ANALYSIS OF THE EFFECT OF CURRENCY EXCHANGE RATE, BROAD MONEY (M3) AND OIL PRICES ON INFLATION IN INDIA

Shikha Sharma, Galgotias University
Manju Dahiya, Galgotias University

ABSTRACT

Inflation is characterised in a variety of ways. In general purpose dictionaries, such as the one produced by Orient Longman, inflation is defined as "a decrease in the value of money," not as "an increase in the consumer price index," as Goodhart observed (2000). Inflation is defined as "a persistent rise in the general price level usually attributed to an increase in the volume of money and credit compared to available goods and services," according to the Merriam-Webster dictionary. Inflation is described as a prolonged increase in the overall level of prices for goods and services, according to online economics dictionaries such as 'investopedia.com.' It is expressed as a percentage rise each year. It also represents money's dwindling purchasing value.

Purpose: Inflation has become a major concern for India's economic authorities and citizens in the previous decade. Worries arose when the inflation rate (defined as the change in the consumer price index over a twelve-month period) increased from 3.7 percent to 12.1 percent between 2001 and 2010. Inflation has since reduced to 5.2 percent in early 2015, but is on the rise again post-covid, with a 2020 inflation estimate of 6.2 percent

Methodology: This is a quantitative and analytical research. Data analysis is done mainly by statistical and econometric methods. The data analysis is done using Vector Auto Correlation Model (VECM).

Findings: Broad Money and Currency exchange rate have shown negative effect on inflation on the other hand oil prices have positive impact on inflation in long run.

Keywords: Inflation, Money supply, Broad Money, Interest Rate, Oil Prices, Exchange Rate.

INTRODUCTION

In India, the relationship between money, deficits, and prices is studied empirically. The basic model is widely used in emerging markets to analyse the inflationary effects of budget deficits. This underscores the importance of the tax system, which is common in many developing countries. As a result, fiscal-based inflation theory is more widespread in developing countries (e.g., Agheveli & Khan, 1978; Alesina & Drazen, 1991). Fiscal policy in advanced economies, at least theoretically, lags behind inflation decisions, as seigniorage income has little impact on monetary policy (Woodford, 2001). Milo (2012) uses a quantitative economic model to confirm that there is a positive link between government deficit lending in Albania, Bulgaria and Romania and the expansion of the monetary base. They also believe that fiscal imbalances are a major cause of money printing and inflation in these countries. From 1985 to 2012, studied the influence of budget deficits and extensive M2 money supply on inflation in Asian nations such as Indonesia, Malaysia, Bangladesh, Cambodia, the Philippines, Sri Lanka, Thailand, Pakistan, and Vietnam, interest rates and government spending were all sources of inflation with statistical significance.

Honohan & Lane (2003) used several regression models to describe the annual inflation gap in the euro area from 1999 to 2001. They found that changes in the nominal

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effective exchange rate were important in interpreting inflation. In a similar study, Honohan & Lane (2004) conclude that the exchange rate affects the European Union's inflation rate between the strong euro (2002–2003) and the weak euro (1999–2001). Ghosh and Kanjilal studied the influence of oil price changes on India's macroeconomic indicators from March 1991 to January 2009, and discovered that oil price changes had a considerable effect on inflation and foreign reserves.

Sek et al. (2015) estimated two classes of ARL models, one with a high oil reliance index and the other with a low oil dependence index, using annual data from 1980 to 2010. Their findings reveal that in the less oil-dependent group, the long-term association amongst oil price changes and CPI inflation, as well as oil price fluctuations, have a direct impact on domestic inflation, while in the more oil-dependent group, they have an indirect impact.

Rondina (2017) used US quarterly data from the first quarter of 1977 to the fourth quarter of 2016 to examine the impact of changes in real oil prices on New Keynesian model production and inflation. She discovers that the New Keynesian framework produces different interactions between oil prices, domestic factors, and expectations than the more constrained structural vector autoregressive (SVAR) model used in her research. It turned out that a good response was obtained. Emerging market (EME) monetary policy seeks to identify which factors are causing inflation, as non-financial factors such as frequent supply shocks drive inflation. Inflation is unpredictable and difficult to predict. It is also argued that non-monetary factors only have a short-term impact on inflation.

