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ABSTRACT

Persistent increase in food prices and its impact on society and economy have been of prime concern for the government and its policy makers in India since 2005-06. Though these rates have eased to some extent in the recent months; with expected recovery of the economy and inherent supply bottle necks, the problem of inflation remains serious. This paper examines the price movements in rice and wheat, following structuralist principles emphasizing the necessity of long term solutions in combination with short and medium term management. However, unlike completely free systems, markets for these products are characterized by government interventions, calling for a slightly different approach under which interactions of demand and supply need to incorporate government interventions by way of minimum support price and procurement. The sample for this study consists of the period, 1980-81 through 2011-12 on an annual basis. Our results confirm strong impact of demand and supply factors in determining inflation for both the products. These include the role of government interventions as well as public investment in agriculture in ensuring price stability.

Keywords: Food grain inflation, demand and supply management, procurement, minimum support prices, capital stock.

JEL Classification: C3, E31, Q11, Q18

1. PRICES AND PRODUCTION

This exercise deviates from the usual task of evaluating inflation with its coverage of different items and focused on short and medium term policy issues. It may be fair to consider the exercise as one in the structuralist tradition of taking a longer view of the problem with an important role for state supplementing the market process[1]. The implicit underlying perception that the country would have to live with inflation for some more years, may not be misleading. We have deliberately chosen to highlight the price movements of only two items in the food grains basket, namely, rice and wheat. This was done in view of their traditional importance both as the dominant food products of India's agricultural sector as well as major items in the household basket of food, particularly for those in the middle and the lower end of the income distribution. The formal econometric analysis we undertake is based on annual rates of change in the prices of the two products. Given the structure of the agricultural sector the choice to go by annual observations looks appropriate. For, quarterly or monthly data would apparently be more appropriate for a focus on short run issues.

Let us first have a look at the price movements of the two products and of total food grains for the two decades starting with 1990- 91. For this we choose to examine centered three year moving averages, again to focus more closely at medium and long run changes. Data in Table 1 give us the intended data profile which may be related to different policy developments under different phases. We see broadly four different regimes which characterize similar price movements not only for rice and wheat but also for total food grains. The first regime covers the first four years of the sample period, namely, 1990-91 through 1993-94. Needless to recall that it was in this period that India's economic policy was substantially redrafted with considerable emphasis on market system all across the economy as a major component of the intended structural change.

As expected, these few years marking the birth of the modern and organized part of the economy were bound to be eventful. A high rate of price rise was bound to be there as the result of major restructuring process. Fortunately, the magnitudes did not turn out to be excessive. For rice as well as

[1] This may be closely seen as based on an outlook proposed prominently by Taylor (1983).

wheat the annual rise in their wholesale prices remained between 10 and 15 percent.

Table: 1

Annual Rates of Increase in Prices

(Three Year Moving Average: Percent)

Year	Rice	Wheat	Total Food Grains
1990-91	10.7	10.2	10.5
1991-92	14.0	15.3	13.7
1992-93	14.5	13.8	13.5
1993-94	11.0	10.7	11.4
1994-95	8.0	7.8	9.7
1995-96	8.7	11.4	11.3
1996-97	6.5	8.7	6.8
1997-98	7.6	11.0	7.6
1998-99	10.2	8.5	8.8
1999-00	7.9	8.7	7.9
2000-01	4.9	5.1	4.6
2001-02	-1.0	0.2	-0.4
2002-03	0.3	0.9	0.5
2003-04	0.2	1.7	1.0
2004-05	2.2	3.3	3.0
2005-06	3.1	8.6	7.4
2006-07	7.0	10.5	9.4
2007-08	10.2	12.1	10.7
2008-09	12.8	10.0	10.8
2009-10	11.0	8.6	10.1
2010-11	7.1	4.7	7.7
2011-12	7.2	5.6	8.2

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation

The second phase covering the remaining six years of the last decade of the twentieth century witnessed some reduction in the annual rates of inflation without falling considerably below 10 percent per year. While it remained close

to 8 percent for rice it was somewhat higher at about 10 percent for wheat. This period was also marked by considerable political instability even though the economy was getting adjusted to the new policy regime. Phase 3 covering the first five to six years of the first decade of this century witnessed continuation or, even closer adjustment of the new policy set up and much greater political stability. The result was a greater price stability after a long period of the opposite tendency. The annual rates of price increase for rice, wheat as well as all food grains typically remained below 5 percent and even turned out to be negative for some cases.

