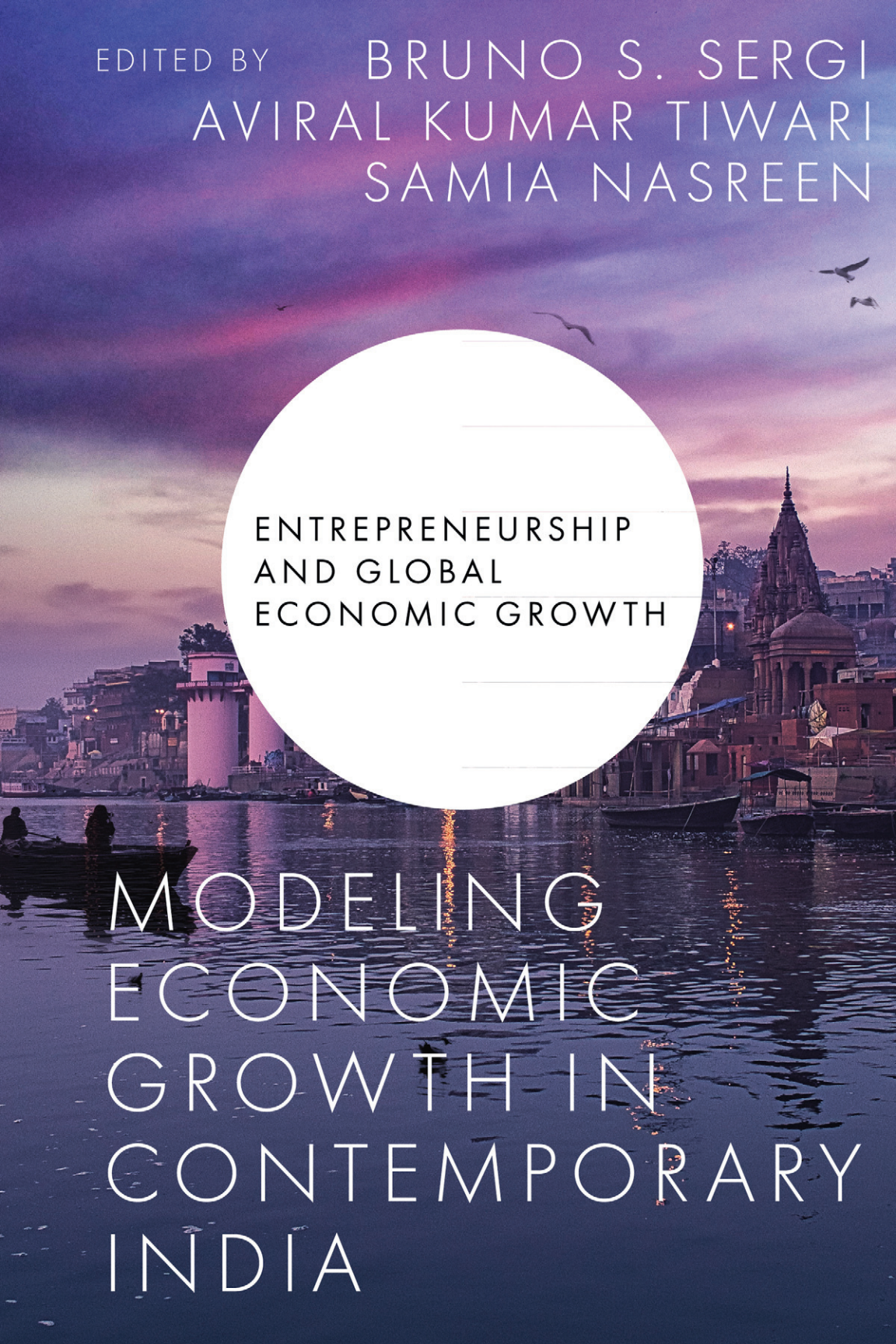
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BRUNO S. SERGI
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ENTREPRENEURSHIP AND GLOBAL ECONOMIC GROWTH
MODELING ECONOMIC GROWTH IN CONTEMPORARY INDIA

Modeling Economic Growth in Contemporary India

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Emerald Publishing Limited
Emerald Publishing, Floor 5, Northspring, 21-23 Wellington Street, Leeds LS1 4DL

