to be either negative or minimal (Bernanke & Kuttner, 2005). According to Paul (2020), before the financial crisis of 2007–2009, stock and housing price reactions to monetary policy shocks were too low. Since the GFC, opinions have altered, and financial stability has begun to gain significant traction. The conditions of the financial system can affect monetary policy's efficacy, and monetary policy itself can contribute to the accumulation of financial imbalances, which in turn can affect the likelihood and severity of future crises. A prolonged period of accommodative monetary policy significantly amplifies the likelihood of experiencing financial turmoil in the future (Grimm, Jordà, Schularick, & Taylor, 2023). A post-crisis study by Blot, Hubert, and Labondance (2018) demonstrated that expansionary monetary policies inflate asset price bubbles, whereas contractionary policies deflate them. The choice of the policy instrument also influences the outcome of expansionary monetary policy. Quantitative easing, for instance, causes asset price bubbles to expand, and interest rate reduction has a positive impact on stock price bubbles.

Literature broadly defines financial imbalance as the deviation between the desired trajectory of financial variables and their actual value. Such imbalances may arise because of many domestic or external factors. For example, capital flows, loose monetary policy, and inadequate regulation (Merrouche & Nier, 2010). From a policy perspective, it is critical to assess whether the central bank should intervene to prevent an escalation in financial imbalances. This article is an empirical attempt to address this issue. In the literature, numerous mechanisms have been found through which monetary policy has aided in the development of financial imbalances. The majority of them are operated through policy rates. A widely used monetary policy tool, namely the Taylor (1993) rule, serves as the foundation for the nexus between monetary policy rules and financial stability. According to Taylor (2007), the Federal Reserve's accommodative policy, which is characterized by low short-term interest rates, may have influenced an increase in the supply and demand for credit, particularly mortgages. This expansion, in turn, led to an increase in asset prices, particularly in the housing market. As a result, the accommodative policy stance during the period from 2001 onward is seen as a contributing factor to the accumulation of financial imbalances, specifically in terms of housing demand and asset prices. The Taylor (1993) rule has become the most popular monetary policy tool for determining the policy rate in the early 1990s and early 2000s. There was a widely held consensus that central banks should adjust interest rates solely based on the level of inflation and output. Since then, it has attracted research attention. Mishra and Dubey (2022) conducted a study to investigate the potential spillover effects associated with the implementation of an inflation-targeting monetary policy on financial stability across 64 emerging market economies. Their findings reveal significant and positive spillover effects on external capital inflows and banking sector resilience resulting from the adoption of an inflation-targeting monetary policy framework. Furthermore, their findings suggest that, on the whole, inflation targeting does not have a detrimental impact on financial stability. Fouejieu (2017) analyzed 26 emerging countries, among which 13 countries implemented inflation targeting using quarterly data from 2000 quarter 1 to 2010 quarter 4. They found that monetary policy in countries adopting inflation targeting was comparatively more susceptible to financial risks compared to non-targeting countries. Sethi and Acharya (2020) explored the association between financial instability and inflation targeting for Asian economies, using housing prices as a metric to gauge financial instability. They discovered a negative correlation between housing returns and inflation, suggesting that the implementation of inflation-targeting policies in Asian countries has had a detrimental effect on financial stability. Consequently, countries experienced a decrease in financial stability during the inflation-targeting regime.

The Taylor rule is considered significant because it has the capability to predict how the central bank will adjust the policy rate. The original form of the Taylor rule consists of a linear combination of inflation and the output gap. Several empirical works in the literature have supported this linearity (Hutchison, Sengupta, & Singh, 2010; Singh, 2010; Virmani, 2004). Due to its linear nature, the monetary authority responds equally to both inflation and the output gap, regardless of whether they are above or below the target level. Some studies augment this linear rule by incorporating additional variables, for example, exchange rates, to conduct monetary policy (Ball, 1999; Svensson, 2000; Taylor, 1998). An augmented nonlinear Taylor rule offers a more precise depiction of the decision-making patterns followed by monetary authorities in developing economies (Caporale, Helmi, Çatık, Ali, & Akdeniz, 2018). Nair and Anand (2020) employed the Generalized Method of Moments to estimate an augmented and expanded version of the Taylor rule. The findings of their analysis suggest that the inflation rate does not have a significant impact on determining the policy rate in India. In Nigeria, Ajisafe, Odejide, and Ajide (2021) found a significant impact of monetary policy changes on financial stability for the period 1986 to 2017. Their analysis revealed that the exchange rate channel emerged as the primary mechanism for transmitting the effects of monetary policy and maintaining financial stability in Nigeria.