Phase 4 covering the years 2005-06 through 2009-10, unfortunately marks a return to the near double digit inflation rates for the two products as well as for total food grains. It is tempting to attribute it to the world financial crisis which covered good part of this phase but this view cannot be sustained. Moreover, the fact that rates of change in food grains prices have recently turned back to the single digit level is not of much comfort. The problems are deeper and somewhat built into the system. Understandably, the new government that has just taken over will make some effort to ensure that one third of the population which lives below the poverty line, gets access to food. But, our fear is that the country will have to live with about 5 percent rates of increase in food grains prices for another couple of years despite different policy initiatives that are likely to be undertaken.

Turning now to production, we see from Table 2 that the annual growth rates of food grains output has mostly been below 2 percent. More specifically, it has been negative for three years, namely, 1990-91, 2001-02 and 2003-04; less than two percent for nine years and in excess of three percent for only eight years. Let it be noted that we are looking at rates which are centered three year moving averages for a better understanding of the underlying trends and not get lost in short term fluctuations. Needless to say that usual annual rates are considerably more widely fluctuating. Even so, we see that the overall rates of growth are generally low. The three percent mark has been chosen deliberately as a cut off because it is in line with population growth and the need to increase the availability of food to those at the lower end of the income distribution in the country.

Table: 2

Annual Rates of Increase in Production

(Three Year Moving Average: Percent)

Year	Rice	Wheat	Total Foodgrains
1990-91	2.0	1.2	-0.3
1991-92	-0.3	4.8	1.7
1992-93	2.8	2.8	1.6
1993-94	3.2	5.7	4.4
1994-95	2.1	3.0	0.3
1995-96	0.7	5.3	2.9
1996-97	0.4	0.6	0.5
1997-98	3.8	4.9	4.3
1998-99	3.2	3.4	1.8
1999-00	1.1	1.9	0.8
2000-01	2.9	0.9	1.7
2001-02	-6.2	-4.7	-5.3
2002-03	3.4	1.5	4.1
2003-04	-2.0	-1.6	-1.0
2004-05	9.2	2.0	6.7
2005-06	2.0	1.8	0.8
2006-07	5.2	4.7	5.2
2007-08	2.6	5.2	4.0
2008-09	-1.3	2.2	0.3
2009-10	0.0	3.5	2.2
2010-11	2.4	5.6	3.7
2011-12	5.5	4.7	5.5

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation

For rice which is a vital component of staple diet for a large part of the country annual growth in excess of 3 percent has been achieved for only seven out of twenty two years. On the other hand, it has been negative or zero for five years and positive but below three percent for the remaining ten years. Again, we see poor growth and considerable fluctuations. For wheat it is somewhat

better but not considerably so. Growth rate is in excess of three percent for eleven years, negative for only two years and positive but below three percent for the remaining nine years. Clearly, the overall situation has hardly been different.

Before we proceed further we need to have a closer look at the way markets function for major food products like rice and wheat which we are focusing on. The conventional idea of a market for agricultural products as the bargaining process between the large number of small producers and an equally large number of ultimate consumers is no longer quite true[2]. Many important changes have, indeed, taken place over the last two to three decades. First, a large number of intermediaries who now operate in these markets have made a lot of difference. For, these intermediaries have the ability to hold on to stocks of food products as long as these may be profitable to them to do so (Rakshit, 2011). This also means that the poor producers get a rather small part of the price that would typically be paid by the ultimate consumers.

