This chapter sums up the contents presented in the preceding chapters and main findings obtained from the empirical analyses. Accordingly, section VIII.1 presents contextual framework and objectives of the study. Section VIII.2 elicits main findings and compares them with the results obtained in other studies that have addressed somewhat similar issues.

**VIII.1 Contextual Framework, Objectives and Hypotheses**

With the inception of Structural Adjustment Programme, the agricultural sector in many developing countries have begun to be viewed in a larger macro-economic policy framework and being looked to as a source of income growth in its own right. The programme, based on an open economy model of the neo-classical, supported a greater integration of domestic economy with the world economy for higher economic growth and technological advancements. Thus, the ‘anti agriculture bias’ manifested through overvalued exchange rate, restrictive trade policy and high industrial protection identified in the classical ‘industry-led growth’ model is to be obliterated by currency devaluation, reduction in tariffs, elimination of trade restrictions and initiation of liberal farm price and marketing policies. Developments in these macro and sector specific policies are expected to change incentive structure in favour of agriculture through increase/decrease in domestic price of exportable/importable relative to world price. A near convergence of world and domestic price and greater openness of agriculture to international trade is expected to accelerate production, exports, private investment and higher rates of economic growth. This vision envisages agricultural sector to increasingly face global markets for taking land allocation and production decisions in favour of crops that are price competitive and have export demand. In this process, world price would become the reference point in measurement of relative price structure of farm commodities, domestic resource cost and allocation of scarce resources within the economy.

How do macro-economic and sectoral policies affect relative prices and hence producers’ incentives for higher production and growth? What is the likely response of agricultural sector to liberalization in these policies? The empirical resolution on these issues rests on the movement of world and domestic commodity prices and the response
of crop acreage/supply and exports to changes in relative farm prices. Literature in this respect, available mainly for the developed and Sub Saharan African countries provides evidence in favour of strong theoretical and empirical linkages between macro economic policies and the performance of agriculture. However, the findings differ as far as the magnitude of the effects of various policies on producers’ incentives (prices), agriculture supply and growth are concerned. It is maintained that the linkage from trade liberalization to output and export response, is not a simple one. Following economic reforms, the terms of trade have indeed become favourable to agriculture and there has also been an improvement in commodity price transmission from world to domestic markets in many developing countries. But the desired impact of policies on agricultural output is not distinctively visible due to presence of various factors and policies operating within and outside the economy. Some of the external factors include (i) volatility in global commodity prices, (ii) exchange rate variations, (iii) high tariffs and domestic support (subsidy) by the developed nations that distort world trade, (iv) low market access of developing country’s exports in other countries, and (vi) presence of NTBs. The internal factors are (i) little export incentives, (ii) poor infrastructure and marketing facilities, (iii) high dependence of agriculture on weather, (iv) physical and legislative controls on private trade, (v) institutional mechanism to maintain price stability and food security, and (vi) lack of convergence between external and internal trade policies.

Recognizing many of these factors and concerns that confront agricultural sector in the developing countries, the WTO has streamlined multilateral trading policies/rules for farm commodities. Proposals on certain exemptions to agriculture of the developing nations, formulation of food security box, placement of subsidies into different boxes, trade through STE, special and differential treatment to agriculture on grounds of food security and livelihood needs etc. have been discussed in various rounds of trade negotiations. While some of these suggestions have already been agreed upon in the July Package 2004, agreement on many other proposals are still underway. Policy decisions related to these issues may alter the movement of world and domestic prices of tradable commodities and have strong implications for rate of growth of crop production, exports/imports and government intervention.

With this backdrop, the present research has aimed to delineate reforms in the macro and sector level policies that influence producers’ incentive and the extent to
which these policy measures have influenced the performance of agriculture. The main objectives of the study are to:

(1) map external and internal trade policies, price and marketing policy reforms and measure the extent of openness of Indian agriculture,

(2) empirically test whether domestic prices of major crops at the state level respond to variations in world prices and/or minimum support price,

(3) measure the extent of commodity price transmission within the domestic markets and from world to domestic (state-level) markets in the pre and post-liberalization periods;

(4) examine regional changes in cropping pattern during the eighties, nineties and early 2000 and their implications for production and productivity growth;

(5) estimate acreage response function for major crops at all India and in the selected crop producing states with respect to price (individual and competing crop price, world price, input price) and non-price policy (tariffs, exchange rate, MSP) and supply side (irrigation, weather, technology) factors;

(6) investigate sensitivity of commodity prices, trade, crop shifts and hence production mix to hypothetical shocks/changes in the exogenous price, policy and natural factors viz. world price, tariffs, exchange rate, minimum support price and rainfall.

