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Food and Non-Food Prices Nexus in Developing Economies: Disaggregated Panel Data Analysis

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Abstract

In this paper, an attempt has been made to examine a new transmission mechanism of inflation that is effect of food prices on non-food prices. The panel generalized method of moment (GMM) has been employed on the panels of 47 developing countries disaggregated by income, i.e. low-income, lower-middle income and upper-middle income countries. The data-set covers the time period of 2000 to 2014. The panel Granger causality tests like error correction model, panel Stacked and Dumitrescu Hurlin test of causality are also employed to see the direction of causality between food prices and non-food prices. The results of panel GMM estimation indicate that food prices positively affect non-food prices in all the income groups of economies. The causality direction is also found from food prices to non-food prices in these groups of economies. It concludes that inflation transmission mechanism of food prices to non-food prices exists in developing countries. For policy making, it is suggested that any attempt to control inflation in developing economies, one component of anti-inflationary policy should be to control the food prices.

Keywords: Food prices, Non-food prices, Granger causality, Inflation transmission, Money supply.

1. Introduction

The investigation of causes of inflation and inflation transmission mechanism all over the world has been remained a major focus of economists. Since developing economies are structurally different from the advanced economies, the inflation in developing countries might have some unique causing factors as well as transmission mechanism. The inflation transmission from food prices to non-food prices may exist in developing economies. It is based on the fact that people in developing economies spend a greater share of their budget on food items against their counterparts in advanced countries (Muhammad et al. 2011; Mead et al. 2014). Seal et al. (2003) concluded that on average the consumers in low-income countries spend 52.58% of their budget on food and beverages while those in high-income countries spend 16.97% of their budget on food and beverages. Gilbert and Morgan (2010) have shown that average household income

devoted to food in most developed countries is around 10-15%. Similarly, the share of household expenditures on food is 73.24% in Tanzania and 9.73% in United States.

IMF (2008) showed that the pass-through from international to domestic food prices and from domestic food prices into core inflation was much higher in emerging economies than in advanced economies. About one half of the shocks to domestic food prices passes through to core inflation in emerging economies, while less than one quarter passes through in developed countries. This is consistent with the differences in the shares of food expenditures in total household expenditures between developed and developing countries.

Under the classical theory, the relative price changes (say in the current case changes in food prices) are determined by real factors, whereas changes in money supply drive absolute prices. Friedman (1975) argued that changes in prices of a subset of commodities, e.g. food or oil, should not feed aggregate inflation. A rise in the relative price of food (for a given level of money supply) in isolation, reduce households' real income and, therefore, their demand for other goods and services. This suggests a lower rise in prices for other goods and services, so that the overall consumer price index does not necessarily rise to a considerable extent. It keeps the aggregate price level and the inflation rate unchanged. There has been a vast literature thereafter which has studied the links between relative price changes and aggregate inflation. For example, Fischer (1982) introduced the hypothesis of downward inflexibility of prices to explain why relative price changes could feed into aggregate inflation. Subsequently, Ball and Mankiw (1995) showed that when price adjustment is costly (through menu costs) and firms adjust to large shocks but not to small shocks, aggregate inflation depends on the distribution of relative price changes. Therefore unlike the implicit assumption of perfect flexibility of all nominal prices in Friedman's analysis, in a real world with rigidities, a link between relative price changes and aggregate inflation is clearly possible. Such a link motivates analysis of price changes in a subset of commodities. In the case of effect of food prices on inflation a number of studies exists in literature. See for instance, Sand (2008) for contribution of global food prices in consumer price index, Walsh (2011) for effect of food prices on non-food prices for 91 economies, Mishra and Roy (2012) for pass-through effect from food to non-food and from food to aggregate inflation in India, Bhattacharya and Gupta (2012) for pass-through effect from food to non-food and general inflation in India, Thamae (2012) for effect of food prices on non-food prices in Lesotho, and Misati and Munene (2015) for effect of global as well as national food prices on non-food non-fuel inflation and overall inflation.

This study attempts to empirically analyze the inflation transmission mechanism that is transmission of food prices into non-food prices in developing countries. The argument for the hypothesis of this unique inflation transmission channel for developing countries is as follows: in developing countries a significant ratio of the households being poor spends a higher proportion of their budget on food items. They spend 60 to 70 percent of their income on food items and a small ratio of it on non-food items like house rent, clothing and utility bills. According to Cranfield et al. (2007), the poorest people spend roughly three quarters of their income on staple food. In this situation the increase in prices of food and non-food items have different implications for general inflation. A slight increase in prices of non-food items can be absorbed quickly by reduction in the quality and quantity of food. On the other hand an increase in the prices of food items

cannot be quickly absorbed by reduction in the expenses on non-food items (unlike the assumption of perfect flexibility of relative prices given by Fischer) because non-food expenses are fixed and not in the control of the households in the short-run. For example, house rent can be minimized by moving into an inferior house as this adjustment takes time (in real terms price adjustment is costly as given by Ball and Mankiw 1995).

In developing economies a significant ratio of households is involved in informal sector employment which produces the goods and services for their own consumption as well as for market. Totally 89.9 percent of the labor force in developing countries is working in informal sector (ILO 2018). The increase in prices of food items (alternatively decrease in real income) gives two alternatives to these households to compensate the decrease in real income; first to increase the real income (by increase in quantity of goods and services produce by the households); and second to increase the nominal income (by increase in prices of goods and services produced by the households). The first alternative is difficult because the poor are poor and they cannot increase their real income. Alternatively, the households increase their nominal income, i.e. they increase the prices of their goods and services. Consequently, the prices of other commodities increase after an increase in food prices. Mishra and Roy (2012) explained another mechanism for pass-through of food prices to non-food prices, that is a rise in food prices works as an income effect for net producers of food and it feeds into increased demand for non-food items and consequently food inflation occurs.