Second, role for the Food Corporation of India (FCI) must be seen to be important. How far this is properly articulated or even implemented may be open to question; but, it is there to intervene in the market so as to stabilize it and to benefit both basic producers as well as the ultimate consumers. This is particularly true for rice and wheat on which we focus. Finally, we feel strongly about the curtailed public investment in this sector. The result has been a lower supply potential and reduced ability to cope with adverse natural conditions like inadequate rainfall or its adverse distribution over time and space. No wonder, agricultural growth is lower as well as unsteady.[3] The low and highly fluctuating annual rates of growth in production of food grains, particularly of rice and wheat as shown in table 2 above. We need also to note that like rest of the economy the agricultural sector and the market for food products have to adjust to the overall open economy system. In particular, this holds for possibility of exports and imports which cannot be ruled out whenever profitable.

[2] See Chand (2012) and Ali Jan and White (2012)
[3] For a detailed econometric analysis of this see Mani, Bhalachandran and Pandit (2010)

2. THE PROPOSED MODEL

The analytical framework that we follow here draws heavily from the one adopted by us earlier (Gopakumar and Pandit, 2014) for analyzing inflation in the aggregate food grains market. This runs in terms of a formal structural model incorporating various factors that influence demand, supply and thereby changes in the price levels for the two products. While most of these factors are well known there are two significant departures from the convention. First, as mentioned earlier, we stipulate an important role for public investment in the agricultural sector. This is done by specifying total capital stock in this sector as one of the determinants of supply. Second, we assign an important role for government policy in terms of procurement and the minimum support prices for the two products. This adds up to a three equation set up for each product; one for demand, one for supply and one for procurement. The stipulation is that producers are free to sell either in the regular market or to the government. It is important to note that the two markets do not function independently for we allow for the two products to be substitutes in demand as well as supply. The model may be formally specified as follows. Third, the model permits substitution across the two markets for demand as well as supply.

I. RICE

Demand:

$$PR=D(QR, QR(-1)\ Y, M3, (PROCR-OFTKR), RPR) \quad (1)$$

Supply:

$$QR=S(PR, AREAR, RAIN, KAG\ (-1), RPR, MSPR\ (-1)) \quad (2)$$

Procurement:

$$PROCR=PROC(QR, (MSPR-PR)) \quad (3)$$

II. WHEAT

Demand:

$$PW=D\ (QW\ (-1)\ Y, M3, (PROCW\ -\ OFTKW), RPW) \quad (4)$$

Supply:

$$QW=S\ (PW, AREAW, RAIN, KAG\ (-2), RPW\ (-1), MSPW\ (-2)) \quad (5)$$

Procurement:

$$PROCW=PROC\ (QW\ (-1), (MSPW\ (-1)-PW)) \quad (6)$$

The notation used in the foregoing model is as follows.

PR (PW)	: Annual rate of change in the price of Rice (Wheat)
QR (QW)	: Annual rate of growth of output of Rice (Wheat)
Y	: Real income
M3	: Money supply
RPR (RPW)	: Relative price of Rice (Wheat)
PROCR (PROCW)	: Quantity of procurement of Rice (Wheat)
OFTKR (OFTKW)	: Off-take of Rice (Wheat) by government
MSPR (MSPW)	: Minimum support price for Rice (Wheat)
AREAR (AREAW)	: Area cultivated for Rice (Wheat)
RAIN	: Total annual rainfall
KAG	: Real capital stock in the agricultural sector

While the subsequent empirical exercise follows the foregoing model some deviations become necessary in keeping with the way information is available to the decision makers, requirements of the econometric methodology and, of course, in view of unincorporated factors which often result in a few outliers. Specifically, this requires the use of variables in certain functional forms, use of lagged observations, and occasionally introduction of dummy variables to take care of some large outliers.

3. EMPIRICAL RESULTS

The sample period chosen for this analysis covers the years 1980-81 through 2011-12 on an annual basis. Prices are Wholesale Price Index (WPI) for the respective commodities with 2004-05 as the base year. Data for price is obtained from *Office of Economic Adviser, Minister of Commerce and Industry.* Relative prices *(RPR* and *RPW)* are weighted averages of the price of wheat and coarse cereals for rice and rice and coarse cereals for wheat; with weights equal to their corresponding weights in the WPI at 2004-05 prices. Real income is obtained by deflating the corresponding nominal magnitudes with all commodity wholesale price index (WPI-AC) at 2004-05 prices. Data on *KAG*, capital stock in agriculture are available from *National Account Statistics* at 2004-05 prices. The variable rainfall (RAIN) considered is area weighted annual rainfall data released by *Indian Institute of Tropical Meteorology, Pune*. Data for all the other variables are taken from *Handbook of Statistics on Indian Economy* published by the *Reserve Bank of India*.

