Pakistan Journal of Applied Economics: Special Issue 2018, (1-25)

WELFARE IMPLICATIONS OF ALTERNATIVE POLICY OPTIONS: Analysis of Wheat Market in Pakistan

Momena Abdur REHMAN,* Khalid MUSHTAQ, ABEDULLAH,*** and Faisal ABBAS******

Abstract

The objective of this study is to analyze the impact of alternative food policy options adopted in wheat sector in Pakistan, on the welfare of consumers, producers, government revenue, and foreign exchange requirements. In order to estimate the consumer and producer surpluses/losses, it requires supply and demand elasticities of wheat and demand elasticity of fertilizer. These elasticities were calculated by estimating supply and demand functions of wheat and demand function of fertilizer using co-integration and error correction techniques. However, partial equilibrium model has been used for welfare policy analysis which indicates that input subsidy gives net return to the society, while import and price support generates net losses. Combined policy option generates the highest net return to the society when input subsidy and price support are combined in the ratio of 90 and 10 per cent, respectively. Such comparison would help the policy makers in making optimal allocations of scarce resources.

Key Words: Wheat Market, Welfare Analysis, Fertilizer Subsidy, Wheat Support Price, Wheat Import Subsidy, Co-integration Analysis, Consumer Surplus, Producer Surplus, Partial Equilibrium, Time Series, Pakistan.
JEL Classification: P16, Q11, Q18.

I. Introduction

In Pakistan, wheat support price policy is designed to protect interest of both the consumers and producers. On production side, the policy objective is to increase productivity and output, as well as to improve income of the farmers. On consumption side, policies were aimed at ensuring availability of wheat-flour at affordable price and maintaining price stability [Khan and Qasim (1996)]. Short-run policy

* Lecturer, Department of Economics, Government College Women University, Faisalabad, **Associate Professor, Institute of Agricultural and Resource Economics, University of Agriculture Faisalabad, ***Chief of Research, and Head, Department of Environmental Economics, Pakistan Institute of Development Economics, Islamabad, ****Visiting Research Fellow, Research Center of Poverty, Equity and Growth, Department of Economics, University of Gottingen, Gottingen, Germany.

instruments used by the government are public sector procurement at support price and sale to mills at release price and, the government imports and maintenance of security stocks. This results in significant cost to government exchequer due to marketing and storage of wheat by the public sector [Government of Pakistan {GOP} (2013). Over the years, Pakistan government has also tried to keep price of wheat below the international levels through subsidy on imported wheat in order to subsidize the domestic consumers. The cost incurred by the government on wheat procurement and import subsidy, are further increased by input subsidies to wheat producers. Wheat in Pakistan has a comparative advantage at export parity price. Higher cost of production and higher marketing costs (due to high transportation charges) result in inability of farmers to compete in the world market. On import parity price, Pakistan has comparative advantage in producing wheat. In this context input subsidies and support prices are helpful in making domestic producers competitive in the world market [Anwar, et al. (2005)].

1. A Snap Shot of Wheat Support Policies

Since independence of Pakistan till early 80's the government intervened in the wheat market rigorously by imposing taxes on producers and subsidizing consumers. Until 1987, the government maintained a ration system to distribute wheat to millers at fixed price and flour to the licensed ration shops only. However, in 1987, the ration system was abolished because it did not fulfill its objective of helping poor people. In late 80's, informal restrictions were imposed on quantity of wheat to be released and the number of worked milling hours per day, to maintain low prices [Ender, et al. 1992)]. From late 1980s to 2002, the government took several initiatives to liberalize wheat markets. However, from 2001-02 to 2003-04, crop shortfall led to increase market prices and lower the quantities of procurement. The Federal and Punjab province governments, designed many wheat policies to increase supplies and increase the government stocks, and to stabilize the prices; for example, government imported wheat and sold it at subsidized prices, placed restrictions on inter-provincial transport of wheat (and inter-district transport of wheat in Punjab). Furthermore, for 2004-05, the government increased the procurement price of crop to Rs.400.40 per kg. In the face of good wheat harvest in 2005, transport restriction of wheat was removed and the private sector commercial wheat import was also encouraged [Dorosh and Salam (2008)]. Comparison of domestic and international prices showed that to assure wheat supply in the country there were two distinct periods with respect to government policies. In the first period (until 1971), the prices were kept higher than the international market prices, after converting the latter at wholesale level. Since 1972, it has turned the other way around (Table 1). There seemed to be two objectives of the government food policies during the decades of 70s and 80s: first, to keep the domestic wheat price low

for benefit of the urban and rural poor, and second to discourage private sector involvement in the wheat sector [Abedullah and Ali (2001)]. Government involvement in marketing was operated through a ration-shop network and public sector's flour mills were nationalized; and during mid-seventies there was a direct involvement of the Pakistan Agricultural Storage and Services Corporation (PASSCO).

To discourage the private sector involvement in wheat marketing, a narrow margin between the farm-gate and release price to flour mills was maintained. Furthermore, difference in release price in different regions and different times of the year was not kept. The ultimate result was the prohibition of private sector to bid prices up to the equilibrium level, which created an inefficient marketing system. Below-equilibrium prices of wheat and wheat flour, naturally created a gap between the supply and demand and forced the government to import around one million tons of wheat per year (to fill the gap), and bear subsidy for urban consumers (equal to the difference in international and domestic prices). Due to the rapidly growing population, especially in urban areas (as well as increasing the middle class), there is a dire need to revisit the wheat policy scenario in a dynamic modeling framework. Furthermore, there was a large fluctuation in the price of wheat crop due to which welfare implications of alternative wheat policies have also changed. The aim(s) of this research endeavor is to show that the objective of increasing per capita consumption could have been achieved

TABLE 1

Domestic and International Prices of Wheat in Pakistan (US dollar/ton)

Years	Wholesale Price (*b*)	CIF International Prices (*c*)	International Prices + 20% handling Cost (*d*)	Difference in Prices (*d*)-(*b*)
1975	119.92	138.40	166.00	46.16
1985	145.13	128.70	154.00	9.31
1995	100.82	146.00	175.00	74.38
2000	116.27	104.33	125.00	8.93
2001	249.27	254.98	305.98	56.71
2002	246.55	283.73	340.48	93.93
2003	220.02	294.50	353.40	133.38
2004	239.81	289.80	347.76	107.95
2005	252.10	255.51	306.61	54.51
2006	248.86	214.49	257.39	8.54
2007	239.81	334.03	400.83	161.02

Source: Abedullah and Ali (2001); Agricultural Policy Institute (2008).

by alternative policies and with different implications for producers, consumers, and government revenue. In addition, this study will also empirically estimate wheat supply and demand elasticity and fertilizer demand elasticity. Based on the short-run elasticity estimates, the present study estimates the welfare implications of alternative wheat policies on different stakeholders, in Pakistan. Secondly, the impact of different policy options (import, input subsidy and price support) on welfare distribution of producers and consumers will be analyzed. Also, the paper will look at the effects of above policies on government revenue and foreign exchange.

