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MARKET INTEGRATION IN AGRICULTURAL COMMODITIES IN INDIA:

A STUDY ON IMPACT OF MOVEMENT IN INTERNATIONAL PRICES ON HOUSEHOLD WELFARE

NAMRATA GHOSH

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

MARKET INTEGRATION IN AGRICULTURAL COMMODITIES IN INDIA:
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NAMRATA GHOSH

ABSTRACT

Global commodity prices affect a country's prices if these commodities form a major share of the country's traded items. However, the impacts are different in different local and regional markets. The "theory of one price" and the no-arbitrage condition is based on conditions of efficiency as well as of development. Therefore, a way of measuring the degree of integration across markets is to see how these prices have moved over time. The proposed study will be divided in two parts. In the first part, we will test for market integration of agriculture commodity prices in India with the rest of the world. In the second part, we will estimate welfare impact of a rise in price of principal traded agricultural commodities. We use the Engle and Granger (1987) two-step method to test for cointegration between two variables, methods for establishing causality, error-correction and symmetry, and offer a framework for the assessment of price transmission and market integration. To understand the net benefit of a rise in prices, we use Deaton's (1989, 1997) approach to estimate the short run welfare impact of price changes of agricultural commodities in household welfare. The welfare effect of food price change is proportional to the net benefit ratio (NBR).

Keywords: Food Security, Cointegration, Inflation, Net Benefit Ratio, Household Welfare

SECTION 1
INTRODUCTION

Global commodity prices affect a country's prices if these commodities form a major share of the country's trade. Studies on integration of markets, particularly commodity markets, have assumed greater significance in recent years. With increasing globalisation, markets that are otherwise spatially separated are being progressively linked through trade, be it financial or real. Different economies have reacted differently to global shocks depending on how integrated they are to the rest of the world.

For India too, one would expect greater integration with the world economy as globalisation proceeds. However, while in some sectors India is integrated with world markets, in certain sectors, like agriculture, this may not be entirely true. This is not only because world trade in agriculture is more restricted than in manufacturing, say; but also because there are restrictions in agricultural trade among regions within the country. It is, therefore, possible for food price inflation to be different in different regions because it is not that easy to move such products from low price to high price areas. In a world of no transaction costs, the way to measure such integration is the difference in the prices of similar commodities in different regions/countries. The more integrated a market, the less would be this gap. If certain commodities in country A are more expensive than in the neighbouring country B, the free flow of goods will encourage B producers to sell in A and consumers from country A to buy from country B. This movement will continue till prices are equated in the two regions. In the real world there are various transaction costs that prevent this from happening. Therefore, another way of measuring the degree of integration is to see how these prices have moved over time.

Agriculture in India contributes about 17 percent to GDP and employs about 70 percent of the workforce. Small farmers comprise 80% of holdings and own less than 2 ha of land and marginal farmers, with less than 1 ha, comprise 62% of holdings. Given this scenario, any change in prices of agricultural commodities can have varying impact on producers or consumers. An increase in prices is known to hurt consumers as this leads to a lower purchasing power, given a fixed income. Ghosh and Sharma (2009) studied the impact of food price rise on the welfare of Indian households (the exercise was done using changes in domestic prices). Obviously, this depends on whether they are net producers or consumers. Not immediately obvious is the fact this price rise also leads to increased nominal wages and this somewhat mitigates the food price rise for consumers.

Given this situation, it is worthwhile to see whether the domestic agricultural prices move with international prices and check for the degree of price transmission from international to domestic market, if any. There have been studies that have found the impact of a change in domestic prices on household welfare. However, the impact of international prices, if found integrated with domestic prices, on household welfare in India has not been widely studied. This paper extends the study to measuring welfare impact using international prices, once the price of a commodity in the domestic market is found to be cointegrated with the international market. The price elasticity of demand is used to calculate the welfare impact on households state wise, depending on whether the state is a net consumer or producer of the commodity, segregated by land size class.

While we talk of greater integration with the world economy, it is also important to remember that India is a very small player in the global trade scenario. According to World Trade Organisation, India's share in world total exports is 1.32 percent while its share in total imports is 2.02 percent as of 2009. Agricultural products contributed 10.2 percent to the

economy's total exports while 5.6 percent of agricultural products were imported[1]. Agriculture contributes much lesser than manufacturing and services. This goes on to say that India is not a big enough market to impact world prices. However, with integrated markets, price transmission from the world to domestic markets is likely to take place, and we should expect some impact on domestic producers and consumers of those commodities. In the absence of trade barriers, world food prices will establish upper and lower bounds for domestic food prices. One would expect price transmission to be higher when domestic price is near the import parity price or when it is near the export parity price. One would expect limited price transmission when there are policy barriers to international trade, lack of market information or uncompetitive markets[2].

There are impediments to Indian trade (in the form of tariffs) especially in the agriculture sector that prevent the Indian markets from getting fully integrated with the world markets. It is thus useful to study if with increased globalisation, we have achieved market integration in agricultural commodities, if not in the stricter sense of having "one price" but in a weaker sense where the price differentials move in the same direction.

The rest of the paper is organised as follows. Section II provides a brief literature survey of market integration studies across the world and, and transmission of world prices to domestic prices in terms of welfare impact on households. Section III provides the theoretical structure of market integration to be studied as well as the net benefit ratio model while Section IV provides the econometric model for testing cointegration. Section V provides the data and methodology. Section VI gives the empirical results of cointegration tests and the net benefit ratios. Section VII concludes.

[1] Compare this with China, where its share in total world exports is 9.6 percent while that in imports is 7.91 percent. Agricultural products form 3.4 percent of the total exports while they form 7.6 percent of the total imports.

