WILL OECD AGRICULTURAL TRADE REFORMS IMPACT INDIA'S CROP PRICES AND FARMERS WELFARE?

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ABSTRACT

Rich countries use a combination of domestic market interventions and border protection or export subsidies as a part of their domestic policies. Developed countries such as the United States and the European Union (EU) resort to trade distorting policies to make their crop more competitive – both groups maintain high domestic prices for producers, stimulate production, and thus distort prices in the world market. The distorting effects of international trade can be distinguished between consumer surplus, producer surplus and tariff revenue approaches.

The present paper emphasizes on the welfare of the producers with the main focus on small farmers. The analysis presented in the paper is an approximation of the general equilibrium analysis. The four parts of this approximation are: first, the estimation of the world price effect of removal of OECD (Organisation for Economic Co-operation and Development) distortions; second, estimation of the effects of changes in world prices on domestic prices through a price transmission model; third, estimation of the impact on domestic production through a supply response model; and, four, the estimation of changes in supply and welfare on the poor small farmers.

The simulation exercise shows that due to elimination of subsidies in OECD countries the world crop prices are expected to rise. The results confirm that the depressed world prices can be corrected by removal of OECD subsidies, but the challenge for India remains: How much can these price corrections benefit the farmers? India's domestic price response to this world price change is very small for rice and wheat and slightly better for cotton and sugar. On the production front, with reduction in subsidies and rising of the world price, the production in OECD countries would decline, but it is not very clear if this would have a discernable effect on India's production. In response to the rise in world price, this paper concludes that this change would have almost negligible impact on India's production for rice and wheat and a marginal increase in the production of cotton and sugar. The welfare impact on small farmers based on these changes is also estimated. The important fact to be observed in this study is that the developed countries' policies protecting their farming sector critically affect the lives of billions of people who depend on agriculture in developing countries.

Key Words: OECD Agriculture, Trade Policy, Subsidy Elimination, Producer Welfare

JEL Classification: F13, F17, Q17

OECD AGRICULTURAL TRADE REFORMS IMPACT ON INDIA'S PRICES AND PRODUCERS WELFARE[1]

1. Introduction

1.1 Motivation

The main objective of WTO (World Trade Organization) agreement on agriculture (AoA) was to encourage fair trade in agriculture by removing the trade distorting measures. It was expected that implementation of AoA would raise international prices of agricultural commodities and would improve the exports prospects of the country like India. However, contrary to this, the world prices had declined sharply, became even lower than the domestic prices, creating a more favourable imports rather than exports.

Whilst most rich countries use a combination of domestic market interventions and border protection or export subsidies as a part of their domestic policies, developed countries such as the United States and EU resort to trade distorting policies to make their crop more competitive. Both groups maintain high domestic prices for producers, stimulate production, and thus distort prices in the world market. In the current negotiations under WTO it is being proposed to reduce the level of agricultural support in developed world, phasing out of trade distorting subsidies and elimination of export subsidies. Taking a long-term view, developing countries have been looking forward with a lot of optimism that distortions in agricultural markets will eventually be eliminated. The pressure for change in agricultural policies in developed countries is growing and there is a broad agreement that distortions in agricultural markets, including direct payment and border protection leads to overproduction and price decline, reducing opportunities for developing countries to expand exports.

Trade liberalization affects poverty through multiple channels. The immediate effect is through change in price level, which would trigger exports and domestic prices would rise and equalize world prices. Apart from direct price effect there is lagged effect through agricultural wages and

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employment (Winters, 2002). Higher prices would stimulate production, which is expected to increase demand for agricultural labour, driving up wages and offering gainful employment. An increase in agricultural prices may adversely affect the net consumers of those agricultural products in the short run, but the agricultural labourers and small farmers who supplement their incomes from agricultural wages could gain through wage and employment increase (Gulati, 2002). One consideration is that these price effects should get transferred to the poor.

Thus, the key dimension of trade and poverty question include price transmission from the border to households, and its impact on production, wages, employment and poor producers' welfare. The present study is based on the hypothesis that if the OECD agricultural policies change and domestic subsidies are eliminated and tariff levels are relaxed then there will be a decline in the production in the OECD countries, which will help the world prices to rise from a depressed level, leading to a boost in production in developing poor countries and bringing about a change in the welfare of producers in these countries.

Cutting back on subsidies and other protection that primarily benefit relatively wealthy farmers in rich country markets and in some cases middle-income country markets can open up opportunities for poor farmers in developing countries. The effects on incomes in poor countries would be strong and immediate. In many cases the gains could be substantial, greater than the development assistance provided to these same countries.

1.2 Selection of commodities

For India rice, wheat, cotton and sugar are the important agricultural commodities. India is the largest producer of these commodities in the world. Rice and wheat are the major staple food in the country. A minimum support price (MSP) for rice and wheat is announced every year by the Commission for Agricultural Costs and Prices taking into account the cost of production and aiming at protecting the agricultural producers from any sharp fall in farm prices. India follows the procurement and stocking policy for public distribution of rice and wheat and the Central Government plays an important role in setting up the national agriculture policy in spite of the fact that agriculture is a state subject in the Constitution, therefore the state governments have to give their concurrence to the prices and policies drawn up by the Central Government.

Cotton production policy in India has been oriented towards promoting and supporting the textile industry. Thus, prior to the recent reforms, the producers were heavily taxed by export controls aimed at providing low cost cotton to domestic textile mills. To encourage producers, the Government of India (GoI) announces a minimum support price for each variety of seed cotton. India is also the largest consumer of sugar in the world. GoI had totally decontrolled the sugar industry in 2002-03 subject to futures trading becoming fully operational. A MSP is also annually announced for sugarcane.

Gulati and Kelly (1999) estimated that India would be exporting tons of rice, wheat and cotton with globalization of agriculture. Gulati (2002) also found that India would be competitive in exporting sugar and cotton if trade liberalization takes place. Indian agriculture is getting connected to the world agriculture but the price fluctuations due to trade distortions are keeping the country away from being competitive.

1.3 Objective

There are very few studies or database exercises which have investigated and identified the impact of OECD agricultural reforms (Annexure) on developing countries and its further bearing on poverty or welfare of producers. This is one of the first studies to quantify this impact on India, through a partial equilibrium analysis and simulation techniques. Sensitivity analysis is also done to have an estimate of changes in prices and production at alternative world demand and supply elasticity. In the study we are looking into the impact of elimination of domestic support and decline in tariff levels in the OECD countries on prices, production, quantify the effect of this price change on the welfare of farmers given their production bundles.[2] The crops that are studied are rice, wheat, cotton and sugar. Thus, the main objective of the study is to

1. Analyze the impact of change in OECD agricultural policy - domestic support, export subsidy and tariff change (full liberalization impact) on world price, world production and OECD production.
2. Track the impact of world price change on domestic prices through a price transmission model.
3. Analyze the impact of change in domestic prices on domestic production through a supply response model.
4. Compute the changes in welfare of producers with main emphasis on small farmers, due to change in prices and production.

2 Literature Review

2.1 Links between OECD policies and poverty

Agricultural products have the most distorted markets in the world economy. The OECD secretariat estimated in 2002 that support for agricultural producers just in OECD member countries totalled US$248 billion on average per year between 1999 and 2001 (Townsend, 2003). The competitive situation remains severely distorted by high protection granted to domestic producers in agriculture, consumer goods and other industries, by major budget subsidies in agriculture (World Bank, 2004). Studies by UNCTAD (Supper, 2001) and Oxfam (Watkins and Sul, 2002) have investigated the extent to which distortions in trade have effected the developing country exports and found that U.S. cotton subsidies are destroying livelihoods in Africa by encouraging overproduction and product dumping.

Estimates by the International Cotton Advisory Committee (ICAC) indicate that withdrawal of U.S. cotton subsidies would raise cotton prices by 26 per cent. Competitive countries have suffered as a result of both lower prices for exports and loss of world market share. Studies (Leetmaa, 2001; Hoekman et.al., 2004) show that distortions in agricultural markets lead to overproduction and price declines, reducing opportunities for developing countries to expand

[2] It would have been idle to look into the consumption bundle also, but due to lack of data that can identify producers as consumers also; this study does not address the total welfare impact but only concentrates on the producer welfare gains as a measure of impact on poverty.

exports. Hertel and Winters, 2005, found that a 40 per cent reduction in agricultural tariffs, export and production subsidies results in global welfare gains of around $70 billion per year. For India, subsidies given by the United States to cotton producers means a huge loss as imports are flooding in and otherwise Indian cotton could have been much more competitive (Sengupta, 2003). It is observed that for most of the years in major agricultural commodities domestic prices are higher than world prices (Chand, 2002). Thus it is expected that the implementation of AoA the rise in the international prices of agricultural commodities would improve export prospects for India and other countries (Chand and Mathew, 2001). Although recent study by Dimaranan et al (2003) found that liberalization of OECD policies might hurt consumers in developing countries.

Trade liberalization is widely considered as a positive contributor to poverty reduction, although the linkages are not direct. Thus we need to identify different characteristics of the poor including the information about their consumption, production and employment activities (Winters et al , 2004). The other key dimension of trade and poverty question is price transmission from the border to households and at farm gate, thus it would be due to factor price changes, higher wages, and change in employment level that a reduction in poverty could be anticipated. This has been shown in case of Brazil (Hertel and Winters, 2005).

Another important link in trade and poverty analysis is change in wage-employment situation. Factor markets play an important role in the context of the linkages. When trade liberalization enhances profitability then the demand for labour is likely to expand. The majority of the poverty reduction is due to factor price changes, that is, higher wages, and change in employment level. Many of landless agriculture poor rely on labour markets for the bulk of the income. Thus the effects of trade reforms on wages and employment are important, especially for the unskilled. Due to trade liberalization and a consequent change in prices and production, either wages or employment or both is likely to increase. The proportional shock to earned income induced by trade liberalization depends on the shares of factors and household income and the proportional changes in the returns or wages (Winters et al, 2004). An alternative polar view of labour markets is that labour is available in perfect elastic supply in developing countries, thus the wages will be fixed exogenously and thus all the adjustments will take place in terms of employment. In India, there is an abundance of un- and under-employed labour in rural areas that can be drawn into agriculture without much change in wages. In this case the wages are fixed exogenously by what labour can earn elsewhere and the adjustment can take place in terms of employment. This linkage needs to be worked out through employment elasticity in agriculture sector. Insufficient data and elasticity computation posed a handicap in computing this aspect in this particular study.

With trade liberalization, an increase in price of products, which a household is producing, would lead to an increase in its income and poor households gain from increased wages and profits (Singh et al, 1986). Households being consumers too might have to face the adverse effect of increased prices thus its ability to adjust to trade shock affects the size of any impact it suffers. Households will be exposed to new risks also but the net effect can reduce overall risk because the world markets are often more stable than domestic ones (Winters, 2002). The developing countries with large mass of poverty often want to keep prices of agricultural

products suppressed with a view to keep food within the reach of the masses. But this results in lower incentives to cultivators, which then forces the governments to extend non-product-specific support to farmers. This is built in the structure of the economy (Gulati and Kelly, 1999). But for the developed countries, this PSE is even more distorting for farmers in the developing countries. There is deterioration in the relative productivity of labour in agriculture in the United States and EU countries on account of high farm support. The food surpluses of the farmers produced at high cost could not become competitive in the export market without heavy subsidies on exports. Developed countries have a tendency to subsidize agriculture because of unfailing regularity in the process of development (Hanumantha, 2001). An ideal analysis should try to deal directly with the effects of trade liberalization on the chances of moving into or out of poverty in an uncertain world. This requires information on the way that liberalization affects the distribution of shocks and households' ability to cope with them. But inclusion of these factors makes the analysis very complicated (Winters, 2002). According to Sachdeva (2003) the internally domestic prices are affected and influenced by the low price and income elasticity, production, government interventions like minimum support prices and procurements, subsidies, devaluation, etc.

2.2 Key results from literature

Anderson and Valenzuela (2006) in their paper conclude that the global trade distortions are still harming the developing country farmers. The study shows that global liberalization would have a positive farm income rise for India. Hertal and Winters' (2005) paper worked out that if Doha development agenda is implemented then employment of lowest skill workers in Brazil might get a boost by 40 per cent. In China, the poverty reduction would be fuelled by increased agricultural export to the highly protected agricultural market of the East Asia.