The self-employed workers are in large fraction of total employment in developing countries due to weak industrial base in these economies. They are 77.1 percent in low income countries, 65.8 percent in lower-middle income countries and 34.7 percent in upper-middle income countries (World Bank 2018c). The impact of increase in food prices may be different for varying categories of labor force. For example, the increase in food prices makes self-employed labor force unable to meet their food requirements, so they raise the prices of their own produced goods and services. It results into rise in general price level. It is reasonable to suppose that self-employed workers increase the prices of their goods and services, following the increase in food prices, much quicker than industrial workers. In the case of industrial workers, they have to resort to labor unions for increase in their wages which may take time.

The increase in food prices keeps the employers or firm owners indifferent but the employees strive for raise in their wages. All the other things being constant, the employers increase the wages under the pressure of employees and avail the opportunity to raise the prices of their products. In this way a rise in food prices enhances the general price level in the economy. The mechanism of general price level through wages is supported by Zhang and Law (2010) as they have evidenced that no effect of food prices on inflation occurred in China due to rigidity of wages.

The food to non-food inflation transmission mechanism has scarcely been analyzed by the researchers for developing economies. Some of the studies have explained that support / procurement price of wheat contributes in general inflation. Since the wheat and its derived products constitute a major part of the consumption price index (CPI), so rise in wheat support / procurement price raise general CPI. This mechanism of wheat price to influence general prices is more mathematical than economic. Hasan et al. (1995) concluded that a substantial increase in support prices has an inflationary effect on consumer prices. According to Khan et al. (2007), this effect (effect of wheat price on

general price level) is due to the fact that wheat and wheat related products account for 5.1% of the CPI basket. Similarly, Khan and Gill (2010) explained that support prices of wheat, sugar-cane, rice and cotton contribute to general inflation. The studies have not mentioned the mechanism by which a rise in food prices may lead to general price level. The current study focuses on the economic mechanics, i.e. to see if the food prices contribute in non-food prices in developing countries. The precise objective of the study is to estimate the effect of food prices on non-food prices in developing countries disaggregated into income groups.

2. Existing Literature

A small body of literature exists on the interaction of food and non-food prices. The literature is concerned with the effect of price of a particular food item on general inflation as well as effect of food prices on inflation. In the earlier studies, majority of the studies has estimated the price of one food commodity on general inflation (Hassan et al. 1995). Gaiha and Kulkarni (2005) showed a strong positive correlation between the level of support prices of rice and wheat and general inflation in India after controlling time trends and level of income.

Khan and Qasim (1996) regressed CPI and components of CPI (food and non-food) on money supply, domestic economic activity, import price index and interest rate. They concluded that non-food inflation is contributed by real GDP, money supply, import prices and electricity prices, while food inflation is influenced by money supply, value added in agriculture and support price of wheat. The study estimated that a 10 percent increase in wheat support prices results into 7.5 percent increase in food prices.

Seale Jr. et al. (2003) analyzed the income and price elasticity of categories of consumption items and sub-groups of food for 114 low, middle and high-income countries by using the data-set of 1996 International Comparison Project (ICP). They concluded that low, middle and high-income countries have distinct demand responses. The low-income countries are more responsive to income changes than middle- and high-income countries. Additionally, the magnitude of demand responses varies among consumption items, with smaller responses to income changes for staple consumption categories such as food and clothing, and larger responses for rent, medical care, and other luxury items such as recreation.

Khan and Schimmelpfinning (2006a) investigated the response of consumer price index (CPI) to money supply, credit to private sector, real GDP, nominal effective exchange rate, interest rate, exchange rate and support price of wheat for Pakistan. They estimated the above relationship in two specifications: firstly to investigate the long-run behavior of the relationship with the tools of co-integration and error correction model (ECM) when the variables were in their level form; and secondly to study the short-run dynamics of the relationship when the variables were in their growth rate form. They used monthly data for the time period 1998 to 2005. For the short-run they concluded that inflation is determined by monetary factors (credit to private sector and money supply), real GDP and wheat support price. For the long-run dynamics they concluded that only monetary factors explain inflation. Wheat support price does not contribute in inflation in the long-run. Even the wheat support price has shown insignificant and opposite effect to the expected sign. It may be firstly due to severe multi-colinearity which was evident from the correlation matrix. Secondly, the prices in Pakistan are not so flexible to adjust in one

month in response to change in food (wheat) prices. The data frequency should be so that the general prices have enough time to adjust in response to change in wheat support price. Instead of monthly data the yearly data might be best to capture the postulated effect. Khan et al. (2007) estimated the impact of government sector borrowing, private sector borrowing, import prices, exchange rate, government taxes, adaptive expectation and wheat support price on CPI. The study concluded that real demand relative to real supply; exchange rate and import prices significantly explain inflation in Pakistan.

In the recent studies, majority of the studies has focused on the impact of prices of food commodities (cereals---wheat and rice) on food item prices, core inflation (inflation without food and fuel prices) and general inflation. Some of the studies has seen separate effects of food commodities on prices of food items (Mishra and Roy 2012 for India). The international food prices effect on domestic inflation on food and non-food items has also been estimated by a number of studies (Rangasamy 2011 for South Africa; Cruz et al. 2011 for Mexico; Christopher et al. 2012 for Tanzania). They have termed the process as food price transmission and food price pass-through effect. Baek and Koo (2010) analyzed the factors that influence inflation caused by increase in food prices and found that this kind of inflation "food price inflation" is of increasing importance in USA. Cruz et al. (2011) has evidenced those movements in world food prices contribute in development of inflation in Mexico.