After the introduction in Section I, a brief review of the literature is given in Section II, and methodological framework and data sources are presented in Section III. Results are discussed in Section IV, while Section V provides summary and main conclusions.

II. Review of Literature

Pakistan has a history of agricultural input subsidies beginning with the decade of 50s. Despite the commitments to their removal, subsidies on agricultural inputs had tendency to persist. Input subsidies did not accrue to the farm sector but were eaten up by inefficiencies production and distribution systems. The removal of subsidy on agricultural inputs: such as seed, fertilizer and pesticides led to inefficiency of input use as use of modern input was already much below the recommended level and, its price increase reduced the use of modern inputs further. [Chaudhry and Sahibzada (1995), Iqbal (1992)] analyzed the effects of wheat price distortions that existed in Pakistan from 1975 to 1990 using Marshallian economic surplus framework. It was found that distortions due to government intervention through subsidies and price support reduced the allocative role of prices because they under-valued or over-valued the resources and thus, resulted in misallocation. Government intervention adversely affected the national economy because they resulted in transfer of resources out of agriculture when prices were set too low and put an excessive burden on consumers when prices were above the world prices. Ryan and Khan (1993) examined the effect of ration shop and price leader systems on Pakistan's economy and found that both systems remained urban biased. Thus, under both systems, the objective of subsidizing consumers was not achieved, due to diversion of subsidy to the flour mills. Barker and Hayami (1976), in their pioneering study on government policies illustrated the price support and fertilizer subsidy program for achieving self-sufficiency in rice in Philippines. With the assumption(s) of perfect competition in factor and product markets, government interventions resulted in a net loss in social welfare matrix.

Ahmed (1979) analyzed the policies which determined the consumption and distribution of food grains in Bangladesh, using secondary data for the years 1974-75 and 1975-76. The results showed that price support program favored the producers at the cost of government. The total social benefits were positive under both programs,

but the net social benefits were negative for the price support program. Barkely (1992) studied the impact of domestic wheat price policy in Pakistan by using partial equilibrium Marshallian welfare analysis for Pakistan from 1972 to 1987. The results indicated that Pakistan could be the net exporter of wheat from 1971 to 1986, if domestic prices reflected the opportunity cost of resources used in agricultural production. Ender, et al. (1992) reviewed wheat price policies in Pakistan and analyzed their effects on economy. Low release price, not only benefited consumers through lowering wholesale prices but also the millers because they had ability to set flour prices, jointly. Ghani (1998) showed that on supply side, procurement price played an important role in determining wheat production because of the inelastic wheat demand price increase had a minor impact on overall consumption of wheat. However, increase in wheat price, significantly affected the lower income households as they spend a large share of income on wheat and wheat flour.

Ahmed and Martini (2000) analyzed the agricultural policy of Pakistan, using policy analysis matrix and concluded that profit for wheat was negative, which implied that the system could not sustain without the government intervention. The adopted system was wasting resources because social cost of wheat production was higher than the social benefits. Therefore, to increase social profitability, it required new policy. Farooq and Iqbal (2000) reviewed the past institutional efforts in attaining and maintaining self-sufficiency in wheat production in Pakistan and showed that wheat supply was highly inelastic which necessitated institutional support in addition to price incentives. Support price of wheat was equal to the cost at farm gate which resulted in reduced input used for wheat production and hindered the area expansion under wheat. Abedullah and Ali (2001) analyzed the impact of short-run policy options adopted in the wheat sector; on welfare of consumers, producers, government revenue and foreign exchange requirements using partial equilibrium model. The analysis showed that if government imported wheat; only consumers would gain while the government and producers will bear losses. Under input subsidy again, consumers would gain while government and producers will have to pay for it. In case of price support, both the producers and consumers would gain at the cost of government.

Ashfaq, et al. (2001) analyzed welfare effects of government interventions in wheat economy of Pakistan and used simulation experiments with an econometric model to quantify producer's loss, consumer's gain, government budget cost and overall the efficiency loss that occurred due to government pricing interventions in the wheat market over the period 1973 to 1996 using static and dynamic welfare analysis. The results showed the transfer of economic surplus from producers to consumers; government budget cost due to subsidy on imported wheat and overall the welfare loss to the society. The dynamic welfare losses as a percentage of real GDP from agricultural sector were greater as compared to static welfare losses. Khan, et al. (2003) concluded that in Pakistan, support price system was close to procurement system where there was no restriction on sale of produce by the farmers in open market.

Croppenstedt, et al. (2006) indicated that Egypt's economy had to pay high cost of increasing wheat self-sufficiency through increased area cultivated under wheat. Wheat expansion reduced barseem and maize the main livestock fodder which reduced livestock production, rural employment and the farm-household's income. Siam (2006) explored effects of shifting from the system of bread subsidy at consumer level to cash transfers; and finally analyzed the impact of world price shock on consumption, production and income distribution for Egypt. Expansion of area under wheat cultivation reduces the area under barseem (winter fodder crop) which is the main livestock feed. Thus, consumer's welfare in both the urban and rural areas would also be reduced, due to higher prices. Furthermore, the wheat subsidy constituted a major part of government expenditure and the main benefits of subsidy accrued to urban consumers because of differential access to subsidized bread. Anderson, et al. (2009) explained that price support policies and farm trade restrictions imposed by advanced economies hurt, not only the domestic consumers and exporters of other products but also the foreign producers and traders of farm products which resulted in reduced national and global economic welfare.

From the empirical evidences, it becomes clear that most studies used either the partial equilibrium Marshallian welfare framework, Policy analysis matrix and/or estimated welfare impacts of policies using econometric modeling. This study goes further and use annual time series data for the first time for Pakistan and analyzed the long-run (co-integration) relationship. Furthermore, from the long-run analysis error correction modeling approach is employed to estimate the short-run elasticity. This is uniqueness of the current study, as according to the author(s), so far, no study has been used for this kind of time series data-set and estimated the long-run and short-run elasticities to estimate welfare impacts of stakeholders. For example, Abedullah and Ali (2001) used one year (1999-2000) data for wheat and took elasticity estimates from other studies; whereas the current study have estimated the long-run and short run elasticities, and these short-run elasticities are employed to estimate the welfare implication in Pakistan's agriculture sector, focusing on the important food (wheat) crop.