The world rice market is highly distorted due to heavy support provided by Japan, Korea, Europe, and the United States to their rice produces. Total OECD support is more than $26 billion, and in Japan support is a staggering 700 per cent of production cost at world prices (Stedman and Edwards, 2005). Gulati and Narayanan (2003) believe that with the removal of trade distortions in rice, there could be rice flows from poorer to richer countries. Thus, it can be expected that poorer countries such as Vietnam, Thailand, and India would be important net exporters while the richer countries such as Japan, Korea, and the EU would be net importers. Minot and Goletti (2003) predicted that the elimination of the rice export quota in Vietnam could raise prices by 14 to 22 per cent on average, and can be expected to reduce both the incidence and depth of poverty. Prospects for growth in trade therefore rely on policy reforms. Tariff and related border protection is very high, averaging about 40 per cent globally and rising to 200 per cent in some markets. The pattern of protection depresses world prices for high-quality, milled long-grain rice (Wailes, 2003). It is estimated that global reforms (elimination of all border barriers and support) could lead to average price increases of about 33 per cent, rising to 90 per cent for medium- and short-grain rice. Since most production is by small farmers in these countries, the gains could be very pro-poor as well. Liberalization is expected to help increase the rice trade by 10-15 per cent. Production could continue its shift to developing countries, namely China, Thailand, Myanmar, Cambodia, India and South America (Stedman and Edwards, 2005). Producers in poor exporting countries will benefit from a price increase of 25-35 per cent.

Given the prevalence of small-scale producers in poor Asian countries, the poverty alleviation benefits will be widespread, even though consumers will pay higher prices.

Farmers in EU have been encouraged to produce wheat with a combination of market price support (through intervention buying and export subsidies and direct payments), that contribute to over production and surpluses. Total production support averaged about $10 billion annually during 1999-2001, corresponding to a protection rate of almost 50 per cent. The prices were artificially kept higher than the world price. That time, EU's Common Agricultural Policy (CAP) has brought these prices equal to the world price. Since the cost of producing wheat is very high in EU, so to compensate farmers for reduction in intervention price, direct payments are given to farmers under various schemes, and they are encouraged to continue growing wheat even at a higher cost of production. This wheat is dumped into the world market at a price which is at least 40 per cent less than the other countries cost of production. This has extensively affected the farmers of developing nations.

India has not yet established itself as a regular wheat exporting nation. The quantity of food grains allowed to be exported depends on the domestic demand-supply situation. In the era of trade liberalization, however, no such control can be expected to be exercised if production is plentiful. At present the stagnant production, increased demand and high speculation in the Indian market resulted in inflated wheat prices (Mittal, ET, 2006) and the government had to import wheat. Not much information is available which provides deep insight into the global changes due to the liberalization, more specifically about the removal of subsidies.

Cotton is one of the most important cash crops in developing countries and small landholders play a major role in its production. Cotton production and processing employ as much as 7 per cent of all labour force in developing countries. About one-third of raw cotton is traded. World trade in *cotton* shows severe policy distortions, but, unlike sugar, the distortions come through producer support rather than from border measures such as tariffs and quotas (Baffes, 2004). Agricultural subsidies in the United States are the main reason for a significant drop in world cotton prices, which have fallen by half since the mid-1990s. Costs of production in the United States are three times than in Burkina Faso, yet the United States has expanded production in the midst of a price slump. The United States provides the greatest support to its producers—$3 billion annually and the European Union about $0.6 billion each year. Producer prices in the United States were 91 per cent higher than the world market price in 2001-02. High producer support encouraged the U.S. cotton production to grow about 25 per cent faster than world production after 1970, and EU production accelerated once. (Greece and Spain joined the European Community in 1981 and 1986.) Economic models estimates show that if full liberalization takes place in the cotton sector then in next 10 years, cotton prices would increase by an average of 12.7 per cent over a price that would be prevailing in absence of reforms (CUTS, 2005). World cotton trade would increase by 5.8 per cent while Africa's cotton export would increase by 12.6 per cent, Australia by 2.7 per cent, while exports from the United States would decline by 3.5 per cent. Cotton production in the United States would decline by 6.7 per cent; in the European Union, by 70.5 per cent. In effect, cotton production in the European Union would fall back to levels that existed prior to the Common Agricultural Policy.

The European Union, Japan, and the United States account for $6.4 billion of OECD-zone support to the producers of sugar, which is approximately equal to developing-country exports. Consequently, the world prices of sugar today are below the costs of production of some of the most efficient producers. The world market has shrunk to a trade residual, with an estimated 80 per cent of world production being sold in high priced, protected markets. Presently, developed countries are protecting their sugar producers at great cost to themselves and to developing countries with export potential. Study of the global sugar and sweetener markets (USDA, 2003) estimated that removing all trade protection and support would bring annual global welfare gains of $4.7 billion. For sugar it is estimated that with sugar policy reforms in countries with highest protection, net imports will increase by 15 tons per year. World sugar price could increase by 40 per cent, while sugar prices in countries that heavily protect their markets would decline. The greatest price decline would occur in Japan, where sugar price would fall by 65 per cent followed by 40 per cent decline in Western Europe and 25 per cent decline in the United States. Brazilian producers would gain the most from liberalization - about $2.6 billion per year but this gain would be partially offset by higher consumer prices. Japan's net gain from lower consumer prices would more than offset lower producer prices on the 40 per cent of sugar that is domestically produced. In the United States, producer losses would be some $200 million greater than consumer gains. Western Europe would show a net gain of $1.5 billion, with consumer gains of $4.3 billion exceeding producer losses of $3.3 billion (Stedman and Edwards, 2005). Exporting countries that presently enjoy preferential access to the European Union and the United States now collect some $800 million by selling into protected markets at high prices. The rise of world sugar prices following full liberalization would partially offset the loss of preferences and allow some preferred producers to compete. The net loss to preferred producers from full liberalization is estimated to total about $450 million per year (Borrell and Pearce, 1999; Sheales and others 1999).

Estimates have been made to the effect that a complete removal of all trade distortions would increase net Indian agriculture export by about $2.7 billion a year, which would be a 50 per cent increase in the current levels of agriculture exports (Jha et.al, 2003).

3. Methodology and Data

The study investigates into the impact of elimination of domestic support, export subsidy and decline in tariff levels in OECD countries on the production and poverty level in India. The linkages of impact of trade liberalization on production and poverty is through the change in price, production and its net impact on welfare of poor producers. The effects are based on elasticity of world demand and supply. Any change in international price would affect the domestic producers through elasticity of supply, and then the changes the welfare of producers through price and production effects. These linkages are worked out using a partial equilibrium[3] and simulation techniques. Sensitivity analysis is done to have an estimate of changes in prices

[3] General equilibrium approach would be the best to understand the holistic impact of policy change on poverty as it takes into account the second-best welfare interactions. Due to data constraint, the present study choose to work in a partial equilibrium framework. This approach is less time-consuming and needs relatively less data. The strength of the present study is that supply response, price transmission elasticity and change in world prices and production, due to OECD policy change is computed during the study and not picked up from the literature.

and production at alternative demand and supply elasticity. The models used for the analysis and data are discussed in detail below.

3.1 Changes in world prices

3.1.1 Impact on world due to subsidy elimination

The change in world prices, world production, OECD production and rest of the world production is computed using the following model. The simulations are done under the assumption that there is an elimination of all domestic support and export subsidies.

Model[4]:

Eliminating subsidies in country i would reduce the price received by producers from P+Si to P_0. With an infinitely price elastic demand, production would fall from Q_0i to Q_1i according to equation (1):

$$\text{Ln}(Q_1i / Q_0i) = Es * \ln(P_0 / (P_0+Si)) \quad (1)$$

This calculation is repeated for each country i (OECD – US and EU15 and Other OECD) in order to calculate the total amount which would have been withdrawn from the world market by eliminating subsidies with an infinitely price elastic demand. Equation (2) measures the extent of the horizontal leftward translation of the world supply curve.

$$Q_0 - Q_1 = \Sigma(Q_0i - Q_1i) \quad (2)$$

The leftward shift of the world supply curve leads to a new equilibrium corresponding to price P_0 and quantity Q_2 satisfying equations (3) and (4)

$$\text{Ln}(Q_2/Q_0) = E_d * \text{Ln}(P_1/P_0) \quad (3)$$
$$\text{Ln}(Q_2/Q_1) = E_s * \text{Ln}(P_1/P_0) \quad (4)$$

Subtracting equation (3) from equation (4) gives the market clearing price P_1

$$\text{Ln}(Q_2/Q_1) - \text{Ln}(Q_2/Q_0) = \text{Ln}(Q_0/ Q_1) = (E_s – E_d) * \text{Ln}(P_1/P_0) \quad (5)$$

In countries i, the price increase (P_1/P_0) induces the production increase Q_2i/Q_1i defined by:

$$\text{Ln}(Q_2i/Q_1i)= E_s * \text{Ln}(P_1/P_0) \quad (6)$$

The production decline shown in equation (1) is partly offset by production increase calculated in equation (6). Adding up equations (1) and (6) gives the production decline resulting from the elimination of subsidies:

$$\text{Log}(Q_2i/Q_{0i}) = E_s*[\text{Ln}(P_0/P_0+Si) +\text{Ln}(P_1/P_0)] = Eo*\text{Ln}(P_1/P_0+Si) \quad (7)$$

In countries j, the price increase (P_1/P_0) induces the production increase Q_2j/Q_0j defined

[4] Adapted from Goreux (2004)

by $Ln(Q_{2}j/Q_{0}j) = E_s * Ln(P_1/P_0)$ (8)

After eliminating subsidies, the world supply Q_2 calculated from equation (3) is identical to the sum of the quantities $Q_{2}i$ calculated from equations (1) and (6) or directly from equation (7) plus the sum of quantities $Q_{2}j$ calculated from equation (8).

Where;
i Subscript for countries with subsidies (OECD).
j Subscript for countries without subsidies (Rest of the world).
a Subscript for developing countries (subset of countries j).
Si Subsidy granted by government of country i, in cents per dollar.
P_0 Actual world price with subsidies measured by Index A, in cents per dollar
P_1 Simulated world price after eliminating subsidies, in cents per dollar
Q_0 Actual world supply with subsidies, in thousands tons
Q_1 World production without subsidies and with infinite demand elasticity
Q_2 Simulated world production after removal of subsidies
$Q_{0}i$ Actual production of country i with subsidies, in thousands tons
$Q_{1}i$ Production of country i without subsidies and with infinite demand elasticity
$Q_{2}i$ Simulated production of country i after removal of subsidies
$Q_{0}j$ Actual production of country j without subsidies in thousands tons
$Q_{2}j$ Simulated production of country j after elimination of subsidies
E_s Price elasticity of world supply (positive)
E_d Price elasticity of world demand (negative)
Ln Logarithm

The decline in production by the OECD countries will create supply deficit in the world market, which can be captured by the developing countries, based on their production potential and export competitiveness in that particular commodity.

Sensitivity analysis

Based on the model discussed above the sensitivity analysis is carried out using the combinations of world demand and supply elasticity for each crop individually as presented in the simulation matrix in Table 1. Few elasticity's could be obtained from the literature, thus for the simulation purpose the low, medium and high range elasticities are build around them.

Table 1: Sensitivity matrix for change in world scenario

Scenario	Rice		Wheat		Cotton		Sugar	
	Es	Ed	Es	Ed	Es	Ed	Es	Ed
Low	0.12	-0.02	0.10	-0.03	0.25	-0.37	0.11	-0.10
Medium	0.50	-0.10	0.23	-0.11	0.47	-0.64	0.28	-0.20
High	0.90	-0.50	0.38	-0.20	0.80	-1.27	0.40	-0.40

Note: Es is World Supply elasticity; Ed is World Demand Elasticity.
Rice and Wheat Es from Rosegrant et al (2001), Ed from Paroda & Kumar (2000); Cotton Es from Goreux (2004), Poonyth et al (2004), Becerra (2000), Ed from Goreux (2004) and Shui et al (1993); Sugar Es from Koo et al (2003), Meiners et a l (2003), FAO, Ed from Schmiz et al (2003), Meiners et al (2003).

3.1.2 Impact on world due to change in tariff

The change in world prices due to change in tariff structure and full liberalization is computed using the figures of changes in world prices available in the literature. This information is compiled for rice, wheat, cotton and sugarcane and presented in Table 2 along with the source of reference. Different estimates are available from different sources based on the assumption and base years which may differ across studies used. Thus the present study uses these different estimates as scenarios and incorporates them in further estimation of welfare change.