First edition 2024

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-80382-752-0 (Print)
ISBN: 978-1-80382-751-3 (Online)
ISBN: 978-1-80382-753-7 (Epub)

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Chapter 1

Forecasting Major Macroeconomic Variables of the Indian Economy

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Abstract

A major concern for policymakers and researchers is to ascertain the movement of price levels and employment rates. Predicting the trends of these variables will assist the government in making policies to stabilize the economy. The objective of this chapter is to forecast the unemployment rate and Consumer Price Index (CPI) for the period 2022 to 2031 for the Indian economy. For this purpose, the authors analyse the prediction capability of the univariate auto-regressive integrated moving average (ARIMA) model and the vector autoregressive (VAR) model. The dataset for India's annual CPI and unemployment rate pertains to a 30-year time period from 1991 to 2021. The result shows that the inflation forecasts derived from the ARIMA model are more precise than that of the VAR model. Whereas, unemployment rate forecasts obtained from the VAR model are more reliable than that of the ARIMA model. It is also observed that predicted unemployment rates hover around 5.7% in the forthcoming years, while the forecasted inflation rate witnesses an increasing trend.

Keywords: Forecasting; inflation; consumer price index; unemployment rate; ARIMA; VAR

1. Introduction

The Reserve Bank of India (RBI) underlines that the Indian economy is confronting the strong headwinds of global recessionary risks with sound macroeconomic fundamentals (RBI Press release, 2022). The fifth largest economy of the world has been able to stand firm amid the COVID-19 pandemic and the

Modeling Economic Growth in Contemporary India, 1–24

doi:10.1108/978-1-80382-751-320241001

Russia–Ukraine war. India occupies a significant place in the world economy as it contributes 7% to the global GDP (in purchasing power parity) which is the third highest after the United States and China (World Bank blog, 2019). Additionally, in terms of GDP growth, India is the second largest emerging economy after China and shares 16% of the global GDP growth (World Economic Forum, 2024). The country is also a prominent member of major international trade blocks such as G-20 and BRICS.

The economic march of India, however, has been quite challenging over the years. Every decade since 1990, India is undergoing an economic crisis. First in the year 1991, India faced the balance of payment emergency and currency crisis that prompted the country to liberalize its economy and integrate with the world economy. Further, in the year 2008, the country experienced twin deficit problem which was ensue of the global financial crisis. Later in the year 2015–2016, the Indian economy started experiencing a slowdown as several indicators, viz. GDP growth, private investment, consumption demand and a number of new projects encountered a declining trend (Upadhyay, 2019). The monetary and financial sector also got affected and the country's fiscal deficit shot up to 4.6%, higher than the anticipated figure of 3.5% in the year 2019–2020 (Dev & Sengupta, 2020). Further, in the year 2020, the COVID-19 pandemic afflicted the country and aggravated the state of affairs of already falling Indian economy. The GDP of the country contracted by 23.9% in the first quarter and subsequently by 7.5% in the second quarter of the year 2020 (Economic Survey, 2020–21). The two major contributors of Indian economy – manufacturing and service sector, were badly hit due to the nationwide lockdown imposed by the Government. Nevertheless, agriculture was the only sector that witnessed a positive growth during the first wave of COVID-19.

The COVID-19 emerged as a health crisis and gradually transformed into an economic crisis across the globe. It impacted the world's major economies resulting in 3.4% decline in their collective GDP (Statista, 2023). For a highly populated Indian economy with high population density, greater population of elderly people and with 69% of total population living in rural area, it was unlikely to escape from such crisis (Economic Survey, 2020–21). Despite these impuissance and vulnerabilities, the economy of India was able to recover faster than its counterfeits during the pandemic. The faster recovery can be attributed to the introduction of supply side measures, structural reforms and demand reforms. Moreover, India is witnessing a V-shaped economic recovery and the performance of Indian economy post pandemic has been phenomenal. According to the projections made by the Asian Development Bank (ADB), the International Monetary Fund (IMF) and the World Bank, Indian economy will be the fastest growing economy in the world during the year 2021–2024. It is also expected to grow up to five trillion dollar economy by the year 2025 (Sawhney, 2021). Looking at the growing prominence of the Indian economy, we take a keen interest to look into the trends of certain macro-economic variables of the country and predict their future prospects. In the context of economic development, inflation and unemployment are a couple of factors that hold a direct impact on the general mass of the country as explained theoretically by the Phillips curve. At

