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## How do the financial markets respond to emerging economies' asset purchase program? Evidence from the Covid-19 crisis

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## **ADBI Working Paper Series**

### **HOW DO THE FINANCIAL MARKETS RESPOND TO EMERGING ECONOMIES' ASSET PURCHASE PROGRAM? EVIDENCE FROM THE COVID-19 CRISIS**

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**Abstract**

This study examines the impacts of unconventional monetary policy on the exchange rate, stock market, and bond market during the COVID-19 economic crisis in an emerging economy. It focuses particularly on the asset purchase program conducted by the Central Bank of India. The Central Bank announced an asset purchase program four times during the pandemic. By applying the EGARCH methodology, this study finds that: (1) the asset purchase program effectively reduced the yield rate in the bond market and its volatility; (2) the first two announcements did not exert any impact on the financial market, but the third and fourth announcements helped to compress the yield and its volatility; (3) the program helped to restrain the exchange rate depreciation and volatility in the foreign exchange market; and (4) the impact of the announcements on stock returns, however, was weak.

**Keywords:** unconventional monetary policy, bond market, exchange rate, stock market, EGARCH

**JEL Classification:** E44, E52, E58, E65

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# 1. INTRODUCTION

Unconventional monetary policies are frequently used by advanced economies for macroeconomic stabilization, especially since the global financial crisis of 2008–9. Due to the low interest rate prevailing in these economies, the traditional monetary policy tools, such as altering the domestic interest rate, have proved to be less effective in tackling the financial crisis, providing the required liquidity, and fighting disinflation (Evgenidis and Papadamou 2020). Thus, the central banks of these economies have resorted to unconventional tools, such as asset purchase programs (APPs), negative interest rate policies, extended lending or term funding facilities, and forward guidance. However, in recent days, the COVID-19 crisis and consequent recession have induced emerging economies to follow such unconventional policies. For instance, around 20 central banks of emerging economies engaged in asset purchase programs targeting government or private sector bonds in the local currency during the COVID-19 pandemic (Sever et al. 2021). As these policies aim to maintain the liquidity and stability in the financial system and thereby support the economic revival, it is crucial to understand their impact on various market indicators to evaluate their effectiveness. Therefore, the present paper examines the effect of central banks' asset purchase programs on the financial market of emerging economies.

The existing literature has suggested that asset purchases by central banks affect economic factors through various channels. The first channel, the portfolio rebalancing channel, indicates that the central bank's bond or debt securities purchases compress its yield and induce the sellers of these assets to rebalance their portfolios toward other assets, such as securities and loans (Hammermann et al. 2019). The available studies have suggested that the portfolio rebalancing channel plays a relevant role in transmitting central banks' asset purchases to the financial markets (Gagnon et al. 2011; D'Amico et al. 2012; Altavilla, Canova, and Ciccarelli 2015). The second is the exchange rate channel, through which asset purchases affect the exchange rate when agents rebalance their portfolios. Due to the low domestic interest rate associated with the asset purchase pressure, the demand for external assets increases, exerting pressure on the domestic exchange rate to depreciate (ECB 2015). Some studies have found evidence of the relevance of the exchange rate channel (Glick and Leduc 2013; Rogers, Scotti, and Wright 2014).

Third, through the signaling channel, the asset purchase signals the central bank's commitment to following an accommodative monetary policy for a longer period (Christensen and Rudebusch 2012; Krishnamurthy and Vissing-Jorgensen 2013; Bauer and Rudebusch 2014). Fourth, the inflation anchoring channel shows that the signals of accommodative monetary policy induce agents to expect higher inflation in the near future. Finally, the bank lending channel concerns the compression of yields due to asset purchases reducing the cost of bank lending, thus making lending a more attractive option for banks than investing in debt instruments (Gambetti and Musso 2020). Although there have been studies on the impact of unconventional monetary policies in the context of developed economies (Darracq-Paries and De Santis 2015; Evgenidis and Papadamou 2020; Gambetti and Musso 2020), the exclusive studies on the emerging economies are relatively limited. Thus, the present study examines the effect of asset purchase programs conducted by the central banks of emerging economies on domestic financial markets, such as bond, stock, and foreign exchange markets.

The study addresses the effect of the asset purchase program of the Reserve Bank of India (RBI), the central bank, on financial markets in the wake of the COVID-19

pandemic. The RBI adopted various unconventional monetary policy measures, such as extended lending/term funding, liquidity support, forward guidance, and an asset purchase program. Among these, the asset purchase program targeted the purchase of government securities from the secondary markets. More specifically, the RBI undertook special open market operations that involved simultaneously purchasing long-term securities and selling short-term securities to reduce the term premium by flattening the yield curve. These central bank actions are expected to influence the yield curve structure and thereby affect the demand for alternative assets, such as stocks and bank loans. Similarly, as the Indian economy is well integrated with the global markets, these actions of the RBI could affect the demand for global assets and subsequently influence the country's exchange rate. Therefore, analyzing the effect of asset purchase programs in the Indian context would be an ideal approach to understand the behavior of emerging markets.

The study finds that the asset purchase program was useful in reducing the yield rate and limiting exchange rate depreciation and volatility. It further discovers that the asset purchase program positively affected the stock market returns, but the effects were not statistically significant. This study contributes to the literature by evaluating the usefulness of unconventional monetary policy tools, such as asset purchase programs. It also investigates how unconventional tools can influence the various markets in the economy. The contribution to the literature is as follows. This is the first study in the case of emerging market economies for India and analyzes the impact of the RBI's asset purchase program on various financial variables during the uncertainty produced by the COVID-19 pandemic. The strand of literature to which this study belongs concerns whether the action of the central bank has an impact on financial and macro variables during uncertain times (Blinder et al. 2008; Goyal and Arora 2012; Chebbi 2019; Fratto et al. 2021).

The structure of the paper is as follows. Section 2 presents an overview of the RBI's asset purchase program. Sections 3 and 4 present the data and methodology, respectively. Section 5 discusses the findings and performs sensitivity tests. Finally, section 6 concludes the paper.