Significant uncertainty about the state of the economy today and in the future is the backdrop for the formulation of monetary policy. This uncertainty, which has become a defining feature of today's economic landscape, requires policymakers to pay special attention to its implications. The global financial crisis of 2007-08 not only triggered but also heightened the magnitude of policy uncertainty, leading to disruptions in the global financial system. As a result, researchers have increasingly focused on examining the significance of economic policy uncertainty (EPU) on both monetary policy and financial stability. Financial stability is significantly influenced by uncertainty. Information asymmetry increases as uncertainty increases. When the Economic Policy Uncertainty (EPU) index is elevated, lenders encounter challenges in effectively discerning credit risks, resulting in a decline in lending and investment activities and ultimately leading to a contraction in overall economic activity. Through an analysis of a panel dataset comprising 894 commercial banks in 8 major European countries from 2005 to 2014, Nguyen (2021) observed a negative correlation between EPU and bank stability. In their study, Li and Zhong (2020) discovered that the spillover effects originating from US economic policy uncertainty exerted a considerable influence on China's financial conditions index. Their findings indicated that these spillover effects were the most significant external factor responsible for the decline in house prices, exchange rates, interest rates, and the stock market in China. According to Phan, Iyke, Sharma, and Affandi (2021), EPU has a statistically significant and negative influence on financial stability, and this impact is greater in nations with smaller financial systems. Uncertainty shocks have a significant negative impact on investment because they affect credit availability, leading to procyclical leverage and countercyclical credit spreads (Gilchrist, Sim, & Zakrajšek, 2014). According to Segal, Shaliastovich, and Yaron (2015), who distinguished uncertainty into two components, namely good uncertainty and poor uncertainty, they found that poor uncertainty depresses asset prices and serves as a predictor of an economic growth slowdown.

The Literature is laden with the relationship between monetary policy and financial stability, as well as the role of EPU in both financial stability and monetary policy. We found that very few or a limited number of studies explored the nexus between shocks to monetary policy and financial imbalances in light of economic policy uncertainty in emerging economies. The nexus between EPU, monetary policy shocks, and India's financial imbalance has not yet been directly tested. Therefore, we have contributed to the existing body of literature, unlike earlier works, by gauging the interdependence of monetary policy and financial imbalance in conjunction with the EPU in India. We hypothesized that the relationship between financial imbalances and monetary policy shocks was significantly affected by EPU. The remaining sections of the article are organized as follows: Section 2 describes the data and methodology used in the study. Section 3 presents the empirical results of the analysis. Finally, Section 4 offers concluding remarks based on the findings.

2. DATA AND METHODS

We have taken data for the call money rate (a proxy for interest rate), CPI inflation, the nominal effective exchange rate (NEER), and Index of industrial production (IIP), a proxy for monthly output, from the Reserve Bank of India (RBI) database. Data for the major stock index, the Stock Exchange Sensitive Index (SENSEX), is taken from the Yahoo Finance portal. The time period ranges from January 2001 to March 2022. All variables are deseasonalized using the X12 Autoregressive Integrated Moving Average (ARIMA) method.