III. Methodology and Data

Since the objective of this study is to estimate the impact of different policy options on producers, consumers, government and foreign exchange requirement, therefore it requires supply and demand elasticity of wheat and demand elasticity of fertilizer (as an input) because, government use fertilizer as a major tool to provide input subsidy.

1. Wheat Supply and Demand Function

Production (supply, *lpr*) response of wheat is assumed to be a function of its own-price (*lrwp*), cotton price (*lrcp*), sugarcane price (*lrscp*), basmati rice price (*lrbrp*),

IRRI rice price (*lrirp*), urea price (*lrup*), DAP price (*lrdap*), cropped area under wheat (*lwar*), and water availability (*lwa*). In mathematical form it can be written as:

$$lpr = \alpha_0 + \alpha_1 lrwp + \alpha_2 lrcp + \alpha_3 lrscp + \alpha_4 lrbrp + \alpha_5 lrirp + \alpha_6 lrup + \alpha_7 lrdap + \alpha_8 lwar + \alpha_9 lwa + e \quad (1)$$

Wheat demand (*lwc*) is assumed to be a function of its own price (*lrwp*), basmati rice price (*lrbrp*), IRRI rice price (*lrirp*) and per capita income (*ly*):

$$lwc = \beta_0 + \beta_1 lrwp + \beta_2 lrbrp + \beta_3 lrirp + \beta_4 ly + \mu_1 \quad (2)$$

The coefficients α_i and β_i are respective elasticities; while μ_1 is error term. The expected signs of these elasticity are positive for own price, price of complementary crops, water availability, wheat area and negative for price of competitive crop, urea price and DAP price in supply equation; while in demand equation the expected signs of these elasticities are positive for price of substitute per capita income and negative for price of complementary product.

2. Fertilizer Demand Function

Fertilizer demand for wheat is assumed to be a function of wheat price (*lrwp*), urea price (*lrup*), DAP price (*lrdap*), area cropped under wheat (*lwar*), and credit for fertilizer purchase (*lcr*). In mathematical form it can be written as:

$$lfc = \gamma_0 + \gamma_1 lrwp + \gamma_2 lrup + \gamma_3 lrdap + \gamma_4 lwar + \gamma_5 lcr + \mu_2 \quad (3)$$

where; *lfc* is fertilizer consumption, μ_2 is error term, while γ_1 represents respective fertilizer demand elasticities. According to the theory, the expected sign for fertilizer demand elasticity is negative for urea price, DAP price and positive for wheat price, area cropped under wheat and fertilizer credit.

3. Analytical Techniques (Wheat Supply, Demand and Fertilizer Model)

The estimation of long-run elasticities require time series to be stationary in their level form. Therefore, the first step is to test for stationarity as the most popular ADF unit root test has been used in this study. The ADF test is based on assumption that there is only one unit root in the process [Dickey, et al. (1986). Johansen's full information maximum likelihood (FIML) approach [Johansen (1988), Johansen and Juselius (1990)] is used to test for co-integration. It allows the estimation of all possible co-integration relationships and develops a set of statistical tests to test the hypothesis as to how many co-integrating vectors exist. The under-estimation implies the omission

of relevant error-correction terms and over-estimation shows that distributions of statistics are non-standard. The Johansen maximum likelihood approach for co-integration is based on the following autoregressive (VAR) model:

$$Z_t = A_1 Z_{t-1} + \ldots + A_k Z_{t-k} + \mu_t \quad (4)$$

where Z_t is an ($nx1$) vector of $I(1)$ variables (containing both exogenous and endogenous variables), A_t is an ($n \times n$) matrix of parameters, μ_t is ($nx1$) vector of white noise errors. Since Z_t is assumed to be non-stationary, it is convenient to rewrite Equation (4) in its first difference (error correction) form:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \ldots + \Gamma_{k-1} \Delta Z_{t-k+1} + \Pi Z_{t-k} + \mu_t \quad (5)$$

where; $\Gamma_i = (I\text{-}A_1\text{-}A_2 \text{ - .., .-}A_i)$, ($i=1, k-1$), and $\Pi = \text{ - } (I\text{-}A_1\text{-}A_2\text{- .. -}A_k)$. This specification provides information about the short-run and long-run adjustments to changes in Z_t through estimates of Γ_1 and Π, respectively. The rank of Π matrix provides information about the number of co-integration relationships among variables in Z_t. If the rank (r) of the Π matrix is $0 < r < n$, then there are linear combinations of variables in Z_t which are stationary. In this case, Π matrix can be decomposed into two matrices α and β such that $\Pi = \alpha\beta'$, where, α is error correction term and measures the speed of adjustment in ΔZ_t and β contains r distinct co-integration relationships between the non-stationary variables. Two likelihood ratios (LR) tests, i.e., Trace and Eigen value statistics are used for detecting the presence of a single co-integration vector. Harris (1995) noted that trace test shows more robustness to both the skewness and excess kurtosis in residuals than the maximum Eigenvalue test. The choice of lag length k in VAR is important and the Schwarz Bayesian Criterion (SBC) is used to choose appropriate lag length.

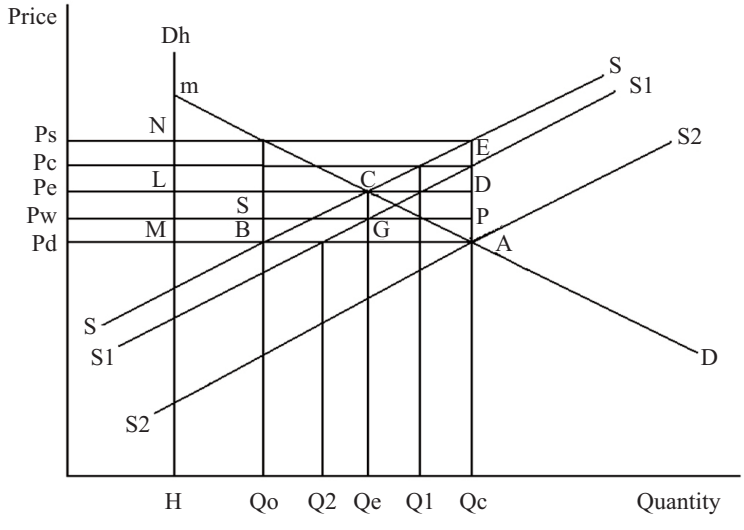
4. Welfare Implications of Alternative Policies

