IOSR Journal of Business and Management (IOSR-JBM)
e-ISSN: 2278-487X, p-ISSN: 2319-7668. Volume 20, Issue 1. Ver. I (January. 2018), PP 87-98
www.iosrjournals.org

Testing the link between Rural Wages and Food Inflation in India A Co-integration Approach

[1]Haroon Rasool, and Prof. Md. Tarique[2]
[1]*Research ScholarDepartment of EconomicsAligarh Muslim University, Aligarh. U.P India (202002)*
[2]*Department of EconomicsAligarh Muslim University, Aligarh.*
U.P India (202002)

Abstract*:Real rural wages have increased since 2007 and food inflation remained around 9 percent during 2007-2013. So the present study looks at the trends in rural wages and its linkage with food prices during July 2006 to October 2013.Using Co-integration approach followed by Granger Causality based Vector Error Correction Model (VECM), the paper empirically tests the dynamic inter- linkage between WPI food prices and rural wages by using time series monthly data. The present study employs Johansen and Juselius Co-integration approach to analyse the long run association among the variables followed by the VECM to check the direction and causality between rural wages and food pricesin short-run and long-run. Cointegration results show that there is at least one co-integration equation among the variables under. The normalized Co-integrating equation reveals that both food prices and rural wages of unskilled labourers have a significant positive effect on agricultural wages. 1 percent increase in unskilled wages of non-agricultural workers will lead to 1.01 percent increase in farm wages. Likewise, 1 percent increase in Food prices leads to 0.30 percent rise in agricultural wages. VECM indicates that all the coefficients of all the three error terms were found to be negative in sign and statistically significant at 5 % and 1% level of significance which implies that there is long run causality between the variables with feedback mechanism. We also tested short run causality based on F-statistics calculated by the 5th order VEC model by using Wald statistics between food prices and rural wages .The Wald test shows there is at least one way causation among the variables.*

Keywords: *Rural wages, Food Inflation, Co-integration,VECM, Wald Statistic, India.*
JEL Classification: E23; E31; J31.

Date of Submission: 26-12-2017 Date of acceptance: 11-01-2018

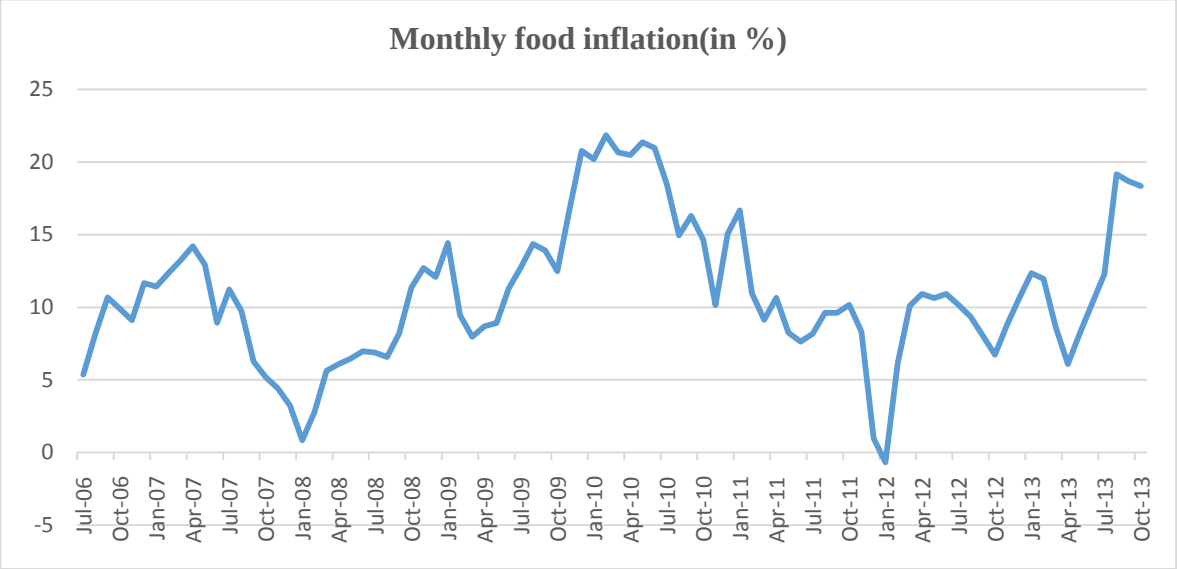
I. Introduction

Wages constitute a part of the price, therefore an increase in wages unaccompanied by productivity increases could lead to a wage-price spiral, offsetting the positive impact of an increase in real wages on welfare. It is commonly believed that higher wages lead to higher inflation. This view takes its root from the Keynesian theory of cost-push inflation which attributes the basic cause of inflation to supply-side factors. Basically, inflation results from a rise in the wage rate. Given the wage rate, firms set their prices by adding a markup which determines their profit margin. Thus, when wages are increasing, firms face higher costs of production and they pass on the higher costs in the form of increased prices *(Bridgman and Trehan, 1996).*

The behavior of food prices and rural wage inflation during the period July 2006 to October 2013 is puzzling. Inflation remained high over 2007–2013, with some fluctuations. Although growth rates fell, real rural wages rose sharply and were above the food prices. India experienced one of the highest rates of food inflation among emerging economies at an average rate of more than 9% during the period 2006 to 2013(*see fig 1*). Moreover, the rate of increase in food prices during this period was close to double digit level while as it was not so that witnessed in the previous decade**.** Persistent and high food prices since 2007 has become a major issue for the policy makers of Indian economy. The concern is not only about ensuring food security but it is also stimulating the inflationary situation in an economy, which in turn will affect adversely growth and income distribution of an economy. WPI food inflation between 2011-13 remainsroughly around 9.37% on average and in August 2013 it was 18%.This high WPI inflation for food articles has led to an intense debate among policy makers in India on its various causes.Various studies have tried to find out the causes for the increase in food inflation.The different reason that has been found includes a fall in Indian agricultural output 2008-09 and 2009-10, higher demand for food exports, continuous increase in the domestic demand for food and high value crops, higher MSP, hoarding, and speculation, higher oil and global food prices. *(Kumar et al 2010; Chand 2010; Carrasco et al 2012; Nair and Eapen 2011, 2012; Khundrakpam 2008).*