Monetarists believe that financial variables have a long-term impact on inflation. Therefore, the traditional model of the output gap is considered more realistic in portraying the inflation process in emerging markets. Tiwari et al. (2014) studied the relationship between the output gap and the output gap in France using the discrete and continuous wavelet method 4, and found that the output gap can predict short-term and medium-term inflation dynamics there seems to be a Phillips curve. Mohanty & John (2015) used the time-varying SVAR model to assess the primary determinants of inflation in India from 1996 to 2014, when the output gap has an uneven impact on inflation. It turned out that it has decreased in recent years investigated the Indian economy from 1989 to 2013 and found that the money supply, depreciation, and the negative output gap were the main contributors to inflation.

Data from 1951-1971 and 1951-1980 were first provided . He understands that money generates both real income and price, and that price generates real income, which generates both real income and money. Based on the analysis of 1954-1955-1982-1983, Gupta (1984) believes that both nominal and real income have a one-way impact on the money supply. Nachane & Nadkarni (1985) conclude that money has a one-sided relationship with price and is an important driver of nominal income, but using quarterly data from 1960-1961 to 1981, money and reality the relationship of production volume is ambiguous.

The intercausal relationship between money and price is also presented by Singh (1989) using a quarterly table of monthly data from 1970 to 1971 to 1986 to 1987, 1962 to 1980 and 1957 to 1986. According to Jadhav (1994), during the period 1955195619871988, money causes both price and production. As a result, the results of previous studies are inconsistent. In India, a lot of studies have been done on the consequences of government deficits, money supply, and inflation found, after Agheveli & Khan (1978), a process usually in which deficits produce inflation and inflation creates India's imbalances. Jadhav (1994) found a self-sustaining trend in government deficits and inflation in the macroeconomic framework from 1970-1971 to 1986-1987. Rangarajan & Mohanty (1998) extended their argument that the government deficit was the main driver of inflation in India until the 1990s. In contrast, Ashra et al. (2004) have not found a long-term relationship between the budget

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deficit and the RBI's net lending to the government, or between the government and M3. In doing so, they question the goal of reducing the budget deficit in order to achieve stability.

Bhattacharya et al. (2008) the effect of fluctuations in the nominal exchange rate on India's WPI and CPI was investigated. They found that they were in a cointegration relationship and that ERPT was important but incomplete. Khundrakpam & Goyal (2008), on the other hand, use more recent data to perform a cointegration analysis using the ARDL approach. In this case, the government deficit is important to facilitate the accumulation of additional reserves and the expansion of the total money supply that leads to inflation. Raj et al. (2008) employed VECM to demonstrate that in the long haul, India's exchange rate and inflation are in balance. Between 1953 and 2005, before the FRBM, and 1953-2009, after the FRBM, Khundrakpam & Pattnaik (2010) looked at the empirical relationship between budget deficits and inflation. Their results suggest that price levels and deficit spending, on the one hand, and budget deficits and price levels, on the other hand, are in a cointegration relationship. According to Mohanty (2010), rising inflation in India in 2008 and 2009 has raised concerns among policy makers because of its costs. In his view, addressing structural supply constraints, especially in agriculture, is critical to the success of monetary policy in controlling inflation.

Tiwari & Tiwari (2011) investigated the relationship between India's budget deficit and inflation, taking into account all variables that could affect the position of the budget deficit. They found that the budget deficit was not caused by inflation. Meanwhile, government spending and the money supply have proven to be important predictors of increasing fiscal imbalances. Tiwari et al. (2012) On the other hand, assessing the same dataset using the VECM method, Granger causality, and the Wald test, inflation does not actually generate a budget deficit, money supply, or government spending, and of these factors. Neither has found to cause Granger budget deficits.

