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Does Oil Inflation Lead to Increase in Prices of Agricultural Commodities?

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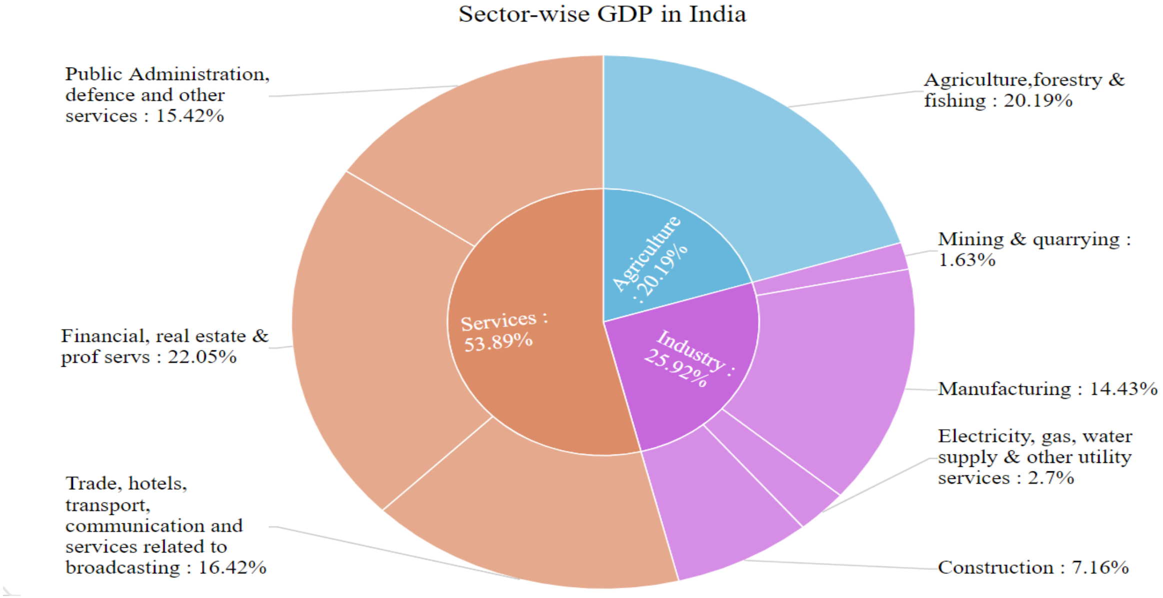
Abstract – Oil, a major component in transportation, is likely to bring about price fluctuations in the agricultural commodities when its price changes. Naturally, this relationship tends to be positive i.e., with an increase in global oil prices, the food prices would go up. This paper attempts to study this relationship and obtain its nature by taking the case of wheat (cereal), gram (pulse) and coffee with the help of Vector Error Correction Model (VECM).

Index Terms – oil prices, food prices, agricultural commodities, VEC model

I. INTRODUCTION

Energy is one of the most critical components in the production process. Manufacturing, distribution, transportation are all closely knit to oil and fuel. Consequently, any shock in oil prices is bound to impact the costs of subsequent processes involved. Additonally, the global oil prices are closely related to the price of imported crude oil for any country. The data of past 20 years verifies this result in the case of India. Such fluctuations are vividly illustrated in the agricultural commodities. Oil, an essential component of energy, is widely used in transportation of food items, processing and packaging. Grains, pulses, cereals, spices and oilseeds further serve as raw materials in preparation of other processed food items. Thus, domestic food prices tend to react to these changes in oil prices. In agrarian economies, like India, this effect is more so apparent. Agriculture contributes around 20% towards the Indian GDP and employs 56% of the workforce in the economy. Total agricultural land in the country as a percentage of the total land has witnessed an increase from about 8% in 2000 to more than 9.5% in 2020.



Source – Ministry of Statistics and Programme Implementation

This paper attempts to understand the changes in food prices explained by indicators like global oil prices, inflation rate, GDP and the gross cropped area. The case of wheat (cereal), gram (pulse) and coffee (beverage) has been used to represent the food items.