This period of high and persistent food inflation has also been reflected by high rural real wages. Daily rural real agricultural wages (deflated by WPI food prices base year 2004-05)went up from Rs.60.76 in July 2007 to Rs.80.07 inMay 2013whereas rural daily non-agricultural skilled increased from Rs.88.45 to Rs. 105.32 and daily wages of rural real non-agricultural unskilled went up from Rs. 57.49 to Rs 81.06 (based on data published by labour Bureau of India). This increase in real rural wages can affect food prices both by encouraging demand and by rising cost of production if there is no corresponding increase in the productivity level. Rising food prices, in turn, will generate inflationary expectations among workers which will induce them to demand higher nominal wages.

Figure-1



Source: RBI Database.

II. Review Of Existing Literature

*Nair and Eapan (2012)*in the paper "food price inflation in India 2008-2010" analyses the causes of high food inflation and found that due to the domestic supply side constraints, most of the commodities were subject to inflationary pressures.

G V Nadhanael (2012) in "Recent trends in rural wages: an analysis of inflationary implications" shows sharp increases in real wages since 2007 has led to significant changes in the wage-price dynamics in the rural area. While in the period prior to 2007, money wages were responding to changes in prices, in the recent period, prices are determined by wages. Both high and sustained inflation and institutional factors like the introduction of MGNREGA could explain some part of the increase in wages. Apart from this, reduced work force participation rates in recent period both on account of increased participation in education and withdrawal of female work force has also contributed to increase in wages and this generates inflationary pressures.

Gulati and Saini (2013), in the paper 'Taming Food Inflation in India'' using a variety of factors to explain food inflation found that apart from fiscal deficit and global food price index, wages has the largest contribution in recent inflation. Farm wages do have a strong influence on food prices via rising costs of production. The model shows 1% increase in this index cause close to 0.3 % increase in both food articles price index and in the food price index.

Thangzason Sonnaet al, (2014), a recent working paper from the RBI—"Analytics of Food Inflation in India" has come to the conclusion that the increase in real rural wages is the main factor behind the rise in food inflation. The other factors that have often been cited as responsible for food inflation, such as the increased intake of proteins as a consequence of rising incomes, the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) and the vagaries of the monsoon have not been found to have a significant effect. The paper's conclusions are at odds with the others that say the causation runs in the opposite direction, or that it is high food inflation that is responsible for the rise in rural wages

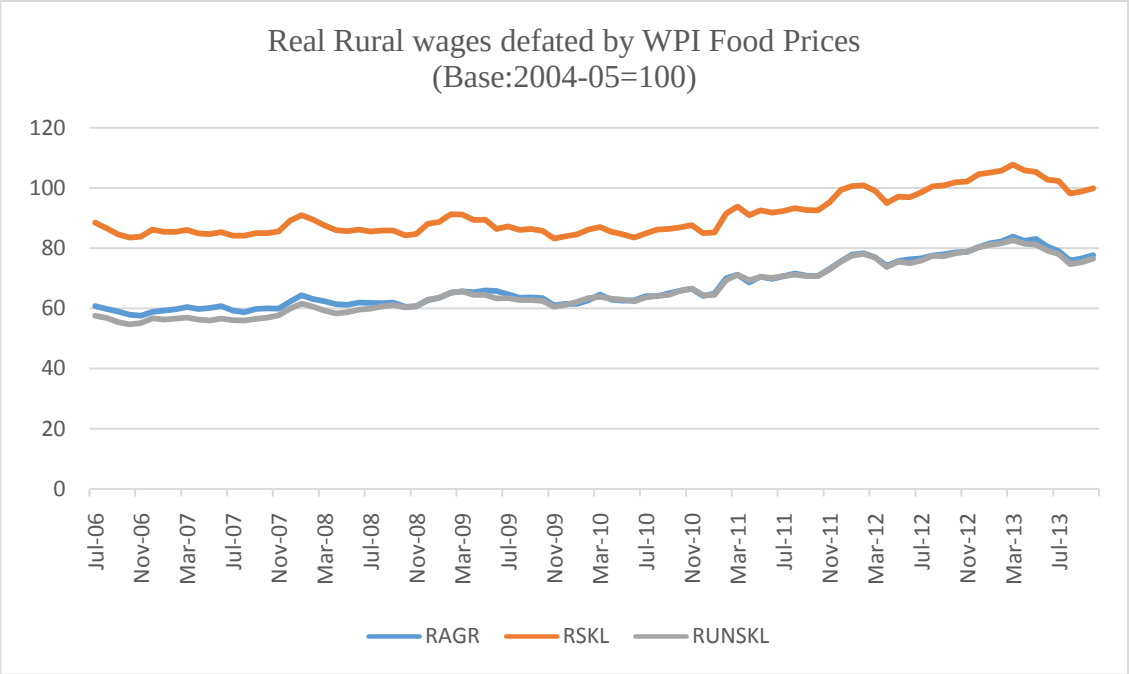
Ashima& Akash kumar, (2014) in a paper on "Psychology, cyclicality or social programmes: Rural Wage and Inflation Dynamics in India" point out that between 2005 and 2010, agriculture lost 15 million workers, who found jobs in the construction sector. This outflow of rural labour and also the withdrawal of female labour (NSSO) data must also have led to higher rural wages. Between 2010 and 2012, agriculture lost another 13 million workers.