Table: 3

Augmented Dickey – Fuller (ADF) Stationarity Test

Variable	Levels	First Difference	Order of Integration
PR	-3.99	-	I(0)*
PW	-5.11	-	I(0)**
RPR	-5.09	-	I(0)**
RPW	-4.71	-	I(0)**
QR	-10.35	-	I(0)**
QW	-9.04	-	I(0)**
PROCR	-6.29	-	I(0)**
PROCW	-5.19	-	I(0)**
OFTKR	-4.46	-	I(0)*
OFTKW	-5.20	-	I(0)**
MSPR	-3.21	5.77	I(1)**
MSPW	-3.96	-	I(0)*
AREAR	-8.60	-	I(0)**
AREAW	-6.79	-	I(0)**
Y	-4.54	-	I(0)**
M3	-4.67	-	I(0)**
KAG	-3.90	-	I(0)*
RAIN	-9.65	-	I(0)**

**, * indicate stationarity at 1% and 5% level of significance.

Before estimating the model, stationarity of each of the variables in the model is checked using the Augmented Dickey – Fuller (ADF) test. The results are indicated in Table-3 above. Each of the variables is measured as year on year (y-o-y) rate of increase in percent. After checking the stationarity for the variables, the structural model for both rice and wheat are estimated using the OLS methodology. As mentioned earlier, each equation also includes a dummy variable intended to capture specific outliers caused by factors not featured in the model. However, these outliers are typically for very few years in each equation. The t-statistics are given in the parenthesis below each coefficient.

a. Estimated Model: Rice

Demand

$$PR = -9.04 - \underset{(-4.61)}{0.37^{*}}QR - \underset{(-3.95)}{0.27^{*}}QR(-1) + \underset{(4.83)}{0.98^{*}}Y + \underset{(2.30)}{0.41^{*}}M3 + \underset{(9.40)}{0.63^{*}}RPR +$$

$$\underset{(4.36)}{0.08^{*}}(PROCR - OFTKR) - \underset{(-2.71)}{0.46^{*}}AR(1) + \underset{(5.87)}{9.67^{*}}DUMR1 \quad \textbf{(7)}$$

$R^2 = 0.90 \qquad D - W = 2.27 \qquad F - Stat = 21.27$

DUMR1 takes value +1 for 1992, and -1 for 1997, 2007 and 2010.

Supply

$$QR = -33.89 + \underset{(3.48)}{0.62^{*}}PR + \underset{(2.19)}{0.23^{*}}RAIN + \underset{(9.49)}{2.18^{*}}AREAR + \underset{(3.67)}{1.82^{*}}KAG(-1) -$$

$$\underset{(-2.78)}{0.41^{*}}RPR + \underset{(1.90)}{0.19^{*}}\Delta MSPR\,(-1) + \underset{(7.28)}{12.61^{*}}DUMR2 \quad \textbf{(8)}$$

$R^2 = 0.92 \qquad D - W = 1.82 \qquad F - Stat = 34.47$

DUMR2 takes value +1 for 1986, 1997, 2002, 2004 and -1 for 2009

Procurement

$$PROCR = 4.38 + \underset{(2.01)}{0.41^{*}}QR + \underset{(3.83)}{1.41^{*}}(MSPR - PR) + \underset{(4.96)}{26.36^{*}}DUMR3 \quad \textbf{(9)}$$

$R^2 = 0.65 \qquad D - W = 1.93 \qquad F - Stat = 16.33$

DUMR3 takes value +1 for 1990, 1993, 2000 and -1 for 1999 and 2011.

b. Estimated Model: Wheat

Demand

$$PW = -9.66 - \underset{(-4.48)}{0.63^{*}}QW(-1) + \underset{(3.74)}{0.95^{*}}Y + \underset{(1.83)}{0.43^{*}}M3 + \underset{(9.00)}{0.76^{*}}RPW + \underset{(2.00)}{0.04^{*}}(PROCW -$$

$$OFTKW) - \underset{(-4.01)}{0.66^{*}}AR(1) + \underset{(4.92)}{9.31^{*}}DUMW1 \quad \textbf{(10)}$$

$R^2 = 0.82 \qquad D - W = 2.13 \qquad F - Stat = 13.49$

DUMW1 takes value +1 for 1992, 2001 and -1 for 1999, 2009 and 2012.

