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The monetary policy during shocks: an analysis of large Asian economies' response to COVID-19

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ABSTRACT

The economies all over the world that have been adversely affected by the COVID-19 pandemic have recently started to devise different strategies to mitigate its consequences. Therefore, in order to dwell deeper into the measures taken by the policy makers around the world, this paper specifically analyzes how the monetary policies have been devised, in response to COVID-19. For this purpose, this paper has taken into consideration a panel of 8 Asian economies that have been affected the most acutely by the virus, have faced multiple lockdowns, and have also experienced other economic restraints, due to this very phenomenon. In order to compare the possible monetary policy options, and their outcomes during the COVID-19 pandemic, this paper refers to the global recession shock, as a valid point of reference. In addition to this, in order to gain access to the empirical evidence, the ARDL methodology has been applied on the quarterly data from 2005Q3 to 2020Q3. The results of the study have indicated that various plans have been taken into consideration, so as to lessen the consequences of these shocks that have trickled down into the respective economies of these countries. That is to put forth that, in the incidence of global recession, the monetary authorities have resorted to a less prudent stance. Whereas, more flexibility, through a persistent decrease in the policy rate has been observed since the pandemic first hit the world. In this regard, our results imply that a successful, efficient and effective response to the economic consequences of COVID-19, would ideally entail a set of remedial policies and structural reforms.

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1. Introduction

The novel COVID-19 pandemic has not only adversely affected, but has also severely altered the very definition of normal life, all over the globe, in a mere time span of a year. After medical sciences, the most damaged sector of the countries around the

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globe happens to be their entire economy, resulting in millions of people to be rendered jobless, homeless and starved. The severe enforcement of lockdowns in some advanced countries has also influenced the economic situation of those countries, where traces of the COVID-19 infestation were meager, but were dependent, in many ways, on the others. Similarly, the policy response towards these changes in the economic environment remained mainly prudent, and the respective governments made use of their social safety nets, in order to extend aid to the working class.

Keeping these intricacies in mind, in this particular paper, our focus has primarily been on investigating how effective the monetary policies would ideally be, so as to mitigate the worsening effects of COVID-19. In this regard, it is noteworthy that the most immediate signs of spreading contagion happen to be the loss of the consumer's and investor's trust. However, the asset price deflation, and poor aggregate demand are also phenomenon that are related to this situation (Palley, 2007; Schwartz, 2009; Su, Sun, et al., 2021). Since the world experienced the financial crisis of 2008-09, the effort towards recovery, and at the same time, a general downward economic depression in different regions of the world has been hanging over the global economies (Su, Khan, Tao, et al., 2020). In this regard, the past decade has been marked by an increased sense of economic anxiety, coupled with financial market instability, fragmented multilateral structures, and reduced space for policy planning and plans (Su, Song, et al., 2021; Tao et al., 2021; Umar et al., 2020). However, as an early response to the COVID-19 Pandemic, a study by Mirza et al. (2020), Uddin et al. (2020) and Rizvi et al. (2020a, 2020b) proposed that there a unique practice of switching has been observed from the higher risk options, to the lower risk options, especially in terms of the size and the investment strategy that is being adopted and resorted to in the European Union asset markets.

Thus, this study identifies the monetary response to the pandemic, that too in selected economies that are emerging in Asia. Since we are still living in a world where the pandemic is prevalent, the primary aim of this study is to assess the economic impact of this shock. For this purpose, we require further longitudinal observations, which have to be compared to the responses that were extracted during the global recession of 2007–2009, the biggest turmoil to the global economy since the great depression (Su et al., 2020b; Su, Huang, et al., 2021). Although the fiscal stimulus, and the other measures that have been taken have mostly been prompt, but at the same time, they seem to be insufficient without prudent monetary actions put into their place. During the time period of this novel pandemic thus far, the economic slowdown has compelled the global economies to put their public and private funding initiatives for the bailout of the affected masses. In this context, monetarism provides the view that the supply of money determines the GDP level of an economy. Therefore, in this regard, bigger, more established economies have long been in a "liquidity trap" situation, in which the real interest rates have become sluggish and close to zero. The consequences of the risks involved, by increasing the money supply in the economy have thus been disproved.

In general terms, the argument that goes in favor of the concept of deficit funding by private borrowing, tends to vary greatly. In the dropdown of nominal interest rates, governments find incentives to borrow amid high debt-to-GDP ratios. This is

Table 1. COVID-19 situations in selected economies.

Country	Total Confirmed Cases (as of 28-12-2020)	Total Tests	Total Deaths	Population
China	87,003	160,000,000	4,634	1,439,323,776
India	10,237,117	169,801,749	148,329	1,386,678,800
Indonesia	727,122	7,224,452	21,703	274,945,642
Pakistan	475,085	6,619,983	9,992	222,986,166
Bangladesh	511,261	3,199,115	7,509	165,496,450
Japan	223,120	4,802,239	3,306	126,284,197
Philippines	471,526	6,679,776	9,162	110,296,613
S. Korea	58,725	4,098,181	859	51,291,035

Source: Author Calculation.

primarily because there is virtually no cost of borrowing this money, coupled with negligible inflationary pressures, in which case, as a result high debt levels can be maintained. Furthermore, in most Asian countries where the fiscal situation is generally believed and experienced to be weak, the inflationary pressure tends to pose as a big trial, thus ultimately being an obstacle in generating stimulus with ease (as sometimes perceived). Alternatively, there is a slightly different monetary policy response. The expansion of the money supply in an economy tends to lower the interest rates sufficiently for the maintenance of critical investment; this then evades the otherwise impairing effects of the rising borrowing costs and a cash crunch, at the time of the recession or any shocks that are experienced by the economy (Azzimonti, 2018; Baker et al., 2016; Su et al., 2020a).

In this paper, we have analyzed the effect of shocks to the economy, on the monetary policy, and then the economy's response to the shock-led policy in the selected 8 Asian economies that have been taken into account. These economies have been selected based on their population sizes, and the number of confirmed cases of the novel COVID-19. In this regard, Table 1 presented in the online appendix of this study, presents the relevant details. The monetary response to the current pandemic has mostly been expansionary in nature, as dictated by the central banks of these selected economies. For example, the three leading central banks, those are RBI, BB, and SBP, lowered their policy rates by 65 BPS, 125 BPS, and 500BPS, respectively, in response to the COVID-19 crisis. At some instances, these central banks also resort to the usage of open market operations (OMO), in order to push down the interest rates. Keeping these intricacies in account, this study contains a situational analysis that is based on the information available so far regarding the sample countries.