[2] Minot, Nicholas "Transmission of World Food Price Changes to African Markets and its Effect on Household Welfare" January 2010, IFPRI

SECTION 2
LITERATURE SURVEY

Market integration studies have been carried out mainly by testing co-movement of prices that are indicative of competitive markets. Most studies utilize time series econometric techniques that test for co-movements in prices. Engle and Granger's co-integration and error correction mechanism techniques have become the standard tool for analyzing spatial market relationships. However, time series analysis has been criticized as unreliable. Recent research has focused on models that incorporate data on prices, volume traded and transaction costs. Linear tests for market integration and price transmission are considered inappropriate. In theory spatial price determination models suggest that if two markets are linked by trade in a free market regime, then excess demand or supply shocks in one market will have an equal impact on price in both markets.

Barret (2005) talks of the concept of spatial market integration, where markets aggregate demand and supply across actors distributed in space. At the international level, monetary policy, exchange rate adjustment and the distribution of the gains from trade depend fundamentally on how well prices equilibrate across countries, as vast literatures on the law of one price and purchasing power parity emphasize (Froot and Rogoff, 1995; Anderson and van Wincoop, 2004). At the national level, well functioning markets ensure that macro-level economic policies (for example, with respect to exchange rates, trade, and fiscal or monetary policy) change the incentives and constraints faced by micro-level decision-makers. Barret and Li (1999) introduce a new market analysis methodology based on Maximum Likelihood Estimation of a mixture distribution of model incorporating price, transfer cost and trade flow data.

There has been a lot of debate on the welfare impact of inflation on rural households, both producer and consumer. It is said that net producers should benefit from a rise in price of their product. However, in developing countries, some of the rural farmer households are so poor that they are not able to sell their produce to the market at competitive prices and end up consuming their own produce. Hence, the positive impact of inflation on these households is suspect.

Deaton (1989) examined the effects of rice prices on the distribution of real incomes across different households, and finds that higher prices for rice are likely to benefit rural households at all levels of living. He found that it is the households in the middle income group that stand to gain the largest percentage income gains from increase in the price of rice. In another paper by Ravallion (1989), a similar study for Bangladesh finds that in the short run, rural rich are likely to gain and rural poor likely to lose from an increase in relative price of food staples in a food producing economy. However, in the long run, the welfare of a typical rural household is more likely to be neutral, and the poorest households will benefit somewhat.

Responsiveness of wages to changes in prices of rice and wheat has been debated upon in a lot of countries. There has been little agreement on how responsive agricultural wages are to food prices. While Sah and Stiglitz (1987) contend that terms of trade against agriculture hurts everyone in the sector, whether rich or poor, de Jenvry and Subbarao (1984, 1987) highlight the adverse effects on the rural poor of higher food prices.

SECTION 3
THEORETICAL BASIS

3.1 MARKET INTEGRATION

An integrated market is defined as one in which geography or nationality do not have systematic effects on transaction prices for otherwise identical products (Goldberg and Knetter (1997)). The law of one price (LOP) holds that identical products sell for the same common currency price in different countries, assuming costless transportation and resale. If p_{i1} and p_{i2} are prices in domestic and international markets of good "i" respectively, then according to the law of one price the two will be equal adjusted for the exchange rate.

However, the assumptions of costless transportation and resale (such as tariff barriers) do not hold in practice. Hence, these frictions should give rise to a stable price differential across the two markets. This is the weaker or relative version of the law of one price. The two prices then differ by some constant, α .

Markets play an important role in reducing price variability faced by producers and consumers. If two regions are integrated, then it is more profitable for producers to sell in the region where goods are more expensive. The movement will continue till prices equate across regions. If price of good "i" in the international market is higher than that in the domestic market, then it is more profitable for domestic producers to sell in the international market as they get higher returns for their product. The exports will take place till prices in the domestic market also rise and the gap between the two markets is no longer there. In such a situation, it is not more profitable to sell the commodity abroad. Conversely, if the price of good "i" in the international market is lower than the domestic market, imports of the commodity will be encouraged. They will take place till the domestic price comes down and it is no longer more profitable to import. The above situations take place when there are no trade restrictions. When either export or import restrictions are placed, then the prices in the national market might not move with those in the international markets.

Restrictions could be for imports but not for exports of the same commodity, and vice versa. As mentioned earlier, if the domestic producer finds it more profitable to sell in the international market as the price is higher there, the exports will continue till the prices equalize. If the domestic market then faces shortage, with no import restrictions the commodity can be traded till the price differential is no longer there. However, if there are no export restrictions but some level of import restrictions, the shortage in the domestic market cannot be filled up, and the price differential among markets for the same commodity may not go away.

The Enke-Samuleson-Takayama-Judge (ESTJ) spatial equilibrium model (Barret 2005) says that the dispersion of prices in two locations for an otherwise identical good is bounded from above by the cost of arbitrage between the markets when trade volumes are unrestricted and bounded from below when trade volumes reach some ceiling value (for example, associated with a trade quota).

$$p_0 = p_1 + t_{10} \text{ if } q_{10} \in (0, q_{10})$$

$$\leq p_1 + t_{10} \text{ if } q_{10} = 0$$

$$\geq p_1 + t_{10} \text{ if } q_{10} = q_{10^*}$$

where p_0 is the price in market 0, p_1 is the price in market 1, t_{10} is the transportation cost of moving the good from market 1 to market 0, q_{10} is the physical volume of trade between the two markets and q_{10^*} is a maximal permitted trade volume between the two markets (for example, due to a trade quota). The strict equality is the situation where the law of one price holds under competitive markets. The first inequality highlights a situation where no trade occurs. The latter weak inequality occurs with binding trade quotas that may yield positive returns through arbitrage. Spatial market integration occurs when the ESTJ equilibrium holds irrespective of whether trade occurs.

