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Food Inflation in India and Role of Middlemen: The Case of Speculative Buffering and Government Intervention

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Abstract

In India, the major driver of recent food inflation has been vegetables, pulses and oilseeds for which there is no public procurement. This paper aims to model the behaviour of big retailers or middlemen who hoard such perishable commodities and add to food inflation by creating artificial shortages due to speculative hoarding. The paper shows the adverse impact of speculative buffering on average price. Lastly the paper argues that import of food items and execution of open market sale by the government will help to reduce inflation not only by bridging the supply gap, but also by reducing speculative buffering.

Keywords: Food inflation, Buffering, Open-Market Sale.

1. Introduction

Food inflation has become a major cause of concern for not only the common-man, but also for the policy makers. Of late, high inflationary, pressure particularly double digit food inflation since October 2008 is turning out to be a spoilsport in an otherwise robustly growing Indian economy. Food prices in India started increasing since mid-2008 onwards. The year 2010 witnessed overall inflation rate crossing 10% for five consecutive months. Inflation based on year-on-year wholesale price index (WPI) of primary food articles, still rules high at above 10% (in November 2011). Several factors like drought-induced shortages in food supply, rising international prices, various tiers in the value-chain are deemed to be the major reasons for food inflation in India. Greater government spending leading to increased money supply, structural changes in demand patterns, etc. are being cited as some other major reasons behind this high food inflation.

The problem of food-inflation is not new in India. The country has already witnessed many episodes of food-inflation. It can be shown that apart from random supply-shock, which is held responsible for the recent surge in food inflation, there is also a clear supply-demand gap. On the other hand, due to increase in income as well as population pressure, the growth rate in demand has been increasing. Because of this widening gap, many economists have provided some long-term solutions. These mainly involve increasing the productivity of crops and augmenting the supply of food-grains (Chand, Gulati, Shinoj and Ganguly, 2011). Chand et.al. (2011) advocate a proper export-import policy that will enable a sustainable availability of food grains in every year depending upon the domestic production. Vimani and Rajeev (2001), advocate a lowering of Minimum-Support Price (MSP), as a long-term solution for bringing down the overall price level. In their opinion, the word minimum should cover only the variable cost of production. But these authors fail to capture the fact that this channel will work only for those items for which there is a public procurement. In recent times, the major drivers of food inflation have been onions, sugar, oilseeds and vegetables for which there is no public procurement. Further, a lowering of MSP may not alter the market price if the amounts the middlemen (big-retailers) pay to the farmers enter as a fixed cost in their profit function. In fact, in many situations, the price that the farmers receive from the middlemen is subsistence price, and the increase in market price is often not passed to the direct producer of crops. This paper adds this aspect in its analysis and shows that for the speculators, a change in MSP may have no effect on overall price level.

The major problem with the above studies is that these are only long-term solutions. Since food inflation affects a huge section of the Indian population who live at the brink of starvation, the government has to rely on short-term measures as well. Also, none of these studies captures the reality of the Indian agricultural market, where the entire value-chain is comprised of many stages between the initial production stage executed by the farmers and the final stage of sell to the consumers by the small retailers. The present paper brings in this aspect neglected in the afore-mentioned studies by analyzing the behaviour of the big retailers/ middlemen/ traders who purchase crops from the farmers and hoard them, before they sell it in the final market to either the small retailers or the ultimate consumers. The paper, by bringing in this aspect adds to the existing literature how the behaviour of these traders can be affected so that they do not further contribute to supply shortages and therefore

to food inflation by speculative buffering.

The role of middlemen or speculators has not been comprehensively studied in the literature. The major area of concern for economists in this area has been whether the behaviour of the speculators is based on adaptive expectation or on rational expectation (Chavas, 1999; Gillespie and Schupp, 2002; Holt and Mc. Kenzie, 2003). While the former study deals with expectation formation in US pork market, the latter two are concerned with the US ostrich and broiler markets respectively. Hardly an endeavour has been made in regulating their behaviour. Chavas' empirical attempt finds that in US pork market, expectation formation is mainly backward looking (for 73% of the players considered) and only 19% of the players have rational expectation. In Gillespie and Schupp, there is evidence against rational expectation in US ostrich industry due to lack of information. In the early stage of development of this industry, speculators expected future demand to increase and this led to a price rise for ostrich. However, markets did not grow as expected, and this led to a price crash in the latter stage. In Holt and Mc. Kenzie, the authors fit a quasi rational model to US broiler industry and find that in addition to the quasi-rational forecast, the true supply shock, future price and ex-post commodity price forecast errors have at times been influential in producer's price expectation. This study says that the extent of supply shock affect price expectation.