## **2. OVERVIEW OF THE RBI'S ASSET PURCHASE PROGRAM**

In the wake of the COVID-19-induced uncertainty since the middle of February 2020, stock markets across the world crashed and yield rates started to rise. The Indian economy also experienced significant capital outflows and exchange rate depreciation. To reduce the impact of these adverse events, the Reserve Bank of India adopted various conventional and unconventional monetary policy measures. The unconventional policy tools included extended lending/term funding, liquidity support, forward guidance, and asset purchase programs.<sup>1</sup> Table 1 provides an overview of the asset purchase programs conducted by the Reserve Bank of India during the COVID-19 period.<sup>2,3</sup> The first and second asset purchase programs were announced on March 18, 2020 and March 20, 2020, respectively. These programs aimed to inject liquidity into the markets by purchasing long-term government securities. Similarly, the

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<sup>1</sup> For more information regarding the various conventional and unconventional monetary policy measures taken by the Reserve Bank of India, refer to the RBI working paper by Talwar, Kushawaha, and Bhattacharyya (2021).

<sup>2</sup> For more information about the RBI's asset purchase programs, see Appendix Table 1.

<sup>3</sup> See further the BIS working paper by Cantú et al. (2021) for other unconventional policy measures.

third program was announced on April 23. Finally, on October 9, 2020, the government purchased state government development loans. These measures' main intention was to lower the term premium and reduce the steepness of the government securities' yield curve, thereby increasing the transmission of monetary policy to the real sector (Talwar, Kushawaha, and Bhattacharyya 2021).

**Table 1: The RBI's Asset Purchase Program during the COVID-19 Pandemic**

No. of Event	Date	Size of Asset Purchase	Types of Security Purchase	Interest Rate Cut
1	Wednesday March 18, 2020	Rupees 10,000 crores	Purchase of govt securities	No
2	Friday March 20, 2020	Rupees 30,000 crores	Purchase of govt securities	No
3	Thursday April 23, 2020	Rupees 10,000 crores	Purchase and sale of govt securities	No
4	Friday October 9, 2020	Unspecified amount	Purchase of state development loan securities	No

Source: BIS.

Table 2 shows the cursory effects of the asset purchase programs on the day of the announcement and the next 2 working days of the 10-year government securities' yield rates, stock returns, and exchange rate. It can be observed from the table that the first announcement, on March 18, 2020, did not have much impact on the markets on the next day. For the second announcement, on March 20, the table shows a decline in the yield rate on the next day, and the stock market improved on the same day. Meanwhile, in the cases of the third and fourth announcements on April 23 and October 9, the bond yield declined slightly. This evidence indicates that asset purchases helped to flatten the yield curve and provide liquidity in the market. These findings confirmed those of Fratto et al. (2021), who found that asset purchases have a slight impact on bond yields at medium- and long-term maturities in the case of India. However, the clear impact can be captured through the appropriate econometric estimation; in the next part, this estimation is performed.

**Table 2: Announcement Effect on Yield Rates, Stock Returns, and Exchange Rates**

Announcement of Asset Purchase	Days	Yield Rates (Govt 10-Year Securities)	Stock Returns (NSE-Nifty-50)	Exchange Rate (Nominal INR–USD Rate)
March 18, 2020	1-Day	6.710	–2.482	74.173
	2-Day	6.740	–1.066	75.058
	3-Day	–	–	–
March 20, 2020	1-day	6.790	2.420	75.006
	2-Day	6.640	–6.03	75.881
	3-Day	6.620	1.075	76.152
April, 25, 2020	1-Day	6.410	0.594	76.064
	2-Day	6.430	–0.750	76.417
	3-Day	6.370	0.602	76.127
October 9, 2020	1-Day	6.130	0.654	73.354
	2-Day	6.120	0.057	73.474
	3-Day	6.130	–0.092	73.383

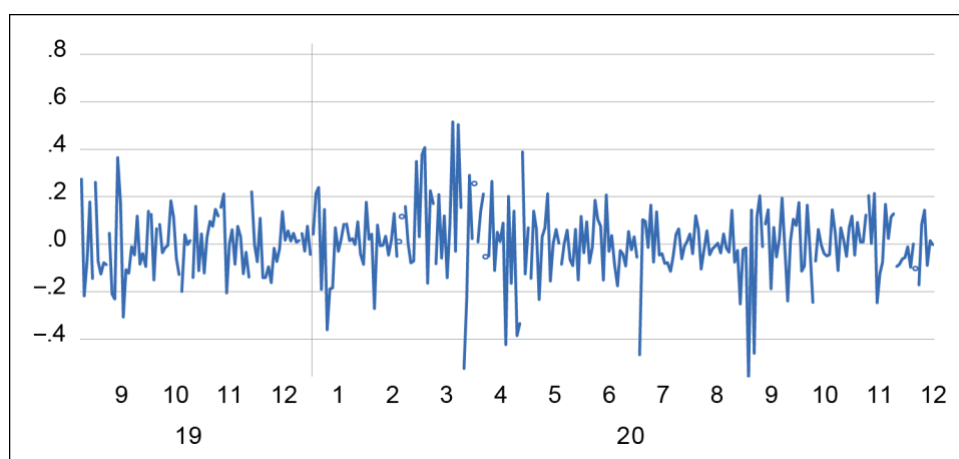
Note: 1-Day window represent the same day of the announcement, 2-Day and 3-Day represent the next working day.  
Data source: CEIC.



