PRICING THE WHEAT IN PAKISTAN

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CERTIFICATE

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Quotation from the Holy Quran

وَاِنْ تَعُدُّوْا نِعْمَتَ اللّٰهِ لَا تُحْصُوْهَا

ترجمہ: اور اگر تم اللہ کی کسی ایک نعمت کو شمار کرنا چاہو تو تم اس کا احصاء نہیں کر سکتے۔

And if you would count the bounty of Allah Almighty you cannot reckon (econometrize) it

Surah Ibrahim Ayah No. 34 ع۴

Surah Annahal Ayah No. 18 ع۸

DEDICATIONS

To my parents (late), teachers, fellows and my family

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ABREVIATIONS

ARDL Model:	Autoregressive Distributed Lag Model
CPI:	Consumer Price Index
EU:	European Union
FAIR:	Federal Agriculture Improvement and Reform
FBS:	Federal Bureau of Statistics
FSRI Act:	Farm Security and Rural Investment Act
GATT:	General Agreement on Tariffs and Trade
MINFAL:	Ministry of Food, Agriculture and Livestock
NFDC:	National Fertilizer Development Centre
NWFP:	North West Frontier of Pakistan (Khyber Pakhtunkhwa)
PES:	Pakistan Economic Survey
S& D:	Special and Differential Conduct
SEM:	Simultaneous Equations Model
WTO:	World Trade Organization

SYMBOLS OF VARIABLES

Symbol	Variables
Acreage	Acreage
At	Area under cultivation
Fat	Fitted Area
Cd	Credit Disbursed
Fodder	Fodder
Ft	Fertilizers
Gp	Global Price
Import	Import of wheat
Info	Information
Is	Improved Seed
OR	Operative Reserves
P_t	Market Price
Pest	Pesticides
Pg	Govt. Set Price
Ph	Price Hike
Pop	Population
Ps	Price of Substitute (Rice)
Q_d	Quantity Demanded
Q_s	Quantity supplied
Rain	Rain
Ratio	Relative Price (Global Price / Domestic Price)
SR	Strategic Reserves
T	Tractors
Tt	Transportation
Wt	Water Resources
Yt	Per Capita Income

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ABSTRACT

This study examines the pricing of wheat in Pakistan based on interaction of the supply and demand forces. This analysis is carried out to determine a sustainable measure for stable price of the wheat (flour- as final shape) because much increase has been observed over time and wheat is the major cereal crop of Pakistan both from production and consumption aspects.

Perfect competition is an ideal market condition, resulting into efficient allocation of resources. There are so many consumers of wheat in Pakistan and almost everybody takes it in the daily meal as a staple food. Pakistan belongs to the group of top growers of it. Wheat is considered more or less as a homogenous (same) product in Pakistan. Keeping in view, these symptoms of competitive market for wheat, the tools of demand and supply are applied. Latest econometric techniques are used to arrive at a scientifically proven measure for pricing the wheat. The traditional method of simultaneous equations indicates that its price is less elastic. This investigation supports our recommendation that it should be adjusted against international price. The cobweb model also reflects that price of wheat and government set price having same level of less elastic coefficients can be adjusted against international price.

ARDL approach aimed at deriving a reduced model of wheat price estimate and forecast on the basis of many factors. For this purpose, we have compiled yearly data for the time period with effect from 1975 to 2009. Particularly, global price activities would have a major role, as expected. But we too have expected that some local factors would also matter, e.g. strategic reserves, which can lowers market prices to some extent, and effect of fertilizers, which should raise wheat domestic market prices, as it appeared to be. Government set prices also influenced the prices but at the same pace as the domestic market lagged wheat prices appeared to be. But

beyond this, area under cultivation and information too appeared to impact wheat prices (having statistically a negative effect). Overall, incorporation of all these elements the reduced model and estimated equations are in a position to use them with some reasonable accuracy as a tool for forecasting the wheat price movements.

This research work afterward moved to some particular policies for responding to volatility in domestic wheat prices. Three policy options suggested are as follows:

(1) Important policy objectives should be expansion of free-market more than apparent.

(2) Regulation of strategic wheat reserves to drive a better difference between government set procurement price and domestic prices along with some other factors.

(3) Price of wheat relative to the global price of wheat appears to have been affecting domestic market.

These three policy instruments should be able to play together more powerful role to moderate volatility in the price of wheat domestically.

CHAPTER 1 INTRODUCTION

Generally speaking, prices of goods and services are based on the mechanism of demand and supply. Paul A. Samuelson (2000) also recognized Adam Smith regarding the virtues of market mechanism under perfect competition. Therefore, he referred that wheat market is perfectly competitive all over the world because a single producer firm cannot affect its price.

Wheat is a cereal crop of winter in Pakistan. Its biological name is Triticum Aestivum L. which is an auto-pollinated crop. Pakistani foods are chiefly comprised of wheat. Most common usage of wheat is "chapatti" a form of bread. It is also used in biscuits, pastry, macaroni etc. Pakistan is among the top growers of wheat like USA, Canada, Australia, Argentina, Germany, China and India. As wheat cannot be affected so much by sever climatic conditions therefore, it is grown almost in all provinces of Pakistan. But the Punjab province is the major grower of it (Abdul Waheed et al, 2009).

1.1 The Issue and Current Debate in Pakistan

In the first two decades with effect from 1947 to 1967, the agricultural price policy in Pakistan followed the development strategy of that time which sought to 'channel resources away from the massive agricultural population to the urban industrial entrepreneurs. The procurement price of wheat remained almost stagnant during the fifties and the early sixties rising from Rs. 0.26 per kilogram in 1947-8 to Rs. 0.38 in 1966-7. It is therefore, not surprising that the wheat output also remained stagnant during this period. It was generally assumed in policy-making circles that agricultural production does not respond to price changes and that low prices, resulting from compulsory government procurement or high export duties on agricultural

products, would not affect the output level. In 1960, as part of a policy of general liberalization and relaxation of economic controls, 'voluntary' procurement of food grain replaced the system of 'compulsory' procurement. Controls on the prices and movement of wheat were lifted. There was also growing pressure on the government to pursue a price policy more favourable to agriculture. The reduced local production in the mid-sixties also coincided with reduced availabilities under PL-480. Agricultural stagnation was perceived as responsible for the worsening balance of payments position, low savings, and low demand for indigenous industrial goods. The price incentives also changes the farmers 'long-run expectations of profitability and this influences their decisions regarding investment and use of labour inputs and technology (Ahmed & Amjad, 2002).

Basically, our economy is agricultural. Wheat is a food crop. Last five decades of wheat production are presented in Table 1.1 given below. We can see that Pakistani farmers have enhanced the wheat production from four million tonnes in 1967 to nine million tonnes in 1977 when the government tried to stabilize the prices of wheat as compared to the international prices. In this decade improved varieties of wheat were introduced. During next decade, pace of production slowed down due to government's neglecting policy of keeping the agricultural product prices lower than industrial sector products. Provision of low prices agricultural product to urban consumers while generating public revenues by exporting these procured products at higher prices has a disincentive to the growers, as a response this resulted into a relatively lower production. It had been an observed fact up to 1987. During this decade wheat production was increased at a lower rate to 12 (twelve) million tonnes. Next decade with 16 (sixteen) million tonnes in 1997 showed enhancement in wheat productivity by use of technology. In 2007, a boost in production was due to a well in time lift of four year ban on

export of wheat. The reason behind this action was to raise prices for formers and unsuitable weather conditions in the major wheat producing countries during this period also raised the prices of foods.

Table- 1.1: Wheat Production in Last Five Decades
Production(MT)

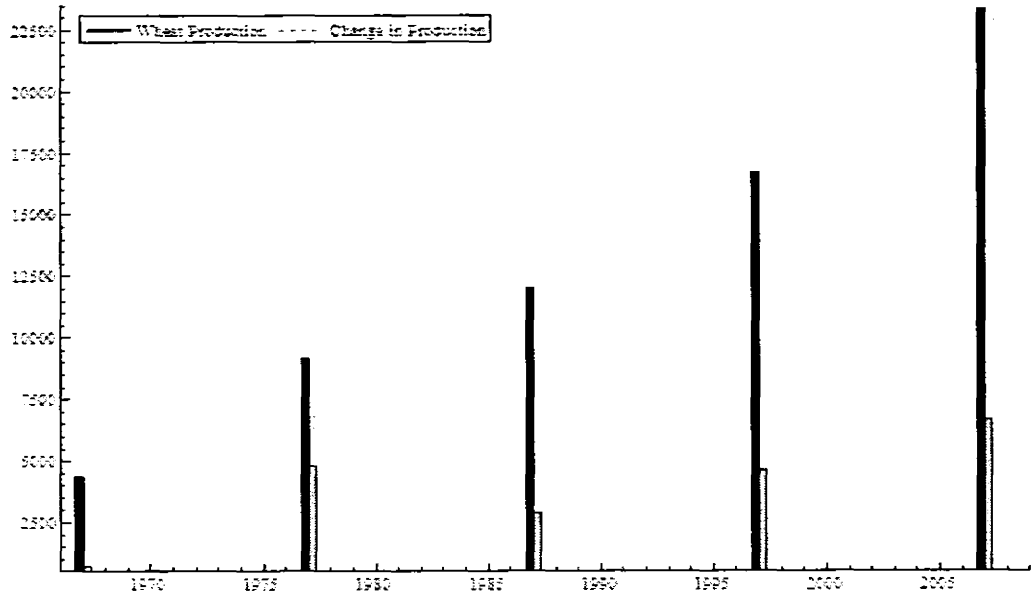
S. No.	Year	Wheat Production	Change in Production
1	1967	4,335	698*
2	1977	9,144	4,809
3	1987	12,016	2,872
4	1997	16,651	4,635
5	2007	23,295	6,644

Source: Pakistan Economic Survey, various editions.

MT: Million Tonnes.* The difference between 1967 and 1957's production is taken from Ministry of Food Agriculture and Livestock (MINFAL).

Price volatility during these decades remained an issue. Almost every country in the world helps the agricultural sector through different techniques like government procurement, rationing and subsidy. But in Pakistan, all these approaches are not as much effective as these should be. Therefore, market mechanism can be an effective tool. We need to distinguish between the government set procurement price and market price. These have different roles and will be different variables.

Figure- 1.1: Wheat Production in Last Five Decades



1.2 Objective of the Study

Perfect competition in the wheat farming is demonstrated frequently all over the world. Therefore, the hypothesis that wheat market would behave as if it were competitive perfectly would have been a true objective to pricing the wheat in Pakistan.

Keeping wheat prices lower than price parity of import developed into an unavoidable common practice of subsidizing the wheat by the government. In fact, the relatively low prices of wheat paid the benefit to the foreign producers and millers instead of consumers and growers. Especially, the flour mills owners in Pakistan not only availed their quota of subsidized purchase below the market price but also sell their flour at market prices.

"Wheat imports alone cost about $5 billion per year at 1998 prices. This puts enormous strain on Pakistan's foreign exchange requirements and slow-downs the future development of the country" (Pray & Fuglie, 2001).

When we discuss wheat price, it can be classified into market price, procurement price, import parity, export parity and issue price. Procurement price may be the marginal cost of the product. Now, if procurement price is Rs.1025.00 and import of wheat is usually made through Karachi gateway with a transport cost of Rs.100.00 and Multan is the wheat surplus zone the carriage from/ to Multan may be Rs.70.00 if the import price is Rs.955.00 the import parity will become Rs.1125.00 (955+100+70). Export parity on the other hand, will suggest that price at Multan should be Rs.785.00 (955-100-70).

This research work is an effort of explaining that the price of wheat can be settled down at the equilibrium intersection of demand and supply in competitive market environment using econometric methods. Previous literature has not followed use of ARDL approach to the classical theory of perfect competition and trade openness therefore; this will be a new and novel approach.

1.3 The Wheat Market Model

1.3.1 The Economic Framework

An economic model is a theoretical construction of processes using logically set variables. It may comprise of some quantitative relationship, a mathematical form and data that can be used to make an econometric analysis. Therefore, a general market clearing model of supply and demand is developed. The association of variables is framed as per economic theory. Two versions of methodology are presented. Economic theory regarding market equilibrium is included for the interaction of variables pertaining to demand and supply models.

1.3.2 Simultaneous Equation Models

These are used as apparatus for issues that arise in interpreting and estimating the versions. Where, price of wheat is associated with different demand and supply-side exogenous variables like price of close substitute (rice), area under wheat cultivation etc. In these log-linear models coefficients are elasticities and the models are following reduced form equations. After finding the empirical results our focusing is on the significant variables only. For example, the variable associated with quantity demanded may be population with positive impact on quantity demanded. On the other hand, area under cultivation may be included into supply equation that is positively associated with quantity supplied, having a negative impact on price of the wheat. In this way, different equations are estimated.

1.3.3 Autoregressive Distributed Lag Model

As econometric theory is empirical analysis of economic theory therefore, formation of a model for pricing the wheat requires interaction of both the demand and supply for making its foundations. For example, farmers make decisions on the basis of previous year price, rain conditions, water availability, provision of best quality seed and facilities of pesticides and fertilizers. Incorporating the influence of such past decisions and pattern of prices is a way for rendering it dynamic.

Another usual assumption concerning the way in which past behavior affects the present is that the more recent of past levels of price and quantity demanded (in case of demand function) have a greater influence on present consumption pattern and required level of income than remote ones. These models are a form of '*distributed lag models*'. When a dependent variable of

the model is also included in the model as an explanatory variable then it becomes an autoregressive distributed lag model.

1.4 Sources of Data

The data is collected from the Statistical Supplement as complement of the statistical data already published in the Economic Survey released every year prior to the presentation of the Federal Budget. The Statistical Supplement updates the data for the entire fiscal year. Most of the data given here is Statistical Supplement collected from finance ministry, Government of Pakistan's Economic Survey, Bulletins of Statistical Division (Federal Bureau of Statistics) and Ministry of Food Agriculture and Livestock (MINFAL) and others for different periods of time.

1.5 Organization of the Study

The first chapter on introduction contains objectives and organization. Second chapter is a historical review of relevant literature. Methodology is detailed in third chapter while, data and variable sources are defined in chapter four. Chapter five is devoted to estimation and interpretation and finally chapter six is for conclusion with references and appendix at the end.

CHAPTER 2 LITERATURE REVIEW

2.1 Background History of *'The Wheat'*

Flour from wheat produced in Pakistan has a unique taste along with consistency. Grains collected from different regions all over the world will not produce such taste produced here with the few inches of winter rain in the sub-monsoon strip.

2.2 Empirical Studies - An Overview

The traditionally used econometric techniques like Simultaneous Equations are being applied at mega level. A vital role of Simultaneous Equations is the causal flow at endogenous and exogenous levels. Here, we can easily apply 2-SLS and 3-SLS to time series type of data.

2.2.1 Developed Countries

History showed that there have been two neoclassical strands to look into perfect competition. First is non-influence of any agent on prices. This is because of the fact that any firm or individual consumer is small enough as compared to the whole market (Aumann, 1964). And the second is that, agents take advantage but eliminate the opportunities of profit exchange i.e. there is instantaneous adjustment that takes place through Walrasian approach of price taking.

Gardiner C. Means (1972) had stated critically in his thesis on "administered price" that prices are administered in a different way and do not behave in a classical manner. He also indicated that markets were not as much competitive as presented by the orthodox economic texts. But Means too, admired prices of wheat and steel-stock determined in the free market

mechanism. Means although stressed on administered prices but he too advocated that wheat prices are competitive (Kaboub).

Modern alterations in the American agricultural strategy have focused on the improvement of a more market based sector of agriculture. Before the presentation of the "Federal Agriculture Improvements and Reform (FAIR) Act" 1996, the state subsidies on agriculture were attached to the price-volatility of market. Govt. payments to growers decreased when agricultural product price enhanced and increased otherwise. The FAIR Act reformed that important relationship by segregating American agricultural markets from this old subsidy structure. Furthermore, the Act passed in 2002 relative to Farm Security and Rural Investment (FSRI Act) again authorized by 2007 a trade program previously framed in 1996's farm bill to develop and increase profitable channels for the American products. Farm Security and Rural Investment (FSRI) Act also introduced novel packages to address barriers other than tariff to American exports along with provision of information to help exporters, and developing long-term policy for agriculture trade that ascertains growth chances of export. Those policy dynamics posed vital tests and openings for economists used to develop product models to create useful information for market representatives. The institutions associated with market-modeling research are more scientific in timely and accurate information provision to the market activists. Information matter to the growers and businessmen and policy makers as per their requirements e.g. the policy makers benefited from information because of their usual need for projections of price and output to assess in a better way all of the impacts of agricultural policies. The doubts about fresh policies of agriculture too, present an important opportunity for the product makers to deliver timely information to policy discussions (Robledo, 2002).

Tomek (1997) stated that various types of queries arose relative to the quality of information regarding grain markets developed with the help of prevailing models of econometrics, quoting an example that high prices of grain during spring 1996 were not predicted exactly in the summer just before due to non-availability of accurately predicted levels of demand and supply. The expected size crop was greater than actual as a result the usage of this crop resulted into more than expected. Hence, closing stocks of the year hovering over 1995-96 for the grains were smaller.

This was the way of research regarding American Wheat Market that was followed to assess the accuracy of predictions and simulation information made with the help of the newly generated models that balance the conventional way of agricultural product markets modeling with modern achievements in modeling various forms of nonstationarity. Therefore, these study and assessment of the impacts of such a new modeling approach provided research chances to polish up prevailing product- market-models or to generate new and novels.

2.2.2 Developing Countries

Valdes and Zietz (1990) examined the suggestions put forward by the bigger players on improving agricultural trade in the light of general agreement to curtail subsidies. The possibility of compromise among the United States, the EU, the Cairns Group, and Japan was evaluated as was the result of the discussions on developing countries.

Whalley (1990) discussed the problem of special and differential conduct (S&D[2]) for developing countries in General Agreement on Tariffs and Trade (GATT). He evaluated its

[2] In Ministerial Declaration of Doha, the special and differential (S & D) conduct was reaffirm by trade ministers for developing countries agreeing on different aspects with a view to precise and strengthening all S & D conduct provisions making it operational and effective. There remain a dilemma between developed and developing countries however: it was agreed during December, 2005 meeting to five S & D provisions regarding LDC's including duty-free and quota-free access.

significance for the development, trade, and growth of developing countries and examined the ways how these developing countries can extend application of S&D in agriculture.

Hertel (1990) analyzed the belongings of price on trade liberalization, explaining the meaning of rise in price for the poorer and food-deficit countries, highlighting their strategies of handling the price changes, and telling the ways that how GATT negotiations can improve some of the short-run weaknesses.

Knudsen (1990) examined the significance of food security and the ways to compensate developing countries in the framework of trade liberalization, highlighting the currently available mechanisms to deal with these issues, and discussed the ways for structural adjustment that can enable developing countries to avail the benefit of the liberalization in the future.

Siamwalla (1990) focused on the effects of agricultural trade policies of the United States, the EC, and Japan prevailing at that time on price volatility, by explaining how these approaches may affect the discussions in the Uruguay Round, and national and global action to cover the effects of global price unpredictability on developing countries.

Tyers (1990) discussed that how local market protection can lead to global price instability, along with its nature and importance. And liberalization gains from trade at national and international level. He stated that policies regarding market betterment serve additional purposes. Although local markets can measure helpful net monetary profits that may be trivial as compared to the national income. Therefore, risk run into increased (BoP) regarding a few countries would be possible. This advocates a vital role aimed at the "tariffication" mechanisms for the suggestions under considerations those days in the Uruguay Rounds (Anderson, Tyers, & Kym, 1990b). He also stated that strict trade barriers will affect state trading of all GATT

members conditionally due to restrictions other than tariff and other variable tolls having the risk of high food prices.

According to Yavapolkul, Gopinath, & Gulati (2006) the Agreement Round of Uruguay, regarding agriculture tried to decrease obstacles of world-wide agricultural markets. But, a substantial reduction in the product prices at the end of 1990s may have curtailed incentives of the globe.

2.2.3 Empirical Overview and Current Debate in Pakistan

Naqvi and Cornelisse (1986) viewed that as government occupies the "commanding heights", and therefore, is suggested that storage capacity at the farm level be enhanced to prevent losses, the State must carry most of the marketable wheat literally on its shoulders. Marginal cost and benefit of minimizing wheat losses must be carefully balanced. Regulation of wheat market constitutions are required to be made coherently.

Ahmed and Stern (1987) discussed non-linear schedules of demand for wheat in Pakistan with their elasticities in two cases; the supply of wheat in the shape of rationing to the urban and the rural people's demand for wheat, applying the method of maximum-likelihood. The results observed in the former case were that "A higher payments to all purchases made after rationing and possibility of price differentiation in selling and buying prices of the rural households in the latter case".

Pinckney (Summer, 1989) suggested that an increase in the procurement price increases production which, thus, raises marketed surplus and procurement.

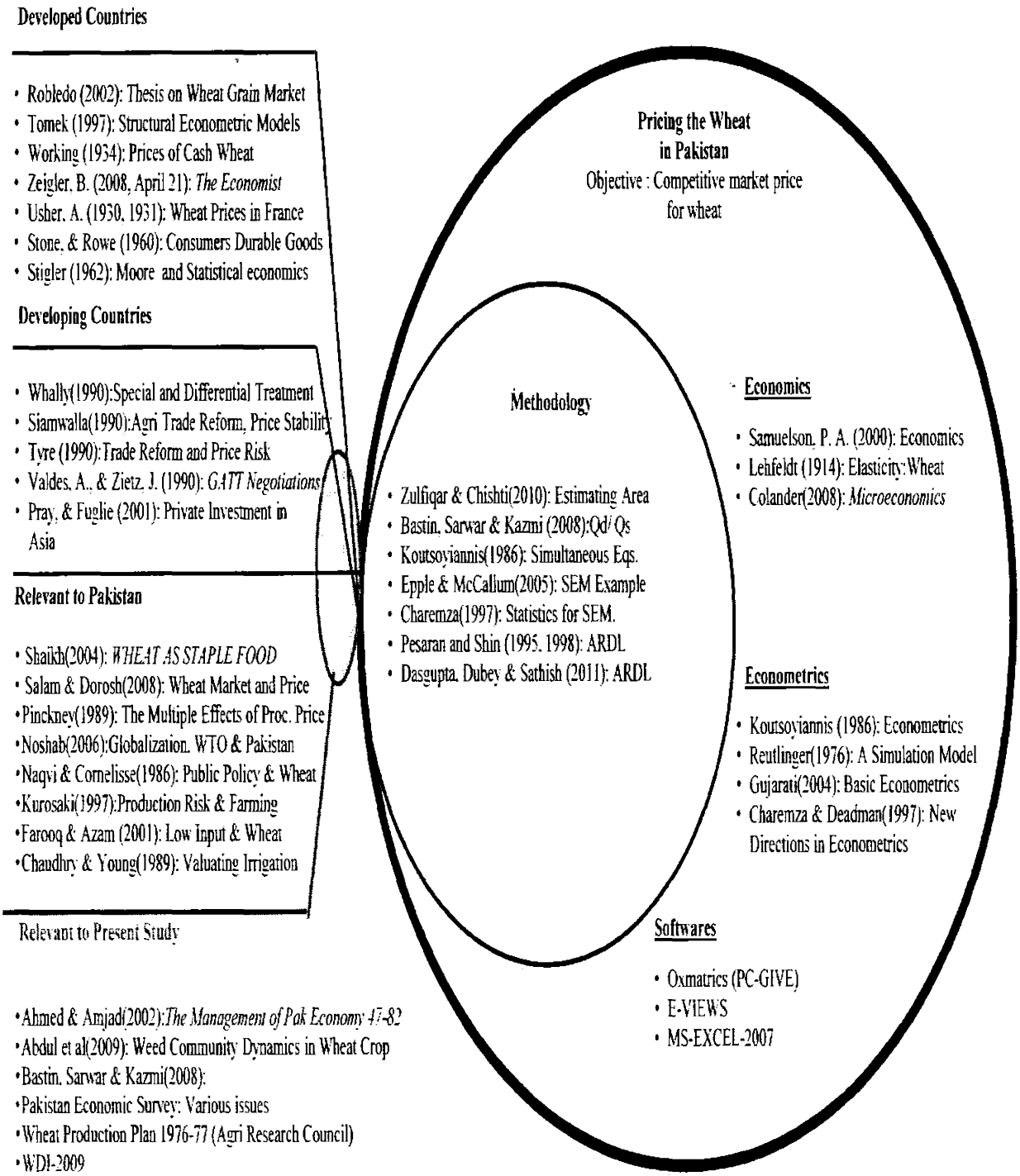
Chaudhry and Young (1989) observed that there are choices for irrigation levels in each of the province while, models of linear programming are framed for the sake of valuation of irrigation water using a typical farm of a district of the Punjab.

Kurosaki (March 1997) suggested a pragmatic model of profit changeability at an individual farmhouse level. He applied his model in the agriculture sector of Pakistan. The results showed that the adding of a distinctive return shocks and adjustment for input costs resulted into a much larger unpredictability.