The present study is an addition to the existing literature by incorporating the latest available data. The relationship between wages and food inflation has been worked out by categorizing the rural work force into three categories. Co-integration, VECM and Wald test were applied to analyse the both longrun and shortrun dynamics, and the direction of causality between food prices and rural wages to reach at certain definite conclusion so that it can be of some use for the policy makers.

III. Trends In Rural Wages

Recent dynamics in Indian rural wages, particularly since 2007 has received much public attention. It has now become a well-established fact that that rural wages have increased at a much faster pace than the food inflation and thereby lead to a rise in real wages *(RBI, 2012)*. This period is also characterized by the introduction of MGNREGA which guarantees 100 days of employment for each household. It has been argued that MGNREGA has been one of the contributing factors to increase wages *(CACP, 2012)*.From the figure-2, it can be noticed that there has been a significant pick-up in the rate of increase in rural real wages since 2007-08.Apart from the impact of MGNREGA on wages, it has been found that there is a significant decline in work force participation rate mostly among women which have influenced the overall structure of wages in rural India in the recent period. Improved educational facilities have been thought to be the reason behind the withdrawal of young population from work force *(Nadhanael, 2012)*. Figure-2 shows the monthly daily real rural wages deflated by WPI food prices (base year 2004-05) from July 2006 to July 2013. It clearly shows that real rural wages in India have gone up during this period. From the Figure, it is evident that the rural wages of skilled workers are higher than the farm and unskilled non- agricultural wages. The real wage rate of all the three sectors has risen without showing a uniform trend during this period. From table-1 it is clear that from august 2006 to august 2007 average growth rates of all the threesectors were negative. From December 2010 both farm wages and unskilled non-agricultural wages starts to rise continuous and were more or less equal. It is evident from the table that unskilled rural wages began to grow first followed by agricultural workers. Rural skilled wages initially shows a declining trend upto December 2009 and started to grow in the beginning of 2010 but at a slow rate.

Figure-2



Source: Labour Bureau of India

Table-1 Average growth rate of Real Rural Wages (in %)

	Farm wages	Non-agricultural unskilled	Non-agricultural skilled
August2006 - August 2007	-0.23	-0.19	-0.37

September 2007 - December 2009	0.15	0.33	0.004
January 2010- November2012	0.73	0.75	0.58
December 2012-May 2013	0.90	0.48	0.52

Source: Authors own calculations.

It has been found that real rural wages has gone up not because of any lewisian transformation or growth in the rural construction sector but there is the possibility that the bargaining power of rural workers has increased due to many public works schemes which employs mostly unskilled workers and this induces them to bargain for more wages because of high food prices *(A Guha and Triathi 2014)*.

IV. Convergence among rural wages in the recent Period

There has been a significant pick-up in rural wages since 2007, so one important aspect is whether this period is characterized by convergence in rural wages across different sectors. Therefore, identifying whether the rural wages in India have converged across different sectors (agricultural and non-agricultural) in the recent period could be helpful in realizing the fact that the increase in wage rates is temporary or more persistent. The coefficient of variation of wage rates (in Rs.) across different categories in rural India for the period under study has been calculated is given in a table-2.

Table-2 Coefficient of Variation

	(July2007-Dec2009)	(Jan2010-May 2013)
Farm wages	12.55	19.72
Unskilled Wages	14.38	19.20
Skilled Wages	10.30	14.78

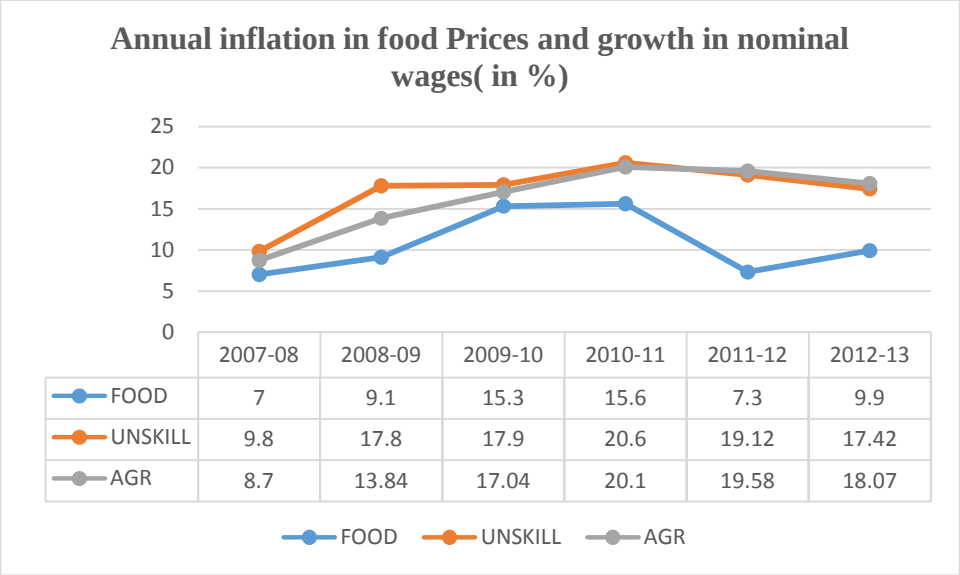
Source: Authors own calculations

The variability in the Farm and Non-agricultural Unskilled wages has increased in the recent period and both the values seem to converge with each other in the due course of time, as is also reflected in the figure-2. But there is no possibility of the existence of long run convergence between rural skilled non-farm wages and the other two rural wages. This may be due to presence of difference in labour productivity due to variations in their skills that prevent them to move from one sector to another. *So we will be using only rural wages of agricultural and non-agricultural unskilled labourers while testing the link with food prices in our empirical analysis.*