3.2 NET BENEFIT RATIO

If the domestic markets for certain agricultural commodities are integrated with world markets in terms of prices, we can estimate the effect of a rise in prices of these commodities on household welfare through the concept of net benefit ratio. In general, with inflation, cost of purchasing food increases and hence, this adversely impacts food security of a poor household. However, the impact of price rise is not uniform across all households. It depends on whether the household is a net producer or consumer. In such a scenario, it is important for the policy makers to determine who is impacted the most by such a food crisis.

To understand the net benefit of a rise in prices, we use Deaton's (1989, 1997) approach to estimate the short run welfare impact of price changes of agricultural commodities in household welfare. The welfare effect of food price change is proportional to the net benefit ratio (NBR). The NBR is calculated as the difference between the production share of the commodity and its consumption share in total household expenditures. The net benefit ratio can thus be interpreted as the elasticity of expenditures (or real income) to the commodity price change. We can capture the longer run effects arising from induced wage responses[3] to price changes, by combining Deaton's model with Ravallion's (1990) approach. The basic model is:

$$\mathbf{NBR_i\ (or\ \Delta W) = \Delta\ p\ [(PR_i - CR_i) + \Delta\ w\ L_i\ ]}$$

Where,

NBR_i	=	Net Benefit Ratio, or the welfare effect expressed as percentage of total expenditures of household *i*
Δp	=	Percentage change of food price change
PR_i	=	Food production ratio or production of food item per household ÷total household expenditure
CR_i	=	Food expenditure ratio or consumption of food item per household ÷ total household expenditure
Δw	=	Change in wages per household
L_i	=	Labour share in household expenditures

[3] In place of wage elasticity to commodity prices, we simply use nominal changes in wages. It is difficult to capture wage changes in response to a particular food item. Also, for estimating welfare impact of a household it is important to capture the changes in nominal wages and not changes in nominal wages arising out of the price change.

SECTION 4
ECONOMETRIC MODEL

The concept of cointegration (Granger, 1981) and the methods for estimating a cointegrated relation or system (Engle and Granger, 1987; Johansen, 1988, 1991, 1995) provide a framework for estimating and testing for long run equilibrium relationships between non-stationary integrated variables. If two prices in separated markets (or different levels of the supply chain) p_{1t} and p_{2t} contain stochastic trends and are integrated of the same order, say I(*d*), the prices are said to be cointegrated if:

$$p_{1t} - \beta\, p_{2t} = u_t \qquad \textbf{(1)}$$

is I(0). β is referred to as the cointegrating coefficient whilst equation (1) is said to be the cointegrating regression. The above relationship can be estimated utilizing Ordinary Least Squares OLS (Engle and Granger, 1987), or a Full Information Maximum Likelihood method developed by Johansen (1988, 1991) that is most commonly encountered in the literature. More specifically, p_{1t} and p_{2t} are cointegrated, if there is a linear combination between them that does not have a stochastic trend even though the individual series contain stochastic trends. Cointegration implies that these prices move closely together in the long run, although in the short run they may drift apart, and thus is consistent with the concept of market integration. Engle and Granger test the null of no cointegration between two series by applying unit root tests on the estimate of the error term.

Economic theory often suggests that certain subset of variables should be linked by their long term relationship. Although the variables under consideration may drift away from equilibrium for a while economic forces might restore back the equilibrium. According to the Engle Granger approach to testing for cointegration, if the two series p_{1t} and p_{2t} are I(d) or integrated of order d, and in general any linear combination of the two series is I(0), we can say that p_{1t} and p_{2t} are cointegrated. We estimate the long run relationship $p_{1t} = \beta\, p_{2t} + u_t$ and obtain the residuals of this equation.

A test for the order of integration is a test for the number of unit roots as provided in the steps below.

1. Test p_{1t} to see if it is stationary. If yes, then $p_{1t} \sim$ I(0); if no, then $p_{1t} \sim$I(n); n>0.
2. Take first difference of p_{1t} as $\Delta\, p_{1t} = p_{1t} - p_{1t-1}$ and test to see if $\Delta\, p_{1t}$ is stationary as in step 1.
3. Take second difference of p_{1t} as $\Delta^2\, p_{1t} = \Delta\, p_{1t} - \Delta\, p_{1t-1}$ and test $\Delta^2\, p_{1t}$ to see if it is stationary. We continue these steps till we find that the series is stationary and then we stop.

Dickey and Fuller devised a procedure to formally test for non-stationarity (testing for the existence of unit root).

$$p_{1t} = \phi\, p_{1t-1} + \varepsilon_t \qquad \textbf{(2)}$$

The null hypothesis is $H_0: \phi = 1$ against $H_1: \phi < 1$.

A better and convenient version of the test can be obtained by subtracting p_{1t-1} from both sides of (2).

$$p_{1t} - p_{1t-1} = \phi\ p_{1t-1} - p_{1t-1} + \varepsilon_t \quad \textbf{(3)}$$

$$\Delta\ p_{1t} = \gamma\ p_{1t-1} + \varepsilon_t \quad \textbf{(4)}$$

where $\gamma = (\phi - 1)$

The null hypothesis is $H_0: \gamma = 0$ against $H_1: \gamma < 0$.

However, since the error term is unlikely to be white noise, Dickey and Fuller extended their test procedure to an augmented version that includes extra lagged terms of the dependent variable in order to eliminate autocorrelation. This is called the augmented Dickey Fuller (ADF) test. The three possible forms of the ADF test are given by the following equations with no constant, with constant, and with constant and trend respectively.

$$\Delta\ p_{1t} = \gamma\ p_{1t-1} + \sum_{i=1}^{n} \beta_i\ \Delta\ p_{1t-1} + \varepsilon_t \quad \textbf{(5)}$$

$$\Delta\ p_{1t} = \alpha_0 + \gamma\ p_{1t-1} + \sum_{i=1}^{n} \beta_i\ \Delta\ p_{1t-1} + \varepsilon_t \quad \textbf{(6)}$$

$$\Delta\ p_{1t} = \alpha_0 + \gamma\ p_{1t-1} + \alpha_2 \boldsymbol{t} + \sum_{i=1}^{n} \beta_i\ \Delta\ p_{1t-1} + \varepsilon_t \quad \textbf{(7)}$$

Phillips Perron (PP) test is a more powerful test for checking stationarity. It is a modification of the ADF t statistics that take into account less restrictive nature of the error process. The Mackinnon (1991) critical values are applicable with both tests.