Farooq and Azam (2001) advocated, "Biodiversity in agricultural sector increases the value of the product, makes resistance, eradicates panic of genetic homogeneity and guarantee food security for the world".

Khan and Schimmelpfennig (2006) posed that in Pakistan the support price of wheat is greater than international price of wheat. They introduced a conventional model of inflation that comprises of some supply side standard monetary variables e.g. the exchange rate, support price of wheat, money supply and credit to the private sector. The model received substantial attention in the country. They also observed that short run changes only in the government support price of wheat influenced inflation. Furthermore, they opine that government set price matters only over the medium term if the monetary policy is effective.

2.3 Relevance of Literature Review



This snapshot is a presentation of literature relevance with the current study. It indicates that objective of this study is competitive market price for wheat in Pakistan. More specifically, studies like Salam and Dorosh (Spring, 2008) also indicated that market mechanism is an effective tool. A report from Shamsher Khan (2007) also advocates competitive domestic marketing. It is another important research contribution that is often ignored in wheat market modeling to consider that free market can play a better role as Zulfiqar and Chishti (Summer, 2010) suggested the policy makers in Pakistan to allow free market to protect the producers.

Noshab (2006) stated that as Pakistan availed the opportunities and faced the challenges of global village therefore, in the coming years Pakistani policy makers should take care of WTO policies in this regard. Especially, it is needed to assess the policies of its trading partners. She also advocated a mutually dependent global economic order i.e. a give and take policy. As Pakistan needs to succeed, therefore requires studying of the competition very closely.

Salam and Dorosh (Spring, 2008) provided an empirical analysis of the policies of Pakistan regarding government trading inflation in the country. They concluded that market mechanism is an effective tool for stability of price and curtailing financial costs.

Mushtaq and Dawson (2002) used the co-integration and impulse response techniques in order to quantify the responses of acreage of wheat, rice, cotton and sugarcane in the country. Their results indicated insignificant response of acreages of Pakistani wheat and basmati rice. This thesis on "Pricing the Wheat in Pakistan" arrived at a different response using SEM and ARDL approaches.

CHAPTER 3 FRAMEWORK FOR THEORETICAL AND EMPIRICAL ANALYSIS

3.1 Background

Muslim scholars like Ibn-e-Taymiyyah explained the way how demand and supply are interlinked with price well-before the European Renaissance (Hosseini, 2003). James Denham-Steuart (1767) and Adam Smith (1776) used the term "supply and demand" while, David Ricardo (1817) devoted a chapter on it. Antoine Augustin Cournot (1838) developed first model of supply and demand mathematically.

3.2 Supply of Wheat

Economic theory illustrates that supply is the quantity of wheat that producer/ sellers/ farmers are able and willing to sell at some given price with the assumption that other factors are held constant. Generally, supply curve is positive i.e. with the increase in price of wheat, quantity supplied also increases. Some factors affecting the wheat supply are as follows:

Wheat market price, Price of substitute (Rice), Inflation or Price Hike, Acreage (wheat output multiplied by area under cultivation), Fertilizer, Pesticides, Improved Seed, Area under Cultivation, Tractors, Transportation, Govt. Procurement Price, Information, Water Resources, Operative stocks , Credit Disbursed and Global Wheat Price.

Wheat price has a fundamental relationship with its supply. The price of substitute goods like rice has a negative relationship with wheat because if its price goes up the supply of wheat would decrease and wheat supply curve shifts to the left i.e. farmers learn that rice is more profitable than wheat. Price hike can directly affect the supply. The producers may increase their

production of wheat in response of the future price increases. The more significant factors are those that relate to the state of technology that may include Acreage, Fertilizer, Pesticides, and Improved Seed. Inputs like Area under Cultivation too affect the wheat supply. More will be the quantity supplied on increase of Area under Cultivation and timely rainfall. Government policies regarding procurement price, operative stocks, credit disbursement, and provision of water resources, tractors and publically available Information also affect the wheat supply. Shortage of rain in any year affects the wheat production directly. There are also long-run effects on production of irrigated wheat since the water table is lowered. This in turn reduces supply due to raised production costs. Extreme rainfall on the contrary, has a negative effect too on the supply due to wheat supply destruction. Ultimately, there exists some import of wheat during such periods.

Main determinants of elasticity may include: the complexity of production process, time to respond e.g. a wheat farmer cannot immediately respond to an increase in the price of its substitute (rice) because of some factors like time period for cultivation. Storage capacity is also one of the determinants. A wheat producer who has unused wheat can quickly respond to price changes in the market.

Slope for linear supply curve intersecting at origin has unit elasticity. It will be infinite elastic if the curve intersects at Y-axis and zero elastic in case if the curve intersects at X-axis (Colander, 2008).

Wheat is the main staple food of Pakistan. All other crops are dominated by wheat's production and acreage. Indus Plains are more productive in terms of rich soil, irrigation facilities and suitable topography but the Highlands of the West are not so, due to less

availability of these facilities. Two regions are wheat growing, mainly in Punjab, from the southern district of Rahimyar Khan to the northern district of Sailkot and in Sindh, the districts of Nausharo Firoz and Nawabshah. Not as much but to some extent, other regions; the Punjab's eastern and northern districts, and some nearly situated districts of Khyber Pakhtunkhwa (formerly NWFP) are included. In Sindh, districts that are nearby the main wheat-growing districts are also included. Since no amount of heat or cold is too severe for the growth of wheat plant, it is grown in almost all parts of the country.

3.2.1 Price

Economic theory states that in a competitive wheat market farmers use prices as an important factor to find what and how much to produce. Due to agricultural nature, the response is lagged to the last year price. The greater is the supply of wheat if the price is higher. Generally, the farmer's price is used in the supply equation but, due to lack of data on farmer's price, this study depends on average retail price of wheat flour for determining the supply.

3.2.3 Area under-cultivation

The main element of achieving self-sufficiency in the wheat production is cultivation of wheat on a larger area. Total area under wheat cultivation in 1972-73 was 15.1 million acres[3] that increased to 32.34 million acres in 2008-09 i.e. more than double. Area has positive relationship with price of wheat.

[3] 1 ha = 2.47 acres

3.2.3 Acreage

Acreage is determined by multiplying wheat output with area under its cultivation. Acreage also has positive relationship with supply of wheat.

3.2.4 Quantity Supplied

The quantity supplied includes production of wheat within the country in a year along with import of wheat from different countries to meet the basic need of the people of the country. Since Punjab has been main source of agricultural production in the country therefore, it has remained the focus of major agricultural planning and development efforts.

Pilferage, Fodder, and other losses: Earlier estimates of pilferage of food grains according to a discussion paper (Bastin, Sarwar, & Kazmi, 2008) calculated as much as 15% for wheat, similar percentage is deducted for fodder and seed use of wheat as well as for processing and distribution losses. The post harvest losses were considered 20%. This study too, considered the same procedure to fmd the total quantity of wheat flour supply by further converting it into protein and carbohydrate enriched supply of wheat flour. Tabulation is made in the appendix at the end.

3.2.5 Fertilizer

Fertilizers are important in increasing wheat production to fulfill Pakistan's food needs. Loss of fertility is a threat to food production in many developing countries. The loss of fertility curtails yields. "The farmer's main objective is to uphold the productivity of his land. Fertilizers make up the most important scientific breakthrough in feeding the growing population of Pakistan. Studies in Pakistan showed that contribution of fertilizers through crop production

ranges between 30 to 50 per cent under a given soil climatic conditions. Fertilizer production and consumption in the country showed an outstanding growth over time (Alam & Khan, 1999)".

3.2.6 Improved Seed

Improved seed is "comparatively low-cost input, with the potential" to increase the yield. It comprises of efficiencies, availability, accessibility and quality. Seeding rates for wheat vary across Pakistan due to changes in soil types and production techniques.

"Foreign firms accounted for much of the growth in private research in Asia. They accounted for about half of all private research in these countries and were concentrated in the industries where private agricultural R&D has been growing most rapidly—chemicals, livestock, and seed. The farm sector produced inputs, such as crop seed and animal feed. Studies observed the supply of these inputs as less than perfectly elastic (Pray & Fuglie, 2001)".

3.2.7 Water Resources

Proper watering can enhance the wheat production. But there is a shortage of water in Pakistan. Glaciers are not melting adequately to raise water level in rivers. Reservoirs in the country are shrinking. The storage capacity of Tarbela, Chashma, and Mangla dams has been reduced. As a result, water table in Pakistan not in a position to meeting the irrigation needs. Water must be properly and equitably distributed but the purpose should be making it more productive for crops.

3.2.8 Credit Disbursed

"Future changes of free market economy and faster globalization have further necessitated modernization of agricultural machinery through transfer of latest, efficient and cost effective technologies to the farming community. Efficient use of scarce agriculture resources and accelerated agricultural mechanization are, therefore, vital to meet the challenges of future scenario that need a comprehensive strategic loaning for future"[4]. To manage the demand of credit to be used in the agriculture sector it is decided to provide the farmers this facility through institutions. Therefore, private banks of domestic nature, about four to five commercial type of banks, Punjab Provincial Coop. Bank Ltd., along with ZTBL are working for the purpose of food security.

3.2.9 Tractors

One of the major contributions of the institutional finance is provision of tractors. ZTBL has started the Benazir Tractor Scheme. This scheme is an initiative of the Federal Government. It is planned to provide 10,000 tractors to the farmers through balloting with the help of computer. A subsidy of 50% is being provided up to Rs.200, 000.

3.2.10 Rain

In Pakistan some wheat is grown under irrigated water but even that is affected by the amount of rainfall. Shortage of rain in any year affects the wheat production directly. There are also long-run effects on production of irrigated wheat since the water table is lowered. This in turn reduces supply due to raised production costs. Extreme rainfall on the contrary, has a

[4] Pakistan Economic Survey, 2009-10, pp. 24.

negative effect too on the supply due to wheat supply destruction. This occurs more often in the rainy season of Monson.

3.2.11 Pesticides

"All parts of wheat plant are subject to diseases and one or more diseases can occur on virtually every plant and in every field. In Pakistan, 50 diseases of wheat are reported and some of them are important economically. These are caused by parasitic bacteria, fungi and viruses (Ahmad & Iram)".

Crops in Pakistan remain vulnerable to diseases due to hot season and high humidity in different parts of the country. Therefore, use of chemicals and pesticides is very important for farmers in order to increase yield and protect plants from diseases.

3.2.12 Operative Reserves

Operative reserves are operational stocks to be used for regular issues to market during shift to new wheat policy, and a targeted food for the poor along with allocations for military etc. In international discussions it is often suggested prominently to increase global grain reserves. In this research work, operative reserves are considered as a supply side variable.

3.2.13 Price of Substitute

As the farmers have labour, land and capital in a limited quantity and their goal is assumed to be profit maximization therefore, we assume that they allocate the resources in the best way to achieve their goals. Since relative prices significantly affect the profits therefore, we must consider the price of substitute i.e. rice along with the price of wheat. A study for analyzing global impact for rice-wheat grower's incentives in Pakistan is conducted by NARC

at the Social Sciences Institute using protection level, resource cost, and subsidy equivalents for producers for the period from 1991 to 2000 (Akhtar & Sharif, 2012).

In this research work, rice competes with wheat all over Pakistan and farmers choose to grow either wheat or rice or both, depending on their profitability perceptions. Again wholesale price of rice is used for the same as mentioned under wheat price.

3.2.14 Transportation

Transportation helps in mobilization of local leaders involved in the process of increasing adoption of modern technology for increasing wheat production. It also spread the extension workers comprising of Agriculture Officers and Field Assistant to motivate and improve the knowledge of farmers. In order to avoid damage to wheat crop it is essential that it should reach to the wholesalers in time. Its marketing can be improved with a better storage facility and by providing reliable transportation between farms and markets.

3.2.15 Information

Reliable information to measure the changes in wheat supply in response to a change in price is necessary, live communication on radio and television programs are quite useful. Government can encourage broadcasting of such programs for guidance of farmers. Although information costs and as a result there may be an increase in the price of wheat but, its benefits can overcome such costs. Luckily, government of Pakistan has reasonably accurate data. Although public stocks and releases of wheat can be observed but private reserves cannot be easily accounted. As a result additional information regarding short run wheat supply is required

therefore, all types of communications are added that are available through Pakistan Economic Survey.

3.2.16 Government Procurement Price

Government of Pakistan and its provincial governments need to control issues of international surge in food prices, increasing oil prices, cost of wheat production for neighbours and security conditions that are creating price differentials along with domestic inflation. Therefore, government set procurement price is generally for the purpose of strategic and operative reserves and securing formers' income and households' requirements.

3.2.17 Inflation or Price Hike

Inflation in Pakistan is on rise due to increased electricity tariffs, withdrawal of food subsidies, oil prices, taxes and increase in the domestic prices of wheat. Aggregate supply is weakened due to poor situation of law and order and shortage of energy.

Controlling inflation is (a means to an end) to stabilize price for stabilizing inflation keeping it lower than the trading partners and competitors. By achieving this Pakistan will not require depreciating the nominal exchange rate. Pakistan should have a strong agricultural policy to enhance output and improve competitiveness as it can be a key to curtail food price inflation.

3.2.18 Import of Wheat

Pakistan always has used to import wheat. Prior to 1970 it remained lower. This was due to green revolution during 1960s. Population pressure over time has forced government to import more wheat in the next decade. However, at the beginning of 1980s import of wheat is liberalized by government and rationing system is abolished. At the end it was again disallowed.

1990s throughout remained a decade of wheat import. High production in the beginning of 2000 reduced import to the bottom. Changing climate, and increased wheat prices again shifted the imports up. Even then, 2007 and 2009 are years of high production.

3.3 Demand for Wheat

Wheat is a staple food in Pakistan. Its demand is due to a large proportion of young population called working labours that requires this energized by carbohydrate food being affordable. Chapatti is the most widespread and popular. The upper and to some extent the middle class too use it in many different ways in the form of bread (dabal roti), biscuits, porridge, cookies, sweets and macaroni. But chapatti (roti) is a typically wide spread meal.

Law of Demand for Wheat: Due to price change in response of a change in wheat supply, buyers will change the wheat quantity they demand. On dropping of price, more quantity of wheat will be demanded. If the price rises, lesser quantity of wheat will be demanded.

Slope of Demand Curve: As per economic theory, diminishing marginal utility and substitution effects are causes of downward demand curve slope. Because the successive units of wheat consumed provide less additional utility than the previous one therefore, buyers will pay for such units only if their price is lowered. When the price of wheat decreases relative to its substitute (Rice), the buyer will lessen the use of rice because its price is not changed. In case of decrease in price of wheat, the buyer will become wealthier in real terms. Therefore, more of wheat can be purchased as well as of rice (e.g.) whose price has not changed. Here, income and substitution effects reinforce each other. More of normal or superior good is purchased on decline of its price. Slope of demand for wheat will be from left to right downward. While the market demand for wheat is horizontal summation of individual demand curves.

Determinants of Demand for Wheat: The basic determinant of demand for wheat is its price, whose change causes movement along with its demand curve. A decrease in price leads to downward movement in the demand for wheat resulting into increase in the quantity demanded for wheat and vice versa.

Other determinants are those causing a shift in the demand for wheat. These may include the number of buyers (i.e. population of Pakistan), the income of buyers (i.e. Per Capita Income), the change in price of relative goods (i.e. Price of Substitute: Rice), buyers expectations regarding future price (i.e. Price Hike or Inflation), Strategic reserves of wheat, Govt. Procurement Price.

Elasticity here is the responsiveness of quantity demanded for wheat to changes in its price. Main determinants of elasticity are the willingness and ability of consumers to delay consumption and search for substitute in response to change in price. If the consumption cannot be delayed and the substitute is not readily available the demand will be less elastic.

Slope for linear demand curve intersecting at origin has unit elasticity. Above this point is the elastic range of the demand curve and below is the inelastic range. It will be infinite elastic if the curve intersects at Y-axis and zero elastic in case if the curve intersects at X-axis (Colander, 2008). A decline in elasticity on moving down-ward of the curve is a result of falling P/Q ratio.

3.3.1 Price

The world economy is growing rapidly. Competitiveness is required to meet the wheat demand for the growing population of Pakistan. As government is lacking behind to handle the price issue therefore, selling and procuring wheat at market prices is inevitable. It will boost supply, decrease smuggling profits, and make government enable to sell wheat in the open

market after sending some flour to its utility stores. It will also curtail the profit of millers due to issue price differential.

3.3.2 Quantity Demanded

The quantity demanded includes wheat flour consumption within the country. To illustrate quantity demanded, if procurement price of wheat in Pakistan during 2008-09 is Rs.950/- for 40 kg. And consumers in the market are able and willing to procure 9231 thousand tonnes of it then, quantity demanded is 9231 thousand tonnes. However, the theoretical model presented in this research work allows separating the demand for consumption from export of wheat as a separate variable and the implicit demand for storage, under specific assumptions on the competitive structure[5]. A nutritionist's approach to the demand for wheat has been used following the protein and carbohydrate requirements. The demand for wheat is determined by multiplying the yearly population with the required protein (16 kgs/annum) and carbohydrate (14kgs/annum) from wheat in particular and then added both similar to the technique of Bastin, Sarwar, & Kazmi (2008). Appendix at the end explains the calculations of quantity demanded for wheat.

3.3.3 Government Procurement Price

Maintenance of wheat (flour) price at an affordable level on the basis of demand is the main concern in Pakistan. The price of wheat is a bellwether for the general price level also. If the flour price goes up, the price of tomatoes and potatoes too goes up almost in the same way. It

[5]"For example, no matter how urgent is the demand for grain to consume today, some wheat must be held on docks as ships are loaded and unloaded, and in other elements of the supply chain" (Wright and Cafiero, 2009).

emphasizes that the price of wheat to be stabilized. Therefore main objective of government procurement price is provision of the staple food to the dwellers along with reduction in import of wheat keeping the prices affordable through price controls and subsidy.

3.3.4 Strategic Reserves

The government as a practice fixes the price announced before sowing season, with a strategic reserve for price stabilization to be maintained for emergency purposes and, this should be different from the operational stock to be used for regular issues to market during shift to new wheat policy, and a targeted food for the poor along with allocations for military etc. In real world farmers also maintain a reserve for their own requirements. It should be a strategic reserve to compete at the market. But in Pakistan, it is observed that these farmers could not benefit from the same due to barter type of trade.

3.3.5 Inflation or Price Hike

Demand for wheat is almost inelastic i.e. if price increases by double digits e.g. 10 %, even then the demand for wheat will not decrease at all and if it increases by 50%, the demand may not decrease even by 5%. It shows that wheat consumers will curtail other items to eat the same number of Chapatti as they were eating before. As a result, when there is a shortage, the hoarder can easily increase the prices and earn extra profits at the cost of poor consumers.

3.3.6 Income

Per capita income is calculated by dividing the GNP (at market prices0 with the population. We have used the GNP rather than GDP as Pakistan's primary national income and product concept. Because the practical difference between GDP and GNP is not negligible. It can

diverge significantly. For example, in the recent past, our GNP differed from GDP due to remittances from Pakistani living abroad. Market prices reflect the prices of commodities in relative terms. Relative prices are used to show how much consumers value their marginal units of the goods.

3.3.7 Price of substitute (Rice)

Rice and wheat are said to be close substitute because increase in the price of rice leads to an increase in the demand for wheat. Therefore, if the price of rice increases, people tend to make use of wheat and vice versa. Keeping in view such economic theory, we have included the price of rice as a substitute in our model.

3.3.8 Global Price

Use of global price as a criteria have some relevance because some wheat is imported in Pakistan for consumption. The gap between global and domestic market price remained diminishing, however it was widened during mid-seventies.

3.3.9 Information

In this respect, live communication on Radio and Television programs regarding prices and availability are quite useful. Government can encourage broadcasting of such programs for guidance of consumers. Although information costs and as a result there may be an increase in the price of wheat but, its benefits can overcome such costs.

In order to solve such issues governments should also revise its policies for the betterment of consumers. The priority should not only be to collect large amount of data with attractive analysis and presentation but the real task should be its transferability to consumers

and producers in a useful form. The information about major agricultural commodities should be broadcasted daily on the TV and radio at suitable time both the communities.

3.3.10 Population

The increase in demand for wheat consumption has been driven mainly by the increase in the population, and the rate of population growth has been slowing down in recent decade. In poorer countries like Pakistan increase in income is an important driver of wheat consumption per capita, which is naturally limited by the capacity of the human stomach. There is a positive association between quantity demanded for wheat and population. Pakistan is sixth in the world's populated countries. Median age is 20 years therefore; it is a 'young' country. Majority of the population used to seek energy taken from carbohydrate rich "Roti" being staple food.

3.3.11 Relative Price

Relative price is the ratio (domestic price of wheat over global price). Relative prices are used to show how much consumers value their marginal units of the goods. This term is applied to ARDL model.

3.4 Methodology of Research

3.4.1 Models and Reality

Human beings often attempt to understand the unfamiliar by matching it with something familiar. This is the essence of the process of 'modeling', whereby some complex real situation is represented in some other, usually mathematical form, which is easier to handle, manipulate and understand. Our representation of reality, in the form of a model usually smooth's away the rough edges and simplifies and reduces the thousand and one complications of reality to a few

"essentials." Mathematical modeling is an extremely powerful tool. This is because mathematics provides us with models which can be exceedingly complex and yet be subjected to a few laws which allow us to understand and manipulate the model easily. Thus, these mathematical models are adopted to provide a match to extremely complex manifestation of real phenomenon.

3.4.2 The Model

A pragmatic approach has been adopted in this thesis, although it is not presented in a utility function but has expressed the demand and supply functions in such a way as to incorporate the classical assumption of perfect competition.

3.4.3 Demand and Supply Equations

Economics assume a negative functional relationship between the price and quantity demanded.

$$Q_{dt} = f(P_t, Z_{dt})[0 < P_t] \tag{3.1}$$

Similarly, the theory of economics assumes a positive functional relationship between the price and quantity supplied.

$$Q_{st} = f(P_t, Z_{st})[0 > P_t] \tag{3.2}$$

At market equilibrium level

$$Q_{dt} = Q_{st} \equiv Q \tag{3.3}$$

Here, Q_{dt} and Q_{st} represent quantity demanded and supplied whereas, P_t is average retail price of wheat, Z_{dt} show values of different demand-side exogenous variables associated with P_t. On the other hand, Z_{st} indicate different supply-side exogenous variables associated with P_t.

The relations presented below in the common structural specification are invariant in time. The parameters of the three equation model below i.e. α(s) and β(s) are unchanged for different values of *t*. This means that the model repeats itself for each *t*. It is conditional on the values of the variables only, and not on time. The movements in parameters are permitted to be systematically related to the movements in variables not appearing in the model and it is not related to the movements of variables appearing in the model.

3.4.4 Common Structural Specification

For supply-demand model, the simultaneously determined variables are market quantity Q and price P. The basic demand and supply functions are written as

$Q_{dt} = f(P_t, Z_{dt})$ & $Q_{st} = f(P_t, Z_{st})$ with Z_{st} represents the important factors relating to supply of wheat and Z_{dt} represents the factors of demand for wheat. The partial derivatives of Q_{st} and Q_{dt} would be expected to have the following signs: $Q_{st1} > 0$, $Q_{st2} < 0$, $Q_{dt1} < 0$, and $Q_{dt2} > 0$. In order to illustrate the mechanism of SEM we assume for the time being that Z_{st} and Z_{dt} denote only a single supply and demand side variable respectively and P_t is the only wholesale price as follows:

$$Q_{dt} = \alpha_0 + \alpha_1 P_t + \alpha_2 Z_{dt} + \varepsilon_{dt} \tag{3.4}$$

$$Q_{st} = \beta_0 + \beta_1 P_t + \beta_2 Z_{st} + \varepsilon_{st} \tag{3.5}$$

Taking Ln

$$LnQ_{dt} = Ln\alpha_0 + \alpha_1 LnP_t + \alpha_2 LnZ_{dt} + Ln\varepsilon_{dt}$$

$$LnQ_{st} = Ln\beta_0 + \beta_1 LnP_t + \beta_2 LnZ_{st} + Ln\varepsilon_{st}$$

At market equilibrium level

$$LnQ_{dt} = LnQ_{st} = LnQ$$

For simplicity, it is useful to represent the logged variables in small letters as follows:

$$LnQ_{dt} = q_{dt},\ LnQ_{st} = q_{st},\ Ln\alpha_0 = a_0,\ \alpha_1 = a_1,\ \alpha_2 = a_2,\ LnP_t = p_t,\ Ln\beta_0 = b_0,$$

$$\beta_1 = b_1, \beta_2 = b_2,\ LnZ_{dt} = z_{dt},\ LnZ_{st} = z_{st}$$ therefore,

$$q_{dt} = a_0 + a_1 p_t + a_2 z_{dt} + u_1 \qquad (3.6)$$

$$q_{st} = b_0 + b_1 p_t + b_2 z_{st} + u_2 \qquad (3.7)$$

$$q_{dt} = q_{st} \equiv q \qquad (3.8)$$

As suggested above, we presume that $a_1 < 0$, $a_2 > 0$, $b_1 > 0$, and $b_2 < 0$. In (3.6) and (3.7), u_1 and u_2 are error terms. It is assumed that $E(u_1) = 0$, $E(u_2) = 0$, $E(u_1)^2 = \sigma(u_1)^2$, and $E(u_2)^2 = \sigma(u_2)^2$ for all values. Further it is assumed that Z_{st} and Z_{dt} are exogenous and not correlated with u_1 and u_2.