In India, Ashwani (2014) used annual data from 1981 to 2011 to establish long-term and short-term relationships between inflation, the money supply, personal and social spending, and exchange rates. Mohanty & John (2015) used the time-varying SVAR model to identify the major determinants of inflation in India from 1996 to 2014. The output gap has a disproportionate effect on inflation. However, its importance has declined in recent years. Crude oil prices were the main factor in inflation from 2009 to 2011, but the budget deficit from 2011 to 2012 was the main factor.

As a result, the literature addresses a broad spectrum of inflationary variables in many economies. Some of the most important influences on inflation include the monetary base, currency rates, fiscal variables, and supply shocks. Because the material is so conflicting, empirical research on the relationship between inflation and budget deficits have failed to achieve an agreement. The RBI's Financial Working Board (RBI, 1998) investigated this and found that inflation in India could be fairly well explained by the expansion of the money supply over time.

Interest rates have been shown to be unhelpful in generating economic stability (Svensson, 2011), hence obtaining price stability should not be the exclusive goal. Current research focuses on the money supply route rather than interest rate strategies to assess inflation trends in India. Exchange rates and crude oil prices are based on the theory that exchange rate fluctuations not only directly affect the prices of imported products, but also indirectly affect the prices of locally produced products that compete with the imported products. It is treated individually as a variable that affects inflation.

In addition, crude oil prices are an important supply-side factor that makes our model incomplete. Changes in oil prices have many implications for the macroeconomic performance of the economy. Soaring oil prices have a direct impact on travel costs, resulting in higher bills and prices for oil-dependent products. The redistribution of capital and labour

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between the segments of the economy that are energy-intensive and non-energy-intensive is the result of fluctuations in oil prices.

In this article, the important components in determining inflation in India are interest rates, monetary policy, exchange rates and oil prices.

Layout of the Study: The present study is divided into six sections. Section 2 presents study of relationship between inflation and currency exchange rate. Section 3 presents the relationship between inflation and broad money. Section 4 presents the relationship between inflation and oil prices. Section 5 summarizes the findings of the significant impact of Currency Exchange Rate, Broad Money (M3) and Oil Prices on inflation. Last section deals with the conclusions.

Inflation and Currency Exchange Rate: For the country's economic performance, the exchange rate regime is critical. The exchange rate measures a country's monetary competitiveness on a global scale. A country's currency rate has a direct effect on its exports and imports. Currency appreciation hurts exports, whereas currency depreciation makes imports more expensive. The inflation targets of central banks are affected by exchange rate volatility. The exchange rate regime and economic growth have a close relationship. Although a direct or indirect relationship between the exchange rate and total economic growth is difficult to establish, the exchange rate is associated to both growth and inflation. The change in the currency rate has the greatest influence.

To study the short term and long-term relationship between the two we have used VECM process and cointegration approach.

Testing for cointegration: Even if and are non-stationary processes, there exists an in a bivariate model with y_t and x_t variables such that $y_t - x_t$ is I (0). Even if the two variables are stochastic separately, they are cointegrated or have a fixed long-term connection. The concept of VAR can be used to begin investigating such processes. A VAR model with p lags can be expressed in general as Equation Table 1.

Table 1
LAG DETERMINATION OF VECM OF INFLATION AND CURRENCY EXCHANGE RATE

Sample: 2005-2021 Number of observations: 17 Selection Order Criteria

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-103.911				884.126	12.4601	12.4698	12.5581
1	-72.2625	63.296	4	0.000	34.4348	9.20735	9.23659	9.50143
2	-66.261	12.003	4	0.017	27.9923	8.97188	9.0206	9.46201
3	-63.1429	6.2362	4	0.182	33.2402	9.07564	9.14384	9.76181
4	-52.6768	20.932*	4	0.000	17.7934*	8.31492*	8.40262*	9.19715*

The FPE, AIC, HQIC, SBIC, and LR tests all chose four lags, as shown in the findings above. This indicates that four lags will explain our bivariate model of inflation and currency exchange. After determining the number of lags, the following step is to look for cointegration between the variables Table 2.