i. **Bangladesh:** In March 2020, Bangladesh Bank (BB) announced the purchase of treasury bonds and bills from other banks. As a result, the repo rate was successively cut from 6% to 4.75%, from March 2020 onwards. Furthermore, the cash reserve ratio (CRR) for the banks was reduced to 3.5% from 5%. Through this initiative, BB created several refinancing schemes which have totaled nearly US$4,475.9M, in order to facilitate the implementation of the government's stimulus packages. Also, following this, companies of foreign origin, working in Bangladesh have been able to acquire short-term working capital loans, and to regain the pace of exports, foreign factoring has also been imposed.
ii. **China:** During the pandemic, the People's Bank of China (PBC) has provided support to safeguard the financial market stability, by injecting liquidity into

the banking system and reducing the interest rate (Su, Qin, Rizvi, et al., 2020; Umar et al., 2021). For eligible SMEs and households, the PBC also eased the loan size constraints, and eased the credit support measures. Moreover, increased fiscal support for credit guarantees, flexibility in implementing asset management reform, and the easing of housing policies was also implemented as an effective measure to save the economy. The central bank also expanded the credit line of banks to private firms (RMB 350 billion), and introduced a zero-interest "funding-for-lending" scheme worth RMB 400 billion, in order to finance 40% new, "risky" loans, of the local banks. Other than that, the exchange rate flexibility has also been allowed during the pandemic. The counter-cyclical factor of adjustments, in the essential parity structure of the daily trading band, has also gradually been reduced, that too with a zero reserve requirement.

iii. **India:** Since March 2020, the Reserve Bank of India has reduced the repo and reverse repo rates by 115 and 155 basis points (bps), to 4.0 and 3.35 percent, respectively. The central bank also asked financial institutions to assess the impact of this on their asset quality, liquidity, and other parameters that came into play from the COVID-19 shock. On August 6, 2020 RBI permitted the banks to reform and classify their existing loans to "Micro, Small and Medium" Enterprises. The risk weights for these new housing loans have not been linked to the size of the loan, while they will indeed remain linked to the loan-to-value ratios. On March 16, 2020 and the previous one, with equal volume and tenor, RBI announced a second FX swap. Therefore, following these measures, the limit for the foreign portfolio investment in corporate bonds was raised to 15% of the remaining stocks.

iv. **Indonesia:** During the course of the pandemic, Bank Indonesia (BI) reduced the policy rate by 125 bps cumulatively, in February, March, June, July, and November 2020, to 3.75 percent. BI also adjusted the financial regulations, in order to ease the liquidity conditions and support the bond market stability. In addition to this, a burden-sharing scheme was introduced, in order to help finance the economic response to the pandemic. This initiative covered BI's purchases of the government bonds, with coupons at the policy rate, so as to finance the public goods spending, such as that on health and social protection. Also, in order to sustain market conditions, BI also intervened in the spot, and the domestic non-deliverable foreign exchange markets. The stimulus packages also included measures to lift import and export restrictions, so as to alleviate the supply chain disruptions caused by the outbreak of COVID-19.

v. **Japan:** The Bank of Japan announced a comprehensive set of measures, in order to maintain a smooth functioning of the financial markets. Typically, these markets provide lending support through a special, funds-supplying operation. The bank has, till date, made purchases of Japanese government securities, commercial paper, corporate bonds, and exchange-traded funds. The total size of this measure amounts to about US$838 billion. In addition to this, the Financial Services Agency has reassured banks that they can assign zero risk weights to loans that have been guaranteed under the public guarantee

schemes. As a precautionary measure though, the limit of the government guarantees for capital injections into banks, has expanded from ¥12 trillion to ¥15 trillion.

vi. **Korea:** Several measures have been taken by the Bank of Korea (BOK), in order to ensure continued accommodative monetary conditions. As one of these measures, a KRW 100 trillion financial stabilization plan (5.3% of GDP) was announced on the fiscal side. The BOK lowered the base rate from 1.25 percent to 0.5 percent on March 24, by a staggering cumulative 75 basis points. The ceiling of the Bank's Intermediate Lending Support Facility was also increased by approximately KRW 18 trillion, so as to increase the available financing for SMEs.

vii. **Pakistan:** The State Bank of Pakistan (SBP) cut the policy rate by 575 basis points to 8.0 percent, since March 17, 2020. The SBP also expanded the scope of the existing refinancing facilities, thus incentivizing businesses to avoid dismissing their workers during COVID-19. Furthermore, SBP also introduced temporary regulatory measures, in order to maintain the reliability of the banking system, and uphold economic activity. This also included binding targets for banks in order to ensure loans to construction activities, which accounted for at least 5% of the private sector portfolios by December 2021. Also, the SBP introduced further regulatory measures, so as to facilitate the import of medical equipment, and medicine related to COVID-19. The SBP also relaxed the 100% cash margin requirement for imports of certain raw materials.

viii. **Philippines**: The Bangko Sentral ng Pilipinas (BSP) reduced its policy rate by five times in 2020, from a cumulative 200 bps to 2.00 percent. The BSP also lowered the reserve requirement ratio for commercial banks by 200 bps to 12 percent during this time. In addition to this, BSP also made purchases of government securities in the secondary market, in order to support the programs countering the impacts of COVID-19. It announced a series of regulatory relief measures for the banking sector, including a temporary relaxation of requirements on the compliance reporting and penalties on the required reserves. The BSP has currently relaxed documentary and reporting rules for the FX operations.

The main policy instruments and the target variables are highlighted in Figures 1–5. As presented in the figures, the discount rate is seen to be significantly lower during the pandemic, but the same cannot be fathomed about the great recession. Moreover, the consumer prices show a higher trend during COVID-19, as compared to the producer prices, although both the variables exhibit co-movement.

2. Literature

The emphasis of this study is to investigate the impact of the pandemic, on the monetary policy, and then the subsequent policy that is based on specific markets, in light of the economic uncertainty. Therefore, this section aims to provide a concise exposure to the literature that forms the basis of our research. The literature presented in

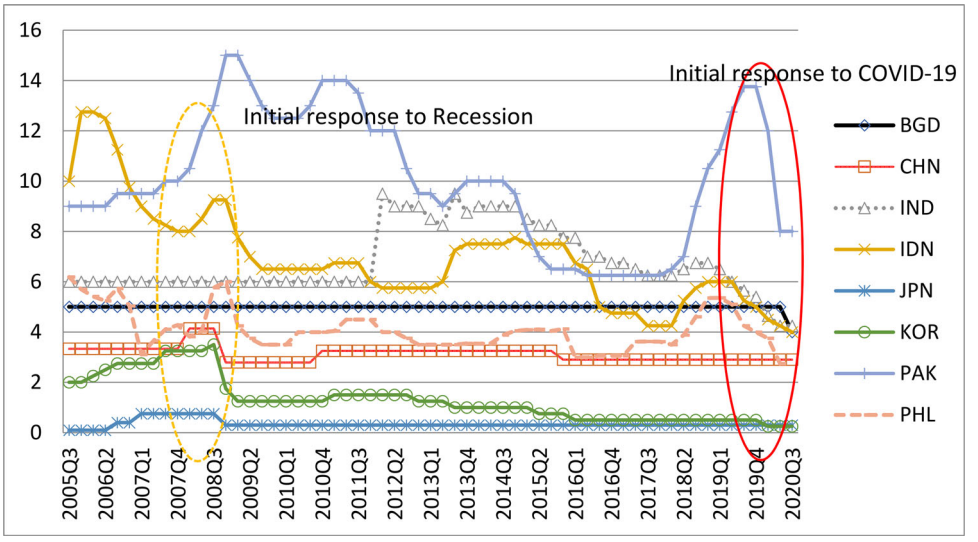

Figure 1. Discount/policy rates of selected Asian economies, %.
Source: Author Calculation.