Walsh (2011) has analyzed the effect of food prices on non-food prices for 91 countries. The headline CPI and widest definition of food (excluding alcoholic beverages where this distinction is made) have been used in the analysis. The sub-index of "food" and "food and beverages" both were used. Non-food CPI was calculated from total CPI, weight of food in the CPI, and the food CPI. The study found that food inflation in many countries is transmitted into non-food inflation in a significant and important way, and again, this is particularly so in developing economies. In both rich and poor countries, large upward food price shocks are propagated into non-food prices relatively quickly. However, this effect has been found much more pronounced in poor countries than in rich countries. In rich countries, a one percent shock to food prices on average results in a 0.15 percent increase in non-food prices, but in poor countries the average is around 0.3 percent. This effect is aggravated by the high volatility of and right skew to food prices. With large price shocks more likely to occur among food prices than among non-food prices, discounting food price developments in countries where food price shocks are transmitted strongly or quickly to non-food prices can lead to an underestimate of the medium-term effect of those shocks.

Zhang and Law (2010) used household and national data of China to estimate the determinants of food inflation and to see its role in general inflation. They concluded that food inflation has not generated significant effect on non-food inflation. It explained that although the food inflation pushed up the China's inflationary expectations but it is not driving force for wage growth. It may be partially due to the abundant supply of labor in the county as well as little bargaining power of labor for wage increment.

Muhammad et al. (2011) estimated income and price elasticity of demand for major consumption categories and food groups by using 2005 ICP data-set. They concluded that poor countries spend a greater proportion of their budget on necessities such as food while high income countries spend a greater share of their budget on luxuries such as recreation. Low value food such as cereals constitute larger share of the food budget of

low income countries while high value food constitute greater share of food budget in rich countries. Low income countries respond more to changes in income and prices and make larger adjustment to their food consumption pattern but this adjustment varies across all food categories. The cereals consumption changes the least while high value food consumption changes the most.

Jongwanich and Park (2011) concluded that the magnitude of the pass-through has been limited from global food and oil price shocks to inflation in developing Asian countries, and government policies such as subsidies and price controls have played a role in reducing or delaying the pass-through effect. Jalil and Zea (2011) studied how international food price shocks have impacted local inflation processes in Brazil, Chile, Colombia, Mexico, and Peru in the past decade. The results indicate that international food inflation shocks take from one to six quarters to pass-through to domestic headline inflation, depending on the country.

Mishra and Roy (2012) have seen the trends of inflation in India and empirically estimated the role of food in overall inflation, the role of commodities which drive food prices and the factors of food prices. The study concluded that animal source food (milk, fish), processed food (sugar, edible oil), fruits and vegetables, and cereals (rice and wheat) are main drivers of food inflation. It evidenced that pass-through from food to non-food and from food to aggregate inflation. A one unit shock to food inflation increases the non-food inflation by 0.1 percentage points in half a year.

Thamae (2012) analyzed the role of food price movements in inflation for Lesotho. The results revealed that food inflation has generally not only been more volatile and higher than non-food inflation, but also more persistent than the inflation of non-food products. Furthermore, the food price movements have been discovered to have significant impact on core inflation, thereby giving the evidence that food prices set the inflation trends in the country. On the other hand, the results have shown the presence of strong second-round price effect between food and non-food inflation. The findings, therefore, imply that any attempt to capture the inflation using measures that exclude control on prices of food items on the basis of their high volatility is unjustified.

Sivarajasingham and Balamurali (2014) measured the pass-through of global food price inflation in Sri Lanka. They showed that the global food price pass-through have statistically significant effect on food price and headline inflation in the long and short run.

Meade et al. (2014) also analyzed the cross price elasticity between major consumption categories by using 2005 ICP data-set. They also estimated the cross price elasticity between food and non-food items through two goods system. For two goods system of food and non-food, they found that cross price elasticity for food with respect to non-food prices is low in low income countries. In these countries, people spend little portion of their budget on non-food items and a higher portion on food items, so non-food prices change has little effect on food consumption. As for as the cross price non-food elasticity with respect to food is concerned, it is higher in low income countries, suggesting a high response of non-food spending to changes in food prices, since food items constitute a larger share in budget in low income countries.

Bhattacharya and Gupta (2015) have analyzed the determinants of food inflation (for different food items) and pass-through effects from food to non-food and general

inflation. They evidenced the transmission of food inflation to non-inflation and overall inflation. A rise in food inflation has an impact on non-food and overall inflation keeping it quite persistent for a long period of time.

Misati and Munene (2015) attempted to examine the relationship between food price and overall and non-food non-fuel inflation for Kenya using gap methods and Phillips curve estimations. The study considered both international food prices to capture the fact that Kenya imports some food products and domestic food prices which capture locally produced and consumed foods. Based on gap models, the results confirm presence of second round effects from food prices to inflation while estimations of the Phillips curve suggest a domestic food price pass-through of 0.49 to overall inflation and 0.38 to non-food non-fuel inflation. The international food prices pass-through to overall inflation and non-food non-fuel inflation are estimated at 0.09 and 0.08, respectively.

Redukic et al. (2015) narrated that prices of agricultural and food products contribute 34.5 percent (unprocessed and processed food contribute 12.6 and 21.9 percent respectively) in consumer price index of Serbia. They analyzed the primary and secondary effect of increase in agrarian products on the inflation and concluded that increase in food prices is the main determinant of increase in inflation. To maintain the price stability in the country in indirect control in the form of control of food prices is very important. The instruments for the purpose may be the commodity reserves, storage policy, and fiscal and foreign trade policy.

