A VAR Model Analysis of Consumer Price Index Volatility in the UK (2001-2022): Impact of Macroeconomic Variables.

**INTRODUCTION**:

Consumer Price Index or CPI is one of the most important indications reflecting the mean alterations in consumers’ expenses for specified goods and services over time. It serves as a benchmark for understanding inflation trends in an economy. This helps professionals in policymaking, analyse the economy and manage various forms of risk. Understanding the relation between CP1 and another macroeconomic variable will lead to a better understanding of how parameters react in the economy for effective decision-making.

VAR or Vector Autoregression modelling is used to examine the relationship between variables to discover the maximum possible losses over a specified time frame. This study consists of analysing the yearly data so that the relationship between macroeconomic variables and CPI volatility is understood. Through his study, the extent of the contribution of the variables to the changes in consumer price levels over time can be analysed.

There are several models that can be used to understand the effect of variables in econometrics but two alternative models most appropriate for the given study are:

VAR Model: In the paper "The Relationship Between Selected Financial and Macroeconomic Variables with Consumer Confidence Index.” by Cagatay Basarir Ibrahim, Murat Bicil, Ozer Yilmaz uses the procedure of VAR to analyse consumer price index of Turkey along with variables lie industrial production index, BIST 100 closing prices ,consumer confidence index and dollar exchange rate. After performing the unit root tests, the dataset was found to be non-stationary and hence stationarity was achieved using the method of differencing. Granger causality tests were performed to understand the casual relationships between variables. This was followed by VAR model estimation with optimal lag length determination. The insights generated show that when it comes to consumer confidence index, the exchange rate affects the most in terms of predicting the CCI variance. After that the parameters affecting the CCI, are in order of CPI followed by BIST 100 and finally the industrial production index. For consumer price index or CPI, exchange rate has had the most impact followed by CPI BIST 100 CCI and industrial production index. When it comes to exchange rate, CPI has the most impact on this variable which is preceded by BIST 100 ,CCI and industrial production. Finally for industrial production, the exchange rate is the most influential followed by CCI,CPI and finally BIST 100.

GARCH MODEL

In the study of “Analysing Volatility of Colombo Consumer Price Index using GARCH Models” Alibuhtto (2014), a study was conducted to understand the volatility of the CPI of Colombo. The study was done by using various forms of Generalized Autoregressive Conditional Heteroskedasticity models or the GARCH models. In the study the unit root of CPI was studies using again the ADF test. The variable was found to be non-stationary and then was converted into their natural log. The unit root test was conducted again and the variable was found to be stationary. Then three models of GARCH are considered which are: GARCH (1, 1), TGARCH (1, 1), and EGARCH (1, 1). The parameters were estimated using maximum likelihood estimation and BIC conditions were used to test the optima lag order. After the analysis was done, the diagnostic tests included to check serial autocorrelation, ARCH effects, and normality of residuals. Based on the results the EGARCH model was proclaimed to be the best of all the models estimated. EGARCH model successfully capture all shocks also known as the leveraging effect. Hence EGARCH model successfully captured the volatility of the CPI with no serial auto correlation, no residuals and no ARCH effects.

Data and Methodology:

For this study, the VAR model is used to capture the volatility of CPI with respect to the other macroeconomic variable defined as follows:

Data Variables:

The variables included in the data are given below, where every variable is log adjusted for the reduction of skewness in the variable:

* Control Variable

Year: The time period of 2001 to 2022.This time period is selected to capture the recent effects as well as due to the availability of the data easily.

* Dependent Variable

LOG CPI : Consumer price index with base year as 2015.

* Independent Variables

Log Returns: Measures the returns from stock market prices

LOG GDP GROWTH: Percentage of growth in Gross Domestic Product.

LOG BANK RATE: The base rate selected by the Bank of England

LOGVIX : Volatility index, capturing the sentiment of the financial markets.

LOG TOTAL TRADE INFLOWS: The total trade inflows to the country from different nations and economies.

LOG INFLOWS: The foreign direct investment made towards the nation.

LOG EXCHANGE RATE: The exchange rate is given in terms of Pounds to Dollars.

LOG UNEMPLOYMENT: The percentage of unemployment persistent throughout given years.

LOG GROWTH RATE: The percentage of population growth rate for the said years.

The country chosen for this study is the United Kingdom.

DATA ANALYSIS:

* Stationarity test



The stationarity test is conducted using the Augmented dickey fuller test or the ADF test. Here the Z-score for all critical values are given at 1%,5% and 10% significance level. Since the p-value is estimated to be which is definitively less than all the critical values at all levels, it is to be claimed that the variable LOG CPI is stationary. It is important to establish stationarity as it gives insights on the dependent variable having a mean variance and covariance, constant over time. It establishes a better model to be forecasted using time series.

* VAR MODEL



Following the ADF test, the data set is declared to be time series with a gap of one year in between. Then the VAR model is estimated with LOGCPI being the dependent variable and rest of the variables being exogenous by nature. The maximum number of lags is taken as 2 to begin with.

From the analysis it is clear that CPI at lag 2 is insignificant but is significant at lag 1. This means that the consumer price index of previous years has a short run effect on the current CPI. Among the independent variable Bank Rate, Volatility Index at 10% critical level, Trade Inflows, Foreign direct Investments are significant in terms of p-value metric. This refers that according to this model, Stock Price Returns, GDP growth, Unemployment and Exchange Rate do not have a significant impact on the CPI. The results in the test may not be synonymous to the results of the VAR model chosen as different parameters are taken to evaluate the model. The reason for the insignificance of some of the variables can be due to various reasons like non stationarity, heteroscedasticity, autocorrelation among the variables themselves etc. But it can be concluded that in terms of hierarchy Volatility index has the highest impact on CPI followed by Bank Rate, preceded by Foreign Direct Investment and finally with Trade Inflows, the relationship between trade inflows and CPI is inverse proportional as evident by the negative coefficient.

DIAGNOSTIC TESTS: 

After the VAR model,some diagnostics test are conducted.

The first one is to check the appropriate lag using Akaike information criterion (AIC), Bayesian information criterion (BIC) or Schwarz criterion (SC), Final Prediction Error (FPE) criterion, and Hannan--Quinn information criterion (HQC) criterions.Based on the table it is evident that at lag 1,all the coefficients of the criterions are the lowest.This indicates a lag of 1 is appropriate of rhte testing of this model.

Then in the Granger Causality test it is seen that the p-value is 0.This indicates that the time series is casual .The null hypotheisisvthat the first time series has an influence over the preceding time series is rejected.

The Largrange Multiplier test for autocorrelation at both the lag orders is insignificant.This implies that the null hypothesis of no autocorrelation is to be rejected for both lag orders and there is enough evidence to claim a presence of autocorrelation among the variables.

In the next test , the Eigenvalue stability condition is checked which is found to be unstable at lag order of 1.This concludes that the model doesnot satisfy the stability conditions.

Finally at Wald lag exclusion test in both cases for lag 2 the null hypotheisis of a set of coefficients at a specific lag all equal to zero is failed to be rejected.In case of lag 1,the null hypothesis is rejected.

Conclusion:

This study is a preliminary on what extent CPI is affected by macroeconomic variables. In future the model should include more data for a better estimation of the model. Most of the diagnostics test came out to not be significant. It is required to further understand the reasons of this. Using more advance tests and stabilizing the model would be the first criterial. If the model is stabilized further improvements can be made so that better policies can be made using this study. Then more variables can be included to understand in better detail the nuanced relationship of CPI with the economy. Also to perform modifications to understand better on how the insignificant variables can be made significance to establish their impact on CPI.

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