3.4.5 Simultaneous Equations Model

The text book treatment of above mentioned model is called simultaneous equations model (SEM) started from (Haavelmo, (Jan., 1943) analysis. The simultaneous equations models were opined to be a remarkable improvement in econometrics. The main thing for introduction of the relevant issues has been a system of supply and demand relationship for determination of quantity and price of wheat simultaneously. Text books have included such type of system

featuring data in which structural models are estimated using instrumental variables (IV), 2SLS, or maximum likelihood method (ML) to yield plausible estimates than OLS.

3.4.6 Reason behind Use of SEM

The purpose of this research model specifically, is to develop and estimate the model of supply and demand system involving Pakistan's annual wheat related time series data since its emergence. The specification of the supply and demand equations is made plausibly workable; IV estimation is expected to yield statistically significant estimates as compared to OLS.

Substitution results into

$$q_t = \frac{a_0 b_1 - a_1 b_0}{b_1 - a_1} + \frac{a_2 b_1}{b_1 - a_1} z_{dt} + \frac{-a_1 b_2}{b_1 - a_1} z_{st} + \omega_1$$

$$p_t = \frac{a_0 - b_0}{b_1 - a_1} + \frac{a_2}{b_1 - a_1} z_{dt} + \frac{-b_2}{b_1 - a_1} z_{st} + \omega_2$$

where, $\omega_1 = \frac{u_1 b_1 - a_1 u_2}{b_1 - a_1}$, $\omega_2 = \frac{u_1 - u_2}{b_1 - a_1}$,

Reduced form equations are as follows:

$$q_t = \pi_1 + \pi_2 z_{dt} + \pi_3 z_{st} + \omega_1 \qquad (3.9)$$

$$p_t = \pi_4 + \pi_5 z_{dt} + \pi_6 z_{st} + \omega_2 \qquad (3.10)$$

Here,

$$\pi_1 = \frac{a_0 b_1 - a_1 b_0}{b_1 - a_1}, \pi_2 = \frac{a_2 b_1}{b_1 - a_1}, \pi_3 = \frac{-a_1 b_2}{b_1 - a_1}$$

$$\pi_4 = \frac{a_0 - b_0}{b_1 - a_1}, \pi_5 = \frac{a_2}{b_1 - a_1}, \pi_6 = \frac{-b_2}{b_1 - a_1}$$

Using the selected sample data on q_t, p_t, z_{dt} and z_{st} we can apply OLS to the reduced form equations and can obtain estimates of πs. Now, substituting the πs into the system of coefficients we can arrive at

$$a_0 = \pi_4[\frac{\pi_1}{\pi_4} - \frac{\pi_2}{\pi_6}], a_1 = \frac{\pi_3}{\pi_6}, a_2 = \pi_5[\frac{\pi_2}{\pi_5} - \frac{\pi_3}{\pi_6}],\ b_0 = \pi_4[\frac{\pi_1}{\pi_4} - \frac{\pi_2}{\pi_5}], b_1 = \frac{\pi_2}{\pi_5}, b_2 = \pi_6[\frac{\pi_3}{\pi_6} - \frac{\pi_2}{\pi_5}]$$

As the equations are exactly identified therefore, there will be unique values for all above coefficients. By solving the system, structural parameters can be obtained. However, if the empirical model is over-identified, then the reduced form equations will not produce unique estimates of the coefficients.

Two Stage Least Squares: There are two stages.

Stage 1: Regress each endogenous variable $\hat{}_P$, $\hat{}_Q$ on all exogenous variables in the equation.

Stage 2: Use $\hat{}_P$ and $\hat{}_Q$ as instrumental variables.

Therefore, in these log-linear models coefficients are elasticities. And the models are following reduced form equations for obtaining consistent estimates of the parameters of demand and supply equations.

The π(s) are called reduced form parameters. The estimation of (3.9) and (3.10) by OLS will give consistent estimates of the reduced form parameters. And from these reduced form parameters consistent estimates of the parameters in equations (3.6) and (3.7) will be obtained called structural parameters as per econometric theory.

For consistency, the models are checked for the correlation of included variables with quantity demanded and supplied if they have the right sign and the matching elasticity. Commonly, price is negatively associated with demand and positively with supply. Similarly, staple-foods are less elastic as per theory. Data-admissibility requires that if the price of bread is a dependent variable then this research work has no interest in a model that is capable of predicting negative values of bread price when the explanatory variables are given plausible values.

And importantly, for the goodness of fit criterion our models contained with high R-squared. The aim of our models is to produce the main systematic parts of the required process. Therefore, Durbin-Watson statistic has been observed for the residuals not to be auto-correlating the explanatory variables. However, Durbin-h is used in cases where dependent lagged-variable appeared in the shape of an explanatory variable. Data coherency is important because our preferred models that arise out of the testing down process must always be rigorously checked for misspecification. Our models are parsimonious, as we have used only some explanatory variables to explain a complex reality of pricing the wheat at country level by running against the problem of degree of freedom.

Determinations of the regression equations (as per association and correlation of the variables with the quantity demanded and supplied) statistics are as follows:

(1) $\sigma = \left[\frac{RSS}{T-k}\right]^{1/2}$ the estimated standard error of the residual, where k = number of independent variables including the constant.

(2) SE: these are the estimated standard errors of the coefficients, calculated as the square roots of the diagonal elements of the variance-covariance matrix of the OLS estimator.

(3) T-Val.: The ratio of the estimated parameter value to its estimated SE used to test the null hypothesis that the parameter is equal to zero. Under the null hypothesis and additional assumptions about normality for the error term, the ratio has the Student-t distribution with (T – k) degree of freedom.

(4) R^2: Coefficient of determination defined as: $R^2 = 1 - \frac{\sum \hat{u}^2}{\sum (y-\bar{y})^2}$. It is model fit statistic. If we keep on adding more and more variables the RSS will reduce or remain same. Hence, R^2 in general will keep on increasing as we keep adding more and more variables.

(5) F: Statistic used for testing the null hypothesis that all the parameters in the model (without intercept) are jointly equal to zero. $F = \frac{ESS/(k-1)}{RSS/(T-k)}$

(6) DW: This is used for testing autocorrelation errors in the model, particularly first order autocorrelation. Technically, tests are conducted using the statistical tables.

(7) *Chow Test*: Model specification test on the constancy of the model's parameters over the entire sample and forecast periods. $Chow = \frac{(RSS^* - RSS)/(T^* - T)}{RSS/T-k}$ Where, RSS^* is the RSS of the estimated model using both sample and post sample data. Rejection of the null implies rejection of the model estimated over the sample and forecast period.

(8) *Model Selection Criteria*:

a. Higher R^2 or Adjusted R^2 means better fit.

b. Akaike Information Criteria (AIC): AIC is given by $e^{2k/n}$ * RSS/ n or Ln (AIC) = 2k/ n +Ln (RSS/ n). So for each extra independent variable, 2/n is added in the Ln (AIC). Lower AIC indicates better fit.

c. Schwartz Information Criteria (SIC): SIC = $n^{k/n}$ * RSS/ n or

Ln (SIC) = k/ n * Ln (n) +Ln (RSS/ n). So for each extra independent variable, Ln (n)/n is added in the Ln (AIC). Lower AIC indicates better fit. As Ln (n)/ n is bigger than 2/ n, it is clear that SIC puts harsher penalty than AIC for additional variable. AIC is harsher than Adjusted R^2 for additional variables.

Dynamisation of the demand function presents the view that past behavior affects the recent trading behavior. To express the idea that current decisions are influenced by past behavior, this research work has postulated a particular type of relationship between the past and present. The most common assumption in this respect is that current behavior depends on past levels of price and past level of income.

On the other hand, quantity supplied is positively associated with e.g. area under cultivation in the last year and current year price. Incorporating the influence of such past decisions and pattern of prices is a way for rendering it dynamic.

Another usual assumption concerning the way in which past behavior affects the present is that the more recent of past levels of price and quantity demanded (in case of demand function) have a greater influence on present consumption pattern and required level of income than remote ones. These models are a form of '*distributed lag models*'. The indispensability of a dynamic approach has long been recognized for the study of the demand of such durable commodities as wheat (Stone, 1960).

3.4.7 Difference Equations and the Cobweb Model

Economists used to study the development over time in the economic variables like price of wheat. And the behavior of relating variables of supply and demand is expressed in a system of equations. Price of wheat is not a continuous variable therefore, the equations of demand and

supply present values of variables at different points of time having difference equations. Usually, time is counted forward or backward with an initial time t = 0, observed at fixed time intervals e.g. a year.

As the time series data containing random components is dealt in econometrics by estimation of difference equations. Classical analysis of time-series is to forecast the time path of a variable. A remarkable way to explain the know-how of the traditional method is the cobweb model. This model was originally developed for explaining the instability of agricultural prices. Therefore, a simple model is as follows:

$$Q_{dt} = \alpha_0 - \alpha_1 P_t \tag{3.11}$$

$$Q_{st} = \beta_0 + \beta_1 P_{t-1} + \varepsilon_t \tag{3.12}$$

$$Q_{dt} = Q_{st} \equiv Q \tag{3.13}$$

Where: Qdt = Quantity demanded, Qst = Quantity supplied, P_t = current market price, P_{t-1} = price of previous period (year) that farmers expect to exist at time t, ε_{st} is a random supply shock with zero mean with $(\alpha_0, \alpha_1, \beta_0 \& \beta_1) > 0$ such that $\alpha_0 > \beta_0$ (i.e. equilibrium price > 0)

This model states that consumers purchase required wheat at market clearing price P_t. The farmers make their production decision on the basis of previous year's price because they do not know what will be the price at harvest time. The government anyhow, should announce the price before sowing season, with a strategic reserve for price stabilization to be maintained for emergency purposes and, this should be different from the operative stock to be used for regular issues to market during shift to new wheat policy, and a targeted food for the poor along with allocations for military etc.

Market equilibrium requires that Qs = Qd therefore, the strategic reserves (a demand side variable) is equal to the operative reserves (a supply side variable) having negligible effect. The long-run equilibrium price and quantity differs from the classical Cobweb model due to error term. If $\varepsilon_t = 0$, then price over time remain the same. In this case, long run equilibrium price will become $p = (\alpha_0 - \beta_0) / (\alpha_1+\beta_1)$. Similarly, the quantity will become

$$Q = (\alpha_1\beta_1+\beta_0\alpha_1) / (\alpha_1-\beta_1).$$

Suppose all supply shocks are zero. If formers produce more wheat keeping in mind that the previous year's price will prevail, consumers will agree to buy more at a relatively low price in the competitive environment and the condition can be

$$\beta_0 + \beta_1 P_{t-1} + \varepsilon_t = \alpha_0 - \alpha_1 P_t \rightarrow P_t = (-\beta_1 / \alpha_1) P_{t-1} + (\alpha_0 - \beta_0) / \alpha_1 - \varepsilon_t / \alpha_1 \qquad (3.14)$$

Evidently, this is a stochastic 1st order linear difference equation with constant coefficient. Now, starting with P_0 it is possible to find P_t algebraically

$P_1 = (-\beta_1 / \alpha_1) P_0 + (\alpha_0 - \beta_0) / \alpha_1$ because $\varepsilon_t = 0$

Let $a = (-\beta_1 / \alpha_1)$ and $c = (\alpha_0 - \beta_0) / \alpha_1$ then

$P_1 = a P_0 + c$

Similarly, $P_2 = (-\beta_1 / \alpha_1) [(-\beta_1 / \alpha_1) P_0 + (\alpha_0 - \beta_0) / \alpha_1] + (\alpha_0 - \beta_0) / \alpha_1$

$= (-\beta_1 / \alpha_1)^2 P_0 + (-\beta_1 / \alpha_1) (\alpha_0 - \beta_0) / \alpha_1 + (\alpha_0 - \beta_0) / \alpha_1$

$P_2 = a^2 P_0 + a c + c$

$P_3 = a^3 P_0 + a^2 c + ac + c$

$P_4 = a^4 P_0 + a^3 c + a^2 c + ac + c$

$P_5 = a^5 P_0 + a^4 c + a^3 c + a^2 c + ac + c \ldots$

$P_t = a^t P_0 + a^{(t-1)} c + a^{(t-2)} c + a^{(t-3)} c + \ldots a^{t-(t-1)} c + c$

Overall sum shows that the pattern starts with the term $a^t P_0$ and then add $a^{(t-1)} c$, $a^{(t-2)} c$, $a^{(t-3)} c, \ldots a^{t-(t-1)} c$, c results in

$$\dot{a}P_0 + \sum_{k=1}^{t}(a)^{t-k}c$$

The hypothesis now can be

$P_t = a^t P_{t-1} + c \qquad (t = 1, 2, 3, \ldots)$ (3.15)

$$\rightarrow P_t = \dot{a}P_0 + \sum_{k=1}^{t}(a)^{t-k}c$$

When $t = k\ a^{t-k} = a^0 = 1$

$$a^t P_{t-1} + c = a[a^{t-1}P_0 + \sum_{k=1}^{t-1}(a)^{t-1-k}c] + c = \dot{a}P_0 + \sum_{k=1}^{t}(a)^{t-k}c$$

$$\rightarrow c[\sum_{k=1}^{t}(a)^{t-k}] = c(a^{t-1} + a^{t-2} + \ldots + a + 1)$$

The sum for such geometric series is $= (1-a^t)/(1-a)$ for $a \neq 1$.

$P_t = a^t P_{t-1} + c \leftrightarrow a^t [P_0 - c/(1-a) + c/(1-a)\ (a \neq 1)$ (3.16)

For a = 1, we have $1+a+ \ldots + a^{t-1} = t$ and $P_t = P_0 + t\,c$.

Equilibrium Conditions and Stability

To concentrate on the stability of $P_t = a^t P_{t-1} + c$ we assume for the time being that $P_0 = c/(1-a)$ then $Pt = c/(1-a)$ for all t. In case, the system begins from the long run market equilibrium condition i. e. $x \geq 0$ then $P_{x+1} = a[c/(1-a)] + c = c/(1-a)$ similarly, $P_{x+2} = c/(1-a)$

and so on. It is therefore, concluded that if P_x ever results in c/(1-a) in the long run i. e. x then P_t will remain constant for each $t > x$.

And the constant $P^* = c / (1-a)$ (3.17)

is called stationery or equilibrium condition for $P_t = a P_{t-1} + c$ when $a \neq 1$.

Equation (3.17) permits it to rewrite equation (3.16) as

$$P_t - P^* = a (P_{t-1} - P^*) \leftrightarrow P_t - P^* = a^t (P_0 - P^*) \quad (3.18)$$

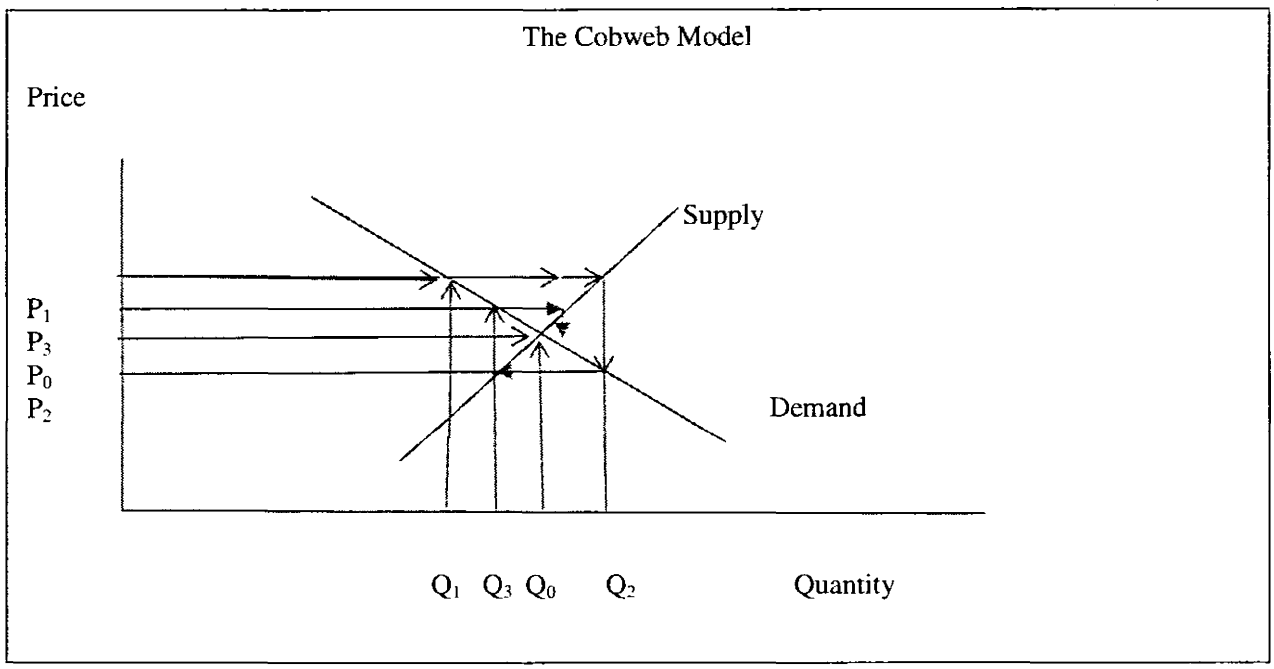
Where $P_t - P^*$ is deviation of P_t from its equilibrium value. So (3.18) show that this deviation shrinks (or grows) at a proportional constant rate (a-1). If $|a| < 1$ or $-1 < a < 1$ then $a^t \rightarrow 0$ as $t \rightarrow \infty$ therefore, (3.16) implies that $P_t \rightarrow P^* = c/(1-a)$ as $t \rightarrow \infty$.

Hence, if $|a| < 1$, the solution in (3.16) converges to the equilibrium condition when $t \rightarrow \infty$.

If $|a| > 1$, the absolute value of a^t approaches to ∞ as $t \rightarrow \infty$. From (3.16), it follows that P_t diverges from the equilibrium condition except when $P_0 = c/(1-a)$.

Convergence can be explained diagrammatically as follows:

Figure- 3.1: Convergent Case of the Cobweb Model



In the above diagram, the initial price is P_1, at this price $Q_{dt} < Q_{st}$, this surplus result into decreased price to P_2 but at P_2 level of price $Q_{dt} > Q_{st}$ (i.e. a shortage) that results into an increase in price to P_3. Again, at this price $Q_{dt} < Q_{st}$, this surplus results into a decrease of price. In this way, the price ultimately converges to equilibrium price of P_0 where, $Q_{dt} = Q_{st}$.

3.4.8 Autoregressive Distributed Lag (ARDL) Model

The simultaneous equations models (SEM) are the models which depend on theory. ARDL has the capacity to incorporate many SEM equations in it. ARDL can be simplified by imposing various restrictions and it will as a result reduce to some SEM. This is the advantage of ARDL. Our simple model for short-run wheat price in Pakistan would be relatively straight forward, using OLS. As the supply model may be in the following functional form incorporating adjustment lags in the shape that wheat firms adjust their area under cultivation partially toward their desired level anticipating increase in the price of wheat. Therefore, they have to adjust their area (A_t). But they cannot change it immediately. Let A^d be their desired area under wheat cultivation then ($A^d - A_t$) is their desired change. The actual change may be a fraction of it.

$$(A_t - A_{t-1}) = \delta ((A^d - A_{t-1}) \; [0 < \delta < 1]$$

Suppose $A^d = a_1 + a_2 P_t + \varepsilon_{at}$ $\quad [\varepsilon_{at} \sim IID(0, \sigma^2)]$ putting in the above equation we get

$$A_t = \delta a_1 + (1 - \delta) A_{t-1} + \delta a_2 P_t + \delta \varepsilon_{at} \text{ or}$$

$$A_t = \alpha_0 + \alpha_1 A_{t-1} + \alpha_2 P_t + u_{at} \text{ (Hereafter } A_t = \text{Fitted } a_t)$$

Where, $\alpha_0 = \delta a_1$, $\alpha_1 = (1 - \delta)$, $\alpha_2 = \delta a_2$, $u_{at} = \delta \varepsilon_{at}$. And $(0 < \alpha_1 < 1)$ is an additional condition for partial adjustment model. Here, the properties of ε_{at} are the same as u_{at} therefore, this partial adjustment does not change the properties of the error term. Keeping in view, how other developing countries are deciding on such issues would help the policy makers by learning from

each others experiences, the approach of Dasgupta, Dubey, & Sathish (2011) is followed to establish an ARDL model.

3.4.9 Pricing the Wheat in Pakistan and Global Competitiveness

Such a behavioral channel of transmission in the domestic markets of development countries is certainly less discussed. Theoretically, local markets have to integrate even if developing countries such as Pakistan are not integrated physically due to restrictions on trade but wheat markets are locally operating. But assimilate global markets almost instantaneously due to chances of near-riskless arbitrage transactions. Mass agricultural output however, can assure food-security and export at competitive prices. This is subject to efficient agricultural resources utilization and improvement.

3.4.10 Testing Domestic Wheat Price Formation Model

OLS will be used to estimate a reduced formation of domestic price. The stationarity and long-run cointegration of variables incorporating time-series behaviour and its drift will be tested and the results in detail will be reported in chapter 5. Cointegration tests are helpful for confirmation of main results reporting. We will report the OLS results, principally because these allow forecasting tools. Yearly prices and other data will be used with effect from 1975 to 2009.

3.4.11 Testing the Efficacy of Strategic Reserves to Help Poor and Price Stabilization

Strategic Reserves: It is already known from the data that wheat's strategic reserves are less than operative reserves, having a poor record of helping the poor and stabilizing the wheat prices. Theoretically, if the sign and direction is statistically correct, then government can be in a

position to stabilize the domestic prices, having the effect of curtailing prices by using public stocks. It would be much better that government should use strategic reserves held to counter the market. But the practice is that its influence is evidently not so significant. Therefore, releasing and buying stocks should be frequent from open market for effective price stabilization.

3.4.12 Bounds Test Approach to Cointegration in the Wheat Market of Pakistan

Along with the standard OLS approach, a newly introduced by Pesaran and Shin (1995, 1998) time-series econometrics' technique called bounds testing approach of cointegration, using Autoregressive Distributive Lags (ARDL) framework, will be used in this research work. This estimation is important to avoid possibility of spurious inference from the application of OLS to time series data, and to find existing of cointegration and long run balancing relationship among main variables that are stated in this thesis. It is also for checking the adjustment of short run dynamics towards long run equilibrium.

Stationarity of Variables

Properties of yearly time-series data will be examined. It is necessary also to check that whether given variables are stationary to avoid spurious results that can occur when R^2value become higher than the DW Value. Cointegration of the variables is necessary too for establishing long-run equilibrium relation among them. And for this purpose, checking of the order of integration among these variables is required. Variables having unit root cannot be integrated therefore, conducting Augmented Dicky Fuller (ADF) test is necessary for order of integration. Conventional time-series cointegration techniques like maximum likelihood method, The test of Engel & Granger (1987), Johnson & Juselius (1990) required the variables to be either I(0) or I(1) and that is the reason that these are not fit for small sample size. ARDL model

introduced by Pesaran and Shin (1995), Pesaran and Pesaran (1997), Pesaran and Shin (1998) and Pesaran et al. (2001) is suitable for samples of small sizes and even applicable to variables having different orders of integration namely, I(0) or I(1) or mutually cointegrated. ARDL approach can also be applied to different large samples. On the other hand, other techniques can incorporate large samples with equal degree of cointegration. For ensuring that order of variables is not integrated of 2 or more, ARDL bound test require pretesting of variables.

3.4.13 Bounds Testing Approach to Cointegration

Bounds tests approach to cointegration analysis can differentiate between regressors and regressond. The benefit of ARDL is that endogenous explanatory variables can also be estimated with bounds tests approach. At first, this approach will be used for testing the cointegration prices of domestic wheat and the relevant explanatory variables by OLS technique. Then, F- tests will be applied to the hypotheses as follows:

H_0: $\delta_1 = \ldots = \delta_i = 0$ & H_1: $\delta_1 \neq \ldots \delta_i \neq 0$.

Pesaran et al. (2001) provided two suitable sets of critical values for F-test. The critical values given are bounds for independent variables as test for cointegration with upper limit bound assuming I(1) for all regressors and similarly lower bound assuming I(0) for all regressors. In this way a band of possible variable classifications is available for all I(0), I(1) etc. If a calculated F-statistics is lying above or below this band, then null hypothesis will be rejected. This will indicate existence of cointegration on the other hand; the inference will be inconclusive if F-statistics lies within given band. Akaike Information Criteria (AIC) or Schwartz Bayesian Criteria (SBC) can be used for the derivation of short run relationship of the variables if there is a long run relation among the variables of our model.