As per standard literature, the apex bank in India, the Reserve Bank of India (RBI), reacts to both inflation and the output gap when it decides about the short-term interest rate. Further, the nominal effective exchange rate is also observed to have a significant impact on the RBI's decision-making, especially during periods of high exchange rate volatility. So the relevant augmented Taylor rule equation will be:

$$i_t = \alpha + \Upsilon i_{t-1} + \beta_1(Y_t - \overline{Y}) + \beta_2\Delta\text{CPI} + \beta_3\Delta\, NEER + \epsilon \qquad (1)$$

The output gap $(Y_t - \overline{Y})$ is estimated using the Christiano and Fitzgerald (2003) filter, which has a certain statistical advantage over the traditionally popular time series of Hodrick and Prescott (1997). The lag of interest rates is added as an explanatory variable to incorporate the inertia of central bank policy (Hutchison et al., 2010; Woodford, 2001). The Δ symbolizes the difference operator. For the exchange rate, an increase in NEER implies a decrease in the value of Indian currency vis-à-vis its major trading partners. The consumer price index (CPI) is used to measure inflation. According to Taylor's rule, the expected sign of β1, β2, and β3 is positive. It indicates that a large output gap, change in inflation, or exchange rate dynamic in the short run should induce the interest rate to rise.

Prior to the estimation of Taylor's equation, we checked the stationarity of all variables. A brief note on the unit root test is presented in section 2.1. Results from three different unit root tests are shown in Table 1.

Step 1: Upon verifying the stationarity of all variables, we estimated the augmented Taylor's rule as represented in Equation 1 and extracted the estimated error (ϵ) as policy innovation. The estimation result of the augmented Taylor equation is summarized in Table 2.

Step 2: In the second step, we have estimated a regression model to derive the financial imbalance in the Indian economy. Financial imbalance, like policy innovation, is a measure of deviation between the desired financial trajectory and the actual one. Following Filardo, Hubert, and Rungcharoenkitkul (2019), we have estimated the following regression equation to gauge financial imbalance:

$$Financial\ Index_t = a + \delta_1 financial\ cycle_t + \delta_2 Output\ growth_t + \delta_3\text{Inflation}_t + \text{v}_t \qquad (2)$$

Though the original model was a bivariate nexus between the financial index and the financial cycle, we have augmented this version in the Indian context to incorporate the influence of real variables like output and inflation on the financial condition of the economy.

In Equation 2, the dependent variable Financial Index is generated from three monthly indicators, namely, broad money, SENSEX, and exchange rate. All variables are used in a standardized form, i.e., by dividing the mean data with the corresponding variable's standard deviation. The choice of financial indicators is mainly constrained by the unavailability of monthly data in the Indian context. We applied the principal component analysis (PCA) technique to assign an appropriate weight to each variable and construct the composite index (Financial Index). A brief note on PCA is presented in Section 2.2. The major explanatory variable is the financial cycle, which is basically a cyclical component of the financial index. Trends and seasonality in the financial index are removed using the Christiano-Fitzgerald filter and the X-12 ARIMA method, respectively. The estimation result is summarized in Table 3.

Step 3: In the final step of our analysis, we have assessed the nexus between monetary policy shocks and financial imbalances. According to theory, the shock term in the Taylor rule, which indicates a higher level of policy sensitivity, would consistently have a negative impact on the financial market. This, in turn, means a greater financial imbalance. Thus, we can expect a strong positive association between policy shocks and financial imbalances. However, Baker, Bloom, and Davis (2016) discovered that the nature and intensity of this nexus depend on EPU, a monthly measure. The index is generated using information pertaining to the Indian economy's uncertainty from seven leading newspapers. It covers mainly uncertainty related to fiscal or monetary measures, legislation, state politics, etc. Recent literature on empirical economics is laden with the application of this index. The impact of EPU on financial stability and monetary policy has been assessed by many researchers (Phan et al., 2021). This is why we have empirically examined the nexus between monetary policy shocks and financial imbalances against the backdrop of EPU. We estimated a rolling regression of 24 months where the financial imbalance measure is used as a dependent variable and monetary policy uncertainty is the explanatory variable.

$$Financial\ Imbalance_t = a + b * \text{Monetary policy shock}_t + Error_t \quad (3)$$

Further, the t-statistic of coefficients of monetary policy (b) is plotted (Figure 1) against monthly EPU over the sample period. We considered the 2-t rule of thumb for considering statistically significant relationships between two variables.