A bulk of literature has attempted to estimate the determinants of inflation. For instance, Hasan et al. (1995), Khan and Qasim (1996), Khan and Schimmelpfinning, (2006a & 2006b) and Khan and Gill (2010) have investigated the effect of food item (wheat) on general inflation. According to our knowledge, none of the studies has exclusively seen the effect of general food prices on non-food inflation, which is the gap in literature going to be filled by the current study. Furthermore, the studies which have estimated the effect of food items (wheat) on inflation suffer from a common defect, i.e. they have not eliminated that specific component (wheat) from general CPI. They regressed the general CPI which postulates regressing a variable on itself because wheat and related products constitute quite a reasonable share of the general CPI. The current study will remove this shortcoming.

The positive relationship between wheat price and inflation found in earlier studies, might be due to the fact that both wheat price and other prices (as captured by CPI) were caused to increase by some other factors such as money supply. In this case one would find significant and positive relationship between these variables and one would erroneously conclude that wheat price significantly affects inflation. However, the positive and significant relationship in this case may be due to increasing trend of both variables and not because of any meaningful relationship between the variables. The judgment in such cases may be provided by causality tests. If the causality direction is only from wheat price to overall inflation then it can be confidently said that wheat price determines inflation. None of the previous studies has resorted to causality tests.

Majority of the studies (Hasan et al. 1995; Khan and Qasim 1996; Khan and Schimmelpfinning 2006a, 2006b; Khan and Gill 2010; Thamae 2012) has analyzed the individual economies. The present study will extend the analysis to developing economies disaggregated by income.

Since the current study proposes that not only wheat but other food prices determine inflation, so instead of using only one food item (wheat) price in the inflation equation, food and beverages index, available in UN data sets, has been used in the inflation equation by the current study.

3. Methodology

The objective focus of current study is to check the impact of food prices on non-food prices. To substantiate the hypothesis that food prices affect non-food prices, it resorts to causality tests to verify that direction of causality is really from food prices to non-food prices and not merely the result of co-movement of the variables. In line with the objectives of the study, it goes along the following course of analysis.

(1) For the groups of developing economies first of all the stationarity of the variables is tested by panel unit root tests. If the variables are not stationary at level, they are converted into their first differenced form to avoid the problem of spurious regression. It is also necessary because the non-stationary variables cannot be used for granger causality analysis (Engle and Granger, 1987)

(2) To estimate the effect of food prices on non-food prices, model with dependent variable as non-food prices and independent variable as food prices and other control variables, is estimated by generalized method of moment (GMM). The following model will be estimated.

$CPINF_{it} = f (CPIF_{it}, M2_{it}, GDPP_{it})$ …… (1)

where

i = 1,2,3,……n; t = 1,2,3,…… T

CPINF = CPI of non-food items (Non-food prices)

CPIF = CPI of food items (Food prices)

M2 = M2 supply of money (Money supply)

GDPP = GDP per capita

GMM being an efficient estimation technique is used to estimate the linear form of model (equation 1). The following equation will be estimated by GMM.

$CPINF_{it} = \beta_0 + \beta_1 CPIF_{it} + \beta_2 M2_{it} + \beta_3 GDPP_{it}$ ------- + u_i ……. (2)

Determinants of inflation such as money supply (M2) and output (GDP), on which economists generally agree (Bokil and Schimmelpfinning, 2006; Khan and Gill, 2007) are included as control variables. CPIF is index of food and beverages prices (a part of general CPI which comprises of food and beverages items) and CPINF is index of non-food items. The GMM estimation will indicate whether food prices positively and significantly affect non-food prices or not.

(3) GMM explains the direction of food prices to non-food prices, further it is verified from the battery of causality test.

(4) The Johnsen cointegration test is applied to see whether the food and non-food prices are co-integrated or not. The analysis is carried out on the stationary variables at first difference (Engle and Granger, 1987; Austerious and Hall, 2007).

(5) If cointegration is established, then in the next step, ECM is applied for its apparent advantage of revealing short and long-run causality. Finally, to corroborate the ECM results, Dumitreush Hurlin and Stacked test of causality are applied.

3.1 Data and Variable Construction

Data of food price index is taken from FAO database (FAO 2018) and of money supply and GDP is taken from World Development Indicators (WDI) (World Bank 2018a) for the time period 2000 to 2014. The developing countries are disaggregated by income. The World Bank has defined low-income, lower-middle income and upper-middle income economies as the countries that have GNI per capita 1025 dollars or below, between 1026 and 4035 dollars, and between 4036 and 12475 dollars respectively. In the sample, the low income countries are Benin, Burundi, Chad, Congo, Gambia, Guinea, Madagascar, Mozambique, Nepal, Senegal, Togo, Uganda, Burkina Faso and Rwanda; the lower-middle income countries are Bangladesh, Bhutan, Cameroon, Egypt, Ghana, India, Indonesia, Lao PDR, Mauritania, Pakistan, Philippine, Sri Lanka, Tunisia, Nigeria, Morocco, Moldova, Syria and Armenia; and upper-middle income countries are Botswana, Columbia, Ecuador, Fiji, Gabon, Jordon, Maldives, Namibia, Paraguay, Thailand, Peru, Malaysia, Brazil, Mauritius and Albania. Since the data on non-food prices is not available, it is computed from general CPI and food price index following Khan and Qasim (1996) and Walsh (2011).