However, none of these studies can be likened to the Indian market for agricultural products for various reasons. First, in India, the market for pork or ostrich is very thin and supply shock in these markets hardly has an effect on overall food inflation. Secondly, food inflation in India is mainly attributable to food grains like wheat, rice, pulses and recently to vegetables. And thirdly, though price for meat and animal protein have increased over the years, it is not due to a supply shock but due to an increased demand for nutrition led by higher income of people. The kind of asymmetric information adduced as a reason for failure of expectation process being rationally formed in Gillespi and Schupp is not applicable in the Indian case, as markets for food products are stable (atleast in the short-run) and food inflation is primarily due to supply shock. The present paper considers this aspect. Further, it assumes that it is the supply shock that affects the expectation of the traders about future price and thus buffering by these agents (as in Holt and Mc. Kenzie). One relevant study that has focused on the Indian rice market is due to Ramaswamy (2000), where the author points the absence of rational expectation in the Indian wheat market. He argues that the agents make regular error in predicting future price. However, even this study does not talk about actions that the government can take to regulate their behaviours and cool down rice price.

The aim of this paper is to study how the decisions of the big-retailers/ traders or speculators affect the open-market price during a supply crunch, and secondly to see if government intervention in the form of Public-Distribution System can have favourable impact on the open market price. In reality, we get to see both types of situations: for some crops like rice, wheat, pulses, sugar there is government procurement of these items from the farmers, and analogously for other types of food items like vegetables or fruits, government does not intervene in the functioning of the market. The purpose of this paper is to see how the middlemen (synonymous with traders or big retailers in this paper) aggravate food-price inflation in these two cases during a negative supply shock by the act of speculative buffering. Naturally, if the degree of food inflation is lower in the former case, we argue that there is a case for intervention of the government in the latter case as well. This model is cast in a partial-equilibrium framework. Thus, food inflation is synonymous with general inflation. The rest of the paper is arranged as follows. Section 2 examines the behaviour of traders in aggravating food inflation due to their speculative buffering in the absence of government intervention (i.e., PDS). Section 3 talks about the policy intervention, that is, what the government can accomplish to reduce the inflationary impact of a negative supply shock. Section 4 draws the conclusion of the paper.

2. Role of Middlemen in a Perfectly Competitive Set-Up under Exogenous Expectation and without Government Intervention

Let us now formulate the behaviour of middlemen in creating food-price inflation. Since there are many crops like onion, vegetables, fruits and others for which there is no public procurement, we concentrate on this case. We assume that there are a very large numbers of traders (middlemen) who purchase crops directly from the peasants at subsistence price $\overline{w}$. This model is cast in a perfectly competitive set-up, so that none of the traders has any market-power in either the market from which they buy crops from the farmers, or in the market in which they sell crops to the final consumers (or say, for the matter of fact to the small-retailers. But here we assume that the big retailers sell directly to the final consumers). Let each middleman purchase $\bar{x}$ amount of food grain, which we assume to be exogenous. The reason why we take the marketable surplus as exogenous is because the amount of harvest is a function of the decisions taken by the peasants at the previous period. Since there is no public procurement for this type of crops, there is no restriction on the price paid to cultivators being

equal to the procurement price. The amount of output purchased by the middlemen is contingent on the decision taken by the cultivators regarding acreage area, input subsidies received and other market conditions. We further assume that this amount of produce is exogenous to the model. The middlemen behave as follows: they purchase $\bar{x}$ amount of grain at the beginning of period t directly from the cultivators. Out of the total amount they purchase, they decide how much to sell in period t to the final consumers and how much to carry over for sell in the next period, t+1. In period t+1, no further arrival of crop occurs. Fresh stock comes only at period t+2. The reason for this assumption is as that while production and harvest occurs only once or twice during a year, consumption occurs through out the year. For simplicity we assume production and harvest occurs at t while consumption occurs twice; at t and at t+1.