It is estimated that changes in consumer surplus, producer surplus, foreign exchange requirement, government cost, net effect on society and rate of return of policy are designed by using Barker and Hayami (1976) model. To evaluate and compare different policy options the work of Abedullah and Ali (2001) was followed. Each policy options is briefly discussed below. A simple model of wheat import, price support and input subsidy in Pakistan, is presented in Figure 1; SS represents the domestic supply curve of wheat at the existing fertilizer prices. The vertical line D_hH indicates the demand of producers for home consumption which represents the amount of wheat that producers kept at home for their own consumption. The line D_hmD represents the total demand corresponding to each level of price, and the horizontal distance between D_hH and D_hmD representing the total amount of wheat marketed in the country by local

producers. The domestic price P_d in Figure 1 is lower than the equilibrium price P_e. At price P_d, domestic supply is Q_o but the total demand is Q_c. The difference in the quantity demanded and supplied of wheat at price P_d creates a gap of Q_oQ_c in the country. This gap can be filled by using five alternative policies: (a) Free market option, (b) import of Q_oQ_c quantity of wheat, (*c*) price support which requires government to buy wheat from producers at a higher price and sell it to consumers at a lower price, (d) subsidize input prices to shift the supply curve to S_2S_2 and (*e*) a combination of import, price support, and input subsidy with different proportions.

a) Free Market Option

One of the options available to the government is to leave the market uninterrupted. In periods when there exists a gap between supply and demand, consumer prices may become intolerably high if the situation is left entirely to free market-mechanism, which will balance the excess demand with supply through raising prices. High prices are not favorable to low-income consumers because of their inability to purchase food. Higher prices encourage wheat supply and discourage wheat consumption to match supply and demand at the equilibrium price. Free market option serves as a standard of comparison for alternative policies like; wheat import, price support and input price subsidy.



Source: Barker and Hayami (1976).

FIGURE 1

Analysis of Wheat Import, Price Support and Input Subsidy Policy

b) Import

If the government decide to fill the gap between production and consumption through importing Q_oQ_c quantity of wheat, the consumers gains equal to the area *MLCG* and *CGA* (due to higher consumption and lower price as compared to free market option), while producers bear loss (because of reduced production due to low price as compared to equilibrium price) and the government would bear the cost (due to higher international prices as compared to domestic prices and interest on foreign exchange) which would be equal to the area *MLCB* and *ABSP* respectively, as shown in Figure 1.

c) Input Subsidy

The gap between consumption and production can be filled by shifting the supply curve from *SS* to S_1S_1 (Figure 1). Since supply curve represents the rising portion of the marginal cost curve, therefore, supply curve can be shifted to the right through lowering input prices. Usually the government provides fertilizer subsidy for this purpose. The demand curve of fertilizer for wheat is $D_{fo}D_{fo}$ (Figure 2) and quantity demanded for wheat production at existing price (P_{fd}) is X_o. To fill gap between production and consumption, if the government subsidizes the fertilizer use in wheat production, the fertilizer demand will increase to X_s (Figure 2). The supply curve of fertilizer is assumed to be infinitely elastic at the world price. An upward sloping domestic supply curve is not considered to avoid subsidization of fertilizer industry. In this case, gain to consumers is equal to the area *MLCG* and *CGA* (Figure-1). Producers do not only gain due to increase in output value (due to higher level of fertilizer use) which is equal to an area AQ_cQ_eG (Figure-1); and the net savings from the fertilizer used (because of subsidized fertilizer price) which equals to area $P_{fs}\ P_{fd}\ IK$ minus the additional fertilizer cost which is equal to the area $LX_s\ X_o\ K$ (Figure-2), but it also bears loss (due to lower domestic price of wheat than the equilibrium price) which equals to the area *MLCG*. The net return to producers depends on relative magnitudes of gain and loss. The government cost of fertilizer subsidy to wheat is represented by area $P_{fs}\ P_{fd}\ IK$ and *KLMN* (Figure 2).

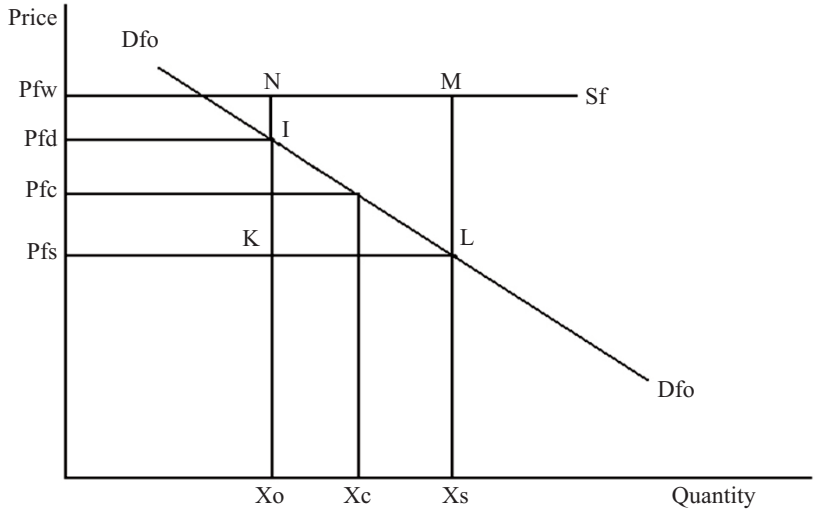
d) Price Support

The government use the price support policy to encourage production (above the equilibrium level) within the country so that consumption can be met from the local supply at a higher level than the equilibrium because equilibrium level of consumption is low and is not sufficient to provide the required necessary calories for consumption. This can be achieved by offering a higher (than equilibrium) price to farmers for producing wheat quantity for consumers' demanded at a lower (than equilibrium) price.