2.1 Unit Root Test

Multiple tests are available to analyze whether a unit root exists in time series data. One prominent method is the Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) test, which is widely utilized to assess stationarity and identify the presence of a unit root. This test is highly valuable in comprehending the characteristics and dynamics of the data, enabling more precise time series analysis and forecasting. The general equation for the ADF test is as follows:

$$\text{ADF test: } \Delta Z_t = \gamma_0 + \gamma_1 Z_{t-1} + \delta_t + \zeta_1 \Delta Z_{t-1} + \zeta_2 \Delta Z_{t-2} + \cdots + \zeta_k \Delta Z_{t-k} + e_t \quad (4)$$

Where Z represents a time series, t denotes the linear trend, Δ represents the first difference operator, γ_0 represents a constant term, k represents the optimal lags in the response variable, and the random error term is represented by e_t. Several researchers have highlighted that the conventional ADF test may not be suitable for variables that have experienced structural changes. In particular, Zivot and Andrews (1992) provided evidence that structural changes can introduce a bias in the standard ADF test, increasing the likelihood of failing to reject the null hypothesis of a unit root. Therefore, it would be inaccurate to conclude that the variables are nonstationary solely based on the outcomes obtained from the standard ADF test. To tackle this concern, Zivot and Andrews (1992) devised a unit-root test procedure that enables the incorporation of an estimated break in the trend function as a component of the alternative hypothesis. Therefore, it seems reasonable to treat the structural break as endogenous and evaluate the level of integration using the Zivot and Andrews procedure. Therefore, in this study, in addition to the ADF test, both the Kwiatkowski, Phillips, Schmidt, and Shin (1992) test and the Zivot and Andrews (1992) test are utilized to ascertain the stationarity of the series. In the ADF and Zivot and Andrews (1992) tests, the null hypothesis assumes the existence of a unit root, whereas the KPSS test takes the opposite position and considers it the alternative hypothesis.

2.2. Principal Component Analysis

PCA is employed to form financial indices by incorporating measures of financial development that effectively capture the potential high correlations among the various measures. Despite reducing the dimensionality of the data, the main objective of PCA is to retain all the variation present within it. This is accomplished by transforming the data into a set of new variables called principal components, which are uncorrelated with one another. The first principal component of the original variables contains the most significant amount of variation. The second principal component captures the greatest amount of variability that the first component does not explain, and this pattern holds for subsequent components. Essentially, each principal component can be seen as a weighted average of the underlying variables. To construct an aggregate financial index, PCA has been utilized on broad money, a SENSEX, and exchange rate indices. In this study, the first principal component has been chosen as the index for measuring financial development. The decision to retain the first principal component is based on its ability to capture the highest amount of variation within the data, making it an appropriate choice for analysis.

Table 1. Unit root tests.

Variables	ADF test statistic	KPSS test	Zivot andrews test
Output gap (y_t-$\bar{y}$)	-28.38**	0.14	-26.19**
Interest rate (i_t)	-3.99*	0.22	-4.94*
Inflation (ΔCPI)	-3.31*	0.28	-93*
Exchange rate fluctuation(Δ NEER)	-4.00**	0.12	-4.99*

Note: * and ** symbolize statistical significane at 5% and 10% level of significance resectively.

3. RESULTS

It is evident from all three tests that all variables are stationary (Table 1). ADF and Zivot-Andrews tests posit non-stationarity as the null hypothesis, whereas Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) have the same assertion as an alternative hypothesis.

Table 2. Augmented taylor model.

Variables	Coefficients (Standard error)
Output gap (y_t-$\bar{y}$)	0.02(0.01)**
Lag of interest rate (i_{t-1})	0.98(0.009)**
Inflation (ΔCPI)	0.01(0.005)*
Exchange rate fluctuation (Δ NEER)	0.01(0.002)**

Note: * and ** symbolize statistical significane at 5% and 10% level of significance resectively.