$CPIG = \theta\ CPIF + (1- \theta)\ CPINF$ …….. (3)

Where CPIG = General CPI

θ = Share of food items in general CPI

$1- \theta$ = Share of non-food items in general CPI

CPINF = Non-food CPI

From equation 3, we have

$CPINF = CPIG – \theta\ CPIF/(1- \theta)$

The data on θ, i.e. share of food items in general CPI is taken from International Comparison Project (ICP) (World Bank 2018b)

3.2 Econometric Estimation

3.2.1 Panel Unit Root Tests

To check the stationary of the series Levin, Lin and Chu (2002), Fisher ADF, PP Fisher PP (Maddala and Wu 1999) and Im, Pesaran and Shin (2003) are applied.

3.2.2 ECM for Causality Testing

For using ECM for causality, the procedure given by Asterious and Hall (2007) is applied to determine long and short-run causality by estimating two equations as:

$\Delta CPINF = \Delta CPINF_{t-i} + \Delta CPIF_{t-i} + ect_{-1}$ ……. (4)

$\Delta CPIF = \Delta CPIF_{t-i} + \Delta CPINF_{t-i} + ect_{-1}$ ……. (5)

In the equations (4) and (5) $\Delta CPIF$ is the differenced food and beverages index and $\Delta CPIF_{t-1}$ is the differenced lagged values of food and beverages index and the lags are determined by using model selection criteria such as Akaike information criterion (AIC) and Schwarz information criterion (SBC). The $\Delta CPINF$ is differenced non-food CPI and

$\Delta CPINF_{t-1}$ is differenced lagged values of non-food CPI and the lags are determined using model selection criteria such AIC or SBC. The ect_{-1} is the error correction term.

In the equation (4), if the Wald test indicates that ect_{-1} is not zero, then we have long-run causality from food prices to non-food prices; and if the Wald test indicates that $\Delta CPIF_{t-1}$ is not zero, then we have short-run causality from food prices to non-food prices.

Similarly in the equation (5), if the Wald test indicates that ect_{-1} is not zero, then we have long-run causality from non-food prices to food prices; and if the Wald test indicates that $\Delta CPINF_{t-1}$ is not zero, then we have short-run causality from non-food prices.

3.2.3 Panel Causality Tests

Stacked test of causality and Dumitrescu Hurlin test (Dumitrescu and Hurlin 2012) of causality are also employed for robustness of the results.

4. Results and Discussion

The results of panel unit root tests for income groups of developing economies at level and growth rate are shown in table 1. The CPIF and CPINF for low income, lower-middle income and upper-middle income countries are found nonstationary on level based on various tests of stationarity. We consider their growth rate.

Table 1: Results of Panel Unit Root Test for the Variables at Level and Growth Rate for Income Groups of Developing Countries

	Level				Growth rate				
Variable	**Levin Lin and Chu stat**	**Im, Pesaran and Shin stat**	**ADF Fisher stat**	**PP-Fisher stat**	**Variable**	**Levin Lin and Chu stat**	**Im, Pesaran and Shin stat**	**ADF Fisher stat**	**PP-Fisher stat**
Low-income countries									
CPIF	8.8215 (1.000)	10.026 (1.000)	1.6736 (1.000)	1.9401 (1.000)	CPIF-g	-7.7238 (0.000)	-8.0150 (0.0000)	111.210 (0.0000)	132.55 (0.000)
CPINF	3.5552 (0.994)	7.0759 (1.000)	10.646 (0.993)	15.970 (0.962)	CPINF-g	-7.5894 (0.000)	-5.3581 (0.0000)	81.8153 (0.0000)	99.681 (0.000)
M2	5.3126 (1.000)	7.3201 (1.000)	4.0282 (1.000)	2..740 (1.000)	M2-g	-12.071 (0.000)	-9.0735 (0.0000)	124.224 (0.0000)	149.95 (0.000)
GDPP	2.7357 (0.943)	6.0047 (1.000)	9.3586 (0.925)	3.3780 (0.084)	GDPP-g	-11.254 (0.000)	-9.4785 (0.0000)	130.04 6 (0.0000)	156.78 (0.000)
Lower-middle income countries									
CPIF	11.228 (1.000)	14.918 (1.000)	3.2695 (1.000)	2.1828 (1.000)	CPIF-g	-6.7521 (0.000)	-5.2266 (0.0000)	90.1653 (0.0000)	149.64 (0.000)
CPINF	11.381 (1.000)	13.500 (1.000)	8.2433 (1.000)	7.8958 (1.000)	CPINF-g	-8.4259 (0.000)	-6.9692 (0.0000)	113.655 (0.0000)	145.50 (0.000)
M2	7.7236 (1.000)	11.273 (1.000)	2.5829 (1.000)	1.8592 (1.000)	M2-g	-10.007 (0.000)	-8.7067 (0.000)	137.725 (0.0000)	135.91 (0.000)
GDPP	4.6632 (0.972)	8.5280 (1.000)	11.582 (0.993)	12.497 (0.962)	GDPP-g	-6.5583 (0.000)	-5.3520 (0.0000)	98.3479 (0.0000)	119.75 (0.000)
Upper-middle income countries									
CPIF	4.7115 (1.000)	8.4100 (1.000)	3.0168 (1.000)	3.8509 (1.000)	CPIF-g	-9.1149 (0.000)	-6.11507 (0.000)	89.3672 (0.0000)	78.249 (0.000)
CPINF	1.6839 (0.953)	5.9952 (1.000)	11.560 (0.999)	43.928 (0.048)	CPINF-g	-8.7237 (0.000)	-6.4871 (0.0000)	95.1169 (0.0000)	93.182 (0.000)
M2	9.6294 (1.000)	13.397 (1.000)	4.7829 (1.000)	3.2561 (1.000)	M2-g	-10.459 (0.000)	-7.2786 (0.0000)	104.177 (0.0000)	112.41 (0.000)
GDPP	10.492 (1.000)	12.367 (1.000)	9.3890 (1.000)	9.2973 (1.000)	GDPP-g	-9.7573 (0.000)	-8.0493 (0.0000)	117.637 (0.0000)	137.59 (0.000)

Note: In the parenthesis are the p values of the respective unit root statistics.