V. Food inflation and Rural Wage dynamics in India

Figure-3: show that how annual inflation in WPI food articles and growth in nominal wages (both agricultural and non-agricultural unskilled) have moved from 2007-08 to 2012-13.The following conclusion can be drawn from the graph. Firstly growth rate in nominal wages of unskilled labouers have gone up from 9.8% in 2007-08 over the previous year and after that it has increased continuously at double-digit rates between 2008-09 to 2012-13 with a staggering figure of more or equal to 17% every year. Growth in wages began in 2007-08 when nominal wages for the unskilled workers increased by 9.8%. MGNREGA was introduced in February 2006 and was implemented in different phases with the last phase in 2007-08 and this should have an impact on rural nominal wages with some lag. Secondly, the growth movements in agricultural wages in relation to rural wages for unskilled labourers shows a strong correlation between the two i.e.it shows a similar growth pattern. However, it is clear that growth rate is faster in case of unskilled non- agricultural workers followed by agricultural wages. Thus rural wages of unskilled workers have a strong influence on the rate of agricultural wages with some gestation period. Thirdly, in line with the growth rate of both agricultural as well as non-agricultural unskilled workers, WPI food inflation has also gone up. The annual inflation in food prices reached 15.6% in 2010-11, however, showing some reprieve after that and coming down to less than two digit level.

Figure-3



Sources: office of the economic advisor (GOI) & Labour Bureau of India

To sum up we can say that the steep rise in rural wages of unskilled workers during the period under study is expected to push farm wages up. It is believed that if rural wages increases, the demand for wage goods is expected to rise. The rise in demand for wage goods need not to be inflationary, if it is reflected by higher productivity. However, agricultural productivity growth has remained stagnant in the recent past (Subbarao 2011). Therefore its effect should be passed on to output prices which results in high food prices. Further, rise in agricultural wages leads to increase in the cost of production in agriculture and this should have an inflationary pressure on food prices. Therefore, it appears that food prices, agricultural wages and rural wages of unskilled workers are related to each other through a direct transmission and feedback mechanism.

It is in this background that we have undertaken an empirical study to examine the long run and causal relationship between food prices, agricultural wages, and rural wages for unskilled labourers by applying the vector error correction model (VECM).

VI. Variables used and Database

In order to examine the relationship between wages and food inflation monthly time series data has been used for the period July 2006- October2013. The monthly data of WPI (base year 2004-2005) for Food articles used as the price deflator has been collected from the official site of the RBI database. Further, we have categorized rural workers occupation into three categories- 1.Agricultural workers 2. Skilled non-agricultural and finally 3. Unskilled non-agricultural. Agricultural workers are involved in ploughing, sowing, weeding, winnowing Transplanting and harvesting. Skilled non-agricultural workers are employed as carpenters, blacksmith, mason, cobbler and tractor drivers. The simple average of daily wage rates of agricultural occupations for men has been considered as a proxy for daily agricultural wages, while the daily unskilled labour wage for men in the category of nonagricultural occupations has been considered as a proxy for the daily wages rates of rural unskilled workers. The simple average of daily rural wage rates of skilled non-agricultural occupations for men has been considered as a proxy for daily skilled rural non-agricultural wages. The data published by the Labour Bureau of India in its annual yearbook "wage rates in rural India" has been used for the average daily agricultural and rural wages of skilled and unskilled workers at the all-India level. There are five different sources of data on rural wages available in India and out of five sources the data available from the labour bureau survey of rural wage rates in India could serve as an important database for analysis. The only drawback of this source is that is not available for the years prior to 1998.

VII. Methodology

7.1 Unit root Tests of Stationary

In the analysis of time series data, non-stationarity is the most common observed complication. So, the first step involves to test the stationarity of the series .A time series is called as stationery if its mean, variance and covariance (at various lags) remains constant.

7.1.1**The Augmented Dicky- Fuller test**

The most widely unit root test for stationary is ADF test. Depending upon the essence of time series it may be represented as in the following three equations

$\Delta Y_t = \delta Y_{t-1} + u_t$(RWM without drift) ….1

$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t$ (RWM with drift) ….2

$\Delta Y_t = \beta_1 + \beta_2 + \delta Y_{t-1} + u_t$ (RWM with both drift and deterministic trend) ….3

The Augmented Dicky Fuller (ADF) test under the null of non-stationarity can be conducted to test whether a given series is stationary or not. This test is conducted by augmenting either of the above three equations by adding the lagged value of the dependent variable ΔY_t. Thus each of the above equation can be as written as:-

$\Delta Y_t = \delta Y_{t-1} + \propto_i \sum_{i=1}^{m} \Delta Y_{t-i} + e_t$ ….4

$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + e_t$ ….5

$\Delta Y_t = \beta_1 + \beta_2 + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + e_t$ ….6

Where e_t is a pure white noise error term, and the number of lagged difference term to include is determined empirically (Gujarati, 2005). In each of the above equations if δ=0, then the series is termed as non-stationary. The Dicky Fuller critical values can be used to test the significance of the null hypothesis.

7.2 Order of the Series

Having found unit roots of the time series, the order of integration becomes very important. The order of integration of a time series implies, the number of times that the series has to be differenced to make it stationary.