Table 2 summarizes the estimation result of the augmented Taylor rule (Equation 1). As per theoretical expectation, all three coefficients of output gap, inflation, and exchange rate fluctuation have a positive and statistically significant impact on the interest rate. This indicates that the Reserve Bank of India has typically increased the interest rate when the output has exceeded its potential level, inflation has risen, or there has been a positive change in the nominal exchange rate, i.e., when there is a depreciation in the exchange rate. Additionally, Table 2 indicates that the interest rate has demonstrated greater persistence, meaning that there has been a higher level of inertia in monetary policy throughout the study period. The results align with the findings of Gupta and Sengupta (2016). The residual term in this model is basically a measure of the exogenous monetary policy shock, which is a deviation between intended and actual policy responses.

Similarly, following Filardo et al. (2019), we have estimated a regression model, Equation 2, to derive the financial imbalance for the Indian economy. Though the original model focused on the relationship between a financial index and the financial cycle, we have augmented the model to suit the Indian context by including the impact of real variables such as output and inflation on the financial condition of the economy. The residual term in this augmented model serves as a measure of financial imbalance, which is a deviation between the desired financial trajectory and the actual one. Table 3 presents the estimated result of Equation 2.

Table 3. Financial imbalance model estimation result.

Variables	Coefficients (Standard error)
Financial cylce	0.912 (0.166)**
Output growth	-0.018 (0.006)**
Inflation	-0.112(0.027)**
Constant	0.804 (0.388)*

Note: * and ** symbolize statistical significane at 5% and 10% level of significance resectively.

In our final step, we have examined the relationship between monetary policy shocks and financial imbalances in the presence of economic policy uncertainty (EPU). To do so, we conducted a rolling regression over a 24-month period, using the financial imbalance measure as the dependent variable and the monetary policy shock as the explanatory variable (Equation 3). Additionally, we plotted the t-statistic of the coefficients of monetary policy (b) against the monthly EPU throughout the sample period (Figure 1). We applied the 2-t rule of thumb to determine the statistical significance of the relationship between these two variables.

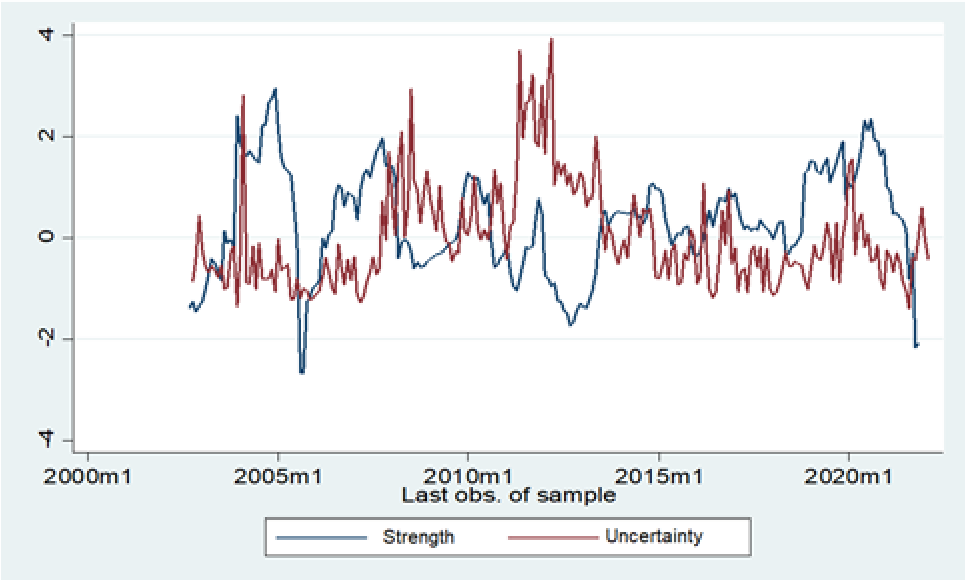

Figure 1. Plot of strength of financial imbalance and monetary policy against uncertainty.