Both the producers and consumers will benefit in this case, but the government has to bear the cost. Assuming a fixed domestic supply curve SS. An increase in wheat production to the desired level of OQ_c can be achieved by offer in higher price (P_s) than the equilibrium price to producers. Since the government maintains the consumers' price at P_d level, increase in production of wheat would involve a cost to government which equals to the area *AENM*. Area *CENL* and *CLMA* (Figure 1) represents respectively, an increase in income of wheat producers and consumer's surplus at government cost.

e) Combined Policy Options

Generally, different policies are combined by the government to achieve alternative goals. The fertilizer component of the policy shifts the supply curve to right from *SS* to S_1S_1 (Figure 1), while price support component creates an incentive for producers and attracts them to produce at a higher level along the new supply curve. The fertilizer subsidy component yields additional output of (Q_1 - Q_o) at given price P_d and the remaining gap of (Q_c - Q_1) is filled by price support component of the policy by giving higher price to farmers at P_c. In the combined policy, a lower support price P_c in the single price-support policy P_s is required. Similarly, a relatively low shift in demand for fertilizer (X_o to X_c) and reduction in fertilizer prices (P_{fd} to P_{fc}) is required in this case. The combined policy induced the fertilizer use in wheat production from X_o to X_c (Figure 2).



Source: Barker and Hayami (1976).

FIGURE 2

Effect of Fertilizer Subsidy on Price and Demand of Fertilizer

5. Estimation of Cost/Benefit

Welfare distribution among different stakeholders under import subsidy, input subsidy and price support are calculated by employing the following equations (Table 2) where, Q_e, Q_c and Q_o are equilibrium quantity, total demand and quantity of wheat supplied at domestic price, respectively. Furthermore, H is Producer's demand of wheat for home consumption. $P_e, P_d, P_w, P_s, P_{fs}, P_{fd}, P_{fw}$ is equilibrium price, domestic price, import parity price and support price of wheat, subsidized price, existing market price, and world market price of fertilizer, respectively. X_s and X_o is quantity demanded of fertilizer at subsidized price and at existing the market price.

6. Data

Time Series data from 1976 to 2008 was collected for all variables at national level from Pakistan. Data on wheat production, wheat area, water availability, wheat price, basmati rice price, IRRI rice price, per capita wheat consumption and the fertilizer credit were collected from various issues of the agricultural statistics of Pakistan [GOP (2009a)]. Data on the price of urea, DAP, sugarcane, cotton, fertilizer off-take in wheat and per capita income were collected from various issues of the Economic Survey and

TABLE 2

Welfare Distribution of various Policies among Stakeholders

Policies	Costs and Benefits			
	Δ in CS[1]	Δ in PS	GC	FER
Import	$(Q_e-H)*(P_e-P_d) + 0.5*(Q_c-Q_e) * (P_e-P_d)$	$(Q_e-H)*(P_e-P_d) - 0.5*(Q_e-Q_o) * (P_e-P_d)$	$(Q_c-Q_o)*(P_w-P_d)$	$(Q_c-Q_o)*P_w$
Input Subsidy	$(Q_e-H)*(P_e-P_d) + 0.5*(Q_c-Qe) * (P_e-P_d)$	$(Q_c-H)*P_d - (Q_e-H)*(P_e-P_d) - [P_{fs}*(X_s-X_o) -(P_{fd}-P_{fs})*X_o]$	$[(P_{fd}-P_{fs})*X_o + (P_{fw}-P_{fs})*(X_s-X_o)]$	$(X_s-X_o)* P_{fw}$
Price Support	$(Q_e-H)*(P_e-P_d) + 0.5*(Q_c-Q_e)*(P_e-P_d)$	$(Q_c-H)*(P_s-P_e) - 0.5*(Q_c-Q_e) *(P_s-P_e)$	$(Q_c-H)*(P_s-P_d)$	$(X_s-X_o)*P_{fw}$

Note: [1]Δ shows a change, either increase or decrease and CS and PS is consumer and producer surplus, respectively. GC is government costs and FER is foreign exchange requirements.

Statistical Year Book, respectively [GOP (2009b)]. The financial data was converted into real terms by using GDP Deflator. The data could have been obtained for longer period (after 2008) but it was restricted till the year 2008, because of the following reasons; First, the year 2008 was the year when globally the prices of food were risen. Also in Pakistan, there was a shift in government from the dictatorial regime to democracy. Second, in 2010 the Pakistan experienced a huge devastation due to flood across the country, which deteriorated the unripened standing crops in the fields (especially wheat); the agriculture sector incurred heavy losses. Finally, the elected democratic government announced a new support price in the year 2011-12 which was to be empirically examined with previous support price fixed by the dictatorial regime. During this era agriculture sector was also growing at relatively slow pace. Hence, to avoid any structural break or outlier in the data, this study was restricted to sample from 1975-76 to 2007-08.

IV. Results and Discussion

1. Wheat Supply and Demand Model (Long and Short-Run Relationship)

Before estimating the elasticities, the unit root properties of variables using ADF test with trended and non-trended models was analyzed. First, it was concluded that all variables are first differenced stationary.[1] Wheat demand and supply model is estimated using Johansen co-integration approach. Both, the Eigen value and Trace tests do not reject $r <= 1$ at 5 per cent significance level, on a move from top to bottom. Therefore, number of co-integrating vectors in wheat supply and demand model are estimated to be one. The Johansen model is a form of ECM and if only one co-integrating vector exist, its parameters can be interpreted as estimates of long-run co-integrating relationship between the variables [Hallam and Zanoli (1993)]. Therefore, normalized estimated parameters from wheat supply equation are long-run elasticities and are given in Table-3. The coefficients in wheat supply model represent estimates of long-run elasticities of wheat output with respect to cotton price, sugarcane price and, basmati rice price, and the wheat area. ECM provides estimates of short-run elasticitys. The preferred ECM is selected using general to specific modeling procedure [Hendry and Ericsson (1991)]. The signs on estimated coefficients are according to a priori except for water availability. These results indicates that one per cent increase in cotton price increases wheat production by 0.00029 per cent in the short-run and decreases it by 0.771 per cent in the long-run. This means that cotton is competitive and complementary crop for wheat in the long- and short-run, respectively. Wheat price positively affects wheat production, only in the short-run. Own price elasticity

[1] Detail results of ADF unit root test and Johansen co-integration test with Trace and Eigenvalue statistics are not presented to conserve space, however, they are available with the authors.

of wheat indicates that one per cent increase in wheat price increases wheat production by 0.32 per cent. Wheat elasticity with respect to urea price was -0.302 which states that a one per cent increase in urea price decreases wheat production by 0.3 per cent. The coefficients of wheat demand model presented in Table 3 indicate that Basmati and IRRI rice price has positive relationship with wheat consumption in the long-run,