3.4.14 Application from General to Specific

We will start with the general model. It will be suitable to start from a general ARDL model with one lag because it takes one year to enhance wheat production within Pakistan. It can be seemed that whether it fits to the data well and effectively with the variables are significant or not. The F statistics will inform that a static long run solution for the particular set of variables treated as lost variables are significant or not, so that none of these variables can be entirely excluded from the model on purely statistical grounds.

The error correction terms may indicate the adjustment pace among the variables that is at what speed the variables return back to their equilibrium representing a negative sign and remain statistically significant. A high significant term of error correction therefore, can be an additional proof for existence of a long run stable equilibrium. ARDL model may also meet the criteria for diagnostic tests OLS violations.

This study will empirically investigate long run equilibrium relationship for local market wheat price, relative price of wheat to the global one and strategic reserves of wheat. The bound testing technique to cointegration will help in confirming OLS results. This research work will be done with the view to derive a reduced-form-model for the estimation and prediction of likely local wheat flour prices, using a variety of factors. For this purpose, we collected annual data with effect from 1975 to 2009.

Keeping in view the above mentioned techniques following hypotheses are made to arrive at a competitive wheat market.

3.5 Hypothesis No. 1

Competitive prices can be ensured for all (producers and consumers) subject to market competitiveness where resources are efficient and consistent.

3.6 Hypothesis No. 2

Distinguishing the role of government set procurement price and that of market price using the cobweb model.

3.7 Hypothesis No. 3

Three possible expectations for counter-movement options and policies to respond unnecessary volatility in domestic wheat prices are

(1) Publically held reserves should be sold in open-market to counter the market price movements more powerfully.

(2) Regulate strategic reserves of wheat much more strongly to drive a better difference between government set procurement price and domestic prices alongwith some other factors.

(3) The relative price of wheat to the global price of wheat is effective.

Evidently, these three instruments, together, are in a position to play a vital role in mediating local wheat price volatility.

3.8 Application of New Version of Time Series Software

The empirical results are obtained by the use of Generalized Instrumental Variables Estimators (GIVE). It's a latest version of *PC-GIVE*, a computer package for data analysis using econometrics. It reflects the econometric methodology especially relevant to time series analysis. Hendry also described some features of this package. Using *PC-GIVE,* we introduced all the variables with lagged values. Importantly, to test how well our model predicts out of sample periods some last observations are reserved for this purpose.

CHAPTER 4 DATA ANALYSIS

4.1 Introduction

The availability of appropriate and dependable data set is important for empirical research. The availability of data creates impositions to test various economic models and their quality affects the results. For the purpose of pricing the wheat and econometric analysis, we need long series of time-series data. In order to find, the price of wheat in Pakistan over time, the appropriate economic unit would be yearly data since the emergence of Pakistan. The market to be studied is that of wheat, termed as *"staple food"* in Pakistan. A large volume of data pertaining to the production and consumption of wheat is collected and reported by the Pakistan Economic Survey (PES). Our reported supply and demand estimates will be based on annual time series data since the beginning of Pakistan. However, so far as our information is concerned, the requisite published data sets from the very beginning level in Pakistan are not available. Anyhow some information is available up to some extent but that needs further manipulation.

Therefore, the data set used in the present study covers the period with effect from 1975 to 2009 for some available variables. However, for all the variables included the estimation is made with effect from 1975-2009, out of this data set a forecast period is used with effect from 2007 to 2009. The four provinces account for principal share in population and resources of the country and therefore, provide sufficient information for our purpose.

Collection of the data on wheat market in Pakistan is from the Economic Survey issued by the Ministry of Finance, Government of Pakistan from time to time especially Supplement 2006 and Pakistan Economic Survey (PES) 2008-09.

The Statistical Supplements are updated for the entire fiscal years so it is very useful for time series analysis. Therefore, we have used this statistical data already published in the Economic Survey released every year prior to the presentation of the Federal Budget.

4.2 Construction of Data Sets

The required sets of variables used in estimation are derived from data given in the above-mentioned sources. We shall discuss the variables used in the present study in some detail as under:

4.2.1 Global Price of wheat

Average wheat farm price received in Illinois for the 1975- 2011 Calendar Year(s) is used along with various editions of Pakistan Economic Survey since 1979-2011 and supplement 2008-09 Table 8.16 for exchange rate as compared to US dollar. Using the standard weight for wheat as 60lb = 27.21 kg, conversion of Global Price (Gp) is made with the help of following formula: Global Price (Gp)[PKR/kg] = [{Gp(USD/lb)*(Exchange Rate in the particular year)} /(27.21)]. Up to the end of seventies Pakistan remained pegged with a fixed exchange rate.

4.2.2 Income

Economists used per capita income for determining the demand for food. Wheat foodstuffs were not well-thought-out products for consumers with increasing incomes. But the general growth in per capita consumption reveal some changes that included the increase in outdoor eating, the desire of consumers for more convenience and greater variety in food products. This study used tables for Series: GDP (current LCU) and Series: Population, total from WDI (2009) for calculating income.

4.2.3 Population

As annual data on population was not available up to the required period in the Pakistan Economic Survey therefore, World Bank's popular dataset named World Development Indicators dataset (WDI-2009) are used for population.

4.2.4 Improved seed

Table 2.1 (A) of Supplement 2008-09 & table 2.1 (b) of Pakistan Economic Survey 2009-10 are used.

4.2.5 Inflation/ Price hike

Following tables are used after indexation on the basis of 1976. The data up to 1981 is based on the base year (1976). Thereafter, a multiplier of 1.57 is used to streamline the base year of 1976.

A) Table 7.1 &7.1a of Supplement 2006

B) Table 7.3 of Supplement 2008-09 and

C) Table 6.1 (c) of Pakistan Economic Survey 2009-10

INDEXATION: {(Preceding year)/ (Base year)}* (Value of current year)

e.g. (value of 1981/1976) * Value of 1982 ⟶ 157.4/100*115.95= 182.50

4.2.6 Govt. procurement price

The gap between government procurement prices and global prices of the wheat is very large with effect from 1998 to 2005 due to high government procurement prices. The domestic procurement prices also remained low in comparison with government procurement prices in this

period. Table 2.16 of Supplement 2008-09 & table 2.12 (a) of Pakistan Economic Survey 2009-10 are used.

4.2.7 Use of Fertilizers

The fertilizers-off take includes total fertilizers (n+p+k) and import of fertilizers collected from the sources as follows:

1. FBS 2. N FDC

Table 2.12 of Supplement 2008-09 and table 2.9 of Pakistan Economic Survey 2009-10 are used for the estimation purpose.

4.2.8 Pesticides

The pesticides are converted into (000) tones by dividing each by 1000. Here, total import includes 181 N/Tonnes of Zinc Sulphate. We used table 2.12 of Supplement 2008-09 & table 2.9 of Pakistan Economic Survey 2009-10 in this connection.

4.2.9 Water Resources

Area irrigated by different resources is used given in Table 2.15 of Supplement 2008-09 & Table 2.11 of Pakistan Economic Survey 2008-09.

4.2.10 Production of wheat (quantity supplied)

Earlier estimates of pilferage of food grains according to a discussion paper (Bastin, Sarwar, & Kazmi, 2008) calculated as much as 15% for wheat, similar percentage is deducted for fodder and seed use of wheat as well as for processing and distribution losses. The post harvest losses were considered 20%. This study too, considered the same procedure to find the total supply of wheat flour i.e. further converting it into protein and carbohydrate enriched supply of

wheat flour. Tabulation is made in the appendix at the end. As basic data for wheat supply is derived from multiplication of acreage with area under cultivation therefore, tables 2.5 and 2.3 of supplement 2008-09 are used respectively.

4.2.11 Quantity demanded

A nutritionist's approach to the demand for wheat has been used following the protein and carbohydrate requirements. The demand for wheat is determined by multiplying the yearly population with the required protein (16 kgs/annum) and carbohydrate (14kgs/annum) from wheat in particular and then added both similar to the technique of Bastin, Sarwar, & Kazmi (2008). Table 2.4 of supplement 2006 and 2008-09 are used as basic data. Calculation of quantity demanded is tabulated in the appendix at the end.

4.2.12 Price of substitute (Rice)

Table 7.8 of Supplement 2008-09 & Pakistan Economic Survey 2009-10 are used.

4.2.13 Acreage

Table 2.5 of Supplement 2008-09 & Pakistan Economic Survey 2009-10 are used.

4.2.14 Area under cultivation

Table 2.3 of Supplement 2008-09 and Pakistan Economic Survey 2009-10 are used.

4.2.15 Transportation

Only those vehicles on the road are used that helps in carrying wheat from fields to the mills or storages. That may include motors, jeeps, taxies, tractors, trucks and others excluding

ambulances as per table 13.4 of Supplement 2008-09 & 14.4 of Pakistan Economic Survey 2009-10.

4.2.16 Information

Information play vital role in market behavior. In perfect competition it is a pre-requisite therefore, all type of communication resources (Post offices, telegraph offices, Telephones, Mobile phones, internet connections, PCOs and TV sets) are considered as per supplement 2008-09: Table 13.6 and table 14.4 of Pakistan Economic Survey 2009-10.

4.2.17 Credit Disbursed

To manage the demand for credit to be used in the agriculture sector, it is decided to provide the farmers this facility through institutions. Therefore, private banks of domestic nature, including Punjab provincial Coop. Bank Ltd., along with Zari Taraqqiati ban Limited (ZTBL) are working for the purpose of food security. Table 2.17, Table 2.11 of Supplement 2008-09 and Table 2.8 of Pakistan Economic Survey 2009-10 are used in this study.

4.2.18 Tractors

Table 2.1 (b) of Supplement 2008-09 and Table 2.1 (b) of Pakistan Economic Survey 2009-10 are used in this study.

4.2.19 Rain

Average of rainfall (millimeters) in seven major cities of Pakistan as per Table 2.20 of Supplement 2008-09 is included into thesis for analyzing rain.

4.2.20 Operative Reserves

Table 2.13 of Pakistan Economic Survey 2009-10 and table 2.17 of supplement 2008-09 are used considering the stocks as operative reserves.

4.2.21 Strategic Reserves

Table 2.13 of Pakistan Economic Survey 2009-10 and 2.17 of supplement 2008-09 are used, taking stocks as strategic reserves.

4.2.22 Price of wheat

Table 7.8 of Supplement 2008-09 & Table 6.4 of Pakistan Economic Survey 2009-10 are used for the price of wheat flour. We have just multiplied the per kg price with 1000 in order to change it into tonnes.

4.2.23 Import of wheat

Import data regarding wheat is collected from various editions of Pakistan Economic Survey (1970-2009) e.g. Table 34 pp. 70, Table 8.8 pp. 89, Table 11.9 pp. 175, Annual Report: v-1, SBP Review of the Economy 2004, pp.145, Annual Report: v-1,SBP Review of the Economy 2005-06, pp.171.

4.2.24 Export of wheat

Dummy variable for export is used as official export of wheat is almost invisible.

CHAPTER 5 EMPIRICAL ANALYSIS AND RESULTS

For the purpose of estimation this research work has applied Simultaneous Equations and Autoregressive Distributed Lag Models. Pakistan Economic Survey's published data sets are used to arrive at the specific models. Generalized Instrumental Variables Estimators (PC-GIVE 8.1) a professional computer package for data analysis in econometrics is used. It is compatible to run on IBM personal computer. It is especially designed for the analysis of time series data. This package provides a sophisticated set of descriptive and diagnostic statistics. We have however; concentrated on a small part of its potential output.

Our market model having familiarity with the assumptions of the competitive market contain the following additional assumptions:

1. No constraint imposed on the parameters of demand/ supply equations estimated below.
2. The parameters are taken as unchanged for different values of time.
3. These parameters are structurally unchanged.
4. Quantity demanded (Qd), quantity supplied (Qs) and price (p) are endogenous for SEM while, all other variables are exogenous.

5.1 Hypothesis No. 1

Competitive prices can be ensured for all (producers and consumers) subject to market competitiveness where resources are efficient and consistent. As simultaneous equations models (SEM) provide us the facility to find consistent and efficient results therefore, we arrived at a supply model using a general to specific approach. To investigate long-run relationship among the variables of interest by taking sufficient number of lag lengths supply equation becomes:

qs = 4.93 + 0.045*OR_1 + 0.10*p - 0.12*Ph_1 - 0.57*Acreage+ 0.015*Wt + 1.61*cd_1 + 0.04*tractors_1 - 0.09*Info_1
(SE) (0.363) (0.0139) (0.0224) (0.0389) (0.083) (0.00271) (0.051) (0.0103) (0.0211)

Table -5.1: Estimation of Quantity Supplied Using OLS (PC-GIVE)
The estimation sample is: 1977 – 2007

Independent Variable:	Coefficient	Standard Error	T- value	P- value	HCSE
Constant	4.935	0.363	13.600	0***	0.303
OR_1	0.045	0.014	3.230	0***	0.016
P	0.105	0.022	4.680	0***	0.030
Ph_1	-0.123	0.039	-3.160	0***	0.046
Acreage	-0.576	0.083	-6.930	0***	0.089
Wt	0.015	0.003	5.650	0***	0.003
cd_1	1.612	0.051	31.600	0***	0.062
tractors_1	0.044	0.010	4.270	0***	0.010
Info_1	-0.094	0.021	-4.470	0***	0.019

Significant at 1 %Level of Significance ***

Summary of Test Statistics

Test	F(num, denom)	Value	Probability
AR 1-2 test:	F(2,20)	0.1040	[0.9018]
ARCH 1-1 test:	F(1,20)	0.5032	[0.4863]
Normality test:	Chi^2(2)	0.7797	[0.6772]
RESET test:	F(1,21)	0.2780	[0.6036]
Hetero-X test: not enough observations			
Hetero test:	F(16,5)	0.6439	[0.7706]
1-step (ex post) forecast analysis 2008 - 2008			
Parameter constancy forecast tests:			
Forecast	Chi^2(1)	4.8787	[0.0272]**
Chow	F(1,22)	1.6259	[0.2156]

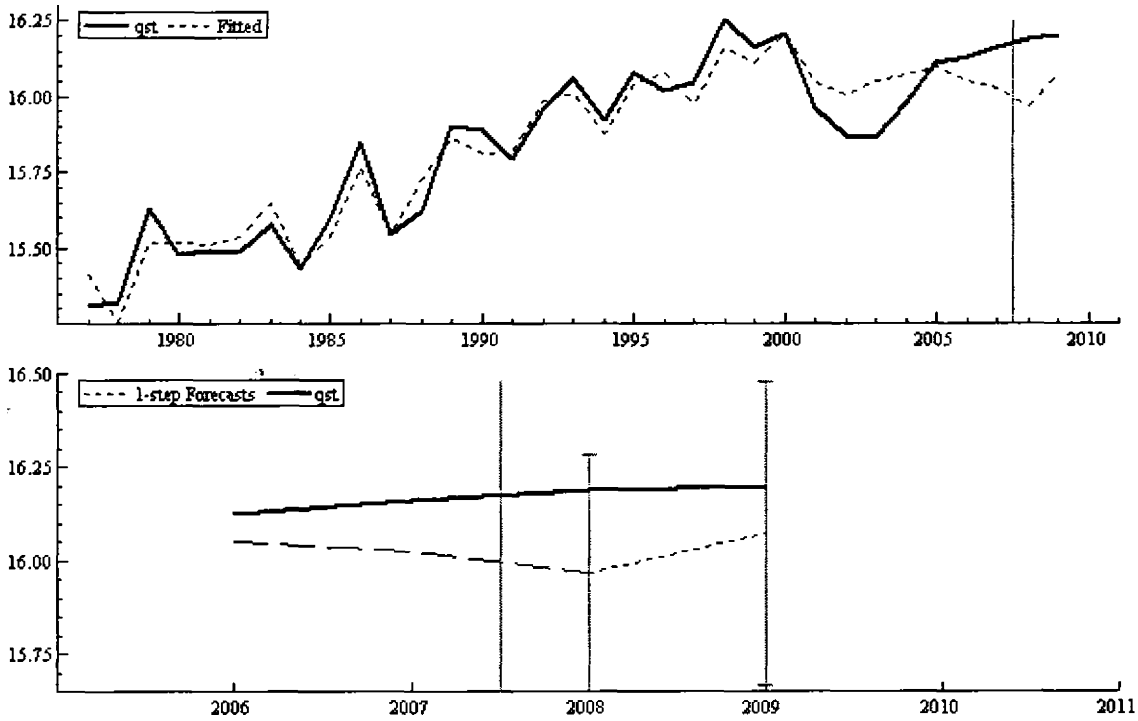
Sigma =	0.012	RSS =	0.003
R^2 =	0.9986	F(8,22) =	2022[0.000]***
Log-likelihood =	98.670	DW =	2.15
Mean(qs) =	15.828	Var(qs)=	0.0741
No. of observations =	31		
No. of parameters =	9		

The fit of the model is satisfactory as p-values are significantly high. Here, the coefficient of determination is high i.e. $R^2 = 0.99$ and Durbin Watson test statistic is satisfactory at 2.15. The traditional and heteroscedastic consistent standard errors of the estimated coefficients are not dissimilar therefore heteroscedasticity in the errors is not indicated.

The sign of market price of wheat flour, water resources, credit disbursed and tractors is as per economic theory. But, acreage, price hike, and information have signs opposite to the theory. Other statistics are given in Table 5.1. The coefficients in this log linear model are elasticities. Standard errors are low and t-values are high, indicating high level of significance.

Figure (5.1) is the graphical representation of selected supply model. This figure indicates that post sample performance of this model is a little bit satisfactory. The forecasted values are generally below the realized values and these values lie inside the confidence limits for the forecast. Here, the forecasted values are below the actual. Chow and Chi^2 Forecast reject the hypothesis of no change in the model's parameters between the sample and post sample periods.

Figure- 5.1: Graphical Representation of Selected Supply Model



Similarly, the demand equation is as follows:

qd = qd_1 + 0.0004*SR_1 + 0.002*p + 0.001*Ph - 0.003*Ps(Rice) - 0.004*Info_1 + 0.0002*Yt + 0.0001*exp_1
(SE) (0.00) (0.00) (0.00) (0.00) (0.001) (0.00) (0.00) (0.00)

The sign of strategic reserves, price of substitute, income, and export of wheat is as per economic theory. But, price and information have sign opposite to the theory. In this log linear model, the coefficients are elasticities that may be considered as less elastic, zero elastic or more elastic. The staple food has less elastic demand as per economic theory (Samuelson and Nordhaus, 2000).

Table -5.2: Estimation of Quantity Demanded Using OLS (PC-GIVE)
The estimation sample is: 1977 – 2007

Independent Variable:	Coefficient	Standard Error	T- value	P- value	HCSE
qd_1	1.003	0.000	4994	0***	0.000
SR_1	0.000	0.000	4.640	0***	0.000
P	0.003	0.001	2.710	0.01**	0.001
Ph	0.002	0.001	2.360	0.03*	0.001
Ps(Rice)	-0.004	0.001	-3.100	0.01**	0.001
Info_1	-0.004	0.000	-9.240	0***	0.001
Yt	0.000	0.000	3.050	0.01**	0.000
exp_1	0.000	0.000	5.890	0***	0.000

Significant at 1 %Level of Significance	***
Significant at 5 % Level of Significance	**
Significant at 10 % Level of Significance	*

Summary of Test Statistics

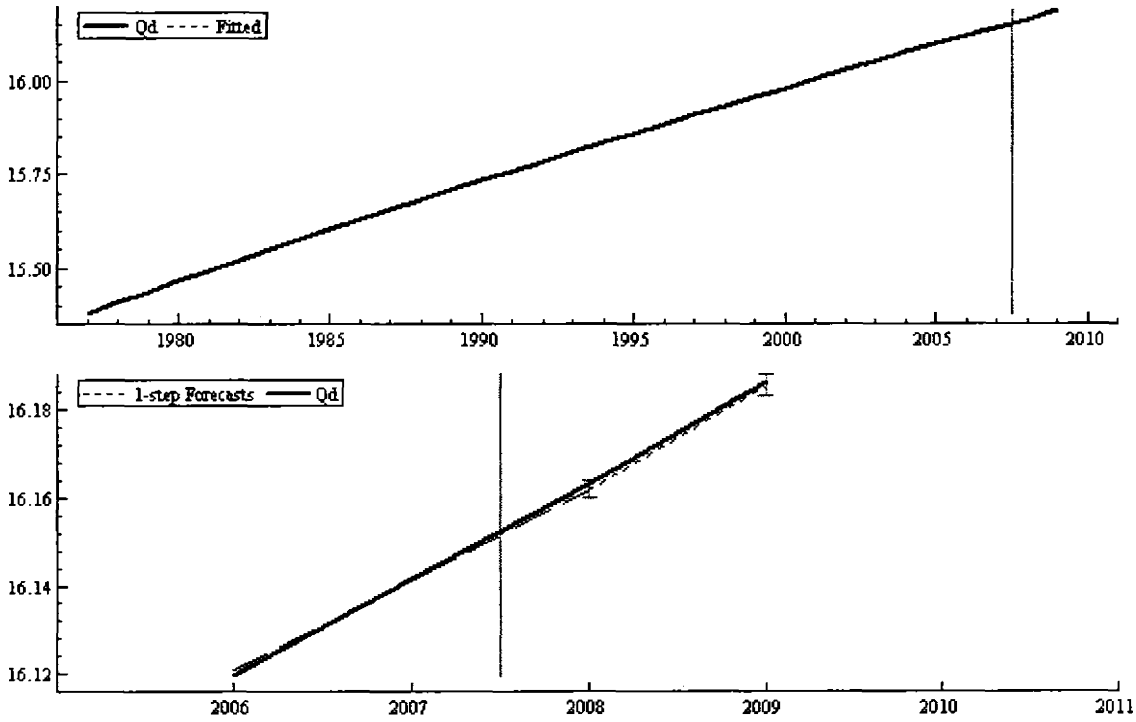
Test	F(num, denom)	Value	Probability
AR 1-2 test:	F(2,21)	3.529	[0.0477]*
ARCH 1-1 test:	F(1,21)	7.380	[0.0129]*
Normality test:	Chi^2(2)	4.361	[0.1130]
RESET test:	F(1,22)	0.246	[0.6251]
Hetero-X test: not enough observations			
Hetero test:	F(16,6)	2.061	[0.1902]
1-step (ex post) forecast analysis 2008 - 2008			
Parameter constancy forecast tests:			
Forecast	Chi^2(1)	43.197	[0.0000]***
Chow	F(1,23)	14.284	[0.0010]***

Sigma =	0.0003	RSS =	0.000
R^2=	0.999	F(7,23) =	2.188e+005 [0.000]***
Log-likelihood=	205.282	DW =	2.63
Mean(qd)=	15.770	Var(qd)=	0.0500
No. of observations=	31		
No. of parameters=	8		

The Demand Model is used for the period with effect from 1977 to 2007. Here, the coefficient of determination is high too i.e. R^2 = 0.999 and Durbin Watson test statistic is 2.63.

Other statistics are given in the table 5.2. The demand for wheat in the previous year is unit elastic. The P-value is highly significant. Standard errors are low and t-values are high, indicating high level of significance. Both the Chow and Chi^2 Forecast reject the hypothesis of no change in the model's parameters between the sample and post sample periods.

Figure- 5.2: Graphical Representation of the Selected Demand Model



When two stages least squares (2SLS) technique is employed to this system, estimates of parameters are:

qs = 0.04*OR_1 + 0.10*p - 0.12*Ph_1 - 0.57*Acreage+ 0.01*Wt + 1.61*cd_1 + 0.04*t_1 -0.09 Info_1+ 4.93
(SE) (0.0139) (0.0224) (0.0389) (0.083) (0.003) (0.051) (0.0103) (0.0211) (0.363)

qd = qd_1 + 0.0004*SR_1 + 0.002*p + 0.001*Ph - 0.003*Ps(Rice) - 0.004*Info_1 + 0.0002*Yt + 0.0001*exp_1-0.04
(SE) (0.006) (0.00) (0.001) (0.00) (0.001) (0.001) (0.00) (0.00) (-0.09)

2SLS equation for supply of wheat has all highly significant variables as reflected from P-values in Table 5.3 below. If we discuss the sign relevance and interpretation, then all variables have same behaviour as of the OLS supply model already presented in (5.1).

The 2SLS estimates of the parameters of demand for wheat with the two stage least squares method at the system above showed that strategic reserves in the previous year and income are negligible i.e. not responsive to the dependent variable. We can see that most of the variables are less elastic and this is according to the theory of demand for agriculture products. One important implication of demand model is that sign of market price is not according to the economic theory and it is insignificant even at 10% level of significance. The staple food has less elastic demand as per economic theory. *"For necessities like food, fuel, and shoes, demand tends to be inelastic. Such items are the staff of life and cannot easily be foregone when their prices rise"*. Unit elastic quantity demanded for the previous year is derived from the population in the year therefore, population is a deriving factor.