Once we have checked for the order of integration of the price series, we test for cointegration between the two series.

The Engle Granger cointegration test is carried out in two steps.

1. Run the OLS regression of $p_{1t} = \beta\ p_{2t} + u_t$, t=1….T and obtain the residuals,

   as $p_{1t} - \beta\ p_{2t} = u_t$.

2. Apply a unit root test to u_t by constructing an AR(1) regression:

   $u_t = \Phi\ u_{t-1} + \varepsilon_t$. **(8)**

We test the null, $H_0: \Phi = 1$ against $H_1: \Phi < 1$.

If the series are found to be cointegrated, the residuals from the equilibrium regression can be used to estimate the error correction mechanism (ECM) and to analyse the long term and short term effects of the variables as well as to see the adjustment coefficient, which is the coefficient of the lagged residual terms of the long run relationship.

The error correction term is defined as

$$p_{1t} -- \beta\ p_{2t} = u_t \quad \textbf{(9)}$$

where β is the cointegrating coefficient.

The ECM can be derived as follows.

$p_{1t} = \beta\ p_{2t} + u_t$ **(10)**

$p_{1t-1} = \beta\ p_{2t-1} + u_{t-1}$ **(11)**

We know $u_t = \Phi\ u_{t-1} + \varepsilon_t$ **(12)**

Subtracting u_{t-1} from both sides in (12), we get

$u_t - u_{t-1} = (\Phi - 1)\ u_{t-1} + \varepsilon_t$ **(13)**

Subtracting (11) from (10), we get

$\Delta\ p_{1t} = \alpha\ u_{t-1} + \beta\ \Delta\ p_{2t} + \varepsilon_t$ **(14)**

Where, ε_t is identically and independently distributed (iid) and $\alpha = (\Phi - 1)$. Equation (14) says that $\Delta\ p_{1t}$ can be explained by the lagged u_{t-1} and $\Delta\ p_{2t}$. u_{t-1} can be thought of as an equilibrium error. α is the error correction coefficient and is called the adjustment coefficient. It tells us how much of the adjustment to equilibrium takes place each period, or how much of the equilibrium error is corrected.

SECTION 5
DATA AND METHODOLOGY

We test for cointegration of domestic prices with international prices of five agricultural commodities, namely, rice, wheat, soyabean, sugarcane and groundnut oil. We use the Engle and Granger (1987) two-step method to test for cointegration between two variables, say prices P_{1t} and P_{2t} which entails using ordinary least squares (OLS) to estimate the long-run equilibrium relation of the law of one price.

We have used monthly data on international producer food prices obtained from the Food and Agriculture Organisation's website. Indian data on prices of commodities (*mandi* wise per state) can be obtained from the Department of Agriculture and Cooperation, Government of India.

The NBR for the states in India will be calculated primarily for the year 2004-05 for which the production and expenditure ratios are given from National Sample Survey (NSS) 61st round. We take data on changes in prices from 2006-07 to 2007-08 as the year witnessed a big jump in food prices in the country. Wages will also be taken for the years 2006-07 to 2007-08. We also assume that the labour share in household expenditure (obtained from NSS 59th round 2003) has not changed significantly over time.

The variables required for estimating household welfare are aggregated up from the household to the state level. While consumption expenditures at the household level can be aggregated to the state level using the NSS 61st round, the production data cannot be directly obtained from this dataset. We take those households that use their own produce of the commodity, confirming that these are producer households. Also since NSS 61st round does not provide the area under cultivation by commodity for a household, we multiplied the area cultivated of a household with the proportion of consumption of the commodity (say soyabean) from home produce to the total consumption of all commodities from home produce for that household. This would give us atleast the area that went into the production of the commodity for a household. The next step is to find the production of the food item. We do this by taking the total area cultivated per producer household (after adjusting for the home produce proportion of the commodity) and multiplying it with the total yield of the state (taken district wise). The value of production will be obtained by multiplying it with the average price of the food item in the state as of 2007-08.

For labour income as a share of total expenditure, we will use NSS 59th round data from the Situation Assessment Survey of Farmers, 2003, as NSS 61st round does not provide information on labour income. We will impute this data (income from wages to total consumption expenditure) to the NSS 61st round using land size classes as the common variable. The land size class is based on the Agricultural Census of India 2001, with categories starting from less than 0.01 hectares to greater than 10 hectares. For more details, refer to Ghosh and Sharma (2009).

SECTION 6
EMPIRICAL RESULTS

The price series that are to be tested for cointegration in our study are the domestic prices (dependent variable, p_{1t}) of agricultural commodities (rice, wheat, soyabean, sugarcane and groundnut oil) and international prices of those agricultural commodities (independent variable, p_{2t}). The series are first tested for stationarity at levels and then at first differences (Table 1) and if they are integrated of the same order, tested for stationarity of their residuals (Table 2).

Table 1 provides the standard Augmented Dickey Fuller (ADF) and PP test results (test statistics) when applied to the data in levels and first differences. For the data in levels, we cannot reject the null of a unit root while it can be rejected in first differences. Given that the ADF test suffers from poor size and power properties we conduct another powerful test –the Phillips-Perron test. All unit root tests at first difference indicate the price series are stationary or integrated of order 1.