Table 2: Per cent change in world price

Crops	Scenario 1 Doha round tariff	Scenario 2 EU tariff elimination	Scenario 3 Global tariff removal	Scenario 4 Full liberalization	Scenario 5 Full liberalization
Rice	8.3	1.6	5.9	10.1	3.83
Wheat	2.1	2.2	3.4	18.1	3.83
Cotton	6.9	3.0	4.2	5.6	0.75
Sugar	3.2	2.5	10.9	16.4	2.52

Note: Cotton figures pertain to plant fibres information; Per cent change is from base year.
Scenario 1 and 2 are from Winters 2005. Per cent are calculated at base year 2001;
Scenario 3 and 4 are from USDA (Burfisher, 2001). Per cent are calculated at base year 1997;
Scenario 5 is from Polaski (2006). Per cent are calculated at base year 2001.
Analysis for domestic price change is done for all the scenarios. The scenarios giving the maximum change in domestic prices and production are further used to see the impact on welfare change.

3.1.3 Data

The data for domestic support is aggregated for all the OECD countries from the countries' notifications to WTO[5] by criteria of amber, blue, and green and export subsidy. To ensure that the data is comparable across countries, we limit the analysis to domestic support for the major commodities that are notified to the WTO for the years 1995-2001/03 for rice, wheat, cotton and sugar.

AMS[6] (aggregate measure of support) values are specified for both the product specific and non-product specific values of domestic support. Since the present study has a commodity specific

[5] All WTO members have to notify the Committee on Agriculture the extent of their domestic support measures. The listing is done for the Green Box, developmental measures, direct payments under production limiting programmes (Blue Box) and de minimis levels of support. AMS (aggregate measure of support) calculations and also and the Current Total AMS is also notified by each country.

[6] While both the PSE and the AMS are measures of domestic support, their concepts differ. For the present study AMS measure is thought to be more appropriate relative to PSE database for domestic policy reform using current WTO criteria. The PSE is a broad concept designed to measure overall developments in agricultural policies, across countries, based on a measure of current benefits to farmers (or costs to consumers and taxpayers). PSE has two components: market price support and budgetary outlays. It includes the effects of trade policies (import barriers and export subsidies) in its measure of market price support, which is calculated as the gap between the domestic producer price and a current world reference price times eligible production for each commodity. It also includes all government budget expenditures on farm programmes, including WTO exempt (Green Box) outlays that are made

approach, thus the non-product specific AMS is weighted by share of the crop in value of production for each country. This part is then added to product specific AMS and total AMS is constructed. Similar weighting is also done for Blue Box subsidies to get the product specific subsidy component. Data on production, value of production is compiled from WTO sites, OECD database.[7] The world market prices used for analysis is compiled from IMF-IFS statistics.

3.2 Price transmission: Border price to farm gate

3.2.1 Model

An incomplete price transmission arise because of wide range of unclear factors such as transaction costs, market power, non-constant returns to scale, product homogeneity and changes in exchange rate (Conforti, 2004). Its difficult to incorporate all these factors, thus an alternative way is to estimate price transmission elasticity to deals with the price transmission between border and domestic farm gate price (Valenzuela et al, 2005). This elasticity takes into account the domestic and border policies and time trend that link the world and domestic prices. Price transmission elasticities were first proposed by Bredahl, Meyers and Collins (1979) to measure incomplete adjustment in domestic prices in response to changing world prices as a single parameter. They have since been used in other studies of wheat markets, such as Tyers and Anderson (1988) and Devadoss and Meyers (1990). A discussion of their use for policy representation in global models is found in Conforti (2004) and in Van Tongeren, Van Meijl, and Surry (2001). We follow the lagged price transmission specifications of Abbott (1979) and Collins (1980) to formulate a relationship between changes in international prices and domestic prices. Due to the prevailing annual shocks, short-run price transmission elasticity is used for analysis. The econometric specification is autoregressive, and takes the form of a partial adjustment model in which incomplete transmission arises from policy and institutional rigidities (Abbott, 1979).

The data in the econometric analysis is expressed in logarithms to reduce data variability; the estimated parameter can directly be interpreted as transmission elasticity of domestic price with respect to world prices. The value of the parameters and their significance level provides information about the extent to which markets share the same price shocks (Conforti, 2004). A transmission parameter summarizes the overall effects of a set of factors affecting price signals. Since most estimation includes a constant term, they should include only the effects of those elements that change proportionally with prices. Two variations of the model are analyzed. One is with trend factor and other is without trend. General specifications of international price transmission through a partial adjustment model are of the following form:

$$ln\ PD_t = \alpha + \lambda \ln PD_{t-1} + \beta\ \ln PW_{t-1} + \gamma T + \varepsilon_t$$

---

directly to producers, all of the WTO non-exempt (Amber Box) subsidies, and all of the WTO Blue Box forms of domestic support.

[7] Neither the OECD data nor the WTO data are sufficient for a comprehensive and consistent comparison of the impacts of domestic support policies potential production and trade distortions resulting from domestic support programmes. While countries report domestic support to the WTO the reporting is sporadic and considerable lags occur in reporting. The OECD scheme provides a comprehensive list of policy types based on the method of implementation; however the OECD classification does not distinguish between production distorting and non-distorting programmes.

where PD_t is domestic price at time *t;* PW_t is world price; T is time trend; β is a short-run price is transmission elasticity.

Price transmission elasticity indicates how much of a given change in the world commodity price is transmitted to the domestic price in the current period. The model is a partial adjustment model; OLS estimators maintain the relatively more important properties of consistency and efficiency (Greene, 2004). The error term (ε) in the price transmission model is assumed to be identically, normally, and independently distributed. Given the time-series nature of the data, we first investigate the dynamic properties of the price series through unit root and co-integration tests, followed by the possible adoption of an error correction model (Conforti, 2004). A key limitation, however, is that our annual price series covers 11 years only. This limits our ability to test the dynamic properties of the series and to test for serial correlation through a Breusch-Godfrey approach or similar method. Regressions are presented in Appendix 2.

3.2.2 Data

The world price data is obtained from the IFS statistics. Domestic prices for the period 1990-2001 is compiled from FAOSTAT (2006). The study uses international prices of Thailand market for rice, Australia market for wheat, US Liverpool market for cotton and Caribbean free market for sugar. For domestic prices the study uses the market price of Kakinada, Andhra Pradesh, for rice; Sagar, Madhya Pradesh, for wheat; Abohar, Punjab, for cotton lint; and Hapur, Uttar Pradesh, for sugar.

3.3 Supply response model

4.3.1 Model

In a general framework, it is important to know how the producers respond to price change. The most plentiful evidence on production efforts concerns responses to changes in prices, usually in agriculture, based on aggregate time series data. Many such supply response studies[8] have been conducted which suggest that producers are quite responsive to price incentives and other factors. With price change production level also change, talking into account the price level of competitive/substitute crops.[9] The following log linear functional form of nerlovian supply response model is estimated for each crop. The elasticities formulation is also given below.

$$A_{it} = \alpha_o + \alpha_1 \ln A_{itlag} + \alpha_2 \ln P_{itlag} + \alpha_3 \ln P_{jtlag} + \alpha_4 \ln Y_{it} + \alpha_5 \ln W_{tlag} + \alpha_6 \ln F_{tlag}$$
$$+ \alpha_7 \ln Rain_{tlag} + \alpha_8 Z + statedummy$$

Where:

A_{it} : Own Area; P_{it}: Own Farm Harvest Price; P_{ji}: Competitive Crop Farm Harvest Price; Y_{it} : Own Yield; W: Wage Rate; F: Fertiliser Price; Rain: Annual rainfall; Z: Other Variables

[8] Various research papers on Indian economy have computed these elasticities, but this study prefers to compute these elasticities on own. This is so because, different studies compute these elasticities with reference to different time periods, different regional zones and use different methodology.

[9] The study uses cotton and sorghum as competitive crops for rice, rapeseed & mustard and sugarcane for wheat, coarse cereals for cotton and rice, wheat for sugarcane.

Short Run Elasticity: Own Elasticity $= \alpha_2$ *; Cross Elasticity:* α_3

Long Run Elasticity: Own Elasticity $= \alpha_2 / 1-\alpha_1$ *; Cross Elasticity:* $\alpha_3 / 1-\alpha_1$

Supply elasticities[10] are computed by pooling the time series and cross section data of each crop separately. OLS and 2SLS techniques are applied to the model. Yield is being used as proxy for technology variable. Results are corrected for autocorrelation and hertoscedasticity. The elasticities from different literature sources as compiled in Gulati and Kelly (1999) also support the elasticities computed in the study.

3.3.2 Data

State-wise crop specific data on area, yield, production, use of inputs and their prices and irrigation is collected from various published reports of the Directorate of Economics and Statistics (DES), Government of India (GoI), and from the "Comprehensive scheme for the study of cost of cultivation of principal crops," of the DES are used in the analysis. Duration of period of data is 1980-2000. The missing year data on inputs and their prices were predicted using interpolations based on trends in the available data. Rainfall index for each state is constructed by averaging the monthly rainfall data for different centres of each state. The state average is weighted by the area under each centre. The data was obtained from various reports published by India Meteorological Department. Cropping patterns are investigated to identify the major states where a particular crop is cultivated. The states that together contribute to more than 95 per cent of India's area and production are pooled together to compute the country's supply elasticity.

3.4 Welfare model -- Trade liberalization and poverty linkages

3.4.1 Model [11]

There are a very few research papers done in India which have quantified the trade liberalization and poverty linkages. There is yet no universal conclusion as to weather a particular trade liberalization policy will increase or reduce poverty. Winters (2002) has developed a framework for exploiting the link between trade liberalization and poverty by considering its effect on the prices of tradable goods and then of these changes on households and individual welfare. In this framework, trade reforms and shocks trickle down to households via their direct effects on product and factor markets and indirectly through changes in the government revenues and social spending. All of these have implications for poverty. Through the price channel, trade induced price changes in product markets affect both the nominal and real incomes of households in their

[10] Due to data constraint supply elasticity for different operational farm size groups can't be computed.

[11] The present study looks into the producer surplus to measure the impact of change in policy on poverty emphasizing on the small framers welfare. Producer surplus measures are only a rough gauge, a better measure would have been equivalent variation. OECD policies have a positive impact on consumers due to the inflow of cheap produce and also because in some products India might be a net importer only, thus a more liberal environment could affect consumers welfare. Studies have shown that a liberal environment would have an adverse impact on households that are eventually net consumers. Since the present study is looking into the welfare impact of only producers this aspect is not considered. Also the consumption information of the same set of producers is not available.

capacity as producers as well as consumers.[12] The direction and strength of these real incomes depend on whether households are net buyers or net sellers of the products concerned.

The present study uses a similar approach to investigate the trade and poverty linkage. The model quantifies the effect of price change and production change on welfare of farmers, and poor farmers[13] in particular. The welfare change for the landless wage labourer would be estimated through employment change as discussed in Section 3.4. The study assumes that the supply elasticity to be same for all farm sizes. This is a limitation to the study because the small farmers will have a lower elasticity of supply response and a larger share of their total production in food crops vis-à-vis the large farmers. But due to data constraints separate supply elasticity can't be computed.

The following model (Sadoulet and Janvry, 1995) will capture the producer welfare effect through the producer surplus approach in a partial equilibrium framework.

Welfare gain of producer (Changes in Producer Surplus)
$\Delta PS = q\,(p - p^b) - NSCP < 0$
Net Social Change in Production (NSCP) = $1/2E_s t^2 W > 0$
$t = \frac{p - pb}{pb}$; $W = p^b q^b$
Where: p^b = Border price; q^b = Quantity produced at the border price; p = New Border price after price change; q = New Quantity produced after price change; E_s = Supply elasticity

3.4.2 Data

Information on operational land holdings by farm size is compiled from the different Agricultural Census, Agricultural Census Division, Ministry of Agriculture, Government of India. Supply elasticity, new prices and new quantity information is generated in this study itself.

4. Impact of Trade Liberalization on Prices and Production

A simulation and sensitivity analysis is analyzed in this chapter to see the impact of change in different OECD trade policies on price and production both in the world and the Indian markets for rice, wheat, cotton and sugar.[14] The policy changes considered are first, if the subsidies are fully eliminated. Subsidies for the purpose of the analysis in this study are defined as the sum of Total AMS, *de minimis*, Blue Box subsidy and export subsidy. For rice, which is aggregated country-wise to get the total OECD figure. The sensitivity analysis is run at a range of low, medium and high world demand and supply elasticities as described in Table 1. The sections below individually talk about the impact on prices and production. The second policy analyzed is

[12] The present study looks into the producer surplus only. Household consumer information is available in India which can't be effectively compared with the state level producer information. This is discussed in detail in the section on limitation to the study.