### 3. DATA

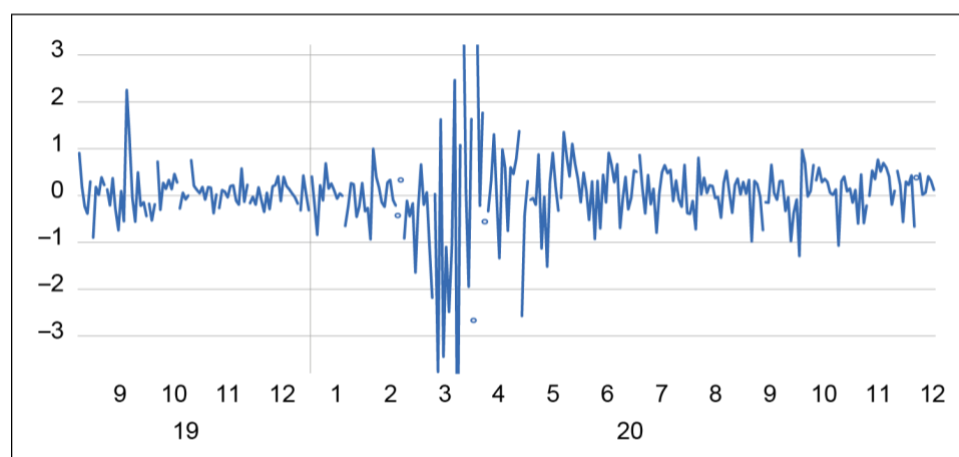
We obtain daily data from January 1, 2019 to August 13, 2021<sup>4</sup> for the analysis. The stock price data are obtained from the National Stock Exchange of India Limited and are proxied by the NIFTY-50 index. Similarly, the nominal exchange rate (*ER*) between the Indian rupee (INR) and the US dollar (USD), 10-year government securities yield rates (*YR*) as a proxy for yield rates, and policy repo rates (*PR*) are obtained from the China Economic Information Center (CEIC) database. The information related to the asset purchase programs (*APP*) of the RBI is obtained from Cantú et al. (2021). For the estimation, we select the announcement date of the asset purchase program rather than the actual implementation date. Fratzscher (2005) documented that central banks' oral interventions are more beneficial in moving the exchange rate in the expected direction than actual interventions. To control the global variables, we use the VIX index as a proxy for the volatility in the market.

**Figure 1: Exchange Rate Return (%) (Nominal INR–USD)**



Data Source: CEIC database.

**Figure 2: Stock Market Returns (%) (NIFTY-50)**

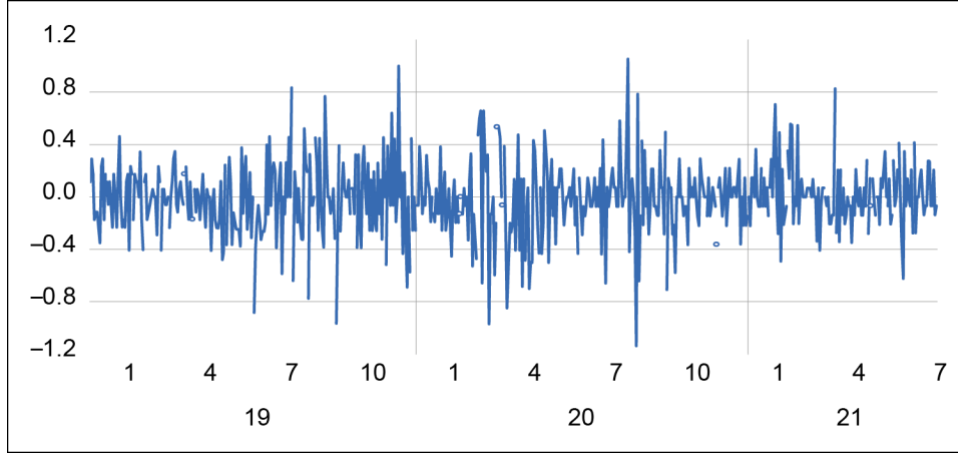


Data Source: CEIC database.

<sup>4</sup> At the time of the data collection, the latest data points available are selected. Further, sufficient data points are needed to obtain meaningful findings; therefore, we choose the stated sample period.

The return series of exchange rate returns, stock price returns, and yield rates are plotted in Figures 1, 2, and 3, respectively. All the series are found to be revolving around the mean, that is, stationary in nature and characterized by volatility clustering. These characteristics suggest modeling these variables by considering a method that takes heteroscedasticity challenges into account.

**Figure 3: Yield Rate Returns (%) (Government 10-Year Securities' Returns)**



Data Source: CEIC database.

## 4. METHODOLOGY

The autoregressive process ARCH/GARCH-type models are helpful in measuring the volatility in daily frequency data. Initially, we estimate various threshold-GARCH and exponential-GARCH (EGARCH) models by maximizing the log-likelihood through an iterative process. The best model is selected based on the AIC, the SIC, and the Q-test. We find that the EGARCH model is more suitable for our data as the selected variables have experienced heightened volatility during the COVID-19 period, and we obtain evidence of asymmetric effects. Therefore, we use the EGARCH method proposed by Nelson (1991). The basic GARCH model has coefficient restrictions, but the EGARCH is more helpful for the estimation than GARCH for two reasons. First, the volatility is not restricted, and it can react asymmetrically to good or bad news. Second, in the EGARCH model, parameters are free to move to positive or negative values (Enders 2010, 155–156). Based on the estimation, we find that the most suitable model for our estimation is AR (2) EGARCH (2, 2).<sup>5</sup> The mean and variance equations of the basic model are as follows:

$$X_t = \omega + \lambda APP_t + \phi_1 X_{t-1} + \phi_2 X_{t-2} + \epsilon_t \quad (1)$$

$$\ln(h_t) = \alpha_0 + \sum_{i=1}^2 \beta_i \left| \frac{\epsilon_{t-i}}{\sqrt{h_{t-i}}} \right| + \gamma \frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}} + \sum_{i=1}^2 \theta_i \ln(h_{t-i}) + \lambda APP_t \quad (2)$$

<sup>5</sup> The estimation is carried out in Eviews by using the Marquardt and Eviews legacy, and the EGARCH model AR (2) EGARCH (2, 2) is found to have better results and robustness than other available algorithms.

