Nexus between inflation and fiscal deficit: a comparative study of India and China

Gurleen Kaur
Department of Economics, Sri Guru Gobind Singh College of Commerce, University of Delhi, New Delhi, India

Abstract

Purpose – The purpose of this paper is to examine the deficit–inflation nexus in the two fastest growing economies, India and China, which happen to be crucial affiliates of the global growth generator countries apart from their association in Brazil, Russia, India, China, and South Africa.

Design/methodology/approach – The paper uses the prism of the vector auto regression framework, for the period 1985–1986 to 2016–2017 for both India and China. For this purpose, gross fiscal deficit, money supply, exchange rate, crude oil prices and output gap are examined as the key elements in the determination of inflation. The econometric framework used chiefly comprises of cointegration analysis, vector error correction model, Granger causality and impulse response functions.

Findings – The findings of this paper support the hypothesis that fiscal deficits are inflationary only in the Indian context and that the Ricardian equivalence cannot be negated for China at least in the short run. The results presented in the paper are a little agnostic about whether New Keynesian Phillips Curve (NKPC) explains the inflation dynamics in India, given that both inflation inertia and output gap are not robust. However, for the Chinese economy, NKPC along with structural theory is instrumental in describing trends pertaining to inflation during the period of the study.

Practical Implications – The paper warrants broader policy framework to aim at addressing structural bottlenecks to ensure non-inflationary growth keeping in mind the structural views on inflation. Furthermore, the paper fosters greater synthesis between monetary and fiscal policies, especially considering the global economic disruptions the world economy is subject to.

Originality/value – Considering there are only a limited number of studies on fiscal deficit of China, the present paper is of paramount significance in terms of growing concern over the sustainability of the growth process in China. Additionally, the paper is first-of-its-kind attempt to account the effectiveness of a healthy monetary–fiscal interface in achieving macroeconomic stability in India and China.

Keywords Exchange rate, Fiscal deficit, Inflation, Money supply, New Keynesian Phillips curve, Output gap, Ricardian equivalence

Paper type Research paper

1. Introduction

The episode of global financial crisis (GFC) and economic disruptions like Covid-19 flag the issue of containing inflation and fiscal deficit as a prerequisite for reviving growth in emerging market economies (EMEs). Fiscal policy which is permanently expansionary is not only highly unsustainable but also often blamed for high and persistent inflation. Much of

JEL classification – C32, E31, E51 and H62

The authors would like to thank anonymous referees and the Editor of the journal for their constructive suggestions and comments. The usual disclaimer applies.

Funding: The authors did not receive any funding to complete this study.

Journal of Chinese Economic and Foreign Trade Studies
Vol. 15 No. 2, 2022
pp. 193-216

1754-4408
DOI 10.1108/JCEFTS-07-2021-0028

the prevailing literature is full of the unfriendly results of inflation irregularities but has not explored its major sources and deficit–inflation nexus in the two fastest growing economies, India and China, who happen to be crucial affiliates of the global growth generator countries [1] apart from their association in Brazil, Russia, India, China, and South Africa.

Mohanty and Klau (2001) called the steady transition of the inflation to stable levels as well as monetary policy preference for inflation targeting as the two prominent developments of the monetary sectors in EMEs during the 1990s. [2] According to them, information regarding factors determining inflation in these economies serves as a precursor for a better understanding of monetary policy in EMEs. The empirical literature also articulates the key role of fiscal dominance and exchange rate channels in forming inflation expectations in such economies. Although India adopted a flexible inflation targeting (FIT) regime no sooner than 2016, People's Bank of China (PBC) does not explicitly target inflation till date; still the issues surrounding the causes of inflation and whether such pressures stem from the fiscal side of the policymaking are pertinent considering the fundamental role that these economies play in driving the growth story of Asia.

1.1 Inflationary trends in India and China

Price stability is an important goal of the monetary policy in both India and China. Reserve Bank of India (RBI) in India has specifically moved from multiple indicator approach to FIT regime based on headline consumer price index (CPI) after the recommendations of the Expert Committee to Revise and Strengthen the Monetary Policy Framework (the Expert Committee) which submitted its report in 2014 (RBI, 2014). While China's central bank, the PBC does not explicitly target inflation; the State Council, China's primary administrative authority, does announce yearly targets for CPI along with the target of economic growth.

The inflation pattern as exhibited by CPI in both the economies is reflected in Figure 1. The trajectory of inflation throughout indicates that CPI (India) is above CPI (China) consistently after 1996–1997. The period before that saw CPI (China) touching above 15% level between 1987 and 1989 and 1993 and 1995 majorly because of the liberalisation

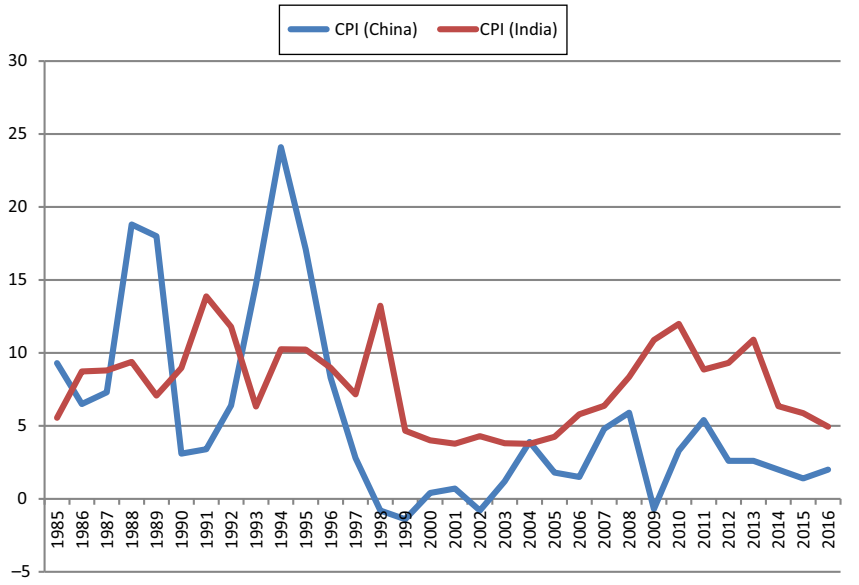


Figure 1.
Annual inflation – India and China (CPI)

reforms coupled with an expansion of the money supply. Between 1998 and 2003, China witnessed two periods of mild deflation, one in 1998–2000 and then 2001–2003. Some researchers related this deflation with growth in productivity and appreciation of the exchange rate post the Asian Financial Crisis (Ha *et al.*, 2003); others attributed it to the structural matter of the economy (Lin, 2004). Guerineau and Jeanneney (2005), however, recognised that such a pattern could be linked with lower commodity prices and WTO-related tariff cuts.

After 1998, inflation in India was somewhat condensed and surged to touch the mark of 10% after 2008 because of the ill effects of the GFC; in additon, the period from 2008 to 2013 saw inflation hovering around 8–9% on an average. Following the recommendations of the Expert Committee, inflation started easing on a more sustained basis by the second half of 2014. Sharp fall in the oil prices and a relatively stable exchange rate further aided this process. China, however, experienced a bout of deflation in 2009 caused by the GFC and the proactive stance of China's monetary policy. To sum up, inflation seems on a downward trend for India and consistently tamed for China during the past few years of our study as can be seen in Figure 1.

1.2 Trends in fiscal deficit: India and China

An important factor causing upward trends in inflation in EMEs is the vicious link between deficits and inflation. Conversely, a persistent drop in inflation can be identified with a long-term improvement in the fiscal position and a moderate monetary growth that brings actual output closer to potential. Economic reforms in China started in 1978 with a focus on invigorating state-owned enterprises, while India shuddered with a BOP crisis before embracing the reforms in 1991 oriented to liberalise, globalise and privatise the economy. China revised its more than 20-year-old budget law in 2014, which was a significant step towards the modernisation of the economies' public financial management system. In India, however, the Fiscal Responsibility and Budget Management (FRBM) Act was passed in the parliament in 2003 which gave a significant stimulus to the cause of fiscal consolidation.

China is a striking example of the importance of the broader public sector for the assessment of the fiscal position. The official data shows that China's state budget deficit has hovered at relatively low levels [2–3% of gross domestic product (GDP)] over the past 20 years, even though fiscal activity extends well beyond the official state budget. The issue of fiscal deficit assumed importance in India in the late 1980s when the fiscal deficit to GDP ratio rose to levels above 7% (Figure 2). The deficit of the Centre in India, however, has generally been on a downward trend since 1986–1987 but with a stop-go pattern. A commonality between the deficit levels of both India and China is that around 2001–2007 when growth was increasing coupled with favourable domestic conditions, fiscal policy appropriately withdrew stimulus as can been seen in the downturn of fiscal deficits level during this time. The rapid fall in fiscal deficit in India can be attributed to the timely enactment of the FRBM act which strengthened the fiscal discipline momentum. However, exceptional domestic or global pressures sway away this motive. This is observed for the years 2008–2009 and 2009–2010 when the government had to provide many incentives to the industry to help them cope up with the global recessionary scenario. Interestingly, that is when the gross fiscal deficit (as a % of GDP) in China touched about 2.5% mark as against 0.5% an year before, in India, it was around 8.3% in 2008–2009 and further rose to 9.3% in 2009–2010, indicating that the fiscal imbalance after GFC was of a similar magnitude that existed at the time of 1991 crisis. More recently, in 2016, China has unveiled a budget deficit of more than 3% of GDP, the highest level for China since 1979. Fiscal deficit in India, although non-disturbing, still remains beyond the levels prescribed by the FRBM Act.