[13] The poor farmers constitute the small and marginal land holders who have less than 2 hectares of land to cultivate.
[14] Detail in methodology section.

the change due to reduction in tariff and full liberalization. Simulations are done for 5 scenarios picked up from the literature.

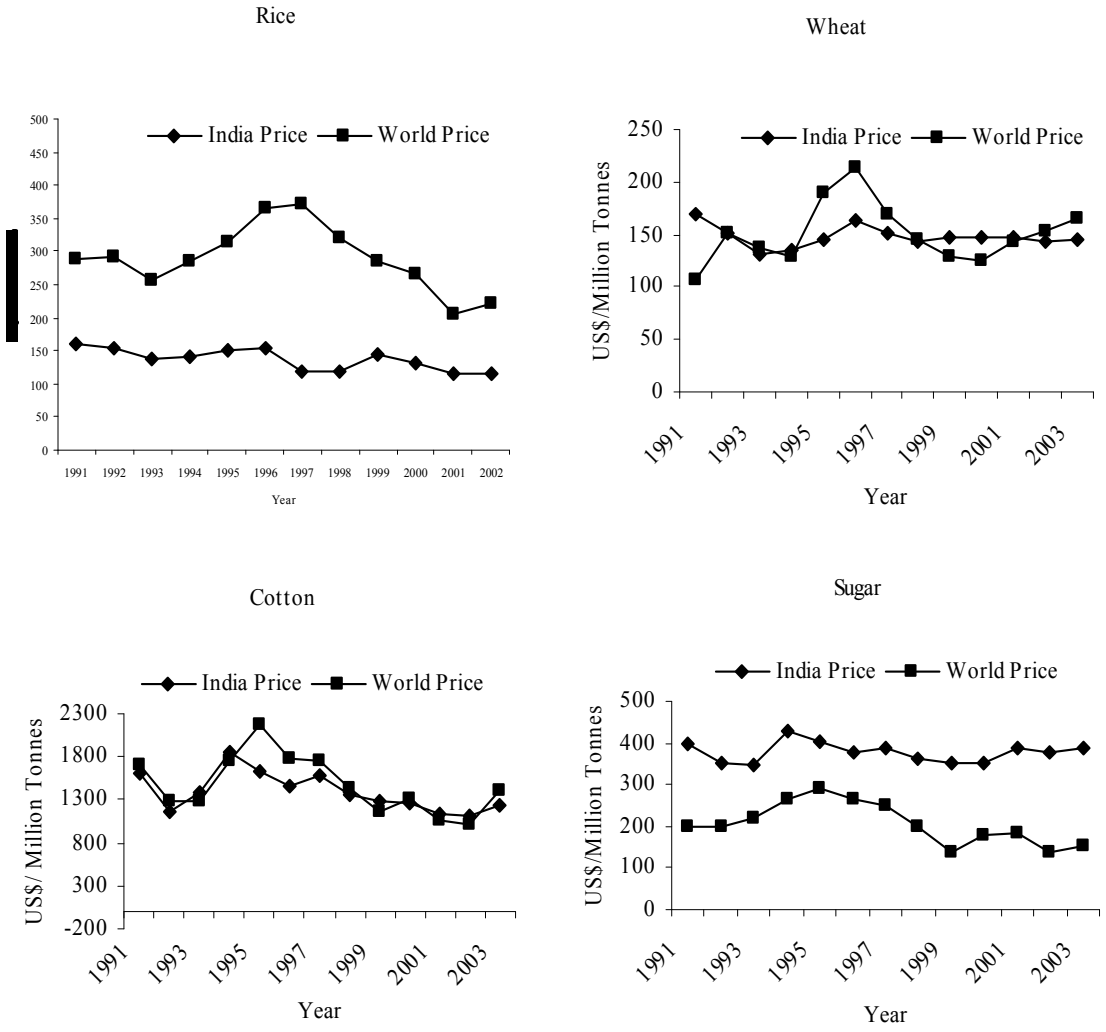
4.1 Impact of elimination of subsidy on prices

The study follows the hypothesis that if the OECD agricultural subsidies are fully eliminated then it would no longer be profitable for the OECD farmer to produce for exports. In short run, some production could be withdrawn from the world market which makes the world market clearing price to rise from its depressed level. Thus, in long run as market forces adjust and the world market stabilize at a point where the equilibrium price is above the depressed prices. In this situation the existing shortfall in supply in the world market could be met by the other developing countries, which were earlier not competitive in the world market due to depressed prices.

The percentage change in world prices based on the sensitivity analysis for range of world demand and supply elasticity are presented in Table 3. The results are given for nine scenarios which are the combination of the range of world demand and supply elasticity respectively for each crop. If the OECD subsidies are eliminated then price of rice could increase by 1.05-4.86 per cent in the world market. The overall impact on price change in rice would not be very huge. For wheat, the maximum change in world prices due to subsidy elimination could be 7.35 per cent and minimum could be 2.61 per cent. Higher supply elasticity would give a higher change in price. For cotton, the world price might rise from its depressed level by 6.55 per cent to 20.85 per cent. The overall impact on cotton price is quite substantive. Similarly for sugar this change in world prices could range between 7.45 per cent and 26.42 per cent under alternative supply and demand scenarios. These simulations support the hypothesis that with removal of subsidies the price gain could be significant in the world market.

For the changes in the world market to have an impact on Indian market it is important to understand the relationship between the world and Indian price series for the commodities. Figure 1 shows the comparison between the Indian price market and world prices for rice, wheat, cotton and sugar. It shows that over the last one decade the Indian rice prices have been lower than the world market prices and also the two price series don't seem to correlate with each other. Indian wheat prices and world market prices series have been moving hand in hand. The world prices seem to impact the Indian market also. Indian cotton prices and world market prices follow similar trends and are not very different from each other. The two price series don't seem to correlate with each other. Indian sugar prices have been higher than the world market prices and also the two price series seem to correlate with each other.

Figure 1: World and India Price Trends



The impact of the OECD policy change on the world prices get transmitted to other countries. This impact on Indian price market is computed through the price transmission model. The price transmission elasticity (PTE) is computed for all the four crops under two models, one with the time trend and other without the time trend. The PTE and regressions are presented in Appendix 2. The stationary tests, unit root test and co-integration tests are also performed to verify the results. The study tries to predict the maximum possible change in welfare of the farmer through price and production changes thus the PTE used for analysis are 0.049 for rice, 0.2 for wheat, 0.728 for cotton and 1.064 for sugar. The elasticity for rice is very small and statistically non-significant. The two price series are not co-integrated and are non-stationary. This implies that the impact of change in world price on Indian rice prices would be almost negligible. This might be true in case of India because rice being a staple food is usually a controlled price market through the fixing a minimum support price by the Government of India, which does not allow the rice price to fall below it. The deficit supplies in the market are met either by release of government stocks or imports. The PTE for wheat, cotton and sugar are statistically significant.

The Indian commodity market for these crops is co-integrated with the world market and thus it is assumed that the price rise signal in the world market will have a positive impact on Indian producers.

The net impact of change in world price due to elimination of subsidies on the domestic prices is obtained by multiplying the per cent change in world prices with the price transmission elasticity. The results are presented in Table 3 under all alternative world supply and demand elasticity.

Table 3: Changes in world and domestic prices due to elimination of subsidy in OECD for rice

(Unit: in per cent)

Scenarios	Rice		Wheat		Cotton		Sugar	
	World Price	***India Price***	***World Price***	***India Price***	***World Price***	***India Price***	***World Price***	***India Price***
E_{11}	4.86	0.24	6.27	1.25	16.84	12.26	19.06	20.28
E_{12}	4.54	0.22	7.10	1.42	20.77	15.12	25.57	27.21
E_{13}	3.90	0.19	7.35	1.47	20.85	15.18	26.42	28.11
E_{21}	2.98	0.15	3.76	0.75	11.45	8.34	12.54	13.35
E_{22}	3.89	0.19	5.34	1.07	15.35	11.17	19.75	21.02
E_{23}	3.57	0.18	6.09	1.22	16.63	12.11	21.58	22.96
E_{31}	1.05	0.05	2.61	0.52	6.55	4.77	7.45	7.92
E_{32}	2.32	0.11	4.18	0.84	9.54	6.94	13.57	14.44
E_{33}	2.54	0.12	5.10	1.02	11.30	8.22	15.78	16.79

Note: Ed and Es are different range of world demand and supply elasticity (Appendix 1)

For rice impact of change in world prices on Indian price range from 0.05 per cent to 0.24 per cent. This illustrates that in scenario E_{11} of the 4.86 per cent rise in world rice prices only 0.24 rice prices would increase in the domestic market. For rice the total price change advantage that the Indian rice producers might be very small as prices are not transmitted fully from border to domestic market. In case of wheat the world price change gets transmitted to Indian farmers by an increase of 0.52 per cent to 1.47 per cent only. With the world price change due to elimination of subsidies, subsequent change in prices transferred to Indian market for cotton is of the range of 4.77 per cent to 15.18 per cent. The best possible scenario for cotton is scenario E_{13} which means that a 20.85 per cent rise in the cotton prices in the world brings a 15.18 per cent rise in the prices of cotton in the Indian market. In case of sugar the total change that the Indian sugar producers will face in terms of price change in the world is quite substantive. This price rise could be as high as 28 per cent or minimum of 7.92 per cent.

4.2 Impact of elimination of subsidies on production

4.2.1 World production

The changes in world prices as shown in Table 3 brings about a shift in the supply curve. The change in production levels of rice, wheat, cotton and sugar in the world, OECD countries and rest of the world is shown in Table 4. The simulations show the variation in the change in level of production with different combinations of supply and demand elasticity.

Table 4: Change in production under alternative world demand and supply elasticity

(Unit: in per cent)

Crop		**OECD**			**Rest of the World**			**World**		
Rice	**Es →**	**0.12**	**0.50**	**0.9**	**0.12**	**0.50**	**0.9**	**0.12**	**0.50**	**0.9**
	Ed ↓									
	-0.02	-10.14	-36.06	-55.53	0.57	2.24	3.51	-0.08	-0.07	-0.06
	-0.10	-10.34	-36.26	-55.66	0.35	1.93	3.21	-0.29	-0.38	-0.35
	-0.50	-10.54	-36.74	-56.06	0.13	1.15	2.28	-0.52	-1.14	-1.25
Wheat	**Es →**	**0.10**	**0.23**	**0.38**	**0.10**	**0.23**	**0.38**	**0.10**	**0.23**	**0.38**
	Ed ↓									
	-0.03	-1.33	-2.86	-4.63	0.61	1.59	2.75	-0.16	-0.19	-0.19
	-0.11	-1.56	-3.23	-5.06	0.37	1.2	2.29	-0.4	-0.57	-0.64
	-0.20	-1.67	-3.47	-5.36	0.26	0.95	1.91	-0.51	-0.82	-0.99
Cotton	**Es →**	**0.25**	**0.47**	**0.80**	**0.25**	**0.47**	**0.80**	**0.25**	**0.47**	**0.80**
	Ed ↓									
	-0.37	-31.48	-50.11	-69.36	3.97	9.27	16.35	-5.59	-6.74	-6.77
	-0.64	-32.29	-51.17	-70.22	2.75	6.94	13.1	-6.7	-8.73	-9.38
	-1.27	-33.04	-52.34	-71.31	1.6	4.37	8.94	-7.74	-10.92	-12.71
Sugar	**Es →**	**0.11**	**0.28**	**0.40**	**0.11**	**0.28**	**0.40**	**0.11**	**0.28**	**0.40**
	Ed ↓									
	-0.10	-10.85	-24.23	-32.54	1.94	6.58	9.83	-1.73	-2.25	-2.32
	-0.20	-11.4	-25.23	-33.58	1.31	5.18	8.13	-2.34	-3.54	-3.83
	-0.40	-11.85	-26.33	-34.87	0.79	3.63	6.04	-2.83	-4.96	-5.69

With the elimination of OECD subsidies the production of these commodities decline in OECD countries creating a deficit supply in the world market in the short run. As the prices adjust and reach equilibrium the price signals gets transmitted to other countries. In the analysis and results presented in Table 4 rest of the world mainly constitute of the developing countries. After price transmission the production level in rest of the world is expected to increase in the long run. The world market is left with a supply shortage but the magnitude is very small, thus in next lag of price adjustments the market economy would attain equilibrium. The decline in OECD rice production is responsive to the world supply elasticity. At a low supply elasticity the reduction in OECD production is low and at a high supply elasticity of 0.9 the decline in OECD production could be huge. The developing countries can benefit from the decline in OECD production in the

long run with the advantage of rise in world price and the world environment become more efficient for them to export their produce. These results are evident of the fact that the removal of production distorting subsidy could accrue benefits to developing nation which can further have positive implication on poverty reducing policies for poor farmers.