Based on the objectives of the study and available literature, the following hypotheses are formulated for empirical testing.

(1) following liberalization, domestic commodity price variations have increased;

(2) economic reforms and liberalization measures have transpired higher transmission of price signals from world to domestic agricultural markets;

(3) liberal policies and improved world and domestic price integration influence changes in cropping pattern;

(4) crop area shifts in a liberalized regime are relatively more responsive to price factors than the non-price factors;

(5) supply response (price elasticity of output) is positive and high for those crops and regions whose prices are well integrated with the world prices;

(6) sensitivity of area shifts to price factors varies as per competitiveness of crops and regional conditions.

The investigations are carried out at the national and state level, separately for six important tradable commodities viz. wheat, rice, sugar, cotton, groundnut and soyabean seeds. Both descriptive statistics and empirical models viz. cointegration and error
correction approach, OLS and structural econometric models are applied to test various hypotheses. The analyses are carried out from 1980/81 to 2002/03, broadly representing pre-liberalization (1980/81-1990/91) and post-liberalization (1991/91-2002/03) periods. Counterfactual simulation experiments under alternate policy scenarios are done from 2000/01 to 2002/03. The research is based on secondary published data (monthly and annual) and unpublished reports brought out by various ministries.

VIII.2 Main Findings
A delineation of reforms from 1991/92 to 2002/03 reveals that the liberal measures in the external trade of farm commodities have gained momentum only from the mid-nineties when the URAOA was signed under the auspices of the WTO. High import duties (tariffs) imposed on agricultural commodities have significantly got reduced in accordance with the WTO bound rates over a period of time. Import and export of several commodities that were subject to quantitative ceilings, canalization, licensing, minimum export price and other NTBs are regulated and placed under OGL. The trade reforms have shown compliance with all the three stipulations advanced under the URAOA viz. market access, domestic support and export competition. However, for some essential commodities such as cereals, sugar and dairy products, trade controls and regulations such as obtaining agricultural permits, trade through state trading enterprises and notifications to state agencies such as FCI, APEDA, JCI and registration with these continue to be in place. Some of these are imposed on grounds of health, religion, food security and livelihood needs and are acceptable under the WTO provisions. Compared to external trade liberalization, reforms in internal trade within the country have moved at a much slower pace. Private trade, especially in the foodgrains and sugar continues to be inflicted with government intervention through price, institutional and legislative controls and regulations. Certain relaxation in the legislative Acts and commodity stock limits, restrictions on commodity movements across the states, private sector entry into storage of foodgrain have been initiated and many more are placed on the table in the recent period. Consequent upon reduction in tariffs and NTBs, share of exports of rice, sugar and oilseeds and imports of edible oils, pulses and cotton in NDP agriculture has increased and so is the import penetration ratio, which has got accelerated for many commodities. Such developments undoubtedly elicit a greater openness of Indian agriculture to world trade and hence reduction in the magnitude of protection during the nineties and early 2000 compared to its status during the eighties. Nevertheless, the
overall progress towards openness is considered partial due to continuation of protection given to essential commodities. While protection on external front is given through agricultural permits, trade through state trading enterprises and other NTBs, the same on internal front is extended through stringent trade and marketing policies and legislative rules. Though an alignment of internal and external trade policy is not mandatory under the WTO mandate but a near convergence in the two is stated to be desirable. This is to avoid any constraining factor in reforming external trade and achieving a greater integration of agricultural economy with the world markets.

To what extent changes in domestic commodity prices responded to variations in the world prices following liberalization and whether agricultural trade liberalization has led to a quicker and higher integration of world and domestic prices? This issue is dealt with by first analyzing the relative price movements (variations) in the world and state-level wholesale prices of selected commodities. This is followed by an empirical analysis of the extent of price integration or transmission that has taken place (a) within the domestic markets and (b) between world and domestic commodity markets. Both exercises have been carried out using monthly wholesale price data (in rupees) from 1980/81 to 2002/03 adjusted for crop year, separately for the pre-reform and post-reform periods. The wholesale price data in the domestic markets is collected for major wholesale markets operating in the important crop growing Indian states and international price is taken for the major trading centre in the world. The division of time series data is done in accordance with the structural breaks identified in the relative price series. The main findings, on this aspect are as follows.