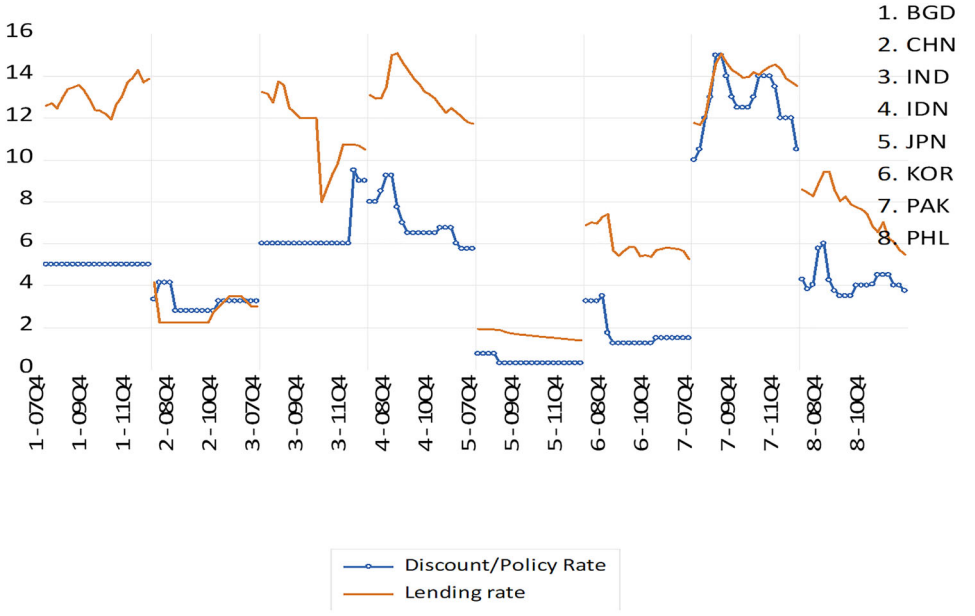

Figure 2. Interest rate based monetary response during economic recession.
Source: Author Calculation.

this section, though not exhaustive, conveys important information on three key areas of concern. These include the traditional and unconventional monetary policy, and the economic policy uncertainty.

Most of the related, existing studies concentrate on the relationship between conventional monetary policy, while the prices of goods within this literature covers

Figure 3. Interest rate based monetary policy response to pandemic.
Source: Author Calculation.

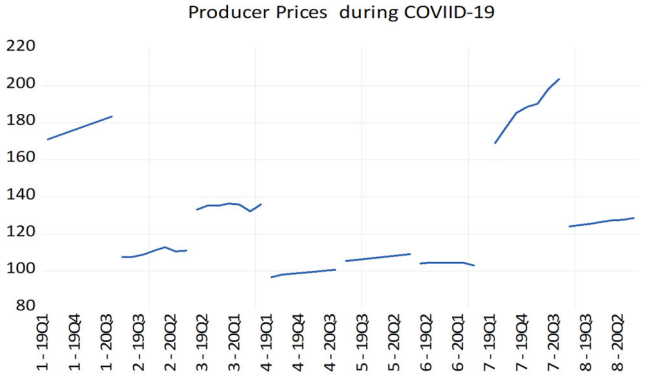

Figure 4. Prices behavior (Producer).
Source: Author Calculation.

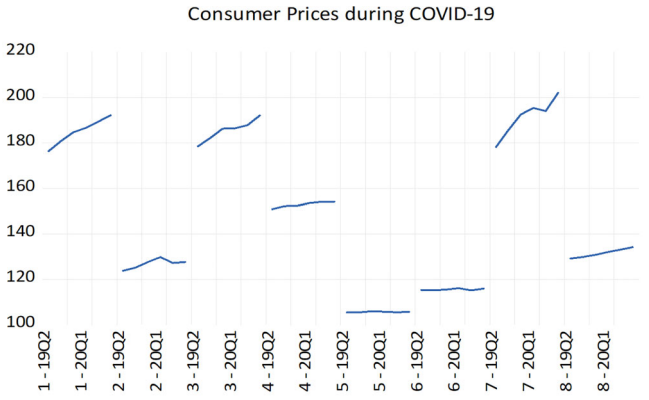

Figure 5. Prices behavior (Consumer).
Source: Author Calculation.

various markets, including those that are facing certain foreign and domestic financial situations. Since the initial study by Dornbusch (1976), many studies have applied the monetary policy channel in the context of different markets, including Frankel (1986), Barsky and Kilian (2001), Arango et al. (2008), Baker et al. (2016) and Azzimonti (2018).

These sectors typically include agriculture, food prices (Frankel, 1986), and the oil sector (Barsky & Kilian, 2001). In particular, the decline in the real interest rates is expected to lead to higher commodity prices through three main channels. These channels include (i) the supply-side channel (i.e., the declining cost of holding inventories), (ii) investors turning to futures contracts (i.e., increased demand for goods), and (iii) the increase in the demand for capital goods. In this regard, Arango et al. (2008) found that the commodities output tends to rise when the real interest rates are very low. Moreover, Mirza et al. (2020) also provided a more recent analysis of the price volatility, towards unexpected shocks to the economic environment, such as the novel COVID-19 virus and the subsequent pandemic. Other than that, Yarovaya et al. (2020) also found that the properties of Islamic equity funds are safer for investors who are aiming to hedge the pandemic risks. Furthermore, their analysis reveals an investment drift from riskier styles, to more prudent options, in response to the uncertainties underlying at each stage.

After the Great Recession, there has been an increase in the critical economic analysis that has been undertaken in the context of the policies, especially when they are operating under a period of uncertainty. In this regard, Baker et al. (2016) developed an index of the overall economic policy, under periods of uncertainty, based on the event of some essential keywords that appeared in the news reports. Several papers thus used the variables generated from publicly released FOMC documents, in order to study the FOMC communication. These primarily included Acosta (2015) and Acosta and Meade (2015). The empirical relevance of the two different transmission channels of policy include, (i) the financial frictions channel, specifying that the delay in investment is mostly due to an increase in the financing costs (see for example, e.g., Arellano et al., 2012; Christiano et al., 2014); and (ii) the 'real options' theory, that builds on the premise of permanent investment (for example Bloom, 2009). In this regard, there seems to be an indicative confirmation about the investment persistence and financial constraints that can expand the negative effect of the policy under uncertainty. This reflects the working of both types of the transmission mechanism.