Supply

$$QW = -36.89 + \underset{(7.00)}{0.63^{*}}PW + \underset{(3.49)}{0.25^{*}}RAIN + \underset{(3.95)}{0.84^{*}}AREAW + \underset{(4.50)}{1.70^{*}}KAG(-2) - \underset{(-4.97)}{0.33^{*}}RPW\ (-1) + \underset{(2.59)}{0.14^{*}}MSPW(-2) + \underset{(6.45)}{7.92^{*}}DUMW2 \quad \textbf{(11)}$$

$R^2 = 0.87 \qquad D-W = 2.02 \qquad F-Stat = 19.57$

DUMW2 takes value +1 for 1985, 1988, 2001, 2012 and -1 for 2010.

Procurement

$$PROCW = -1.11 + \underset{(1.82)}{0.62^{*}}QW\ (-1) + \underset{(8.28)}{1.97^{*}}(MSPW\ (-1) - PW) + \underset{(10.09)}{41.74^{*}}DUMW3 \quad \textbf{(12)}$$

$R^2 = 0.88 \qquad D-W = 1.55 \qquad F-Stat = 62.60$

DUMW3 takes value +1 for 1994, 1999, 2002, 2009 and -1 for 1993 and 1998. It is equal to +2 for 1999 when wheat procurement increased abruptly by 101.02 percent.

c. Definitional and Accounting Identities

R, W, and CC represents Rice, Wheat and Coarse Cereals respectively.

$$WPI\ R = ((PR/100) + 1)^{*}WPI\ R\ (-1) \quad \textbf{(13)}$$

$$WPI\ W = ((PW/100) + 1)^{*}WPI\ W\ (-1) \quad \textbf{(14)}$$

$$WPI\ RCC = (WPI\ R^{*}1.79 + WPI\ CC^{*}0.46)/(1.79 + 0.46) \quad \textbf{(15)}$$

$$WPI\ WCC = (WPI\ WHT^{*}1.12 + WPI\ CCS^{*}0.46)/(1.12 + 0.46) \quad \textbf{(16)}$$

$$RPR = ((WPI\ WCC - WPI\ WCC(-1))/WPI\ WCC(-1))^{*}100 \quad \textbf{(17)}$$

$$RPW = ((WPI\ RCC - WPI\ RCC(-1))/WPI\ RCC(-1))^{*}100 \quad \textbf{(18)}$$

$$PROCUREMENT\ R = ((PROCR/100) + 1)^{*}PROCUREMENT\ R\ (-1) \quad \textbf{(19)}$$

$$PROCUREMENT\ W = ((PROCW/100) + 1)^{*}PROCUREMENT\ W\ (-1) \quad \textbf{(20)}$$

$$TOTAL\ PROCUREMENT = PROCUREMENT\ R + PROCUREMENT\ W \quad \textbf{(21)}$$

$$PROCTFG = ((TOTAL\ PROCUREMENT - TOTAL\ PROCUREMENT(-1))/TOTAL\ PROCUREMENT\ (-1))^{*}100 \quad \textbf{(22)}$$

4. LOOKING INTO THE RESULTS

Let us recapitulate that each variable is specified as the annual rate of change in percent. Prices of the two products are sought to be explained in terms of simple market system. On the demand side we observe that equations (7) and (10) shows significant and positive impact of income and money supply on rate of change in prices. In both cases the coefficient for income is close to unity. With reference to inflation, this is a strong indication of demand pull pressure on food grain prices. As expected, the impact of quantity available is found to be negative on the rate of change of prices. More importantly, lagged quantity is also found to be significant. For wheat it is only the lagged quantity that is found to be significant. This is understandable as wheat is harvested only once towards the end of the agricultural year.