The intra-year COV of commodity prices reveals decline in the price variability of rice, cotton, groundnut and soyabean seeds across the major states during 1980 to 2003. The average COV of wheat prices is higher in the post-liberalization period in Gujarat, Karnataka, Madhya Pradesh and Rajasthan and that of sugar prices in two markets, one in Bihar and other in Maharashtra, and cotton price in Maharashtra compared to that in the pre-liberalization period. For two commodities viz. wheat and rice, price variability in most of the domestic wholesale markets is stable at a low level compared to a high level of price variability in the world markets. This aspect is attributed to government intervention in maintaining price stability through price and procurement policies and insulating domestic producers from the effects of volatility in world prices. For other commodities, annual price variations in the world and domestic markets are more or less at the same level and in fact are devoid of any trend.
Results based on decomposition of monthly world and Indian commodity prices into seasonal, trend and cyclical/irregular factor, estimated separately for the eighties and the nineties are consistent with the estimates obtained from the COV method. The band of seasonality has narrowed down in the post-reform period for groundnut seed, soyabean seed and sugar. The trend factor is estimated to be significantly positive for all the commodities in both the time periods and is relatively higher in the post-reform period. The cyclical and irregular factors estimated after taking account of seasonal and trend factors reveal large fluctuations, both in the world as well as domestic commodity prices. Evidence on whether global price cycles have caused similar movements in the Indian prices is mixed and varies across the states. The world wheat price cycles have got reflected in the Indian price cycles in some years and in a few states during the eighties and in most of the states during 1990 to 1994. In case of sugar and rice, world price cycles are clearly identified in domestic prices in several states from 1980-1991. However, during 1996-2001, only a few selected domestic markets of sugar have followed world price cycles. World price cycles of rice have caused similar movements in the Indian price cycles from 1991-1994 and then from 1999-2002 in many states, which indicate a greater integration of rice markets. Like sugar, picture has been same for cotton and oilseeds with only selected state level prices to have followed world price cycles. Of all the six commodities, price cycles in the case of wheat and rice are relatively more pronounced at the global level with major upswings and downswings than that in the Indian markets. This implies a greater stability in the wheat and rice prices in the Indian markets compared to that in the international markets.

These results substantiate the finding given in literature that price policy insulates Indian producers and consumers from high fluctuations in free market price. It enables domestic producers to realize profits during boom periods and protects them against losses in periods of slump. And this the reason why state level domestic price variability of wheat, rice and in some cases of sugar is explained more by variations in the MSP than by the world price in the OLS equations estimated from 1980/81 to 2002/03 at constant prices. In contrast, in case of domestic price variability of other commodities viz. cotton, groundnut and soyabean seeds, global prices have turned out to be statistically significant and MSP insignificant. Further, in almost all the commodity cases, significant responses of domestic prices to world prices as well as MSP are identified only in the important crop producing states. This is expected due to high-
marketed surplus available from major crop growing states for exports and procurement of wheat-paddy by the government/state agencies only from the selected states.

On the issue of the extent of price transmission, first within the domestic state-level markets and second between the world and domestic state-level markets, empirical findings based on cyclical index of price series are again mixed. The results vary across the states as well as agricultural commodities both in the pre and post-reform periods. Within the domestic markets, cointegration and error correction model provides evidence in favour of an improvement in the long run and short-run price integration of wheat, rice, sugar and groundnut in the post-reform period with a larger set of states to be integrated with each other. Studies done on this issue also support an improvement in the price integration of these commodity markets across the states following reforms. For cotton and soyabean seed, price integration is non-existent in the post-reform period across the Indian markets. Results are satisfactory only for states that are major producers of these crops. Market integration tested between the world and state level wholesale markets again reveals a higher transmission of prices but for all the chosen commodities in the post-reform period compared to the pre-reform period. A strong association between world and state level market prices in the pre-reform period is found only in case of rice and sugar. One commonality between the two exercises is that an improvement in the long run integration is found only in the major crop producing state level markets. The short run dynamics, captured through VECM are also negatively significant and have varied between 0 and 1 in all commodity cases under both exercises, one within domestic markets and other between world and domestic markets. However, the values of the error term coefficients are not in close proximity to 1, which imply slow speed of adjustment of almost all the markets including world markets towards equilibrium. A slow speed of adjustment of commodity prices to equilibrium can be attributed among other factors to (a) instability in international prices, (b) variations in exchange rate, (c) East Asian crisis, (d) delay in price information across the markets, transport and other bottlenecks and (e) changes in the trade policy.

