

Inflation Targeting: An Application of ARIMA Modelling Using Forecasting of CPI And WPI

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Abstract- *Inflation management is always a problem area for any person or economist holding a senior position in the finance ministry of any economy. Among other methods, the target inflation method has become quite popular to manage inflation. In this method, forecasting inflation is essential. The forecast would be able to tell the direction of the future inflation so that any corrective action can be taken to keep the inflation within the target levels. The forecast of the inflation helps the policymakers take proactive decisions to control the inflation and the economy in the long-run.*

Indexed Terms- *Inflation, Inflation Targeting, ARIMA, White Noise, Forecasting*

I. INTRODUCTION

A. Inflation and its impact on the economy

An economy is considered to be doing good provided it is in harmony with external as well as internal forces [23]-[7]. The balance of payments statement of a country reflects the external balance. However, there is no standard statement which can do the same as balance of payment does for the external balance. Hence, we need to look for other measures to ensure the internal balance or equilibrium in the economy. Inflation, interest rate, employment, production rate, etc [2] are some of the economic indicators which do reflect the internal balance of the economy. Among them, inflation is considered to be the most important indicator. Moreover, inflation plays a very vital role in the development and growth of the economy [4].

B. Methods of Inflation Management

There are several ways by which inflation can be managed. Monetary policy, fiscal policy and open market operations. The central bank of the country usually plays a pivotal role to ensure that the inflation of the economy remains under control [21]-[8]-[9]-

[10]. Inflation, if it remains within the acceptable range (usually 5% for an emerging economy similar to India), positively influence the growth and development of the economy. On the contrary, if it is below or above the acceptable range, it creates a problem for the economy. The acceptable range may be dependent upon the nation concerned [22]. This situation leads to one concept of inflation management, inflation targeting.

C. Inflation Targeting

Inflation targeting is a concept in which an acceptable range of inflation is decided by the economist. Then using all the tricks in the books, the economists try to contain or maintain the pre-decided rate of inflation [3]-[11]-[39]-[16].

II. LITERATURE REVIEW

A. Forecasting of the Time Series

Forecasting of the time series can be done with the help of several ways. Among them, the following are important methods of forecasting. The methods can be divided two broad categories: univariate and multivariate methods. In the univariate methods, it is assumed that the future value of the time-series can be determined by itself, and it does not need input from any other variable. In the univariate methods of forecasting the time series following methods are quite popular: 1) trend method; 2) moving average method; 3) exponential smoothing method; 4) regression analysis (autoregressive models); 5) machine learning and ANN; and 6) ARIMA (Auto-Regressive Integrated Moving Average Method) [38].

B. ARIMA modelling to forecast the time Series

ARIMA modelling is supposed to be the most advanced method of time series forecasting among statistical learning tools. ARIMA modelling is comprised of three parts: 1) Autoregressive (AR) part;

2) Moving average part (MA); and 3) stationarity of the time series.

Among the three parts, the third part is taken up first. A time series can be and should be modelled only when it is stationary. Stationarity (co-variance stationarity) of a time series means, for a given length of the time period, the mean and variance remain constant irrespective of the location of the time series. In addition to this, the co-variance of any two terms having 'h' time period of difference becomes zero as the 'h' is increased (weak-dependence time series). If a time-series is not stationary, it may produce spurious results which cannot be relied upon. Hence, to model a time-series, it is always recommended to ensure it is stationary (weekly dependence property is supposed to be included in the broader definition of stationarity and hence by saying a series is stationary, it is taken for granted that it is also weekly dependent series) [12].

The time series are usually not stationary at the level. However, usually, they become stationary if time-differencing is done [15]. If the time differencing is done one time, the order of integration (or stationarity) is considered '1'. If the stationarity is seen after two differencing, the integration is considered as '2'. In case a time series is stationarity in the level itself, it is called integrated of the order '0'. The third term in the ARIMA modelling denotes the integration of the time series. Unless it is converted into a stationary time series, ARIMA modelling cannot be performed.

The next step is to go for AR part. AR stands for autoregressive models. Here the lagged values of the time-series decide the future values. The next step in the ARIMA modelling is MA term. MA stands for moving average term. It is a misnomer to call it moving average as there is nothing moving average in this. In fact, it is lagged values of a random term through a random process (white noise process or term). The last step in the ARIMA modelling is to determine the lag length using information criteria.

C. Volatility in the market and inflation

Stock markets are an integral part of any economy [34]-[31]-[28]-[26]-[30]. Market Efficiency is something which also helps to understand whether the market is mature or not [18]-[19]-[17]-[28]. Although

there may not be any direct association between volatility in the market and inflation, it is seen that high volatility if sustains for long, causes inflation. The volatility may not be limited to the stock market. It can be seen in the markets other than the stock market including the commodities market [29]-[28]-[36]. The commodities markets are derivatives market of commodities where they can very well be used for hedging, which can be contributory to the inflation [37]-[35]-[25]-[27]-[33].