Apart from the quantity available in market through production, the model also accounts for government intervention so that availability of food grains involves government intervention via procurement and off-take. The net impact of difference between rates of growth of procurement and off-take is found positive and significant implying that when procurement is more than off-take prices tend to rise. However, the impact of these government interventions on prices is only marginal.

With respect to supply, we note a strong and positive impact of capital stock. As expected capital stock works well with lags signifying the need for time required for the completion and utilization process. Moreover, the impact of capital stock on output is found to be stronger than the price and minimum support prices. The coefficient for capital stock is 1.80 and 1.70 for rice and wheat respectively. This clearly indicates the significance of investments to boost production. This is particularly important in the current scenario in which capital formation in agriculture is found declining along with stagnant growth in food grain production and increasing prices[4]. The impact of minimum support price on quantity of production is found to be significant with one year lag for rice and two year lag for wheat. Clearly, capital formation, market prices and support prices have a vital role on top of area of production, and rainfall for a significant positive impact on available supply.

[4] It may be emphasized that, as discussed earlier, public investment in agriculture crowds-in private investment nor is it substituted by private investment. (Mani et. al. , 2010)

Role of government intervention is specifically brought into the model through equations (9) and (12) so as to incorporate procurement. The results clearly, describe the dual market structure for food grains, where producers offer for procurement when minimum support prices are more than the market prices. Apart from minimum support price, quantity of production have a positive impact on procurement. Minimum support prices earlier was found to have positive impact on rates of production. However, its impact is found to be much stronger on procurement than on production, as expected. Thus impact of minimum support prices on market prices will depend on its effect on production and procurement given the off-take. This link is established earlier in the demand equation by estimating the impact of difference of procurement and off-take on rate of growth of prices. On the other hand, higher off-take will tend to reduce market prices.

The foregoing results also suggest strong impact of the prices of coarse cereals and other food products, through change in relative prices. With respect to demand, this means consumers shifting from costlier grains adding to mounting prices of cheaper cereals. This is clearly evident from the demand equations where *RPR* and *RPW* yield significant positive coefficients. With respect to supply, relative prices have a negative impact on production of cheaper food grain as producers move away towards profitable alternative, as expected theoretically. Finally, one can say that relative prices have direct and well as indirect positive impact on food grain price movements. The model as a whole captures the dynamic relationships that exist in the food grain market. The estimated equations also has got reasonably good levels of goodness of fit and also rules out the possibilities of serious auto correlation. For all the variables in the equations, t-values signifying the statistical significance of the variables are also found significant.

5. RELIABILITY, PREDICTION AND POLICIES

The estimated structural model is now subjected to three related exercises. The first one relates to an evaluation of how accurately it can describe movements of critical variables over the sample period. Next, it would be useful to have a look at how the immediate future looks like under plausible policy initiatives. This involves solving the model under some assumptions about the policy parameters. In the third case we may examine the impact of individual policies, one at a time, on the basis of individual simulation exercises using

counterfactual data on exogenous policy variables in the model by way of experiments. Table 4 below classifies the relevant variables into exogenous and endogenous ones in this exercise.

Table: 4
Endogenous and Exogenous Variables

ENDOGENOUS VARIABLES	EXOGENOUS VARIABLES
PR, PW, QR, QW, RPR, RPW, PROCR, PROCW, PROCTFG.	*Y, M3, KAG, WPI CC, AREAR, AREAW, OFTKR, OFTKW, MSPR, MSPW, RAIN.*

a. Reliability

Before the model is used for forecasting or policy modeling it is necessary to check the accuracy of the model. For this purpose first we need to solve the estimated model together with the identities. Then the solutions from the estimated model (baseline solutions) could be corroborated with the actual values of the respective endogenous variable. This can be done by calculating Root Mean Square Percentage Error (RMSPE) for the endogenous variables. RMPSE values for selected endogenous variables are presented in table 5.

$$RMSPE = \frac{1}{n}\sqrt{\left[\sum \frac{(y^s - y^a)^2}{(y^a)^2}\right]}$$

Tale: 5
RMSPE for Primary Endogenous Variables

	Q	*P*	*PROCTFG*
RICE	0.23	0.93	1.00
WHEAT	0.50	0.52	

The RMPSE values for all the variables well within the 5 percent limits, indicate that model has done fairly well in capturing the movements in the endogenous variable. Besides, one may also validate the baseline solutions for important endogenous variables against their actual values. These results are presented in Table 6. For rate of growth of total food grain procurement *PROCTFG,* the baseline solutions are slightly off the mark. But the historically observed turning points are fairly well captured in all cases.