The CPIF-g and CPINF-g are the growth rates of CPIF and CPINF and they are found stationary based on all the stationarity tests. For symmetry purposes, the other variables such as GDP per capita, money supply, intended to be include in the equation are also considered in their growth rate form. The growth rate of money supply (M2-g), GDP per capita (GDPP-g) are also found stationary based on various stationary tests.

4.1 Results of GMM Estimation

Since GMM is an efficient method that overcomes many econometric problems such as endogeneity, so we have employed the GMM to see the impact of food prices on non-food prices. The results of GMM estimation for growth rate of the variables are given in table 2.

Table 2: Results of GMM Estimation for Income Groups of Developing Countries

	Low Income Countries	**Lower-Middle Income Countries**	**Upper-Middle Income Countries**
Dependent Variable: CPINF- g (growth rate of non-food prices)			
Variables	Coefficient [Std-error] t-stat (prob.)	Coefficient [Std-error] t-stat (prob.)	Coefficient [Std-error] t-stat (prob.)
CPIF-g	0.4203*** [0.1339] 3.1377 (0.0020)	0.5599*** [0.1365] 4.1008 (0.0001)	0.4303** [0.2105] 2.0436 (0.0425)
M_2-g	0.2491*** [0.0943] 2.6410 (0.0091)	0.4528*** [0.1552] 2.9170 (0.0039)	0.2433* [0.1279] 1.9020 (0.0588)
GDPP-g	-1.1759** [0.4695] -2.5044 (0.0132)	-1.2332** [0.5719] -2.1560 (0.0321)	-0.4381 [0.2766] -1.5839 (0.1150)
Model diagnostic			
J-stat	6.4643 (0.0910)	8.306 (0.0809)	4.1345 (0.5302)
R^2	0.2244	0.1722	0.7265
Adj. R^2	0.2392	0.1651	0.7460
DW	1.6268	2.3065	2.0572
No of Crs.	14	18	15
No of obs.	168	234	180

Note: *, ** and *** indicate 10, 5 and 1 percent level of significance respectively.

The results in table 2 show that food prices positively and significantly affect non-food prices for all income groups of developing countries, i.e. low income, lower-middle income and upper-middle income groups. It is supported by the existing literature. For instance, Rangasamy (2011) concluded that food prices can create enormous inflationary pressure in South Africa. Gregorio (2012) reported that food inflation more than energy inflation has relevant core inflation for emerging economies, where the share of food in consumer basket is significant. The weight of food items in the consumer basket makes them relevant in terms of propagation of inflation through wages and prices. Mishra and Roy (2011) evidenced pass-through from food to nonfood, and from food to aggregate inflation in India. Apergis and Rezitis (2011) noted that the fact that persistent food price increases translate into higher inflation that leads to higher wages and inflationary

expectations. Anand et al. (2014) explained that effect of food inflation on general inflation in India is relatively high due to high share of food expenditures in household incomes and since food inflation influences inflationary expectations and future wage settings. Misati and Munene (2015) concluded that domestic food prices and global food prices have positive impact on non-food and non-fuel inflation as well overall inflation.

Aksoy and Isik-Dikmelik (2008) claimed that in order to understand the impact of higher food prices on welfare, it is important to distinguish between net food sellers and net food purchaser. We borrow this notion and suggest that it is also important to see the effect of food prices on general inflation in developing economies. A net food seller is defined as someone for whom total sales of food to the market exceed total purchases of food from the market, whereas for a net food purchaser the reverse is true. The net food purchaser particularly rural ones mainly belongs to developing nations. Net food purchasers are generally hurt by higher food prices (alternatively by decrease in real income), while net food producers take benefit. Although nearly all urban dwellers are net food purchasers, but not all rural dwellers are net food producers. FAO (2008) concluded that very small farmers and agricultural laborers are often net consumers of food, as they do not own enough land to produce enough food for their family. These landless rural households are often the poorest of the poor and majority of such households live in developing and poor economies. Although some of these laborers work on farms and are occasionally paid in food, they typically do not earn enough food to sell a surplus on the market. Instead, they need to purchase food on markets and are likely to hurt from higher prices. Net food purchasers are extensively exist in developing economies and they have to compensate the decrease in real income by increasing the goods and services produced by themselves which enhance general inflation.

Sand (2008) explained that it is normal to assume that economic agents are forward-looking when making decisions. If wage-earners anticipate high inflation due to food inflation, they demand higher wages. Likewise, enterprises raise their prices further if they anticipate high inflation. Consumers' inflation expectations can be affected by changes in the food price index today. Higher food prices can, therefore, put pressure on other prices and wages via higher inflation expectations.

The results further elaborate that M2 supply of money accelerate inflation in all income groups of the economies. It signifies the role of monetary policy of developing economies for control of inflation. The results are in line with theory and supported by literature (Khan and Qasim 1996). The GDP growth rate has shown negative impact on inflation in all income groups of developing economies. Theoretically higher output insert sliding down pressure on inflation. It is also supported by empirical literature (Khan and Qasim 1996). The economies should put the efforts to increase the growth rate of national income.

4.2 Results of Causality Tests

We have seen through GMM estimation that food prices positively and significantly affect non-food prices. It completes one part of the proof in favor of the hypothesis that food inflation transform into non-food inflation but to make sure that the direction of causality is from food prices to non-food prices, we resort to causality checking. For the purpose three panel causality estimation methods, i.e. Stacked test, Dumitrescue Hurlin method and error correction model (ECM) method are employed as part of robustness

analysis to show that causality direction is independent and invariant of causality estimation methods.