The analysis also reveals that in the case of wheat and rice, a higher and improved integration in the post-reform period is driven primarily by administered prices than the liberal trade policy measures and the setting up of the WTO. Again, an integrated price relationship within domestic markets as well as between domestic and world markets is visible only in those state level wholesale markets where government undertakes procurement at the pre-announced MSP. This finding is empirically verified
by bifurcating monthly price series during the nineties into two time periods. The first period from 1991/92-1995/96 commensurate with a rising trend in MSP of both wheat and rice and second period from 1996/97-2002/03 corresponds to an upward trend in MSP of wheat and unchanged trend in MSP of rice. Cointegration test has confirmed presence of 5 cointegrating vectors among wheat prices of Punjab, Haryana, Karnataka, Rajasthan, Uttar Pradesh and world in these two time periods when price series have shown an increasing trend. No integration has been identified between world and domestic prices from 1996.4 to 2000.3 when world price declined and domestic prices aligned with higher MSP. In case of rice, the null hypothesis of no cointegration is rejected from 1991.10 to 1994.9 and then from 1998.10 to 2001.9 thereby affirming long-run relationship to be present among prices in Andhra Pradesh, Tamilnadu, Haryana, Uttar Pradesh and world markets.

In sum, the hypotheses that domestic commodity price variations respond positively to world price variations and that reforms have transpired a higher transmission of price signals from world to domestic agricultural markets are accepted for the chosen commodities but only in the major crop producing states of India. The states include Tamilnadu, Andhra Pradesh, Maharashtra, Gujarat, Karnataka, Rajasthan, Uttar Pradesh, Haryana and Punjab. An increase in commodity price variability as well as weak price integration in states other than those mentioned above during the nineties and early 2000 are explained by (i) lack of price competitiveness of a commodity in the selected wholesale markets, (ii) varietal and yield differences across the states, (iii) incoherent price transmission across spatial markets, (iv) divergent trade policies being followed that could result in a large gap in commodity price difference, (v) partial openness of Indian agriculture to world trade, (vi) low marketable surplus, (vi) weak infrastructure and marketing facilities, (vii) locational disadvantage i.e. port/trading center may not be near to the production centre (viii) regional bias in the price policy.

The next objective that is taken up in the study relates to cropping pattern changes and the magnitude of responsiveness of crop area shifts to price incentives manifested in the liberal macro economic and sectoral policies. The temporal behaviour of cropping pattern and spatial area changes at all India reveal significant shift in the seventies away from coarse grains and pulses to wheat and rice (paddy), in the eighties towards oilseeds, cotton and sugarcane and in the nineties and early 2000 towards rice, fruits-vegetables, fibres, plantations, condiments and spices. While area under wheat and paddy have expanded solely at the cost of coarse cereals and pulses due to price support
and HYV programme, commercial crops have benefited both from area shifts as well as fresh land brought under cultivation. The absolute area under cereals and pulses reveals a marginal change/increase in the latter half of the nineties. The relative share of area under cereals in GCA has declined from 60.86 percent in the early seventies to 52.61 percent in the early 2000. A significant aspect of area shift has been an increase in absolute acreage under oilseeds from 10.77 million ha in 1971-75 to 27 million ha in 1996-00. In relative terms, area share of oilseeds has risen from 10.77 percent to 14.8 percent in 1991-95 and then fallen to 13.01 percent in the early 2000. At the dis-aggregate state level while dominance of cereals (wheat-paddy) is visible in all the states, oilseeds acreage has become more prominent in the western, central and southern parts than in the northern states during the nineties and early 2000 compared to that during the eighties. Two states viz. Madhya Pradesh and Rajasthan emerge as the major states in oilseed production and southern states have increased acreage in both absolute and relative terms to cotton and sugarcane crops.

Spatial shifts identified through relative contribution of each state in crop area reveal Uttar Pradesh, West Bengal and Andhra Pradesh as the leading rice growing states; northern states viz. Punjab, Haryana and Uttar Pradesh as the highest wheat producing states and Maharashtra to have maximum area share in cotton cultivation. In case of cotton, a slight locational shift is observed in the nineties away from Punjab, Karnataka and Madhya Pradesh to Andhra Pradesh, Gujarat and Rajasthan. Similarly, area share of sugarcane in Uttar Pradesh, which was the maximum at around 50 percent in the eighties, have fallen to 46 percent in the nineties as a result of which, Karnataka, Andhra Pradesh and Maharashtra have gained the share of sugarcane acreage. It appears from the analysis that the initial spurt towards oilseeds from the mid-eighties, provided mainly by the Technology Mission programme on oilseeds, a favourable price policy and restricted trade policy has got subsided. Also, there has been considerable change in its structure and composition with the result traditional oilseeds, notably groundnut, rapeseed-mustard, castor and coconut are losing out their area share to new oilseeds such as soyabean, safflower and sunflower.