7.3 Co-integration:

It is well documented that most of the time series are non-stationary in their levels (integrated of order 1) but stationary in their first difference (0). If the series under consideration are of the same order then it is quite possible that there is a linear combination of integrated variables that is stationary; such variables are said to be co-integrated meaning there by that there is a long run association among the variables or in the long run they move together. (Enders, 1995). There are two popular methods for co-integration in economic literature, they are:

1. Engle Granger (1987) Method
2. Johansen and Juselius (1990) Method

The present study will use Johansen's Methodology which is based on maximum likelihood method in a VAR model for estimating co-integration in multivariate systems. Johansen's test of co-integration enables estimating and testing for the presence of multiple co-integration equations relationship in a single step procedure. This test for Cointegration is specifically meaningful if we are dealing with Cointegration a multivariate framework, which takes due care of endogeneity as well as the simultaneity problems associated with simple cointegration test. Critical values of Trace and max statistic developed by Johansen are used to identify the number of co-integrating equations. If the Test statistics is greater than the critical value at a significance level then we say that there is a presence of co-integration equation.

7.4 Error Correction Model

After identifying the co-integration among the specified variables the research has further used the VECM to check the temporal causality among the variables under consideration. The error correction model indicates the speed of adjustment back to long run equilibrium after a short run shock. The model is called error correction model because it has an auto regulating apparatus whereby deviation from the long run equilibrium is automatically corrected. (Shivam and Jayadev, 2004). The ECM shows the long run as well as short run equilibrium between the variables *(Bishnoi and Koirala, 2004).* We have used the VECM to investigate the temporal causality between the selected macroeconomic variables. The Granger Representation Theorem states that if a set of variables is co-integrated, then there exists a valid error correction representation among the variables (Engle & Granger, 1987).Hence the VECM can be used to investigate the short-run and long run causality (Granger, 1969). A set of equations to serve our purpose is as follows.

$\Delta LNAGR_t = \Phi_1 + \sum_{i=1}^{l} \gamma_1 \Delta LNWPI_{t-i} + \sum_{i=1}^{l} \gamma_2 \Delta LNAGR_{t-i} + \sum_{i=1}^{l} \gamma_3 \Delta LNUNSKL_{t-i} + \Phi_2 ECT_{LNAGRt-1} + \mathcal{E}_{LNAGRt}$ …. 7

$\Delta LNWPI_t = \eta_1 + \sum_{i=1}^{n} \beta_1 \Delta LNAGR_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta LNWPI_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta LNUNSKL_{t-i} + \eta_2 ECT_{LNWPIt-1} + \mathcal{E}_{LNWPIt}$ … 8

$\Delta LNUNSKL_t = \chi_1 + \sum_{i=1}^{m} \delta_1 \Delta LNAGR_{t-i} + \sum_{i=1}^{m} \delta_2 \Delta LNUNSKL_{t-i} + \sum_{i=1}^{m} \delta_3 \Delta LNWPI_{t-i} + \chi_2 ECT_{LNUNSKLt-1} + \mathcal{E}_{LNUNSKLt}$ ….9

Where ECT's are the error correction terms derived from the co-integrating vector. γ's, β's and δ's are the short run parameters to be estimated and Ɛ's are the white noise error terms. Negative and statistically significant parameters of ECT's would indicate the long run causality in the respective models. The short-run significance of sum of each lagged explanatory variable (γ's, β's and δ's) can be tested either by using joint F or Wald χ^2 test. The rejection of the null hypotheses ($\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = 0$), ($\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$) and ($\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$) would prove the short-run causality from food prices and unskilled wages to farm wages, agricultural wages and unskilled non-agricultural wages to food prices and from food prices and farm wages to unskilled non-agricultural wages respectively.

VIII. Results of empirical findings

8.1 Stationary Test of the variables

To estimate the model, stationarity test of the specified variables has been examined first followed by a lag order specification. Further to smoothen the data, the log transformation of all the three series has been undertaken. To check the stationarity of all the three series-log of food prices(LNWPI), log of agricultural wages(LNAGR) and log of rural wages of unskilled workers(LNUNSKL) - we conducted Augmented Dicky-fuller Test and the results are shown in table-3 and 4.

Table-3 Augmented Dicky-Fuller Test in the levels (Unit Root Test)

Variable	ADF Statistic	Lags (SIC)	Prob.	Model
LNAGR	-2.04	0	0.99	Constant
LNWPI	-1.76	0	0.99	Constant
LNUNSKL	-0.27	0	0.97	Constant

Source: Results obtained from using E-views 8.

Table-4 Augmented Dicky-Fuller Test in the first difference(Unit Root Test)

Variable	ADF Statistic	Lags (SIC)	Prob.	Model
LNAGR	-10.01	0	0.00	Constant
LNWPI	-9.75	0	0.00	Constant
LNUNSKL	-7.59	0	0.00	Constant

Source: Results obtained from using E-views 8.
Mackinnon test statistic values at 1%, 5% and 10% level of significance are -3.50%, -2.89% and -2.58% respectively.

The ADF test results of all the three variables show that all series are non-stationary at level and we failed to reject the null hypothesis of a unit root in all the three series at 5 % significance level. However, all the three series becomes stationary at first difference. Thus we can conclude that all the series are of the same order i.e. their order of integration is one I (1). Since all the series are of the same order in their first difference, co-integration relation can exist among the variables. So, co-integration test has to be conducted on the data. But before we go for co-integration test, it is necessary to test the lag order selection of the co-integrated VAR system.