As it is the focus of our paper to identify a more powerful impact of unusual monetary policies, on the prices and output, such a policy is by chance usually resorted to during economic turmoil and periods of shock to the economy. As a result, these particular efforts of the authorities that design the policies, could potentially result in the perception of greater risk by the economic agents. In this situation, studies conducted by Baker et al. (2016) and (Jurado et al., 2015) provided measures to analyze the volatility of the capital and equity markets. Estimates made by Jurado et al. (2015) show that there can be major differences in the popular uncertainty proxies, signifying that much of the variation is not in fact determined by uncertainty. Quantitatively vital, uncertain events appear more occasionally, than specified by general uncertainty proxies. However, when they do occur, they are more persistent and correlated with

real activity. These results provide a scale to estimate the theories, for which uncertainty plays an active role during the business cycles.

On the other hand, Baker et al. (2016) developed a new index of economic policy uncertainty, based on the frequency of newspaper coverage. Several types of evidences from such initiatives specify that the index tend to proxy for the movements in policy-related economic uncertainty. Thus, using the firm-level data, they found that policy uncertainty is associated with greater stock price volatility, and reduced investment and employment in policy-sensitive sectors such as defense, health care, finance, and physical infrastructure. At the macro level, policy uncertainty suggests that there might be a decline in the investment, output, and employment, specifically in a panel vector autoregressive model, for 12 countries.

On the empirical side of the recent literature, an investigation into the long and short-run relationships of monetary policy with inflation and output in Pakistan was carried out by Chaudhry et al. (2012). Similalry, at another instance, Mugume (2011) used the non-recursive VAR model, in order to estimate the monetary transmission mechanisms in Uganda, using broad money and lending rate as proxies of the monetary policy. Findings by Mugume (2011) showed that negative interest rate-based monetary shocks decreased economic growth for up to two quarters, while the M2 innovation had no statistically significant effect on the production. Since the findings of Taylor (2000) and others were explored, it has been observed that a DSGE model, based on a system of structural equations has been tested by many researchers in almost every part of the world, and mixed results for these have been presented. For reference, these studies include the works of Adolfson et al. (2007) Ahmed (2008), Negro and Schorfheide (2013), Jawaid et al. (2011), Mahmood and Shahab (2012), Smets and Wouters (2007), Svensson (2010) and Mahmood (2010). These models have been estimated with the Bayesian techniques, using some of the key macroeconomic variables that are referred to commonly. However, since the analysis of Blanchard et al. (2016) was published, the robustness of these models became questionable, particularly in terms of them allegedly simplifying the assumptions made in the solutions of these models, which seemed to be 'heavy' treatment. On the other hand, in their study, Mirza et al. (2020) found that for a moderate deterioration in the economic conditions, a tax deferral is usually sufficient. However, in the event of exacerbating business shocks, there should be a mixed approach towards the support extended, ideally through debt and equity, so as to avoid a disaster.

A strand of recent literature emphasizes on the new transmission mechanism measures, and predicts that there will be rapid responses of the economy, particularly towards monetary policy shocks. Using the same high-frequency instruments to identify monetary policy shocks, in their analysis (Alessi & Kerssenfischer, 2019) revealed that large-scale dynamic factor models find overall stronger, as well as quicker asset price reactions, as compared to a benchmarked VAR model. They further suggested that incorporating a sufficiently large information set is crucial in estimating monetary policy effects. At yet another instance, Castelnuovo and Pellegrino (2018) also evaluated a non-linear VAR model, in order to study the real effects of monetary policy shocks in regimes that have been characterized by high vs. low macroeconomic uncertainty. Unexpected monetary policy moves are usually made to exert a much

milder impact in the presence of high uncertainty. The DSGE model is found to be able to replicate the VAR evidence in both the regimes, and a steeper new-Keynesian Phillips curve is identified as the key factor behind the DSGE model's ability to replicate the minor macroeconomic responses towards monetary policy shocks that are estimated to be in high in terms of the uncertainty factor.

Moving further, Alves et al. (2020) presented the main elements of the heterogeneous-agent New Keynesian models and dwelled deeper into how these elements strengthened or reduced the response of aggregate consumption to the monetary policy shocks. Their findings suggested that the capital adjustment costs do not affect the aggregate responses, but they do change the transmission mechanism. Furthermore, Alves et al. (2020) also inferred that the fiscal reaction to a monetary policy shock tends to have a stronger effect on the aggregate consumption response.

To identify the monetary policy shocks series in the US economy, Bu et al. (2021) bridged the conventional and unconventional policymaking periods in their analysis. Their results showed that the shock series tends to be moderately correlated with the inferences drawn in the previous literature, but have some significant differences and gaps. They also presented evidence, thus confirming the hypothesis in the literature that the information effect can indeed lead to the assertion that the shocks to the monetary policy can have transmission effects. Moreover, they also provided evidence of the first-order importance to the staff at central banks, taking into consideration the quantitative theoretical modeling of the effects of monetary policy, particularly during periods of shocks.

However, in general, these models have described that monetary policy shocks drive variations in output, and also respond to inflation during recessionary periods, and other uncertain conditions. Based on the literature discussed above, we have adopted an economic model in order to capture the effect of the monetary policy in the Asian Region, during periods of uncertainty, keeping the COVID-19 pandemic as a reference point. The pandemic is such a condition that it should be analyzed and tested empirically, in order to find the objectivity factor in the monetary policies of these countries.

3. Baseline model and methodology

When taking into account the baseline model and methodology, in the most initial terms, we have introduced a structural model comprising of the following set of equations. Following this, we have used an ARDL specification, based on the reduced-form equation that has been achieved through this structural model. This model is based on the teachings and methodologies of Ball (1999), Mahmood and Shahab (2012), Shahab and Mahmood (2013), Svensson (2010), Mahmood (2010) and Taylor (2000).[1] The model also consists of the estimation of a demand function, a Phillips Curve (a proxy for Supply Function), International Parity Condition, and the Monetary Policy Response Function.