The inter-crop diversification index constructed at all India reveals an increased level of specialization towards cereals, sugarcane-fruits-vegetables, plantation and fodder crops during 1971-2003. It indicates a bent towards diversification within pulses and fibres during the eighties, nineties and early 2000. Picture with respect to oilseeds has shown an increasing tendency towards diversification till the end of eighties and specialization during the nineties and early 2000. The state level index constructed for major crop groups
from 1980-2002 provides a mixed picture revealing a trend towards specialization in cereals in the northern states and oilseeds in Maharashtra, Madhya Pradesh and northern states. In case of other crop groups viz. pulses, foodgrain, non-foodgrain, commercial crops and all major crops, an increased diversification is witnessed in almost all the states mainly on account of pulses and cotton and to some extent to change in area under oilseeds.

What implications do these crop area shifts have on output and productivity growth? The analysis based on sources of output growth indicates a significant fall in the annual rate of growth of area, production and yield for all the principal crops in the post-liberalization period (1991/92-2000/01) compared to that in the pre-liberalization period (1980/81-1990/91). However, no structural break has been found in the area, yield and output of crops during 1980-2000. While trend growth rates in the case of rice, wheat, sugarcane and all oilseeds has shown a marginal decline, rates of growth of ‘other cereals’, pulses, rapeseed-mustard, cotton are significantly lower in the nineties than in the eighties. This finding is contrary to what has been observed in the post-green revolution period, especially during 1981/82 to 1991/92 when annual rate of growth of food and non-food crop output and productivity rose significantly to a higher level compared to that during 1968/69 to 1981/82 (Sawant and Achuthan, 1995). It is important to mention that in contrast to ‘other cereals’ and pulses, wheat and rice have certainly maintained area and productivity and hence output growth over a period of time, particularly in the northern states and West Bengal. Area growth of pulses accompanied by higher rate of output and yield growth is observed only in Karnataka. Area shifts from coarse grains to high value oilseeds have been impressive till the middle of the nineties as they have resulted into higher oilseeds yield and output growth in Karnataka, Tamilnadu and West Bengal. However, from the middle of the nineties, acreage under oilseeds, in particular rapeseed-mustard has lost to fruits-vegetables and ‘other crops’ with hardly any improvements in its yield and output growth. Similar is the case of cotton that has gained area in almost all the states at the cost of ‘other cereals’ group and pulses but are not able to sustain higher output growth due to fall in their productivity growth.

A declining trend in the rate of growth of crop area is acceptable as long as its productivity is retained. In other words, an increasing yield level must compensate for a declining share of crop area or its growth so as to maintain same or a higher level of output. And this has not been happening in the case of principal crops grown in the country, which could be due to increasing degradation of land, less availability of water
both from the surface and groundwater sources, imbalance in the use of NPK and little technological innovations. A further probing is required to ascertain the extent to which these factors have contributed to lower rate of growth of productivity. One of the implications of this finding is that the high level of productivity achieved through adoption of HYV of cereals and Technology Mission Programme on oilseeds has already reached its peak, which calls for further intensification of agriculture. A decline in the rate of growth of crop yield has serious implications for food security, oilseeds production due to large imports of edible oils, level of exports and overall agricultural growth.

One may also note from the above findings that in the face of not so impressive increase in the rate of growth of crop productivity and output and technological improvements, preference towards cultivation of rice, sugarcane and other commercial crops could have taken place due to the influence of market incentives. A greater openness of agriculture to world trade following economic reforms and setting up of multilateral trading rules under the WTO appear to have provided signals to the farmers on growing particular crops that are price competitive and also have greater demand in the international markets. Within the domestic economy, alternative commodity mixes and hence changes in production pattern might be taking place due to shifts in the consumption pattern attributable to rising per capita incomes. Based on this proposition, two hypotheses are put to test. First, crop area changes are relatively more responsive to price incentives accruing due to liberal macro and sectoral policies compared to other supply side factors and second, acreage (supply) response is positive and high for those crops and regions whose prices are well integrated with the world prices.