where  $X_t$  represents the dependent variable, such as the exchange rate ( $ER$ ), stock market return ( $SR$ ), and yield rate ( $YR$ ), respectively. The variable  $APP$  is an asset purchase program variable. Both the mean and the variance equation are useful in transforming the residuals and squared residuals into a white noise process; hence, it signifies that there is no autocorrelation in the data (Goyal and Arora 2012). In the mean equation, the constant term  $\omega$  gives the average rate of return of the  $ER$ ,  $SR$ , and  $YR$ , respectively. In equation (2), the EGARCH model specifies the conditional variance ( $h_t$ ) of the error term denoted by  $\epsilon_t$ . It also incorporates the constant, lagged error terms standardized with the ARCH ( $\beta_i$ ) and EGARCH ( $\gamma$ ) term, and lagged conditional variance (GARCH term). Finally, the equation includes the asset purchase program, our variable of interest. We also estimate individual  $APP$  announcements' impact on the  $ER$ ,  $SR$ , and  $YR$  in that case; rather than including only the single variable for an  $APP$ , we incorporate the individual asset purchase program announcement policy dummy. Further, as a robustness check of the model, we estimate an extended model that includes the policy rate ( $PR$ ) and the volatility index ( $VIX$ ) in both mean and variance equations in the basic model and the individual  $APP$  announcement models.

## 5. EMPIRICAL FINDINGS

Table 3 summarizes the descriptive statistics of  $ER$ ,  $SR$ ,  $YR$ ,  $PR$ , and  $VIX$ . The kurtosis is higher for  $ER$ ,  $SR$ , and  $YR$ , indicating leptokurtic distribution with higher fat tails. In addition, the Jarque–Bera test rejects normality for all the variables at the 1% level. Similarly, we check the stationarity properties of the variables using the conventional unit root tests, such as the augmented Dickey–Fuller (ADF) and Phillip and Perron (PP) unit root tests, and the results are reported in Table 4. The findings suggest that all the variables are  $I(0)$  or stationary at levels except for  $ER$  and  $PR$ . The nonstationary variables are transformed into the first difference for the estimation.

### 5.1 EGARCH Empirical Findings

#### 5.1.1 Findings from the Aggregate Announcement of APPs

We report the mean and variance equations obtained from the EGARCH estimation in Tables 5 and 6, respectively.<sup>6</sup> In the event of the asset purchase announcement by the Reserve Bank of India, the coefficient of the asset purchase dummy ( $APP_t$ ) is found to have a negative effect ( $-0.185$ ) on the exchange rate, but it is not statistically significant in Table 5. Following the theory, the asset purchase is expected to depreciate the domestic currency due to the capital flight associated with the decline in the domestic interest rate. However, the present negative sign clearly indicates that the asset purchase program of the RBI does not lead to currency depreciation. This can probably be attributed to the active intervention of the RBI in the foreign exchange market by buying and selling foreign exchange swaps (see Prabheesh and Kumar 2021).<sup>7</sup>

<sup>6</sup> The EGARCH (2, 2) model is chosen based on the AIC criteria, and the results are found to be better.

<sup>7</sup> The authors document that the Reserve Bank of India's foreign reserves declined from USD485.818 billion to USD477.450 billion during the foreign exchange intervention from February 28, 2020 to May 1, 2020.

**Table 3: Summary of the Descriptive Statistics**

Variables	Mean	Maximum	Minimum	Std Dev.	Skewness	Kurtosis	Jarque–Bera
<i>ER</i>	72.558	76.808	68.366	2.089	−0.105	2.006	26.206*
<i>SR</i>	0.029	4.443	−6.038	0.661	−1.298	22.665	10,000.360*
<i>YR</i>	−0.012	1.053	−1.137	0.275	−0.047	4.593	64.716*
<i>PR</i>	4.796	6.500	4.000	0.863	0.504	1.773	64.155*
<i>VIX</i>	21.685	82.690	11.540	9.931	2.558	12.345	2,884.968*

Note: This table presents the descriptive statistics of *ER* as the exchange rate, *SR* as the stock return, *YR* as the yield rate, *PR* as the policy rate, and *VIX*. The asterisk \* indicates the 1% significance level.

Source: Author's calculation.

**Table 4: ADF and PP Unit Root Test Results**

Variable	ADF		PP	
	Level	First Difference	Level	First Difference
<i>ER</i>	−1.484 (0.541)	−24.951 (0.000)*	−1.506 (0.530)	−24.948 (0.000)*
<i>SR</i>	−28.042 (0.000)*	−19.380 (0.000)*	−27.818 (0.000)*	−115.793 (0.000)*
<i>YR</i>	−26.628 (0.000)*	−13.661 (0.000)*	−26.609 (0.000)*	−164.41 (0.000)*
<i>VIX</i>	−2.942 (0.041)**	−16.030 (0.000)*	−2.954 (0.039)**	−33.032 (0.000)*
<i>PR</i>	−1.870 (0.346)	−24.851 (0.000)*	−1.890 (0.336)	−24.855 (0.000)*

Note: This table presents the unit root results of the exchange rate (*ER*), stock return (*SR*), yield rate return (*YR*), volatility index (*VIX*), and policy rate (*PR*). The asterisks \*, \*\*, and \*\*\* indicate the significance levels of 1%, 5%, and 10%, respectively.

Source: Author's calculation.