Let B_t denote the amount of buffering done by a representative trader at period t. Obviously, if q_t is the total amount of grain sold in period t, then $B_t = [\bar{x} - q_t]$. Out this amount of buffered grain, a trader decides q_{t+1}, that is how much to sell in t+1. Let the cost of buffering be given by $c[\bar{x} - q_t]^2$. Moreover, out of this buffered amount let θ fraction of the grain gets perished in by period t+1 and the entire amount of grains are perished beyond t+1. That is grains last maximum for two periods. The incorporation of this fraction, θ, is necessary to include transportation cost in the model (ala, the famous ice-berg model due to Samuelson), apart from capturing the perishable nature of vegetables, fruits and other food items. This assumption is essentially valid for vegetables, a major source for of the recent food inflation. Thus in period t+1, a trader can sell the maximum amount $(1-\theta)[\bar{x} - q_t]$.

In period t, the trader knows the price, however, in period t+1, he is unaware of the price due to lack of perfect foresight. He can only guess the future price and depending upon this expected price, he decides his optimum allocation between period t and t+1. Let p^e_{t+1} be the expected price of food crop in period t+1.

The trader faces two constraints: first, total sale $(q_t + q_{t+1})$ and total amount of wastage $[\theta[\bar{x} - q_t] + \{(1-\theta)[\bar{x} - q_t] - q_{t+1}\}]$ must sum upto total amount of grain purchased $(\bar{x})$. Secondly, total sale in t+1 must be less than or equal to effective buffering, i.e.,

$$q_{t+1} \leq (1-\theta)[\bar{x} - q_t].$$

A representative trader will maximize his profit subject to the previous two constraints.

Mathematically,

Max.

$$\pi = p_t q_t + p^e_{t+1} q_{t+1} - c[\bar{x} - q_t]^2 - \bar{w}\bar{x}$$

s.t

$$q_{t+1} \leq (1-\theta)[\bar{x} - q_t] \qquad (1)$$

$$q_t + q_{t+1} + \theta[\bar{x} - q_t] + \{(1-\theta)[\bar{x} - q_t] - q_{t+1}\} = \bar{x} \qquad (2)$$

At equilibrium, (1) implies (2), and thus, we neglect constraint (2) from the maximizing problem.

The Lagrangian is given by:

$$L = p_t q_t + p^e_{t+1} q_{t+1} - c[\bar{x} - q_t]^2 - \bar{w}\bar{x} - \mu\{q_{t+1} - (1-\theta)[\bar{x} - q_t]\}$$

With the Kuhn-Tucker conditions being:

$$\frac{\partial L}{\partial q_t} = 0, \frac{\partial L}{\partial q_{t+1}} = 0, \frac{\partial L}{\partial \mu} \leq 0, \mu \frac{\partial L}{\partial \mu} = 0$$

Now, $\frac{\partial L}{\partial q_t} = 0$ implies,

$$p_t + 2c[\bar{x} - q_t] = (1-\theta)\mu \qquad (3)$$

And $\frac{\partial L}{\partial q_{t+1}} = 0$ implies:

$$p^e_{t+1} = \mu > 0 \qquad (4)$$

and thus,

$$\frac{\partial L}{\partial \mu} < 0 \qquad (5)$$

Therefore,

$$q_{t+1} = (1-\theta)[\bar{x} - q_t] \qquad (6)$$

Lemma 1: A representative trader will not dispose or destroy any part of the food grain (contrary to Basu, 2011). That is, the often heard argument that traders purposely waste/ dispose a part of his procurement and allows it to rot, in order to reap higher price per unit creating artificial shortage is not found to be true in this model. The intuition is that, since fresh stock appears at t+2, and grains are perishable beyond two periods, it is profitable for the traders to sell the entire amount of effective buffer stock.