TABLE 1
ADF Test Results for Unit Roots

	World		**India**		**World**		**India**		**Lags**
	ADF Test				**PP Test**				
Price - Levels (test statistic)	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	
log (rice)	-2.92	-1.72	-2.31	0.33	-2.71	-1.73	-5.82	-0.72	4
log (wheat)	-2.00	-1.47	-2.86	-1.46	-1.87	-1.33	-3.01	-1.405	2
log (soyabean)	-2.70	-1.14	-2.62	-1.50	-2.85	-1.46	-2.48	-1.41	1
log (sugarcane)	-3.06	-1.16	-1.93	-0.77	-2.28	-0.95	-2.50	-1.04	2
log (groundnut oil)	-3.09	-2.02	-2.90	-0.91	-1.97	-1.07	-5.16	-1.65	4
	World		**India**						
	ADF Test								
Price - First Differences (test statistic)	With Trend	Without Trend	With Trend	Without Trend	Lags				
log (rice)	-4.66*	-4.65*	-7.34*	-7.22*	3				
log (wheat)	-5.01*	-5.05*	-4.27*	-4.28*	2				
log (soyabean)	-7.58*	-7.48*	-7.69*	-7.67*	1				
log (sugarcane)	-5.25*	-5.26*	-8.44*	-8.47*	1				
log (groundnut oil)	-3.25***	-3.27**	-6.09*	-6.11*	3				

* 1% significance level, ** 5% significance level, and *** 10% significance level. The lag length is chosen according to Akaike's Final Prediction Error (FPE) criterion.

Table 2 provides the results of the Engle Granger two-step methodology for testing cointegration between two series.

TABLE 2

Cointegration Test Results

Cointegration Results						**Critical Values**		
ADF Test of Residuals (test statistic)	Rice	Wheat	Soyabean	Sugarcane	Groundnut Oil	1%	5%	10%
With lags	-2.21 (2)	- 1.82 (1)	-3.57** (2)	-2.69 (2)	- 2.50(2)	-3.73	-3.17	-2.91
Without lags	-3.92**	-1.74	-4.51*	-3.56**	-3.66**	-4.07	-3.37	-3.3

* 1% significance level, ** 5% significance level, and ***10% significance level. The number in brackets is the lag length chosen according to Akaike's Final Prediction Error (FPE) criterion.

The null hypothesis of no cointegration cannot be rejected for all commodities except soyabean. Since soyabean domestic prices show integration with the world prices, we get the error correction model for the same.

The coefficient β in equation 14 provides us the price elasticity coefficient. This coefficient has been used in place of domestic prices in the NBR equation in Section III while calculating the net benefit ratio. For soyabean, the elasticity coefficient at the all India level is 0.28 while the error correction coefficient is -0.41. The net benefit ratio for net producers and consumers of soyabean as a result of changes in international prices (price elasticity coefficient based on the error correction model) is provided in Tables 3-6.

We present results (net benefit ratio or NBR) state wise of a change in domestic prices with respect to international prices for the states of Maharashtra (price elasticity coefficient is 0.55) and Rajasthan (price elasticity coefficient is 0.54) for both net producers and consumers for soyabean and find positive welfare impact across all land size classes. For consumers, it is observed that the wage impact possibly overrides the impact of the higher price level. Table 3 and 4 provide the NBR for net consumers and producers of Maharashtra respectively. Note that for net consumers the net benefit declines as the land size class increases, that is, the lower land size classes gain more from the rise in prices than those in the higher land size class. The rise in agricultural wages seems to have dominated the small land size holding of the small farmers. For net producers (in Maharashtra, producers of soyabean are those who possess land between 2-4 hectares), the net benefit is positive for this land size class as well (Figures 1 and 2). Tables 5 and 6 provide the NBR without taking into account changes in wages in Maharashtra. Note that if we do not take into account changes in wages, the NBR is negative ((even though marginal) for the land size classes for which the NBR with the wage change was positive earlier. For net consumers, this would mean that the wage impact is clearly benefiting them especially in rural areas and those with lower land size classes, below 2 hectares. For producers, the NBR is also negative as the land size class

is too less to give them a positive NBR with a rise in prices. It is possible that the producers are also working for wages to supplement their income.

Tables 7 and 8 provide NBR for net consumers and producers respectively for the state of Rajasthan (with wage impact). For Rajasthan again, as in the case of Maharashtra, the net benefit for consumers declines as one goes the higher land size class, and for producers who belong to the land size category 1-2 hectares, the NBR is positive (Figures 3 and 4). Again, the rise in agricultural wages seems to have dominated the small land size holding of the small farmers. Tables 9 and 10 provide the NBR for net consumers and producers respectively for Rajasthan without the wage impact. As we can observe that the NBR without taking into account the wage impact is negative for both net producers and consumers in their respective land size class. This shows that wage changes do mute the impact of price rise of a commodity to a large extent.

TABLE 3

NBR for Net Consumers of Soyabean (Maharashtra)

Size class	Land possessed (hectares)	NBR (%)
1	less than 0.01	3.28
2	btw .01 & .40	4.11
3	btw .40 & 1.00	3.55
4	btw 1.00 & 2.00	1.94
5	btw 2.00 & 4.00	1.48
6	btw 2.00 & 10.00	0.68
7	greater than 10.00	0.49

FIGURE 1

NBR for Net Consumers of Soyabean (with wage impact)