Figure 2 entails further attention, as it points to a drastic difference in the levels of fiscal deficits in both the economies. It is worth mentioning here, that fiscal policy in China is

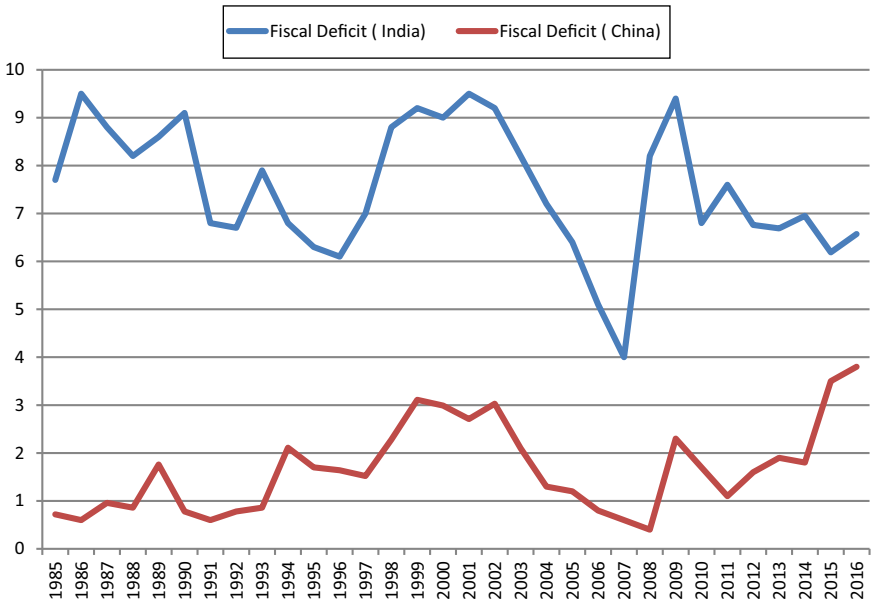


Figure 2.
Gross fiscal deficit (as a % of gross domestic product) – India and China

Source: Monthly Monetary and Financial Statistics from OECD statistics (2017) for India (Liu *et al*., 2005)

executed by a variety of central and local government agencies. Off-budget spending by local governments, however, is substantial and does not reflect the real fiscal position of the economy. Indian case, on the other hand, represents more realistic levels of fiscal deficit; nonetheless, in the absence of augmented fiscal data for the Chinese economy, we headed with the analysis for the data available as per Asian Development Bank statistics. The present study analyses India and China to develop an understanding of the dynamics of their fiscal deficit and inflation, thereby identifying major macroeconomic determinants of inflation and examining the inflationary aspects of fiscal deficit, if any.

The rest of the paper is organised as follows: Section 2 presents a brief narrative on the determinants of inflation and also offers a review of earlier empirical studies related to inflation and its sources with special emphasis on India and China. Econometric framework is outlined in Section 3, while Section 4 presents the study's empirical results with a focus on comparative analysis of inflationary effects of fiscal deficit in both the economies. Finally, the conclusions drawn from the comparative analysis are documented in Section 5.

2. Determinants of inflation: a literature-based assessment

Present-day macroeconomics relates inflation to the output gap which is defined as the deviation of output from its potential level (Romer, 2012). The New Keynesian Phillips Curve (NKPC) explains how past inflation, expected future inflation and the size of real aggregate demand (output gap) govern the current inflation rate. The Monetarists who emphasise the quantity theory of money regard inflation as a monetary phenomenon (Friedman, 1963, 1992). It arises when money supply increases faster than output. Monetarists, therefore, argue that combating inflation comes chiefly within the purview of the monetary authority. As an alternative, the fiscal

theory of price level describes the relationship between fiscal policy and inflation in its two main forms. The first version is centred on "unpleasant monetarist arithmetic", also recognised as a weak form of fiscal theory, according to which inflation rate relies on the coordination between monetary and fiscal authorities (Sargent and Wallace, 1981). In its stronger version, the fiscal theory of price level clarifies that the determination of the price level is administered merely by fiscal variables, namely, government debt, current and potential revenue and spending plans, and monetary factors play no role in price determination. The Ricardian equivalence, on the other hand, perceives deficit spending as a harbinger of neither good nor ill (Thornton, 1990). According to this standpoint, fiscal policy wields no impact on the outlook for economic growth or inflation. Structural economists, on their part, claim that, in addition to money, structural factors (supply and demand conditions) also exert an equally vital role in determining prices in the economy (Kaur, 2017). Under this view, a host of non-monetary supply-oriented factors presumably influence the price level in the economy.

The present paper follows an assorted approach, including the role of supply and demand factors to assess the inflationary experiences of India and China. For this purpose, gross fiscal deficit of the central government indicating fiscal policy of the government, M3 representing the money supply aggregate, domestic exchange rate *vis-a-vis* the US Dollar encompassing external influence on the economy, oil prices as one of the supply side factor and output gap reflecting the impact of economic activity from the demand side are examined as the key elements in the determination of inflation.

2.1 Fiscal deficit

Implications of fiscal policy for monetary policy and vice versa are significant because controlling inflation using monetary measures alone is debatable in the presence of soaring fiscal deficits and public debt (Bova and Klyviene, 2020). Empirical investigations examining the relationship between inflation and budget deficits have not reached a consensus on the possible relationship, as evidence is fraught with contradictory results. Ashra *et al.* (2004) studied annual data for India spanning from 1950–1951 to 2000–2001 and concluded that there is no rationale in targeting fiscal deficit as a tool for stabilisation. Khundrakpam and Pattanaik (2010) examined the empirical relationship between fiscal deficit and inflation over the pre-FRBM period 1953–2005 as well as the full sample period of 1953–2009. Their findings suggest that there exists a cointegrating relationship between the price level and seigniorage financing of the deficit on one hand and fiscal deficit and price level on the other. Mohanty and John (2015), using a time-varying structural vector auto regressive (SVAR) model for the period 1996–2014, found that fiscal deficit contributed significantly to inflation in India during the post-2008 crisis period. As far as China is concerned, to the best of our knowledge, there have hardly been any studies analysing the nexus between fiscal deficit and inflation.

2.2 Money supply

A one-to-one proportionality between changes in the steady-state money growth rate and the rate of inflation in the long run is commonly regarded as an explanation of inflation grounded in the quantity theory of money (Nelson, 2003). This conception is summarised in the famous statement of Milton Friedman, that inflation is always and everywhere a monetary phenomenon (Friedman, 1963; restated in Friedman, 1992). To facilitate a robust comparison between the India and China, we used broad money as proxied by M3, representing the monetary policy indicator both for India and China. Ashra *et al.* (2004) and Tiwari and Tiwari (2011) have also used M3 as indicating the growth of money stock in Indian context. Several studies on China suggest that the interest rate policies pursued by

the PBC had a marginal impact on the real economy of China (Geiger, 2006; Laurens and Maino, 2007; Fernald *et al.*, 2014). Contrastingly, the policymakers tried to control cyclical fluctuations using direct credit policies. Monetary policy studies around the same time by the PBC tend to demonstrate that the monetary authority pursued a simple money growth rule, as in the case of Burdekin and Siklos (2008).

2.3 Exchange rate

With the gradual opening up of India and China to the rest of the world, exchange rates are playing an increasingly crucial role in determining inflationary forces. According to the purchasing power parity theory, in the long run, exchange rates move in the same proportion to prices, *ceteris paribus*. The quantity theory of money, on the other hand, states that prices move in the same proportion as the money supply in the long run, *ceteris paribus*. Combining these two theories, we can derive the proposition that money, the exchange rate and prices should move proportionally in the long run (Grauwe and Grimaldi, 2001).

Some studies on domestic prices and exchange rate pass through (ERPT) in the Indian context suggest that 100 basis points (bps) change in the exchange rate impacts inflation to the tune of 10 bps (Bhattacharya *et al.*, 2008; Khundrakpam, 2008; Kapur and Behera, 2012). Jiang and Kim (2013) using monthly data from January 1999 to September 2009 studied the ERPT to domestic price levels in China based on an SVAR model. He concluded that for achieving price stability in China, exchange rate stability is a must and that the domestic production decisions are subject to changes in world commodity prices. Liu and Chen (2017) with a similar objective used monthly data from 2003 to 2012 under a VEC framework and observed that after 2005 exchange rate appreciation pulled the price levels down in China.

2.4 Oil prices

Soaring oil prices directly affect transportation costs, thereby increasing bills and prices of goods that depend on crude oil. Studies by Chinoy *et al.* (2016) used quarterly data from 2000:Q2 to 2015:Q1 and found that global oil prices explain most inflation fluctuations in India except during 2013–2014 and 2014–2015. More recently, Abu-Bakar and Masih (2018) used non-linear ARDL (NARDL) approach to examine oil pass-through to domestic inflation using a sample that spans from January 1994 to January 2018 and found that the oil price increase is associated with increase in inflation, whereas a decrease in oil prices has no significant association with inflation. Further, some studies on long-run relationship between oil prices and inflation in China suggest that an increase in oil prices exert long-term influence on domestic prices (Du *et al.*, 2010; Qianqian, 2011; and Zhao *et al.*, 2016).