Table: 6
Base Line Solutions for Endogenous Variables

Variable		2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
PR	Actual	4.56	11.30	14.83	12.31	5.86	3.05
	Baseline	5.82	9.35	16.78	18.00	4.97	3.91
PW	Actual	19.14	7.32	9.90	12.81	2.99	-1.84
	Baseline	18.95	5.03	12.91	15.51	6.52	-2.84
QR	Actual	1.70	3.58	2.58	-10.17	6.99	9.44
	Baseline	-0.53	5.84	4.37	-7.81	6.24	8.46
QW	Actual	9.32	3.64	2.69	0.15	6.35	9.27
	Baseline	14.83	2.00	4.73	-0.13	7.89	8.19
PROCTFG	Actual	-14.34	5.32	48.40	4.41	-2.05	16.83
	Baseline	-1.40	12.04	39.37	-4.98	-14.53	11.70

b. Predictions

We next turn to the second exercise intended to examine the ability of the model to predict beyond the sample period which includes the year 2011-12. Accordingly, we make predictions for the four years, 2012-13 through 2015-16. The information needed for the exercise is mostly guess work based on advance estimates, policy statements and other announcements made by agencies mentioned earlier. Table7 below gives the specific data used for this exercise.

Table: 7
Exogenous Variables: 2012-13 through 2015-16

	2012-13	2013-14	2014-15	2015-16
Y	8.80	9.00	9.20	9.30
M3	13.80	15.50	16.50	17.00
AREAR	-3.55	2.53	1.60	2.00
AREAW	-0.84	4.30	1.60	2.00
KAG	6.01	6.20	6.40	6.60
MSPR	15.79	4.80	6.00	6.00
MSPW	5.60	3.80	6.00	6.00
OFTKR	1.50	-10.50	6.00	8.00
OFTKW	24.70	1.50	6.00	8.00
RAIN	100.00	115.00	100.00	111.00
WPI CC	235.12	254.81	270.00	285.00

In Table 8 below we report the predicted rates and the actual rates, as available, for only the rates of price change for the two products in keeping with the focus of this exercise.The inflation forecasts for 2012-13 and 2013-14 are fairly good for wheat. For rice it is somewhat off the mark for 2013-14 but good for 2012-13. However from the perspective of this analysis, what is important is the rates for 2014-15 and 2015-16. Though the rates of price rise are lower 2013-14 onwards, these continue to remain above the comfort zone for the Indian economy. Moreover, for both the years especially 2015-16 the inflationary forces appear to be strong despite expectations of better supply conditions. With Indian economy resuming the growth momentum, and the resulting increase in demand, India may have to live with higher food inflation, unless supply conditions are more strongly addressed. With unpredictable weather conditions the need for supply management is crucial for years ahead. This is strongly in line with our assertion in the beginning itself.

Table: 8.
Forecasts for Rates of Inflation in Rice and Wheat

	PR		*PW*	
Year	Actual	Forecast	Actual	Forecast
2012-13	12.69	12.81	15.51	13.91
2013-14	16.51	10.20	9.20	9.04
2014-15	-	6.40	-	6.54
2015-16	-	8.10	-	10.80

c. Policy Implications

In the third exercise we look at the policy implications from the model. Since the model as a whole has performed reasonably well it is legitimate to take this exercise seriously. For this purpose the model is solved, incorporating desired changes in the independent policy variables. The values of endogenous variables are obtained from the structural model with counterfactual values for exogenous policy variables. These are then compared to the baseline solutions to measure the policy impact in each case. In this exercise we have considered four independent policy simulations as follows.