Table-5 VAR lag order selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	359.9249	NA	3.33e-08	-8.70548	-8617434	-8.670134
1	788.2144	814.7947	1.20e12	-18.9320	18.57986*	18.79065*
2	798.4991	18.81354	1.17e12	-18.9633	-18.34704	-18.71594
3	803.0920	8.065546	1.30e12	-18.8559	-17.97540	-18.50239
4	815.0984	20.20587	1.22e12	-18.9292	-17.78457	-18.46967
5	826.3836	18.16642	1.16e12	-18.9849	-17.57615	-18.41935
6	837.6790	17.35638*	1.11e12*	-19.0409*	-17.36799	-18.36928

Source: Results obtained from using E-views 8.
**indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.*
In our case, the optimal lag length is determined by different criteria. Out of five information criteria, three have suggested a lag order of six for the VAR model (results shown in the table-5). Therefore, we move with six lags on a VAR model for endogenous variables. It is to be noted here that the lag length orders suggested are at the level for endogenous variables,
Whereas the lag interval required in the Johansen co-integration test is for different endogenous variables. Therefore, the optimal lag length should be five for the co-integration test.

8.2 Empirical results and discussions of co-integration Analysis

After finding out that all the series are integrated of the same order i.e., I (1), the next step in our analysis is to identify the long run behavior among all the three variables under study by applying co-integration test. Further, it is necessary that if two non-stationary variables are co-integrated, the model ought to include residuals from the vectors (lagged one period) in the dynamic VECM system. This has been done by applying Johansson's multivariate co-integration test. The test (both trace and max-Eigen) statistics and conventional 5% critical values are shown in the table-6 and table-7.

Both trace and max-Eigen tests reject the null hypothesis that there is no co-integration equation at the 5% level of significance, therefore the conclusion is that there is at least one stationary relationship among the levels of variables and the study concludes that there exists a long run association among the proposed variables i.e. in the long run they move together. Both trace and max-Eigen test indicate that there is at least one co-integrating vector.

Table-6 Johansen Co-integration test -Trace Statistics

Null Hypothesis	Eigen value	Trace Statistic	5% Critical Value	Prob.**
None*	0.29	33.89	29.79	0.01
At most 1	0.05	5.05	15.49	0.80
At most 2	0.00	0.04	3.84	0.84

*Trace statistics indicates 1 cointegrating eqn(s) at 5% level of significance,*Denotes rejection of hypothesis at 5% level and **Mackinnon-Haug Michellis (1999) P-values.*

Table-7 Johansen co-integration test- Maximum Eigen value Test

Null Hypothesis	Eigen value	Max-Eigen Statistic	5% Critical Value	Prob.**
None*	0.29	28.83	21.13	0.00
At most 1	0.05	5.01	14.26	0.73
At most 2	0.00	0.04	3.84	0.84

Source: Results obtained from using E-views 8.

*Max-Eigen statistics indicates 1 cointegrating eqn(s) at 5% level of significance.*Denotes rejection of hypothesis at 5% level and **Mackinnon-Haug Michellis (1999) P-values.*

The results shows that there exists a complex relationship between agricultural wages (LNAGR), food prices (LNWPI), and the rural wages of unskilled labourers (LNUNSKL). The long run relationship between the specified variables is given below:

Co-integration Normalized Equation

LNAGR= -0.05 + 0.30LNWPI + 1.01LNUNSKL

(0.13) (0.08)

[-2.30] [-11.64]

Note: standard errors in ( ) & t-statistics in [ ]

The above equation was normalized on the LNAGR. The normalized co-integrating coefficients given above reveals that the food prices and wages of rural unskilled labourers have a significant positive effect on agricultural wages. Considering that the logs of variables have been taken, the above relationship expresses the elasticity of agricultural wages on food prices and wages of unskilled rural labourers. Hence, a 1 percent increase in the wages of rural unskilled labour leads to a 1.01 percent increase in agricultural wages. Likewise, 1 percent rise in food prices leads to0.30 percent increase in agricultural wages. Both the results seems reasonable as many studies have shown that due to public work programmes (MNREGA) real wages of causal workers have increased, pushing the wages of agricultural labouers up (berg et al, 2012). Second, higher food prices may have forced them to bargain for higher wages which in turn leads to increase in farm wages.

8.3 VECM (Testing for Causality)

From the co-integration results it is thus clear that there exists a long term equilibrium between the agricultural wages and the other two variables. The temporal long run and short run dynamics among the variables are performed by using VECM. The coefficient of ECM model reflects the self-regulating dynamic mechanism.The results of the VECM are presented in the table-8.

Table-8 Vector Error Correction Estimates

CointegratingEq:	CointEq1			
LNAGR(-1)	1.000000			
LNWP(-1)0.302920		D(LNWPI(-5))	-0.103258	-0.039725	-0.032262
0.13623)			(0.06484)	(0.12821)	(0.05341)
[2.30175]			[-1.59247]	[-0.30983]	[-0.60404]
		D(LNUNSKL(-1))	-0.078730	-0.514153	-0.266639
			(0.20366)	(0.39181)	(0.16322)

LNUNSKL(-1)	-1.016251		
(0.08728)			
[-11.6431]			
C	-0.056447		
ErrorCorrection:	**D(LNAGR)**	**D(LNWPI)**	**D(LNUNSKL)**
CointEq1	-0.282025	-0.258759	-0.162286
	(0.06262)	(0.12382)	(0.05158)
	[-4.50364]	[-2.08974]	[-3.14615]
D(LNAGR(-1))	0.008915	0.364093	0.056483
	(0.14250)	(0.28177)	(0.11738)
	[0.06256]	[1.29215]	[0.48120]
D(LNAGR(-2))	0.1772050	0.541947	0.058153
	(0.13863)	(0.27411)	(0.11419)
	[1.27863]	[1.97708]	[0.50926]
D(LNAGR(-3))	0.008050	0.280966	0.098325
	(0.13963)	(0.27610)	(0.11419)
	[0.05765]	[1.01762]	[0.85487]
D(LNAGR(-4))	0.147403	0.341293	0.022702
	(0.13566)	(0.26825)	(0.11175)
	[1.08655]	[-1.27230]	[-.20316]
D(LNAGR(-5))	0.148934	-0.367877	0.041676
	(0.13413)	(0.26522)	(0.11048)
	[1.11038]	[-1.38709]	[0.37722]
D(LNWPI(-1))	0.124874	0.122749	-0.005504
	(0.06024)	(0.11911)	(0.04962)
	[2.07300]	[1.03054]	[-0.11092]
D(LNWPI(-2))	-0.031579	-0.220144	-0.027935
	(0.06197)	(0.12254)	(0.05105)
	[-0.50955]	[-1.79649]	[-054722]
D(LNWPI(-3))	0.101734	0.107765	0.113935
	(0.06569)	(0.12988)	(0.05411)
	[1.54879]	[0.82971]	[2.10575]
D(LNWPI(-4)	0.065955	-0.154486	0.020628
	(0.06394)	(0.12643)	(0.05267)
	[1.03154]	[-1.22194]	[0.39167]