2.5 Output gap

Output gap is the differences between the log of actual values of GDP and the log of potential or the target value. Potential output has been ordinarily defined as the level of output compatible with stable inflation (Okun, 1962; Mishkin, 2007). It is estimated by applying Hodrick–Prescott (HP) filter on the real GDP of India and China as obtained from the Monthly Monetary and Financial Statistics (MEI)-OECD statistics. Albeit, the evidence of Phillips curve relationship in India and China is mixed. Mohanty and John (2015) in their work on the identification of major inflation determinants in India found that output gap had an asymmetric impact on inflation with its effect dampening in the recent period. Alam and Alam (2016), in their study spanning from 1989 to 2013, also confirmed money supply, depreciation and negative output gap as major causes of inflation. Funke (2006) observed the explanatory power of lead and lag inflation on current inflation in China and found that

the significance of the output gap under the NKPC framework provides useful insights in explaining inflation dynamics in China. Huang *et al.* (2010) based on vector error correction model (VECM) and SVAR analysed both annual as well as monthly data for China and found out that excessive liquidity and the output gap are the chief factors affecting inflation.

3. Analytical framework

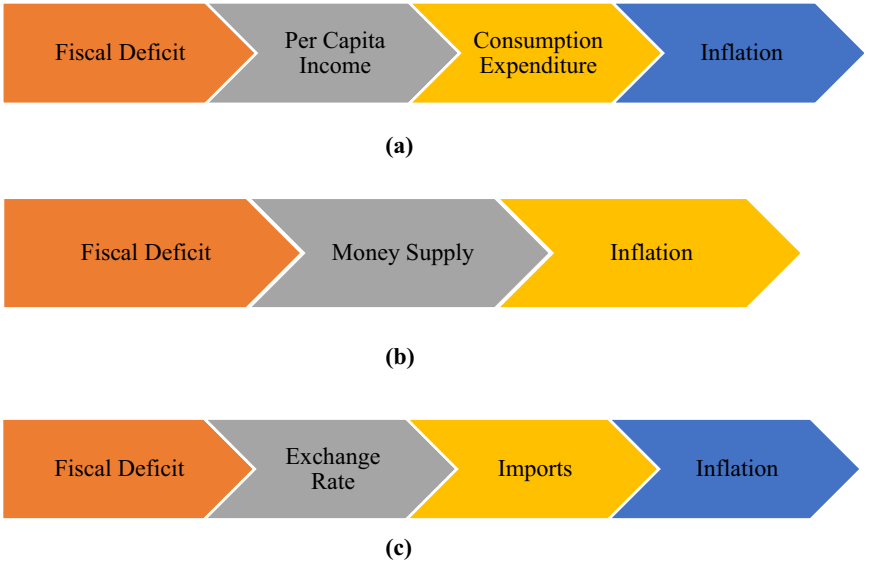
Taking into cognizance the theories of inflation and following Anantha Ramu and Gayithri (2017) and other available literature discussed in the previous section, we consider the possible transmission mechanisms sketching out the deficit–inflation nexus as presented in Figure 3. Accordingly, a six variable vector auto regression (VAR) following Gottschalk *et al.* (2008) [3] is formulated and is expressed as:

$$CPI = f(GFD, M3, ER, OIL, GDP\_GAP) \quad (1)$$

where:

CPI = inflation rate as indicated by consumer price index;
GFD = gross fiscal deficit of the central government;
M3 = money supply M3;
ER = exchange rate as depicted by the movement in the exchange rate index;
OIL = Fuel (Energy) Index; and
GDP_GAP = output gap as estimated by applying HP filter on the annual real GDP.

As equation (1) is only in an implicit form, the explicit form of the model could be expressed as the conventional log-log model for the long-run equilibrium inflation function:



Source: Author's understanding based on the literature

Figure 3. Possible transmission channels underscoring fiscal deficit–inflation linkages

$$LNCPI_t = a_0 + a_1 LNGFD + a_2 LNM3 + a_3 LNER + a_4 LNOIL + a_5 LNGDP\_GAP + u_t \quad (2)$$

...

To investigate the dynamics of the short- and long-run relationships between the aforesaid variables in India and China for the period 1985–2016, equation (2) considers the annual time series data expressed in natural logarithms. The parameters of the log-log model have an interpretation as elasticities. So the log-log model assumes a constant elasticity over all the values of the data set. In the model represented by the equation above, the a_s are the parameters to be estimated and u is the error term that captures other variables not explicitly included in the model with t being the time period. The choice of study period is on account of the availability of data pertaining to both the economies for all the aforementioned variables. A detailed model-wise synopsis of all the data sources along with literature support is charted in Table 1.

All variables are treated symmetrically in the VAR framework. A VAR model can be quite helpful in capturing the intertwined dynamics of time series data (Enders, 2004; 293).Therefore, to analyse the deficit–inflation relationship, we use VAR; however, the type of VAR used depends on the cointegration results obtained. Therefore, the estimation framework includes five main concepts – VAR, cointegration, VECM, causality and impulse response functions (IRFs).

We take the lag length p (which is found to be 2 as can be seen in subsequent section). The VAR equation (3) represents a dynamic model, containing an intercept and 12 regressors:

$$\begin{aligned} LNCPI = {} & \mu_1 + c_1 LNCPI_{t-1} + c_2 LNCPI_{t-2} + c_3 LNGFD_{t-1} + c_4 LNGFD_{t-2} + c_5 LNM3_{t-1} \\ & + c_6 LNM3_{t-1} + c_7 LNER_{t-1} + c_8 LNER_{t-2} + c_9 LNOIL_{t-1} + c_{10} LNOIL_{t-2} \\ & + c_{11} LNGDP\_GAP_{t-1} + c_{12} LNGDP\_GAP_{t-2} + \in_{1t} \end{aligned} \quad (3)$$

A VECM is constructed from the first differences of cointegrated I(1) variables, their lags and some error correction terms (ECTs). In matrix notation, the VECM is given by the following equation:

$$D_{y_t} = \mu + \prod y_{t-1} + \sum_{i=1}^{p} \beta_i^* D_{y_{t-1}} + \in_t \quad \ldots (4)$$

where y_t is an m × 1 vector of variables. In our case, it is a 6 × 1 vector. D_{y_t} is a 6 × 1 vector of the first difference of the variables in y_t; μ is a 6 × 1 vector of intercept coefficients. $\prod$ and β_i^* are m × m, that is, 6 × 6 coefficient matrices. $\in_t$ is a 6 × 1 error vector with contemporaneous correlation but no autocorrelation. In equation (3), y_t is I(1), then D_{y_t} is I(0) by assumption and so is $\in_t$.

$\prod$ can be thought of as the product of an m × r matrix "α" and the transpose of an m × r matrix "β" as in $\prod = \alpha\beta'$. This allows us to re-write equation (3) as:

$$\prod y_{t-1} = (\alpha\beta')y_{t-1} = \alpha(\beta' y_{t-1}) \quad \ldots (5)$$

Here, $\beta' y_{t-1}$ is an $r \times 1$ vector containing the ECTs. The r columns of β (rows of β') are the cointegrating vectors. The coefficients of α determine the size of the effects of the r correction term in the m equation of the VECM. Therefore, β_i^* in equation (4) tells about the short-run dynamics and $\prod$ tells about the cointegrating relationships.

Variables	Model	Description	Source	Literature support
CPI representation – Inflation	I and II	Consumer price index (in percentage, 2010 = 100)	MEI from OECD statistics (2017)	Huang *et al.* (2010), Zhang and Clovis (2010), Tiwari and Tiwari (2011), Qianqian (2011), Dholakia and Kadiyala (2018) and Kaur (2021)
GFD representation – Gross fiscal deficit	I	Gross fiscal deficit (as a % of GDP)	RBI's Handbook of Statistics for the Indian Economy (2017)	Liu *et al.* (2005), Khundrakpam and Goyal (2009),
	II	Gross fiscal deficit (as a % of GDP)	Data from 1985 to 1999 from Liu, Y., Fung, H. G. and Wang, Z. (2005) and from 2000 to 2016 from Asian Development Bank's (ADB) statistical database system	Khundrakpam and Pattanaik (2010), Makochekanwa (2011), Tiwari *et al.* (2012), Khumalo (2013) and Kaur (2021)
M3 representation – domestic money supply	I and II	Broad money (M3) Index (2010 = 100)	MEI from OECD statistics (2017)	Ashra *et al.* (2004), Geiger (2006), Laurens and Maino (2007), Burdekin and Siklos (2008) and Tiwari and Tiwari (2011)
ER representation – exchange rate level	I and II	Currency exchange rates per USD	MEI from OECD statistics (2017)	Bhattacharya *et al.* (2008), Bouakez and Rebei (2008), Raj *et al.* (2008), Murchison (2009) and Audu and Amaegberi (2013)
Oil representation – oil prices	I and II	De-seasonalised Fuel (Energy) Index (2005 = 100)	MEI from OECD statistics (2017)	Cunado and De Gracia (2005), Qianqian (2011), Sek *et al.* (2015), Zhao *et al.* (2016) and Kaur (2021)
GDP_GAP representation – output gap	I and II	Estimated by applying Hodrick–Prescott (HP) filter on real GDP (2010 = 100)	MEI from OECD statistics (2017)	Funke (2006), Mehrotra *et al.* (2010), Jahan and Mahmud (2013), Chowdhury and Sarkar (2017), Berger *et al.* (2020) and Kaur (2021)

Source: Author's own compilation

Table 1.
Data sources of the study

If two series are cointegrated, then a Granger causality test must be applied to determine the direction of causality between the variables of the study. The Granger causality test for the case of two stationary variables Y(t) and X(t) is given as follows:

$$Y_t = a_1 + \sum_{i=1}^{n} \beta_i X_{t-i} + \sum_{j=1}^{m} \gamma_j Y_{t-j} + e_{1t} \quad (6)$$

...

$$X_t = a_2 + \sum_{i=1}^{n} \theta_i X_{t-i} + \sum_{j=1}^{m} \delta_j Y_{t-j} + e_{2t} \quad (7)$$

...where it is assumed that both $\mathbf{e}_{Y(t)}$ and $\mathbf{e}_{X(t)}$ are uncorrelated white-noise terms. In this model, following Asteriou and Hall (2011), we can have the following different cases:

- Case 1 – The lagged X terms in equation (6) may be statistically different from zero as a group, and the lagged Y terms in equation (7) is not statistically different from zero. In this case, we see X(t) causes Y(t).
- Case 2 –The lagged Y terms in equation (7) may be statistically different from zero as a group, and the lagged X terms in equation (6) is not statistically different from zero. In this case, we see Y(t) causes X(t).
- Case 3 – Both sets of X and Y terms are statistically different from zero in equations (6) and (7), so there is bi-directional causality.
- Case 4 – Both sets of X and Y terms are not statistically different from zero in equations (6) and (7) so that X(t) is independent of Y(t).