With the elimination of OECD subsidies the production of cotton is most hampered in OECD countries. Since huge production distorting cotton subsidies are given to framers in OECD countries, these policy changes could have a positive impact on rest of the world production. Developing countries, which are efficient in cotton production, could possibly export to fill in the supply deficit created due to decline in OECD production. The OECD production of cotton could possibly decline by 31.48 per cent to 71.31 per cent, in response to the lag of time the market signals can maximum lead to increase in production of other countries by 16.35 per cent. For rice and sugar also huge decline in OECD production is predicted to decline due to elimination of subsidies. These changes could possibly motivate efficient countries to produce more and export to have an access of the world market. Not many changes are anticipated in the wheat market.

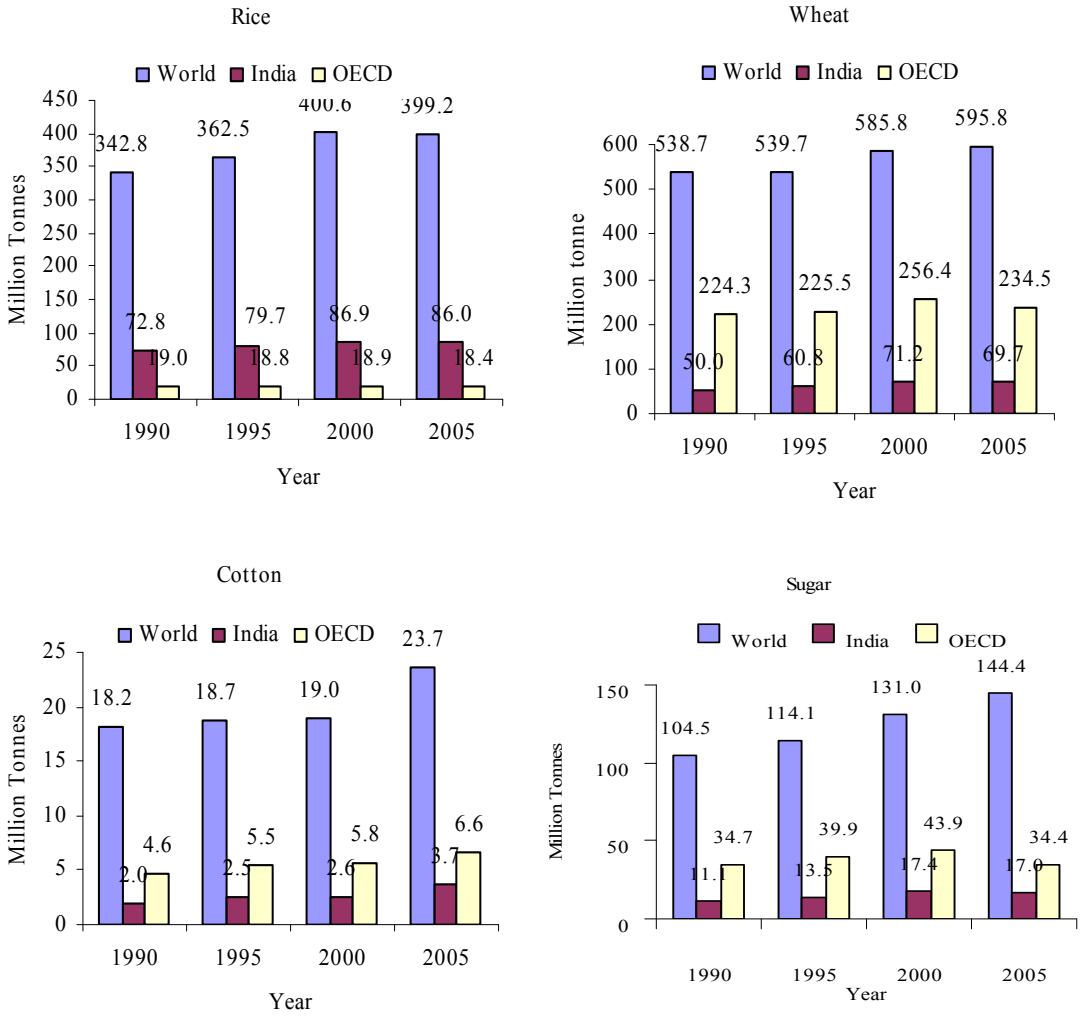
4.2.2 India production

As discussed in the above section, a possible market supply deficit created can be captured by the countries which have surplus to export. This section looks into the possibility of India exporting the commodities to the world market. When we compare the production levels of India, world and OECD countries (Figure 2), it is seen that the total world production of rice was 399.2 million tons in 2005, of which 86 million tons were produced in India alone and OECD countries collectively produce a mere 18.4 million tons. This proportion has been nearly same since 1990. India alone accounts for almost one-forth of world rice production and thus creates a major impact on world rice prices if a regular export of rice is done.

In the total world production of wheat of 595.8 million tons in 2005, OECD countries have a big share of 50 per cent of the world wheat, while India's share is only 11.6 per cent. As far as cotton is concerned, India produces only half of the OECD production and its share in the world share is very low. India is not a major producer of sugar, but the cost of production is quite low because it is produced from sugarcane as compared to the sugar beet used in most of the developed countries.

With the change in OECD trade policy on subsidies, the change in prices would send signals on production level in India. The response of Indian producers to the change in world prices and domestic prices will have an impact on the production in India. In the partial equilibrium framework the domestic supply response model is estimated (Appendix 3-6) to get the long-run supply elasticity for India. The domestic supply elasticities used for the analysis are 0.374 for rice, 0.658 for wheat, 0.914 for cotton and 0.666 for sugar. The possible change in domestic production due to the price changes is presented in Table 5. The changes are presented with respect to alternative supply and demand elasticities (Appendix 1) and the change in world and domestic prices as presented in Table 3.

Figure 2: World, India and OECD Production Trends



For rice and wheat the net impact of price change on India's production is very small. This is because very little of change in world prices for rice and wheat gets transmitted to the domestic market. Only if the price transmission from border to farm gate improves then only the Indian rice producers can gain from the elimination of OECD subsidies.

The reduction in OECD cotton production could create enough opportunity for India and other major cotton producing countries to export in the world market. The net impact of price change on Indian domestic production is quite significant. Under alternative scenarios and at different sensitivity level of supply curve the domestic cotton production change can range from 4.36 to 13.87 per cent. In case of sugar, India can have an edge over the other countries and the price signals transmitted to the domestic market could possibly increase the domestic production of sugar by 5.28 to 18.72 per cent, as an impact of subsidy elimination.

Table 5: Impact of subsidy elimination on India's production under alternative scenarios

(Unit: in per cent)

Scenarios	Change in India production			
	Rice	Wheat	Cotton	Sugar
E_{11}	0.089	0.83	11.20	13.51
E_{12}	0.083	0.93	13.82	18.12
E_{13}	0.072	0.97	13.87	18.72
E_{21}	0.055	0.50	7.62	8.89
E_{22}	0.071	0.70	10.21	14.00
E_{23}	0.065	0.80	11.07	15.29
E_{31}	0.019	0.34	4.36	5.28
E_{32}	0.042	0.55	6.35	9.62
E_{33}	0.046	0.67	7.52	11.18

4.3 Impact of reduction in tariffs and full liberalization

4.3.1 Impact on prices

The change in world prices due to reduction in tariffs and full liberalization has been picked up from some well known studies in literature as discussed in detail in Table 2. The Scenarios 1, 2 and 3 deals with tariff reduction policy and under scenario 4 and 5, full liberalization is taken into account.

The results of change in world market price and further the price change transmitted to India is presented in Table 6 under these scenarios. If the tariff changes take place as per the Doha Round (Scenario 1) then the price in the Indian market could only go up by 0.41 per cent for rice and

Table 6: Change in world and domestic prices under alternative scenarios of tariff change and full liberalization

(Unit: in per cent)

Scenario	Rice		Wheat		Cotton		Sugar	
	World	India	World	India	World	India	World	India
Scenario 1	8.30	0.41	2.10	0.42	6.90	5.02	3.20	3.41
Scenario 2	1.60	0.08	2.20	0.44	3.00	2.18	2.50	2.66
Scenario 3	5.90	0.29	3.40	0.68	4.20	3.06	10.90	11.60
Scenario 4	10.10	0.50	18.10	3.62	5.60	4.08	16.40	17.45
Scenario 5	3.83	0.19	3.83	0.77	0.75	0.55	2.52	2.68

Note: Scenario 1: Doha Round tariff; Scenario 2: EU tariff elimination; Scenario 3: Global tariff removal; Scenario 4: Full liberalization; Scenario 5: Full liberalization. Per change in world prices is compiled from different sources[15].

[15] Also see Table 2.

0.42 per cent for wheat. If only EU eliminates its tariffs then the price changes are very low for rice. A global tariff removal would have a major increase in the world and domestic prices both for rice and wheat. The maximum price change in the Indian market is observed under Scenario 4 of full liberalization. The world prices increase by 10 per cent for rice and 18 per cent for wheat. The price change transmitted to India could be 0.5 per cent for rice and 3.62 per cent for wheat. The amount of changes for rice and wheat are small because of these are staple food and due to the food security concerns not much price fluctuations are observed.

For cotton under the tariff reduction scenario the impact on Indian prices might be to the tune of 2-5 per cent, and with full liberalization the price rise could be 4 per cent. The numbers show that the variations due to the change in tariff policy would not be as huge as the gains that India might accrue if subsidies in OECD are eliminated. A OECD policy change for sugar would reap the maximum benefits to India. A global tariff change could make the world prices to rise by 10.9 per cent and as price gets transmitted to India the Indian sugar industry could see a price hike of 11.60 per cent. This price rise would provide an incentive for the farmers to produce more and get better prices.

4.3.2 Impact on production

The price change and production change impact on Indian domestic market for rice and wheat is very small in the simulations for subsidies, tariffs and full liberalization. Under alternative tariff and full liberalization scenarios the maximum production change could be 0.19 per cent for rice and 2.38 per cent for wheat (Table 7). Since India is producing 22 per cent of the world rice, even a small change in world policy for trade liberalization will impact India's rice production by 16 million tons.[16]

Table 7: Impact of tariff change and full liberalization on India's production under alternative scenarios

(Unit: in per cent)

Scenarios	Change in India production			
	Rice	**Wheat**	**Cotton**	**Sugar**
Scenario 1	**0.15**	0.28	**4.59**	2.27
Scenario 2	0.03	0.29	2.00	1.77
Scenario 3	0.11	**0.45**	2.80	**7.72**
Scenario 4	**0.19**	**2.38**	**3.73**	**11.62**
Scenario 5	0.07	0.50	0.50	1.79

Note: Scenario 1: Doha Round tariff; Scenario 2: EU tariff elimination; Scenario 3: Global tariff removal; Scenario 4: Full liberalization; Scenario 5: Full liberalization. Per change in world prices is compiled from different sources. The figures in bold are used for calculation of welfare change in next section.

[16] 0.19 per cent of total India's production of rice of 86 million tons in 2005.

For rice, the gains are far more from tariff reduction than from changes in subsidy levels in OECD countries. If the OECD trade policies change, then a competitive price could increase the chance for Indian rice producers to be economically viable to supply in the world markets. In case of wheat - since India is producing only 12 per cent of the global production - the trade liberalization policies might not have much impact on gains to the Indian farmers.

The impact of change in price of cotton and sugar in the world market on India's production could be to the tune of 4.59 per cent for cotton and 11.62 per cent for sugar. The change in OECD trade policies on India is quite substantive for both cotton and sugar. These two crops being more of commercial value could have a major impact on the welfare of Indian farmers as discussed in the next section. The scenario maximum price and production changes are selected under each policy scenario to do the welfare change calculations.