D. Miscellaneous discussion

The volatility present in the international market can very well be transferred to the domestic market through the volatility spillover effect [32]-[33]-[24]-[27]. Dividends paid in the market may also indirectly contribute to inflation in the domestic country [5]-[6]-[20]-[21].

In addition to these, machine learning tools (ML) and artificial neural networks (ANN) are the other popular methods which are used for the forecasting of the [1]-[13].

III. DATA

Monthly data of inflation (WPI and CPI) from February 2011 to January 2022 is gathered for the purpose.

IV. ISSUES TO BE ADDRESSED

ARIMA modelling can be used for the forecasting of a time series. The data of WPI and CPI indices can be used to predict the inflation in the coming months.

- 1) Estimate WPI and CPI values per month for the coming quarter.
- 2) Calculate the WPI and CPI based inflation for all the three months of the coming quarter.

REFERENCES

- [1] Ahmed, N. K., Atiya, A. F., Gayar, N. E. & El-Shishiny, H. (2010), "An empirical comparison of machine learning models for time series forecasting", *Econometric reviews*, Vol. 29 No. 5-6, pp. 594-621.

- [2] Alvarez, F., Lucas, R. E. & Weber, W. E. (2001), "Interest rates and inflation", *American Economic Review*, Vol. 91 No. 2, pp. 219-225.
- [3] Balakrishnan, P. & Parameswaran, M. (2021), "Modelling Inflation in India", *Journal of Quantitative Economics*, Vol. 19 No. 3, pp. 555-581.
- [4] Barro, R. J. (2013), "Inflation and Economic Growth Annals of Economics and Finance", *Society for AEF*, Vol. 14 No. 1, pp. 121-144.
- [5] Bhimavarapu, V. M. & Rastogi, S. (2021), "Dividend and Bank Performance in India: Evidence using Panel Data Analysis", *International Journal of Management and Humanities*, Vol. 6 No. 1, pp. 1-4.
- [6] Bhimavarapu, V. M., Kanoujiya, J., & Rastogi, S. (2022), "An Impact of Default Risk and Promoters' Holding on the Dividend Policy in the Firms in India: Evidence using Panel Data", *International Journal of Management and Humanities*, Vol.8 No.6, pp. 12-18. <https://www.ijmh.org/wp-content/uploads/papers/v8i6/F1420018622.pdf>
- [7] Corden, W. M. (1960), "The geometric representation of policies to attain internal and external balance", *The Review of Economic Studies*, Vol. 28 No. 1, pp. 1-22.
- [8] Gautam, R. S., Bhimavarapu, V. M., & Rastogi, S. (2021), "Impact of Digitalization on the Farmers in India: Evidence Using Panel Data Analysis", *International Journal of Management and Humanities (IJMH)*, Vol. 6 No. 1, pp. 5-12.
- [9] Gautam, R. S., Kanoujiya, J., Bhimavarapu, V. M., & Rastogi, S. (2021), "Financial Technology and Its Impact on Poverty in India", *International Journal of Management and Humanities (IJMH)*, Vol. 6 No. 3, pp. 1-10.
- [10] GAUTAM, R. S., RASTOGI, D. S., & RAWAL, A. (2022), "Study of Financial Literacy and Its Impact on Rural Development in India: Evidence Using Panel Data Analysis", *Iconic Research and Engineering Journals*, Vol. 5 No. 9, pp. 483-492.
- [11] Gelos, G. & Ustyugova, Y. (2017), "Inflation responses to commodity price shocks – How and why do countries differ?", *Journal of International Money and Finance*, Vol. 72 No. C, pp. 28-47.
- [12] Giles, D. E. (2007), "Spurious regressions with time-series data: further asymptotic results", *Communications in statistics—Theory and methods*, Vol. 36 No. 5, pp. 967-979.
- [13] Hill, T., Marquez, L., O'connor, M. & Remus, W. (1994), "Artificial neural network models for forecasting and decision making", *International journal of forecasting*, Vol. 10 No. 1, pp. 5-15.
- [14] Kanoujiya, J., Bhimavarapu, V. M., & Rastogi, S. (2021), "Banks in India: A Balancing Act Between Profitability, Regulation and NPA", *Vision*. <https://doi.org/10.1177%2F09722629211034417>
- [15] Leybourne, S. J., McCabe, B. P. & Tremayne, A. R. (1996), "Can economic time series be differenced to stationarity?", *Journal of Business & Economic Statistics*, Vol. 14 No. 4, pp. 435-446.
- [16] Obstfeld, M. (2002), "Inflation-targeting, exchange-rate pass-through, and volatility", *American Economic Review*, Vol. 92 No. 2, pp. 102-107.
- [17] Patil, A. C. & Rastogi, S. (2019), "Time-Varying Price–Volume Relationship and Adaptive Market Efficiency: A Survey of the Empirical Literature", *Journal of Risk and Financial Management*, Vol. 12 No. 2, pp. 1-18.
- [18] Patil, A. C. & Rastogi, S. (2020a), "Multifractal Analysis of Market Efficiency across Structural Breaks: Implications for the Adaptive Market Hypothesis", *Journal of Risk and Financial Management*, Vol. 13 No. 10, pp. 1-18.
- [19] Patil, A. C. & Rastogi, S. (2020b), "Multifractal Analysis of Time-Varying Market Efficiency: Implications for Adaptive Market Hypothesis", *Test Engineering and Management*, Vol. 83 No. May-June pp. 16646–16660.
- [20] Pinto, G. & Rastogi, S. (2019), "Sectoral Analysis of Factors Influencing Dividend Policy: Case of an Emerging Financial Market", *Journal of Risk and Financial Management*, Vol. 12 No. 3, pp. 110.