4.2.1 Stacked Test of causality

The CPIF and CPINF are non-stationary at level, so they cannot be considered for simple Granger causality at level, but their growth rate form may be considered. The results of Stacked test for food and non-food prices are given in the table 3.

Table 3: Stacked Test of Causality Results

	Low Income Countries		**Lower-Middle Income Countries**		**Upper-Middle Income Countries**	
Lags	CPINF-g does not cause CPIF-g	CPIF-g does not cause CPINF-g	CPINF-g does not cause CPIF-g	CPIF-g does not cause CPINF-g	CPINF_g does not cause CPIF-g	CPIF-g does not cause CPINF-g
1	3.6 (0.5913)	12.61 (0.0005)	4.51 (0.0300)	22.84 (0.0000)	2.73 (0.090)	11.19 (0.001)
2	4.05 (0.0197)	7.76 (0.0006)	2.02 (0.1301)	16.79 (0.0000)	2.28 (0.103)	4.76 (0.009)
3	2.54 (0.0583)	3.69 (0.1300)	1.71 (0.1600)	15.71 (0.0000)	0.78 (0.572)	2.78 (0.040)
4	1.81 (0.1269)	4.3 (0.002)	0.93 (0.4411)	10.65 (0.0000)	9.52 (0.0000)	3.61 (0.007)
5	1.47 (0.2051)	3.76 (0.003)	0.91 (0.4703)	8.5 (0.0000)	3.48 (0.005)	2.97 (0.0130)
6	0.88 (0.5016)	3.04 (0.008)	1.0 (0.4200)	7.53 (0.0000)	3.65 (0.0020)	1.38 (0.224)
7	1.11 (0.3519)	2.05 (0.057)	0.63 (0.7215)	6.62 (0.0000)	2.67 (0.0100)	1.32 (0.2450)
8	1.17 (0.3248)	2.08 (0.0491)	1.19 (0.3137)	1.16 (0.3240)	0.57 (0.7959)	1.99 (0.0561)

The results in table 3 reject the null hypothesis that food prices do not affect the non-food prices up to lag 8 and it may be concluded that food prices cause non-food prices (for all the income groups) because at each lag, the p value is below 5 percent.

The converse hypothesis that non-food prices do not affect food prices cannot be rejected at any lag, the p value for the hypothesis that food prices do not affect the non-food prices is much lower for the hypothesis that non-food prices do not affect food prices. So at each lag up to lag 8, except al lag 2, we can accept the null that non-food prices do not affect food prices.

4.2.2 Dumitrescu Hurlin Test of Causality

We present the Dumitrescu Hurlin test of causality. Two lags in this test can be estimated i.e. lag one and two because they are the most relevant lags as being the latest lags. The results of Dumitrescu Hurlin test of causality are given in table 4.

Table 4: Dumitrescu Hurlin Test of Causality Results

	Low Income Countries		Lower-Middle Income Countries		Upper-Middle Income Countries	
Lags	CPINF-g does not cause CPIF-g	CPIF-g does not cause CPINF-g	CPINF-g does not cause CPIF-g	CPIF-g does not cause CPINF-g	CPINF-g does not cause CPIF-g	CPIF-g does not cause CPINF-g
1	-0.35 (0.7100)	4.31 (0.0000)	0.70 (0.4800)	0.70 (0.4832)	0.29 (0.773)	1.71 (0.080)
2	-1.06 (0.2828)	2.85 (0.0041)	-0.29 (0.7737)	3.23 (0.001)	0.07 (0.931)	-0.34 (0.7343)

The results in table 4 make clear that for both lags the hypothesis that food prices do not cause non-food prices (for all income groups) can be rejected and it may be concluded that food prices cause non-food prices because for both lags the p value of the test is very low. For the opposite hypothesis that non-food prices don not cause food prices cannot be rejected and it can be concluded that non-food prices do not cause food prices because the p value of the test statistic is higher than conventional 5%.

4.2.3 Error Correction Model for Panel Causality

The results in table 3 show that both variables are cointegrated at level since the p-value of trace statistic and Max-Eigen test is lower than 1% for all income groups of developing countries, so ECM application is justified. The results of ECM for D (CPINF) and D(CPIF) as dependent variables are given in table 5 and 6 respectively.

Table 5: Results of ECM for the Equation with Dependent Variable as D(CPINF)

	Low Income Countries	**Lower-Middle Income Countries**	**Upper-Middle Income Countries**
Variable	Coefficient [Std-error] T stat (prob)	Coefficient [Std-error] T stat (prob)	Coefficient [Std-error] T stat (prob)
C	1.7816*** [0.5431] 3.2999 (0.0010)	1.5326*** [0.7053] 3.8652 (0.0000)	1.9817*** [0.3730] 5.3126 (0.0000)
D(CPINF(-1))	0.4374*** [0.0898] 5.1340 (0.0000)	-0.1947** [0.0863] -2.2555 (0.0211)	0.2252*** [0.0758] 2.9698 (0.003)
D(CPINF(-2))	0.2261** [0.0857] 2.4415 (0.0121)	-0.2215** [0.0905] -2.4476 (0.0130)	0.1341* [0.0718] 1.8676 (0.0610)
D(CPIF(-1))	0.1537** [0.0659]	0.7962*** [0.093]	0.0898** [0.0362]