5. Welfare Gains Through Change in Price and Production

This section investigates the trade and poverty linkage through a producer surplus model. The model quantifies the effect of this price change and production change on the welfare of poor farmers. The poor farmers constitute small and marginal land holders who have less than 2 hectares of land to cultivate. The information on price change and production change has been computed in earlier section for rice, wheat, cotton and sugar. The study assumes that the supply elasticity is same for all farm sizes, which means that whatever is the size of land holdings the farmers respond in a similar fashion to price changes. This assumption has a problem, because the small farmers typically have a lower elasticity of supply response and a larger share of their total production in food crops than large farmers. But due to data constraints this aspect aggregate supply elasticity is only used as a proxy for small farmers. The model (Sadoulet and Janvry, 1995) as discussed in the methodology section of this study is used to get the results which are presented in the tables below. The impact on producer welfare is measured by change in producer surplus in this model.

This study assumes that due to rise in prices and its implication on increase in production, the small farmers tend to produce more or even diversify in producing the crops that are more profitable. The crop substitution aspect is taken into account while computing the supply elasticities. In this case the net producer surplus is the welfare gain to the small producer which is a proxy to the net impact on his poverty level. This study does not compute actual change in poverty level. OECD report (Tangermann and Ash, 2006) say that all sectors could potentially generate $44 billion welfare gains globally if trade protection and domestic support is halved. Most of these gains arise from agricultural reforms. Hertel et al (2004) also found that a 40 per cent reduction in agricultural tariffs, export and production subsidies results in global welfare gains of around $70 billion per year. Impacts of liberalization on agricultural trade volumes are mixed -- while reducing tariffs tends to increase import volumes, reductions in production and export subsidies tend to reduce volumes.

Tables 8-11 discuss the impact of change in OECD policies on the welfare of poor farmers in India. The results are presented under alternative scenarios of elimination of subsidies, tariff reduction and full liberalization. The details of these scenarios and assumptions behind them have been discussed in earlier sections of the study. The net impact of the policy change on small

farmers who are cultivating rice or wheat is very small or almost negligible. For rice (Table 8) the per cent change in production due to subsidy elimination is 0.09 per cent and if tariff

Table 8: Impact of change in OECD policy on welfare of rice cultivating poor farmers in India

Scenarios	Subsidy Elimination	Tariff Reduction	Full liberalization
Change in Production (%)	0.09	0.15	0.19
New Total Production (mt)	89.41	89.47	89.50
New Production of poor farmers (mt)	74.15	74.26	74.29
Change in Prices (%)	0.24	0.41	0.49
New Domestic Price ($/mt)	114.71	114.91	115.01
NSCP ($)	0.01	0.03	0.04
Producer Gain ($)	20.21	34.54	42.04
Welfare Gain (%)	0.24	0.41	0.50

Note: Poor farmers constitute of small and marginal farmers with land less than 2 hectares; NSCP (Net Social Change in Production)

reduction takes place then it is 0.15 per cent and is 0.19 per cent in case of full liberalization. The price change varies from 0.24 per cent to 0.49 per cent under these scenarios. The net social change in production of small farmers due to the combined effect of price and production change is almost negligible. The welfare gain to a rice cultivating farmer will be 0.24 per cent in case of full subsidy elimination, 0.41 per cent in case of tariff change and 0.50 per cent in case of full liberalization. The welfare gains are producer gains as per cent of the new value of produce at new price and quantity. These changes are very small and in some ways are almost zero.

A similar case is for the wheat cultivators in India. The welfare gains are better than that of rice cultivators but overall the net impact is very small. As seen in Table 9 the welfare gains to small farmers is only 1.48 per cent when there is full subsidy elimination, under the scenario of tariff elimination the impact on wheat farmers is even smaller. A full liberalization scenario might give them a welfare gain of 3.66 per cent. Both for rice and wheat the impact of trade liberalization in OECD countries is almost negligible. Due to food security concerns the prices of these crops are more of administered prices rather than being determined by the market. Farmers, especially small farmers, produce rice and wheat also for self-consumption and don't take a big portion of their produce to market for sale. Because of this also the supply elasticity and substitution elasticity are small in case of these two crops.

Table 9: Impact of change in OECD policy on welfare of wheat cultivating poor farmers in India

Scenarios	Subsidy Elimination	Tariff Reduction	Full liberalization
Change in Production (%)	0.97	0.45	2.38
New Total Production (mt)	72.98	72.60	74.00
New Production of poor farmers (mt)	55.55	55.27	56.33
Change in Prices (%)	1.47	0.68	3.62
New Domestic Price ($/mt)	149.03	147.87	152.19
NSCP ($)	0.57	0.12	3.48
Producer Gain ($)	119.36	55.07	296.01
Welfare Gain (%)	1.48	0.68	3.66

Note: Poor farmers constitute of small and marginal farmers with land less than 2 hectares; NSCP

In case of cotton, the poor cultivators see a change in production of 13.87 per cent after OECD cotton subsidies are removed. The results are presented in Table 10 for cotton which highlights the variations in the welfare gains that accrue under different policy scenarios. Under the scenario of subsidy elimination, the price gains to farmers are 15.18 per cent and producer gain of $242.67. A welfare gain of 16.23 per cent is evident if the subsidies are removed in OECD countries. Under alternative scenarios, a tariff reduction will bring about a welfare gain of 5.14 per cent to the small cotton producers in India and a full liberalization will give 4.15 per cent of welfare gain. Thus the maximum gains come to the small farmers by subsidy elimination through increase in production.

Table 10: Impact of change in OECD policy on welfare of cotton cultivating poor farmers in India

Scenarios	Subsidy Elimination	Tariff Reduction	Full Liberalization
Change in Production (%)	13.87	4.59	3.73
New Total Production (t)	2.97	2.73	2.71
New Production of poor farmers (t)	1.50	1.38	1.37
Change in Prices (%)	15.18	5.02	4.08
New Domestic Price ($/t)	1,304.81	1,189.80	1,179.08
NSCP ($)	15.74	1.72	1.14
Producer Gain ($)	242.67	76.84	62.10
Welfare Gain (%)	16.23	5.14	4.15

Note: Poor farmers constitute of small and marginal farmers with land less than 2 hectares; NSCP

Similarly for sugar, the welfare gains are maximum when subsidy is eliminated in OECD countries. Among all the crops discussed above gains to sugar producers will be of the highest order. Table 11 illustrates the welfare gains to sugarcane producing small farmers. A 30.75 per cent welfare gain will accrue to small farmers under sugarcane cultivation. Under the scenario of tariff reduction these gains are of 12 per cent and with full liberalization the welfare gains will be 18.46 per cent.

The major gains for the small farm producers of cotton and sugar can also be seen . The results also vary according to the policy implemented. Different policy scenario give a wide variation in the welfare gains and thus the results are also indicative of the fact that if the small farmers are to be benefited then the right policy instrument is to be used to get them the maximum benefit of trade liberalization.

Table 11: Impact of change in OECD policy on welfare of sugarcane cultivating poor farmers in India

Scenarios	Subsidy Elimination	Tariff Reduction	Full liberalization
Change in Production (%)	18.72	7.72	11.62
New Total Production (t)	23.01	20.88	21.63
New Production of poor farmers (t)	16.51	14.98	15.53
Change in Prices (%)	28.11	11.60	17.45
New Domestic Price ($/t)	495.75	431.84	454.48
NSCP ($)	141.67	24.11	54.58
Producer Gain ($)	1,654.90	678.36	993.82
Welfare Gain (%)	30.75	12.05	18.46

Note: Poor farmers constitute of small and marginal farmers with land less than 2 hectares; NSCP

6. Summary and Conclusion

Rich countries use a combination of domestic market interventions and border protection or export subsidies as a part of their domestic policies. Developed countries such as the United States and EU resort to the trade distorting policies and make their crop more competitive – both by maintaining high domestic prices for producers, stimulate production, and thus distort prices in the world market. The study hypothesizes that if the OECD agricultural policies change and domestic subsidies are eliminated and tariff levels are relaxed then there will be a decline in the production in the OECD countries, which will help the world prices to rise from a depressed level, leading to a boost in production in developing countries and bringing about a change in the welfare of producers in these countries, which will have implication on their poverty levels. This is one of the first studies that quantifies the impact on India, through a partial equilibrium analysis and simulation techniques. Sensitivity analysis is also done to have an estimate of changes in prices and production at alternative demand and supply elasticity. In this study we are looking into the impact of elimination of domestic support and decline in tariff levels in the OECD countries on the prices, production, quantify the effect of this price change on welfare of

farmers given their production bundles. The crops that are studied are rice, wheat, cotton and sugar, which are of vital interest to developing countries but OECD countries' agricultural policies create considerable distortions.

The scenarios considered here are, first when the total subsidies are fully eliminated. Total subsidies are the sum of AMS, *de minimis*, Blue Box subsidy and export subsidy for each crop, which is aggregated country wise to get the total OECD figure. The sensitivity analysis is run at a range of low, medium and high world demand and supply elasticities. The second scenario considered is change in tariff levels and third scenario illustrates the impact of full liberalization.

The per cent change in world price as an impact of subsidy elimination is ranged from 1.05 to 4.86 per cent for rice, 2.60 to 6.27 per cent for wheat, 6.55 to 20.85 per cent for cotton and 7.45 to 26.42 per cent for sugar. The world price change due to tariff reduction and full liberalization are taken from literature. The impact on change in world price is transmitted to domestic Indian market. This impact is computed through the price transmission elasticity. The price transmission elasticity varies across crops. It is very low in case of rice and wheat. For cotton and sugar the price transmission from world to domestic market is quite substantive.

Due to change in world prices the maximum impact on the domestic price under the scenario of subsidy elimination is 0.24 per cent for rice, 1.47 per cent for wheat, 15.18 per cent for cotton and 28.11 per cent for sugar. Under the scenario of tariff reduction the domestic price is likely to increase by 0.41 per cent for rice, 0.68 per cent for wheat, 5.02 per cent for cotton and 11.60 per cent for sugar. For full liberalization scenario the price increase is estimated to be 0.49 per cent for rice, 3.62 per cent for wheat, 4.01 per cent for cotton and 17.45 per cent for sugar.

As the world prices rise from the depressed level due to change in OECD policy the production of these crops on OECD show a decline. The decline is in response to the world supply elasticity. Total OECD rice production can decline by 10.54 per cent to 56.06 per cent. The change in OECD wheat production is -1.67 per cent to -5.36 per cent, for cotton it is -33.04 per cent to -71.31 per cent and for sugar the change is expected to be -11.85 per cent to -34.87 per cent. The reduction in OECD production will create enough opportunity for market excess for the countries which are competitive and cost efficient in the production of those particular crops.

At the domestic level the net impact of price change on India's production is almost negligible for rice and wheat for all the policy changes. But when OECD subsidies are eliminated then the farmer's response to price change is to the tune of 10 to 13 per cent for cotton and 13 to 18 per cent for sugarcane. The results vary at different elasticity level of supply response and price transmission. If tariffs in OECD are reduced then India's domestic production in response to it might increase by 3-4 per cent for cotton and 7-10 per cent for sugarcane.

The net impact of either of the policy change on small farmers who are cultivating rice or wheat is very small or almost negligible. The net social change in production by small farmers due to the combined effect of price and production change is almost negligible for these crops. The welfare gain to a rice and wheat small farmers is also almost zero. Both for rice and wheat the impact of trade liberalization in OECD countries is almost negligible. Due to food security concerns the prices of these crops are more of administered prices rather than being determined

by the market. Farmers, especially the small farmers, produce rice and wheat also for self-consumption and thus don't take a big portion of their produce to the market for sale. Because of this also the supply elasticity and substitution elasticity is small in case of these two crops. This also implies that the trade liberalization does not affect the producer of rice and wheat in the country. Any policy instrument of liberalization will not have a negative impact on food security or self-sufficiency of farmers and poor, unless the market forces are allowed to play their role.

For cotton, under the scenario of subsidy elimination, the price gains to farmers are 15.18 per cent and producer gain of $242.67. A welfare gain of 16.23 per cent is evident if the subsidies are removed in OECD countries. Tariff reduction will bring about a welfare gain of 5.14 per cent to the small cotton producers in India and a full liberalization will give 4.15 per cent of welfare gain. Thus the maximum gains come to the cotton producers by subsidy elimination mainly through increase in production. Similarly for sugar, the welfare gains are maximum when subsidy is eliminated in OECD countries. Among all the crops discussed above gains to sugar producers will be of highest order, about 30.75 per cent welfare gain will accrue to small farmers under sugarcane cultivation. Under the scenario of tariff reduction these gains are of 12 per cent and with full liberalization the welfare gains will be 18.46 per cent. The producer gains due to subsidy elimination is $1,654.90 for sugarcane producer. Different policy scenario give a wide variation in the welfare gains and thus the results are also indicative of the fact that if the small farmers are to be benefited then the right policy instrument is to be used to get them the maximum benefit of trade liberalization. This will have positive implication on the poverty level of these farmers. A boost in price and production will collectively help them to come above the poverty line. As the world prices will rise from the depressed level then the farmers will also find it profitable to produce for exports.