TABLE 3

Short and Long-Run Elasticity Estimates

Variables	Wheat Supply Model		Wheat Demand Model	
	Short-Run	Long-Run	Short-Run	Long-Run
Constant	0.370 (0.215)^{ns}	6.75 (0.709)^{ns}	-0.090 (0.13)^{ns}	4.19 (3.62)***
Dlrcp	-	-0.771 (1.470)	-	-
Dlrcp(-1)	0.00029 (2.74)***	-	-	-
Dlrscp	0.348 (2.36)***	1.468 (2.063)***	-	-
Dlrscp(-1)	0.488 (2.76)***	-	-	-
Dlrbrp	-0.000493 (3.57)****	-0.403 (1.425)	-	-0.285 (2.24)***
Dlrbrp(-1)	-0.000367(2.18)***	-	-	-
Dlwar	-	0.117 (0.1413)^{ns}	-	-
Lrwp	0.316 (1.59)**	-	-0.37 (2.86)***	-
Lrup	-0.302 (2.075)****	-	--	-
Lwa	-0.754 (4.32)****		-	-
Dlrp(-1)	-0.456 (3.40)****	-	-	-
Dlrirp	-	-	-	-0.163 (1.011)
Dly	-	-	0.039 (1.549)**	0.391 (1.58)**
Dly(-3)	-	-	0.494 (1.99)***	-
ECM	-0.597 (4.77)****		-0.566 (4.64)****	
Diagnostic Tests				
R^2	0.68		R^2	0.4
DW-statistics	2.22		DW-statistics	2.3
LM-test-χ^2 (1)	0.715 [.398]		LM-test-χ^2 (1)	0.94[0.33]
RESET -χ^2 (1)	0.659 [.417]		RESET -χ^2 (1)	3.49 [0.06]
JB-χ^2 (2)	2.12 [.347]		JB-χ^2 (2)	0.66 [0.72]

Note: Values in parenthesis are t-ratios. Values in square brackets are p-values. ns = l non-significance.**, ***, **** shows significance at 10, 5 and 1 percent respectively.

meaning that basmati and IRRI rice are substitute for wheat. Wheat consumption has positive relationship with per capita income in the short- and long-run with the elasticity of less than unity employing that wheat is basic necessity in Pakistan and is a normal good in the short- and long-run. The coefficient of error correction term for wheat supply and consumption explains about 60 per cent of deviation of wheat production and 56 per cent of wheat consumption from long-run equilibrium corrected in the current period.

2. Fertilizer Demand Model

The Eigen value test does not reject r <=1, and the Trace test does not reject r <=2 at 5 per cent significance level. Eigen value test indicate that the number of co-integrating vector is one while the Trace test indicates that there are two co-integrating vectors (Trace and Eigen value statistics are not presented here for conserving space). The coefficients in fertilizer demand model represent estimates of long-run elasticities of fertilizer consumption with respect to wheat area and fertilizer credit (Table 4). One per cent increase in wheat price increases fertilizer consumption by 0.42 per cent and one per cent increase in DAP price decreases the fertilizer consumption by 0.40 per

TABLE 4

Short and Long-Run Elasticity Estimates for Fertilizer Demand Model

Variables	Short-Run	Long-Run
Constant	3.0733 (2.568)***	-2.029 (0.283)^{ns}
DLWAR	0.435 (4.126)****	1.625 (2.476)***
DLCR	-	0.268 (5.688)****
LRWP	0.421 (3.438)****	-
LRDAP	-0.40 (1.775)**	-
ECM	-0.597 (4.371)****	-
Diagnostic Tests		
R^2	0.645	
DW-statistics	1.88	
LM-test-χ^2 (1)	0.075401[.784]	
RESET test-χ^2 (1)	1.4844[.223]	
Jarque-Bera Normality-χ^2	0.31861[.853]	

Note: t-ratios are in parenthesis.p-values are in square brackets.ns = Non-significant. **, ***, **** shows significance at 10, 5 and 1 percent, respectively.

cent. Diagnostic tests for estimated models (i.e., wheat supply and demand and fertilizer demand) give satisfactory results. The LM test for up to one order indicates no serial correlation problem in the residuals. The p-value for RESET test for functional form misspecification and Jarque-Bera test for normality are greater than 0.05. This means that functional form is correct and the residuals are normally distributed.

3. Alternative Policy Options

There are different policy options available to fill the gap between supply and demand and the welfare implications of each of these alternatives (free market, import, price support, input subsidy and combined policy options) are estimated and discussed below.

a) Free Market Option

To understand implications of free market mechanism on production and consumption, equilibrium price and quantity was estimated by using short-run wheat supply and demand elasticities of 0.32 and -0.37, respectively. The estimated supply and demand equations are $Q^s_o = 0.697\ (P_o)^{0.32}$ and $Q^d_o = 825.4\ (P_o)^{0.37}$ where 0.697 and 825.4 are intercept of supply and demand, respectively; whereas the exponential term is short-run price elasticity of demand and supply estimated using error correction technique, respectively [GOP (2009)].[2] Solving supply and demand equations simultaneously gives equilibrium price at Rs.28,486 per ton and equilibrium quantity at Rs.18.55 million tons for 2008-09. However, equilibrium price is undesirable due to; first, equilibrium quantity produced, may be too small to supply enough food; second, even if it results in sufficient production, it may be beyond the reach of the poor. Thus, to make food affordable to poor, the equilibrium price was fixed (lower than) at Rs.23857 per ton [GOP (2009)]. This encouraged the consumption; and discouraged the production creating a gap of 2.28 million ton between supply and demand. The implications of other four policy options are compared to the free market option.

b) Imports

The welfare implication of import policy shows that only consumers gain while government and the producers have to pay for it (Table 5). The total loss paid by producers and the government together was higher than the consumer's gain. The policy produced net loss to the society and the rate of return on policy was 77 per cent.