We use the Wald Chi-square (χ^2) test to check the statistical significance of the F-tests applied to the joint significance of the sum of the lags of each explanatory variable (that is the Wald Test) which will indicate the Granger causality (or endogeneity of the dependent variable).

In applied work, it is often of interest to know the response of one variable to an impulse in another variable in the system, the system having a number of other variables. Of course, if there is a reaction of one variable to an impulse in another variable, then we may call the latter causal for the former. We study this type of causality by tracing out the effect of an exogenous shock or innovation in one of the variables on some or all of the other variables. Thus, IRFs are useful for studying the interactions between variables in a VAR model.

4. Empirical results

The sources of annual inflation in India and China are examined using the prism of VAR framework, for the period 1985–2016 in the form of empirical models, namely, Model I (India) and Model II (China). The long-run relationship between the variables of the study is tested using Johansen Cointegration test and relies on the unit root tests like Augmented Dickey Fuller (ADF) test and Breakpoint unit root test. The results of both the unit root tests given in Tables 2 and 3 point to the fact that the annual time series data used in Models I and II of our analysis are I(1). When we checked VAR lag order selection criteria (Table 4), lag order of 2 is suggested by AIC for Models I and II.

4.1 Cointegration analysis

All the study variables being I(1) gives a good justification for using the Johansen cointegration-VECM approach for further analysis. Table 5 reveals that the null hypothesis of at most five cointegrating equations for India and the null hypothesis of at most three cointegrating equation cannot be rejected in case of China. Thus, our variables are cointegrated, implying that they share a long-run equilibrium relationship in both the models. As inflation

Table 2. Break point unit root test

	Level				First difference			
	Model I		Model II		Model I		Model II	
Variables	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
LNCPI	−3.295 (0.5061)	−4.0803 (0.3229)	−4.2714 (0.0797)	−3.5334 (0.6728)	−7.2053 < (0.01)	−7.2270 < (0.01)	−7.0113 < (0.01)	−7.6483 < (0.01)
LNGFD	−4.0865 (0.1288)	−4.2260 (0.2441)	−3.1032 (0.6252)	−4.4059 (0.1651)	−6.2054 < (0.01)	−6.6668 < (0.01)	−7.2076 < (0.01)	−7.7886 < (0.01)
LNM3	−3.8540 (0.2125)	−2.7153 (0.9651)	−2.8796 (0.7483)	−3.0160 (0.9066)	−4.4941 (0.0440)	−5.2223 (0.0166)	−6.4003 < (0.01)	−6.4084 < (0.01)
LNER	−2.8346 (0.7706)	−6.1615 < (0.01)	−3.0768 (0.6416)	−3.5401 (0.6685)	−4.6868 (0.0256)	−5.1251 (0.0225)	−10.1275 < (0.01)	−9.2149 < (0.01)
LNOIL	−3.3580 (0.4679)	−2.9091 (0.9357)	−3.6064 (0.3272)	−3.6652 (0.5871)	−6.6754 < (0.01)	−6.5993 < (0.01)	−7.2059 < (0.01)	−7.2545 < (0.01)
LNGDP_GAP	−4.3266 (0.0699)	−5.5847 < (0.01)	−4.1815 (0.1032)	−4.1060 (0.3102)	−5.4599 < (0.01)	−5.5487 < (0.01)	−4.4910 (0.0443)	−4.4293 < (0.0434)

Note: Brackets show *Vogelsang (1993) asymptotic one-sided p-values

Table 3.
Augmented Dickey Fuller test results

	Level				First difference			
	Model I		Model II		Model I		Model II	
Variables	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
LNCPI	−2.4735 (0.1314)	−3.0575 (0.1362)	−2.7379 (0.0792)	−2.8759 (0.1834)	−6.7409 (0.000)	−6.6313 (0.000)	−5.8548 (0.0000)	−5.755 (0.0003)
LNGFD	−2.9702 (0.0590)	−3.2488 (0.0938)	−2.3243 (0.1710)	−2.5722 (0.2944)	−5.7512 (0.000)	−5.6365 (0.0004)	−6.5300 (0.000)	−6.4129 (0.0001)
LNM3	−0.7542 (0.8179)	−1.7383 (0.7088)	−2.2752 (0.1858)	−2.1347 (0.5073)	−3.7335 (0.0086)	−3.6705 (0.0040)	−5.3738 (0.0001)	−5.8061 (0.0003)
LNER	−2.2040 (0.2089)	−1.3967 (0.8420)	−2.2040 (0.2089)	−1.3967 (0.8420)	−3.9621 (0.043)	−4.3418 (0.0090)	−4.6134 (0.0009)	−5.3034 (0.0009)
LNOIL	−1.3299 (0.6029)	−1.4875 (0.8123)	−1.0590 (0.7190)	−2.3829 (0.3805)	−5.2636 (0.0002)	−5.2786 (0.0009)	−6.0381 (0.0000)	−5.9342 (0.0002)
LNGDP_GAP	−2.7955 (0.0705)	−2.7464 (0.2264)	−2.2820 (0.1859)	−1.9597 (0.5900)	−5.1552 (0.0002)	−5.0736 (0.0015)	−3.6511 (0.0107)	−3.6662 (0.0413)

Note: Brackets show MacKinnon (1996) one-sided *p*-values

and its standard determinants move together in the long run for both India and China, consequently, we run the restricted VAR that is the VEC model.

4.2 Vector error correction analysis

After confirmation of long-run relationships, a VEC specification as given in equation (4) is estimated. The short-run dynamics via VEC of Models I and II are presented in Table 6, in which the ECT with inflation (LNCPI) as the dependent variable has been reported where our dependent variable is normalised.

The coefficient of error correction with inflation as the dependent variable is statistically significant in both the models (Table 6). The negative ECT shows that the system is driven to its long-run cointegration path. The coefficient of ECT reflecting the speed of adjustment is estimated to be around 88% for India and 38% for China. This reflects a high speed of the adjustment process in India as against a moderate speed of adjustment in China.

In the short run, the coefficient of fiscal deficit has a positive impact on inflation in both the models, but it is statistically insignificant in the case of China. Thus, Ricardian equivalence cannot be negated for China at least in the short run. Money supply coefficient in the first-year lag is both negative as well as significant at 5% level for Model I; however, one period lag coefficient of M3 for Model II demonstrates a positive but a statistical insignificant case. This makes a stronger case of the effectiveness of monetary policy in the Indian context, albeit displaying that a high money growth and low inflation (and vice-versa) can coexist. The explanation for a negative coefficient could be because of money

	LogL		LR		FPE		AIC		SC		HQ	
Model→Lag:	I	II	I	II	I	II	I	II	I	II	I	II
0	31.24	−56.77	NA	NA	7.49	2.65	−1.68	4.18	−1.40	4.46	−1.59	4.27
1	186.29	90.07	237.73*	225.17	2.82*	1.72	−9.61	−3.20	−7.65*	−1.24*	−8.99*	−2.57
2	224.39	137.98	43.17	54.29*	3.36	1.07*	−9.75*	−3.99*	−6.11	−0.35	−8.59	−2.83*

Notes: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; and HQ: Hannan-Quinn information criterion

Table 4.
Lag selection results

Model	Lags included	Ho (No. of cointegrating equations)	Trace statistic	Critical value	Probability#
I (India)	2	None	325.807	117.708	0.000
		At Most 1	194.222	88.803	0.000
		At Most 2	128.835	63.876	0.000
		At Most 3	78.027	42.915	0.000
		At Most 4	32.880	25.872	0.005
		At Most 5	11.227	12.517	0.081
II (China)	2	None	182.066	95.753	0.000
		At Most 1	106.420	69.818	0.000
		At Most 2	57.297	47.856	0.005
		At Most 3	21.850	29.797	0.306
		At Most 4	16.286	25.872	0.469
		At Most 5	6.124	12.517	0.444