The study has empirically highlighted that with the removal of subsidies and tariff changes, the world prices are likely to rise significantly and also the price distorting production in the OECD countries is likely to decline. This will help the developing countries which have the cost advantage and competitiveness to gain market access.

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Appendix 1: Reference matrix for world supply and demand elasticity

Rice	**Es**		
Ed	**0.12**	**0.50**	**0.90**
-0.02	E_{11}	E_{12}	E_{13}
-0.10	E_{21}	E22	E_{23}
-0.50	E_{31}	E_{32}	E_{33}
Wheat	**Es**		
Ed	**0.10**	**0.23**	**0.38**
-0.03	E_{11}	E_{12}	E_{13}
-0.11	E_{21}	E22	E_{23}
-0.20	E_{31}	E_{32}	E_{33}
Cotton	**Es**		
Ed	**0.25**	**0.47**	**0.80**
-0.37	E_{11}	E_{12}	E_{13}
-0.64	E_{21}	E22	E_{23}
-1.27	E_{31}	E_{32}	E_{33}
Sugar	**Es**		
Ed	**0.11**	**0.28**	**0.40**
-0.10	E_{11}	E_{12}	E_{13}
-0.20	E_{21}	E22	E_{23}
-0.40	E_{31}	E_{32}	E_{33}

Appendix 2: Regression between domestic and international price

Crop	Independent Variables	With Trend	Without Trend
Rice	**PDt-1**	-0.016 (-0.04)	0.391 (1.3)
	PWt	0.002 (0.03)	0.049 (0.82)
	Trend	-3.175 (-1.57)	-
	Constant	6477.023 (1.59)	65.391 (1.57)
	No of Observations	11	11
	F test	2.02	1.52
	Prob>F	0.20	0.28
	R-Square	0.46	0.28
	Adj-R-Square	0.23	0.09
	DW-Stat	2.05	1.99
Wheat	**PDt-1**	0.337 (1.70)	0.261 (1.23)
	PWt	0.200** (2.39)	0.146 (1.72)
	Trend	1.063 (1.68)	-
	Constant	-2057.500 (-1.61)	85.978** (2.47)
	No of Observations	12	12
	F test	2.6	2.07
	Prob>F	0.12	0.18
	R-Square	0.49	0.32
	Adj-R-Square	0.30	0.16
	DW-Stat	1.53	1.24
Cotton	**PDt-1**	-0.481*** (-2.12)	-0.337 (-1.44)
	PWt	0.705* (0.00)	0.728* (4.55)
	Trend	-19.818 (-1.75)	-
	Constant	40610.920 (1.79)	790.996* (3.47)
	No of Observations	12	12
	F test	12.62	14.15
	Prob>F	0.00	0.00
	R-Square	0.83	0.76
	Adj-R-Square	0.76	0.71
	DW-Stat	1.86	1.66
Sugar	**PDt-1**	-0.309 (-0.96)	-0.275 (-0.85)
	PWt	1.064** (2.35)	0.866** (2.08)
	Trend	2.213 (1.06)	-
	Constant	-4433.475 (-1.05)	68.487 (0.42)
	No of Observations	12	12
	F test	1.89	2.24
	Prob>F	0.21	0.16
	R-Square	0.42	0.33
	Adj-R-Square	0.20	0.18
	DW-Stat	1.86	1.88

Note: Figures in Parenthesis is t-value. * indicates at 1% level significant, ** indicates at 5% level significant, *** indicates at 10% level significant. PDt-1 = Domestic Price (one lag) for crop wise; PWt = International Price for crop wise. Dependent variable is domestic price.

Appendix 3: Supply response model and elasticity for paddy (rice) in India

Dependent Variable: log pdarea

Variables	OLS		2SLS		OLS		2SLS	
	Coeff.	LR elasticity	Coeff.	LR elasticity	Coeff.	LR elasticity	Coeff.	LR elasticity
Area lag	0.7236* (14.72)		0.4907*** (1.66)		0.7143* (14.21)		0.5278** (1.92)	
Own price lag	0.1022* (3.06)	0.370	0.1904*** (1.84)	0.374	0.0732*** (1.71)	0.256	0.1390 (0.16)	0.294
CC1 price lag	-0.0767* (-2.54)	-0.277	-0.1099** (-2.00)	-0.216	-0.0687** (-2.17)	-0.240	-0.1019** (1.97)	-0.216
CC2 price lag	0.0453** (1.94)	0.164	0.04872 (1.36)	0.096	0.0475** (1.95)	0.166	0.0434 (1.17)	0.092
Yield lag	-0.0482 (-1.28)		-0.0606 (-1.04)		-0.0639 (-1.59)		-0.0888 (-1.44)	
Fertilizer price lag	-		-		-0.0422 (-1.22)		-0.0697 (-1.19)	
Wage price lag	-		-		0.0215 (0.90)		0.0569 (1.52)	
Rain lag	0.0268 (0.99)		0.0298 (0.51)		0.0295 (1.07)		0.0331 (0.58)	
Road density lag	-0.0047 (-0.17)		0.0004 (0.01)		-0.0100 (-0.35)		-0.0133 (-0.24)	
Electrification lag	-0.0012*** (-1.78)		-0.0025 (-1.43)		-0.0014** (-1.96)		-0.0024 (-1.44)	
AR (1)	-0.3602		-0.06208		-0.3608		-0.1059	
Constant	1.7381*		3.0883***		1.9903*		3.3963**	
N	180		171		180		171	
DF	163		154		161		152	
DW stats.	2.0492		1.9819		2.0480		1.9938	
State Dummies	Yes		Yes		Yes		Yes	
Adj R Sq	0.99		0.99		0.99		0.99	

Note: Pooling of cross section time series data for 9 states (AP, HY, KN, MP, MH, OR, PB, TN, UP);
These states together contribute to nearly 90% of area under cultivation and 92% of production of wheat in India.
t-value is given in parenthesis.
*: Significant at 1%; **: At 5%; *** At 10%;
All the variables are in log
Own crop is Paddy; CC1 Sorghum, CC2 is cotton; yield is being used as technology variable. Input price are relative to product price; results are autocorrelation and hetroscedasticity corrected
Paddy price is Farm Harvest Price (FHP)
Random effect, sig for brensch and pagan lagrangian multiplier test

Appendix 4: Supply response model and supply elasticity for wheat in India

Dependent Variable: log wharea

Variables	OLS		2SLS		OLS		2SLS	
	Coeff.	LR elasticity	Coeff.	LR elasticity	Coeff.	LR elasticity	Coeff.	LR elasticity
Area lag	0.6762* (10.76)		0.6876** (2.07)		0.6894* (10.96)		0.5929** (2.33)	
Own price lag	0.1496** (1.99)	0.462	0.1248 (1.14)	0.399	0.2043** (2.25)	0.658	0.2135*** (1.73)	0.524
CC1 price lag	-0.0522 (-0.65)	-0.161	-0.0268 (-0.24)	-0.086	-0.0788 (-0.90)	-0.254	-0.0538 (-0.46)	-0.132
CC2 Price lag	-0.0180 (-0.37)	-0.056	-0.0148 (-0.19)	-0.047	-0.0024 (-0.05)	-0.008	-0.0069 (-0.09)	-0.017
Yield lag	-0.1144 (-1.54)		-0.1505 (-1.45)		-0.1049 (-1.42)		-0.1377 (-1.37)	
Fertilizer price lag	-		-		-0.07899 (1.37)		0.1049 (1.26)	
Wage price lag	-		-		-0.0217 (-0.46)		-0.0232 (-0.33)	
Rain lag	-0.0459 (-1.44)		-0.0394 (-0.73)		-0.05431*** (-1.65)		-0.0481 (-0.99)	
Road density lag	-0.0353 (0.81)		0.04312 (0.65)		0.02975 (0.67)		0.0252 (0.38)	
AR (1)	-0.0572		-00629		-0.0747		-0.0045	
Constant	2.4645*		2.5736		2.2534*		3.0981***	
N	140		133		140		133	
DF	126		119		124		117	
DW stats.	2.0232		2.0231		2.0359		2.0074	
State Dummies	Yes		Yes		Yes		Yes	
Adj R Sq	0.99		0.99		0.99		0.99	

Note: pooling of cross section time series data for 7 states (BH, HY, MP, MH, PB, RJ, UP);
These states together contribute to nearly 95% of area under cultivation and 97% of production of wheat in India.
t-value is given in parenthesis.
*: Significant at 1%; **: At 5%; *** At 10%;
All the variables are in log
Own crop is Wheat; CC1 sugarcane, CC2 is rapeseed and mustard; yield is being used as technology variable. Input price are relative to product price; results are autocorrelation and hetroscedasticity corrected
Wheat price is Farm Harvest Price (FHP)
Random effect, sig for brensch and pagan lagrangian multiplier test

Appendix 5: Supply response model and supply elasticity for cotton in India

Dependent Variable: log Ctarea

Variables	OLS		2SLS		OLS		2SLS	
	Coeff.	LR elasticity	Coeff.	LR elasticity	Coeff.	LR elasticity	Coeff.	LR elasticity
Area lag	0.8046* (17.17)		-0.4614 (-1.07)		0.7783* (15.73)		0.3372 (0.46)	
Own price lag	0.1414* (2.94)	0.724	0.0513 (0.62)	0.035	0.2026** (2.47)	0.914	0.2391*** (1.84)	0.361
CC1 price lag	-0.1236** (-1.99)	-0.633	0.14115 (0.79)	0.097	-1.665** (-2.40)	-7.510	-0.1159 (-0.61)	-0.175
yield lag	0.1648* (4.59)		0.1113* (2.77)		0.1694* (4.71)		0.1368* (2.74)	
Fertilizer price lag	-		-		0.0374 (0.42)		0.0330 (0.21)	
Wage price lag	-		-		0.0250 (0.66)		0.0779 (0.68)	
Rain lag	-0.0128 (-0.29)		0.0675 (0.97)		-0.0232 (-0.52)		-0.0241 (-0.31)	
Road density lag	-0.1146** (-2.22)		-0.2647** (-2.17)		-0.1196** (-2.28)		-0.1824 (-0.87)	
AR (1)	-0.1911		0.8234		-0.1857		0.3607	
Constant	0.7575*		7.6134*		1.1303*		3.9327	
N	180		171		180		171	
DF	165		156		163		154	
DW stats.	2.0966		1.7855		2.0928		2.13	
State Dummies	Yes		Yes		Yes		Yes	
Adj R Sq	0.97		0.95		0.97		0.96	

Note: pooling of cross section time series data for 9 states (AP, GJ, HY, KN, MP, MH, PB, RJ, TN);
These states together contribute to nearly 99% of area under cultivation and production of cotton in India.
t-value is given in parenthesis.
*: Significant at 1%; **: At 5%; *** At 10%;
All the variables are in log
Own crop is Cotton; CC1 is coarse cereals (Jowar, bajra and maize weighted average by production because all these are highly correlated); yield is being used as technology variable. Input price are relative to product price; results are autocorrelation and hetroscedasticity corrected
Cotton price is Farm Harvest Price (FHP)
Random effect, sig for brensch and pagan lagrangian multiplier test