**Table 5: Contemporaneous Effect of the RBI's Asset Purchase Program on the Exchange Rate, Stock Returns, and Yield Rate Returns in the Mean Equation**

Basic Model for the Mean Equation			
Variables	Exchange Rate ( <i>ER</i> )	Stock Return ( <i>SR</i> )	Yield Return ( <i>YR</i> )
$\phi_1$	−0.028 (−0.620)	0.040 (0.999)	−0.095 (−2.033)**
$\phi_2$	−0.034 (−0.800)	−0.001 (−0.032)	−0.012 (−0.316)
$\lambda (APP_t)$	−0.185 (−1.118)	0.200 (0.110)	−0.145 (−0.545)
$\omega$	0.003 (0.354)	0.012 (0.723)	−0.009 (−0.893)
LM	0.044 (0.956)	0.394 (0.673)	0.031 (0.969)
LB(10), std res.	7.780	11.897	6.966
LB(20), std res.	17.170	15.920	11.610
SIC	−0.058	1.409	0.250
N	608	608	608

Note: This regression is estimated using the AR (2) EGARCH (2, 2). The  $\phi_i$  represents the autoregressive term of *ER*, *SR*, and *YR*, respectively. *APP* is an asset purchase announcement, a dummy variable that takes the value 1 on the day of announcement of the purchase of government securities and 0 otherwise;  $\omega$  is a constant term. The asterisks \*, \*\*, and \*\*\* indicate the statistical significance levels of 1%, 5%, and 10%, respectively. For diagnostics, the ARCH-LM test for autocorrelation and the Ljung–Box Q-statistic of the standardized residuals at the 10th and 20th lag are shown in the table.

Source: Author's estimation.

Meanwhile, in the case of the stock return model,  $APP_t$  is found to have a positive but not statistically significant effect (0.200), indicating that the asset purchase does not have any significant effect on the stock market. However, the positive sign of  $APP_t$  can be explained through the portfolio rebalancing channel. When the RBI purchases bonds and other securities the yield of those assets is compressed, which induces the agents to rebalance their portfolios toward other assets, such as equity and corporate bonds, to compensate for the loss of income due to the low bond yield rate. Finally, in the yield rate model,  $APP_t$  is found to have a negative (−0.145) impact, but again it is not statistically significant. The negative effect indicates that the asset purchase program led to a reduction in the yield rate, which can be explained through the signaling channel. The asset purchase signals the commitment of the central bank to maintaining an accommodative monetary policy stance and under controlled inflation reduces the long-term interest rates. This indicates that the overall purchase of securities has the desired effects. It helps to reduce the long-term yield, although the effect is not statistically significant.

In the variance equations reported in Table 6, the coefficient associated with  $APP_t$  is found to have a positive effect on all the models, indicating that the unconventional monetary policy does not help to reduce the volatility in the foreign exchange, stock, and bond markets. As the asset purchase by the RBI was carried out in the midst of the pandemic-induced health and economic crisis, the panic was at a high level in economies all over the world, including India. Therefore, the announcement of the asset purchase by the RBI was not able to limit the volatility in these markets.

Further,  $\gamma$ , which captures the asymmetric effect, is found to have a negative and significant effect on the stock return model. It shows that negative news has a greater impact on the stock market than positive news. Further, the findings suggest that stock markets react more to negative news than exchange rate and bond markets as the asymmetric effect is not significant in the case of the latter markets.

**Table 6: Contemporaneous Effect of the RBI's Asset Purchase Program on the Exchange Rate, Stock Returns, and Yield Rate Returns in the Variance Equation**

Basic Model for the Variance Equation			
Variables	Exchange Rate (ER)	Stock Return (SR)	Yield Return (YR)
$\alpha_0$	−0.508 (−3.075)*	−0.140 (−2.671)**	−0.432 (−2.705)**
$\beta_1$	0.248 (3.810)*	0.013 (0.165)	0.352 (4.911)*
$\beta_2$	−0.082 (−0.758)	0.104 (1.369)	−0.055 (−0.505)
$\gamma$	0.024 (1.523)	−0.129 (−3.103)*	0.043 (1.293)
$\theta_1$	1.512 (9.849)*	1.146 (4.014)*	0.476 (1.820)***
$\theta_2$	−0.637 (−5.032)*	−0.179 (−0.652)	0.447 (1.844)***
$\lambda (APP_t)$	0.786 (2.169)**	0.574 (1.671)***	0.178 (0.309)

Note:  $\alpha_0$  represents the constant term,  $\beta_i$  is the ARCH effects,  $\gamma$  is the leverage effects,  $\theta_i$  is the GARCH effects, and  $APP_t$  is the asset purchase announcement. The asterisks \*, \*\*, and \*\*\* indicate the significance levels of 1%, 5%, and 10%, respectively.

Source: Author's estimation.

### 5.1.2 Findings from Individual APP Announcements

We examine the individual effects of each asset purchase announcement, and the results related to the mean equation are reported in Table 7. In the case of the exchange rate, the first and second asset purchase announcements ( $APP_1$  and  $APP_2$ ) do not show any significant effects. However, the third and fourth announcements ( $APP_3$  and  $APP_4$ ) have negative and statistically significant impacts. These findings show that the asset purchase announcements by the RBI helped to stabilize the exchange market and to prevent the depreciation of the Indian rupee against the US dollar in the later stage of the COVID pandemic.

**Table 7: Contemporaneous Effect of the RBI's Individual Asset Purchase Program on the Exchange Rate, Stock Returns, and Yield Rate Returns in the Mean Equation**

Basic Model for the Separate Policy Dummy for the Mean Equation			
Variables	Exchange Rate	Stock Return	Yield Return
$\phi_1$	-0.017 (-6.405)*	0.054 (1.388)	-0.082 (-1.737)***
$\phi_2$	0.002 (0.145)	-0.005 (-0.121)	0.030 (0.765)
$\lambda_1(APP_t)$	0.182 (5.543)*	-2.393 (-0.028)	0.403 (8.831)*
$\lambda_2(APP_t)$	0.008 (1.026)	2.492 (0.081)	0.328 (10.163)*
$\lambda_3(APP_t)$	-0.696 (-6.701)*	1.028 (0.073)	-0.215 (-12.086)*
$\lambda_4(APP_t)$	-0.039 (-57.292)*	0.402 (0.090)	-0.277 (-23.208)*
$\omega$	-0.045 (-151.481)*	0.013 (0.771)	-0.004 (-0.386)
LM	1.483 (0.226)	0.350 (0.703)	0.056 (0.945)
LB(10), std res.	8.653	10.889	11.560
SD(20), std res.	22.281	15.201	16.872
SIC	-0.100	1.466	0.269
N	608	608	608

Note: This regression is estimated using the AR (2) EGARCH (2, 2). The variable  $\phi_i$  represents the autoregressive term of  $ER$ ,  $SR$ , and  $YR$ , respectively.  $APP$  is the asset purchase, which is a dummy variable that takes the value 1 on the day of the announcement of the purchase of government securities and 0 otherwise. The asterisks \*, \*\*, and \*\*\* indicate the statistical significance levels of 1%, 5%, and 10%, respectively. For diagnostics, the ARCH-LM test for autocorrelation and the Ljung–Box Q-statistic of the standardized residuals at the 10th and 20th lag are shown in the table.