Substituting (4) in (3) and solving for q_t , B_t and q_{t+1} we get:

$$q_t = \frac{p_t + 2c\bar{x} - (1-\theta)p_{t+1}^e}{2c} \qquad (7)$$

Now, it might be feasible that $q_t < \bar{x}$. As a result, the entire amount of output will be sold in period t itself. This kind of a situation will emerge if $\bar{x}$ is very small or the fixed is very high. We neglect this kind of solution, as the main aim of the study is to capture speculative activity of the traders which requires inter-temporal storage and sell. Now,

$$B_t = [\bar{x} - q_t] = [\frac{(1-\theta)p_{t+1}^e - p_t}{2c}] \qquad (8)$$

This result marks a departure from the result derived in Basu (2011) where hoarding had nothing to do with speculation. Clearly, if agents expect the future price to increase, their buffering increases. In his paper, hoarding is simply the gap between procurement and sale. As a result, the profit maximizing output in cournot competition is an outcome of the profit maximizing exercise, sans any speculation.

Now,

$$q_{t+1} = (1-\theta)\frac{(1-\theta)p_{t+1}^e - p_t}{2c} \qquad (9)$$

Determination of equilibrium prices

Let there be n number of traders. Thus total supply of food grain at period t and t+1 denoted by AS_t *and* AS_{t+1} is n times the individual supply of grain given in (7) and (9) respectively. Now, let the demand curve be given by $AD_t = a - p_t$ and $AD_{t+1} = a - p_{t+1}$ for the two periods respectively. Market equilibrium is given by:

$$AS_t = AD_t$$

And for period t+1 we have,

$$AS_{t+1} = AD_{t+1}$$

That is:

$$n[\frac{p_t + 2c\bar{x} - (1-\theta)p_{t+1}^e}{2c}] = a - p_t$$

Or, $$p_t^* = \frac{2ac + n(1-\theta)p_{t+1}^e - 2nc\bar{x}}{n+2c} \qquad (10)$$

And $$p_{t+1}^{*} = \frac{2ac - n(1-\theta)^2 p_{t+1}^{e} - n^2\bar{x}(1-\theta) + an(2-\theta)}{n+2c} \quad (11)$$

Therefore equilibrium output levels and amount of food buffered are given by:

$$q_t^{*} = \frac{a-(1-\theta)p_{t+1}^{e}+2c\bar{x}}{n+2c} \quad (12)$$

$$q_{t+1}^{*} = \frac{(1-\theta)n\bar{x}-a(1-\theta)+(1-\theta)^2 p_{t+1}^{e}}{n+2c} \quad (13)$$

$$B_t^{*} = \frac{n\bar{x}-a+(1-\theta)p_{t+1}^{e}}{n+2c} \quad (14)$$

Definitely, we need to assume that these variables take positive values. We need another additional assumption here for this system of equations to given by (10) to (14) to be positive and meaningful. Since the equilibrium values of prices and quantities are functions of n, the total number of middlemen, we must make n satisfy two conditions: first, n must be sufficiently large enough so that none of the traders are able to exercise any influence on price, i.e., agents are price takers. Secondly n must not be too large so that all short-run profits are eliminated. In other words n must be such that there is some positive profit.

2.1 Comparative Static Result: Negative Supply Shock

Let us now assume that there is a negative supply shock in output. Our main purpose is to see how speculative buffering adds to price inflation. Considering exogenous expectation, we assume that as there is a negative supply shock, traders expect future (t+1) prices to increase. Since the traders learn about supply shock at the beginning of period t, they can at best assume that future prices will increase, i.e.,

$$\frac{\partial p_{t+1}^{e}}{\partial \bar{x}} < 0 \quad (15)$$

Now, differentiating equations (10) to (14) w.r.t. $\bar{x}$, and using (15), we get:

$$\frac{\partial p_t^{*}}{\partial \bar{x}} = \frac{n(1-\theta)\frac{\partial p_{t+1}^{e}}{\partial \bar{x}} - 2nc}{n+2c} < 0 \quad (16)$$

$$\frac{\partial q_t^{*}}{\partial \bar{x}} = \frac{-(1-\theta)\frac{\partial p_{t+1}^{e}}{\partial \bar{x}} + 2c}{n+2c} > 0 \quad (17)$$