Table 2
JOHANSEN TESTS FOR COINTEGRATION

Trend: Constant Number of Obs. = 17

Sample: 2005-2021 Lags = 4

Maximum Rank	Parms	LL	Eigen Value	Trace Statistic	5% Critical Value
0	14	-61.969845		18.586	15.41
1	17	-55.468166	0.53462	5.5827	3.76
2	18	-52.676825	0.27922		

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The cointegration test uses three techniques to establish the model's rank: Johansen's static approach, the max eigen value statistic method, and finally the choice of r to minimise an information criterion. The summarized data, trend prediction, and number of lags incorporated are all listed in the header. Each conceivable value of r, the number of cointegrating equations, gets its own row in the main table.

We reject the null hypothesis of no cointegrating equations because the trace statistics at r=0 of 18.5860 is more than the crucial value of 15.41 in the table above. The null hypothesis that there is only one co-integrating relationship between inflation and currency exchange is rejected since the trace statistics at r=1 of 5.5827 surpasses the critical value of 3.76 at 5%.

Another alternative is to use the maximal eigen value test statistics. This is depicted in the table's second section. At the 5% level, the aforementioned result likewise shows that the model's number of ranks is 0. At rank 0 max statistics is less than critical value at 5% hence we accept the null hypothesis that there is no cointegration. The next step is to calculate VECM estimates.

Table 3
VECTOR ERROR CORRECTION MODEL

SAMPLE: 2005-2021				NUMBER OF OBS.= 17	
LOG LIKELIHOOD = -55.46817				AIC	= 8.525667
DET (SIGMA_ML) = 2.339442				HQIC	= 8.60849
				SBIC	= 9.35888
Equation	Parms	RMSE	R- Square	Chi 2	P> Chi 2
D_Inflation rate	8	1.17164	0.8057	37.31257	0.0000
D_Currency Exchange	8	2.99857	0.5634	11.61556	0.1692

The Table 3 above shows all the information about the variables. Along with the information R Square value along with p values is also given. According to the R Square value of two variables inflation justify the causality more as compared to currency exchange and p value of inflation is significant.

Table 4
SIGNIFICANT P-VALUE

	Coef.	**Std. Err.**	**z**	**P> IzI**	**95% Conf. Interval**	
D_Inflation rate.						
_ce1						
l1	-0.3810325	0.2033723	-1.87	0.061	-0.7796349	0.0175698
Inflation rate						
Ld	-0.3290106	0.2141839	-1.54	0.125	-0.7488034	0.0907822
L2d	0.087453	0.2320983	0.38	0.706	-3.674513	0.5423573
l3d	0.3942337	0.2386909	1.65	0.099	-0.0735919	0.8620594
Currency Exchange						
ld	0.1172129	0.1487989	0.79	0.431	-0.1744275	0.4088533
l2d	-0.1650228	0.1436931	-1.15	0.251	-0.4466561	0.1166105
l3d	-0.4764607	0.1263627	-3.77	0	-0.724127	-0.2287945
cons	1.638336	0.427005	3.84	0	0.8014215	2.47525

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The above Table 4 shows the regression equations by taking inflation rate as dependent variable and lagged value of currency exchange rate is taken as independent variable. The results can be interpreted as:

Ce1 represents the cointegrating equation. To ascertain long term causality between inflation and currency exchange rate ce1 has to show negative coefficient and a significant p-value. As can be seen in the table above the equation although have a negative coefficient but the p value is not significant enough. Since one of the two conditions is missing VECM do not show long term causality between the two.

To examine the short term causality we look at lag coefficient and p value for each independent variable. This part explains the lagged values of currency exchange for inflation. As per the results only the third lag is significant as its p value is 0.000. This means that only third lag of currency exchange has short term causality with inflation Tables 5 & 6.

Table 5
COINTEGRATING EQUATIONS

Equations	Parms	Chi2	p>chi2
_ce1	1	0.4037417	0.5252

Table 6
JOHANSEN NORMALISATION RESTRICTION IMPOSED

beta	Coef.	Std. Err.	z	P> IzI	95% Conf. Interval	
_ce1						
Inflation rate	1					
Currency Exchange	0.0414023	0.0651588	0.64	0.525	-0.0863065	0.1691111
_cons	-6.724441					

In this inflation is the dependent variable. While considering long run situation the signs of the coefficients are reversed. This means that in long run currency exchange rate have a negative effect on inflation. The coefficients are not statistically significant as p value is high Table 7.