Source: Author's estimation.

Similarly, in the case of stock returns, first asset purchase announcement is found to have a negative impact. This highlights that the announcement of the first tranches of an asset purchase program by the RBI was not enough to mitigate the adverse impact of the COVID-19-induced economic crisis on stock returns. However,  $APP_2$ ,  $APP_3$ , and  $APP_4$  are found to exert a positive impact on stock returns in the mean equation, although the effects are not statistically significant. This indicates that the stock market reacted positively when the central bank announced the asset purchase program. The positive effect may have worked through signaling channels; that is, investors may

have expected that the central bank would follow an accommodative monetary policy in the future, which would induce more investment and corporate profit opportunities.

Finally, in the case of the yield return,  $APP_1$  and  $APP_2$  are found to have positive and significant effects. This finding suggests that the first and second announcements of asset purchases were not able to counter the prevailing risk in the market, thereby being unable to prevent the yield rate from rising. The reason could be that the announcement was made during the peak of uncertainty, and the asset purchases amounted to ₹10,000 and ₹30,000 crores, which are insignificant amounts compared with the size of the bond market. Thus, the amount proposed by the central bank was not sufficient to counter the COVID-19-induced pandemic uncertainties. However, the effects of  $APP_2$  and  $APP_3$  are negative and show a statistically significant impact on the yield return. Due to the announcement of the asset purchase, the price of the government securities increased and, in turn, the yield rate declined. Thus, the central bank was successful in flattening the long-term yield rates. The channel that is at work here is the “portfolio-rebalancing channel.” Whenever a central bank announces the purchase of bonds, it can limit the supply of assets in the markets, increase bonds’ prices, and reduce the yield rates. When the central bank purchases long-term securities in large quantities, it reduces the price risk, and hence investors will be willing to accept the lower yield rate, which will lead to a downward shift in the yield curve (IMF 2013).

**Table 8: Contemporaneous Effect of the RBI's Individual Asset Purchase Program on the Exchange Rate, Stock Returns, and Yield Rate Returns in the Variance Equation**

Basic Estimation for the Separate Policy Dummy for the Variance Equation			
Variables	Exchange Rate (ER)	Stock Return (SR)	Yield Return (YR)
$\alpha_0$	-3.121 (-2.791)**	-0.196 (-2.994)**	-3.056 (-3.071)*
$\beta_1$	0.231 (2.048)**	0.018 (0.241)	0.387 (5.047)*
$\beta_2$	0.256 (2.465)**	0.148 (2.086)**	0.165 (1.467)
$\gamma$	0.000 (0.011)	-0.177 (-3.748)*	0.005 (0.093)
$\theta_1$	-0.018 (-0.096)	0.802 (2.538)**	0.004 (0.016)
$\theta_2$	0.041 (0.205)	0.152 (0.493)	-0.012 (-0.099)
$\lambda_1(APP_t)$	-19.519 (-0.028)	-2.487 (-0.069)	-11.541 (-5.039)*
$\lambda_2(APP_t)$	-10.793 (-0.263)	3.761 (0.203)	-9.975 (-0.379)
$\lambda_3(APP_t)$	-21.901 (-0.451)	0.897 (0.255)	-20.067 (-4.700)*
$\lambda_4(APP_t)$	-22.805 (-2.7E+101)*	0.443 (0.128)	-20.479 (-2.462)**

Note:  $\alpha_0$  represents the constant term,  $\beta_i$  is the ARCH effects,  $\gamma$  is the leverage effects,  $\theta_i$  is the GARCH effects, and  $APP_i$  is the asset purchase separate policy dummy variable. The asterisks \*, \*\*, and \*\*\* indicate the significance levels of 1%, 5%, and 10%, respectively.

Source: Author's estimation.

Table 8 shows the variance equations, and it can be observed that the fourth announcement ( $APP_4$ ) has a negative and significant effect on the exchange rate variance. Similarly, in the case of yield returns, all the announcements are statistically significant, except  $AAP_2$  and carry a negative sign. These findings affirm that asset purchase announcements could contain the volatility in foreign exchange and bond markets. However, in the case of the stock market, except for  $APP_1$  (which is found to have a reduction in the variance),  $APP_2$ ,  $APP_3$ , and  $APP_4$  exhibit a positive sign, indicating that the central bank's announcement of the asset purchase was not fully able to reduce the volatility in the stock market. Finally, the coefficient of the asymmetric ( $\gamma$ ) impact for stock returns is found to be negative and statistically significant. This indicates that the stock market reacts more to negative news than to positive news.

The overall findings of our study reinforce the idea that asset purchase announcements were able to restrain the depreciation in the exchange rate and the rise in the long-term yield rate. Although the initial two announcements could not influence the exchange rate, the last two announcements were able to contain the depreciation of the exchange rate and volatility in the foreign exchange market. Similarly, the last two announcements reduced the long-term yield rate and bond market volatility. However, the impact of these announcements on the stock markets is found to be weak. Our findings are largely similar to the findings of the IMF (2013) wherein, in the case of developed economies, unconventional monetary policies could achieve domestic goals. Unconventional monetary policies were particularly effective during the greatest financial downturn.