the same time such factors get majorly affected in case of a crisis. For instance, CPI was among the most affected variable during the COVID-19 pandemic. CPI measures prices at the retail level and determines the general purchasing power of the consumers. At the time when the zoonotic virus started spreading at the global level, people were very uncertain about the longevity of the virus among humans. As a result, people started hoarding necessary goods in their houses which resulted in an increase in overall prices. Citing another instance, during the fall-out of Russia–Ukraine war, the CPI peaked to 7.8% in April 2022. Howsoever, the figure moderated to 5.7% in December with the prompt and adequate efforts made by the RBI and the Government of India (Ministry of finance, Press Release, 2023). Therefore, frequent investigations into the trends of general prices in the second largest emerging market become crucial as the variable also holds a close link with the standard of living of the people.

Similarly, unemployment is another significant element which is frequently discussed at every level of the economy and society. Unemployment constrains the income level of the population which can further limit the per capita income of the country. Notably, as per Lai et al. (2021) the COVID-19 pandemic created a challenging scenario of employment in India. Given this, the study attempts to forecast the CPI inflation and unemployment in India by using Box–Jenkins' ARIMA model along with VAR model. The two noble models also enable us to make a comparative analysis of the results obtained from the same. The study is based on a time series dataset ranging from the period 1991 to 2021 and provides a forecast of the two variables up to 2031.

The current study enhances the extant literature in several aspects. First, the study's data period encompasses a series of crisis including East Asian financial crisis, the global financial crisis and the pandemic period. Second, we employed ARIMA and VAR forecasting models in our study which are considered better than the other estimation techniques namely exponential smoothing. Moreover, our findings provide a comparative analysis about the trend prediction of the CPI and unemployment. Third, the study is based on India, the second largest emerging economy worldwide. Examining the trend and accurately forecasting the variables CPI and unemployment in such an economy is itself a challenging chore. Finally, the study will also suggest appropriate policies and direct the regulatory bodies to be vigilant about the future phase of any crisis.

2. Theoretical Framework

Inflation is the persistent increase in the general price level of services and goods within an economy (Omar et al., 2022). It declines the purchasing power of the currency. It is a monetary phenomenon which is affecting most economies of the world, both developed and developing (Abdulrahman et al., 2018). Different theories of inflation are given by various economists. For instance, classical economists believed in full employment and operation of Say's law in an economy, which is supply creates its own demand. According to Quantity theory of Money (QTM) given by Classical economist, Irving Fisher, there is a direct and

proportional association between quantity of money and price level. This relationship is described by an equation of exchange, $MV = PT$, where M denotes money supply, V stands for circulation or velocity of money, P refers to the general price level index and T is the volume of trade. The velocity of money (V) in any economy is determined by institutional factors that are constant in the short run. The volume of trade or transactions (T) is also assumed fixed under the scenario of full employment level. Therefore, any variation in money supply will have a proportionate change in the level of prices. A change in money supply (M) impacts aggregate demand, and with aggregate supply being fixed at full employment level, it will cause inflation (Fisher, 1911). However, Keynes and his followers believed that the non-monetary impulses are responsible for changes in price level (Gordon, 1976).

According to Keynes, when the economy reaches beyond full employment level, increase in aggregate demand is responsible for rise in the price level. Beyond full employment level, aggregate supply of goods and services cannot be altered. So, any change in aggregate demand in the form of consumption expenditure, investment expenditure or government expenditure, will have a direct influence on the price level. Therefore, at full employment level, when aggregate demand exceeds aggregate supply, an inflationary gap is created in an economy. This inflationary gap will lead to price rise in an economy which is termed as demand pull inflation.