Table 7
LAGRANGE MULTIPLIER TEST

Lags	Chi2	Df	p>chi2
1	2.7177	4	0.60612
2	1.3619	4	0.85080

H_0: *No autocorrelation at lag order*

The null hypothesis states that no autocorrelation is present at lag order. The p values are insignificant at both the lags. This means that VECM model is free of the problem of autocorrelation.

Table 8
JARQUE BERA TEST

Equations	Chi2	df	p>chi2
D_ Inflation rate	0.648	2	0.72333
D_ Currency Exchange.	0.847	2	0.65469
All	1.495	4	0.82753

The null hypothesis states that the residuals of the variables are normally distributed. The p values of all the variables is insignificant indicating the null hypothesis is accepted. Therefore, residuals of the variables are normally distributed. Therefore, VECM does not carry the problem of normality.

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Inflation and Broad Money: The amount of money accessible in a country is known as the money supply. Domestic credit is one of the elements that causes money to move hands. The amount of domestic credit and net foreign assets in a country are used to calculate the money supply. Narrow money and quasi money are two types of money supply. Money supply is defined differently in different countries. This is because total money is determined by what is added by each country.

Inflation is one of the issues linked with increased money supply (Sinah, 2018). Inflation, according to is a prolonged rise in the overall price level caused by a rapid expansion of the aggregate money supply. Individuals will have more money on their hands as the money supply grows, and they will demand more items. Demand pull inflation will result as a result of this. As a result, central banks must maintain tight control over money supply to prevent becoming caught in periods of high inflation. At the same time, a country must avoid falling into deflation or experiencing zero inflation. Both of these circumstances are harmful to a country's health.

Testing for cointegration: Even if and are non-stationary processes, a exists in a bivariate model with yt and xt variables such that y_t-x_t equals I. (0). Even if the two variables are independently stochastic, they are cointegrated or have a fixed long-term relationship. The VAR concept can be used to start looking into such processes Table 9.

Table 9
LAG DETERMINATION OF VECM OF INFLATION AND CURRENCY EXCHANGE RATE

Selection Order Criteria
Sample: 2005-2018 Number of observations: 14

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-102.509				10452.5	14.9299	14.9214	15.0212
1	-44.6517	115.71	4	0.000	4.82446	7.23596	7.21061	7.50984
2	-43.1494	3.0046	4	0.557	7.2636	7.59277	7.55052	8.04924
3	-38.7269	8.845	4	0.065	7.79815	7.53242	7.47326	8.17147
4	-25.6501	26.154*	4	0.000	2.83108*	6.23573*	6.15967*	7.05737*

As indicated in the results above, the FPE, AIC, HQIC, SBIC, and LR tests all chose four lags. This means that our bivariate model of inflation and broad money will be explained by four lags. The next step is to seek for cointegration between the variables after calculating the number of lags.

Table 10
JOHANSEN TESTS FOR COINTEGRATION

Trend: Constant Number of Obs. = 14
Sample: 2005-2018 Lags = 4

Maximum Rank	Parms	LL	Eigen Value	Trace Statistic	5% Critical Value
0	14	-40.384037		29.4679	15.41
1	17	-26.588487	0.86065	1.8767	3.76
2	18	-25.650106	0.12545		

The cointegration test uses three techniques to establish the model's rank: Johansen's static approach, the max eigen value statistic method, and finally the choice of r to minimise an information criterion. The summary data, trend prediction, and number of lags incorporated are all listed in the header. Each conceivable value of r, the number of cointegrating equations, gets its own row in the main Table 10.

We reject the null hypothesis of no cointegrating equations because the trace statistics at r=0 of 29.4679 is greater than the crucial value of 15.41 in the Table 10 above. The null hypothesis is accepted that there is only one co-integrating link between inflation and wide

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money because the trace statistics at r=1 of 1.8767 does not surpass the key value of 3.76 at 5%.