## 5.2 Robustness Check

As a robustness check, we control the effect of macroeconomic variables, such as the policy rate ( $PR$ ) and the volatility index ( $VIX$ ), by including them in both mean and variance equations. The estimated findings are reported in Tables 9 and 10. The overall findings from Table 9 on the impact of the asset purchase program are in line with those from Table 5. However, the variable  $PR$  is found to be significant only in the case of stock returns, for which it exhibits a positive sign, contrary to the expectation. Similarly, the  $VIX$  is discovered to have a positive and significant effect on the exchange rate, indicating that the uncertainty during the period of COVID-19 led to the depreciation of the domestic currency.

Similarly, the findings from the variance equation reported in Table 10 confirm our earlier results in Table 6. The asset purchases show a negative and statistically significant effect on the stock market. The policy rate does not exert any significant effect on any of the equations. Further, the  $VIX$  has a positive and significant effect on the exchange rate and stock market, indicating that the global uncertainty increased the volatility in the foreign exchange market and the stock market during the pandemic. Finally, we include the  $VIX$  and  $PR$  along with the individual  $APP$  dummies, and the findings obtained from the EGARCH model are presented in Tables 11 and 12. The findings from both mean and variance equations further confirm our findings reported in the earlier section. In the variance equation of stock returns, it can be observed that the asset purchase program helped to reduce the volatility in the presence of the  $VIX$ , which is in contrast to the earlier findings. It suggests that controlling the presence of uncertainty helps to gauge the real effect of the asset purchase announcements. The overall findings from this section suggest that, after incorporating  $PR$  and  $VIX$ , the impact of  $APP$  does not change much. Thus, the findings reported in the earlier sections are robust.



**Table 9: Contemporaneous Effect of the RBI's Asset Purchase Program on the Exchange Rate, Stock Returns, and Yield Rate Returns in the Mean Equation**

Extended Estimated Model for the Mean Equation			
Variables	Exchange Rate (ER)	Stock Return (SR)	Yield Return (YR)
$\phi_1$	-0.020 (-0.455)	0.078 (1.713)***	-0.098 (-2.028)**
$\phi_2$	-0.033 (-0.782)	-0.065 (-1.787)***	-0.011 (-0.273)
$\lambda(APP_t)$	-0.235 (-1.426)	0.248 (0.377)	-0.133 (-0.571)
PR	0.049 (0.141)	1.121 (2.845)**	0.303 (0.873)
VIX	0.002 (1.858)***	-0.001 (-0.395)	0.000 (0.291)
$\omega$	-0.038 (-1.618)	0.064 (1.153)	-0.015 (-0.562)
LM	0.003 (0.996)	0.175 (0.838)	0.010 (0.989)
LB (10), std res.	6.578	17.316	6.735
SD (20), std res.	15.622	23.304	11.443
SIC	-0.028	1.392	0.289
N	608	608	608

Note: This regression is estimated using the AR (2) EGARCH (2, 2). The term  $\phi_i$  represents the autoregressive term of ER, SR, and YR, respectively. APP is an asset purchase dummy variable that takes the value 1 on the day of the announcement of the purchase of government securities and 0 otherwise. The asterisks \*, \*\*, and \*\*\* indicate the statistical significance levels of 1%, 5%, and 10%, respectively. For diagnostics, the ARCH-LM test for autocorrelation and the Ljung–Box Q-statistic of the standardized residuals at the 10<sup>th</sup> and 20<sup>th</sup> lag are reported in the table.

Source: Author's estimation.

**Table 10: Contemporaneous Effect of the RBI's Asset Purchase Program on the Exchange Rate, Stock Returns, and Yield Rate Returns in the Variance Equation**

Extended Estimated Model for the Variance Equation			
Variables	Exchange Rate (ER)	Stock Return (SR)	Yield Return (YR)
$\alpha_0$	-0.473 (-2.597)**	-3.756 (-4.654)*	-0.487 (-2.671)
$\beta_1$	0.233 (3.568)*	0.349 (5.589)*	0.338 (4.569)
$\beta_2$	-0.105 (-0.981)	0.054 (0.446)	-0.045 (-0.426)
$\gamma$	0.016 (1.213)	-0.149 (-2.936)***	0.044 (1.301)
$\theta_1$	1.608 (10.827)*	-0.043 (-0.248)	0.451 (1.766)***
$\theta_2$	-0.718 (-6.132)*	0.094 (0.887)	0.464 (1.981)***
$\lambda(APP_t)$	0.436 (1.112)	-1.791 (-2.007)**	-0.150 (-0.220)
i	0.509 (0.921)	4.058 (1.109)	-0.181 (-0.127)
VIX	0.001 (1.687)***	0.089 (4.511)*	0.002 (0.955)

Note:  $\alpha_0$  represents the constant term,  $\beta_i$  is the ARCH effects,  $\gamma$  is the leverage effects,  $\theta_i$  is the GARCH effects,  $APP_t$  is the asset purchase announcement dummy variable, PR is the policy rate, and VIX is the volatility index. The asterisks \*, \*\*, and \*\*\* indicate the significance levels of 1%, 5%, and 10%, respectively.

Source: Author's estimation.

**Table 11: Contemporaneous Effect of the RBI's Individual Asset Purchase Program on the Exchange Rate, Stock Returns, and Yield Returns in the Mean Equation**

Extended Model for the Separate Policy Dummies for the Mean Equation			
Variables	Exchange Rate (ER)	Stock Return (SR)	Yield Return (YR)
$\phi_1$	-0.056 (-44.795)*	0.086 (2.072)**	-0.121 (-2.437)**
$\phi_2$	0.000 (0.872)	-0.042 (-1.017)	0.012 (0.301)
$\lambda_1(APP_t)$	0.025 (14.388)*	-2.055 (-0.028)	0.466 (0.015)
$\lambda_2(APP_t)$	-0.076 (-78.173)*	5.198 (0.511)	0.316 (0.379)
$\lambda_3(APP_t)$	-0.742 (-1.3E+102)*	0.685 (0.055)	-0.208 (-2.941)*
$\lambda_4(APP_t)$	-0.048 (-60.350)*	0.326 (0.126)	-0.248 (-0.450)
$PR$	0.250 (0.923)	1.049 (1.816)***	0.264 (0.985)
$VIX$	0.002 (41.712)*	-0.008 (-2.870)**	-0.001 (-0.575)
$\omega$	-0.108 (-39.044)*	0.159 (2.984)**	0.008 (0.285)
$LM$	0.793 (0.451)	0.287 (0.749)	0.036 (0.963)
LB (10), std res.	7.617	17.306	9.055
SD (20), std res.	20.360	26.585	13.700
SIC	-0.089	1.432	0.359
N	608	608	608