[2] One year lag has been taken between production and consumption, as production for this year will last until the end next year. 15% losses (5% seed, 8% losses and 2% leakages to Afghanistan) have been deducted from production to estimate wheat available for consumption.

c) Input subsidy

Assuming that the government decides to produce $(Q_c\text{-}Q_e)/Q_e$ = 6.78 per cent deficient wheat within the country. Given the production elasticity of -0.30, the price of fertilizer would have to be reduced by (1/0.30)*6.78=23 per cent to produce an additional 6.78 per cent if wheat. This will reduce nitrogen and phosphorus fertilizer prices to 25.04 and 93.78 rupees per kilogram, respectively, instead of the current prices of 32.35 and 121.17 rupees per kilogram and thus create an additional demand for nitrogen and phosphorus. Under the assumption that government will fill the additional demand of fertilizer (nitrogen and phosphorus) by purchasing from the international market, the level of subsidy in nitrogen and phosphorus will be (67.41 –25.04) = 42.38 and (132.66 –93.78) = 38.88 rupees per kilogram, respectively. Using fertilizer demand elasticity equals to 0.40, 23 per cent reduction in fertilizer price will increase the current use of fertilizer in wheat from 1.54 million to 1.68 million tons. The foreign exchange requirements will be worth of 14,117 million rupees, to import 0.17 million tons of fertilizer. Furthermore, net return to producers is negative because, due to lower domestic price of wheat the producers' loss is higher than the sum of producer's benefit, obtained due to increase in output value and the net savings from fertilizer use because of low fertilizer price. The policy has generated a net benefit to the society because consumers' gain is higher than the sum of producers' loss and the total cost of government (column 3, of Table-5).

d) Price Support

If the government decides to give higher wheat price to motivate producers to produce (Q_c) amount of wheat within the country rather than to import, it would have to

TABLE 5

Welfare Implications of Wheat Import Policy (Million Rupees)

Policy Criterion	Import Policy Gain (+)/Loss (-)	Input Subsidy Gain (+)/Loss (-)	Price Support Gain (+)/Loss (-)
Consumer's Gain/Loss	46601	46601	46601
Producer's Gain/Loss	-41320	-1632	65264
Government Cost	18841	29167	118856
Foreign Exchange Requirement	73277	14117	14117
Interest on Foreign Exchange	3664	706	706
Total Cost to Government	22505	29873	119562
Net Gain/Loss to Society	-17224	15096	-7697
Rate of Return	-77%	52%	-6%

offer (P_s) price to the producer. The (P_s) is estimated from the supply response function by substituting the required quantity on left-hand side of the equation and solving for the price. This supports the price (P_s) of Rs.34,968.70 per ton. The additional production (Q_c-Q_o) would require additional input use. If additional production is to be planned and obtained from the higher fertilizer use, it would require import adjustments in order to keep the domestic fertilizer prices unchanged. In this case, the demand curve for fertilizer will shift to right, such that more fertilizer will be used at the given fertilizer price. As estimated in the input subsidy policy, fertilizer import requirement would be 0.17 million tons of nutrients, requiring Rs.14,117 million worth of foreign exchange. However, all cost of fertilizer imports will be recovered from farmers, as there is no subsidy on fertilizer use. This policy has generated a negative return to the society because of higher cost to the government, the benefits goes to consumers and producers (column 4, Table-5).

e) Combined Policy Options

Different combinations of alternative policies are evaluated as: import and input subsidy, import and price support, input subsidy and price support, and import, input subsidy, and price support. Furthermore, consumers gain remains the same due to same quantity consumed by them, irrespective of the policy option.

i) Import and Input Subsidy

When import and input subsidy are combined producers' loss is decreases continuously, with the increase in input subsidy component. The cost to the government increases with an increase in input subsidy, and the decrease in import component (panel a, Table-6). The net benefit to the society is found to be optimal (13,252 million rupees) when import and input subsidy components are combined in the ratio of 10:90 having 47 per cent rate of return on the policy.

ii) Import Subsidy and Price Support

Producers' gain increases with decrease in import and increase in price support; whereas, the cost to the government increases continuously (panel b, Table 6). The net benefit to the society remains negative for all combinations of import and price support. There is no optimal combination of import and price support because the rate of return is negative for all combinations.

iii) Input Subsidy and Price Support

As the share of price support increases the producer gain and the government cost increases. Net benefit and rate of return for each policy option decreases with an increase

TABLE 6

Costs and Benefits of various Combinations of Policies (Million Pak. Rs/Annum)

A) Costs and Benefits of Combined Import and Input Subsidy Policies									
Policy Criterion	1	2	3	4	5	6	7	8	9
	90+10	80+20	70+30	60+40	50+50	40+60	30+70	20+80	10+90
Consumer's Benefit	46601	46601	46601	46601	46601	46601	46601	46601	46601
Producer's Loss (-) / Gain (+)	-36708	-32236	-27907	-23721	-19677	-15778	-12023	-8413	-4949
Cost to the Government	23066	23651	24261	24894	25550	26229	26931	27655	28400
Net Benefit(+)/Loss (-) to Society	-13172	-9287	-5567	-2013	1374	4594	7647	10533	13252
Rate of Return on Policy (%)	-57	-39	-23	-8	5	18	28	38	47
B) Costs and Benefits of Combined Import and Price Support Policies									
Policy Criterion	1	2	3	4	5	6	7	8	9
	90+10	80+20	70+30	60+40	50+50	40+60	30+70	20+80	10+90
Consumer's Benefit	46601	46601	46601	46601	46601	46601	46601	46601	46601
Producer's Loss (-)/Gain (+)	-32310	-22976	-13301	-3272	7129	17917	29108	40718	52765
Cost to the Government	28830	35846	43574	52037	61258	71260	82067	93704	106194
Net Benefit(+)/Loss(-) to Society	-14539	-12221	-10274	-8707	-7527	-6742	-6358	-6384	-6828
Rate of Return on Policy (%)	-50	-34	-24	-17	-12	-9	-8	-7	-6

Source: Author's estimation.

in price support component. The maximum benefit to the society (15,318 million rupees) is observed when input subsidy and price support components are combined in the ratio of 90:10, respectively; where the highest rate of return (44 per cent) is observed (panel a, Table 7). However, if the preference is to protect the government by taking care of the other groups in the society as well, then the best policy option is the time when import and input subsidy components are combined in the ratio of 10 and 90.

iv) Combination of three Policies

Import subsidy, input subsidy, and price support are combined in different proportions and the distribution of loss and benefits among consumers, producers, and the government (panel b, Table 7). The optimal net benefit (12,669 million rupees) is observed to the society, under the policy where each of the import and price support is 10 per cent and fertilizer subsidy component is 80 per cent. The producers' gain under this optional amount (to 48 million rupees), and cost to the government is 33,980 million rupees. Therefore, this is the best under all possible combined policy options for import, input subsidy and price support.