3.1. Demand curve

The goods market equilibrium of a small open economy has been represented by the demand-supply equilibrium condition for domestically produced, final goods. The domestic economic agents consume the good. These include individuals, firms, or the government. And these goods are also consumed by the foreigners. This situation is illustrated in the following function:

$$Y_t = C(Y_t^d) + I(r_t) + \bar{G} + X(E_t) - E_t.M(Y_t, E_t) \tag{1}$$

where C denotes the consumption, I represents the investment, G shows the government expenditures, X denotes the exports, while M shows the imports, and E stands for the nominal exchange rate. It is also noteworthy that C and I carry the usual textbook functions, and Equation 1 is further solved as;

$$dY_t = \frac{I_r}{A} dr_t + \frac{B}{A} dE_t \tag{2}$$

$$\begin{gathered} where \\ A = 1 - c_y + E.M_y > 0 \\ B = X_E. - E.M_E - M \end{gathered}$$

The sign denoted as A is positive, while the sign denoted as B is ambiguous in nature (Taking into account the Marshell/Lerner Condition for stability, ***B*** should ideally be >0). Following this, we have taken the log of all the variables in Equation 2 (lower case show log), and defined that $dx_t = x_t - x_{t-1}$. The final reduced form shape of the demand equation is then formulated to be:

$$\begin{gathered} y_t - y_{t-1} = \phi_1(r_t - r_{t-1}) + \phi_2(e_t - e_{t-1}) \\ where \\ \phi_1 = \frac{I_r}{A} and \phi_2 = \frac{B}{A} \end{gathered} \tag{3}$$

In order to incorporate and interpret Equation 3 into a reduced form econometric equation, we have assumed that *r* and *e* follow a random walk, and can be predicted from their own lags through the following process. Thus, the following functions can be taken into account:

$$\begin{gathered} r_t = \rho_r r_{t-1} \\ e_t = \rho_e e_{t-1} \end{gathered} \tag{4}$$

Hence, when substituting function 4 into 3, we find that;

$$y_t = -\alpha_1 r_{r-1} - \alpha_2 e_{t-1} + \alpha_3 y_{t-1} + \varepsilon_t{}^y \tag{5}$$

where $\alpha_1 = \phi_1(1 - \rho_r)$ $\alpha_2 = \phi_2(1 - \rho_e)$

While the variable α_3 denotes the autoregressive process of the output, and reduces the intensity of the autocorrelation in the errors. Moreover, the variables $\alpha_1$and α_2 are negative, since an appreciation negatively impacts the output and the interest rate, and also impedes the output growth.

3.2. Phillips curve/supply function

An open-economy Phillips curve has been deemed appropriate to represent the supply side of the economy. In this case, the inflation depends on its own lag, the lag of the output, the differenced lag of the exchange rate, and a random shock that has been plugged in. Hence, keeping these intricacies in check, we have decomposed and classified the price behavior into domestic and imported inflations. Moreover, we have also used the price and inflation terms interchangeably, albeit for discussion purposes only. Therefore, the domestic goods inflation is defined by:

$$\pi_t^d = \pi_{t-1} + \beta_1' y_{t-1} + \nu' \tag{6}$$

Here, π_t^d denotes the domestic inflation. Equation 6 is similar to the closed-economy Phillips curve, where π_t^d *it* is determined by the lagged inflation and the lagged output (Where β_1' can also be interpreted as the speed of adjustment). Furthermore, for imported inflation, we assume that foreign firms wish for consistency in the real prices, particularly in their home currencies. It also implies that their desired prices in the domestic currency are denoted by *e*. Nonetheless, they adjust the prices to the changes experienced in *e,* with a lag. Thus, similar to the domestic country firms, foreigners also adjust the prices, based on the factor of lagged inflation.

So, therefore the imported inflation is represented as:

$$\pi_t^m = \pi_{t-1} + \beta_2'(e_{t-1} - e_{t-2}) + \nu'' \tag{7}$$

Here, the function π_t^m represents the imported inflation.

Finally, aggregate inflation is the weighted average of Equations (6) and (7), where the domestic and imported goods have shares in the price index. If the import share is γ, this yields the functions $\beta_1 = (1\text{-}\ \gamma)\ \beta_1'$ and $\nu = (1\text{-}\ \beta_2')\ \nu$'. and hence,

$$\pi_t = \beta_o + \beta_1 y_{t-1} - \beta_2(e_{t-1} - e_{t-2}) + \beta_3 \pi_{t-1} + \varepsilon_t^{\pi} \tag{8}$$

3.3. International parity condition

When taking into consideration the international parity condition, we have referred to the standard textbook parity conditions for the international flow of resources. The proceeding discussion develops a link between the exchange rates and the interest rates. It captures the idea that an increase in the interest rates makes the domestic assets (domestic) more attractive for foreigners, thus leading to an appreciation. For this purpose, we have assumed that the capital is perfectly mobile, and at static points, we can set $i = i^f$. However, this does not mean that the real interest rates in

home and in the international market can be deemed as equal. The following equation of the capital stock provides us the rationale for this phenomenon. Hence, we have developed the following equation in its reduced form.

$$e_t = \theta_1 r_t + \theta_2 e_{t-1} + \varepsilon_t^e \tag{9}$$

The expected sign of θ_1 is positive in nature. Theoretically, the positive value θ_1 puts forth the idea that a rise in the interest rate makes domestic assets more attractive, leading to an appreciation.[2] Considering this in pragmatic and realistic terms, it narrates that an appreciation of the home currency will result in a depreciation of the foreign currency, which eventually raises the cost of production in that country. This then shifts the aggregate supply curve to the left, resulting in (imported) inflation. The sign θ_1 also takes us to the ambiguities that persist in the definition of real exchange rate and its multi-facet impact on the economic indicators. The shock, denoted by ε_t^e captures other influencing factors on the exchange rate. These factors include expectations, investor confidence, and the foreign interest rates.

3.4. Monetary policy reaction function

In the monetary policy reaction function, we have referred to the modified monetary policy response function as suggested by Ball (1999), Mahmood and Shahab (2012), Mahmood (2010) and Taylor (2000)

$$i_t = \psi_0 + \psi_1 \pi_t + \psi_2 y_t - \psi_3 e_t + \varepsilon_t^i \tag{10}$$

where $\boldsymbol{i}$ is the nominal interest rate, and all the other variables are as defined in the earlier equations. Hence, $\psi_0 = \acute{r} + \pi$ and $\psi_1 > 0$, $\psi_2 > 0$ and $\psi_3 < 0$.

Therefore, the model discussed in Equations (5) and (8)–(10) is modified in three ways:

i. Specific changes in the behavior of the model due to two shocks that pertain to different nature, that is, (a) the economic recession of 2008–2009 and, (b) the COVID-19 pandemic. This effect has been tested through dummy variables plugged into the equations. The response towards the pandemic has very few observations, so we have mostly relied on the descriptive and the empirical analysis.
ii. Second, the model is tested for stationarity, and there is a potential trend in some of the series that exhibit a difference in the order of integration of the series. For this, we have resorted to the ARDL approach. The nature of Equations 5 and 8–10 also reveal the autoregressive processes. Thus, we have modified the model for empirical purposes in Equations 11–14, below.
iii. We have also assumed that each equation has a control variable other than the one discussed/derived above. The selection of these indicators is based on a panel causality test (Online appendix Table A2).