Note: # MacKinnon–Haug–Michellis (1999) *p*-values

Table 5.
Johansen cointegration test

	Model I (India)		Model II (China)	
	Coefficient	*t*-statistics	Coefficient	*t*-statistics
ECT	−0.878129*** (0.267867)	−3.278225	−0.382715*** (0.111058)	−3.446096
DLNCPI(−1)	−0.267066 (0.156636)	−1.705011	−0.486290** (0.166282)	−2.924492
DLNCPI (−2)	−0.176568 (0.136889)	−1.289862	−0.393935*** (0.070135)	−5.616819
DLNGFD(−1)	1.161856** (0.450727)	2.577741	0.112606 (0.489192)	0.230187
DLNGFD(−2)	0.994904*** (0.307670)	3.233668	0.178588 (0.246335)	0.724980
DLNM3(−1)	−7.459589** (2.523623)	−2.955905	1.362515 (2.058788)	0.661804
DLNM3(−2)	−3.811385 (2.527089)	−1.508211	−1.041352 (2.407774)	−0.432496
DLNER(−1)	−2.874327*** (0.810787)	−3.545106	3.644331*** (0.865244)	4.211911
DLNER(−2)	−0.519157 (1.046569)	−0.496056	2.233868** (0.769910)	2.901467
DLNLNOIL(−1)	−1.164519* (0.529692)	−2.198481	2.312339** (0.815684)	2.834848
DLNLNOIL(−2)	−0.146260 (0.465396)	−0.314270	1.309974** (0.477492)	2.743444
DLNGDP_GAP(−1)	−2.809701** (0.957815)	−2.933448	7.415118*** (1.322262)	5.607906
DLNGDP_GAP(−2)	0.044986 (1.057719)	0.042532	1.370936 (1.370410)	1.000384

Table 6.
Short-run vector error correction dynamics

Notes: Dependent variable: DLNCPI; Standard errors in parentheses; *** indicates significance at 1%; ** at 5%; and * at 10% level

supply leakages on account of capital flows overseas that did not enter the real economy. Thus, it can be observed that over the short run, gross fiscal deficit and money supply seem to have negligible effects on inflation in China over the period of our study. These results are consistent with Tang (2010), who also established that inflation cannot be regarded as a purely monetary phenomenon in Malaysia during 1971–2008.

The extent of pass-through from one period lagged exchange rates to inflation appears to be statistically significant (at one per cent) for both the models, with an elasticity of 2.87 exhibited by Model I and 3.54 in Model II. However, the pass-through reduces for both the countries when we consider the lagged exchange rates in the second round. The reduction of pass-through can be attributed to factors like inflation targeting and a credible monetary policy for India along with reduced correspondence to Marshall–Lerner condition post-economic reforms. Studies by Bouakez and Rebei (2008) and Murchison (2009) also suggest that short-run ERPT has declined as a result of the move to inflation targeting in Canada post-1990s. However, for China, exchange rate with a positive coefficient is an important factor explaining the inflation dynamics. Theoretically, with exchange rate depreciation, the import prices increase; this, in turn, would increase domestic inflation in an economy. As a manufacturing and export-driven economy which receives huge amounts of foreign exchange for its exports, the Chinese exchange rate *vis-a-vis* US dollar also impacts the inflationary path in the economy.

In the short run, oil prices and past values of inflation have a positive effect on inflation in China at 5% significance, while in India, the coefficient of first lag of oil prices is significant only at 10% level of significance. Output gap which is a key determinant of inflation pressure as per The NKPC is observed to be statistically significant in determining inflation in both India and China. For India, the coefficient of output gap turns out to be negative, while for China, a positive output gap has been observed. Our results conform to a more recent study by Chowdhury and Sarkar (2017), who while estimating hybrid NKPC for India (and Brazil, China and Russia) found the output gap coefficient to be negative and significant for one of the sub-sample. Thus, the existence of the Phillips curve for India is quite a possibility as per Model I, but the robustness of the relationship is certainly less straightforward. The economic significance of the first lag of output gap suggests the

existence of an inflation–output trade-off in China. This conclusion stands in stark contrast to the studies by Ha *et al.* (2003) and Gerlach and Wensheng (2006), who questioned the application of backward-looking Phillips curve for China.

Furthermore, there exists inflation inertia possibly because of the existence of backward-looking expectations (in contracts for wages, rents, etc). in China. However, such lower degree of inflation persistence in India is the likely outcome of inflation targeting stance. This is especially relevant when the goods and services tax-related disruption seems to be impacting the prices of some major components in core CPI (Dholakia and Kadiyala, 2018). In India, notable studies estimating persistence include Khundrakpam (2008), John (2015) and Maji and Das (2016) among others. Khundrakpam (2008) found inflation persistence in India to be low as compared to the international standards. Inflation in China, however, exhibits persistence and is responsive to inflationary shocks, unlike in India where the persistence is low and statistically insignificant. This is in contrast with the results of Zhang (2011), who found that a change in inflation tended to diminish faster in China for the period 1979–2009.

4.3 Causality results

In Model I, the long-run causality is determined by ECT = −87.81% and in Model II ECT = −38.27%, both of which are negative in sign and significant at 1% level. Therefore, there appears to be long-run causality running from fiscal deficit, money supply, exchange rates, oil prices and output gap to inflation in India as well as China.

As there exists a cointegrating relationship between our study variables Granger causality/block exogeneity Wald test is used to ascertain the direction of causality. Table 7 reports the results from the block exogeneity Wald test, and this table includes six parts. The first part reports the result of testing whether we can exclude each variable out of the equation of LNCPI. Similarly, the subsequent parts report the results of testing for the equation of LNGFD, LNM3, LNER, LNOIL and LNGDP_GAP. The last row in each part of Table 7 reports the joint statistics of the five variables excluded from the equation. Table 7 results for Model I provide evidence that we reject null hypothesis of excluding LNGFD, LNM3, LNER, LNOIL and LNGDP_GAP from the LNCPI equation at 5% level of significance. Putting together these results, we can say that all our explanatory variables are significant in increasing the incremental predictability of inflation in India. In Model II, however, the gross fiscal deficit does not explain inflation. Model I provides some reason to believe that there are bidirectional causalities between ER and output gap as well as between money supply and the output gap in India. In contrast, there is a bidirectional causality between exchange rate and the inflation rate in the short run for Model II. The unidirectional causalities observed from money supply to exchange rate and output gap to both money supply and exchange rate point to an indirect role played by monetary policy in managing inflation in China. Inflationary tendencies of fiscal deficits can be confirmed for India, while the same is not true for China as per the Granger results. Another interesting take away is that, in both the economies money supply does not Granger cause the fiscal deficit but does Granger cause inflation. The significance of output gap and exchange rate in explaining inflationary tendencies in both India and China further get established in Table 7.

4.4 Short-run dynamics through impulse response function

A shock to any variable in the VECM not only directly affects the variable but also is transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VEC. An IRF traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables (Ezeabasili and Mojekwu, 2011). Figures 4

Excluded	Model I Chi-sq	Df	Probability	Model II Chi-sq	df	Probability
Dependent variable: D(LNCPI)						
D(LNGFD)	11.387	2	0.003	1.145	2	0.284
D(LNM3)	8.770	2	0.012	7.945	2	0.004
D(LNER)	13.087	2	0.001	4.093	2	0.043
D(LNOIL)	11.523	2	0.0031	0.988	2	0.320
D(LNGDP_GAP)	14.867	2	0.000	19.597	2	0.000
All	49.048	10	0.000	28.977	10	0.000
Dependent variable: D(LNGFD)						
D(LNCPI)	0.066	2	0.967	0.036	2	0.848
D(LNM3)	1.559	2	0.458	1.289	2	0.256
D(LNER)	0.839	2	0.657	0.366	2	0.544
D(LNOIL)	1.178	2	0.554	0.004	2	0.945
D(LNGDP_GAP)	1.257	2	0.533	3.211	2	0.073
All	9.158	10	0.517	4.089	10	0.536
Dependent variable: D(LNM3)						
D(LNCPI)	7.688	2	0.021	0.102	2	0.748
D(LNGFD)	1.450	2	0.484	2.206	2	0.137
D(LNER)	10.315	2	0.005	0.424	2	0.514
D(LNOIL)	3.823	2	0.147	0.006	2	0.936
D(LNGDP_GAP)	12.657	2	0.001	11.481	2	0.000
All	36.080	10	0.000	13.626	10	0.018
Dependent variable: D(LNER)						
D(LNCPI)	0.408	2	0.815	1.883	2	0.034
D(LNGFD)	15.618	2	0.000	10.750	2	0.001
D(LNM3)	5.279	2	0.071	9.225	2	0.002
D(LNOIL)	2.870	2	0.238	9.002	2	0.002
D(LNGDP_GAP)	11.945	2	0.002	8.738	2	0.003
All	37.442	10	0.000	43.796	10	0.000
Dependent variable: D(LNOIL)						
D(LNCPI)	9.291	2	0.009	0.127	2	0.721
D(LNGFD)	1.703	2	0.426	0.142	2	0.705
D(LNM3)	12.060	2	0.002	0.637	2	0.424
D(LNER)	18.274	2	0.000	0.045	2	0.830
D(LNGDP_GAP)	0.399	2	0.819	0.110	2	0.739
All	43.047	10	0.000	1.071	10	0.956
Dependent variable: D(LNGDP_GAP)						
D(LNCPI)	15.183	2	0.000	1.437	2	0.230
D(LNGFD)	4.383	2	0.111	0.483	2	0.486
D(LNM3)	25.909	2	0.000	2.496	2	0.114
D(LNER)	6.914	2	0.031	2.461	2	0.116
D(LNOIL)	3.555	2	0.169	0.069	2	0.792
All	78.935	10	0.000	9.565	10	0.088

Table 7.
Vector error correction block exogeneity Wald test

and 5 plot the impulse responses of inflation as measured by CPI, which are interpreted as a shock in independent variables. The simulation period covers a horizon of ten years. For Model I (India), it can be observed from Figure 4 that in response to a shock in the fiscal deficit indicator, inflation remains positive until the third year before beginning to decline. This is in line with a statistically significant and positive coefficient of fiscal deficit in our