II. LITERATURE REVIEW

In the paper 'Food Inflation in India: Causes and Consequences', Bhattacharya and Gupta elicit the behaviour and determinants of food inflation in India. The analysis indicates a limited role of fuel and international prices. However, significant pass-through effects from global prices were observed for sugar and edible oils. The authors avow the widening gap between demand and supply of major food groups as a significant contributor to food inflation.

An article by Oxford University Press suggests there exists no evidence to establish oil-price driven increase in food prices in the US. Addtionally, it holds that increase in agrucultural commodities prices have a negligible effect on retail food price increase due to a small cost share of agricultural products in food prices. Thus, there is no reason to believe in a tight link between the oil prices and domestic food prices. However, the paper dawns upon the possibility of such a relationship in the developing countries.

Another paper by the Asian Development Bank studies eight Asian countries of Bangladesh, the PRC, India, Indonesia, Japan, Sri Lanka, Thailand and Vietnam to test the presence of a similar relationship with the help of Panel VAR model. It posits a positive relationship betweent the oil prices and food prices in these economies. Furthermore, the impulse response function illustrated that agricultural food prices respond to shocks in oil prices.

In the paper 'Linkages between Crude Oil and Food Prices', the authors attempt to indicate and thereafter quantify the relation between crude oil prices and selected food price indices. It is found that long term relationships exist between oil prices and meat prices. A short term relation is seen in the case of cereals. Moreover, this linkage strengthened in 2006-2020.

III. HYPOTHESIS

An increase in global oil prices leads to a subsequent rise in domestic prices of agricultural commodities in the longer run.

IV. METHODOLOGY AND RESULTS

Now that we have established why there tends to be relation between agricultural commodities prices and the fuel prices, the next step is to set up a model which could quantify both the effect and its nature.

Since other factors such as inflation rate, GDP and agricultural land are closely related to the food prices, they have been included in the model to study the nuances.

The following model will be used to determine the effects of oil price fluctuations on prices of agricultural commodities.

Price of agricultural foods = F (agricultural land, oil price, inflation rate, GDP)

In the form of an equation, we have

$$log(Agrifood_t) = \beta_0 + \beta_1. \log(Agrland_t) + \beta_2. \log(oil_t) + \beta_3. \log(inf_t) + \beta_4. \log(GDP_t) + \varepsilon_t$$

where $Agrifood$ – price of the agricultural commodity, $Agriland$ – gross cropped area of the commodity as a percentage of total land area, $oilp$ – oil prices in the global market , inf – inflation rate in the economy, GDP – GDP of the country, εt – error term

The study uses secondary data for all the variables in consideration for the years 1991 – 2020. The data is sourced from CMIE (Center for Monitoring Indian Economy). The time series data was tested for stationarity using the Phillips-Perron Test for Unit Root. To further analyse the cointegration and the long-term effects of one time series variable over the other, Johansen Test for Cointegration and the Vector Error Correction Model are used. Furthermore, the model has been tested for stability conditions and autocorrelation among the variables. All the tests in the study have been performed on Stata econometrics software.

4.1 Phillips – Perron Test for Unit Root

The test helps us to understand the nature of the variables. More often than not, the data is non-stationary in nature at level. To further analyze the data, it is essential to convert it into stationary form i.e. to ensure the data does not have unit roots. On testing through the Phillips – Perron Test, it is found that the variables are non-stationary at the level. However, at the first difference, the data is stationary and hence is fit for further analysis. The results of the test are summarized in the table below.

Table 1. Results of Phillips – Perron Test for Unit Root

Variables	**Level**		**First Difference**	
	Test Statistic	Critical Value	Test Statistic	Critical Value
Log (Domestic price of wheat)	-0.18	-3.00	-5.59	-3.00
Log (Domestic price of gram)	-1.32	-3.00	-4.42	-3.00
Log (Domestic price of coffee)	-0.98	-3.00	-4.44	-3.00
Log (Global price of oil)	-1.68	-3.00	-3.12	-3.00
Log (Inflation)	-1.68	-3.00	-3.25	-3.00
Log (GDP)	-2.99	-3.00	-3.12	-3.00
Log (Agricultural Land)	-0.81	-3.00	-5.48	-3.00

H_0 : Variable is non stationary

For each variable, at level, absolute value of test statistic < absolute critical value at 5% significance level. Hence, the null hypothesis cannot be rejected. On taking the first difference, absolute value of test statistic > absolute respective critical value for all the variables and hence we reject the null hypothesis. Thus, the model is stationary at the first difference and the variables at the first difference will be employed in further analysis.