3.4.1. Methodological framework

After making the desired changes, we have the final ARDL representation of the model as;

$$\Delta Y_{it} = \sum_{j=1}^{4} \alpha_{1i}\Delta Y_{i,t-j} + \sum_{k=1}^{4} \alpha_{2i}\Delta r_{i,t-k} \sum_{l=1}^{4} \alpha_{3i}\Delta e_{i,t-l} + \sum_{j1}^{4} \alpha_{4i}\Delta \mathrm{ii}_{i,t-j} + \emptyset_1 Y_{i,\ t-1} + \emptyset_2 r_{i,\ t-1} + \emptyset_3 \mathbf{e}_{i,t-1} + \emptyset_4 ii_{i,t-1} + \varepsilon_{1t} \quad (11)$$

$$\Delta P_{it} = \sum_{j=1}^{4} \beta_{1i}\Delta P_{i,t-j} + \sum_{k=1}^{4} \beta_{2i}\Delta r_{i,t-k} + \sum_{l=1}^{4} \beta_{3i}\Delta e_{i,t-l} + \sum_{j1}^{4} \beta_{4i}\Delta \mathrm{Y}_{i,t-j} + \theta_1 P_{i,\ t-1} + \theta_2 r_{i,\ t-1} + \theta_3 \mathbf{e}_{i,t-1} + \theta_4 Y_{i,t-1} + \varepsilon_{2t} \quad (12)$$

$$\Delta e_{it} = \sum_{j=1}^{4} \mathrm{Y}_{1i}\Delta e_{i,t-j} + \sum_{k=1}^{4} \mathrm{Y}_{2i}\Delta r_{i,t-k} \sum_{l=1}^{4} \mathrm{Y}_{3i}\Delta rz_{i,t-l} + \delta_1 \mathbf{e}_{i,\ t-1} + \delta_2 r_{i,\ t-1} + \delta_3 \mathrm{rz}_{i,t-1} + \varepsilon_{3t} \quad (13)$$

$$\Delta r_{it} = \sum_{j=1}^{4} \lambda_{1i}\Delta \mathrm{r}_{i,t-j} + \sum_{k=1}^{4} \lambda_{2i}\Delta P_{i,t-k} \sum_{l=1}^{4} \lambda_{3i}\Delta e_{i,t-l} + \sum_{j1}^{4} \lambda_{4i}\Delta \mathrm{Y}_{i,t-j} + \Omega_1 r_{i,\ t-1} + \Omega_2 P_{i,\ t-1} + \Omega_3 \mathbf{e}_{i,t-1} + \Omega_4 Y_{i,t-1} + \varepsilon_{4t} \quad (14)$$

Here, Y denotes the log of the industrial output, r stands for the money market rate, e represents the log of the exchange rate of domestic currencies with the dollar,[3] and P stands for the log of prices. Moreover, ii is the log of international investment, whereas rz is the log of reserves, in USD. It is noteworthy that these equations have been estimated with and without the presence of shocks. Furthermore, lags indicated in the structural model indicate an autoregressive trend, so that the system can be transformed into ARDL (Equations 11–14). Also, in order to cover the shocks, dummy variables have been used.

Data: The data has been collected from 8 Asian economies, based on the population and intensity of the COVID-19 infection rates. Table A1 in the online appendix shows the population, the total number of tests, and the COVID-19 confirmed cases for the sampled economies. These economies together comprise of 48.5% of the world's population, and 81% of Asia's. As of 29th December, 2020, the confirmed COVID-19 cases in these countries have amounted to a total of 17,305,002 (85% of Asian cases). The data for the analysis has been collected on a quarterly basis, ranging from the time period spanning from 2005Q3 to 2020Q3. The logic behind choosing this time span was to include the policy responses to the global economic recession of 2007–2009. This will put forth the analytical strength of this paper. Moreover, the data has been collected from the IFS. For observations that were missing, other sources such as the FRED have been used.

Table 2. Pairwise panel causality tests.

Lags: 2

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
MMR does not homogeneously cause II	2.17708	0.13125	0.8956
II does not homogeneously cause MMR	5.42324	4.38511	1.E-05
IPI does not homogeneously cause II	4.22508	2.81500	0.0049
II does not homogeneously cause IPI	4.21371	2.80010	0.0051
PC does not homogeneously cause II	3.43905	1.78497	0.0743
II does not homogeneously cause PC	2.81228	0.96363	0.3352
RZ does not homogeneously cause II	4.61456	3.32539	0.0009
II does not homogeneously cause RZ	4.38570	3.02549	0.0025
ER does not homogeneously cause II	2.47075	0.51608	0.6058
II does not homogeneously cause ER	4.18649	2.76443	0.0057
IPI does not homogeneously cause MMR	5.85836	4.95529	7.E-07
MMR does not homogeneously cause IPI	5.60174	4.61901	4.E-06
PC does not homogeneously cause MMR	10.9990	11.6917	0.0000
MMR does not homogeneously cause PC	2.20675	0.17013	0.8649
RZ does not homogeneously cause MMR	13.1826	14.5532	0.0000
MMR does not homogeneously cause RZ	3.97216	2.48357	0.0130
ER does not homogeneously cause MMR	6.19014	5.39007	7.E-08
MMR does not homogeneously cause ER	2.73643	0.86423	0.3875
PC does not homogeneously cause IPI	7.63222	7.27981	3.E-13
IPI does not homogeneously cause PC	4.49497	3.16868	0.0015
RZ does not homogeneously cause IPI	9.14886	9.26726	0.0000
IPI does not homogeneously cause RZ	1.39578	−0.89259	0.3721
ER does not homogeneously cause IPI	4.22192	2.81087	0.0049
IPI does not homogeneously cause ER	5.04182	3.88528	0.0001
RZ does not homogeneously cause PC	1.62897	−0.58701	0.5572
PC does not homogeneously cause RZ	4.57802	3.27751	0.0010
ER does not homogeneously cause PC	1.96123	−0.15161	0.8795
PC does not homogeneously cause ER	4.93579	3.74633	0.0002
ER does not homogeneously cause RZ	3.67663	2.09630	0.0361
RZ does not homogeneously cause ER	6.37933	5.63799	2.E-08

Source: Author Calculation.

4. Results and discussion

Before proceeding forward with the formal analysis, all the series are tested for potential trend and stationarity. The individual series exhibits different trends and order of integration. Moreover, the usual panel cointegration process was ruled out, and the estimations through the ARDL approach were preferred over other techniques. In this regard, Tables 3–6 present the results of the ARDL representations (11-14). The causality result presented in Table 2 in the online appendix indicate that international investments influence the output, exchange rates, prices, and the reserves as well. In addition to this, the changes in the interest rate causes the output and reserves to be influenced only. Also, the output causes the prices and the exchange rate to change only. The prices cause the alterations in the output reserves and the exchange rates only. Moving on further, the exchange rates cause the output, prices, reserves, and the interest rates to change. Also, the reserves cause all the variables to change, except the prices. These causality results help the model specifications and also find appropriate aggressors for each equation (although the causality does not necessitate the correlation!).