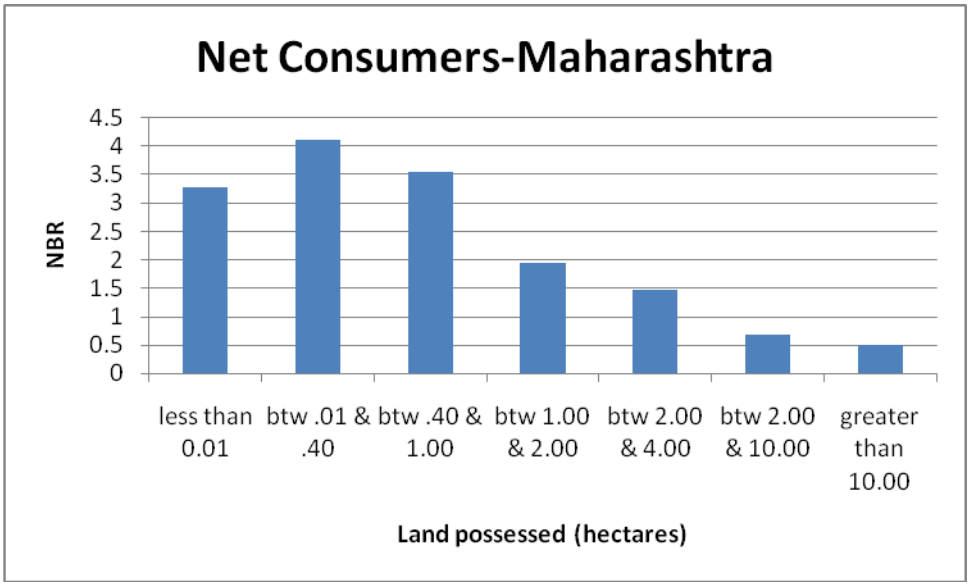

TABLE 4

NBR for Net Producers of Soyabean (Maharashtra)

Size class	Land possessed (hectares)	NBR (%)
1	less than 0.01	NA
2	btw .01 & .40	NA
3	btw .40 & 1.00	NA
4	btw 1.00 & 2.00	NA
5	btw 2.00 & 4.00	1.19
6	btw 2.00 & 10.00	NA
7	greater than 10.00	NA

FIGURE 2

NBR for Net Consumers of Soyabean (with wage impact)

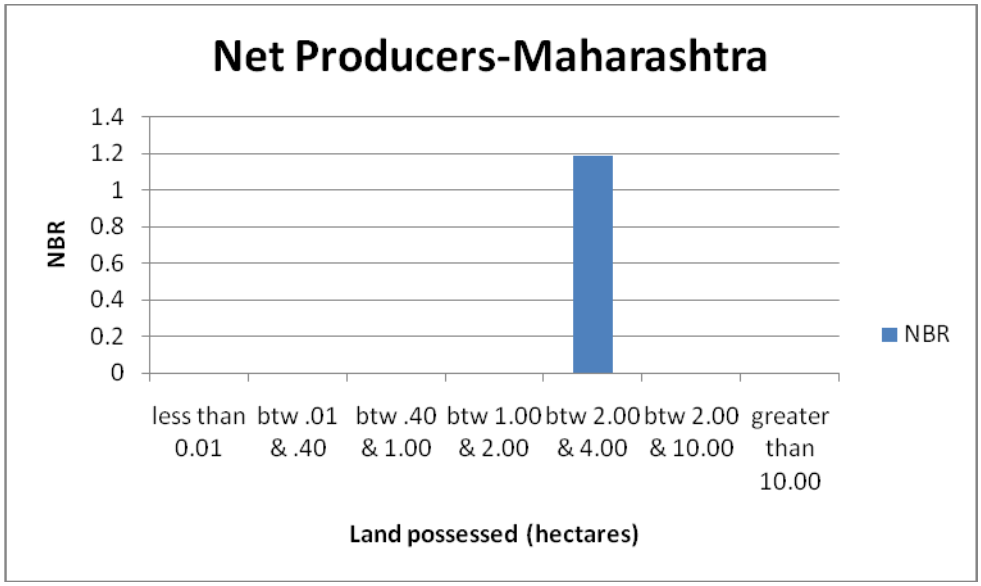

TABLE 5

NBR for Net Consumers of Soyabean (without wage impact) (Maharashtra)

Size class	Land possessed (hectares)	NBR (%)
1	less than 0.01	-0.001
2	btw .01 & .40	-0.001
3	btw .40 & 1.00	0.00
4	btw 1.00 & 2.00	-0.00
5	btw 2.00 & 4.00	0.00
6	btw 2.00 & 10.00	0.00
7	greater than 10.00	0.00

TABLE 6

NBR for Net Producers of Soyabean (without wage impact) (Maharashtra)

Size class	Land possessed (hectares)	NBR (%)
1	less than 0.01	NA
2	btw .01 & .40	NA
3	btw .40 & 1.00	NA
4	btw 1.00 & 2.00	NA
5	btw 2.00 & 4.00	-0.284
6	btw 2.00 & 10.00	NA
7	greater than 10.00	NA

TABLE 7

NBR for Net Consumers of Soyabean (Rajasthan)

Size Class	Land Possessed (hectares)	NBR (%)
1	less than 0.01	7.27
2	btw .01 & .40	7.89
3	btw .40 & 1.00	8.23
4	btw 1.00 & 2.00	6.81
5	btw 2.00 & 4.00	4.68
6	btw 2.00 & 10.00	3.66
7	greater than 10.00	2.65

FIGURE 3

NBR for Net Consumers of Soyabean (with wage impact)