I. **Simulation 1:** Rate of growth of real income *Y* is chosen to be 3 percent lower than actual rate

II. **Simulation 2:** Rate of growth of money supply *M3*istaken to be 3 percent lower than actual rate

III. **Simulation 3:**Rate of growth of capital stock *KAG* is assumed to be 5 percent higher than actual rate

IV. **Simulation 4:**Rate of growth of minimum support price *MSP* and off-take *OFTK* are taken to be at levels 5 percent higher for both rice and wheat.

The results are as follows. Table 9 presents the average annual difference between the simulated values and the baseline solution under respective simulation experiments from 2004-05 through 2011-12.

Table 9
Simulation Results: Changes in Primary Variables

	Rice		**Wheat**		**PROCTFG**
	P	***Q***	***P***	***Q***	
Simulation 1	-2.00	-	-2.26	-	
Simulation 2	-1.53	-	-1.78	-	
Simulation 3	-3.73	6.64	-3.89	6.63	9.02
Simulation 4	0.10	0.07	-0.12	0.52	7.94

The simulation exercises fall in line with the forgoing discussions. The following aspects needs to be highlighted from policy perspective. First, under *simulations 1 and 2,* we observe significant reduction in rate of growth in prices with lower income and money supply growth. Again we need to note that that of income growth the impact of income is considerably stronger than that of money supply. Second, and perhaps more importantly, capital stock is found to have significant impact on all the three endogenous variables as it is seen to boost production which in turn reduces prices and also induces higher procurement. Finally, we see that, increase in minimum support prices, will add to procurement and its impact on production is only marginal though positive.

However it is important to note that increase in minimum support prices along with increase in off-take play a stabilizing role in the market. More importantly, the impact of minimum support prices, on their own, on the rates of inflation is positive but negligible.

These results are clear indication towards role of investment in agriculture which should be the crucial instrument for policy makers while designing policies targeting food grain prices. Moreover, higher capital stock can also add up to procurement through production, where adequate food grains stocks is critical for Indian economy with vows of food security at times of harvest failures.

6. CONCLUSIONS

This paper is primarily intended to examine food inflation that has characterized Indian economy for the last two decades in a structuralist perspective. Though closely in line with earlier studies like Taylor (1983), Pandit (1984), and more recent ones like Goyal and Pujari (2005), Mohanty (2011) and Rakshit (2011), our approach is more specific and the methodology adopted is somewhat different. We have deliberately focused on the two cereals, rice and wheat, the dominant items in our common food basket, to highlight our perception. In our view the market process which has been centre stage in the Indian economy over the last two decades or so, remains important. However, the role of the state to ensure moderation and stability in price movements cannot be overlooked. The reasoning for this is as follows.

First, it has to be ensured that the level of output and productivity in the agricultural sector are augmented through revival of public investment in this sector. This is necessary to enable the agriculturists to prevent major downturns in output during droughts from time to time. It may be recalled that while public investment in this sector cannot effectively be replaced by private investment such investment will also crowd in private investment and promote better growth of the rural economy. **Second**, the state also has a vital role for effective short term supply management through the long established Food Corporation of India (FCI). This must take shape in terms of proper determination of minimum support prices (MSP) for different products and ensure adequate quantum of procurement. This must be followed by appropriate levels of well-timed off-take to ensure price stability. The usual view of most policy advisors that higher MSP is inflationary appears to be an exaggeration, if not incorrect.

Third, the impact of traditional factors like rainfall, area cultivated, money supply and income growth do turn out important, as expected. With inadequate productivity growth and increasing demands on land for urbanization and industry these factors will become more important in future. As usual, the impact of liquidity, as measured by M3 is strong, justifying a policy of tighter growth of money supply. Needless to say that excessive restrictions in this policy may have an adverse effect on growth. One important observation we must make before we close is about income growth**. Finally**, our simulation exercise shows that the impact of this variable is enormously greater than that of any other variable. Accepting it on face of it implies tradeoff between growth and inflation. But, a deeper view that appears to be more plausible to us is that increasing inequality in income and wealth which accompanies growth is considerably adding to inflationary pressure. Unfortunately, the available data do not permit us to separate the two impacts.

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