The Monetarist school of thought also contributed towards theory of inflation. According to them, a rise in aggregate demand, due to change in money supply, is responsible for increase in the price level. Milton Friedman is the main proponent of the monetarist school. There is similarity between Keynesian and Monetarist schools, as both these schools have considered aggregate demand responsible for rise in price level. However, in Keynesian school, increase in aggregate demand is due to change in components of aggregate demand (autonomous investment, government expenditure or consumption expenditure or net exports), which is independent of money supply. Whereas, monetarists considered fluctuations in money supply responsible for any changes in aggregate demand (Totonchi, 2011).

In any economy, prices of goods are determined by their cost of production. Therefore, alteration in cost of production, due to any reason, will have a direct impact on price. The alteration in cost can be due to supply shocks, raise in wage rate or higher profit motives among many reasons. This resultant increase in price due to rise in cost of production is known as cost push inflation. Here, increase in cost takes place without any change in aggregate demand. Hence, a price increase, without any change in wage rate, will lead to price wage spiral in an economy. Due to rising prices, wage earners will seek greater nominal wages, in order to keep their real wages to the same level as before. This rise in wage rate will further lead to rise in prices and this process continues. This type of inflation is also called price–push inflation (Gordon, 1976; Totonchi, 2011).

Besides inflation, unemployment is another unsettling issue which affects both developing and developed economies (Dev & Venkatanarayana, 2011). Unemployment is a situation when there is scarcity of jobs for the employable and willing labour force of a country. There can be multiple scenarios that lead to

unemployment in an economy. As per Singh and Verma (2016), unemployment usually arises when there is a mismatch between the demand and supply of labour in the labour market. That is, the demand of labour is less than the supply of labour.

The unemployment rate is measured by total unemployed labour force as a percentage of labour force (PIB, 2022a). Labour force refers to the people in the population who are either seeking work or already working (PIB, 2022a). The unemployment rate in India is measured based on usual status, current weekly status and current daily status (Dev & Venkatanarayana, 2011). The Ministry of Statistics and Programme Implementation (MoSPI) and the National Statistical Office (NSO) are responsible to gather data on unemployment and employment for Indian economy and for conducting periodic labour force survey (PIB, 2022b).

Inflation and unemployment are among the crucial indicators of the health of an economy. Notably, the two indicators are also associated with each other as exhibited by A.W. Phillips. In the 1960s, A.W. Phillips introduced the concept of the Phillips curve, depicting an inverse association between the wage rate (inflation) and unemployment level. The Phillips curve shows that a rise in the wage rate will lead to a fall in unemployment, and a decline in the wage rate will result in an increase in unemployment. Therefore, in any economy, inflation can be managed by altering the level of unemployment (Totonchi, 2011).

The further stage of the Phillips curve is given by Phelps and Milton Friedman and is called natural rate of unemployment hypothesis. This stage distinguishes between a short-run and long-run Phillips curve. In the short term, there is a negative association between inflation and unemployment, but over a period of time, unemployment becomes stable and does not alter with any change in the inflation rate. This stable unemployment rate is known as the natural rate of unemployment, and the Phillips curve is a vertical, straight line at this level. This stage of Phillips Curve is based on an assumption that people make expectations about inflation on the basis of adaptive or past expectations (Frisch, 1983).

The latter stage of the Phillips curve is given by new classical or rational expectation economists. In this approach, there is no distinction between the short-run and the long-run, and the Phillips curve is a vertical straight line at the natural rate of unemployment level. It is based on the assumption that economic agents act rationally and take decisions on the basis of all the past and current available information (Totonchi, 2011).

3. Literature Review

Forecasting is the mechanism of predicting future trends on the basis of prior data. There has been a quest in the extant literature regarding the appropriate selection of models for forecasting.

One side of literature views linear models are better in forecasting than non-linear models (Awel, 2018; Liu et al., 2012), while the other side offers an opposing view (Marcellino, 2008). However, economic indicators for different