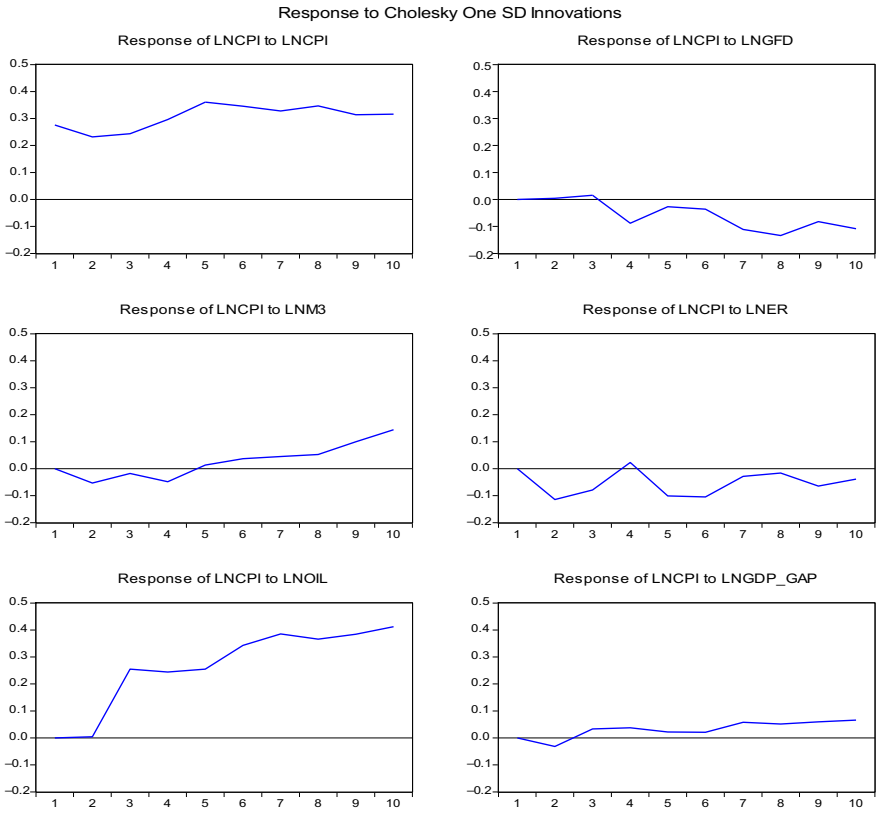


Figure 4.
Impulse response of inflation to a shock in study variables (Model I)

VEC model. Also, it can be observed that a positive monetary policy shock in terms of expansion of M3, however, is associated with a fall in inflation until about five years after which the increase is sustained over a period of time. A shock in official exchange rate affects inflation rates negatively almost throughout as can be seen from the figure. The impact of oil prices on inflation is marginal until two periods beyond which it is positive and sustained. Overall shocks to fiscal deficit tend to have a stronger impact on inflation, while the influence of output gap is peripheral for the Indian economy. These results are in line with the short-run dynamics of our VEC Model I (Table 6) and further report the inflationary tendencies of fiscal deficit in India.

For Model II (China), it can be observed from Figure 5 that in response to a shock in the gross fiscal deficit, inflation remains neutral until two years before beginning to marginally get affected. Also, it can be observed that a positive monetary policy shock in terms of expansion of M3, however, is associated with a marginal change in inflation until about two years after which it starts to fall. A shock in official exchange rate affects inflation rates positively almost throughout, while the impact of oil prices on inflation is marginal until two periods beyond which it is negative and sustained. The output gap, however, has a positive and fluctuating impact on the CPI.

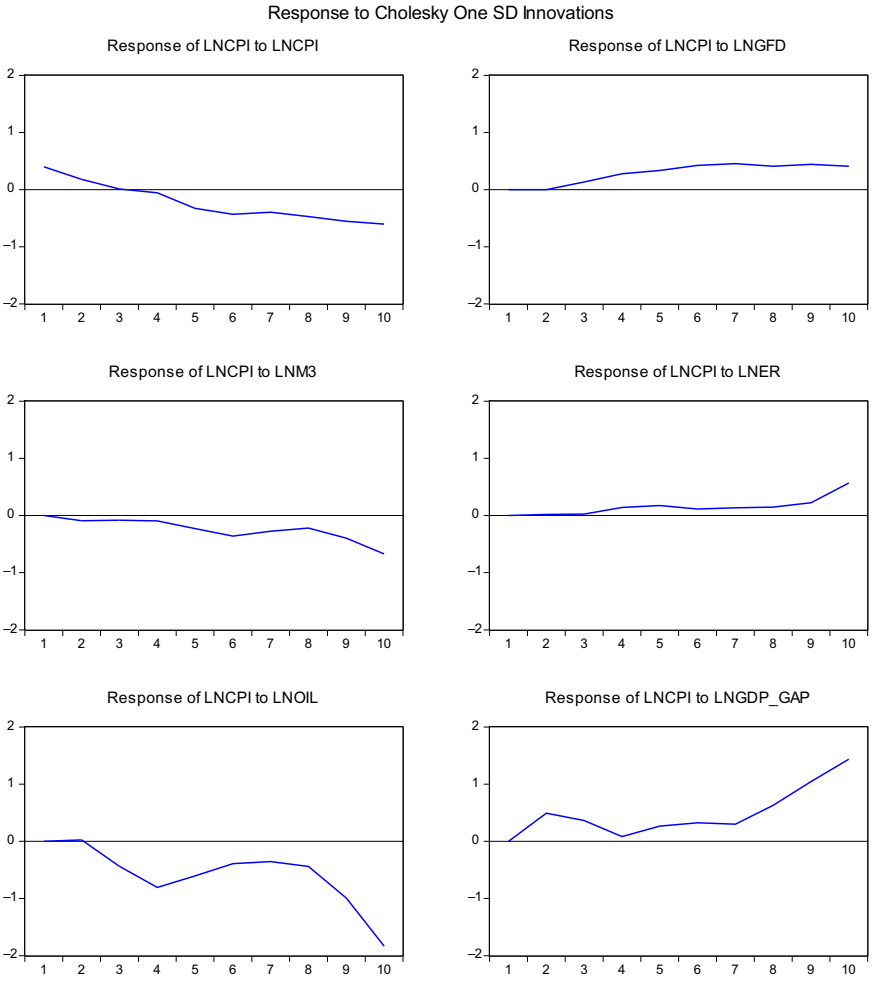


Figure 5.
Impulse response of inflation to a shock in study variables (Model II)

4.5 Diagnostic results

Diagnostic tests statistics given in Table 8 suggest the robustness of the estimated models. The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQs) tests plotted against the critical bound of the 5% significance level show that Models I and II are stable over time (Figures 6 and 7). All the statistics suggest that statistically valid inference can be drawn from the models.

5. Concluding remarks and policy implications

China's boom since the late 1970s has been a major success story in economic circles. Nevertheless, less phenomenal, but still significant growth pickup of India since 1980s intrigues one to carry out a detailed macroeconomic analysis of both the economies. In this light, the

Model	Serial correlation (Breusch–Godfrey LM test)	Heteroscedasticity (Breusch–Pagan–Godfrey test)	Normality (Jarque Bera Test)
I	2.1254 (0.1754)	0.5121 (0.8959)	12.6881 (0.1117)
II	0.5399 (0.5974)	1.009 (0.5149)	0.8341 (0.6589)

Note: Numbers in parenthesis are the *p*-values corresponding to the diagnostic tests

Table 8.
Diagnostic test results

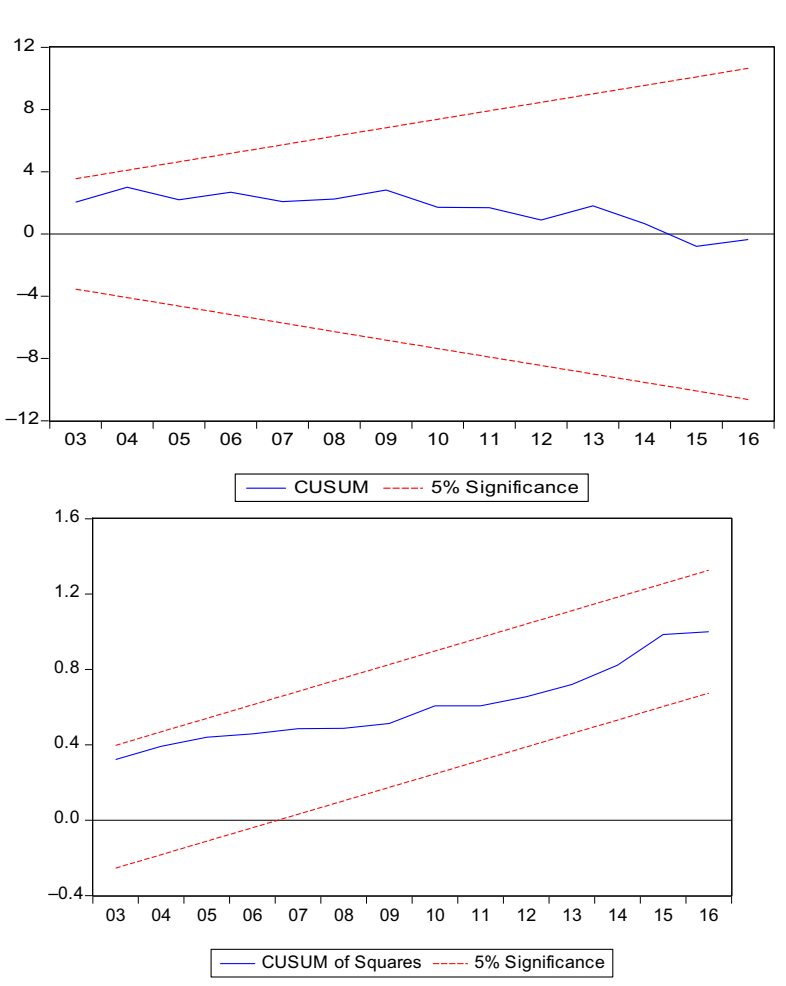


Figure 6.
The plot of cumulative sum and cumulative sum of squares for coefficients stability of error correction Model I