	[-1.26258]	[-1.31227]	[-1.63364]
D(LNUNSKL(-2))	-0.078730	-0.147055	-0.038320
	(0.20366)	(0.40271)	(0.16776)
	[-0.38657]	[-0.36516]	[-0.22842]
D(LNUNSKL(-3))	-0.083106	0.193700	0.022610
	(0.19924)	(0.39396)	(0.16411)
	[-0.41712]	[-0.49168]	[-0.13777]
D(LNUNSKL(-4))	-0.626228	-0.430527	-0.048563
	(0.19498)	(0.38553)	(0.16060)
	[-3.21181]	[-1.11671]	[-0.30238]
D(LNUNSKL(-5))	-0.504228	-0.265969	-0.338949
	(0.20024)	(0.39594)	(0.16494)
	[-2.51811]	[-0.67174]	[-2.05497]
C	0.024938	0.024445	0.018557
	(0.00478)	(0.00946)	(0.00394)
	[5.21506]	[2.58522]	[4.71113]
R-squared	0.555560	0.462313	0.425997
Adj.R-squared	0.321544	0.242728	0.172551
Sum sq.resids	0.004588	0.017939	0.003113
S.E.equation	0.008402	0.016613	0.006921
F-statistic	3.399297	2.622680	2.055698
Loglikelihood	285.0770	229.1737	300.9793
AkaikeAIC	-6.793721	-5.051058	-7.005433
SchwarzSC	-6.294767	-4.552104	-6.506479
Meandependent	0.012639	0.009259	0.012887
S.D.dependent	0.009175	0.019091	0.007608
D-W Statistics	1.968	1.957	1.951
Determinantresidcovariance(dofadj.)			5.74E-13
Determinantresidcovariance			2.86E-13
Loglikelihood			835.1495
Akaikeinformationcriterion			-19.05243
Schwarzcriterion			-17.46751
Note: Standard errors in ( ) , & t-statistics in[ ]			

Source: Results obtained from using E-views 8.

The t-statistics on the variables of the error correction results indicate that all variables are highly significant and the sign of all the three error correction terms is negative. This implies that there is temporal long run relationship between rural wages and WPI food prices variables and in case of any disequilibrium from the long run it has self-regulating mechanism to restore the equilibrium.

The first results of the VEC model indicates that there is longrun causality among the variables running from food prices and wage of nonagricultural unskilled workers to farm wages since error coefficient term is negative(-0.28). The result is statistically significant at 5% level of significance. The coefficient of the error correction terms shows the speed of adjustment towards longrun equilibrium rate of growth. The speed of adjustment towards Long run equilibrium is 28% in case of agricultural wages. This leads to the conclusion that increase in food prices and unskilled wages leads to rise in agricultural wages. If we look at the 2nd model of the VEC system, this states that long run causality is running from rural farm and nonfarm unskilled wages to food prices meaning there by that any rise in rural wages will lead to increase in food prices. And if there is any deviation from long run equilibrium, the speed of adjustment is 25%. Finally in the 3rd model we see that the error correction term is highly significant at 1% level of significance which means that there is long run

relationship between the variables. Therefore any movements in the food prices and agricultural wages will lead to increase in unskilled wages of rural workers. The estimated coefficients of error correction model show that while the speed of adjustment to a shock is quicker in the case of agricultural wages and of food inflation, it is slow in the case of unskilled wages of non-agricultural workers.

Further, Granger causality is done between food prices and rural wages of farm and unskilled non-agricultural workers to see the short run causality running from lag of independent variables to dependent variables by applying Wald Test. The F-Statistics have been calculated under the null hypothesis that changes in the regressor do not cause movements in the regressand in the granger sense .The F-Statistics given in the table-9 measures the significance of the lagged values of the independent variables while explaining the dependent variables.

The first column of table-9 states that F-statistics for the lagged values of food prices and non-agricultural unskilled workers is statistically significant at 5% and 1% level respectively. So the alternative hypothesis stating that changes in food prices and rural wages of unskilled workers cause a movement in agricultural wages in the granger sense has been accepted. However the F-statistics for the lagged values of agricultural wages is statistically insignificant meaning there by that agricultural wages is not influenced by its own past values. This implies that there is short run causality running from food prices and unskilled wages to agricultural wages. The result states that if there is rise in food prices and unskilled wages, this will put an upward pressure on agricultural wages. This seems reasonable as many studies have shown that due to public work programmes (MNREGA) real wages of causal labouers have went up. Second, higher food prices may have forced them to bargain for higher wages which in turn leads to increase in farm wages.