Another option is to use statistics from the maximal eigen value test. The second section of the table depicts this. The aforementioned result also demonstrates that the model's number of ranks is 1 at the 5% level. Because the maximum statistics at rank 1 are less than the crucial threshold of 5%, we accept the null hypothesis that there is only one cointegration. Hence we got the same result from both.

Table 11
VECTOR ERROR CORRECTION MODEL

Vector error correction model
Sample: 2005-2018 Number of obs.= 14
Log likelihood = -26.58846 AIC = 6.226922
Det (sigma_ml) = .1529869 HQIC = 6.15509
SBIC = 7.002921

Equation	Parms	RMSE	R- Square	Chi 2	P> Chi 2
D_Inflation rate	8	1.83086	0.6216	9.85812	0.2751
D_ BroadMoneyM3	8	.575984	0.9979	2856.415	0.0000

The Table 11 above shows all the information about the variables. Along with the information R Square value along with p values is also given. According to the R Square value of two variables the justification of broad money is more as compared to inflation and p value of inflation is insignificant as it is greater than 0.05.

Table 12
INDEPENDENT VARIABLE

	Coef.	**Std. Err.**	**z**	**P> IzI**	**95% Conf. Interval**	
D_Inflation rate.						
_ce1						
l1	-0.8518713	1.000315	-0.85	0.394	-2.812453	1.10871
Inflation rate						
Ld	-0.1494774	0.355848	-0.42	0.674	-0.8469267	0.547972
L2d	-0.0704203	0.38742	-0.18	0.856	-0.8297496	0.688909
l3d	-0.380983	0.5582025	-0.68	0.495	-1.47504	0.7130738
Broad Money m3						
ld	-0.3934855	0.5805711	-0.68	0.498	-1.531384	0.7444129
l2d	3.449486	2.435126	1.42	0.157	-1.323273	8.222245
l3d	-0.6226087	1.780516	-0.35	0.727	-4.112356	2.867139
_cons	2.686049	1.74133	1.54	0.123	-0.7268945	6.098992

The regression equations are shown in the table above, with the inflation rate as the dependent variable and the lagged value of wide money as the independent variable. The following are the conclusions:

1. The cointegrating equation is represented by Ce1. Ce1 must have a negative coefficient and a large p-value to establish long-term causality between inflation and wide money. Although the equation has a negative coefficient, the p value is not significant enough, as shown in the table above. VECM does not reveal long-term causality between the two conditions because one of them is missing.
2. The lag coefficient and p value for each independent variable are used to investigate short-term causation. The lagged values of currency exchange for inflation are explained in this section. According to the findings, none of the broad money's lagged values are noteworthy. This suggests that none of the lags are related to inflation in the short run Tables 13 &14.

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Table 13 COINTEGRATING EQUATIONS			
Equations	Parms	Chi2	p>chi2
_ce1	1	160.4172	0.0000

Table 14 JOHANSEN NORMALISATION RESTRICTION IMPOSED						
beta	**Coef.**	**Std. Err.**	**z**	**P> IzI**	**95% Conf. Interval**	
_ce1						
Inflation rate	1					
Broad Money M3	0.3037657	0.0239835	12.67	0.000	-0.2567588	0.3507725
_cons	-3.058803					

The dependent variable here is inflation. The signs of the coefficients are flipped when studying the long term. This suggests that broad money has a negative impact on inflation over time. Because the p value is 0.000, the coefficients are statistically significant Table 15.

Table 15 LAGRANGE MULTIPLIER TEST			
Lags	Chi2	Df	p>chi2
1	5.4120	4	0.24758
2	4.5368	4	0.33820

H_0: *No autocorrelation at lag order*

At lag order, the null hypothesis states that no autocorrelation exists. At both lags, the p values are negligible. This eliminates the problem of autocorrelation in the VECM model.

Table 16 JARQUE BERA TEST			
Equations	Chi2	df	p>chi2
D_ Inflation rate	0.408	2	0.81532
D_ Broad Money M3.	1.190	2	0.55156
All	1.598	4	0.80909

The null hypothesis states that the variables' residuals have a normal distribution. The null hypothesis is accepted since all of the variables' p values are insignificant Table 16. As a result, the variable residuals are regularly distributed. As a result, VECM does not have the normalcy issue.