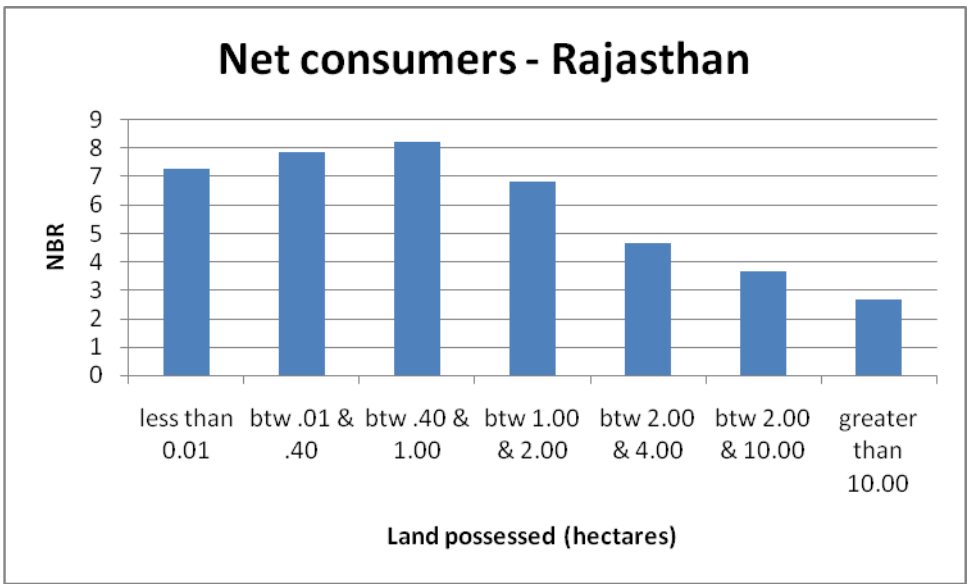

FIGURE 4

NBR for Net Consumers of Soyabean (with wage impact)

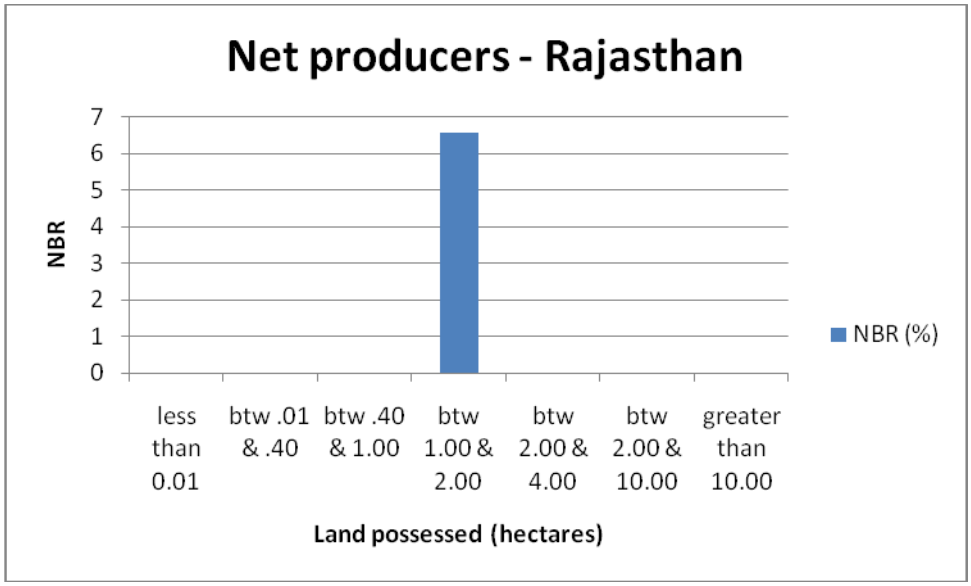

TABLE 8

NBR for Net Producers of Soyabean (Rajasthan)

Size Class	Land Possessed (hectares)	NBR (%)
1	less than 0.01	NA
2	btw .01 & .40	NA
3	btw .40 & 1.00	NA
4	btw 1.00 & 2.00	6.59
5	btw 2.00 & 4.00	NA
6	btw 2.00 & 10.00	NA
7	greater than 10.00	NA

TABLE 9

NBR for Net Consumers of Soyabean (no wage impact) (Rajasthan)

Size Class	Land Possessed (hectares)	NBR (%)
1	less than 0.01	0
2	btw .01 & .40	0
3	btw .40 & 1.00	-0.00
4	btw 1.00 & 2.00	-0.0013
5	btw 2.00 & 4.00	0
6	btw 2.00 & 10.00	-0.00079
7	greater than 10.00	0

TABLE 10

NBR for Net Producers of Soyabean (no wage impact) (Rajasthan)

Size Class	Land Possessed (hectares)	NBR (%)
1	less than 0.01	NA
2	btw .01 & .40	NA
3	btw .40 & 1.00	NA
4	btw 1.00 & 2.00	-0.21
5	btw 2.00 & 4.00	NA
6	btw 2.00 & 10.00	NA
7	greater than 10.00	NA

Note that even though prices of rice and wheat in India are not cointegrated with the rest of the world, since these are staple food items, it would be interesting to see how the rise in domestic prices would impact the net producers or consumers of rice and wheat[4]. Tables 11 and 12 show the NBR for net producers of rice and wheat for 17 major states of India. Our results show that the net benefits of a price rice in staple food items improves the impact of producer households in the states under study. However, an adjustment of wages over time can lessen the impact of a price rise. For rice, most of the states have a positive NBR across all land size classes, except Assam, Bihar, Orissa, Maharashtra and Uttar Pradesh. For Assam, the NBR is positive till land size of 2 hectares and then it turns negative. For Bihar, for land size of 1 hectare onwards, the NBR turns negative, while for Maharashtra, it is negative for the largest land size category of greater than 10 hectares. For Uttar Pradesh, NBR is positive only for the bottom two categories and negative for the remaining ones. For Orissa, the NBR is negative only for the lowest land size category of less than 0.01 hectares. For wheat, the NBR is again positive for all states under study.

[4] Ghosh and Sharma (2009)

Assam has shown a fall in price of rice (1 percent), with an increase of 8 percent in wages. The smaller land size category is compensated of a fall in prices by the wage increase while the bigger land size category clearly shows a fall in surplus as a result of the price fall.

For Bihar, for the period under study, prices of rice declined by 4 percent while that of wheat rose by 5 percent. Wages rose by 7 percent. The NBR for wheat is higher for the lowest land size category as compared to the medium land size classes, rising thereafter for the land size class of 2 hectares and above - implying a wage effect taking precedence over the price effect for the smaller land size classes.

