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# Impact of Macroeconomic Variables on Inflation Using Factor Analysis

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Abstract

The factor analysis concept has been presented and factor model has been proposed. The performance of the proposed network has been measured on a numerical data. To analyse the macro economic variables, which variables are more influenced on the dependent variable of inflation using factor analysis, Factor analysis is mainly suitable to extract the few factors from the vast number of related variables to a more manageable number, prior to using them in other analysis.The data used in this analysis are eight variables of macroeconomic monthly data taken from April 2009 to July 2021. The indicators included in the analysis are Inflation Rate, Crude oil, Nifty Index, USD-INR, Imports, Exports, Money Supply and IP. This work is proposed a factor analysis to identify the factors underlying the variables of a secondary data.In this study, Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of Sphericity are used to assess the factorability of the data. To determine the number of factors to be extracted, Kaiser's Criterion and Scree test are Examined.In this statistical analysis industrial production is very less to compare the other factors (independent variables) of factor analysis. The present scenario also it has a less significant impact on the economy

**Keywords:** Factor Analysis, Kaiser-Meyer-Olkin, Bartlett's test of Sphericity, Scree test, and Varimax

## 1.Introduction

Recent times, several statistical and econometric tools are employed in the analysis of multivariate data. There is an expansive literature on applied multivariate statistical methods of data analysis and reduction namely, Principal Component Analysis (PCA), factor analysis (FA), grouping, classification, clustering and so on. Factor analysis lessens the level of redundancy existing in the data by grouping random variables. the principal component and factor analysis remain the motivating tools to adopt in shrinking big data. Factor analysis is mainly to exclude the relevant factors of the data features, reduce the feature dimensionality, and optimize the network structure. Factor Analysis transforms larger dimension data

(variables) to lower dimension data (factors). Factor analysis is performed by examining the pattern of correlations between the observed measures. Measures that are highly correlated either positively or negatively are likely influenced by the same factors, while those that are relatively uncorrelated are likely influenced by different factors. Factor analysis is mainly to reduce the data dimensionality, While using the neural network to predict, it has some difficulty to design the network structure. If we design the network structure after reducing the dimensionality by factor analysis, and improve the forecasting precision and the efficiency in dealing with the problems. so, the new algorithm is more suitable to deal with the big samples with higher feature dimensionality. The primary purpose of factor analysis consists the data reduction and summarization. Normally, there are many steps for doing factor analysis, The following are the steps used for factor analysis. Preparing data, selecting a factor model, estimating communalities, Determining the Number of factors, the rotating of factor, and estimating factor scores. KMO test is a measure that has been intended to measure the suitability of data for factor analysis. In other words, it tests the adequacy of the sample size and measures sampling adequacy for each variable in the model and for the complete model

## 2.Review of Literature

There are many related studies on macroeconomic forecasting based on factor models and deep learning. For the purpose of dimension reduction under the many predictors environment, a dynamic factor approach based on principal components

**Felix Atanga Adongo (2018):** This paper adopted the principal component and factor analysis to assess nine macroeconomic variables by finding out the level of redundancy among them from the correlation matrix and grouping indicators with higher similarities into the same factors.

**Kim, H. (2008):** The study purpose is to explain correlations among variables and to examine the structure of the data. CFA analyzes only the reliable common variance of data, while PCA analyzes all the variance of data. PCA tends to increase factor loadings especially in a study with a small number of variables. CFA provides a more accurate result. Thus, PCA is not appropriate for examining the structure of data.

**Stock, J.H., Watson, M.W., 1999:** This Paper Inflation forecasts produced by the Phillips curve generally have been more accurate than forecasts based on other macroeconomic variables, including interest rates, money and commodity prices. These forecasts can however be improved upon using a generalized Phillips curve based on measures of real aggregate activity other than unemployment, especially a new index of aggregate activity based on 61 real economic indicators. Ex: IP, Exchange rates, Interest rates, Stock Prices etc.

**Nakamura, E., 2005 :** This paper evaluates the usefulness of neural networks for inflation forecasting. A simple specification of the neural network model and specialized estimation procedures from the neural networks literature appear to play significant roles in the success of the neural network model

**Hornik, K., Stinchcombe, M., White, H., 1989:** This paper studies multilayer feed forward neural networks are a general class of universal approximators. In this feed forward NN have many hidden layers are proveded. Borel measurble function is applies from one finite dimensional space to another to degree of accuracy.