countries can be forecasted by using either or both the methods. In time series forecasting, the statistical and primitive methods of forecasting are considered linear, whereas Artificial Neural Networks (ANN) emerged as a non-linear tool (Stock & Watson, 1998). For instance, in the study by Awel (2018) the economic growth for Ethiopia is predicted for the period 2015 to 2017 by considering the sample from the period 1980 to 2014, by employing the Box–Jenkins Approach. The study discusses the importance of the univariate time series model in a data limited environment and also compares the prediction precision of the univariate model with other forecasters. It is found that the ARIMA (1,1,1) model performs better than the IMF World Economic: Forecasting GDP Growth Outlook (1990–2014) and World Bank Global Economic Prospects (2007–2014) forecasters based on Root Mean Square Error (RMSE) and Mean Absolute Errors (MAE). In addition, the study proposes to look into the VAR model to improve the forecasting. In a similar study, Rahman et al. (2019) uses Exponential Smoothing and ARIMA model to project the ten years growth rates of Bangladesh by taking the data for the period 1982 to 2018. In another study by Liu et al. (2012) the real economic growth for ten Latin American countries namely Brazil, Ecuador, Argentina, Venezuela, Dominican Republic, Chile, Peru, Mexico, Colombia and Uruguay is estimated by using five models: bridge equations, autoregressive model, Bayesian VAR (BVAR) model, dynamic factor model (DFM) and bi-variate VAR model. Moreover, the author evaluates the quarterly nowcast and estimates the quarterly value. The author observes that the auto-regressive model provides reliable and more accurate results using monthly data than quarterly data. Secondly, the nowcast and forecast results of the DFM model are more precise than other used models. And lastly, external indicators improve forecast values for most Latin American economies. Marcellino (2008) also conducted the study using the real-time data for the USA from the period 1980 to 2004 and analysed whether complicated time series models perform better than linear models in forecasting economic growth and inflation by employing fifty-five alternative sequences. The comparison results obtained are evaluated using a bootstrap algorithm. The author concludes that linear models outperform the non-linear models, and their relative performance is better assessed using out of sample evaluation.

However, Higgins et al. (2016) predict the economic growth and CPI inflation of China for the time period 2011 to 2015 by employing BVAR methodology and other competing models. These models are Benchmark model, the BVAR model with Sims–Zha (SZ) US prior, No Prior VAR model, Blue Chip Economic Indicators (BCEI) forecasts, the BVAR model with PLR prior, the gold standard random walk model, the BVAR model with Minnesota prior, the BVAR model with GLP prior, auto-regressive (AR) model without trend, that is AR(1), AR(6) and AR(12) and AR with trend at AR(1), AR(6) and AR(12). On the basis of comparative results, it is proven that the benchmark model yields much more reliable outcomes. Similarly, Chuku et al. (2019) depict the benefits of using ANN and non-parametric models for developing economies and observe that ANN have superior accuracy in predicting economic growth than ARIMA and structural econometric models in developing economies that are exposed to chaotic

factors and external shocks. The economic growth is estimated for South Africa, Kenya and Nigeria using primary commodity prices, inflation, trade intensity and interest rates by using the data from 1970 to 2016.

The study by De Gooijer and Hyndman (2006) throws light on the overall time series forecasting literature. The authors consider the period from 1982 to 2005 and cover nine hundred and forty papers that are summarized and classified either by models or by problems they addressed or on several issues. It is observed that the proportion of papers concerned with time series forecasting is constant over time. However, the quality of papers has changed over time in terms of statistical models, forecast calculation approaches and evaluation tools.

With regards to the variables, inflation is an important macroeconomic variable which is widely considered by researchers globally for predicting in advance. To forecast the inflation rate of different countries, the ARIMA method is highly used by several researchers. ARIMA method is generally used because of its ability to handle all types of data – stationary, non-stationary or seasonal (Chuku et al., 2019). The study made by Youness and Driss (2022), estimates the dynamics of inflation rate for Morocco by considering the data from 1971 to 2019 using the ARIMA model. The inflation rate is estimated for five years from 2020 to 2024 and findings reveal that ARIMA is the appropriate method for forecasting and ARIMA (0,1,1) provides the best result. Similarly, Omar et al. (2022) use the inflation data of Egypt from the year 2018 to 2022 in order to predict five months' inflation rate from August to December 2022 and found that ARIMA (1,1,1) is an appropriate model to foresee inflation rates. Likewise, Vafin (2020) forecasts the major macro-economic indicators, namely real exports, real investment, real consumption and real GDP, in the context of seven major economies, viz. China, France, India, Japan, Russia, the US and the UK using the ARIMA forecasting technique for the period 2020–2024. Varying results are obtained for different economies. For India, the author finds that the inflation rate will rise from a projected 6.19% in 2020 to reach 7.842% in 2021 and will be stable in subsequent years, from 2021 to 2024. The author also predicts the unemployment rate to rise in the same period. In a similar fashion, Abdulrahman et al. (2018) conducted a study on the Sudan economy. The authors employ the ARIMA methodology to estimate the inflation rates for the period 2017–2026 by taking annual data from the period 1970 to 2016 and find that the ARIMA (1,2,1) is an appropriate model for prediction and that inflation will increase in the coming years for Sudan.