The plot Figure 1 is very revealing. The relationship between financial imbalance and monetary policy shock is found to be negative and statistically significant during 2008-2012, generally marked as a period of great economic policy uncertainty caused by the great depression of 2008. The financial crisis had triggered widespread mistrust in the financial system, which was aggravating due to its global spread. Central banks across developed and emerging economies adopted remedial measures to contain the distress. The imbalance in the financial market and that in monetary policy were moving in the opposite direction. Theory suggests that a higher degree of policy sensitivity, represented by the shock term in the Taylor rule, is expected to have a consistently negative effect on the financial market, leading to increased financial imbalances (Fouejieu, 2017; Grimm et al., 2023). Consequently, we can anticipate a strong positive association between policy shocks and financial imbalances. However, our findings deviate somewhat from the existing literature, suggesting that in the presence of significant uncertainty, the nexus between financial imbalances and shocks to monetary policy alters. Post-2012, there was a drastic fall in EPU in India, especially owing to the revival of growth and a stable government, etc. This phase of moderation persists until 2019, before the arrival of COVID-19. It is evident from the graph that the relationship between financial market imbalance and monetary policy uncertainty remains subdued during this phase. However, during the pandemic, the EPU has escalated, and the strength of the positive relationship between financial imbalance and monetary policy shock has also increased. Intuitively, it makes sense, since the financial market was responding strongly to the pandemic and the policies put in place by India's monetary authority to limit the damage COVID-19 was doing to the economy.

4. CONCLUDING REMARKS

In this paper, our analysis emphasizes the significance of monetary policy shocks for financial imbalances against the backdrop of the EPU in India from January 2001 to March 2022. We estimated the augmented Taylor's rule and extracted the estimated error to measure exogenous policy shock. We applied the principal component analysis (PCA) technique to vital financial variables to construct the financial index. The financial index is regressed on the financial cycle, output growth, and inflation. The residual term is used as a proxy to measure the financial imbalance in the Indian economy. In the final step, we estimated a rolling regression, where a financial imbalance is used as a dependent variable and monetary policy uncertainty is the explanatory variable. Further, the t-statistic of coefficients of monetary policy shocks is plotted against EPU over the sample period. The Great Recession of 2008, which is typically characterized as a period of substantial economic policy uncertainty, was found to have a negative and statistically significant relationship between financial imbalances and monetary policy shocks from 2008 to 2012. Post-2012, EPU in India dropped significantly, and this trend persisted till 2019. We found that, during this phase, the relationship between monetary policy uncertainty and financial market imbalance remained moderate. The intensity of the positive relationship between financial imbalances and monetary policy shocks has also gone up significantly with the emergence of the COVID-19 pandemic. Our empirical results indicate that EPU plays a significant role in the nexus between monetary policy and financial imbalance.

In terms of policy implications, our findings suggest that monetary policy is ineffective in preserving financial stability during times of high uncertainty, so policymakers should react accordingly. In a time of low uncertainty, monetary tightening will be helpful for enhancing financial stability. The presence of financial instability introduces uncertainties and impedes the effectiveness of monetary policies. Consequently, policymakers should not perceive financial stability as a standalone objective, but rather as a necessary condition for the successful attainment of stability in inflation and output. Hence, we suggest that policymakers need to prioritize both financial stability and price stability as mutually reinforcing objectives. This is because fluctuations in financial markets and price instability have significant impacts on the real economy. By considering these two objectives together, policymakers can better mitigate the adverse effects of financial market booms and busts, ensuring a more stable and resilient economic environment. Due to the lack of accessible data on economic policy uncertainty, our study is constrained to a specific duration. Furthermore, due to limitations in data availability, we were unable to investigate the relationship between other macro-finance prudential. The investigation opens up a viable area for future study, where it can be extended to include other emerging economies.

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