Economic Affairs, Vol. 67, No. 03, pp. 301-306, June 2022
DOI: 10.46852/0424-2513.3.2022.22

AESSRA

Review Paper

An Econometric Analysis of Food Inflation in India

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Received: 14-02-2022 **Revised:** 17-05-2022 **Accepted:** 02-06-2022

ABSTRACT

In India, Food inflation seems to be persistent in recent years. The objective of this study was to determine the relationship between macroeconomic growth variables and food inflation in India. The period of study was from 1982-83 until 2019-20, the data on food wholesale price index, consumer price index for agricultural labour, interest rate and exchange rate were collected from various secondary sources; dummy variables of trade liberalisation and National Food Security Mission were utilised in this study. The collected data were analysed to check cointegration relationships among the variables by using the Johansen Cointegration Test (JCT) and Vector Error Correction Model (VECM). From 1982-83 to 2019-20, food inflation has been increasing at a rate of 7.47 per cent per annum. Among all the commodities eggs, meat and fish (148.9 %) were found to have a high percentage change in inflation over the last decade (2010 to 2020). The JCT results revealed a long-run cointegration relationship between variables, with three cointegration equations. The error correction model result suggested the existence of a short-run relationship between the variables and the previous year's error term was corrected at a 12.6 per cent convergence speed within the year. The Chow test was used to estimate the presence of structural breaks, and the findings ($F_{cal}>F_{tab}$) revealed that there was a substantial difference between the coefficients of the three groups. The core idea of the study is that food inflation and other macroeconomic targets must be consistent.

HIGHLIGHTS

- Food inflation in India is chronic in recent years.
- Food inflation and macroeconomic variables were integrated in the long run.
- Presence of structural break in the food inflation of India over the years.

Keywords: Chow test, Cointegration test, CPI, Food inflation and VECM

For the last two decades, India has rapid economic growth but it has been accompanied by severe food price inflation. Major contributions to food inflation in India in recent years have been prices of pulses, sugar and vegetables. Agriculture prices tend to fluctuate because demand and supply are inelastic. Despite the volatility, the price indices appear to be on a strong upward move reaching record levels. From Fig. 1, the Food wholesale price index over took overall wholesale price index after 2013 because of population increase, decrease in land use for agriculture, crop diversification, income rise etc.

The growth rate of food inflation (wholesale price index for primary article) is 7.47 per cent per annum in the past years, which are higher than overall wholesale price index. High growth rate of food inflation is recorded in the decade of 1991-2000 during which India market is integrated to international market (prices) by trade liberalization and oil prices were high during the period. Among all the commodities spices and condiments as well as egg, meat and fish was found have high percentage change in inflation over decades. Because people are most concerned on proteinaceous food, people's

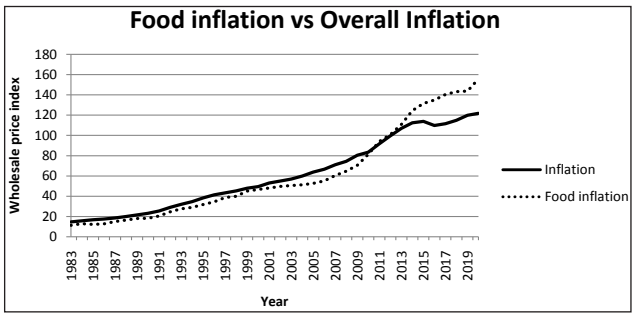
How to cite this article: Teena Lakshmi, B. and Shivakumar, K.M. (2022). An Econometric Analysis of Food Inflation in India. *Econ. Aff.*, **67**(03): 301-306.