**Chen, Xiaohong, Racine, J., Swanson, N., 2001:** In this paper we examine semiparametric nonlinear autoregressive models with exogenous variables (NLARX) from three classes of artificial neural networks with diffrernt types of activation functions applied. We find that all of our semiparametric models outperform a benchmark linear model based on various forecast performance measures.

**Noora Shrestha (2021):** The results have revealed that the factor analysis not only allows detecting irrelevant items but will also allow extracting the valuable factors from the data set of a questionnaire survey. The application of factor analysis for questionnaire evaluation provides very valuable inputs to the decision makers to focus on few important factors rather than a large number of parameters

## 3.Materials and Methods

The data used in this analysis are eight variables of macroeconomic monthly data taken from April 2009 to July 2021. The indicators included in the analysis are Inflation Rate, Crude oil, Nifty Index, USD-INR, Imports, Exports, Money Supply and IP. Here the applicable statistical tool is Factor Analysis.

## 4. Data Analysis

The data used in this analysis are eight variables of macroeconomic monthly data taken from April 2009 to July 2021. by using **SPSS** (Statistical Package for the Social Sciences) Software.

**Table 1.** Descriptive Statistics

| Descriptive Statistics | | | |
|---|---|---|---|
| | Mean | Std. Deviation | Analysis N |
| IP | 6.37405 | 12.005950 | 158 |
| Exports | 2165.04873 | 675.312360 | 158 |
| Imports | 3877.81196 | 1138.518746 | 158 |
| Crudeoil | 11696.88832 | 3042.628887 | 158 |
| NiftyIndex | 8712.65312 | 3449.599081 | 158 |
| USDINR | 62.00312 | 9.994012 | 158 |
| moneysupply | 115972.45646 | 45071.011396 | 158 |

**Table 2.** Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity

| KMO and Bartlett's Test | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .832 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1525.390 |
| | df | 21 |
| | Sig. | .000 |

Table 2 illustrates the value of KMO statistics is equal to 0.832 > 0.6 which indicates that sampling is adequate and the factor analysis is appropriate for the data. Bartlett's test of Sphericity is used to test for the adequacy of the correlation matrix. The Bartlett's test of Sphericity is highly significant at $p < 0.001$ which shows that the correlation matrix has significant correlations among at least some of the variables. The significant value < 0.05 indicates that a factor analysis may be worthwhile for the data set. KMO value, 0.832, which can be considered good and also indicates that factor analysis is useful for the variables.

**Table 3.** Communalities

| Communalities | | |
|---|---|---|
| | Initial | Extraction |
| IP | 1.000 | .026 |
| Exports | 1.000 | .807 |
| Imports | 1.000 | .829 |
| Crudeoil | 1.000 | .788 |
| NiftyIndex | 1.000 | .966 |
| USDINR | 1.000 | .778 |
| moneysupply | 1.000 | .944 |
| Extraction Method: Principal Component Analysis. | | |

**Table 4.** Eigenvalues (EV) and Total Variance Explained

| Total Variance Explained | | |
|---|---|---|
| Component | Initial Eigenvalues | Extraction Sums of Squared Loadings |

| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
|---|---|---|---|---|---|---|
| 1 | 5.138 | 73.403 | 73.403 | 5.138 | 73.403 | 73.403 |
| 2 | .992 | 14.172 | 87.575 | | | |
| 3 | .427 | 6.102 | 93.678 | | | |
| 4 | .261 | 3.723 | 97.401 | | | |
| 5 | .120 | 1.716 | 99.117 | | | |
| 6 | .046 | .659 | 99.776 | | | |
| 7 | .016 | .224 | 100.000 | | | |
| Extraction Method: Principal Component Analysis. | | | | | | |

Table 4 demonstrates the eigenvalues and total variance explained. The extraction method of factor analysis used in this study is principal component analysis. Before extraction, seven linear components are identified within the data set. After extraction and rotation, there isone linear component within the data set for the eigenvalue > 1. The result shows that 73.4% common variance shared by seven variables can be accounted by one factor. This is the reflection of KMO value, 0.832, which can be considered good and also indicates that factor analysis is useful for the variables