$$\frac{\partial B_t^{*}}{\partial \bar{x}} = \frac{(1-\theta)\frac{\partial p_{t+1}^{e}}{\partial \bar{x}} + n}{n+2c} \gtreqless 0 \quad (18)$$

$$\frac{\partial p_{t+1}^{*}}{\partial \bar{x}} = \frac{-n(1-\theta)^2\frac{\partial p_{t+1}^{e}}{\partial \bar{x}} - n^2(1-\theta)}{n+2c} \gtreqless 0 \quad (19)$$

$$\frac{\partial q_{t+1}^*}{\partial \bar{x}} = \frac{(1-\theta)^2 \frac{\partial p_{t+1}^e}{\partial \bar{x}} + n(1-\theta)}{n+2c} \gtrless 0 \qquad (20)$$

And

$$\frac{\partial q_{t+1}^*}{\partial \bar{x}} \gtrless 0 \leftrightarrow \frac{\partial p_{t+1}^*}{\partial \bar{x}} \lessgtr 0 \qquad (21)$$

Therefore, as and when there is a crunch is food supply, price in period t necessarily increases and output supplied in period t necessarily decreases. What is noteworthy is that, had traders had no expectations about a hike in period t+1 due to a supply shock then the increase in price would have been unambiguously less. Buffering (hence, output sold in t+1) can either increase or decrease and accordingly prices in period (t+1) would decrease or increase post negative supply shock.

Lemma 2: Contrary to the general perception that middlemen will increase buffering and under-supply the market, we discern that buffering may actually decrease during a supply shock, i.e., we can have

$$\frac{\partial B_t^*}{\partial \bar{x}} = \frac{(1-\theta)\frac{\partial p_{t+1}^e}{\partial \bar{x}} + n}{n+2c} > 0.$$

Lemma 3: When buffering actually decreases post supply shock, price in period (t+1) automatically increases, whereas, whenever buffering increases due to supply shock, price in period (t+1) decreases, contrary to general perception that speculative behaviour is always inflationary.

Now, for speculative behaviour to inflationary in (t+1) as well, we need:

$$\frac{\partial p_{t+1}^*}{\partial \bar{x}} = \frac{-n(1-\theta)^2 \frac{\partial p_{t+1}^e}{\partial \bar{x}} - n^2(1-\theta)}{n+2c} < 0.$$

This will be the case when

$$\left|\frac{\partial p_{t+1}^e}{\partial \bar{x}}\right| < \frac{n}{1-\theta}.$$

This is the same condition for buffering to decrease due to a supply shock. The intuition for this is: when agents expect future prices to rise less in response to a supply shock, they tend to buffer less and this adds to future inflation. Since all traders are identical, this behaviour leads to relatively lower supply in period t+1. Thus for larger value of future expected price, p_t^* increases and p_{t+1}^* decreases. In other words, when the above inequality holds, agents expect future prices to rise less and thus they supply relatively more in period t and relatively less in period (t+1). Thus, due to lower supply in period (t+1) food price increases in this period.

Lemma 4: Though future price expectation by traders increase inflation in period t, it actually helps to lower inflation in period (t+1).

(the reason is the same as for lemma 3).

What happens to the average price?

We define the average price (AP) by: $\frac{p_t^* + p_{t+1}^*}{2} = \frac{a\{4c+n+n(1-\theta)\} + n\theta(1-\theta)\partial p_{t+1}^e - n\bar{x}\{2c+n(1-\theta)\}}{2(n+2c)}$ (22)

Now, carrying out the usual comparative static result of a negative supply shock, we see that

$$\frac{\partial AP}{\partial \bar{x}} = \frac{n\theta(1-\theta)\frac{\partial p_{t+1}^e}{\partial \bar{x}} - 2nc - n^2(1-\theta)}{2(n+2c)} < 0 \qquad (23)$$

Thus average price unambiguously increases due to a supply shock. The second and the last term on the numerator gives the pure marginal impact on average-price of a negative supply shock while the first term denotes the further increase in the average due to expectation formation by the traders. Thus, it is clear that the effect of a supply shock is further aggravated by the speculative behaviour of the middlemen. What is more interesting is that, price expectation has a detrimental effect of average price. Thus, even though there might be food-price deflation in the second period, average price will always increase. Infact greater the amount of deflation in period (t+1) more is the overall food price inflation. The reason is clear. Since higher inflation due to speculative behaviour by agents leads to greater amount of buffering and thus lower supply in period t causing food price inflation, the opposite happens in period t+1.