Source of Support: None; **Conflict of Interest:** None

Table 1: Decadal percentage change in inflation (%)

Year	Cereals & Pulses	Fruits & Vegetables	Milk	Egg, Meat & Fish	Condiments & Spices	Beverages	Food Inflation	Overall Inflation
1990 – 2000	128.65	115.58	105.98	159.51	188.86	134.78	131.41	109.20
2000 – 2010	71.35	78.10	75.47	83.33	47.64	21.19	72.71	71.73
2010 – 2020	99.72	115.92	124.15	148.92	132.27	136.80	88.54	92.57

demand cannot be fulfilled with available supply in the market hence egg, meat and fish change is more (Table 1). The objective of the study is to reveal the relationship between food inflation and macro-economic factors and to examine the structural break of food inflation over the years.



Source: *Ministry of Commerce & Industry, 2020*

Fig. 1: Food inflation Vs Overall inflation

LITERATURE REVIEW

Sonna *et al.* (2014) observed that factors such as increase in rural real wages, Minimum Support Price (MSP) and input price have a short-run impact on food inflation, however in the long run, rural wages have played the most significant role in determining overall food inflation in India. From the study of Saini *et al.* (2020), there is a food – wage spiral in which changes in food prices and agricultural wages are anticipated to effect each other. Bhattacharya and Sen Gupta (2018) resulted that agricultural wage inflation is universal cause of food inflation. The analysis also indicated the minor impact of fuel and international prices in India. According to Goyal and Baikar (2015), the substantial increase in MGNREGA wages in 2011 was not caused by the rollout of MGNREGA throughout India. In Kenya, crude oil prices have a significant positive impact on food inflation and money supply has no effect on food inflation (Lidiema, 2020). Malhotra and Maloo (2017) and Gupta (2014) found that international prices performed a limited role in explaining variation in domestic food prices, whereas von Braun *et al.* (2008) discovered that increases in foreign food prices were transmitted to local markets to varying degrees. Varma and Nandi (2018) estimated that every 1 per cent increase in MSPs results in a 15 per cent increase in consumer price index (CPI) inflation. Monsoon rains have a substantial impact on agricultural production and hence food inflation due to their volume and spatial dispersion (Mohanty, 2014). Mishra *et al.* (2021) estimated that flash droughts affected 10-15 per cent of rice and maize crop areas in India each year.

METHODOLOGY

Data and Variables

The study was conducted based on secondary data from 1982-83 to 2019-20 of various variables. The time series data were collected from portal of Office of Economic Adviser, Reserve Bank of India and International Monetary Fund.

Econometric Specifications

The data were transformed in natural log form to remove unit root in the time series data and the model used for analysis is,

ln (FWPI) =

-0.62	+ 1.05 ln (ER)***	+ 0.09 ln (CPIAL)***	– -0.10 ln(IR)*	– -0.25 TLIB**	+ 0.38 NFSM***
(0.195)	(0.092)	(0.030)	(0.050)	(0.099)	(0.066)

** indicates significance at 10% level; ** indicates significance at 5% level; *** indicates significance at 1% level; Figures in parenthesis indicates standard error.*

The data processing was carried out to convert raw data into a suitable form for interpretation. The analysis was done using *stata* software and the tools used are:

1. Augmented dickey fuller test
2. Johansen cointegration test
3. Vector Error Correction Model
4. Chow test

Table 2: Selection of variables

Variables	To Measure	References
Food Wholesale price index (FWPI)	Food inflation	Bhattacharya and Sen Gupta, 2018
Income (CPIAL)	Consumer price index for agricultural labour	Saini *et al.* 2020
Interest rate (IR)	Interest rate	Bhutoria, 2020
Exchange rate (ER)	International prices	Bhattacharya and Sen Gupta, 2018
Trade liberalisation (TLIB)	Trade openness	Bhattacharya and Sen Gupta, 2018
National food security mission (NFSM)	Agricultural production supporting scheme	Sonna *et al.* 2014

1. Augmented Dicky Fuller Test

The Augmented Dickey Fuller method was used in the study to estimate the order of integration among the variables (ADF). According to the methodology, the tools of unit root tests ADF test are tested for all variables by comparing the null hypothesis 'presence of unit root' (i.e. presence of non-stationary) to the alternative hypothesis 'series is stationary'.