Appendix 6: Supply response model and supply elasticity for sugarcane in India

Dependent Variable: log Sarea

Variables	**OLS**		**2SLS**		**OLS**		**2SLS**	
	Coeff.	**LR elasticity**	**Coeff.**	**LR elasticity**	**Coeff.**	**LR elasticity**	**Coeff.**	**LR elasticity**
Area lag	0.7264* (12.70)		0.6753* (2.89)		0.6723* (10.85)		0.6299** (2.44)	
Own price lag	0.1660* (2.76)	0.607	0.1698* (2.66)	0.523	0.2184* (3.15)	0.666	0.2294** (2.45)	0.620
CC1 price lag	0.0052 (0.08)	0.019	0.0150 (0.28)	0.046	0.0049 (0.78)	0.015	0.0159 (0.31)	0.043
CC2 price lag	-0.2072* (-2.75)	-0.757	-0.1998** (-2.28)	-0.615	-0.1537** (-1.88)	-0.469	-0.1400 (-1.33)	-0.378
yield lag	0.1841** (2.09)		0.1317 (0.84)		0.1679** (1.88)		0.1066 (0.64)	
Fertilizer price lag	-		-		0.0797** (1.84)		0.08923 (1.29)	
Wage price lag	-		-		-0.0523 (-0.55)		-0.0692 (-0.86)	
Rain lag	0.1096* (2.57)		0.1068* (2.92)		0.1201* (2.82)		0.1155* (2.99)	
Road density	0.1367** (2.49)		0.1347** (1.92)		0.1320** (2.38)		0.1303** (1.98)	
AR (1)	-0.03488		-		0.00039		-	
Constant	-2.0104*		-1.3670*		-2.1865*		-1.5712*	
N	179		175		179		175	
DF	162		158		160		156	
DW stats.	2.0145		1.9905		2.0063		1.9401	
State Dummies	Yes		Yes		Yes		Yes	
Adj R Sq	0.98		0.98		0.98		0.98	

Note: Pooling of cross section time series data for 10 states (AP, BH, GJ, HY, KN, MH, PB, RJ, TN, UP); These states together contribute to 96.7% of domestic area under cultivation for sugarcane and 97.08% of domestic sugarcane production. t-value is given in parenthesis. *: Significant at 1%; **: At 5%; *** At 10%;
All the variables are in log. Own crop is Sugarcane; CC1 is rice; CC2 is wheat; yield is being used as technology variable. Input price are relative to product price; results are autocorrelation and hetroscedasticity corrected. Sugarcane price is Statutory Minimum Price (SMP). Random effect, significant for Brensch and Pagan Lagrangian multiplier test

ANNEXURE

OECD Policies and Reforms[17]

The level of support to farmers in OECD as a whole has not changed since 2000. Despite some major policy initiatives in 2002, there were no notable changes in the main policy instruments in most countries. There has been little change in the level of producer support since the late 1990s for the OECD as a whole. It has fallen from 37 per cent of farm receipts in 1986-88 to 30 per cent in 2002-04 and 29 per cent in 2005. These levels of support are very much the same as almost a decade ago and vary widely across countries and commodities. Annual fluctuations in the level of support mainly reflect policy measures limiting the transmission of international trade price developments to domestic markets. Policy reform has focused on changing the way in which support is being provided, away from the most production and trade distorting measures like import tariffs, export subsidy and domestic support, towards payments based on areas farmed and historical entitlements. While this shift may well continue over the coming years, production-linked measures still dominate producer support in most countries, encouraging output, distorting trade and contributing to lower world prices of agricultural commodities. An interesting dimension to the distortion effects of farm subsidy practices of the rich world is that all support to rice, sugar, and wheat is price support which is potentially most production and trade distorting policy measure.

OECD Policies

Domestic support OECD agriculture continues to be characterized by high levels of support. In 2004, the value of support to producers in the OECD as a whole is estimated at US$279 billion or EUR 226 billion. As measured by the percentage PSE, support accounted for 30 per cent of farm receipts, the same level as in 2003. Including support for general services to agriculture such as research, infrastructure, inspection, and marketing and promotion, total support to the agricultural sector was equivalent to 1.2 per cent of OECD GDP in 2004. A large difference in the level of support exists between countries. Within the OECD, support to producers in 2002-04 was below 5 per cent of farm receipts in Australia and New Zealand. It averaged around 20 per cent in Canada, Mexico and the United States, and 25 per cent in Turkey. At 34 per cent, the level of support in the European Union (EU) was above the OECD average of 30 per cent. Support to producers in Japan and Korea averaged about 60 per cent and around 70 per cent in Iceland, Norway and Switzerland. Progress in reducing the level of support remains uneven across countries. Since 1986-88, the level of producer support has fallen in most countries, remained constant in Norway, but has risen in Turkey. The largest decrease in the level of producer support has occurred in Canada, with other notable decreases in Mexico (since 1991-93) and New Zealand. Among the high support countries, the greatest reduction has occurred in Switzerland. Total support to agriculture in the OECD has fallen from 2.3 per cent to 1.2 per cent of GDP between 1986-88 and 2002-04. This is a similar trend for all OECD countries except

[17] For information on OECD polices and reforms OECD website www.oecd.org and Agricultural Policies in OECD countries: Monitoring and Evaluation 2003, 2005; OECD Agricultural Polices 2004, 2006, at a glance; are referred in general. For definitions WTO website www.wto.org is also referred.

Turkey where the share of total agricultural support in GDP increased, reflecting among other things, GDP levels and growth.

Greater efforts have been made in changing the way in which support is provided to producers. The share of the most production and trade distorting forms of support – those linked to outputs or inputs – has declined from 91 per cent of producer support in 1986-88 to 74 per cent in 2002-04. A decrease in output linked support is also shown by a reduction in the gap between producer and border prices. In 1986-88, the average producer price in the OECD as a whole was 60 per cent higher than the border price; by 2002-04 the gap had reduced to 30 per cent. The largest reductions in the gap have occurred in Switzerland, the EU and Norway, countries with a level of support above the OECD average. However, most of the reduction occurred before the late-1990s. Reductions in these forms of support have been accompanied by increases in payments based on area or animal numbers or on historical entitlements that have limited the impact on farm receipts, with some payments having compliance conditions. Differences in support levels between commodities have declined but little reform has occurred in some sectors. Between 1986-88 and 2002-04 differences in support levels between commodities have declined in all countries, with the smallest decreases in the EU, Japan and Korea and the largest in Canada and Switzerland. The greatest reductions in the level and improvements in the composition of support have occurred in the sheep meat and grain (other than rice) sectors. Sugar, rice and milk remain the most highly supported commodities.

Domestic Support

The main conceptual consideration is that there are basically two categories of domestic support – support with no, or minimal, distortive effect on trade on the one hand (often referred to as "Green Box" measures) and trade-distorting support on the other hand (often referred to as "Amber Box" measures). Under the Agriculture Agreement all domestic support measures are considered to be production and trade distorting that fall into the Amber Box. These trade distorting measures include measures to support prices, or subsidies directly related to production quantities. These supports are subject to limits: "*de minimis*"[18] minimal supports are allowed (5 per cent of agricultural production for developed countries, 10 per cent for developing countries); many of the 30 WTO members have subsidies larger than the *de minimis* levels and are committed to reduce these subsidies. At present there are no limits on spending on Blue Box subsidies.[19]

At WTO, domestic support that is considered to be most damaging in terms of production and trade distortion falls into Amber Box and is subject to agreed limits. The agreed reduction commitments are expressed in terms of a total aggregate measure of support (AMS). Core

[18] In addition to measures covered by the Green Box, two other categories of domestic support measures are exempt from reduction commitments under the Agreement on Agriculture. These are certain developmental measures in developing countries and certain direct payments under production-limiting programmes. Furthermore, so-called *de minimis* levels of support are exempted from reduction.

[19] Any support that would normally be in the Amber Box is placed in the Blue Box if the support also requires farmers to limit production.

problem with the present system of domestic support is that payments exempt under the Green and Blue Box provision covers a broad range of support measures (CUTS, 2005). Blue Box policies are still widely characterized as market distorting and many argue that the current Green Box policies can result in distortions. Several countries have been able to meet their AoA obligations by shifting support to Blue and Green Box without reducing their overall support. Since the commitment is on total AMS, not on product specific AMS, countries can reduce support for some products, while leaving support for other products untouched or even raising it from their original level (WTO site). Developed countries are also increasingly shifting their subsidies from prohibitive to non-prohibitive categories.

The reduction commitments are expressed in terms of a Total AMS, which includes all product-specific support and non-product-specific support in one single figure. In any year of the implementation period, the maximum levels of AMS are bound in the WTO. This system of reduction commitments, give room for the member countries to reduce the product specific support but still continue supporting a particular commodity through the non-product specific support. This movement between the subgroups of AMS help them to come under the allowed *de minimis* level, and thus can continue with the trade distorting practices.

Export Subsidy

"Export subsidies" refers to subsidies contingent upon export performance. The core of the reform programme on export subsidies is the commitments to reduce subsidized export quantities, and the amount of money spent subsidizing exports. An export subsidy increases firms' incentives to export, and so will potentially affect both production and the allocation of goods between home and export markets. All such export subsidies are subject to reduction commitments, expressed in terms of both the volume of subsidized exports and the budgetary outlays for these subsidies. Export subsidies serve as policy instruments to OECD countries by which they can maintain producer prices at support levels above world prices (OECD, 2004, 2006). In the face of an export subsidy elimination schedule, policy-makers must choose whether to allow prices to fall below support levels or whether to control quantities (increase stocks or reduce production) to maintain prices at support levels. Often, quantity controls are in fact stated or implied by the policies in some countries, which may specify supply management schemes or trigger prices for purchasing public stocks, but applying such policies in the scenario produces results that are less comparable across countries and may not represent long-term solutions.

Tariff

In developed countries most of the agricultural products are protected by tariffs. The discussion of tariffs covers both tariffs on quantities within quotas and those outside. Traditionally, the tariff reductions that resulted from trade negotiations came from bilateral product-by-product bargaining, or they were based on formulas that applied over a broad range of products, or combinations of the two. The United States has gone so far as to argue that because so many agricultural tariffs are high, the negotiations to reduce tariffs should start with applied rates (the tariffs governments actually charge on agricultural imports) and not the generally higher bound rates (the legally binding ceilings committed in the WTO as a result of previous negotiations). This has proved quite controversial because it would break a tradition of basing negotiations on

bound rates. A number of countries have also countered that they should be given credit for unilaterally applying tariffs that are more liberal than the negotiated bound rates, instead of being forced to make even deeper cuts than countries that kept to their higher bound rates. In order to protect their own processing industries some countries see tariffs and other import barriers as necessary in order to protect domestic production and maintain food security.

OECD Reforms[20]

Trade agreements can be a catalyst for agricultural policy reform. In 2004, almost all OECD countries were involved in either concluding or commencing implementation of bilateral or regional trade agreements. While these generally include an agricultural component, sensitive products are often exempt from liberalization commitments. After stalling in September 2003, the Doha Development Agenda (DDA) Round of trade negotiations was revived in 2004. Progress was made in establishing a framework for agriculture but many of the important details are still to be negotiated. While bilateral/regional agreements can trigger some policy adjustments, progress at the multilateral level is much needed to invigorate the process of agricultural policy reform.

According to the official document of OECD (OECD, 2005), policy reforms in OECD has focused on changing the way in which the support is provided to the producer, with a shift away from the production linked measures. In spite of the shift the production linked measures still dominate producers support in most OECD countries is encouraging output, distorting trade and contributing to lower world prices of agricultural commodities. In 2004, the value of support to producers in the OECD as a whole is estimated at US$279 billions or EUR 226 billion. The level of producers support is largely different among the different OECD countries and also the process has been reducing the level of the support remains uneven across countries. The CAP 2003 reform process tackled only one aspect of agriculture in the EU that of domestic subsidies. Although according to the OECD documents, some progress in reforms towards meeting the long-term objective of agricultural policy reforms in OECD countries has been seen. These reforms can be evaluated by examining the trends in three elements of production support – level of support, composition of support, that is, the share of the most production and trade distorting forms and the spread of support among the commodities. The trends in these three support elements for the OECD as whole show that there has been some progress towards the goal of policy reform, with some fluctuations. The ongoing trade negotiations in the context of the WTO Doha development agenda would stimulate the process of agricultural policy reforms in OECD. It would also ensure that appropriate commitments and disciplines are placed on the use of domestic support and export subsidies.

Since 1996 the EU and the United States have substantially redesigned their subsidy system in order to move payments to farmers into the new categories and evade subsidy reduction. Thus, their farmers continue to receive subsidies. These encourage over production and much of the additional produce is thus dumped, that is, sold below the cost of production in the developing countries. These depressed prices, make it difficult for the developing countries farmers to compete. Although developing countries are not obliged to reduce their subsidies under WTO

[20] Action Aid, a UK-based NGO, does not believe that either process by OECD or WTO will bring about significant reduction in subsidies that lead to over production and trade distortion.

rules if their support to agriculture is less than 10 per cent of total food output. But this clause is not used to the advantage of these countries due to lack of financial resources for support to farmers. Assessment conducted for the EU in February (Rice, 2003) found that when compared to 2002 production, the decoupled proposal in CAP 2003 would increase EU production for most cereals including soft wheat and rice.