Maharashtra consumes both rice and wheat per capita as a proportion of total expenditure in a similar way (about 9 percent). However, the state saw a -0.4 percent decline in prices of rice, and a 9 percent rise in prices of wheat. There was a 9 percent increase in wages for the state over the same time period. As expected, a decline in prices adversely affected household welfare, which declines as one goes up the land size class. The net benefit even turns negative for the largest land size class category. The net benefit for wheat follows a U-shaped pattern with the lowest land size category benefiting more than the next two categories. The rise in agricultural wages seems to have dominated the small land size holding of the small farmers.

Orissa is predominantly a rice consuming state and is the fifth largest rice producing state in the country. Orissa has had positive net benefit ratios for all land size classes except the lowest land size category. It is important to note that Orissa is one of the poor states of the country, and it is clear that despite being one of the largest rice producing state, the smallest land size category has not benefited from a rise in prices of rice.

Uttar Pradesh is a predominantly a wheat consuming state. It also happens to be the largest wheat producing state and the third largest producer of rice in the country. The net benefit ratio for wheat follows a U-shape. UP saw a 3 percent increase in prices of wheat and a 12 percent rise in agricultural wages.

TABLE 11

Net Benefit Ratio (%) for Rice (net producers)

Land possessed (hectare)	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	J&K	Karnataka	Kerala
less than 0.01	18.76	2.18	2.28	NA	NA	NA	NA	5.64	NA
btw .01 & .40	6.40	4.33	2.31	19.58	17.78	6.85	12.45	9.53	2.98
btw .40 & 1.00	6.57	1.13	0.31	39.22	18.53	9.52	25.26	8.63	13.07
btw 1.00 & 2.00	6.31	0.73	-0.76	69.24	35.95	14.42	43.81	9.53	24.68
btw 2.00 & 4.00	8.47	-0.2	-1.81	75.42	45.75	18.84	71.26	13.83	30.31
btw 2.00 & 10.00	11.17	-0.72	-4.98	164.33	83.39	17.23	117.98	23.83	91.45
greater than 10.00	23.68	-2.07	-11.23	NA	104.84	NA	148.44	49.76	NA

TABLE 11 (contd.)

Net Benefit Ratio (%) for Rice (net producers)

Land possessed (hectare)	Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal
less than 0.01	NA	NA	-6.57	3.17	NA	NA	4.18	1.81
btw .01 & .40	7.40	4.05	3.82	8.83	10.79	13.28	2.45	4.12
btw .40 & 1.00	14.68	3.37	9.84	10.76	18.92	22.42	-0.31	8.26
btw 1.00 & 2.00	25.36	1.56	24.38	18.56	18.70	33.10	-1.24	12.05
btw 2.00 & 4.00	37.47	1.01	44.80	29.18	35.26	48.07	-3.32	18.97
btw 2.00 & 10.00	59.50	0.07	77.85	44.79	44.37	73.57	-6.68	36.14
greater than 10.00	101.86	-0.12	147.74	77.23	NA	117.01	-12.10	73.07

TABLE 12

Net Benefit Ratio (%) for Wheat (net producers)

Land possessed (hectare)	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
less than 0.01	NA	NA	6.58	NA	11.19	8.12	NA	NA	NA
btw .01 & .40	NA	NA	2.8	6.64	10.00	4.73	4.54	NA	NA
btw .40 & 1.00	4.63	NA	2.55	14.71	10.11	4.12	5.67	10.58	NA
btw 1.00 & 2.00	3.88	NA	4.11	26.53	16.62	4.19	7.64	8.35	NA
btw 2.00 & 4.00	3.51	NA	6.98	42.53	23.24	3.57	11.70	13.13	NA
btw 2.00 & 10.00	8.43	NA	11.85	76.08	36.00	2.44	17.02	16.29	NA
greater than 10.00	6.74	NA	24.64	155.38	66.60	0.11	20.25	37.69	NA

TABLE 12 (contd.)

Net Benefit Ratio (%) for Wheat (net producers)

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal
5.22	9.36	NA	1.36	NA	NA	5.39	NA
4.44	5.02	2.04	3.82	8.34	NA	4.00	3.16
7.11	7.20	NA	6.78	9.74	NA	3.25	4.43
9.98	9.82	NA	12.53	9.11	NA	4.31	4.50
16.47	13.49	13.61	22.78	8.99	NA	6.21	6.47
24.59	21.18	NA	33.49	10.71	NA	8.97	11.02
48.12	32.89	NA	56.00	21.09	NA	12.05	NA

SECTION 7
CONCLUSION

We observe that out of the five commodities that we have undertaken for our study, only one, that is, soyabean shows integration between domestic and international prices. We calculate the household welfare of an increase in international prices of this commodity. The welfare is positive across all land size classes. As of 2008-09, India produced 9.91 million tonnes of soyabean, as opposed to 99.18 million tonnes of rice and 80.68 million tonnes of wheat. Indian imports of soyabean oil far outpace its exports. We are hence net consumers of the commodity. The welfare impact on the consumers is positive for most of the states as the wage impact shields the consumers from higher international prices of soyabean that get transmitted to India.

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Biography

Namrata Ghosh is a research fellow at India Development Foundation, Gurgaon. Namrata is a post graduate in Economics from Delhi School of Economics. She has worked with Oxford University Press and Genpact (erstwhile GE Capital) prior to joining IDF. At IDF, she is involved with research in areas of poverty, financial inclusion, cash transfers and market integration. She is also the managing editor of a peer-reviewed journal, Review of Market Integration, brought out by IDF thrice in a year (published by SAGE). Namrata has also won an award for her paper on "Estimating Welfare Impact of a Rise in Prices of Rice and Wheat in India" submitted at the International Development Research Council (Won the IDRC 2009 award in the "Enhancing Food Security" category).

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