First, we analyze the policy reaction function, i.e., in the long run, whether it responds to the changes in the output, exchange rate, and prices, as the standard monetary literature predicts (see among others Azzimonti, 2018; Ball, 1999; De

Table 3. Monetary policy reaction function: Dependent variable = Interest rate.

Model	Restricted model, without shocks		Global recession		Pandemic	
Variables	Long Run	Sort Run	Long Run	Sort Run	Long run	Short Run
Output	2.11(0.50)*	2.33(1.41)**	−7.95 (2.09)*	2.727 (0.933)*	10.29 (2.39)*	−0.82(0.501)**
Ex Rate	0.65(0.22)*	1.26(1.064)	0.59 (1.02)	6.31(5.695)	18.95(4.19)*	−2.66(1.42)**
Prices	−4.86(0.73)*	8.063(5.13)**	2.49 (2.01)	5.93(7.038)	−21.66(4.79)*	2.94(3.64)
Shock Recession			6.16 (1.33)*	0.399(0.235)**		
Shock CoVID-19					−1.52 (0.62)*	0.01(0.02)
Constant		4.32 (1.99)*		3.711 (2.470)		−5.198 (2.8)**
CointEq		−0.299(0.10)*		−0.125(0.07)**		−0.209 (0.08)*
No of Obs.	456		480		160	
AIC	1.289		0.0907		1.569	
F	17.642		24.232		10.391	
Lags	4,3,3,3		1,1,1,1,1		1,1,1,1,1	

Note: *, ** indicate null hypothesis rejected at 5% and 10% level of significance respectively. In parentheses are the standard errors.
Source: Author Calculation.

Table 4. Output model: Dependent variable = Industrial production.

Model	Restricted model, without shocks		Recession (2008Q1–09Q1)		Pandemic (2019Q4–2020Q1	
Variables	Long Run	Sort Run	Long Run	Sort Run	Long run	Short Run
Interest Rate	−0.012(0.005)*	0.098 (0.061)**	−0.005(.003)**	0.084(0.05)**	−0.006 (0.003)*	0.093 (0.070)
Ex Rate	0.121 (0.048)*	−0.12 (0.074)**	0.121 (.049)*	−0.043 (0.09)	0.136(0.047)*	−0.11 (0.073)
Int'al Investment	0.179 (0.014)*	0.085(0.066)	0.181(0.013)*	0.102 (0.07)**	0.186(0.013)	0.06(0.05)
Shock Recession			−0.087(0.03)*	0.054 (0.02)*		
Shock CoVID-19					−0.126(0.039)	0.11(0.035)*
Constant		−0.051 (0.093)		−0.089 (0.08)		−0.154 (0.09)**
CointEq		−0.321 (0.105)*		−0.334 (0.10)*		−0.316(0.09)*
No of Obs.	480		480		480	
AIC	−3.167		−3.172			
F	115.035		100.63		101.27	
Lags	1,1,1		1,1,1,1		1,1,1,1	

Note: *, ** indicate null hypothesis rejected at 5% and 10% level of significance respectively. In parentheses are the standard errors.
Source: Author Calculation.

Castro & de Cos, 2008; Mahmood & Shahab, 2012; Taylor, 1993). The policymakers have assigned a significant amount of weight to the factors of output and prices. However, the magnitude of the response that is elicited towards the changes in the prices happens to be higher in the restricted model. In this sample of the economies that have been taken into consideration, the exchange rate management is achieved only in the long run, while the short-run fluctuations are not commonly included in the central bank's policy objectives. During the recession, the policy tended to put a higher weight towards the factor of output, while there was an insignificant response to the prices, and the exchange rate. However, during a pandemic situation, the weight is skewed more towards the prices, than the output. This is the distinct behavior of the policymakers towards both types of shocks, and it varies. After reviewing the relevant literature and applying the models on the data procured, we have observed a speedy reduction in the interest rates during a pandemic, while the money supply is then expands for the economy. Moreover, many bottlenecks in the process of credit to the private sector are also removed in such a situation. That is to say that, on an average rate, a 1.52% reduction in the interest rates is observed in a pandemic situation, whereas an average increase of 6% is observed when there is an

Table 5. Supply side: Dependent variable = Prices (consumer).

Model	Restricted model, without shocks		Recession (2008Q1–09Q1)		Pandemic (2019Q4–2020Q1	
Variables	Long Run	Sort Run	Long Run	Sort Run	Long run	Short Run
Output	0.978 (0.178)*	−0.052(0.022)*	0.863(0.242)*	−0.05(0.029)**	1.080(7.707)	−0.058 (0.056)
Ex rate	0.15(0.089)**	0.028 (0.024)	0.092(0.099)	0.013(0.028)	−10.551(11.33)	−0.004 (0.026)*
Interest Rate	−0.014(0.006)*	0.007 (0.002)*	−0.018(0.009)*	0.005(0.001)*	0.547(3.567)	−0.003 (0.006)
Int'al Investment	−0.094(0.04)*	−0.031 (0.023)	0.095(0.024)*	−0.019(0.01)**	−1.094(8.808)	−0.051 (0.037)
Shock Recession			0.015(0.038)	0.005(0.002)*		
Shock Covid-19		0.056 (0.024)*			−0.177(1.387)	0.007 (0.004)**
Constant				0.008 (0.007)		−0.135 (0.09)**
CointEq		−0.024(0.015)**		−0.024(0.016)**		0.002(0.0014)**
No of Obs.	480		480		168	
AIC	−6.185		−6.181		−7.067	
F	34.55		37.35		69.93	
Lags	1,1,1,1,1		4,1,1,1,1,1		1,1,1,1,1,1	

Note: *, ** indicate null hypothesis rejected at 5% and 10% level of significance respectively. In parentheses are the standard errors.
Source: Author Calculation.

Table 6. International parity condition: Dependent variable = Exchange rate.

Model	Restricted model, without shocks		Recession (2008Q1–09Q1)		Pandemic (2019Q4–2020Q1	
Variables	Long Run	Sort Run	Long Run	Sort Run	Long run	Short Run
Prices	1.175 (0.12)*	−0.32(0.19)**	0.79(0.055)*	0.23(0.118)*	1.047 (0.109)*	−0.19(0.094)*
Interest Rate	0.009(0.008)	0.102 (0.106)	−0.002(0.004)	0.048(0.048)	0.006 (0.004)**	0.11 (0.102)
Reserves	−0.42(0.09)*	−0.68 (0.212)*	−0.23(0.038)*	−0.42(0.149)*	−0.378 (0.082)*	−0.69 (0.22)*
Shock Recession			0.14(0.047)*	−0.04(0.013)*		
Shock Covid-19					0.055 (0.018)*	−0.02(0.006)*
Constant		3.67(1.341)*		1.028(0.305)		3.77 (1.37)*
CointEq		−0.32 (0.09)*		−0.135(0.039)		−0.34(0.097)*
No of Obs.	480		480		168	
AIC	−4.7738		−4.2164		−4.7585	
F	40.32		61.33		42.84	
Lags	1,1,1,1		1,1,1,1,1		1,1,1,1,1	

Note: *, ** indicate null hypothesis rejected at 5% and 10% level of significance respectively. In parentheses are the standard errors.
Source: Author Calculation.

economic recession. Thus the magnitude and direction of the responses in the case of these two shocks is observed to be entirely different. The behavior of the demand and supply forces reflect how aggregate output behaves in response to the policy shocks. In this regard, the factor of depreciation leaves the policy unchanged in the short run, while the same becomes more responsive in the longer run. Furthermore, the long-run transmission mechanism of the monetary policy towards the changes in the exchange rate alters the composition of aggregate demand as well.