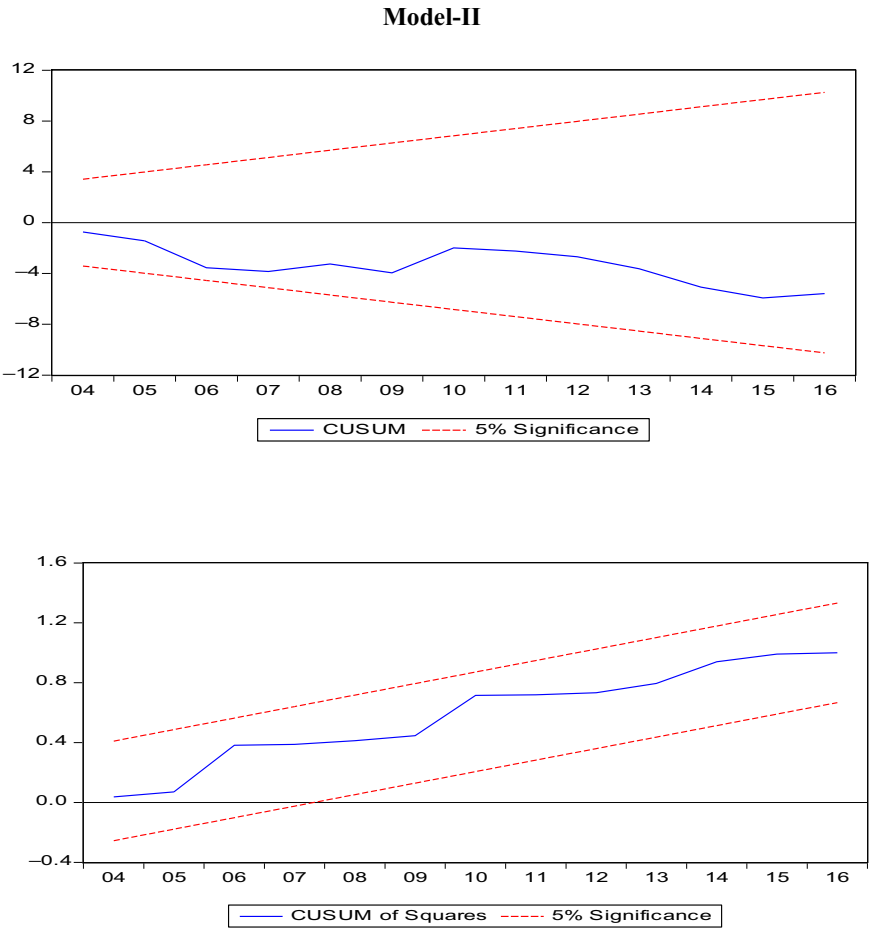


Figure 7.
The plot of cumulative sum and cumulative sum of squares for coefficients stability of error correction Model II

present paper is an attempt to examine the comparative trends in fiscal deficit and inflationary developments in India and China. There is enough support for the hypothesis that fiscal deficits are inflationary only in the Indian context; and that the Ricardian equivalence cannot be negated for China at least in the short run. Our results also suggest that in the short run, monetary policy needs to respond decisively to tackle China's deflation problem considering the indirect role of monetary policy as per the Granger causality results. Besides, in the short run, the supply and demand-driven factors are more important than fiscal policy in managing inflation in China. Concomitantly, almost all the factors, namely, fiscal deficit, money supply, exchange rate and oil prices, are relevant in tackling inflation in India in the near term. The findings pertaining to output gap indicate that the NKPC applies to China more strongly than it does to India. Finally, while little can be done in the short run to mitigate shocks such as rising oil prices, broader policy framework must aim at addressing structural bottlenecks to ensure non-inflationary growth keeping in mind the structural views on inflation. These findings must be taken with a number of caveats, as China and India have very distinct fiscal and monetary

scenarios. Moreover, data availability and reliability issues persist as far as data pertaining to China is concerned. Considering there are only a limited number of studies on fiscal deficit of China, the present study is of paramount significance in terms of growing concern over the sustainability of the growth process in China. However, the study is not projected to be exhaustive in investigating all the causes of inflation, as it also depends on the country characteristics (Kaur, 2021), and there may be many other determinants either which are difficult to quantify or for which no satisfactory data are available. Stimulating growth and sustaining it are different enterprises and require dissimilar policy actions (Rodrik, 2005); akin to this thought is that sustaining growth in both the fastest growing economies of the world does need a greater synthesis between monetary and fiscal policies, especially considering the global economic disruptions the world economy is subject to.

Notes

1. It refers to the terminology explicitly articulated by Buiter and Rahbari (2011), who expect strong growth in developing and EMEs to continue.
2. India, however, experienced relatively higher inflation, which exceeded 8% up to the mid-1990s but then fell to below 8% in the latter half of that decade.
3. For details, see Gottschalk *et al.* (2008). Gross fiscal deficit and output gap are the additional variables in the present study, thereby extending the model given by Gottschalk *et al.* (2008) to incorporate fiscalist explanation and to observe whether an economy is underworking or overworking its resources.

References

Abu-Bakar, M. and Masih, A. (2018), *Is the Oil Price Pass-through to Domestic Inflation Symmetric or Asymmetric? New Evidence from India Based on NARDL*, University Library of Munich, Munich.

Alam, M.Q. and Alam, M.S. (2016), "The determinants of inflation in India: the bounds test analysis", *International Journal of Economics and Financial Issues*, Vol. 6 No. 2, pp. 544-550.

Anantha Ramu, M.R. and Gayithri, K. (2017), "Fiscal deficit and inflation linkages in India: tracking the transmission channels", *Journal of Social and Economic Development*, Vol. 19 No. 1, pp. 1-24.

Ashra, S., Chattopadhyay, S. and Chaudhuri, K. (2004), "Deficit, money and price: the Indian experience", *Journal of Policy Modeling*, Vol. 26 No. 3, pp. 289-299.

Asteriou, D. and Hall, S.G. (2011), *Applied Econometrics*, second edition: *Palgrave Macmillan. Hampshire*, p.512.

Audu, N.P. and Amaegberi, M. (2013), "Exchange rate fluctuations and inflation targeting in an open economy: econometrics approach", *European Journal of Accounting, Auditing and Finance Research*, Vol. 1 No. 3, pp. 24-42.

Berger, T., Morley, J. and Wong, B. (2020), "Nowcasting the output gap", *Journal of Econometrics*,

Bhattacharya, R. Patnaik, I. and Shah, A. (2008), "Exchange rate pass-through in India. Macro/finance group at national institute of public finance and policy", available at: http://macrofinance.nipfp.org.in/PDF/BPS2008_erpt.pdf

Bouakez, H. and Rebei, N. (2008), "Has exchange rate pass-through really declined? Evidence from Canada", *Journal of International Economics*, Vol. 75 No. 2, pp. 249-267.

Bova, E. and Klyviene, V. (2020), "Macroeconomic responses to fiscal shocks in Portugal", *Journal of Economic Studies*, Vol. 47 No. 5, pp. 1051-1069, available at: https://doi.org/10.1108/JES-12-2018-0454

Buiter, W. and Rahbari, E. (2011), "Global growth generators: moving beyond "emerging markets" and BRIC", *Global Economics View*, Vol. 21, pp. 1-9.

Burdekin, R.C. and Siklos, P.L. (2008), "What has driven Chinese monetary policy since 1990? Investigating the people's bank's policy rule", *Journal of International Money and Finance*, Vol. 27 No. 5, pp. 847-859.

Chinoy, S.Z., Kumar, P. and Mishra, P. (2016), "What is responsible for India's sharp disinflation?", *Monetary Policy in India*, Springer, New Delhi. pp. 425-452.

Chowdhury, K.B. and Sarkar, N. (2017), "Is the hybrid new Keynesian Phillips curve stable? Evidence from some emerging economies", *Journal of Quantitative Economics*, Vol. 15 No. 3, pp. 427-449.

Cunado, J. and De Gracia, F.P. (2005), "Oil prices, economic activity and inflation: evidence for some Asian countries", *The Quarterly Review of Economics and Finance*, Vol. 45 No. 1, pp. 65-83.

Dholakia, R.H. and Kadiyala, V.S. (2018), "Changing dynamics of inflation in India", *Economic and Political Weekly*, Vol. 53 No. 9, pp. 65-73.

Du, L., Yanan, H. and Wei, C. (2010), "The relationship between oil price shocks and China's macro-economy: an empirical analysis", *Energy Policy*, Vol. 38 No. 8, pp. 4142-4151.

Enders, W. (2004), "Applied econometric time series, by Walter", *Technometrics*, Vol. 46 No. 2, pp. 293.