The model can be expressed as;

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t$$

Where, Y_t is actual time series

t is the time or trend variable

2. Johansen Cointeration Test:

The statistical implication of the existence of a long-run association between the variables is cointegration. The Johansen Cointegration Test was used to determine whether or not there was a long-run association between the variables. The integration of the variables in the same order is a necessary but not sufficient condition for the Johansen cointegration test. Two tests are used in the Johansen method to detect cointegration and the number of cointegrating vectors:

1. The Trace test:

   $\lambda_{trace}(r) = -T\sum_{i=r+1}^{g} ln\ (1 - \lambda_i')$

   The alternative of more than r cointegrating vectors is compared to the null hypothesis of r or less than r cointegrating vectors.

2. The Maximum eigenvalue test (the Max test):

   $\lambda_{max}(r,r+1) = -T\, ln(1 - \lambda r + \lambda_i')$

   The null hypothesis of exactly r cointegrating vectors is evaluated against the alternative of $r + 1$ cointegrating vectors. r is the number of cointegrating vectors, λ_i' is the estimated eigen value of order i from the matrix and T is the number of observations. The critical values are influenced by the value of $(g - r)$ and the presence of deterministic factors, and the distribution of the two test statistics is not homogeneous.

3. Vector Error Correction Model

The long-run relationship stability is being investigated using the Vector Error Correction Model estimation (VECM). The 'Vector Error Correction Specification' limits endogenous variables' long-run behaviour to cointegrating relationships while allowing for a wide range of short-run dynamics. The Cointegration term is often known as the 'error correction' term because the divergence from long-run equilibrium is gradually adjusted by a series of partial short-run adjustments. As a result, VEC modelling is useful for determining the short-run relationship between cointegrated variables.. It can be expressed as,

$$\Delta Y_t = C + \beta \Delta X_t - \delta u_{t-1}$$

Where, Y_t – dependent variable

X_t – independent variable

U_{t-1} – error term

δ - speed of error correction

4. Chow Test

Chow test was done to estimate the break in time series and to know the significance difference between the regression coefficients of groups (Park, 2011).

Null Hypothesis: No significant difference in the coefficients of three groups

Alternate Hypothesis: the coefficients of three groups differ significantly.

It was calculated using the F statistics;

$$F[(n-1)(k+1), n(T-\mathrm{k}-1)] = \frac{\left(e'e - \sum e_i' e_i\right)/(n-1)(k+1)}{\sum e_i' e_i / n(T-k-1)}$$

Where,

$e'e$ – RSS of the pooled OLS

$e_i'e_i$ – sum of RSS of the OLS for the groups.

n – no. of groups

T – no. of observations

k – no. of parameters

RESULTS AND DISCUSSION

Food inflation, exchange rate, and consumer price index for agricultural labour were all increasing annually at 7.47, 5.16 and 10.38 per cent respectively, while interest rates were declining at 1.74 per cent per year over a 38-year period from 1982-83 to 2019-2020.

Testing of Unit Roots

The presence of unit in time series root was estimated by Augmented Dickey Fuller (ADF) test. Table 3 showed that at first differencing, all of the variables were stationary.

Table 3: Augmented Dickey Fuller test

Variables	ADF test	Difference	p-value
FPI	-4.83 ***	1	0.00
ER	-4.35 ***	1	0.00
CPI	-5.99 ***	1	0.00
IR	-7.23 ***	1	0.00

*** *indicates significance at 1% level.*

Johansen Cointegration Test

The Akaike Information Criterion (AIC) and the Likelihood Ratio (LR) test collectively revealed the optimal lag length is three.

Table 4: Optimal lag selection

Lag	LR	AIC	HQIC	SBIC
0	—	-2.16	-2.07	-1.89
1	159.18	-4.73	-4.08 *	-2.84 *
2	77.72	-4.89	-3.70	-1.39
3	88.51*	-5.38 *	-3.63	-0.26

Note: *LR- Likelihood; AIC – Akaike information Criterion; HQIC - Hannan-Quinn information Criterion; SBIC - Schwartz Bayesian (SBIC) information criterion.*

At the 0.05 level, both the trace statistics and the maximum Eigen statistics (145.79 > 94.15 and 55.39 > 39.37) rejected the null hypothesis of no cointegration (Table 5). The null hypothesis of three cointegration equations among the variables was not rejected by the trace statistics or the maximum Eigen statistics at the 0.05 level (25.25 29.68 and 12.96 20.97, respectively).