- [21] Pinto, G., Rastogi, S., Kadam, S. & Sharma, A. (2019), "Bibliometric study on dividend policy", *Qualitative Research in Financial Markets*, Vol. 12 No. 1, pp. 72-95.
- [22] Pollin, R. & Zhu, A. (2006), "Inflation and economic growth: A cross-country nonlinear analysis", *Journal of post Keynesian economics*, Vol. 28 No. 4, pp. 593-614.
- [23] Portes, R. (1979), "Internal and external balance in a centrally planned economy", *Journal of Comparative Economics*, Vol. 3 No. 4, pp. 325-345.
- [24] Rastogi, S. & Agarwal, A. (2020), "Volatility Spillover Effect in Spot, Futures and Option Markets", *Test Engineering and Management*, Vol. 83 No. May-June, pp. 10114-10127.
- [25] Rastogi, S. & Athaley, C. (2019), "Volatility Integration in Spot, Futures and Options Markets: A Regulatory Perspective", *Journal of Risk and Financial Management*, Vol. 12 No. 98, pp. 1-15.
- [26] Rastogi, S. & Srivastava, V. K. (2011), "Comparative study of conditional volatility of Indian and US stock markets using GARCH (1, 1) model", *Asia Pacific Business Review*, Vol. 7 No. 1, pp. 92-101.
- [27] Rastogi, S. (2010), "Volatility Spillover Effect Acrossbric Nations: An Empirical Study", *Paradigm*, Vol. 14 No. 1, pp. 1-6.
- [28] Rastogi, S. (2011a), "Efficiency and Capital Structure of Companies in India", *ELK: Journal of Finance & Risk Management*, Vol. 2 No. 2, pp. 565-573.
- [29] Rastogi, S. (2011b), "Impact of Currency Futures on Spot Market Volatility: An Empirical Study", *Vidwat: The Indian Journal of Management*, Vol. 4 No. 2, pp. 3-8.
- [30] Rastogi, S. (2014a), "The financial crisis of 2008 and stock market volatility—analysis and impact on emerging economies pre and post crisis", *Afro-Asian Journal of Finance and Accounting*, Vol. 4 No. 4, pp. 443-459.
- [31] Rastogi, S. (2014b), "Investor apathy to stock market: a study using discriminant analysis", *Abhigyan*, Vol. 32 No. 2, pp. 1-14.
- [32] Rastogi, S., & Kanoujiya, J. (2022), "Impact of cryptos on the inflation volatility in India: an application of bivariate BEKK-GARCH models", *Journal of Economic and Administrative Sciences*. <https://doi.org/10.1108/JEAS-08-2021-0167>
- [33] Rastogi, S., Doifode, A., Kanoujiya, J., & Singh, S. P. (2021a), "Volatility integration of gold and crude oil prices with the interest rates in India", *South Asian Journal of Business Studies*. <https://doi.org/10.1108/SAJBS-02-2021-0074>
- [34] Rastogi, S., Sharma, A. & Panse, C. (2021b), "Non-participation in stock markets: A road map for policy initiatives in India", *Finance India*, Vol. 35 No. 2, pp. 521-544.
- [35] Rastogi, S., Tripathi, V. and Kuknor, S. (2022), "Informational role of futures volume for spot volatility", *Pacific Accounting Review*, Vol. 34 No. 1, pp. 49-69. <https://doi.org/10.1108/PAR-01-2020-0005>
- [36] Sarkar, A. & Rastogi, S. (2011), "Impact of gold and silver futures on the spot rate volatility: An Indian perspective", *Nice Journal of Business*, Vol. 6 No. 1, pp. 23-28.
- [37] Sharma, A., & Rastogi, S. (2020), "Spot volatility prediction BY futures and options: an INDIAN scenario", *International Journal of Modern Agriculture*, Vol. 9 No. 3, pp. 263-268.
- [38] Taylor, J. W., De Menezes, L. M. & Mcsharry, P. E. (2006), "A comparison of univariate methods for forecasting electricity demand up to a day ahead", *International journal of forecasting*, Vol. 22 No. 1, pp. 1-16.
- [39] Vega, M. & Winkelried, D. (2005), "Inflation targeting and inflation behavior: a successful story?", *International Journal of Central Banking*, Vol. 1 No. 3, pp. 153-175.