Therefore, it is in the interest of the consumers and policy makers to keep the value of future expected price to a minimum level, if not at zero. This brings us to the policy intervention by the government so that this objective can be realized.

3. Policy Intervention

In this section we look at the various possible ways in which the government intervention can salvage the economy from the pangs of food price inflation as well as affect the behaviour of middlemen so that so that their expectation of a future price rise during a supply shock can be kept to a minimum. It must be noted in this context that it is the expectation of a future price rise due to a supply shock that adds further to the increase in average price. If somehow the expectation of a future price rise due to a supply shock can be moderated by government's policies, then the inflationary impact on food price will be less. This is evident from the expression given in (23). The first term on the numerator gives the aggravation of inflation due to agents' expectation of a future price due to the supply shock. The second and the third term are induced by the actual supply shock. Therefore, the extent of food-price inflation can be sort of reduced if the increase in p_{t+1}^{e} can be moderated. We must also note that in a Marshallian framework, price will certainly increase if supply is reduced. In this section, we try to discern how the behaviour of the middlemen can be controlled so that the extent of price rise is not worsened.

3.1 Reliance on import and ban on export

This has been the conventional measure that the government of India has resorted to various times in the event of a supply shock. Though there have been cases that the country has exported food items despite low production because of higher global price than domestic price, the government must have clear cut policy that will determine whether export should be carried out or not in such events. Since the data on acreage of crops, weather conditions, pests etc are available to the government prior to harvest, this gives leverage to the government to decide on whether to export a particular crop, and if yes, then how much.

Moreover, in the wake of a negative supply shock, the government should rely on imports. With a clear-cut import policy of the government, the traders will know that if there is a supply shock, then import channels will tend to operate and hence final supply in the market will increase to the extent that prices are stabilized. What must be borne in mind is that, small retailers (in this model the consumers) must be able to purchase the imported grain at a price less than equal to what they have to pay to the big retailers or the middlemen. In other words, the government might need to give a subsidy so that cost to the retailers does not increase. With a policy of this sort, the expectation of a future price hike will tend to be small, if not zero. This will happen because traders will know that markets will be flooded with imported goods that will drive down the final price. This will put a rein to speculative buffering. Needless to say, this policy will increase the fiscal deficit

The effect of export ban and greater import will be felt on the domestic currency. Since exports imply supply of foreign currency and imports imply demand for foreign currency, export ban and greater import will put downward pressure on the domestic currency. Under the managed float exchange rate regime that we have, RBI will intervene in the foreign currency market by going for a monetary contraction, if the exchange rate shoots the comfortable ceilings. As a result two opposite effects will occur. The depreciation will boost exports of the non-agricultural sector, and hence output and employment, monetary contraction will reduce this initial expansion somewhat by crowding out investment and reversing the improvement of the trade balance by offsetting the initial depreciation of the currency. The actual direction of employment and output of the non-agricultural sector will depend on the relative strength of the monetary contraction vis-à-vis the exchange rate depreciation. If the monetary contraction is such that the exchange rate settles back at its initial level, unambiguously the non-agricultural sector will shrink. However, if the exchange rate intervention is small there

will be some expansion in the external sector but decline in investment will tend to lower final output. Therefore, whenever the country has to resort to imports of food, it is best for the economy if the RBI does not intervene in the foreign-exchange market, and allows the currency to depreciate. But in this case, the expansion of the non-agricultural sector will lead to increase in the indirect demand for agricultural products, which will contribute to further food inflation.

Another problem that might arise in this case is that import price may even be higher than the open market price. In that case, a subsidy will be required to the retailers/ final consumers who will be able to purchase the grain from the government at a price lower than equal to the open-market price. Higher the amount of import, lower will be the open-market price, and thus, lower will be future price expected by the middlemen. Now, the problem with subsidy is that, it hampers development and poverty alleviation program of the government. But it must be borne in mind that this type of subsidy is only of a transient nature. Moreover, if the RBI does not intervene in the foreign-exchange market so that expansion occurs in the non-agricultural sector, the government will earn greater revenue which will take care of a part of the increase in the fiscal-deficit due to the subsidy.