Inflation and Oil Prices: Crude oil price fluctuations are a worldwide phenomenon that affects every country on the planet. Because emerging economies are not financially stable and are vulnerable to external shocks, the impact of oil prices is particularly important in defining their economies. Oil price movements have a significant impact on inflation and pricing changes. Fluctuations in inflation or price levels may cause further economic shifts, affecting overall economic performance. As a result, the inflation rate is regarded as the most important economic indicator for determining the state of the economy. As a result, policymakers' primary policy objectives are price stability and low inflation.

Testing for cointegration: Even if and are non-stationary processes, there exists an in a bivariate model with y_t and x_t variables such that y_t- x_t is I (0). Even if the two variables are stochastic separately, they are cointegrated or have a fixed long-term connection. The concept of VAR can be used to begin investigating such processes Table 17.

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Table 17
LAG DETERMINATION OF VECM OF INFLATION AND OIL PRICES

Selection Order Criteria
Sample: 2005-2021 Number of observations: 17

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-113.55				2747.87	13.5941	13.6038	13.6921
1	-100.48	26.14	4	0.000	952.154	12.527	12.5562	12.8211
2	-90.5055	19.948*	4	0.001	485.035*	11.8242*	11.8729*	12.3143*
3	-89.6437	1.7236	4	0.786	751.071	12.1934	12.2616	12.8796
4	-87.2051	4.8772	4	0.300	1033.78	12.3771	12.4648	13.2593

The FPE, AIC, HQIC, SBIC, and LR tests all chose two lags, as shown in the findings above. This indicates that two lags will explain our bivariate model of inflation and oil prices. After determining the number of lags, the following step is to look for cointegration between the variables.

The cointegration test uses three techniques to establish the model's rank: Johansen's static approach, the max eigen value statistic method, and finally the choice of r to reduce an information criterion. The summary data, trend prediction, and amount of lags integrated are all listed in the header. Each conceivable value of r, the number of cointegrating equations, has a row in the main Table 18.

Table 18
JOHANSEN TESTS FOR COINTEGRATION

Trend: Constant Number of Obs. = 19
Sample: 2003-2021 Lags = 2

Maximum Rank	Parms	LL	Eigen Value	Trace Statistic	5% Critical Value
0	6	-112.53958		18.1082	15.41
1	9	-106.75757	0.45591	6.5441	3.76
2	10	-103.4855	0.29137		

We reject the null hypothesis of no cointegrating equations because the trace statistics at r=0 of 18.1082 is bigger than the important value of 15.41. The null hypothesis that there is only one co-integrating relationship between inflation and wide money is rejected since the trace statistics at r=1 of 6.5441 surpass the threshold value of 3.76 at 5%.

Use statistics from the maximal eigen value test as another alternative. This is depicted in the table's second part. The aforementioned result also shows that at the 5% level, the model's number of ranks is zero. We accept the null hypothesis that there is no cointegration because the maximum statistics at rank 0 are less than the critical threshold of 5% Table 19.

Table 19
VECTOR ERROR CORRECTION MODEL

Vector error correction model
Sample: 2003-2021 Number of obs.= 19
Log likelihood = -106.7576 AIC = 12.18501
Det (sigma_ml) = 260.3129 HQIC = 12.26072
SBIC = 12.63237

Equation	Parms	RMSE	R- Square	Chi 2	P> Chi 2
D_Inflation rate	4	1.67091	0.3438	7.857559	0.0969
D_ Oil prices	4	12.5783	0.5182	16.13581	0.0028

The information about the variables is displayed in the table above. R Square value and p values are also provided along with the information. Inflation justifies causality more

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than oil prices, according to the R Square value of two variables, and the p value of oil prices is significant.