Ezeabasili, V.N. and Mojekwu, J.N. (2011), "Analysis of fiscal deficits and interest rates in Nigeria", *Journal of Economics and International Finance*, Vol. 3 No. 4, pp. 236-245.

Fernald, J.G., Spiegel, M.M. and Swanson, E.T. (2014), "Monetary policy effectiveness in China: Evidence from a FAVAR model", *Journal of International Money and Finance*, Vol. 49, pp. 83-103.

Friedman, M. (1963), *Inflation: Causes and Consequences*, Asia Publishing House. *New York, NY*.

Friedman, M. (1992), *Money Mischief: Episodes in Monetary History*, *Hartcourt Brace and Company*. *New York, NY*.

Funke, M. (2006), "Inflation in China: modelling a roller coaster ride", *Pacific Economic Review*, Vol. 11 No. 4, pp. 413-429.

Geiger, M. (2006), "Monetary policy in China (1994-2004): targets, instruments and their effectiveness (no. 68)", University of Würzburg, Chair for Monetary Policy and International Economics.

Gerlach, S. and Wensheng, P.E.N.G. (2006), "Output gaps and inflation in mainland China", *China Economic Review*, Vol. 17 No. 2, pp. 210-225.

Gottschalk, J., Kalonji, K.D. and Miyajima, K. (2008), *Analyzing Determinants of Inflation When There Are Data Limitation [s]: the Case of Sierra Leone*, International Monetary Fund. *New York, NY*.

Grauwe, P. and Grimaldi, M. (2001), "Exchange rates, prices and money: a long run perspective, university of Leuven and CEPR", *Paper prepared for the Workshop on Exchange Rate and Monetary Policy Issues*, *Vienna*, 19-20 April.

Guerineau, S. and Jeanneney, S.G. (2005), "Deflation in China", *China Economic Review*, Vol. 16 No. 4, pp. 336-363.

Ha, J., Fan, K. and Shu, C. (2003), "The causes of inflation and deflation in mainland China", *Hong Kong Monetary Authority Quarterly Bulletin*, Vol. 30, pp. 23-31.

Huang, Y., Wang, X. and Hua, X. (2010), "What determines China's inflation?", *China Economic Journal*, Vol. 3 No. 1, pp. 69-86.

Jahan, S. and Mahmud, A.S. (2013), "What is the output gap", *Finance and Development*, Vol. 50 No. 3, pp. 38-39.

Jiang, J. and Kim, D. (2013), "Exchange rate pass-through to inflation in China", *Economic Modelling*, Vol. 33, pp. 900-912.

John, J. (2015), "Has inflation persistence in India changed over time?", *The Singapore Economic Review*, Vol. 60 No. 4.

Kapur, M. and Behera, H. (2012), *Monetary Transmission Mechanism in India: A Quarterly Model (No. 70631)*, University Library of Munich, Munich.

Kaur, G. (2017), "The relationship between fiscal deficit and inflation in India: a cointegration analysis", *Journal of Business Thought*, Vol. 8, pp. 24-41.

Kaur, G. (2021), "Inflation and fiscal deficit in India: an ARDL approach", *Global Business Review*, Vol. 22 No. 6, pp. 1553-1573, doi: 10.1177/0972150919828169.

Khumalo, J. (2013), "Budget deficit-inflation nexus in South Africa: VAR analysis", *Mediterranean Journal of Social Sciences*, Vol. 4 No. 13, pp. 415-424.

Khundrakpam, J. (2008), *How Persistent is Indian Inflationary Process, Has It Changed?*, University Library of Munich, Munich.

Khundrakpam, J.K. and Goyal, R. (2009), "Is the government deficit in India still relevant for stabilisation?".

Khundrakpam, J.K. and Pattanaik, S. (2010), "Fiscal stimulus and potential inflationary risks: an empirical assessment of fiscal deficit and inflation relationship in India", *Journal of Economic Integration*, Vol. 1, pp. 703-721.

Laurens, B. and Maino, R. (2007), *China: Strengthening Monetary Policy Implementation (No. 7-14)*, International Monetary Fund. New York, NY.

Lin, J.Y. (2004), *Lessons of China's Transition from a Planned Economy to a Market Economy*, Leon Koźmiński Academy of Entrepreneurship and Management Warszawa pp. 1-45.

Liu, H.Y. and Chen, X.L. (2017), "The imported price, inflation and exchange rate pass-through in China", *Cogent Economics and Finance*, Vol. 5 No. 1, p. 1279814.

Liu, Y., Fung, H.G. and Wang, Z. (2005), "Fiscal deficit and debt conditions for China", *Emerging Markets Finance and Trade*, Vol. 41 No. 5, pp. 56-74.

MacKinnon, J.G. (1996), "Numerical distribution functions for unit root and cointegration tests", *Journal of Applied Econometrics*, Vol. 11 No. 6, pp. 601-618.

MacKinnon, J.G.. Haug, A.A. and Michelis, L. (1999), "Numerical distribution functions of likelihood ratio tests for cointegration", *Journal of Applied Econometrics*, Vol. 14 No. 5, pp. 563-577.

Maji, B. and Das, A. (2016), "Forecasting inflation with mixed frequency data in India", *Calcutta Statistical Association Bulletin*, Vol. 68 No. 1-2, pp. 92-110.

Makochekanwa, A. (2011), "Impact of budget deficit on inflation in Zimbabwe", *The Economic Research Guardian*, Vol. 1 No. 2, pp. 49-59.

Mehrotra, A., Peltonen, T. and Rivera, A.S. (2010), "Modelling inflation in China – a regional perspective", *China Economic Review*, Vol. 21 No. 2, pp. 237-255.

Mishkin, F.S. (2007), "Inflation dynamics", *International Finance*, Vol. 10 No. 3, pp. 317-334.

Mohanty, D. and John, J. (2015), "Determinants of inflation in India", *Journal of Asian Economics*, Vol. 36, pp. 86-96.

Mohanty, M.S. and Klau, M. (2001), "What determines inflation in emerging market economies?", *BIS Papers*, Vol. 8, pp. 1-38.

Murchison, S. (2009), "Exchange rate pass-through and monetary policy: how strong is the link", ?. Bank of Canada working paper. (No. 29)

Nelson, E. (2003), "The future of monetary aggregates in monetary policy analysis", *Journal of Monetary Economics*, Vol. 50 No. 5, pp. 1029-1059.

OECD (2017), "M. E. I. Historical statistics, OECD.Stat, (database)", (Accessed 13 September 2017).

Okun, A.M. (1962), "Potential GNP: its measurement and significance", *Proceedings of the Business and Economic Statistics Section of the American Statistical Association*, 7, pp. 89-104.

Qianqian, Z. (2011), "The impact of international oil price fluctuation on China's economy", *Energy Procedia*, Vol. 5, pp. 1360-1364.

Raj, J., Dhal, S. and Jain, R. (2008), *Imported Inflation: The Evidence from India*, Reserve Bank of India New Delhi.

Reserve Bank of India (RBI) (2014), *Report of the Expert Committee to Revise and Strengthen the Monetary Policy Framework*, RBI, Mumbai.

Rodrik, D. (2005), "Growth strategies', handbook of economic growth, IA, Aghion Ph. and dauerlauf SN, 967-1014".

Romer, C. (2012), "Fiscal policy in the crisis: lessons and policy implications", *IMF Fiscal Forum*, Vol. 18.

Sargent, T.J. and Wallace, N. (1981), "Some unpleasant monetarist arithmetic", *Federal Reserve Bank of Minneapolis Quarterly Review*, Vol. 5 No. 3, pp. 1-17.

Sek, S.K., Teo, X.Q. and Wong, Y.N. (2015), "A comparative study on the effects of oil price changes on inflation", *Procedia Economics and Finance*, Vol. 26, pp. 630-636.

Tang, C.F. (2010), "The money-prices nexus for Malaysia: new empirical evidence from the time-varying cointegration and causality tests", *Global Economic Review*, Vol. 39 No. 4, pp. 383-403.

Thornton, D.L. (1990), "Do government deficits matter?", *Federal Reserve Bank of St. Louis Review*, Vol. 72.

Tiwari, A.K. and Tiwari, A.P. (2011), "Fiscal deficit and inflation: an empirical analysis for India", *Romanian Economic Journal*, Vol. 14 No. 42, pp. 131-158.

Tiwari, A.K., Tiwari, A.P. and Pandey, B. (2012), "Fiscal deficit and inflation: What causes what? The case of India", *Journal of International Business and Economy*, Vol. 13 No. 1, pp. 57-81.

Zhang, C. (2011), "Inflation persistence, inflation expectations, and monetary policy in China", *Economic Modelling*, Vol. 28 No. 1-2, pp. 622-629.

Zhang, C. and Clovis, J. (2010), "China inflation dynamics: persistence and policy regimes", *Journal of Policy Modeling*, Vol. 32 No. 3, pp. 373-388.

Zhao, L., Zhang, X., Wang, S. and Xu, S. (2016), "The effects of oil price shocks on output and inflation in China", *Energy Economics*, Vol. 53, pp. 101-110.

Further reading

Asian Development Bank (2017), "Statistical database system (SDBS)", (Accessed 11 November 2017).

Reserve Bank of India (RBI) (2017), *Handbook of Statistics of the Indian Economy, 2016-17*, RBI, Mumbai. Available at https://dbie.rbi.org.in

Corresponding author

Gurleen Kaur can be contacted at: gurleenkaur@sggscc.ac.in