3.2 Open market sale

If there is already some short-run profits, increasing the number of traders will help reduce prices of food-grains. Also, as the food market is very large, there is a very high degree of competition among the trader. Whenever, the number of middlemen increases, the short-run profit that accrues to an individual players decreases. Moreover, as n increases, agents will expect the future price to increase by a lower amount. This in turn increases the possibility of a decline in prices in both the periods. Average price is also likely to decrease due to an increase in n.

However, in the short-run, increasing the number of traders may not be feasible, as this is a long-run solution. By the time new players enter the market, it will be time for a new harvest. Thus, in this case, one possible solution is that the government itself has to enter the market as sellers; by purchasing grains from the peasants directly at subsistence price (in case of no public procurement of this crop) and selling the crop in the open market at market price. In other words, there should be open market sale.

Mathematically, if R is the amount of open-market sale (and we assume that in both the periods, the government procures and sell R amount of the crop), then the demand function would be $AD_t = a - p_t - R$ and $AD_{t+1} = a - p_{t+1} - R(1-\theta)$. Hence, the equilibrium price levels for the two periods are given by:

$$p_t^* = \frac{2c(a-R)+n(1-\theta)p_{t+1}^e-2nc\bar{y}}{n+2c} \qquad (24)$$

Here, $\bar{y}$ denotes the amount of food procured by the middlemen. Since the government procures a total amount of $2R$, we have the following identity : $2R + \bar{y} = \bar{x}$. Now,

$$p_{t+1}^* = \frac{(2c+n+n\theta)(a-R)-n(1-\theta)^2p_{t+1}^e-n^2\bar{y}(1-\theta)+R\theta(n+2c)}{n+2c} \qquad (25)$$

Therefore, the effect of a negative supply shock on the prices for the two periods, when the government increases the open-market sale (R), is given by:

$$\frac{\partial p_t^*}{\partial \bar{x}} = \frac{-2c\frac{\partial R}{\partial \bar{x}}+n(1-\theta)\frac{\partial p_{t+1}^e}{\partial \bar{x}}-2nc[1-2\frac{\partial R}{\partial \bar{x}}]}{n+2c} = \frac{n(1-\theta)\frac{\partial p_{t+1}^e}{\partial \bar{x}}-2nc+2c\frac{\partial R}{\partial \bar{x}}(2n-1)]}{n+2c} \qquad (26)$$

Now, unambiguously, an increase in open-market sale will have cooling down effect on the first-period price in the event of a negative supply shock, as the third term on the numerator of the above expression is positive. Similarly,

$$\frac{\partial p_{t+1}^*}{\partial \bar{x}} = \frac{-n(1-\theta)^2\frac{\partial p_{t+1}^e}{\partial \bar{x}}-n^2(1-\theta)+\frac{\partial R}{\partial \bar{x}}[n(1-\theta)(2n-1)+n\theta-2c(1-\theta)]}{n+2c} \qquad (27).$$

Now, the third term on the numerator of the above expression will be positive when the following relation holds:

$$c < \frac{n(2n-1)}{2} + \frac{\theta n}{2(1-\theta)} \qquad (28).$$

Given the fact that in perfect-competition, n takes a very large figure, the relation in (28) will automatically hold. This implies that an increase in open-market sale will tend to lower the inflationary impact of a negative shock on the price during period t+1.

Hence, increase in open-market sale by the government will have cooling down effect on prices for the two periods in the event of a negative supply shock.

Regarding the behaviour of the average price, we know that during a negative supply shock, average price will increase, when the prices in both periods rise, or, price rise in period t is stronger than the decline in price for period t+1. But in the both the cases, an open market sale will bring down the average price.

Mathematically,

$$\frac{\partial AP}{\partial \bar{x}} = \frac{n\theta(1-\theta)\frac{\partial p^e_{t+1}}{\partial \bar{x}} - 2nc - n^2(1-\theta) + \frac{\partial R}{\partial \bar{x}}[n(1-\theta)(2n-1) + n\theta + 2c\{(2n-1)-(1-\theta)\}]}{2(n+2c)}.$$

Since the third term on the numerator is always positive, increasing open-market sale will have a favourable impact on average price when there is a supply shock.