Table 20
CURRENCY EXCHANGE RATE

	Coef.	Std. Err.	z	P> IzI	95% Conf. Interval	
D_Inflation rate.						
_ce1						
l1	-0.0079923	0.1619714	-0.05	0.961	-0.3254505	0.3094658
Inflation rate						
Ld	-0.0108398	0.2532541	-0.04	0.966	-0.5072087	0.4855291
oil prices						
ld	0.0719824	0.0267107	2.69	0.007	0.0196304	0.1243344
_cons	-0.011618	0.3932856	-0.03	0.976	0.7824435	0.7592076

The regression equations are shown in the Table 20 above, using inflation rate as the dependent Variable and lagged value of currency exchange rate as the independent variable. The following is an interpretation of the findings:

1. The cointegrating equation is represented by Ce1. Ce1 must have a negative coefficient and a substantial p-value to determine long-term causality between inflation and oil prices. Although the equation has a negative coefficient, the p value is not significant enough, as shown in the table above. VECM does not reveal long-term causality between the two conditions because one of them is missing.
2. The lag coefficient and p value for each independent variable are used to investigate short-term causation. The lagged values of oil prices for inflation are explained in this section. According to the results, none of the lags are significant because the p value is greater than 0.05 Tables 21 & Table 22.

Table 21
COINTEGRATING EQUATIONS

Equations	Parms	Chi2	p>chi2
_ce1	1	33.00507	0.0000

Table 22
JOHANSEN NORMALISATION RESTRICTION IMPOSED

beta	Coef.	Std. Err.	z	P> IzI	95% Conf. Interval	
_ce1						
Inflation rate	1					
oil prices	-0.1494348	0.0260113	-5.75	0.000	-0.200416	0.0984537
_cons	3.685568					

Inflation is the dependent variable here. When analysing the long term, the coefficients' signs are reversed. This indicates that oil prices have a long-term favourable impact on inflation. The coefficients are statistically significant because the p value is 0.000 Table 23.

Table 23
LAGRANGE MULTIPLIER TEST

Lags	Chi2	Df	p>chi2
1	3.9225	4	0.41660
2	8.1137	4	0.08750

H_0: *No autocorrelation at lag order*

The null hypothesis states that no autocorrelation exists at lag order. The p values are insignificant at both delays. The VECM model's autocorrelation problem is therefore solved Table 24.

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Table 24 JARQUE BERA TEST			
Equations	Chi2	df	p>chi2
D_ Inflation rate	3.350	2	0.18728
D_ Oil Prices	0.402	2	0.81796
All	3.752	4	0.44058

The null hypothesis claims that the residuals of the variables follow a normal distribution. Because all of the variables' p values are negligible, the null hypothesis is accepted. As a result, the variable residuals are distributed uniformly. As a result, VECM is free of the normality problem.

CONCLUSION

We looked at the impact of currency rates, broader money (M3), and oil prices on India's inflation in our research. The influence of the above variables was investigated using the VECM Model. We looked at both short and long-term effects. The findings revealed that inflation and currency exchange rates had a short-term relationship. In the long run, the two have a negative relationship. In the long run, the other link between inflation and wide money is similarly negative. When we look at inflation and oil prices, we can see that they have a positive relationship, meaning that as oil prices rise, so does inflation. Governments, RBIs, and other government agencies need to work together to design and formulate various policies that will help our country grow significantly.

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Citation Information: Sharma, S., & Dahiya, M. (2022). Analysis of the effect of currency exchange rate, broad money (m3) and oil prices on inflation in india. *Academy of Accounting and Financial Studies Journal, 26*(5), 1-13.

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Received: 02-Jun-2022, Manuscript No. AAFSJ-22-12116; **Editor assigned:** 04-Jun-2022, PreQC No. AAFSJ-22-12116(PQ); **Reviewed:** 18-Jun-2022, QC No. AAFSJ-22-12116; **Revised:** 27-Jul-2022, Manuscript No. AAFSJ-22-12116(R); **Published:** 03-Aug-2022

Citation Information: Sharma, S., & Dahiya, M. (2022). Analysis of the effect of currency exchange rate, broad money (m3) and oil prices on inflation in india. *Academy of Accounting and Financial Studies Journal, 26*(5), 1-13.