These hypotheses are tested using a time series structural econometric model for each of the selected commodities viz. rice, wheat, cotton, sugarcane, groundnut and soyabean seeds. The structural model, developed within a partial equilibrium framework represents a simultaneous equation system of three equations and two identities. The behavioral equations are formulated on the basis of theoretical linkages between macroeconomic policies and agriculture as explained in the economic literature. For each commodity, the influence of price incentives, captured through movement of free market price (world reference price), macro exchange rate and trade (tariffs) is seen on three endogenous variables viz. domestic commodity price, exports/imports and absolute crop area. The behaviour of first endogenous variable i.e. domestic commodity price is determined by world reference price (fob/cif price), MSP, procurement, production and exports/imports. Changes in absolute level of exports/imports, the second endogenous
variable, is taken to be influenced by relative world and domestic prices, production (in case of exports), stocks, procurement, personal disposable income, world income per capita, openness, tariffs and NTBs. Variations in the third endogenous variable i.e. absolute area under a crop are determined by lagged ratio of domestic output to input price, own price, competing crop price, rainfall, price or yield risk, technology represented by ratio of own crop yield to competing crop yield, irrigation, infrastructure and lagged crop acreage. The structural model is solved for each commodity, separately under the exportable and importable scenarios, first at all India and then for one selected state for each of the chosen commodity. The results obtained from the empirical exercises are broadly taken to judge the performance of agricultural sector. The parameter estimates are obtained by applying both OLS and 3SLS in double log form at 1993-94 prices from 1980/81 to 2002/03. The results are consistent under both the methods for the chosen commodities. The OLS estimates are finally used to interpret results as the statistical tests indicate robustness of the estimated parameters. They also ensure that the inferences based on OLS would strengthen the model for simulations.

The results reveal that price incentives attributable to liberal trade and exchange rate policies determine domestic prices of cotton, sugar and oilseeds both at the all India and selected states. The coefficients of world reference price for these commodities are positive and statistically significant. For other two commodities viz. rice and wheat, the results show that in case of rice, world price is statistically significant in influencing domestic price only at the state level in Haryana. The coefficient of world price at all India is positive but insignificant. Domestic wholesale prices of wheat in India and Punjab are not determined by world price, which imply absence of integration between the two price series over the years. In fact, domestic prices of wheat as well as rice and to some extent of sugar are influenced more by administered prices than by their respective world prices. The elasticity of domestic price with respect to MSP is higher than that with the world price. Besides MSP, production and procurement by the central/state agencies explain variations in domestic prices of wheat and rice. This is expected because external trade in rice and wheat falls under the domain of central government and is encouraged only when the country has adequate procurement and hence stocks of foodgrains. In all commodities, exports/imports do not stand important in determining commodity prices except in case of sugar and cotton where the estimated parameters are statistically significant. This aspect is explained by lagged relationship between production and exports.
The impact of price incentives and liberal trade reforms on agricultural sector is visible through variations in external trade of farm commodities. The relative world and domestic price movements are statistically significant in explaining exports of rice, sugar, cotton and groundnut seed. For other two exportable commodities viz. wheat and soyabean seed, relative prices are insignificant in explaining exports primarily due to a higher level of domestic price of these commodities to their world price. Similarly, in case of import function of farm commodities, relative prices have the expected negative signs but are significant in explaining variations in imports only in case of wheat and sugar. For other two importable commodities viz. rice and cotton, relative prices are statistically insignificant in explaining imports, which implies that import may take place even if import prices are higher than the domestic prices. A changing level of exports and imports are also explained by factors other than relative price such as availability of stocks, extent of openness of Indian agriculture to world trade, quantitative controls and restrictions on external trade imposed through NTBs and tariffs. The coefficients of these variables have the expected signs and are significant in explaining exports/imports in almost all the commodity cases. The coefficients of tariffs and NTBs (explained by dummy) are negative in determining imports but are not found to be statistically significant. This could be due to that fact that NTBs have got reduced effectively from 1999 onwards as part of commitment to the WTO. Also, tariffs have been raised in the recent years to control import surges arising due to a low level of world commodity prices relative to domestic prices.