One advantage of this open market sale in case of those crops for which there is no public procurement is that, there cannot be any backflow of grains back to the FCI go-downs when the government purchase of food is at subsistence price. Since the government gets the information about a poor crop before the harvest, the government policy should be to directly purchase food grains from the peasant at subsistence wage and sell at market price. Since market price is always higher than the subsistence price, there is no incentive for arbitrageurs to purchase grains at the open market and sell it back to the government, thereby reaping arbitrage opportunities. However, as open market price is higher than the subsistence price, there is no need to provide any subsidy. Infact this will in turn improve the fiscal position of the treasury. First and foremost, there will revenue accretion because of this kind of purchase and sell by the government, and secondly, low food price will give a boost to the non-agricultural sector. The reason why it is so is that, low food price implies greater amount of income that can be spent on the non-agricultural sector. Low agricultural prices will increase non-agricultural good's demand and will provide an expansion to growth and employment in this sector. Finally, this will further add to government's revenue.

Critics will however not advocate any purchase of crops by the government from the farmers at subsistence price. Since the concept of government intervention in food market is associated with a welfaristic conception, it might not be politically feasible for any government to buy crops at subsistence price. Infact, due to a supply shock, already incomes of farmers decrease, and thus, if the government procures at subsistence price, this move will see much resistance and criticism. Now, it is easy to see that any procurement price which is less that market price will ensure that the system is viable. Point to be noted is that, if government intervention does not take place, then competition among traders will ensure that peasants are getting subsistence price, $\overline{w}$ only. Hence government intervention cannot worsen the plight of the farmers further. But as this may not be politically feasible (and also it may not be ethically correct since farmers suffer huge loss when their crops get destroyed, and some protection must be offered to them) the practical solution will to stipulate a procurement-price which is greater than the subsistence price, but lower than the open-market price. In this case, the system will be viable and along with this, the problem of backflow of grains back to the government's storehouses can be taken of.

However, since government has to compete in quantities with the traders in fetching output from the farmers, the easiest and surest way in which the government can increase its procurement and consecutively sell in the open market, is by issuing quotas to the big retailers. In times of lower harvest, the amount of quota should decrease while the government can actually dismantle the quota system in times of normal or bountiful supply. But care must be taken so that export of these crops does not occur to such an extent that it leaves an unfavourable impact on prices in times of normal or super-normal harvest. Not only will this system will fetch additional revenue to the government by selling quotas, but will also boost output in the non-agricultural sector due to low agricultural prices as outlined in former case.

5. Conclusion

This paper does not deal in the exact expectation formation mechanism of the traders, but just assumes that they expect a future price rise when they see a supply shock. In fact, the essence of the model lies in the exogenous expectation regime. Since the agriculture market is too large, it is rational to assume absence of rational expectation. The absence of rational expectation is further proved in Ramaswamy (2000).

This paper provides a theoretical foundation to the behaviour of big retailers. It shows how big retailers decide on the on the amount of hoarding on the basis of their future price expectation. It further shows that agents do not voluntarily destroy any part of output with the hope of reaping higher revenue in the future, when they see that the present price has increased. Since food inflation has become a major problem in India during the past three years, it is high time that the government takes some concrete short-term as well as long-term steps to put the reins on soaring prices. This paper spells out some plausible short-run steps that the government can take, without imposing must fiscal costs.

The contribution of this paper is primarily on the stabilizing effects of price intervention and output intervention by the government. Government intervention not only affects directly the open-market price in this model, but also indirectly affects the future expectations of prices formed by traders. A clear-cut policy will carry the signal the traders about the possible direction of government intervention in the event of a supply shock, and thus would insulate the price of output from the destabilizing speculation of the agents. When the agents know that the government intervention will moderate the extent of the shock, their expectation of a serious price rise will also be moderated. As a result, the food inflation will be purely due to the extent of shock and not due to wrong hoarding actions of the middlemen. This is essentially how the government can control the behaviour of the middlemen

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