On the similar grounds, Adubisi et al. (2018) predict inflation rate of Nigeria for a six-year period from 2015 to 2020 by using the data from 2006 to 2017. The findings of the research suggest that the ARIMA (1,2,1) produces best forecasted values with minimal forecast errors. Ahmar et al. (2018) conducted a study on the Indonesian economy by taking the data from January 2005 to December 2015 and confirm that the model ARIMA (1,0,0) produces best results. Similarly, Habibah et al. (2017) forecast inflation for the period 2017–2021 in the context of SAARC region by considering the economies of Pakistan, Sri Lanka, Bangladesh and India. By considering yearly data for the period 1981–2016, the authors find that the inflation rates will be higher in future for the SAARC region but still is lower than the average inflation rate of the prior year.

Several models other than Box–Jenkins ARIMA are also used to forecast inflation values. Gjika et al. (2018) use the multiple regression model and seasonal autoregressive integrated moving average (SARIMA) model to predict CPI of Albania for the years 2017 and 2018. The authors opine that for a short-term graphical projection, the results of SARIMA model are more satisfactory than that of multiple regression models. Similarly, Thakur et al. (2016) analyse the monthly data for inflation in India for the period January 2000 to December 2012 and predict the inflation for the year 2013 using feed forward back propagation neural networks. As per the authors, satisfactory results are obtained by using neural networks model. The authors also identify a set of variables namely, GDP, exchange rate, imports and exports, foreign reserves and oil and gold prices as significant factors impacting inflation in India. With the quest to find out the best model to forecast, Hussain et al. (2022) employ both ARIMA and ANN to forecast inflation rates, GDP and exchange rate for Pakistan economy. It is found that ANN-based forecasts are more precise to estimate inflation as compared to the ARIMA model. However, ARIMA-based forecasts are comparatively better to predict GDP and exchange rate than that of the ANN model.

The study by Jose et al. (2021) tests the suitability of a Phillips curve relationship for forecasting CPI inflation using ARIMA and SVAR models in the context of India. The out of sample forecast are obtained for the period 2017–2018: Q4 to 2019–2020: Q4 by using the data from the period 1996–1997: Q1 to 2017–2018: Q3. The findings confirm the existence of Phillips curve relationship. Secondly, it is found that while Phillips curve-based models perform better for four-quarters ahead forecast horizon, the univariate models (SARIMA) outperform in forecasting one-quarter ahead inflation in the case of core inflation. Thirdly, SVAR model proved useful for assessing the impact of different shocks on inflation.

The inflation rate of any economy is affected by several factors. Totonchi (2011) reviews and analyses the theories of inflation and reveals that the origins of inflation can be attributed to any of these mentioned factors, mainly supply side shock, demand side shock, monetary shocks, political factors (or the role of institutions) and structural factors. Also, it is observed that inflation is a consequence of dynamic interactions of these independent variables. The author also observes that it is not easy to attribute observed inflation into any one of its components. The author asserts that inflation is always an institutional and macro-economic phenomenon and inflation itself has a tendency to cause further inflation. Likewise, Osorio and Unsal (2013) discussed the inflation dynamics in Asia using Global Vector Autoregression (GVAR) model and Structural Vector Autoregression (SVAR) model. The authors analyse the impact of demand shock and supply shock in price rise and the extent to which these shocks are derived from foreign and domestic sources. In analysis, demand sources comprise output gaps and monetary shocks (interest rates, money supply and exchange rates) while supply factors comprise producer prices and commodity prices. The author uses the GVAR model for thirty-three countries over the period from 1986 to 2010. It is observed that supply pressures and monetary pressures are major forces for driving Inflation in Asia while demand shocks have played a relatively smaller