Table -5.3: Estimation of Quantity Supplied with One Lag Using 2SLS (PC-GIVE)

The estimation sample is: 1977 – 2007

Independent Variable:	Coefficient	Standard Error	T- value	P- value
OR_1	0.045	0.014	3.230	0.005
P	0.105	0.022	4.680	0.000
Ph_1	-0.123	0.039	-3.160	0.006
Acreage	-0.576	0.083	-6.930	0.000
Wt	0.015	0.003	5.650	0.000
cd_1	1.612	0.051	31.600	0.000
tractors_1	0.044	0.010	4.270	0.001
Info_1	-0.094	0.021	-4.470	0.000
Constant	4.935	0.363	13.600	0.000

Estimation of Quantity Demanded with One Lag Using 2SLS (PC-GIVE)
The estimation sample is: 1977 - 2007

Independent Variable:	Coefficient	S. Error	T- value	P- value
qd_1	1.006	0.007	148.000	0.000
SR_1	0.000	0.000	4.450	0.000
P	0.002	0.001	1.600	0.129
Phs	0.001	0.001	2.180	0.045
Ps(Rice)	-0.004	0.001	-2.980	0.009
Info_1	-0.005	0.001	-4.020	0.001
Yt	0.000	0.000	3.020	0.008
exp_1	0.000	0.000	5.480	0.000
Constant	-0.043	0.097	-0.439	0.666

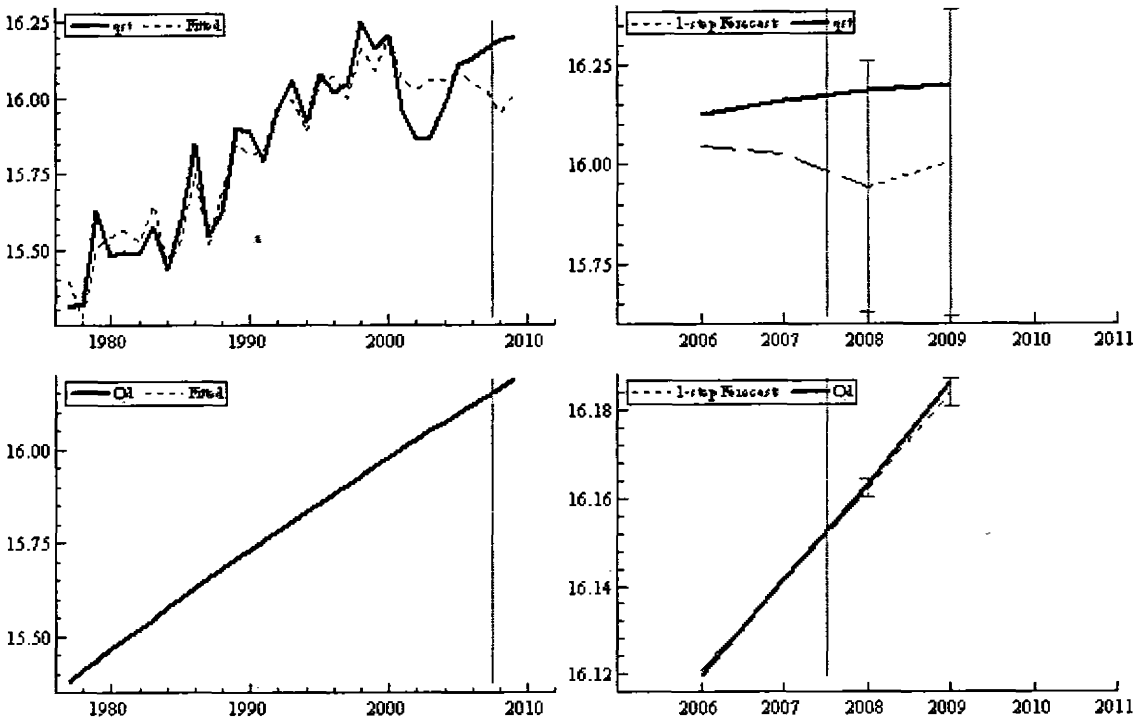
Significant at 1 %Level of Significance	***
Significant at 5 % Level of Significance	**
Significant at 10 % Level of Significance	*

Summary of Test Statistics

Test	F(num, denom)	Value	Probability
1-step (ex post) forecast analysis:		2008 - 2008	
Parameter constancy forecast tests:			
Omega	Chi^2(2)	47.552	[0.0000]
V[e]	Chi^2(2)	15.018	[0.0005]
Omega	F(2,22)	23.776	[0.0000]
V[e]	F(2,22)	7.5092	[0.0033]

Overall the simultaneous equations model presents a competitive market. The SEM model is consistent and efficient. However, the price of wheat is non-responsive in case of demand for wheat. Its coefficient is less elastic for supply also.

Figure- 5.3: Graphical Representation of 2SLS Model



Diagrams illustrate that both quantity supplied and demanded are well forecasted.

5.2 Hypothesis No. 2

Cobweb model is helpful in distinguishing the role of government set procurement price as compared to the market price.

Here: Q_d = Quantity demanded, Q_s= Quantity supplied, P_t = Market price, and P_{t-1} = Previous year's price that farmers expect to exist at time t. The farmers make their production decision on the basis of previous year's price because they do not know what will be the price at reap time. Their regression equation is given below in equation. The fit of this supply equation for the sample period (1977-2000) is satisfactory. The coefficients are statistically significant. Here, previous year market price is less elastic. The signs of variables are as per economic theory for lagged price, water availability, credit disbursed and tractors. However, the constant, acreage

and information do not reflect the true sign. The coefficient of lagged price variable reflects the true picture of this staple food i.e. supply of wheat tend to be inelastic therefore, supply changes very little in response.

qs = 4.6 + 0.035*p_1 - 0.51*Acreage + 0.013*Wt + 1.6*cd_1+ 0.04*tractors_1 - 0.12*Info_1
(SE) (0.245) (0.0104) (0.0593) (0.00237) (0.0401) (0.00774) (0.0117)

Table -5.4: Estimation of Quantity Supplied Using OLS (PC-GIVE)

The estimation sample is: 1977 – 2000

Independent Variable:	Coefficient	Standard Error	T- value	P- value	HCSE
Constant	4.664	0.245	19.000	0.000	0.140
p_1	0.035	0.010	3.390	0.000	0.008
Acreage	-0.506	0.059	-8.530	0.000	0.073
Wt	0.013	0.002	5.420	0.000	0.002
cd_1	1.589	0.040	39.600	0.000	0.056
tractors_1	0.039	0.008	5.080	0.000	0.006
Info_1	-0.121	0.012	-10.300	0.000	0.011
Significant at 1 %Level of Significance		***			

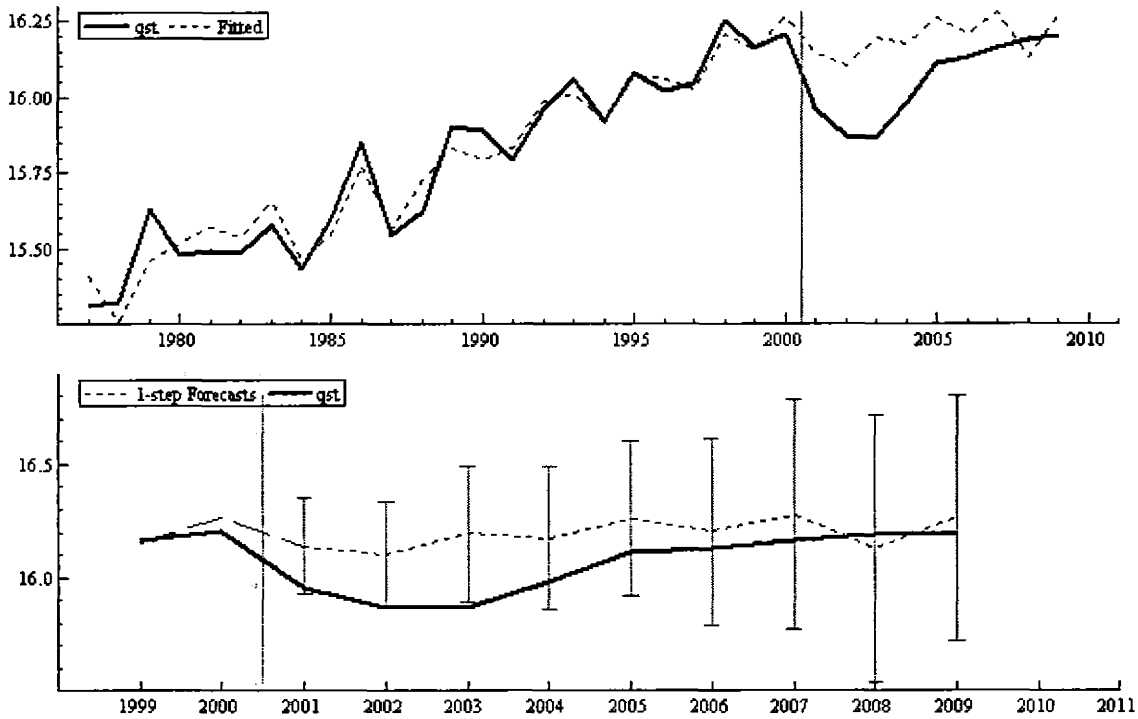
Summary of Test Statistics

Test	F(num, denom)	Value	Probability
AR 1-2 test:	F(2,15)	0.253	[0.7798]
ARCH 1-1 test:	F(1,15)	0.758	[0.3977]
Normality test:	Chi^2(2)	3.107	[0.2115]
Hetero test:	F(12,4)	0.246	[0.9739]
Hetero-X test: not enough observations			
RESET test:	F(1,16)	0.000	[0.9990]
1-step (ex post) forecast analysis 2001 - 2008			
Parameter constancy forecast tests:			
Forecast	Chi^2(8)	96.208	[0.0000]***
Chow	F(8,17)	10.031	[0.0000]***

Sigma =	0.007	RSS =	0.001
R^2=	0.9990	F(8,22) =	2022[0.000]***
Log-likelihood=	86.930	DW =	2.17
Mean(qs)=	15.770	Var(qs)=	0.0800
No. of observations=	24		
No. of parameters=	7		

The P-value is highly significant. Standard errors are low and t-values are high, indicating high level of significance. Both the Chow and Chi^2 Forecast reject the hypothesis of no change in the model's parameters between the sample and post sample periods.

Figure- 5.4: Graphical Representation of Selected Cobweb Supply Model



qd = 1.004*qd_1 + 0.003*p_1 - 0.003*Pg_1 - 0.0041*Info_1 + 0.0002*Yt_1 + 0.001*Import_1

(SE) (0.000) (0.001) (0.001) (0.0003) (0.0001) (0.0006)

The coefficient of lagged quantity demanded, lagged government set price, lagged import and per capita income are according to economic theory. The coefficient of previously available information and lagged price is opposite to the economic theory. Coefficient of lagged import and per capita income in the above equation are close to zero

and these variables can be dropped from this equation. This would imply that supply is not responsive to these variables.

The Demand Model is used for the period with effect from 1977 to 2000. Here, the coefficient of determination is high too i.e. $R^2 = 0.999$ and Durbin Watson test statistic is 1.63. Other statistics are given in the table 5.5. The demand for wheat in the previous year is unit elastic. The P-value is highly significant. Standard errors are low and t-values are high, indicating high level of significance. Both the Chow and Chi^2 Forecast reject the hypothesis of no change in the model's parameters between the sample and post sample periods.

Table -5.5: Estimation of Quantity Demanded Using OLS (PC-GIVE)
The estimation sample is: 1977 – 2000

Independent Variable:	Coefficient	Standard Error	T- value	P- value	HCSE
qd_1	1.004	0.000	3411	0.00	0.000
p_1	0.003	0.001	3.490	0.00	0.001
Pg_1	-0.003	0.001	-2.940	0.01	0.001
Info_1	-0.005	0.000	-13.700	0.00	0.000
Yt_1	0.000	0.000	2.370	0.03	0.000
Import_1	0.001	0.001	2.410	0.03	0.001

Significant at 1 %Level of Significance	***
Significant at 5 % Level of Significance	**
Significant at 10 % Level of Significance	*

Summary of Test Statistics

Test	F(num, denom)	Value	Probability
AR 1-2 test:	F(2,17)	0.373	[0.6939]
ARCH 1-1 test:	F(1,17)	0.035	[0.8531]
Normality test:	Chi^2(2)	4.392	[0.1112]
Hetero test:	F(12,6)	0.411	[0.9103]
Hetero-X test: not enough observations			
RESET test:	F(1,18)	0.0153	[0.9029]

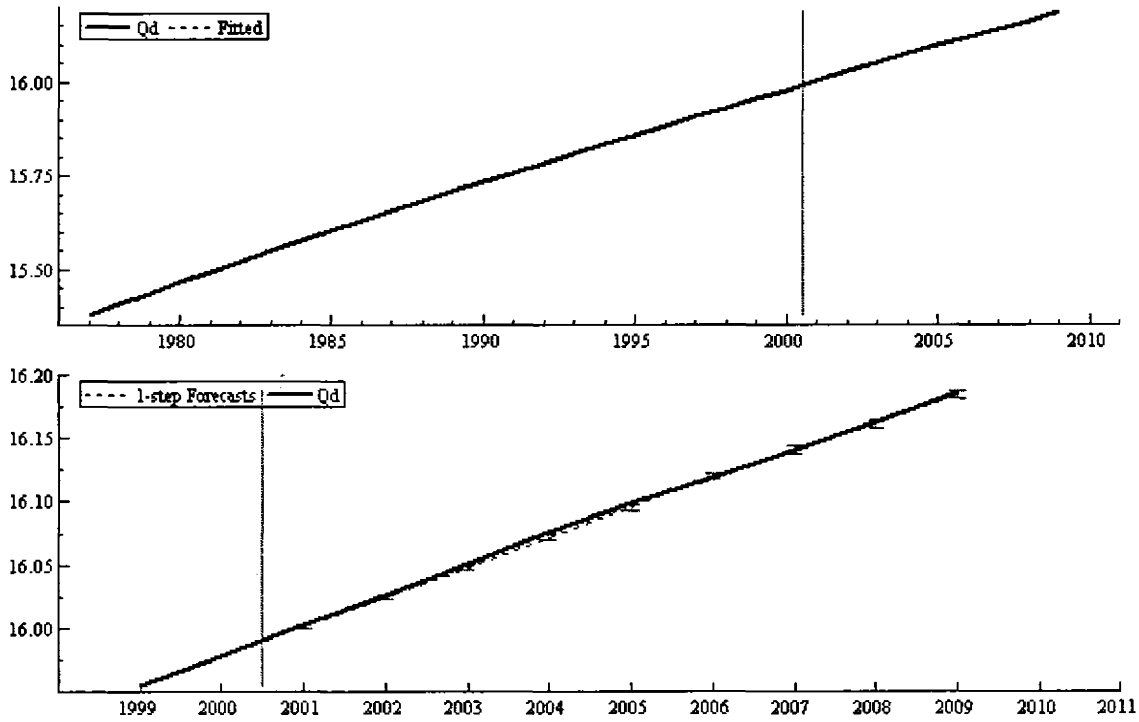
1-step (ex post) forecast analysis 2001 – 2008

Parameter constancy forecast tests:

Forecast	Chi^2(8)	238.32	[0.0000]***
Chow	F(8,19)	12.452	[0.0000]***

Sigma =	0.0003	RSS =	0.000
R^2=	0.999	F(7,23) =	2.188e+005 [0.000]***
Log-likelihood=	170.890	DW =	1.61
Mean(qd)=	15.670	Var(qd)=	0.0350
No. of observations=	25		
No. of parameters=	6		

Figure- 5.5: Graphical Representation of Selected Cobweb Demand Model



When the product is ready for sale, market equilibrium requires that the Qs = Qd. As the market is competitive therefore there is no provision for wheat storage. Therefore, as per cobweb model the farmers develop their expectations in a raw fashion on the assumption that last year's price remain unchanged being a competitive price i. e. $P_{t-1} = P_t^*$

2SLS equation for supply of wheat has all highly significant variables as reflected from P-values in the table. If we discuss the sign relevance and interpretation, then all variables have same behaviour as of the supply model already presented.

The estimates of the parameters of demand for wheat with the two stage least squares method at the system below showed that per capita income, import in the previous year and constant are negligible i.e. not responsive to the dependent variable. Import in the previous year and constant are insignificant even at 10% level of significance whereas, per capita income is insignificant at 5% level of significance. We can see that most of the variables are less elastic and this is according to the theory of demand for agriculture products. It is worthwhile to mention that lagged government set procurement price (Pg) has same coefficient in the demand model when compared to the lagged market price but with an opposite sign. Both are significant at 5% level of significance. In the cobweb model also population is a deriving factor because the unit elastic quantity demanded for the previous year is derived from the population in the year.

Table -5.6: Estimation of Quantity Supplied with One Lag Using 2SLS (PC-GIVE)
The estimation sample is: 1977 – 2000

Independent Variable:	Coefficient	Standard Error	T- value	P- value
Acreage	-0.482	0.073	-6.600	0.000
Wt	0.012	0.003	4.170	0.001
p_1	0.037	0.013	2.850	0.013
cd_1	1.574	0.049	31.800	0.000
tractors_1	0.032	0.009	3.450	0.004
Info_1	-0.123	0.015	-8.510	0.000
Constant	4.730	0.303	15.600	0.000

Estimation of Quantity Demanded with One Lag Using 2SLS (PC-GIVE)
The estimation sample is: 1977 - 2000

Independent Variable:	Coefficient	Standard Error	T- value	P- value
qd_1	1.004	0.009	116	0.000
p_1	0.003	0.001	2.850	0.013
Info_1	-0.005	0.001	-4.170	0.001
Pg_1	-0.003	0.001	-2.440	0.029
Yt_1	0.000	0.000	1.870	0.083
Import_1	0.001	0.001	1.700	0.111
Constant	-0.003	0.119	-0.030	0.900

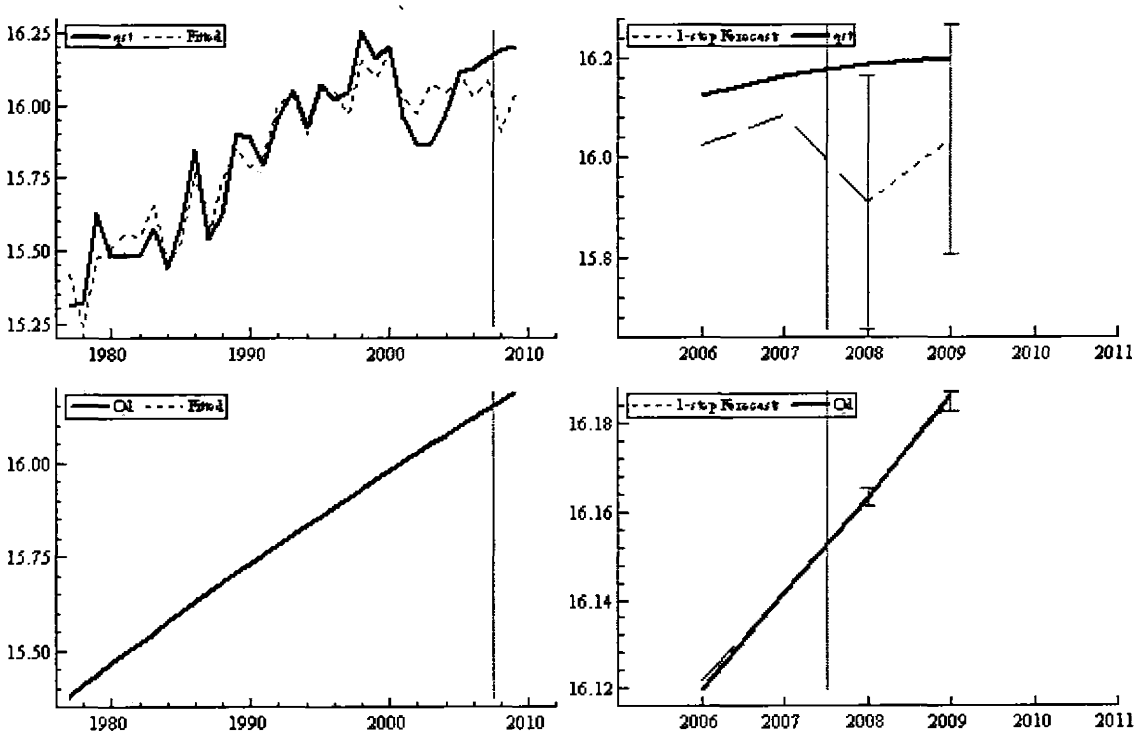
Significant at 1 %Level of Significance	***
Significant at 5 % Level of Significance	**
Significant at 10 % Level of Significance	*

Summary of Test Statistics

Test	F(num, denom)	Value	Probability
1-step (ex post) forecast analysis 2001 – 2008			
Parameter constancy forecast tests:			
Omega	Chi^2(16)	323.42	[0.0000]***
V[e]	Chi^2(16)	92.019	[0.0000]***
Omega	F(16,18)	20.214	[0.0000]***
V[e]	F(16,18)	5.7512	[0.0003]***

In the figure above, the forecast value of supply lies above the realized values in the beginning and thereafter. The fit of demand equation is also satisfactory. The forecast value of demand also lies above the realized values. Chi^2 and Chow forecast test reject the hypothesis of no change in the parameters of the model between the sample and forecast periods.

Figure- 5.6: Cobweb Equation and Its Application



5.3 Hypothesis No. 3

The research work now moved to the particular policies and specific options for countering unnecessary price volatility in domestic prices of wheat. Three possible expectations are as follows:

(1) Open-market sales of publically held reserves are expected to play an effective role than it evidently does, to counter the volatility in market price.

(2) Regulate strategic reserves of wheat much more strongly to drive a better difference between government set procurement price and domestic prices alongwith some other factors.

(3) The relative price of wheat to the global price of wheat is effective. Therefore, these three instruments, together, are in a position to play a vital role in mediating local wheat price volatility.

5.3.1 Transforming an Autoregressive Distributed Lag (ARDL) Model

The simple model for short-run wheat price in Pakistan is formed that is relatively straight forward, using OLS. As our supply model has the following functional form

The area under cultivation in the supply model:

Where, $A_t = \alpha_0 + \alpha_1 A_{t-1} + \alpha_2 P_t + u_{at}$

$\hat{A}t = 2.55 + 0.71*A_{t-1} + 0.03*P_t$

(SE) (0.721) (0.082) (0.010)

$Q_{st}=f(p, P_g, P_h, P_s, Info, T, OR, Fitted at, Acreage, F, Pest, w, C_d, I_s, t, Rain)$ (5.7)

And the demand model is of the form

$Q_{dt}=f(p, P_g, P_h, P_s, Pop, Info, T, SR)$ (5.8)

Therefore, following a general the specific approach the significant variables associated with short-run price at equilibrium level, are framed as follows:

$Pt = f(Pt-1, Gp, C)$ (5.9)

$Pt=f(Pt-1, SR-1, Ps)$ (5.10)

$Pt=f(Pt-1, SR-1, Ps, Ft)$ (5.11)

Price is determined effectively by previous year's price, current global price, strategic reserves, price of substitute (Rice), and fertilizers.

Equations (5.9) to (5.11) are reduced-form equations that have effectively summarized all of the information derived from short run price changes in the wheat markets. According to economic theory, information on demand and supply is captured in the functions of existing demand and supply, as a result, only unknown or unexpected sudden changes in tastes and/ or technology etc that would mostly be extended under demand and established technology. In short-run models, the income variable is ignored because income is unchanged. Sudden shocks in short-run demand, such as a major global wheat price hikes are factored in our reduced-form equation, if situation so changed. Anyhow, per capita income is already introduced standard term into the simultaneous equations. Similar model that is applicable to formation of domestic wheat price is expected to include influence of the following factors:

1. Global wheat prices
2. Domestic Strategic stocks in the previous year, SR-1 , (because public stocks have a replacement of private stock for poor as well as for other strategic purposes that could not be maintained in the private sector at mega level), a vector of policy interventions.
3. Price of rice, a substitute can negatively tell upon the domestic wheat price.
4. Fertilizers are playing a vital role in the global competitive environment. Thus, its impact on quality and quantity is considerable.
5. And finally, the previous year's price is core in deciding the current market price.