	2.5164 (0.0100)	8.6187 (0.0000)	2.4768 (0.013)
D(CPIF(-2))	0.1974*** [0.0655] 3.0903 (0.0020)	0.3596*** [0.1314] 2.7364 (0.006)	0.0051 [0.0371] 0.1371 (0.890)
ect	-0.1153*** [0.0364] -2.9948 (0.003)	-0.1047*** [0.0182] -5.7277 (0.0000)	-0.0809*** [0.0283] -2.8581 (0.004)
No. of Obs.	168	216	180
Cointegration test			
Fisher stats (Trace test) **None** **At most 1**	 132.5 (0.00) 66.86 (0.0001)	 127.1 (0.0000) 79.29 (0.0000)	 133.2 (0.0000) 43.00 (0.0586)
Fisher test (Max-Eigen test) **None** **At most 1**	 114.5 (0.000) 66.87 (0.0001)	 104.3 (0.0000) 79.29 (0.0000)	 131.2 (0.0000) 43.00 (0.0586)
Model diagnostics			
R^2	0.3621	0.3554	0.1967
Adjusted R^2	0.3862	0.3432	0.1736
DW	2.06	1.94	2.09
Wald test of equation	0.002	0.001	0.000
Wald test of D(CPIF) to D(CPINF)	0.001	0.000	0.000

Note: *, ** and *** indicate 10, 5 and 1 percent level of significance respectively.

Table 6: Results of ECM for the Equation with Dependent Variable as D(CPIF)

	Low Income Countries	**Lower-Middle Income Countries**	**Upper-Middle Income Countries**
Variable	Coefficient [Std-error] T stat (prob)	Coefficient [Std-error] T stat (prob)	Coefficient [Std-error] T stat (prob)
C	3.1814*** [0.7616] 4.1453 (0.001)	2.5210*** [0.5210] 3.9010 (0.0004)	1.9649*** [0.7078] 2.7762 (0.006)
D(CPINF(-1))	-0.003 [0.1149] -0.0343 (0.9700)	0.2639** [0.0856] 2.0821 (0.0243)	0.1939 [0.1438] 1.3477 (0.170)
D(CPINF(-2))	0.1796 [0.1121] 1.4637 (0.1439)	0.0094 [0.0897] 0.1051 (0.9132)	0.1465 [0.1362] 1.0756 (0.280)
D(CPIF(-1))	0.3128*** [0.0831] 3.5687 (0.0005)	0.7665*** [0.0916] 8.3650 (0.0000)	0.2327*** [0.0688] 3.3815 (0.002)
D(CPIF(-2))	0.1121 [0.0900] 1.2332 (0.2100)	0.0140 [0.1303] 0.1078 (0.9131)	0.0894 [0.0705] 1.2677 (0.201)
ect	-0.0285 [0.0565] -0.465 (0.6890)	-0.0128 [0.0181] -0.7108 (0.4703)	0.3349*** [0.0537] 6.2345 (0.0000)
No. of Obs.	168	216	180
Cointegration test			
Fisher stats trace test **None** **At most 1**	132.5 (0.00) 66.87 (0.0001)	127.1 (0.0000) 79.29 (0.0000)	133.2 0.0000 43.00 0.0586
Fisher test Max-Eigen test **None** **At most 1**	114.5 (0.00) 66.87 (0.0001)	104.3 (0.0000) 79.29 (0.0000)	131.2 0.0000 43.00 0.0586
Model diagnostics			
R^2	0.1592	0.5376	0.2405
Adjusted R^2	0.1333	0.5288	0.2187
DW	2.16	2.15	2.17
Wald test of equation	0.68	0.70	0.69
Wald test of D(CPIF) to D(CPINF)	0.32	0.31	0.30

Note: *, ** and *** indicate 10, 5 and 1 percent level of significance respectively.

In table 5 the error correction term (ect), the cointegrating term of the equation with dependent variable as D(CPINF) is less than 1, negative and significant for all income groups indicating that there exists long-run causality from food prices to non-food prices in all income groups of developing countries. In table 4, for the dependent variable as D(CPIF), the cointegrating term is less than 1, negative but not significant for low income group and lower-middle income group meaning that there is no long-run causality from non-food prices to food prices. However, for upper-middle income countries, the cointegration term is less than 3, negative and significant, so long-run causality from non-food prices to food prices exists.

In estimating the relationship of the variables, error correction term indicates that there exists long-run relationship among the variables (food and non-food prices) in all income groups of economies where non-food prices are dependent variable. There exists the long-run relationship among the variables (food and non-food prices) only in upper-middle economies where food prices are dependent variable. Then we proceed to check the validity of co-efficient restrictions by Wald test. According to table 3, we reject null hypothesis which means that food prices have significant impact on non-food prices in all income groups of the economies. When we applied Wald test to check the simultaneous effect of food prices and non-food prices, the probe value indicates that there exists different impacts of food prices on non-food prices in income groups of economies. Table 6 also confirms significant impact of non-food prices to food prices.

5. Conclusion

It is concluded that food prices positively and significantly affect non-food prices in low income countries, lower-middle income countries and upper-middle income countries. As for the causality direction, it is also concluded that the causality direction is from food prices to non-food prices and not the other around and it is robust to estimation method for causality checking. It explains the inflation transmission mechanism of the food prices to non-food prices in developing economies. The results suggest that in any attempt to control the inflation in developing countries, one dimension of anti-inflationary policy should be special care of food item prices and not to let their prices to rise. The assumption that monetary authorities should focus on managing the price index without food prices as the food prices are more volatile is negated. The results about the impact of supply of money suggests that monetary authorities should control supply of money to control inflation. The frequent episodes of increase in supply of money by any monetary tool should be avoided. Furthermore, the national output should be the priority of the nation for controlling the inflation.

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