4.2 Johansen Tests for Cointegration

Cointegration, an econometric property of time series variables, is a precondition for the existence of a long run econometric relationship between two or more variables having unit roots, integrated of order one. The Johansen approach shows that two or more random variables are cointegrated if each of the series is themselves non-stationary, and they have a long-run equilibrium relationship among the variables. The precondition for applying Johansen Cointegration test is that the variables must be non-stationary at level but stationary at the first difference.

The null hypothesis of the Maximum Eigenvalue test investigates the number of r cointegrating vectors against the alternative of r+1 cointegrating vectors.

H_0 = There is no cointegration (r = 0)

H_1 = There is cointegration among variables

The results are as follows:

Table 2 – Results of Johansen Cointegration Test for Wheat

Cointegrating Regressors	Null Hypothesis	Alternative Hypothesis	Max Statistic	5% critical value	Null Hypothesis
Log of domestic price of wheat = F (log of price of oil, log of inflation rate, log of GDP, log of gross cropped area as a % of total land)	r = 0	r = 1	76.35	33.46	Reject
	r <= 1	r = 2	38.89	27.07	Reject
	r <= 2	r = 3	21.13	20.97	Reject
	r <= 3	r = 4	8.89	14.07	Accept

Since the critical value is lesser than Max-L statistic at r = 0,1,2 we reject the null hypothesis. It is at rank 3 that Max-L statistic is lower than the critical value at the 5% significance level, thus we do not reject the null and so there exists no cointegration among all variables.

Table 3 – Results of Johansen Cointegration Test for Gram

Cointegrating Regressors	Null Hypothesis	Alternative Hypothesis	Max Statistic	5% critical value	Null Hypothesis
Log of domestic price of gram = F (log of price of oil, log of inflation rate, log of GDP, log of gross cropped area as a % of total land)	r = 0	r = 1	51.77	33.46	Reject
	r <= 1	r = 2	44.67	27.07	Reject
	r <= 2	r = 3	27.99	20.97	Reject
	r <= 3	r = 4	11.78	14.07	Accept

Since the critical value is lesser than Max-L statistic at r = 0,1,2 we reject the null hypothesis. It is at rank 3 that Max-L statistic is lower than the critical value at the 5% significance level, thus we do not reject the null and so there exists no cointegration among all variables.

Table 4 – Results of Johansen Cointegration Test for Coffee

Cointegrating Regressors	Null Hypothesis	Alternative Hypothesis	Max Statistic	5% critical value	Null Hypothesis
Log of domestic price of coffee = F (log of price of oil, log of inflation rate, log of GDP, log of gross cropped area as a % of total land)	r = 0	r = 1	61.57	33.46	Reject
	r <= 1	r = 2	25.72	27.07	Accept

Since the critical value is lesser than Max-L statistic at r = 0 we reject the null hypothesis. It is at rank 1 that Max-L statistic is lower than the critical value at the 5% significance level, thus we do not reject the null and so there exists no cointegration among all variables.

Since the variables are co-integrated, there exists a long-run relationship among them which is now further examined using the VECM test.

4.3 Vector Error Correction Model

Vector Autoregressive (VAR) model is one of the special forms of system simultaneous equations. Model VAR can be applied only if the variables are not cointegrated. But since the variables taken here are both non stationary and not cointegrated, VECM is used. It is a VAR model which has been designed for use white non-stationary data having cointegrating relationship. It is one of the time series modeling's which can directly estimate the level to which a variable can be brought back to equilibrium condition after a shock on other variables. VECM is very useful by which to estimate the short-term effect for both variables and the long run effect of the time series data. A Vector Error Correction Model (VECM), which can be derived from the long-run cointegrating vectors, can be used to determine the direction of this causality.