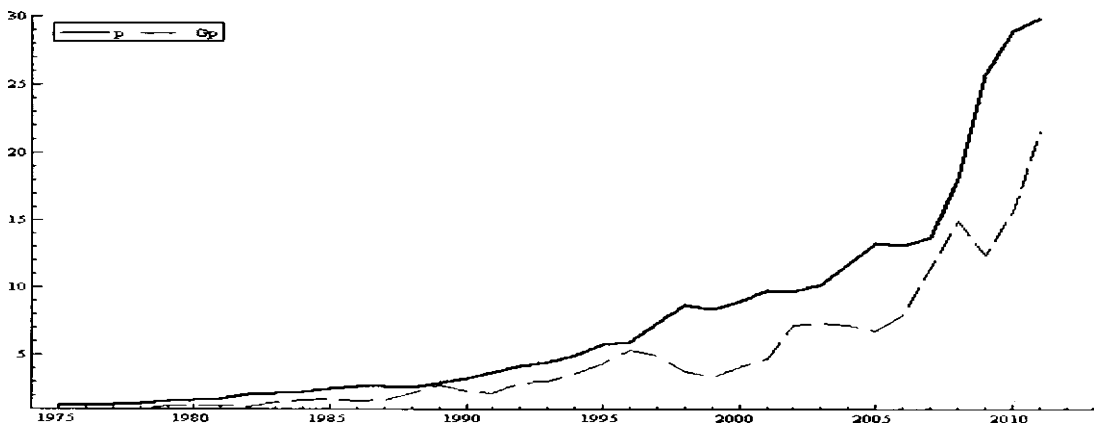
Therefore, the reduced forms domestic wheat price formations expressed in equation (5.9) to (5.11) are evidently comparable to early research e.g. Mushtaq and Dawson (2002) used the co-integration and impulse response techniques in order to quantify the only responses of acreage of wheat, rice, cotton and sugarcane in the country. In exploring the openness of trade by Noshab (2006) only quality framework has been discussed as a vital factor of success in

countries having better economic growth. It does not take quantity as a matter of concern, but the drought and flood crises in Pakistan have turned the mode of research again. Another important research contribution by Zulfiqar and Chishti (Summer, 2010) suggested the policy makers in Pakistan to allow free market to play a role by focusing the fertilizers only but do not considered the strategic reserves, price of substitute and global price along with effects of previous year's market price.

5.3.2 Pricing the Wheat in Pakistan and Global Competitiveness

After the 2008 rapid increase in global commodity prices and its transmission to domestic markets particularly in developing countries like Pakistan is important. Figure (5.7) below explains domestic as well as global price movements of wheat over time, and as global price is more stable than domestic price, especially before 1990, and thereafter unexpected similar movements of domestic wheat prices, to international trends can be observed up to 2011. However, mass agricultural output can assure agriculture surpluses for export at competitive prices along with food security that need efficient utilization and development of agricultural resources.

Figure- 5.7: Domestic and Global Wheat Price Movements during 1975 to 2011



5.3.3 Reduced Form Models

Five reduced-form equations of domestic wheat price represent the OLS estimates. The OLS results principally allow use of these as a forecasting tool as follows:

Table -5.7: Separate OLS Estimations

Model	Intercept	Gp	Ft	Ps	SR_{t-1}	P_{t-1}	Adj. R^2
M-1:coeff	-0.21***	0.21***				1.02***	0.99
M-2:coeff		-0.03		0.38***	-0.04***	0.65***	0.996
M-3:coeff			0.21**	0.26***	-0.03***	0.54***	0.997

Author's Estimates

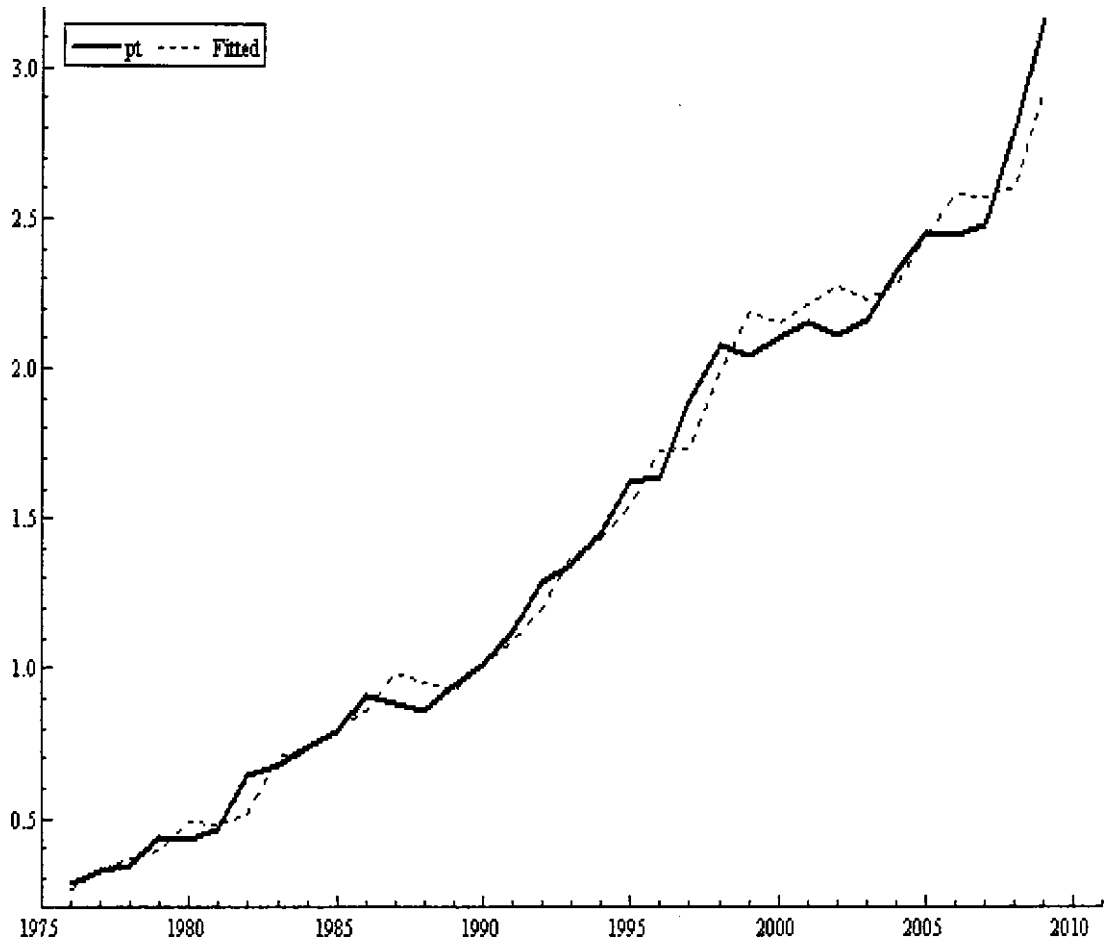
The first equation (M-1) represents just a relationship between global and domestic prices of wheat. The signs of coefficients are according to economic theory. Results show that global price of wheat(see Figure 5.8) is as expected to drive Pakistan's domestic price of wheat with a transmission coefficient of 0.21 that itself is unit elastic. Therefore, overall fit of the estimated equation in figure (5.8) is reasonable; this equation is a little bit reliable estimate because the diagnostic tests (below) also showed problems of autocorrelation above 1% level of significance.

Table -5.8 Diagnostic Statistics of ARDL Estimates (P-Value)

Test	M-1	M-2	M-3
AR 1-2 test:	[0.011]**	[0.4833]	[0.1895]
ARCH 1-1 test:	[0.2875]	[0.7760]	[0.8590]
Normality test:	[0.2682]	[0.8004]	[0.8530]
Hetero test:	[0.1140]	[0.4439]	[0.9443]
Hetero-X test:	[0.1952]	[0.4112]	[0.9435]
RESET test:	[0.6420]	[0.1308]	[0.8728]

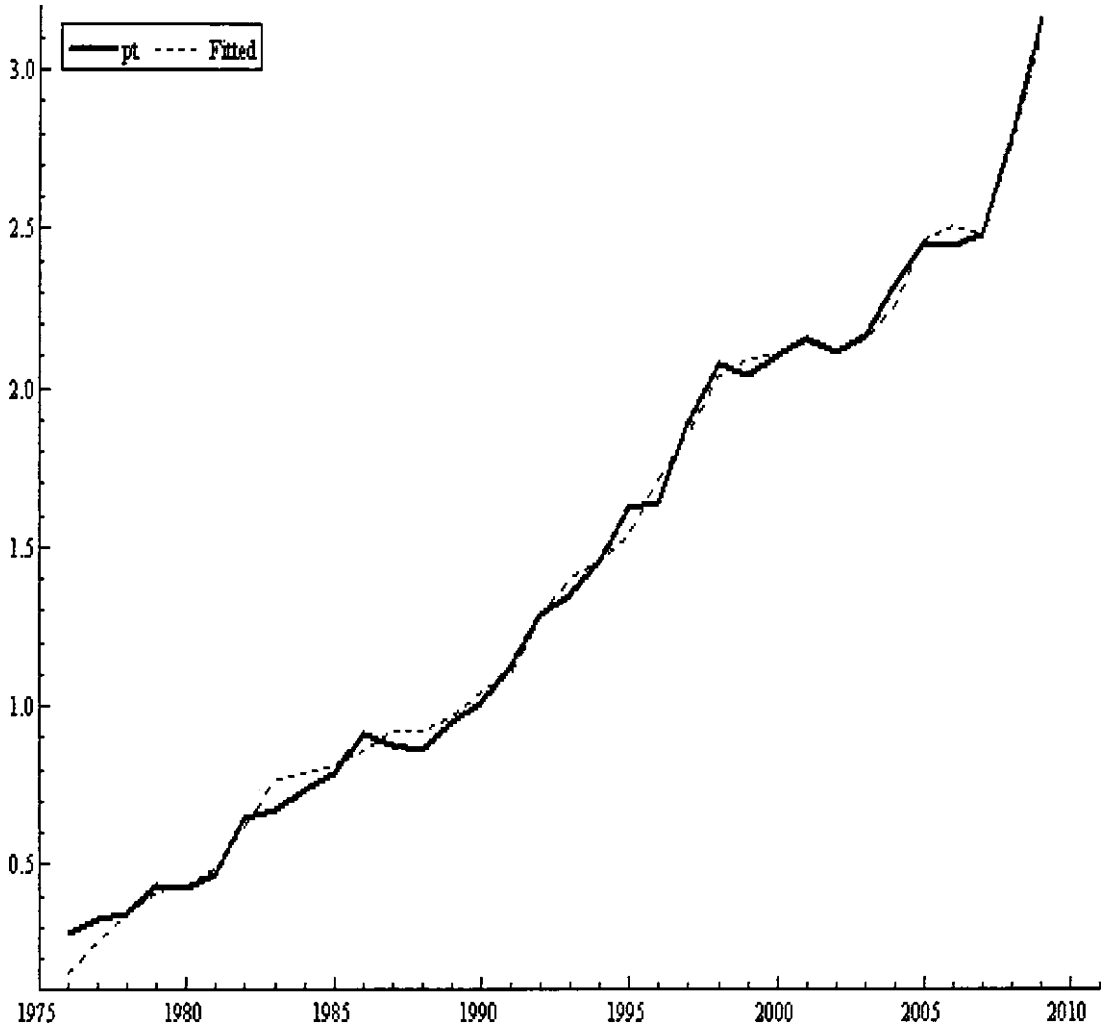
Source: Author's estimates; *** Significant at 1%; ** Significant at 5%;

Figure- 5.8: Estimated versus Actual Domestic Wheat Price: Using P_{t-1}, and Gp_{t-1}



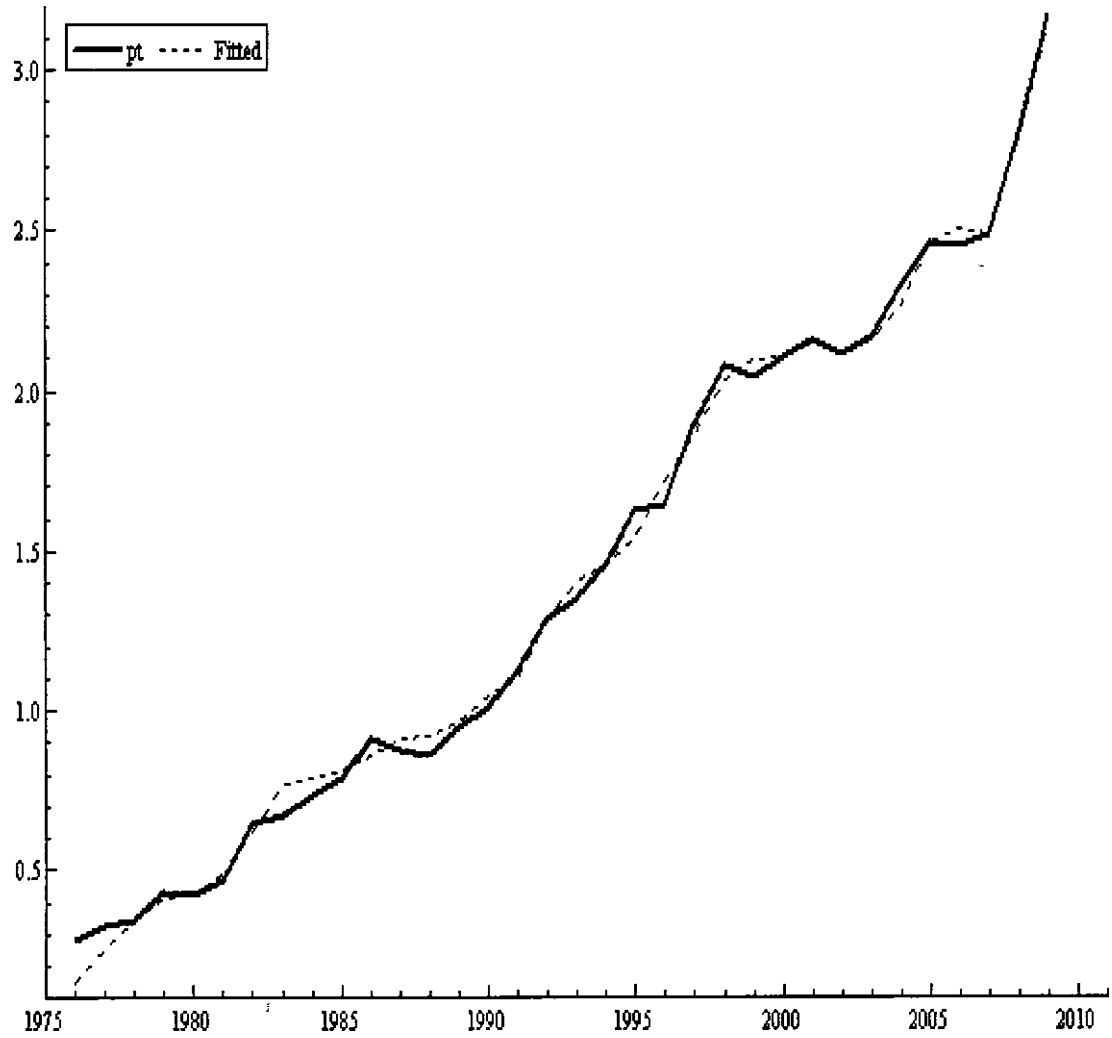
The estimated equation (M2) then along with global price adds some more variables i.e. strategic reserves and price of substitute and suggests very strongly that lagged wheat prices have increased to 0.65. Here too, unexpectedly, the price of substitute (Rice) appears to raise domestic prices a little more to 0.38. But global price is less effective. The fit improves (see Figure 5.9 below).

Figure- 5.9: Estimated vs. Actual Domestic Wheat Price: Using P_{t-1}, and Gp_{t-1} SR_{t-1} and Ps



The estimated equation (M-3) then includes another additional variable as fertilizers. This is our preferred equation to predict domestic wheat prices. The effects are consistent with the earlier summarized SEMs: except fertilizer that causes domestic wheat prices to increase. Other factors are same as discussed earlier. The fit improves (see Figure 5.10 below). There is a low quantitative effect although prices are significant.

Figure- 5.10: Estimated vs. Actual Domestic Wheat Price: Using P_{t-1}, Ps, SR_{t-1} and Fertilizers



5.3.4 Testing Effectiveness of Strategic Reserves to Help Poor and Price Stabilization

Strategic Reserves: It is already known from the data that wheat's strategic reserves holding are less than operative reserves, having a poor record of helping the poor and stabilizing the wheat prices.

5.3.5 Strategic Reserves for Protection of the Poor

If the availability of strategic reserves is not evidently exercising a clear function of price stabilization for determination of wheat wholesale domestic prices in Pakistan, as discussed earlier, then it's better to test of the efficacy of strategic reserves with the help of a parsimonious reduced-form-model as follows:

$$SR_t = \mu + \sum_{i=0}^{m} \gamma_i SR_{t-i} + \sum_{i=0}^{m} \gamma_i p_{t-i} + \sum_{j=0}^{n} \tau_j z_{t-j} + \epsilon_t \quad (5.14)$$

Where Z_t i.e. (p_s, p_h, p_g, info, SR, fitted at, fitted at-1, Ft,), ϵ_t assumed to be homoscedastic and uncorrelated.

Our specific models for strategic reserves of wheat have the following forms:

SR=f(Pt-1, Pg, Ps) (5.15)

SR=f(Pg-1, Ps, Fodder) (5.16)

SR=f(Pg-1, Ps, Fitted at) (5.17)

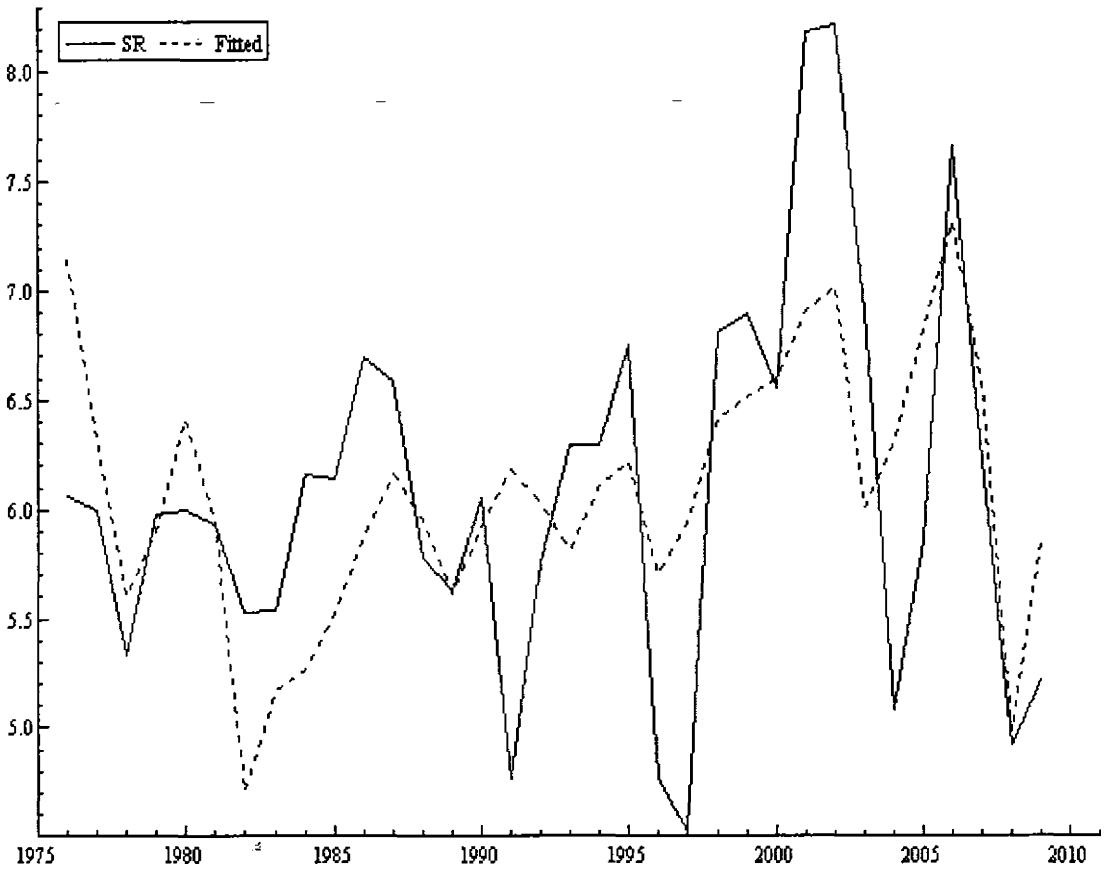
SR=f(Pg-1, Ps, Gp-1) (5.18)

SR=f(Pg-1, Ps, Rain) (5.19)

Results of the

Strategic Reserves Models: The results of this set of models 4 to 8 are shown in Table 5.10 below. Model 4 suggests overall fit as good one (adjusted R^2 was 0.41, Figure 5.11 below), while values of explanatory variables coefficients of are statistically significant at reliable levels of confidence. Strategic reserves of wheat model had significance and both carried the right signs.

Figure- 5.11: Estimated vs. Actual Strategic Reserves: Using Pg, Ps and P_{t-1}



The strategic wheat reserves for the whole sample time-period are affected by the factors of the market. This has positive as well as negative implications. On the positive side, volatility of the market price below the government set price have no impact on strategic wheat reserves because it is as expected, and it is also evident that system is protective to the poor during volatilities in the market. On the other hand, due to a pressure of cross-elasticity of substitute (Rice) possible shortage generate a further gap more than domestic market prices significantly suggesting non-market-determined strategic reserves (see the Figure 5.12 below).

Figure- 5.12: Strategic Reserves, Govt Set Price, Price of Substitute and Domestic Price

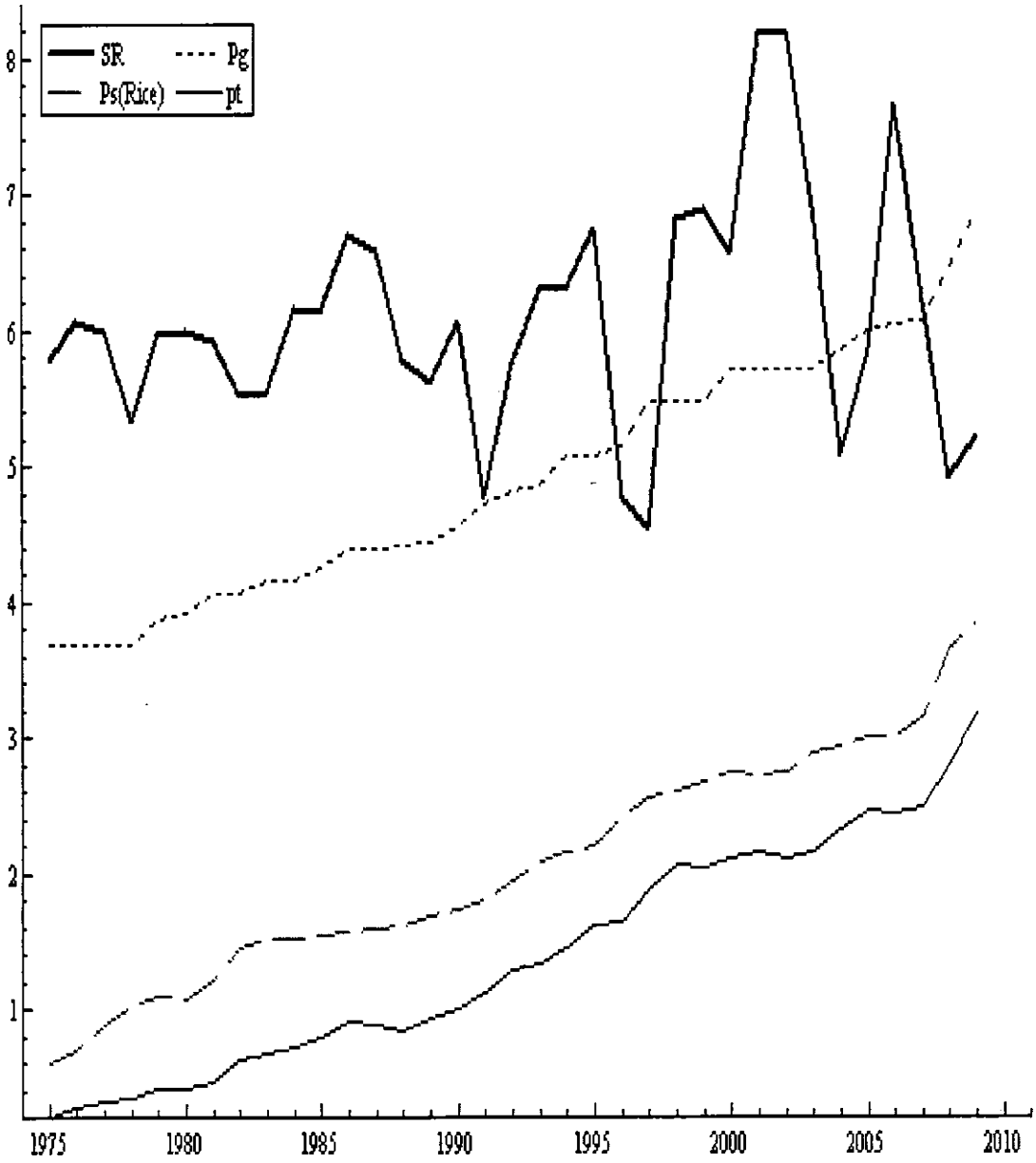


Table -5.9: Strategic Reserves affected from Other Factors

Model	Gp-1	Rain	Pg-1	Pg	Ps	Fodder	Fat	p-1	Adj R-Squared
M-4:coeff				2.79	-4.90			2.30	0.41
P-Value				0.00	0.00			0.00	
M-5:coeff			5.20		-4.90	-0.93			0.48
P-Value			0.00		0.00	0.00			
M-6:coeff			4.90		-4.80		-0.84		0.43
P-Value			0.00		0.00		0.00		
M-7:coeff	-0.84		2.80		-2.28				0.50
P-Value	0.00		0.00		0.00				
M-8:coeff		-0.77	4.47		-4.43				0.50
P-Value		0.00	0.00		0.00				

Source: Author's estimates; *** Significant at 1%; ** Significant at 5%; * Significant at 10%

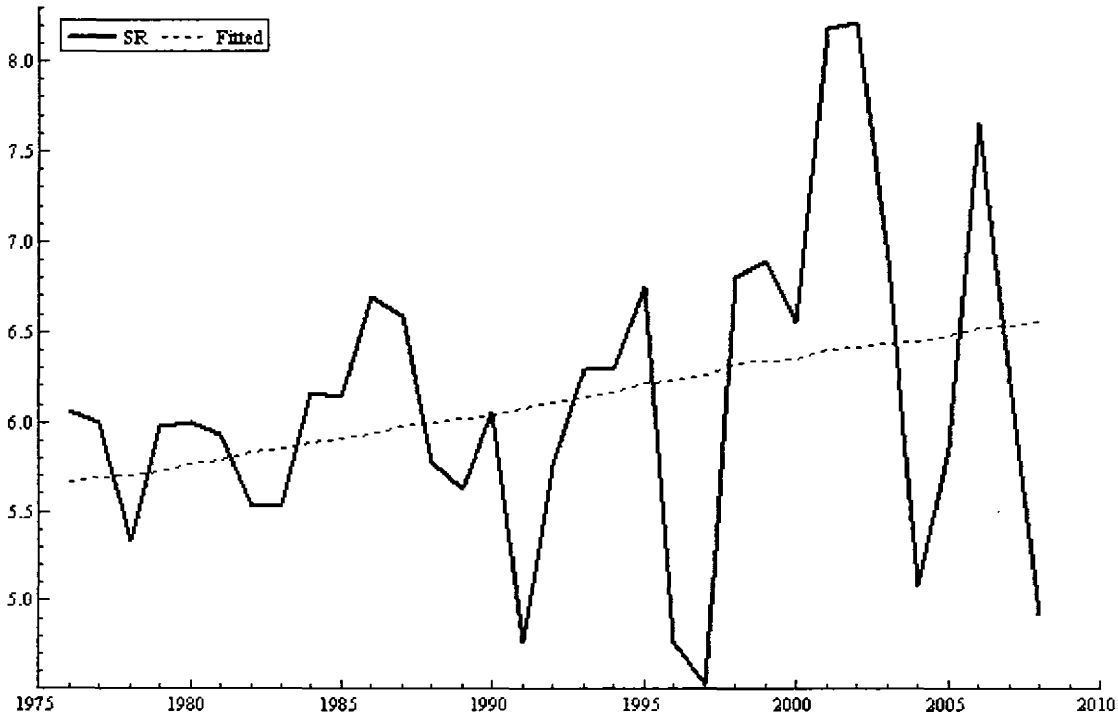
Models 5 to 8 suggest that the overall fit were good (adjusted R^2 were around 0.50), while the coefficients of explanatory variables are significant statistically at acceptable levels of confidence. Strategic reserves of wheat model had significance and both carried the right signs.