The impact of price incentives attributable to macro and sectoral price policies is tried to capture on absolute area under a crop. The acreage response function reveals significant effect of both price viz. profitability or own price and competing crop price (in lagged and current form) and non-price supply side factors viz. irrigation, weather, risk and technology in influencing crop area shifts in all commodities. In fact, a greater dominance of non-price supply side factors particularly of rainfall and technology is found. It suggests that a unit percentage change in these variables would yield much greater growth of crop area and hence output than a unit percentage change in the price (profitability) variable. Only exceptions are wheat in Punjab and soyabean in India and Madhya Pradesh, whose areas are relatively more responsive to price incentives than other supply side variables. The short run estimates in the present study have fallen within a range of 0.05 to 0.10 for wheat; 0.09 to 0.10 for rice; 0.21 to 0.39 for sugarcane; 0.12 to 0.34 for cotton; 0.21 to 0.24 for groundnut seed and 0.51 to 0.65 for soyabean. The long run area price elasticity estimates tend to be higher than the short run price elasticity estimates in all crop cases.
These estimates are not strictly comparable with the ones given in the literature due to inclusion of direct effects of trade, exchange rate, price policies and different model and longer time period of execution of reforms. But they are fairly close to the past estimates on area/supply price elasticity. Hence, the hypothesis of a relatively higher response of crop area changes to price incentives than non-price supply side factors in a free trade regime is rejected. Only exceptional case is that of soyabean, which shows a positive impact of globalization in terms of price convergence and increase in exports, acreage and output. Overall results reveal crop acreage to be driven by a combined effect of own price/profitability, competing crop price, technological change, irrigation and rainfall as elicited in the literature.

Many factors can be put forth behind absence of higher estimates of area price elasticity in a free trade regime compared to those obtained somewhat in a closed trade regime. Some of the factor are (i) sample period 1980/81-2002/03, which covers both pre and post liberalization periods, (ii) partial nature of reforms in agriculture even after 1991, (iii) lack of consensus on many issues in the ongoing WTO forum, (iv) absence of full integration of world and domestic economy, (v) interventions in tariffs and NTBs have taken place effectively from the mid-nineties, (vi) declining trend in world price from 1997, (vii) infrastructure bottlenecks such as cold storage, cilos and transport that facilitate exports, and (viii) high world price variability and lack of mechanism to ensure price stability within the domestic economy.

Further, the hypothesis that area price elasticity is positive and high for those crops and regions whose prices are well integrated with the world prices is also rejected except for soyabean seed. From the estimates, it is apparent that crop acreage is positively responsive to price incentives attributable either to free market prices and/or MSP fixed by the government. But the estimates are not on the higher side compared across crops and regions. This can be explained by the fact that factors other than price/profitability equally dominate land allocation decision of the farmers to a particular crop and hence influence elasticity estimates. Also, the influence of world price on domestic price has become visible only after execution of reforms during the nineties that too in the selected states of India. The findings on price transmission elicited above have already provided evidence in favour of presence of integration between world and domestic commodity prices only in the selected Indian states. We, therefore, rule out the possibility of higher estimates of area price elasticity for crops and regions whose prices are well integrated with the world prices.
To some extent, these findings appear to go against the expectations that are highlighted in the literature regarding a positive and significant impact of trade liberalization on Indian agriculture. It is important to mention that these parameters should not be taken to reflect the complete impact of liberalization and globalization on agriculture. It is evident that the analysis is done within a partial framework by taking only a few selected farm commodities that too in the representative states. The time period of analysis also pertains to both pre and post liberalization regimes (1980/81-2002/03) and hence the parameters obtained from given sample period may not indicate the full impact of changing policies on agriculture. Further, despite of initiation of liberal reforms, Indian agriculture by and large operates under a restricted trade regime and has not fully opened up to external trade. An evaluation of complete impact of trade liberalization on the performance of Indian agriculture may involve a large model that takes into account policy changes across all the sectors in the economy and their linkages with agriculture, preferably in the recent time period. Nonetheless, the findings obtained from empirical analysis are useful in demonstrating an increasing influence of liberal macro economic and sectoral policies in changing the incentive structure and the magnitude of response of external trade, area and output.

Given a positive response of export-import and crop acreage to price incentives arising out of liberal exchange rate, trade and free world commodity prices, two issues are finally taken up before winding up the analysis. First, what would happen to price and production incentives if world prices of farm commodity reach a low level or exchange rate becomes highly volatile or tariffs get changed or MSP is abolished or rainfall becomes erratic? And second, what policy measures can be initiated to neutralize the effects of unexpected changes in the policy and price factors so as to maintain producer’s incentives? The answers to these questions are sought by quantifying the impact of unforeseen changes in the exogenous and policy variables/factors at a time on three endogenous variables using counterfactual simulation experiments. For each commodity, the structural econometric model is run from 2000/01 to 2002/03 to generate simulated values under alternate policy scenarios. The results obtained under alternative scenarios are compared with the base run simulated values to gauge the magnitude of sensitivity or resilience of agriculture to exogenous policy and price changes. Under each of the policy scenarios, maximum and minimum variations are taken, which broadly represent optimistic and pessimistic scenarios.
The results based on selected commodities reveal the performance of agriculture to be significant under an optimistic scenario of maximum devaluation by 30 percent and world price increase by 25 to 30 percent on the basis of six selected commodities. The domestic prices, exports and area/production of commodities are higher by maximum 18, 100 and 6 percent per year than the existing level during 2000 to 2003. The same under the pessimistic scenario of shock due to currency appreciation by 2 and 5 percent and fall in world commodity price between 20-45 percent reveals maximum yearly downfall in prices, exports and area/production by 21, 85 and 8 percent respectively. The volume of imports under the two scenarios have shown maximum annual decline by 80 percent (optimistic situation) and increase by more than 600 percent (pessimistic situation) than the existing level. Since exchange rate is now market determined agricultural sector can be resilient to adverse impacts arising out of currency appreciation. Import surges caused by currency appreciation and world price shocks can be handled by imposing high rates of tariff.