Table 5: Johansen Cointegartion Test

Maximum rank	Cointegration Rank Test (Trace statistics)		Cointegration Rank Test (Maximum Eigenvalue)	
	Trace Statistic	0.05 Critical Value	Max statistics	0.05 Critical Value
0	145.79	94.15	55.39	39.37
1	90.40	68.52	41.17	33.46
2	49.23	47.12	23.98	27.07
3	25.25*	29.68	12.96 *	20.97
4	12.29	15.41	10.68	14.07
5	1.61	3.76	1.61	3.76

The Johansen cointegration test revealed a long-run cointegration relationship, with three cointegration equations between the variables food inflation, exchange rate, interest rate, consumer price index, and dummy variables of trade liberalisation and National Food Security Mission. Estimation of the vector error correction model (VECM) was significant to examine both long-run and short-run relationships between variables.

Vector Error Correction Model

A negative and significant error correction term indicated that variance will be re-equilibrate in the long-run. We can conclude from Table 6 that the error coefficient term was negative and significant which implied the presence of short run relationship between variables. The adjustment term (-0.126) was

statistically significant at 1 per cent level, implying that previous year error term was corrected for within current year at a convergence speed of 12.6 per cent. Sonna *et al.* (2014) found similar results in the short run relationship between wages and food inflation.

Table 6: Vector Error Correction Model

Dependent variable: FWPI		Coefficient	Standard Error	p-value
Ce1	L1	-0.13***	0.03	0.00
ER	L1	0.16*	0.10	0.09
	L2	0.12	0.11	0.26
IR	L1	-0.06***	0.02	0.01
	L2	-0.03*	0.02	0.09
CPI	L1	0.07****	0.02	0.00
	L2	-0.03	0.02	0.12
TLIB	L1	0.05	0.05	0.27
	L2	0.03	0.05	0.52
NFSM	L1	-0.09**	0.05	0.04
	L2	0.06	0.06	0.28
Cons		-0.08***	-0.02	0.00

** indicates significance at 10% level; ** indicates significance at 5% level; *** indicates significance at 1% level.*

Chow Test

The break is estimated by Clemente Montanes Reyes Test and in there are two breaks in the series (1994 and 2010 year) i.e., three groups (1983-1994, 1995-2010 and 2011-2020). According to Nair *et al.* (2015), during the mature stage of the Green Revolution in India (1983–1994), there was a secular shift in the country's food consumption of high-value crops. From Table 7 it can be concluded that, there is significant difference between coefficients of three groups since $F_{cal}>F_{tab}$, so the null hypothesis is rejected.

Table 7: Chow test

	RSS	Observations	K
Pooled reg	0.29	38	5
1st set (1983 - 1994)	0.01	12	5
2nd set (1995 - 2010)	0.01	16	5
3rd set (2011 - 2020)	0.01	10	5
F_{cal}	72.10		
F_{tab}	2.69		

CONCLUSION

The main objective of the study is to estimate the influence on food inflation and macroeconomic variables in India using time series data spanning 1982-1983 to 2019-20. The study included vital macroeconomic variables such as the food wholesale price index, the consumer price index for agricultural labour, the interest rate, the exchange rate, and dummy variables of trade liberalisation and the National Food Security Mission. Johansen Cointegration test and Vector Error Correction Model (VECM) were used to examine cointegration relationships of the variables. The findings revealed a long-run cointegration relationship with three cointegration equations between variables. The results of the error correction model indicated the presence of short run relationship between the variables and suggest that the previous year error term was corrected at 12.6 per cent convergence speed within year. Chow test is used to estimate the presence of structural break and from the results it was revealed that there was significant difference between coefficients of three groups. Chand *et al.* (2011) proposed increasing supply, particularly of fruits and vegetables as well as boosting investments as a short term and long-term solution to control food inflation.