Impact of Other Factors:

If market price, government set price and price of substitute were not influencing the strategic reserves of wheat then other non-market factors can be fodder, area under cultivation, global price of previous year, and rain etc.

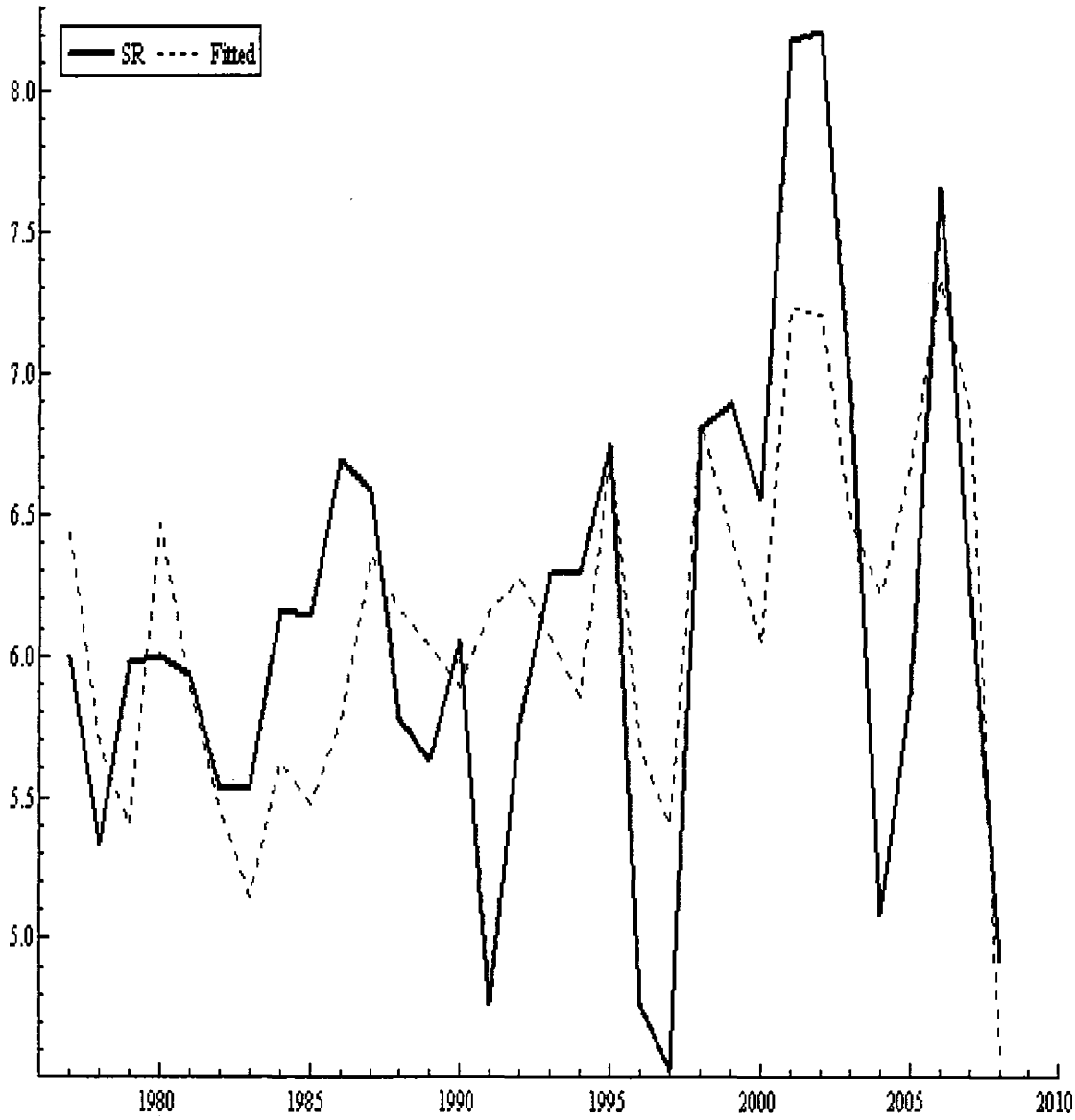
When there is almost unit elastic fodder and government set price is more than unit elastic then strategic reserves will remain lesson even there is a more elastic price of substitute prevails. This is again contrary to the economic theory (see figure 5.13 below).

Figure-5.13: Estimated vs. Actual Strategic Reserves: Using Pg and Fodder



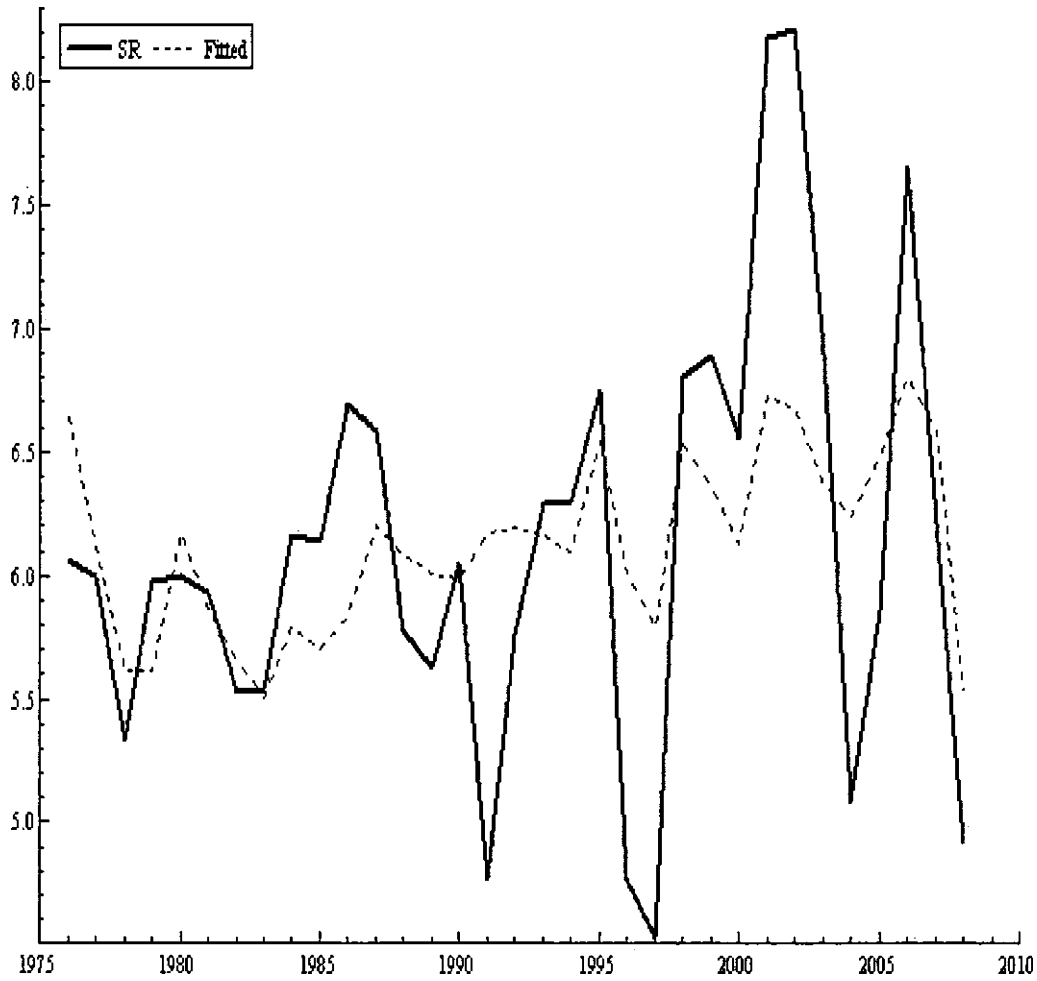
Increasing area under cultivation has a significant effect also i.e. a strong-negative but statistically significant effect is attached with the decreasing strategic reserves due to production of all cereals and cheap wheat grain availabihty as expected (see figure 5.14 below).

Figure-5.14: Estimated vs. Actual Strategic Reserves: Using Pg_{t-1}, Ps and Area



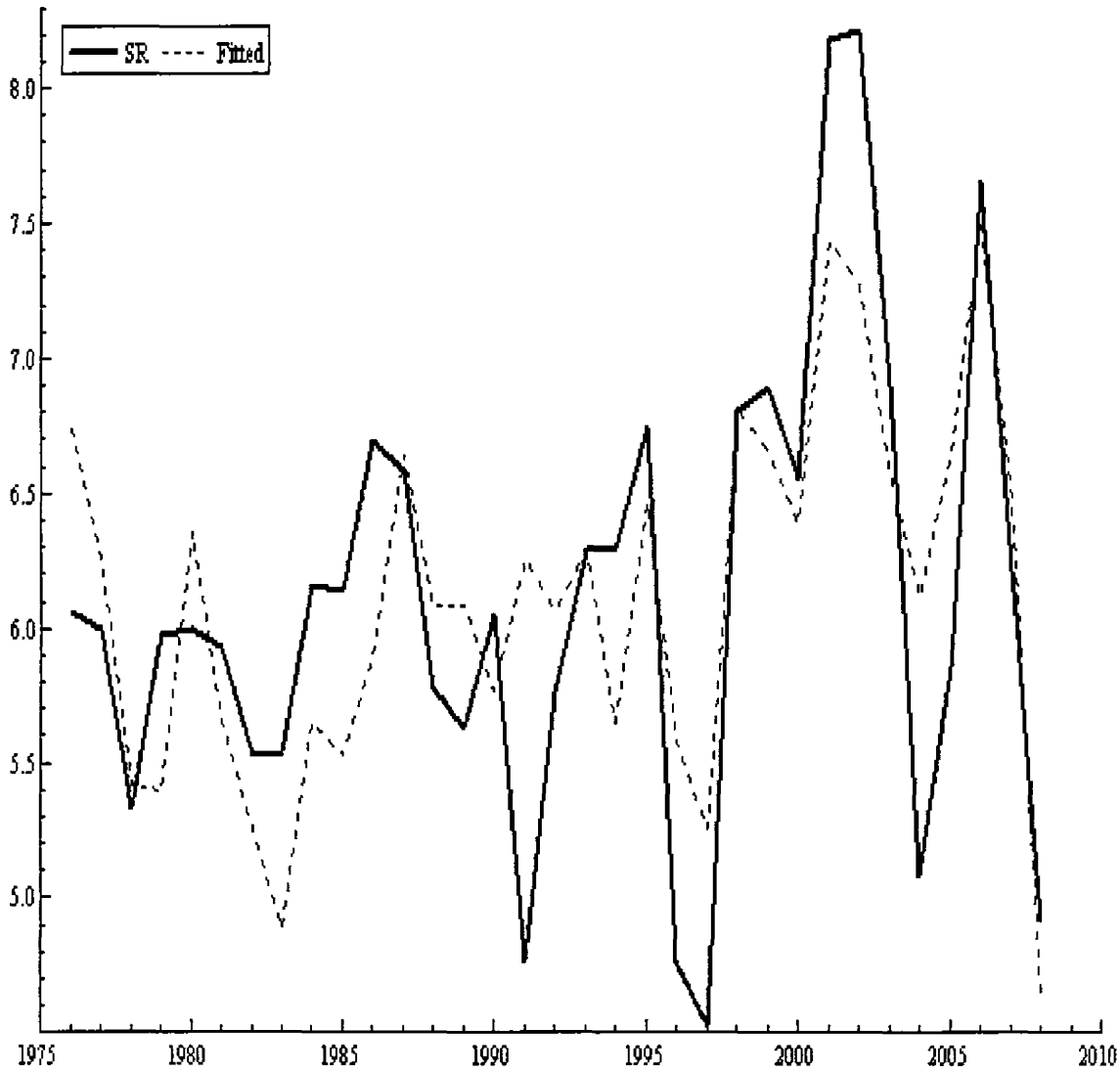
When there is almost unit elastic global price and price of substitute is more than unit elastic then reserves will remain lesson even there is a more elastic government set price prevails. This is again contrary to the economic theory (see figure 5.15 below).

Figure-5.15: Estimated vs. Actual Strategic Reserves: Using Ps, Pg_{t-1} and Gp_{t-1}



Similarly, effect of rain is significant statistically and negative because rain results in sharply higher strategic reserves, as expected.

Figure-5.16: Estimated vs. Actual Strategic Reserves: Using Ps, Pg_{t-1} and Rain



5.3.6 Bounds Test Move towards Cointegration in the Wheat Market of Pakistan

Testing Long-Run Equilibrium Relationships Existing Between:

1. ***Wheat Market Prices***, *Previous year's Wheat Prices, Previous year's Strategic Wheat Reserves, Govt set price, Price of substitute (Rice), Information, Area under cultivation and Previous year's Area under cultivation, and Global Wheat Prices.*
2. ***Strategic Reserve of Wheat,*** *Previous year's Wheat Prices, Govt set price, Price of substitute (Rice), Previous year's Import of Wheat, Fodder, Area under cultivation Previous year's Global Wheat Prices, and Rain*
3. ***Relative (Wheat Market Prices and Global Wheat Prices),*** *Information, Fitted Area under Cultivation, Strategic Reserves, Fertilizer, Previous year's Fodder, Price Hike and. Population.*

Along with the standard OLS approach, a newly introduced by Pesaran and Shin (1995, 1998) time-series econometrics' technique called bounds testing approach of cointegration, using ARDL approach, is used in the present study. This estimation is important to avoid possibility of spurious inference from the application of OLS to time series data, and to set up existing of such relationships that are balancing in the long run and cointegrated among main variables stated in this thesis. It is also for checking the adjustment of short-run-dynamics towards long-run equilibrium between the main.

5.3.7 Autoregressive Distributed Lag (ARDL) Model

A reduced-model of price is formed to estimate with the help of Ordinary Least Squares methodology of time series and its drift. Alternative model is to test the stationarity of associated variables and to set up existence of a long-run equilibrium cointegration between these variables. It is estimated and tested in the next chapter. The cointegration tests can confirm the main results in edition. We have preferred to report OLS results because it allows us to forecast. We are using yearly data for the period with effect from 1975 to 2009. The reduce form estimated equation may take a general form as follows:

$$p_t = \mu + \sum_{i=0}^{m} \gamma_i p_{t-i} + \sum_{j=0}^{n} \tau_j z_{t-j} + \epsilon_t \qquad (3.21)$$

Where Z_t i.e. (p_s, p_h, p_g, pop, T_t, Y_t, Info, strategic and operative stocks, a, acreage, f, i_s, w_t, pest, rain, t, c_d), ϵ_t assumed to be homoscedastic and uncorrelated.

Stationarity of the Variables

In this research work yearly time series data hovering over a period from 1975 to 2009 is used. Therefore, it is compulsory to examine the time series properties of variables. It is required to find the stationary of variables. ADF- test is used to check for unit root at level, and then at first differences (see table 5.10 below). It is clear from the order of variables integration that they are mixture of both I(1) and I(0).

Table-5.10: Unit Root Tests

Variables	Trend	Intercept	Level			1st Difference			Classification	
			t-Stat	Critical Value		t-Stat	Critical Value		I(0), I(I)	
				5%	1%		5%	1%	5%	1%
Gp	No	No	-3	-3.55	-4.27	-5.34	-3.56	-4.28		I(1)
OR	No	Yes	-2.31	-3.55	-4.26	-5.54	-3.55	-4.27		I(1)
Pg	No	No	-1.46	-3.55	-4.26	-4.17	-3.55	-4.27	I(1)	
Ps	No	No	-2.7	-3.55	-4.26	-4.67	-3.55	-4.27		I(1)
P	No	No	-1.6	-3.55	-4.26	-4.9	-3.55	-4.27		I(1)
Rain	No	No	-2.34	-3.55	-4.26	-4.6	-3.55	-4.27		I(1)
Import	No	Yes	-2.35	-3.55	-4.26	-5.85	-3.55	-4.27		I(1)
Ft	No	Yes	-4.05	-3.55	-4.26	-4.16	-3.56	-4.21	I(1)	
SR	No	Yes	-4.61	-3.55	-4.26	-7.25	-3.55	-4.27		I(1)
Info	Yes	Yes	-0.79	-3.55	-4.26	-3.62	-3.55	-4.27	I(1)	
Fodder	No	Yes	-4.94	-3.55	-4.27	-3.31	-3.56	-4.28		I(1)
fitted at	No	Yes	-2.75	-3.55	-4.27	-5.18	-3.56	-4.28		I(1)
p/ Gp	No	Yes	-3.03	-3.55	-4.27	-5.21	-3.55	-4.27		I(1)

ARDL bound test requires pre-testing of variables to ensure integration having order 2 or beyond to avoid a spurious result at the beginning.

5.3.8 The Bounds Testing Approach to Cointegration

This research work has employed bounds tests method to differentiate between regressors and regressond. "The advantage of the bounds tests or ARDL approach is that estimation become possible even when the explanatory variables are endogenous (Pesaran, Shin, & Smith, 2001)".

Following ARDL model (5.22) is estimated applying bounds testing procedure:

$$\Delta \ln P_t = \mu_0 + \sum_{j=0}^{r} \lambda_j \Delta \ln(P)_{t-j} + \sum_{j=0}^{r} \chi_j \Delta \ln A_{t-j} + \sum_{j=0}^{r} \gamma_j \Delta \ln Pg_{t-j} + \sum_{j=0}^{r} \psi_j \Delta \ln Ps_{t-j} + \sum_{j=0}^{r} \tau_j \Delta \ln SR_{t-j}$$
$$+ \sum_{j=0}^{r} \omega_j \Delta \ln Info_{t-j} + \sum_{j=0}^{r} \zeta_j \Delta \ln Gp_{t-j} + \delta_1 \ln(P)_{t-1} + \delta_2 \ln A_{t-1} + \delta_3 \ln Pg_{t-1} + \delta_4 \ln Ps_{t-1} + \delta_5 \ln SR_{t-1}$$
$$+ \delta_6 \ln Info_{t-1} + \delta_7 \ln Gp_{t-1} + v_t$$

where,
Pt = domestic wheat price in Pak Rs.
μ_0 = a drift component
λ, χ, ψ, τ, r, ω, ζ = Dynamic coefficients of short-run;
δs = long-run-multiplier;
ν = error of white-noise.
j = number of lags
(p_s, p_g, info, SR, At, Gp) are independent variables

Bounds tests approach to cointegration analysis makes a difference between regressors and regressond. "The benefit of bounds tests approach or ARDL is possibility of estimation for explanatory endogenous variables (Pesaran, Shin, & Smith, 2001)". At first, this approach is used for testing the cointegration relationship between domestic prices of wheat and the explanatory variables using OLS technique. Then, F- tests is applied the null hypothesis as follows:

H_0: $\delta_1 = \ldots = \delta_i = 0$ & H_1: $\delta_1 \neq \ldots \delta_i \neq 0$.

The long run coefficients are estimated using model (5.23) below:

$$\ln P_t = \mu_0 + \sum_{j=1}^{r1} \delta_1 \ln(P)_{t-1} + \sum_{j=1}^{r2} \delta_2 \ln A_{t-1} + \sum_{j=1}^{r3} \delta_3 \ln Pg_{t-1} + \sum_{j=1}^{r4} \delta_4 \ln Ps_{t-1} + \sum_{j=1}^{r5} \delta_5 \ln SR_{t-1}$$
$$+ \sum_{j=1}^{r6} \delta_6 \ln Info_{t-1} + \sum_{j=1}^{r7} \delta_7 \ln Gp_{t-1}$$

This includes selection order of the ARDL (p, r_1, r_2, r_3, r_4, r_5, r_6, r_7) model among the set of variables using Akaike Information Criteria (AIC). As it is annual data, a maximum lag-length

of 1 is taken. On existence of long-run relationship equation (5.24) is used for estimating short run dynamics of coefficients utilizing error correction model.

$$\Delta \ln P_t = \mu_0 + \sum_{j=0}^{r} \lambda_j \Delta \ln(P)_{t-j} + \sum_{j=0}^{r} \chi_j \Delta \ln A_{t-j} + \sum_{j=0}^{r} \gamma_j \Delta \ln Pg_{t-j} + \sum_{j=0}^{r} \psi_j \Delta \ln Ps_{t-j} + \sum_{j=0}^{r} \tau_j \Delta \ln SR_{t-j}$$

$$+ \sum_{j=0}^{r} \omega_j \Delta \ln Info_{t-j} + \sum_{j=0}^{r} \zeta_j \Delta \ln Gp_{t-j} + vecm + v_t$$

Here vector error correction model is term indicating speed of adjustment back to equilibrium after a short run shock. All coefficients of short run model relates to short-run-dynamic of the equation for converging to the equilibrium as the pace of its adjustment.

5.3.9 Application from General to Specific

We will start with the general models. It will be suitable to start from a general ARDL model with one lag because it takes one year to enhance wheat production within Pakistan. It can be seemed that whether it fits to the data well and effectively with the variables are significant or not. The estimates of coefficients will be reported. The results will be checked for consistency with long run unitary price elasticity. However, the joint tests on the significance for each set of variables will show that whether none of the explanatory variables can be fully eliminated. The F statistics will inform that a static long run solution for the particular set of variables treated as lost variables are significant or not, so that none of these variables can be entirely excluded from the model on purely statistical grounds.

Adopting the procedure of (Pesaran & Pesaran, 1997), OLS regressions are estimated first and thereafter for the wheat pricing models given below.