Note: This regression is estimated using the AR (2) EGARCH (2, 2). The term  $\phi_i$  is autoregressive of  $ER$ ,  $SR$ , and  $YR$ , respectively.  $APP$  represents the asset purchase policy dummy; whenever the RBI announces the policy, it takes the value 1 and otherwise 0.  $PR$  is the policy rate and  $VIX$  is a volatility index. The asterisks \*, \*\*, and \*\*\* indicate statistical significance at the 1%, 5%, and 10% levels, respectively. For diagnostics, the ARCH-LM test for autocorrelation and the Ljung-Box statistics of the standardized residuals at the 10th and 20th lag are reported in the table.

Source: Author's estimation.

## 6. CONCLUSIONS

The COVID-19 pandemic and consequent financial market crash induced many emerging economies to adopt unconventional monetary policies. The RBI, the central bank of India, implemented unconventional monetary policies, such as purchasing government securities to reduce the interest rate and thereby increasing the liquidity in the financial markets. The RBI announced the asset purchase program four times to combat the crisis induced by the COVID-19 pandemic. This paper analyzes the impact of these asset purchase programs on the foreign exchange, stock, and bond markets. Using daily data and the EGARCH methodology, we find that the asset purchase program of the RBI effectively reduced the yield rate in the bond market and its volatility. Although the first two announcements (on March 18 and 20, 2020) did not affect the markets, the third and fourth announcements (on April 23 and October 9, 2020) had a significant effect, compressing the yield and its volatility. However, the impact of these announcements on the stock market was weak, and the effect was positive. At least the last announcement was able to affect the stock market

significantly. Finally, we find evidence that the asset purchase announcements helped to reduce the volatility in the foreign exchange market and curb the depreciation of the Indian rupee against the US dollar. Our empirical findings suggest that a central bank's announcement related to the asset purchase program can significantly restore confidence in domestic macroeconomic and financial variables during a period of uncertainty. Amid the heightened uncertainty and economic crisis caused by COVID-19, the RBI was able to achieve the desired domestic goal by restoring the confidence of domestic investors and foreign investors. Therefore, emerging economies' unconventional monetary policies stabilized the financial markets to a certain extent during the period of COVID-19 uncertainty.

**Table 12: Contemporaneous Effect of the RBI's Individual Asset Purchase Program on the Exchange Rate, Stock Returns, and Yield Rate Returns in the Variance Equation**

Extended Model for the Separate Policy Dummies for the Variance Equation			
Variables	Exchange Rate (ER)	Stock Return (SR)	Yield Return (YR)
$\alpha_0$	-3.182 (-2.682)**	-0.425 (-4.048)*	-2.801 (-2.541)**
$\beta_1$	0.260 (2.380)**	0.160 (2.178)**	0.359 (4.354)*
$\beta_2$	0.241 (2.159)**	-0.125 (-1.451)	0.127 (0.938)
$\gamma$	0.056 (0.770)	-0.203 (-5.616)*	-0.020 (-0.431)
$\theta_1$	-0.018 (-0.090)	0.716 (3.821)*	0.127 (0.350)
$\theta_2$	0.066 (0.339)	0.184 (1.049)	0.095 (0.755)
$\lambda_1(APP_t)$	-23.067 (-0.068)	-6.573 (-0.020)	-7.272 (-3.431)*
$\lambda_2(APP_t)$	-22.097 (-3.8E+101)*	4.233 (0.029)	-3.513 (-0.067)
$\lambda_3(APP_t)$	-22.361 (-3.820)*	-0.596 (-0.240)	-8.483 (-2.242)**
$\lambda_4(APP_t)$	-16.484 (-2.446)*	-0.993 (-0.451)	-3.388 (-0.315)
$PR$	-0.144 (-0.047)	1.425 (1.523)	0.370 (0.127)
$VIX$	0.005 (0.543)	0.012 (4.711)*	0.017 (2.004)**

Note:  $\alpha_0$  represents the constant term,  $\beta_i$  are ARCH effects,  $\gamma$  denotes leverage effects (EGARCH),  $\theta_i$  represents GARCH effects,  $APP$  is the asset purchase policy dummy variable,  $PR$  is the policy rate, and  $VIX$  is the volatility index. The asterisks \*, \*\*, and \*\*\* indicate the significance levels of 1%, 5%, and 10%, respectively.

Source: Author's estimation.

## APPENDIX

**Table 1A: Asset Purchase Description**

<b>Asset Purchase</b>	<b>Announcement Date</b>	<b>Descriptions</b>
1	March 18, 2020	The Reserve Bank decided to conduct open market operations on March 20, 2020 (Friday) in the form of the purchase of an aggregate amount of ₹10,000 crores of government securities through a multi-security auction using the multiple price method.
2	March 20, 2020	The Reserve Bank decided to conduct the purchase of government securities under open market operations (OMOs) for an aggregate amount of ₹30,000 crores in two tranches of ₹15,000 crores each in March 2020.
3	April 23, 2020	The Reserve Bank decided to conduct the simultaneous purchase and sale of government securities under open market operations (OMOs) for ₹10,000 crores each on April 27, 2020.
4	10/9/2020	To improve liquidity and facilitate efficient pricing, it was decided to conduct open market operations (OMOs) in state development loans (SDLs) as a special case during the current financial year. At present, SDLs are eligible collateral for the liquidity adjustment facility (LAF) along with T-bills, dated government securities, and oil bonds.

Source: BIS, obtained from Cantú et al. (2021).

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