VECM Results

$\Delta dlogwheat_t = 0.004 - 0.408\Delta dlogwheat_{t-1} + 0.058\Delta dlogoil_{t-1} + 0.354\Delta dloginf_{t-1} + 0.234\Delta dloggdp_{t-1} + 0.103\Delta dlogagrland_{t-1} - 0.058ECT_{t-1}$

$\Delta dloggram_t = 0.008 - 0.114\Delta dloggram_{t-1} - 0.316\Delta dlogoil_{t-1} - 0.179\Delta dloginf_{t-1} - 0.978\Delta dloggdp_{t-1} - 1.886\Delta dlogagrland_{t-1} - 0.054EC_{t-1}$

$\Delta dlogcoffee_t = -0.001 - 0.498\Delta dlogcoffee_{t-1} - 0.552\Delta dlogoil_{t-1} - 0.643\Delta dloginf_{t-1} - 0.741\Delta dloggdp_{t-1} + 2.490\Delta dlogagrland_{t-1} + 0.029EC_{t-1}$

Long-run Equilibrium

Table 5 – Long-run equilibrium for Wheat

Log (Domestic price of wheat)	**Coefficient**	**Standard Error**	**Z Statistic**	**Probability**
Log (Global price of oil)	-0.22168	0.01795	-12.34	0.00
Log (Inflation)	0.28635	0.02278	12.57	0.00
Log (GDP)	-1.96909	0.05832	-33.76	0.00
Log (Agricultural Land)	10.59515	0.17209	61.57	0.00

$ECT_t = 1.00dlogwheat_t - 0.22dlogoil_t + 0.29dloginf_t - 1.97dloggdp_t + 10.56dlogagrland_t + 0.033$

Table 6 – Long-run Equilibrium for Gram

Log (Domestic price of gram)	**Coefficient**	**Standard Error**	**Z Statistic**	**Probability**
Log (Global price of oil)	1.69946	0.20974	8.10	0.00
Log (Inflation)	-0.05170	0.22239	-0.23	0.00
Log (GDP)	-1.48370	0.60614	2.45	0.00
Log (Agricultural Land)	-27.2751	2.19506	-12.43	0.00

$ECT_t = 1.00dloggram_t + 1.699dlogoil_t - 0.052dloginf_t - 1.484dloggdp_t - 27.275dlogagrland_t + 0.107$

Table 7 – Long-run Equilibrium for Coffee

Log (Domestic price of coffee)	**Coefficient**	**Standard Error**	**Z Statistic**	**Probability**
Log (Global price of oil)	21.19779	1.16556	18.19	0.00
Log (Inflation)	-4.76430	1.28857	-3.70	0.00
Log (GDP)	-11.31646	3.10874	-3.64	0.00
Log (Agricultural Land)	-211.2299	10.05175	-21.01	0.00

$ECT_t = 1.00dlogcoffee_t + 21.198dlogoil_t - 4.764dloginf_t - 11.316dloggdp_t - 211.229dlogagrland_t + 0.858$

Interpretation

Here,

dlogwheat – log(domestic wheat prices) taken at first difference

dloggram – log(domestic gram prices) taken at first difference

dlogcoffee – log(domestic coffee prices) taken at first difference

dlogoil – log(global oil prices) taken at first difference

dloginf – log(inflation) taken at first difference

dloggdp – log(GDP) taken at first difference

dlogagrland – log(percentage of gross cropped area as a percentage of total land) taken at first difference

ECT – error correction term that represents the speed of adjustment

The long-run relationship can be understood using elasticities since the model is a log-log model.

In case of wheat, a percentage increase in global oil prices leads to 0.22% fall in domestic price of wheat. The error correction term is – 0.058 which implies that previous year's errors or deviations from long-run equilibrium are corrected for within the current year at a convergence rate of 5.8%.

For gram, a percentage increase in global oil prices results in a corresponding increase in domestic price of gram by around 1.7%. As suggested by the error correction term, the previous year's errors are corrected for within the current rate at a convergence rate of 5.4%.