Equation (5.25): Domestic Market Wheat Prices

Model 1: P=f(Pt-1, Gp, C) (5.25a)

Model 2: P=f(Pt-1, SR-1, Ps) (5.25b)

Model 3: P=f(Pt-1, SR-1, Ps, Ft) (5.25)

Equation (5.26): Strategic Reserves for Helping Poor and Price Stabilization

Model 6: SR=f(Pt-1, Pg, Ps) (5.26a)

Model 7: SR=f(Pg-1, Ps, Import-1) (5.26b)

Model 8: SR=f(Pg-1, Ps, Fodder) (5.26c)

Model 9: SR=f(Pg-1, Ps, Fat) (5.26d)

Model 10: SR=f(Pg-1, Ps, Gp-1) (5.26e)

Equation (5.27): The Ratio of Domestic over Global Prices

Model 11: Ratio =f(SR, tt, Ft, pop, tractors, Info, Yt, Imp, Fodder, Dxp) (5.27)

The joint null hypothesis (F- statistic) test is that no long-run relationship exists between the variables against the existence of an alternative a long-run relationship. Resultant F -statistics are presented in Table (5.11) below.

Table-5.11: Bounds Tests for Cointegration

Model	Lag Length	95%		99%		Estimated F-Stat	Inference
		I(0)	I(I)	I(0)	I(I)		
Model 1	1	3.15	4.11	4.81	6.02	0.28	No cointegration
Model 2	1	3.15	4.11	4.81	6.02	278.38	Cointegration
Model 3	1	3.15	4.11	4.81	6.02	590.72	Cointegration
Model 4	1	3.15	4.11	4.81	6.02	600.5	Cointegration
Model 5	1	3.15	4.11	4.81	6.02	593.3	Cointegration
Model 6	1	3.15	4.11	4.81	6.02	577.08	Cointegration
Model 7	1	3.15	4.11	4.81	6.02	620.15	Cointegration
Model 8	0	4.2	4.2	7.17	7.17	690.7	Cointegration
Model 9	1	3.15	4.11	4.81	6.02	612.7	Cointegration

Evidently, estimated F-statistics are higher than the critical upper-bound-values at 5% level & 1 % level of significances for all Models except model 1 with either one lag or no lag(as model 8). As a result, null hypotheses of no cointegration for model 2 to 9 are rejected implying long run co-integrating relation among the domestic wheat price and other variables. This has further motivation to investigate the ratio of domestic price to global price of wheat as a dependent variable in model 10 with one lag at 1% level as well as at 5 % level.

Table-5.12: Estimated long run coefficients using the ARDL approach

Models		Constant	Gp	P	Pg	Ps(Rice)	Info	Fat	SR	Ft	Import	Fodder	Rain	Ph	pop	Yt	Dxp
M- 1(p)	**Coefficient**	10.497	-11.47														
	t-value	1.140	-1.060														
	t-prob	0.261	0.297														
M- 2(p)	**Coefficient**					0.581			-0.07	0.471							
	t-value					3.640			-3.61	3.290							
	t-prob					0.001			0.001	0.003							
M- 3(p)	**Coefficient**			2.304	2.793	-4.992											
	t-value			3.060	11.700	-5.050											
	t-prob			0.005	0.000	0.000											
M- 4(SR)	**Coefficient**				4.336	-4.148					-0.736						
	t-value				6.280	-5.890					-3.180						
	t-prob				0.000	0.000					0.004						
M- 5(SR)	**Coefficient**				5.235	-4.933					-0.933						
	t-value				5.240	-5.130					-3.080						
	t-prob				0.000	0.000					0.005						
M- 6(SR)	**Coefficient**				4.926	-4.846		-0.843									
	t-value				5.170	-4.910		-2.910									
	t-prob				0.000	0.000		0.007									
M- 7(SR)	**Coefficient**		-1.667		2.835	-2.699											
	t-value		-3.350		12.100	-8.080											
	t-prob		0.002		0.000	0.000											
M- 8(SR)	**Coefficient**				4.646	-4.680							-0.82				
	t-value				7.340	-6.670							-3.97				
	t-prob				0.000	0.000							0.000				
M- 9(p/Gp)	**Coefficient**	274.654					-2.01	4.890	0.145	1.608		33.329		-1.03	-33.01	0.132	0.416
	t-value	3.580					-5.54	3.360	5.660	6.930		6.050		-3.79	-4.890	4.700	4.340
	t-prob	0.002					0.000	0.003	0.000	0.000		0.000		0.001	0.000	0.000	0.000

Source: Author's estimates; *** Significant at 1%; ** Significant at 5%;

Keeping in view the pace of adjustment using ECM on models as below statistically significant coefficient (see P-values in the above table) with a negative sign in the models are evident that a highly-significant error-correction-term is a further strong proof for existence of a stable long run equilibrium.

ECM = p - 10.49 + 11.47*Gp (M-1)
AIC -2.86494 SC -2.77515
ECM = p - 0.58*Ps(Rice) - 0.47*Ft + 0.07*SR (M-2)
AIC -6.07088 SC -5.88949
ECM = pd - 0.700158*Ps(Rice) + 0.0854971*SR - 0.377033*Ft (M-3)
AIC -6.18499 SC -6.00177
ECM = SR - 2.3*p - 2.79*Pg + 4.99*Ps(Rice) (M-4)
AIC -0.803514 SC -0.666101
ECM = SR - 4.34*Pg + 4.15*Ps(Rice) + 0.73*Import (M-5)
AIC -0.823079 SC -0.685667
ECM = SR - 5.23*Pg + 4.93*Ps(Rice) + 0.93*Fodder (M-6)
AIC -0.807824 SC -0.670411
ECM = SR - 4.92*Pg + 4.85*Ps(Rice) + 0.84*Fat (M-7)
AIC -0.780388 SC -0.642976
ECM = SR - 2.83*Pg + 2.70*Ps(Rice) + 1.67*GP (M-8)
AIC -0.851683 SC -0.714271
ECM = SR - 4.65*Pg + 4.68*Ps(Rice) + 0.81*rain (M-9)
AIC -0.958476 SC -0.821064
ECM = Ratio - 228.29 - 0.11*SR + 0.32*tt - 0.99*Ft + 28.5*pop - 0.16*tractors + 2.42*Info - 0.15*Yt - 0.27*Imp - 33.3*Fodder - 0.41*Dxp (M-10)
AIC -4.64783 SC -4.09818

The ARDL model also qualifies diagnostic tests against auto-correlation, non-normality, heteroscedasticity and functional form misspecification, (see Table 5.17 below) except model 1 and model 7 that fail to satisfy the serial correlation and model 8 and model 9 that have misspecification problems respectively.

Table -5.17: Diagnostic Statistics of ARDL Estimates (P-Val)

Test	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8
AR 1-2 test:	[0.0088]**	[0.4833]	[0.1895]	[0.1189]	[0.0339]*	[0.1164]	[0.0950]	[0.161
ARCH 1-1 test:	[0.2875]	[0.7760]	[0.8590]	[0.8230]	[0.5910]	[0.9524]	[0.9591]	[0.958
Normality test:	[0.2682]	[0.8004]	[0.8530]	[0.2994]	[0.4598]	[0.3251]	[0.3459]	[0.098
Hetero test:	[0.1140]	[0.4439]	[0.9443]	[0.8857]	[0.3206]	[0.6772]	[0.9306]	[0.972
Hetero-X test:	[0.1952]	[0.4112]	[0.9435]	[0.9397]	[0.6406]	[0.8279]	[0.9752]	[0.916
RESET test:	[0.6420]	[0.1308]	[0.8728]	[0.1148]	[0.2713]	[0.0396]*	[0.0160]*	[0.058

Source: Author's estimates; *** Significant at 1%; * Significant at 5%;

The present study empirically investigates a long-run equilibrium relationship among domestic wheat price, relative price of wheat and strategic reserves of wheat and its determinants to supplement the OLS method used in the study; the bound test approach to cointegration confirms the results of OLS.

CHAPTER 6 SUMMARY AND CONCLUSIONS

6.1 Summary of Analysis

Perfect competition is an ideal condition. It results into efficient allocation of resources. There are so many producers of wheat and almost everybody takes it in his/ her daily meal as a staple food. Pakistan belongs to a family of top growers of it. Wheat is considered as a homogenous product in Pakistan. Keeping in view, all these circumstances this study is carried out in a way to apply the tools of demand and supply. Latest econometric techniques are utilized to arrive at a scientifically proven measure for pricing the wheat. The traditional method of simultaneous equations indicated that price of wheat is less elastic. This investigation, gives way to our opinion that it should be adjusted against international price. The models used a general to specific approach by eliminating variables that are not significant and by taking sufficient number of lag lengths in order to investigate long-run relationship among the variables of interest.

The fit of the traditional simultaneous equations models for the period with effect from 1977 to 2007 are found satisfactory as p-values are significantly high. The coefficient of determination R^2 remained high with satisfactory Durbin Watson. The traditional and heteroscedastic consistent standard errors of the estimated coefficients are not dissimilar as a result heteroscedasticity in the errors is not indicated. The sign of market price of wheat flour, water resources, credit disbursed and tractors is as per economic theory in the supply model. But, acreage, price hike, and information have sign opposite to the theory. Standard errors are found low and t-values as high, indicating high level of significance.

Graphical representations of selected models and post sample performance are also satisfactory. Mostly, the Chow and Chi^2 Forecast rejected the hypothesis of no change in the model's parameters between the sample and post sample periods. 2SLS equation for supply of wheat has all highly significant variables as reflected from P-values in the table. If we discuss the sign relevance and interpretation, then all variables have same behaviour as of the supply model.

Policy Recommendations:

The future changes of free market economy and faster globalization have further necessitated modernization of agricultural machinery through transfer of latest, efficient and cost effective technologies to the farming community. Efficient use of scarce agriculture resources and accelerated agricultural mechanization are, therefore, vital to meet the challenges of future scenario that need a comprehensive strategic loaning for future. Similarly, one of the major contributions of the institutional finance can be provision of tractors. Proper watering can enhance the wheat production. Water must be properly and equitably distributed but the purpose should be making it more productive for crops. Reliable information to measure the changes in wheat supply in response to a change in price is necessary, live communication on radio and television programs are quite useful. Government can encourage broadcasting of such programs for guidance of farmers. Although information costs and as a result there may be an increase in the price of wheat but, its benefits can overcome such costs. Controlling inflation has worked both in developed and developing countries. But it is (a means to an end) to stabilize price for stable inflation keeping it lower than the trading partners and competitors. Achieving this Pakistan will not require to depreciate the nominal exchange rate. Pakistan should have a strong agricultural policy to enhance output and improve competitiveness as it can be a key to curtail food price inflation. Economic theory states that in a competitive wheat market farmers use

prices as an important factor to find what and how much to produce. Due to agricultural nature, the response is lagged to the last year price. The greater is the supply of wheat if the price is higher. Therefore, price of wheat should be adjusted against international price.

In the demand model sign of strategic reserves, price of substitute, income, and export of wheat is as per economic theory. But, price and information have sign opposite to the theory. In this log linear model, the coefficients are elasticities that may be considered as less elastic, zero elastic or more elastic. The staple food has less elastic demand as per economic theory. The demand for wheat in the previous year is unit elastic. The 2SLS estimates of the parameters of demand for wheat with the two stage least squares method at the system above showed that strategic reserves in the previous year and income are negligible i.e. not responsive to the dependent variable. We observed that most of the variables are less elastic and this is according to the theory of demand for agriculture products. One important implication of demand model is that sign of market price is not according to the economic theory and it is insignificant even at 10% level of significance. The staple food has less elastic demand as per economic theory. *"For necessities like food, fuel, and shoes, demand tends to be inelastic. Such items are the staff of life and cannot easily be foregone when their prices rise".* Unit elastic quantity demanded for the previous year is derived from the population in the year therefore, population is a deriving factor.

Cobweb model is used to distinguish the role of government set procurement price as compared to the market price. The fit of supply equation for the sample period (1977-2000) is found satisfactory. The coefficients are statistically significant. Here, previous year market price is less elastic. The signs of variables are as per economic theory for lagged price, water availability, credit disbursed and tractors. However, the constant, acreage and information do not reflect the true sign. The coefficient of lagged price variable reflects the true picture of this staple

food i.e. supply of wheat tend to be inelastic therefore, supply changed a little in response. The P-value is highly significant. Standard errors are low and t-values are high, indicating high level of significance. Both the Chow and Chi^2 Forecast reject the hypothesis of no change in the model's parameters between the sample and post sample periods.

2SLS equation for supply of wheat has all highly significant variables have same behaviour as of the supply model already presented. The coefficient of lagged quantity demanded, lagged government set price, lagged import and per capita income are according to economic theory. The coefficient of previously available information and lagged price is opposite to the economic theory. Coefficient of lagged import and per capita income are found close to zero and therefore these variables are observed ineffective implying that supply is not responsive to these variables. Here too, the coefficient of determination is high too i.e. $R^2 = 0.999$ and Durbin Watson test statistic is found satisfactory The demand for wheat in the previous year is unit elastic as observed in the traditional simultaneous equations model. The P-value is highly significant. Standard errors are low and t-values are high, indicating high level of significance. Both the Chow and Chi^2 Forecast reject the hypothesis of no change in the model's parameters between the sample and post sample periods.

The estimates of the parameters of demand for wheat with the two stage least squares method at the system below showed that per capita income, import in the previous year and constant are negligible i.e. not responsive to the dependent variable. Import in the previous year and constant are insignificant even at 10% level of significance whereas, per capita income is insignificant at 5% level of significance. We can see that most of the variables are less elastic and this is according to the theory of demand for agriculture products. It is worthwhile to mention that lagged government set procurement price (Pg) has same coefficient in the demand

model when compared to the lagged market price but with an opposite sign. Both are significant at 5% level of significance. In the cobweb model also population is a deriving factor because the unit elastic quantity demanded for the previous year is derived from the population in the year.

The fit of demand equation is also satisfactory. The forecast value of demand also hes above the realized values. Chi^2 and Chow forecast test reject the hypothesis of no change in the parameters of the model between the sample and forecast periods.

ARDL approach aimed at deriving of a reduced model of wheat price estimate and forecast with many other factors. For such purpose, we have used yearly data for the time period with effect from 1975 to 2009. Particularly, global wheat price is expected to have a major role, and it actually happened. It is expected also that some other local factors to have some affects, e.g. strategic reserves, which can lowers market prices to some extent, and the fertilizer, is expected to raise wheat domestic market price, as it appeared to. On the other hand, government set prices also influenced the prices. Domestic lagged wheat prices also appeared to be influencing at the same pace government set prices also influenced the prices. But beyond this, area under cultivation and information too appeared to affect wheat price (with a statistically-negative-effect). As a whole, the reduced and estimated models with incorporation of all the elements are in a position to picked-up the turning-points very well, and ample to use with accuracy as a forecasting tool for the volatility of future wheat prices.

The research work thereafter moved to particular policy options to respond to the unnecessary price movements in domestic prices of wheat. Three possible proposals are as follows:

1. Publically held reserves should be sold in open-market to counter the market price movements more powerfully.
2. Regulate strategic reserves of wheat much more strongly to drive a better difference between government set procurement price and domestic prices alongwith some other factors.
3. The relative price of wheat to the global price of wheat is effective.

Evidently, these three instruments, together, are in a position to play a vital role in mediating local wheat price volatility.

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APENDICES

Appendix 1: Estimation of Fitted Area under Cultivation OLS (PC-GIVE)
The estimation sample is: 1976 – 2009

Independent Variable:	Coefficient	Standard Error	T- value	P- value
Lagged Area under cultivation(at-1)	0.713	0.082	8.690	0***
Price of Wheat (Pt)	0.026	0.010	2.490	0.018**
Constant	2.546	0.721	3.530	0***

Significant at 1 %Level of Significance	***
Significant at 5 % Level of Significance	**
Significant at 10 % Level of Significance	*

Calculation of Quantity Demanded for Wheat: (Bastin, Sarwar, & Kazmi, 2008) stated, "Pakistani consumer does not value food in the same way other consumers value it in other Asian countries." To incorporate demand as quality requirements for wheat— a cereal that is considered as a staple food this model enhanced the procedure detailed in (Bastin, Sarwar, & Kazmi, 2008) using the data from 1975 to 2009.

Calculation of Quantity Supplied of Wheat: The purpose of supply calculation is to convert wheat into a final product that can be used. Therefore, a proper chain of transforming wheat into flour is adopted following (Bastin, Sarwar, & Kazmi, 2008).

Production of wheat is a multiplicative funstion of area under cultivation and acreage (yield per acre). The chain of losses is same as explained in (Bastin, Sarwar, & Kazmi, 2008) however,we this research has extended the data from 1975 to 2009. Numeric calculations are given below:

Appendix 2: Calculation of Demand for Wheat

Year	Population	Annual protien cap (kg)	Annual protien requirements (tons)	Annual carbohydrates cap (kg)	Annual carbohydrates requirements (tons)	Total Demand (Total tons requirements)
1975	71033000	16	1136528	47	3338551	4475079
1976	73305196	16	1172883	47	3445344	4618227
1977	75626461	16	1210023	47	3554444	4764467
1978	77982330	16	1247717	47	3665170	4912887
1979	80354108	16	1285666	47	3776643	5062309
1980	82730331	16	1323685	47	3888326	5212011
1981	85096000	16	1361536	47	3999512	5361048
1982	87436140	16	1398978	47	4109499	5508477
1983	89831890	16	1437310	47	4222099	5659409
1984	92284301	16	1476549	47	4337362	5813911
1985	94794434	16	1516711	47	4455338	5972049
1986	97353884	16	1557662	47	4575633	6133295
1987	99953232	16	1599252	47	4697802	6297054
1988	102621984	16	1641952	47	4823233	6465185
1989	105269631	16	1684314	47	4947673	6631987
1990	107975060	16	1727601	47	5074828	6802429
1991	110750019	16	1772000	47	5205251	6977251
1992	113561962	16	1816991	47	5337412	7154404
1993	116444165	16	1863107	47	5472876	7335982
1994	119401847	16	1910430	47	5611887	7522316
1995	122374953	16	1957999	47	5751623	7709622
1996	125409851	16	2006558	47	5894263	7900821
1997	128457311	16	2055317	47	6037494	8092811
1998	131582000	16	2105312	47	6184354	8289666
1999	134790000	16	2156640	47	6335130	8491770
2000	138080000	16	2209280	47	6489760	8699040
2001	141450153	16	2263202	47	6648157	8911360
2002	144902409	16	2318439	47	6810413	9128852
2003	148438764	16	2375020	47	6976622	9351642
2004	152061263	16	2432980	47	7146879	9579860
2005	155772000	16	2492352	47	7321284	9813636
2006	159002039	16	2544033	47	7473096	10017128
2007	162481399	16	2599702	47	7636626	10236328
2008	166036895	16	2656590	47	7803734	10460324
2009	169940000	16	2719040	47	7987180	10706220

Appendix 3: Calculation of Quantity Supplied

Year	At	Acre-age	Output	Seed & Fodder(15%)	Farm off-Take	Post harvest losses(20%)	Domestic Supply	Import	Official Export	Black Export(15%) of Domestic Supply	Total supply	Process loss (5%)	Flour output (tons)	Distribution Chain Loss (tons)	Total Flour (tons)	Flour Protein basis (tons)	Flour Carbohy basis (tons)	Combined protein and carbohy supply
1975	5812	1320	7671840	1150776	6521064	1304213	5216851	1344000	0	782528	5778324	288916	5489407	548941	4940467	595237	3844123	4439360
1976	6111	1422	8689842	1303476	7386366	1477273	5909093	1186000	0	886364	6208729	310436	5898292	589829	5308463	639574	4130457	4770031
1977	6390	1431	9144090	1371614	7772477	1554495	6217981	499000	0	932697	5784284	289214	5495070	549507	4945563	595851	3848088	4443939
1978	6360	1316	8369760	1255464	7114296	1422859	5691437	1052000	0	853716	5889721	294486	5595235	559524	5035712	606712	3918232	4524944
1979	6687	1488	9950256	1492538	8457718	1691544	6766174	2236000	0	1014926	7987248	399362	7587886	758789	6829097	822783	5313645	6136428
1980	6924	1568	10856832	1628525	9228307	1845661	7382646	602000	0	1107397	6877249	343862	6533386	653339	5880048	708439	4575201	5283640
1981	6984	1643	11474712	1721207	9753505	1950701	7802804	305000	0	1170421	6937384	346869	6590514	659051	5931463	714634	4615206	5329840
1982	7223	1565	11303995	1695599	9608396	1921679	7686717	360000	0	1153007	6893709	344685	6549024	654902	5894121	710135	4586151	5296286
1983	7398	1678	12413844	1862077	10551767	2110353	8441414	396000	0	1266212	7571202	378560	7192642	719264	6473378	779925	5036864	5816789
1984	7343	1482	10882326	1632349	9249977	1849995	7399982	291000	0	1109997	6580984	329049	6251935	625194	5626742	677921	4378106	5056027
1985	7259	1612	11701508	1755226	9946282	1989256	7957025	980000	0	1193554	7743472	387174	7356298	735630	6620668	797671	5151469	5949140
1986	7403	1881	13925043	2088756	11836287	2367257	9469029	1909000	0	1420354	9957675	497884	9459791	945979	8513812	1025760	6624504	7650264
1987	7706	1559	12013654	1802048	10211606	2042321	8169285	378000	0	1225393	7321892	366095	6955797	695580	6260218	754243	4871007	5625250
1988	7308	1734	12672072	1900811	10771261	2154252	8617009	601000	0	1292551	7925458	396273	7529185	752918	6776266	816418	5272538	6088956
1989	7730	1865	14416450	2162468	12253983	2450797	9803186	2171000	0	1470478	10503708	525185	9978523	997852	8980670	1082008	6987761	8069769
1990	7845	1825	14317125	2147569	12169556	2433911	9735645	2047000	0	1460347	10322298	516115	9806183	980618	8825565	1063321	6867075	7930396
1991	7911	1841	14564151	2184623	12379528	2475906	9903623	972000	0	1485543	9390079	469504	8920575	892058	8028518	967291	6246901	7214193
1992	7878	1990	15677220	2351583	13325637	2665127	10660510	2018000	0	1599076	11079433	553972	10525462	1052546	9472915	1141315	7370771	8512086
1993	8300	1946	16151800	2422770	13729030	2745806	10983224	2868000	0	1647484	12203740	610187	11593553	1159355	10434198	1257132	8118735	9375867
1994	8034	1893	15208362	2281254	12927108	2585422	10341686	1902000	0	1551253	10692433	534622	10157812	1015781	9142030	1101449	7113313	8214763
1995	8170	2081	17001770	2550266	14451505	2890301	11561204	2617000	0	1734181	12444023	622201	11821822	1182182	10639640	1281884	8278587	9560471
1996	8377	2018	16904786	2535718	14369068	2873814	11495254	1968000	0	1724288	11738966	586948	11152018	1115202	10036816	1209255	7809536	9018791
1997	8109	2053	16647777	2497167	14150610	2830122	11320488	2500000	0	1698073	12122415	606121	11516294	1151629	10364665	1248755	8064632	9313387
1998	8355	2238	18698490	2804774	15893717	3178743	12714973	4088000	0	1907246	14895727	744786	14150941	1415094	12735847	1534439	9909622	11444062
1999	8230	2170	17859100	2678865	15180235	3036047	12144188	3240000	0	1821628	13562560	678128	12884432	1288443	11595989	1397107	9022711	10419818
2000	8463	2491	21081333	3162200	17919133	3583827	14335306	2006000	0	2150296	14191010	709551	13481460	1348146	12133314	1461845	9440798	10902643
2001	8181	2325	19020825	2853124	16167701	3233540	12934161	80000	0	1940124	11074037	553702	10520335	1052034	9468302	1140759	7367181	8507941
2002	8057	2262	18224934	2733740	15491194	3098239	12392955	267000	648649	1858943	10152363	507618	9644745	964474	8680270	1045816	6754023	7799839
2003	8034	2388	19185192	2877779	16307413	3261483	13045931	148000	1140351	1956890	10096690	504834	9591855	959186	8632670	1040081	6716986	7757066
2004	8216	2373	19496568	2924485	16572083	3314417	13257666	108000	42857	1988650	11334159	566708	10767451	1076745	9690706	1167555	7540232	8707787
2005	8358	2586	21613788	3242068	18371720	3674344	14697376	427000	0	2204606	12919769	645988	12273781	1227378	11046403	1330892	8595085	9925977
2006	8448	2519	21280512	3192077	18088435	3617687	14470748	816000	0	2170612	13116136	655807	12460329	1246033	11214296	1351120	8725721	10076841
2007	8578	2716	23297848	3494677	19803171	3960634	15842537	136000	0	2376380	13602156	680108	12922048	1292205	11629844	1401186	9049053	10450239
2008	8550	2451	20956050	3143408	17812643	3562529	14250114	1820000	0	2137517	13932597	696630	13235967	1323597	11912370	1435225	9268884	10704110
2009	9046	2657	24035222	3605283	20429939	4085988	16343951	236600	0	2451593	14128958	706448	13422510	1342251	12080259	1455453	9399517	10854970

Source: Author's Estimates