The impact of MSP is identified mainly on wheat, rice and sugar. A change in MSP under optimistic scenario of increase by 8-20 percent and pessimistic scenario of decline by 5-8 percent is found to result in 13, 6 and 7 percent increase and 5, 10 and 6 percent decline in domestic prices of these commodities. The impact of increase in MSP and hence domestic price is severe in terms of changes in the volume of external trade. While exports decline by maximum 26, 12 and 18 percent for wheat, rice and sugar, imports rise by maximum 55, 78 and 109 percent annually for these commodities. Compared to optimistic scenario, the worst scenario of a decline in MSP and hence domestic price maintains the level of exports but prevents imports of only wheat and sugar. Rice imports continue to take place at an average rate of 71 percent per year. The results suggest resilience of cereal area to changes in the MSP at all India. However at the state level, rice area falls at an annual average rate of almost 1 percent.

Under the maximum (high tariff between 100-150 percent) and negligible (zero tariff) protection situation, a heavy inflow of rice and wheat imports may take place at minimum 1.1 percent and maximum 1000 percent per year (for sugar it is more than 1000%) under the best and worst situations. Average prices of cotton and sugar increase by 85 and 4 percent per year under high tariffs and decrease by 9 percent under zero tariffs. Accordingly, imports fall by 42 and 86 percent when tariffs are high and increase beyond limits in case of sugar when tariffs are placed at zero and 4.32 percent for cotton. The latter situation is shown to adversely affect area under sugarcane cotton by an average rate of 11 and 7 percent per year. It shows resilience of wheat and rice acreage as both increases by
0.79 and 0.51 percent per year. The average fall in area under rice in Haryana is estimated to be 1.36 percent per year. A flexible tariff rate policy is, therefore desirable. The impact of rainfall on agriculture is found to have occurred mainly on area that is put to cultivation. While good rainfall (15 percent above normal) results in an increase in crop acreage by maximum 10 percent, drought conditions (20 percent below normal rainfall) lead to a decline in area by maximum 16 percent. There is not much change in the level of prices, exports and imports. The shocks arising due to drought can be countered on its own as rainfall have tendency to follow a cyclical pattern.

In sum, simulation results indicate that variations in all the policy variables viz. exchange rate, world price, tariffs and MSP have a strong impact on changing the incentive structure, exports-imports and area/production. Analysis based on selected cereals and commercial crops indicates that shocks caused by fall in the world price, currency appreciation and tariffs are relatively more extensive than MSP and rainfall and may negatively impinge upon the performance of agriculture. Effects of such shocks on agricultural production can be countered by following trade policy based on appropriate tariff structure. The impact of shocks arising due to various policy variables though significant in bringing down commodity prices, are found to be resilient in terms of change in crop area/production especially of wheat and rice. Only exceptional case is that of rainfall shock that brings down acreage of these two crops. Another finding is that the results vary across the selected crops. It is found that compared to cereals, commercial crops are more vulnerable to shocks. This is because commercial crops are relatively more responsive to price incentives arising out of liberal exchange rate and trade policies and greater openness of domestic markets to international trade. Whereas wheat and rice though open to external trade and respond to price incentives in the selected states, are backed by minimum support price. The price policy backed by procurement provides cushion against external shocks caused by unexpected plunge in the world price.

To wind up, the present research indicates considerable scope for accelerating farm output and growth through favourable price structure in a free trade regime. It also reveals the urgency for initiating appropriate policies to maintain domestic price stability to guard against world price volatility, abrupt fluctuations in the exports-imports and protection from import surge. The empirical findings also reinforce the need for a public policy that promises greater alignment of internal and external agricultural trade policies, encourages sustainable use of land and water resources and accelerates public and private investments in irrigation, yield raising technology and infrastructure.