REFERENCES

Bhattacharya, R. and Sen Gupta, A. 2018. Drivers and impact of food inflation in India. *Macroeconomics and Finance in Emerging Market Economies*, **11**(2): 146-168.

Bhattacharya, R., Rao, N. and Gupta, A.S. 2014. Understanding food inflation in India. *ADB South Asia Working Paper Series, No. 26*, 1-45.

Bhutoria, P. 2020. Inflation and Interest rates are in a relationship? Disponible en https://blog.smallcase.com/the-relationship-between-inflation-and-interest-rates/ (Last Accessed on 5th December 2021).

Von Braun, J. 2008. Food and Financial Crises: Implications for Agriculture and the Poor, Washington DC, International Food Policy Research Institute (IFPRI), Food Policy Report No. 20, http://www.ifpri.org/PUBS/agm08/jvbagm2008.asp Last Accessed on 25th December 2021.

Chand, R., Shinoj, P., Gulati, A. and Ganguly, K. 2011. "Managing Food Inflation in India: Reforms and Policy Options." Policy Brief 35. New Delhi, India: National Center for Agricultural Economics and Policy Research.

Goyal, A. and Baikar, A.K. 2015. Psychology or cyclicality: Rural wage and inflation dynamics in India. *Econ.Polit. Wkly*, 116-125 L(23). June 6.

Goyal, A. and Baikar, A. K. 2015. Psychology, Cyclicality or Social Programmes: Rural Wage and Inflation Dynamics in India. *Econ. Polit. Wkly.*, **50**(23): 116-125.

Lidiema, C. 2020. Trade Openness and Crude Oil Price Effects on Food Inflation: Examining the Romer Hypothesis in Kenya. *J. World Econ. Res.*, **9**(2): 91-100.

Malhotra, A. and Maloo, M. 2017. Understanding food inflation in India: A Machine Learning approach. Available at SSRN 2908354. http://dx.doi.org/10.2139/ssrn.2908354.

Mishra, V., Aadhar, S. and Mahto, S. S. 2021. Anthropogenic warming and intraseasonal summer monsoon variability amplify the risk of future flash droughts in India. *Climate and Atmospheric Sci.*, **4**(1): 1-10.

Mohanty, D. 2014. Why is recent food inflation in India so persistent?. Speech delivered at the annual Lalit Doshi Memorial Lecture, Xavier's Chapter, delivered at the St. Xavier's College, Mumbai, 13.

Nair, S.R. and Eapen, L.M. 2015. Agrarian Performance and Food Price Inflation in India: Pre-and Post-economic Liberalisation. *Econo. Polit. Wkly.,* pp. 49-60.

Park, H.M. 2011. Practical guides to panel data modeling: a step-by-step analysis using *stata*. Public Management and Policy Analysis Program, Graduate School of International Relations, International University of Japan, **12**: 1-52.

Saini, S., Gulati, A., von Braun, J. and Kornher, L. 2020. Indian farm wages: Trends, growth drivers and linkages with food prices. ZEF Discussion Papers on Development Policy, No. 301.

Sonna, Thangzason, Himanshu Joshi, Alice Sebastian and Upasana Sharma 2014. "Analytics of Food Inflation in India", Working Paper 10, Reserve Bank of India, Mumbai.

Varma, S. and Nandi, S. 2018. The changing politics of food price inflation. Disponible en https://www.livemint.com/Opinion/stLIRNoASgl8C9cHunttGK/The-changing-politics-of-food-price-inflation.html (Last Accessed on 23rd January, 2022).

Von Braun, J., Ahmed, A.U., Asenso-Okyere, K., Fan, S., Gulati, A., Hoddinott, J. and Von Grebmer, K. 2008. High food prices: the what, who, and how of proposed policy actions (No. 599-2016-40121).