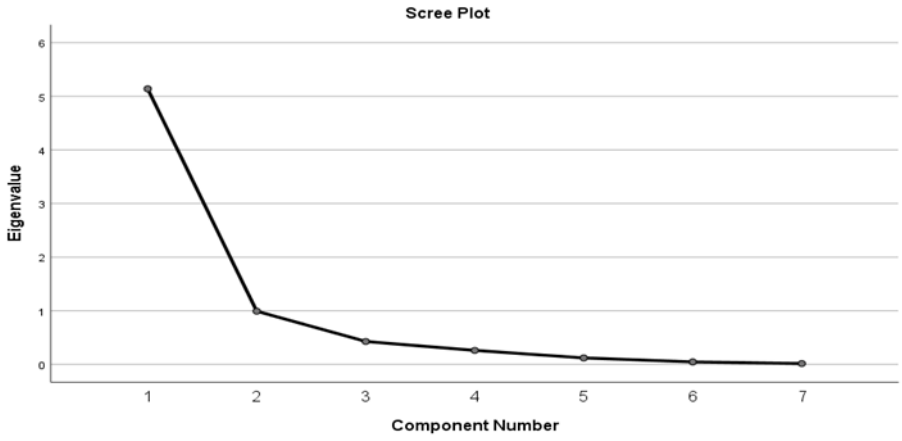


**Figure 1.** Scree Plot of Figure 1

In Figure 1, for Scree test, a graph is plotted with eigenvalues on the y-axis against the eleven component numbers in their order of extraction on the x-axis. The initial factors extracted are large factors with higher eigenvalues followed by smaller factors. The scree plot is used to determine the number of factors to retain. Here, the scree plot shows that there are three factors for which the eigenvalue is greater than one and account for most of the total

variability in data. The other factors account for a very small proportion of the variability and considered as not so much important

**Table 5.** Component Matrix

| Component Matrix[a] | |
|---|---|
| | Component |
| | 1 |
| IP | .160 |
| Exports | .899 |
| Imports | .910 |
| Crudeoil | .888 |
| NiftyIndex | .983 |
| USDINR | .882 |
| moneysupply | .972 |
| Extraction Method: Principal Component Analysis. | |
| a. 1 components extracted. | |

The present study has executed the extraction method based on principal component analysis and the orthogonal rotation method based on varimax with Kaiser normalization.

## 5. Conclusion

Based on the above results of this study, it can be concluded that factor analysis is promising approach to extract significant factors to explain the maximum variability of the group under study. The result shows that the factor analysis is certainly a better choice for the present problem. we discuss various factor models and empirically apply them in forecasting the macroeconomic data variables. We found that six of these indicators including Exports, Imports, Crudeoil, NiftyIndex, USDINR, and Money Supply showed a very high Extraction compared to Industrialproduction(IP).but Inflation on its own uniqueness from the others was classified as Inflation Factor. We finding that factor models and we consider the non linearity and interaction of variables are significant in forecasting the macroeconomic data. However, at the same time, which are assumed to accommodate complex non linearity and interaction of variables, do not necessarily enhance the forecast accuracy. Furthermore, not only factor models but also model selection through composite forecast improves the

forecast performance, and specifically, their joint application is beneficial for macroeconomic variables in forecasting the data.

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**References**

1. Seth R, Tripathi V. Stock Market Performance and Macroeconomic Factors: The Study of Indian Equity Market. Glob Bus Rev. 2014 May 1;15.
2. Tavakol M, Wetzel A. Factor Analysis: a means for theory and instrument development in support of construct validity. Int J Med Educ. 2020 Nov 6;11:245–7.
3. Ayuni NWD, Sari IGAMKK. Analysis of factors that influencing the interest of Bali State Polytechnic's students in entrepreneurship. J Phys Conf Ser. 2018 Jan;953(1):012071.
4. Jia W, Sun M, Lian J, Hou S. Feature dimensionality reduction: a review. Complex Intell Syst. 2022 Jun 1;8(3):2663–93.
5. Kim HJ. Common Factor Analysis Versus Principal Component Analysis: Choice for Symptom Cluster Research. Asian Nurs Res. 2008 Mar 1;2(1):17–24.