The output is affected by the policy changes in both the short and long run, during times of a recession. The short-run response tends to be positive, but over the longer run, the increase in interest rates reduce the output, as the private agents keep their money in the interest-bearing venues. Findings showed that the effect of the exchange rates remain the same with and without the recessionary shock model in place. The exchange rate also affects the production dynamics, over the long run, with no evidence of any temporary influences. This primarily reflects a long-term effect on the demand, with no evidence of any transient influences. Moreover,

international investment helps boost the industrial output, particularly in a slightly recessionary situation. Thus, the foreign investment position of the Asian economies that are taken into consideration will help to increase their performance during the recession, primarily by reducing their financial shortcomings in the global market. Both the shocks pertaining to the recession and the COVID-19 pandemic drastically reduce production, and the effects of this pandemic on the output, like the recession, will be felt in the longer run as well. Thus, we can assert that all the three models converge to their long-run trend.

A positive output shock increase in the prices can be observed in all the three cases. A short-run adjustment mechanism is negative and brings in the factor of convergence. Furthermore, there is a positive response towards the exchange rate, as the depreciation increases the economy's risk through the import prices channel. Other than that, when looking at the international investment initiatives, it can be fathomed that it helps reduce the prices, or in other words, the inflation by primarily reducing the liquidity constraints in the international markets, as created by the other factors, such as exchange rates. During a situation like the spread of the COVID-19 pandemic, the long run model of the prices is statistically insignificant, primarily because the prices respond with a certain level of lag, which is not available. The short-run results indicate that if the appreciation in the current period is more than that in the previous period, then it tends to reduce the factor of inflation, as the exchange rate affects the inflation directly through the import prices.

An increase in the consumer prices also tends to increase the risk of depreciation in both the short and long run, in all three situations. During the pandemic in the countries taken into consideration, the supply shortage has led to the depreciation of domestic currencies, in terms of USD. Similarly, the long-run impact of the interest rate during the recessionary period strengthened the domestic currency, whereas the prices led to depreciation. Moreover, the level of reserves tended to play a pivotal role in managing the currencies, and also reducing the depreciation of domestic currencies in the recessionary phase.

However, it has been evident that the recession itself leads to a reduction in the value of the currency. Surprisingly, the impact of the variables in the restricted and the pandemic situations is akin, both in terms if the direction and magnitude. In this regard, the cointegration equation leads to a level of long-run stability, as well as a similar magnitude for both the restricted and the pandemic models.

Overall, these results have predicted that shocks of two different natures have different influence on the economy, although they both initially appear to be growth retarding. The policy reaction function of the central banks has, however, some additional arguments to respond to during the pandemic, as compared to that in the recessionary period. This deviation in the monetary policy decision-making is mainly due to the global restrictions imposed on traveling, as most of the trade and other business is done via online contracts and the active use of technology. Another reason for the difference in policy is the reaction of the targeted community during both these shocks. That is to say that in the recessionary period, the target tended to be mostly the big financial and business companies. While during the pandemic, it has been the general labor class and the deprived that have been the most severely

affected. In their study, (Yarovaya et al., 2020) found that a significant deterioration in the asset quality across the exposure types, institutional size, and the countries' profile take place due to harrowing situations such as the COVID-19. Moreover, in such instances, substantial increases in the probability of default are recorded, and a considerable reduction in the capital adequacy can also be observed, as also noticed across our sample.

5. Conclusions and policy implications

The world today is going through an extraordinary time, one that will be remembered for years to come. In such an instance, targeted relief packages are the only way to keep the hope alive, in order to contain some of the dire costs of keeping the economies up and running, and more importantly, in order to save precious lives. The risks extended towards financing through money are manifold, and countries that have suffered the fate of hyperinflation have often found its effects to be acute. In this analysis, we have focused on using the monetary policy for the populace economies of Asia, particularly during the pandemic. We compared the current situation with that of the global recession of 2007-2009, and found quite a distinctly varied response by the central banks in both the situations. During the recession, all the central banks were strict and resorted to the contractionary monetary policy. Whereas, in the current pandemic situation, evidence suggests that monetary policy was kept more flexible. This unconventional monetary arrangement is sometimes referred to as "helicopter money." The monetary policy is more responsive to output during the recession, and to the prices during the pandemic. Output demand therefore has usual interpretations for the interest rates and the exchange rates. Moreover, depreciation leads to a higher level of output due to the activity of the trade channels. There is an opportunity for these economies to increase exports through this channel as well. The recession and the pandemic, both have a similar impact on the output. So, in order to cover this loss, international investment, reserves, and export promotion can reduce the cost of these shocks. In addition to this, it can be observed that the prices tend to increase due to the demand and exchange rate shocks. However, these reduce when international investment positions and monetary policy instruments are taken into account. So it is now evident that for these selected Asian economies, the control over inflation can be made, but it largely depends on the cost of sterilization of the domestic economy. Both the economic recession and the pandemic tend to depreciate the domestic currencies.

With these results in mind, it is clear that if the macro-monetary factors would work simultaneously, and in the appropriate directions, the economic cost of a pandemic can be reduced, particularly in the long run, especially in the case of these economies. The careful use of the international financial position by the central banks, alongside the appropriate use of monetary and trade policies can perhaps help the fiscal side to speed up the post-crisis economic recovery. Furthermore, we have also found that the policy mix used during a global recession would not be appropriate during a pandemic, as this situation is more drastic due to its economic-cum-physical nature. Our results also imply that a successful response to the

economic consequences of COVID-19 would ideally entail a set of remedial policies and structural reforms. These would construct a robust, sustainable, and inclusive growth path in order to sustain the economy. For future research, with a few more observations, a calibrated non-linear analysis will add brevity, and help understand the further delineated impact of a pandemic on the economy.

Notes

1. Besides the theoretical underpinning of Taylor (1993), Sevensson (1997) and Ball (1999), the detailed solution of this model can be found in Mahmood (2010).
2. The demand of our bond increases due to a rise in the interest rate, resulting into an increase in the prices of our bonds, by appreciating the real value of our currency.
3. It is defined as domestic currency for one dollar. An increase reflects depreciation.

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