Similarly, coffee witnesses a rise of around 21.2% in its prices when global oil prices increase by a percent. The past year's errors are corrected for in the current year at a convergence rate of 2.9%.

V. CONCLUSION

The volatility in food prices in countries like India casts a doubt on food security. Hence, it remains a concerning topic. A part of these fluctuations could be possibly attributed to changes in global oil prices which offered a starting point to this paper. However, studying three crops – wheat, gram and coffee, portrays an ambigous result. While oil prices are positively related to crop prices in the case of gram and coffee, this relationship is inverse in case of wheat. More so, global oil prices has a significant impact on domestic coffee prices. Nevertheless, the hypothesis cannot be accepted since wheat presents an exception here. On the basis of this analysis, it is difficult to study the effect of changes in oil prices on the prices of agricultural commodities in the country in the longer-run.

VI. SCOPE FOR FURTHER RESEARCH

Although the paper attempts to cover a significant ground, there is a room for further research.

- The categories of cereals, pulses and coffee have been taken as representative of food items due to qualified data. However, the effect of fuel inflation on domestic food prices can be studied more effectively by accounting for other essential food commodities like – sugar, oil and oilseeds, fruits, vegetables etc.
- Explanatory variables can be further diversified to include essential factors like real interest rate in the economy, bio-fuel prices, government taxes/ subsidies among others.
- Further nuances like effects of food prices across different income slabs, agrarian states can be incorporated to get more pervasive results.

VII. APPENDIX

7.1 Testing for Model Stability

Table 8 – Testing stability of Model for Wheat

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
-0.70273 + 0.61689i	0.93509
-0.70273 - 0.61689i	0.93509
-0.69666	0.69666
-0.22091 + 0.23668i	0.32376
-0.22091 - 0.23668i	0.32376
0.29475	0.29475

Table 9 – Testing stability of Model for Gram

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
-0.56717 + 0.53064i	0.77669
-0.56717 - 0.53064i	0.77669
0.06479 + 0.48861i	0.49288
0.06479 - 0.48861i	0.49288
-0.34595 + 0.30719i	0.46266
-0.34595 - 0.30719i	0.46266

Table 10 – Testing stability of Model for Coffee

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
-0.60985 + 0.72059i	0.94402
-0.60985 - 0.72059i	0.94402
0.00703 + 0.57867i	0.57872
0.00703 - 0.57867i	0.57872
-0.33097	0.33097
-0.22029	0.22029

Result - The VECM specification imposes 4 unit moduli.

7.2 Testing for Autocorrelation

Serial correlation or autocorrelation occurs when the error terms in the model are related. When autocorrelation is present, the OLS procedure still produces unbiased estimates but increases the variances hence the OLS estimators ceases to be BLUE. Using the Lagrange-multiplier test:

H0 = There is no autocorrelation at lag order

Table 11 – Testing for Autocorrelation in model for Wheat

Lags	Chi-squared	Probability
1	39.8503	0.43195
2	26.4072	0.07377

Table 12 – Testing for Autocorrelation in model for Gram

Lags	Chi-squared	Probability
1	32.6497	0.14006
2	24.4054	0.49606

Table 13 – Testing for Autocorrelation in model for Coffee

Lags	Chi-squared	Probability
1	25.5493	0.03021
2	35.8950	0.38613

Since p value is more than 0.05 at the 2 lags, we cannot reject the null hypothesis and hence the model does not suffer from the problem of autocorrelation.

The author declares no conflict of interests.

VIII.REFERENCES

Baumeister, C., Kilian, L., Wagner, W., & Unalmis, D. (2014). Do Oil Price Increases Cause Higher Food Prices? *Economic Policy*, 693-747.

Bhattacharya, R., & Gupta, A. S. (2015). *Food Inflation in India: Causes and Consequences* . National Institute of Public Finance and Policy, New Delhi.

Roman, M., Gorecka, A., & Domagala, J. (2020). *The Linkages between Crude Oil and Food Prices* . MDPI.

Taghizadeh - Hesary, F., Rasoulinezhad, E., & Yoshino, N. (2018). *Volatility Linkages Between Energy and Food Prices: Case of Selected Asian Countries* . Asian Development Bank Institute .