Table-9 Short run causality based on Fifth order VECM using F-Statistics

Dependent Variables			
Independent Variables	D(LNAGR)	D(LNWPI)	D(LNUNSKL)
D(LNAGR)	0.65 (0.65)	2.24*** (0.06)	0.70 0.20
D(LNWPI)	2.59** (0.03)	2.79** (0.04)	11.65** (0.03)
D(LNUNSKL)	3.29* (0.01)	0.64 0.66	2.58** (0.03)

Source: Results obtained from using E-views 8.
*Note: ( ) P- Values of F-statistics. ***, **, and * indicates rejection of null hypothesis at 10%, 5% and 1% level of significance respectively.*

F-statistics in the second column indicates that food prices have been significantly influenced by agricultural wages and its past values but are independent of rural wages of unskilled workers. Thus there is shot run causality running from past values of food prices and agricultural wages to food prices but no short run relationship has been found between rural wages of unskilled workers and food prices. Increased agricultural wages can affect food prices in two ways. First, by rising demand for wage goods and then by increasing the costs of agriculture. However if there is growth in agricultural productivity, increase in demand for goods will not generate inflationary pressures. But due to constant growth in Indian agriculture in the recent past has caused inflationary pressure to be passed on food prices. The F-statistics in case of unskilled wages indicates that it is significantly influenced by its own lagged values and food prices. This implies that apart from its own values, changes in food prices cause movements in wages of rural unskilled workers. Rising food prices may have induced unskilled workers to demand higher wages to meet the living standards. Thus in all the cases causality has been found at least unidirectional.

IX. Residual Diagnostics

From table-10, it was found that the residual series of all the three models of the VEC are normally distributed as P- Value of Jerqua-Bera statistics is greater than 5%. There is no problem of serial correlation between the residuals in all the three models as the p value of F-statistics is greater than 5% (Breusch-Godfrey LM test). Finally we also conducted heteroscedasticity test (ARCH) and we find that variance of residuals is constant in all the three models I.e. there is no problem of heteroscedasticity as p value of chi-square statistics is greater than 5%.

Table-10 Residual Diagnostics of VECM

Model	**Jerqua-Bera Statistics**	**Breusch-Godfrey serial correlation** (F-stat)	**ARCH Test** χ^2 **value**
I	0.97 (0.62)	0.20 (0.82)	1.08 (0.43)

II	2.13 (0.24)	0.73 (0.49)	1.05 (0.31)
III	1.93 (0.38)	3.13 (0.06)	0.44 (0.50)

Source: Results obtained from using E-views 8. ( ) represent p-values.

X. Conclusion

The paper studies the relationship between rural wages and food prices in India over the period, July 2006 to October 2013.Food inflation has remained 9 percent since 2007. Looking at the recent trends in real rural wages, it has been seen that real wages have gone up during the period under study. The values of Coefficient of Variation have led us to conclude that although farm and unskilled non-farm wages exhibit convergence but there is no possibility of longrun convergence between the skilled wages of non-agricultural workers and the other two (Farm and unskilled non-farm). It is found that the wage inflation dynamics indicate that the annual growth in rural wages was higher than the growth rate in food inflation so in real terms rural wages increased over the period studied.

The normalized co-integrating equation has led us to conclude that wages of rural unskilled labourers and food prices have a significant positive impact on agricultural wages. The result in log form shows that a one percent increase in the wages of rural unskilled labour has led to a 1.01 percent increase in agricultural wages. Likewise, if prices of food articles increases by 1 percent, rural wages of farm workers will go up by 0.30 percent.

Further, the results of temporal long run and short run dynamics by using VECM indicates that there is long run causality among the variables running from food prices and wages of non-agricultural unskilled workers to farm wages since error coefficient is negative (-0.28) reflecting that the speed of adjustment towards long run equilibrium is 28 percent. The second model of the VEC system states that long run causality is running from rural farm and non-farm unskilled wages to food prices meaning there by that any rise in rural wages will lead to increase in food prices. In case of any deviation from long run equilibrium, the speed of adjustment is 25%. Finally, in the third model we see that the error correction term is negative and highly significant at 1% level of significance which means that there is long run relationship between the variables. Therefore, any movement in the food prices and agricultural wages will lead to increase in unskilled wages of rural workers and the speed of adjustment towards long run equilibrium is by 16 percent. The estimated coefficients of error correction model show that while the speed of adjustment to a shock is quicker in the case of agricultural wages and of food inflation, it is slow in the case of unskilled wages of non-agricultural workers.

The short run Granger Causality test has taken us to conclude significantly that changes in food prices and rural wages of unskilled workers causes a movement in agricultural wages in the granger sense. However, lagged values of agricultural wage is statistically insignificant. This indicates that any rise in food prices and unskilled wages, will lead to an upward pressure on agricultural wages. Empirical evidences from MNREGA supports this, as this programme has led to an increase in real wages of causal labourers. Further, rise in food prices also forces them to bargain for higher wages as they try to maintain their subsistence level.

Another observation indicates that food prices have been influenced by its own past values and agricultural wages but are independent of rural wages of unskilled workers. Increased agricultural wages can affect food prices in two ways. First, by rising demand for wage goods and then by increasing the costs of agriculture. The constant growth in Indian agricultural productivity during the period under study has caused inflationary pressure to be passed on to food prices. In case of unskilled wages, the observation shows that apart from its lagged values it is significantly influenced by food prices. This may be due to the reason that unskilled labour force try to maintain their subsistence living by demanding higher wages under food inflation situation. Thus in all the cases causality has been found at least unidirectional.

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IOSR Journal of Business and Management (IOSR-JBM) is UGC approved Journal with Sl. No. 4481, Journal no. 46879.

Haroon Rasool"Testing the link between Rural Wages and Food Inflation in India A Co-integration Approach." IOSR Journal of Business and Management (IOSR-JBM) 20.1 (2018): 87-98.