V. Summary and Conclusions

In Pakistan, the main objectives of food policies is to achieve the food security, provide low-price food to consumers, assure reasonable prices to producers, and boost agricultural production in the country. The policies adopted to achieve these objectives were assured minimum price support to the producers through the floor price mechanism, providing wheat-flour to the consumer through ration shops, and supplying fertilizer to the producers at subsidized prices. However, in various sectors of the society, the impact of these policies might be conflicting. Therefore, the objective of this study is to analyze the impact of alternative food policy options adopted in the wheat sector. Such comparison will help the policy makers to provide benefits and mitigate distortionary impacts of these policies to particular sectors of the society. Wheat supply, demand elasticities and fertilizer demand elasticity are calculated by estimating supply and demand functions. Co-integration technique and partial equilibrium model has been used for estimation of elasticities and policy analysis respectively.

The welfare analysis indicates that, if wheat is imported, only consumers gains; while other parties, i.e., government and producers have to pay. Consumers' gain was less than the total loss to the government and producer together. Therefore, a negative rate of return of 77 per cent was generated by the policy. Under input subsidy again, consumers gain at a cost to both producers and the government. Consumers' gain is higher than total loss to the government and producers together. Therefore, the policy resulted in a positive rate of return of 52 per cent on government's investment. In case of price support, both the producer and consumer benefited at the government cost

TABLE 7

Costs and Benefits of Combined Input Subsidy and Price Support Policies (Million Pak. Rs/Annum)

A) Costs and Benefits of Input Subsidy and Price Support Policies									
Policy Criterion	1	2	3	4	5	6	7	8	9
	90+10	80+20	70+30	60+40	50+50	40+60	30+70	20+80	10+90
Consumers' Benefit	46601	46601	46601	46601	46601	46601	46601	46601	46601
Producers' Loss (-)/Gain (+)	3442	8832	14553	20622	27055	33868	41079	48703	56759
Cost to the Government	34726	40996	48000	55761	64303	73649	83823	94850	106755
Net Benefit (+)/Loss (-) to Society	15318	14438	13155	11462	9353	6821	3857	454	-3394
Rate of Return on Policy (%)	44	35	27	21	15	9	5	0.48	-3
B) Costs and Benefits of Import, Input Subsidy, and Price Support Policies									
I + II + III[a]	1	2	3	4	5	6	7	8	
	20+20+60	30+30+40	40+40+20	10+80+10	20+60+20	30+40+30	80+10+10	40+30+30	
Consumer's Benefit	46601	46601	46601	46601	46601	46601	46601	46601	
Producer's Loss (-)/Gain (+)	26179	9321	-5923	48	1745	3477	-27766	-503	
Cost to the Government	72406	53793	38235	33980	39570	45963	29391	45330	
Net Benefit(+)/Loss(-) to Society	374	2129	2444	12669	8776	4116	-10556	768	
Rate of Return on Policy (%)	0.45	3	6	32	19	8	31	1	

Note: [a] I, II, and III represents wheat import, input subsidy and price support component of the combined policy, respectively.
Source: Author's estimation.

which is greater than the total gain to both producers and consumers. Due to this reason, the policy generated a negative rate of return on government investment. The highest rate of return is obtained when only the input subsidy option is followed, but the producers' benefits are negative. On the other hand, negative return is obtained when only price support is implemented, but producers' share is highest.

Comparison of import, input subsidy and price support policy shows that highest rate of return is obtained when input subsidy option is followed, but the producers' benefit is negative. On the other hand, negative return is obtained when price support is implemented, but producers, share is highest in surplus generated by the policy. However, net benefits to the society are highest when input subsidy and price support are combined in the ratio of 90:10, respectively; but the highest rate of return is observed when the deficit is filled by importing 10 per cent and remaining 90 per cent to be filled by input subsidy. In case, all the three policies are combined together in different proportions, the maximum benefit to the society is observed when import and each of the input subsidy and price support the policy and contribute 80 per cent and 10 per cent, respectively.

The appropriate combination depends on the welfare function faced by the government for various sections of the society. The technological change, which is purely based on research, is expected to generate benefits to all groups of the society and is likely to produce the highest rate of return to all policy options, specifically in the long-run [Abedullah and Ali (2001)]. The input subsidy generates net benefit to the society, while import at the existing international prices and the price support gives net loss to the society. In the short-run, the best policy is the combined policy, i.e., when input subsidy and price support contributes 90 and 10 per cent, respectively, because it generates maximum net returns to the society. The input subsidy can be selected as a second-best option for short-run because of positive net return as compared to import and price support option.

The governments of Pakistan operate under budgetary constraints and policy-makers have to consider the government's budgetary situation before implementing any policy among the available options. Due to the budgetary constraint, it is not rational to fill the total gap between supply and demand through price support policy; but at the same time, it is also important to consider the distribution of benefits among consumers and producers. This problem can be dealt with the help of a combined policy option by selecting the most desirable combination of two or three combined policy options.

Bibliography

Abedullah, and M. Ali, 2001, Wheat self-sufficiency in different policy scenarios and their likely impacts on producers: Consumers and public exchequer, The Pakistan Development Review, 40(3): 203-223.

Agricultural Policy Institute, 2008, 6: 118-120, Ministry of Food, Agriculture and Livestock, Government of Pakistan, Islamabad.

Ahmed, R., 1979, Food grain supply, distribution, and consumption policies with a dual pricing mechanism: A case study of Bangladesh, Research report 8, International Food Policy Research Institute, Washington, D.C.

Ahmed, S., and R.P. Martini, 2000, Agricultural policy analysis in Pakistan: Illustrations in the use of the policy analysis matrix, CMER working paper series.

Ali, M., 1990, The price response of major crops in Pakistan: An application of simultaneous equation model, Pakistan Development Review, 29(3&4): 305-325.

Anderson, K., J. Croser, D. Sandri and V. Ernesto, 2009, Agricultural distortion patterns since the 1950s: What needs explaining? Agricultural distortions working paper 90, Political Economy of Distortions to Agricultural Incentives.

Anwar, S., Z. Hussain and M.S. Javed, 2005, Comparative advantage and competitiveness of wheat crop in Pakistan, The Lahore Journal of Economics, 10(2):101-110.

Ashfaq, M., G. Griffith and K. Parton, 2001, Welfare effects of government interventions in the wheat economy of Pakistan, Pakistan Journal of Agricultural Economics, 4(1).

Azhar, B.A., 1993, Stagnation in food grain production in Pakistan: Evidence, causes and prospects, The Pakistan Development Review, 32(4) Part II: 789-797.

Bale, M.D., and E. Lutz, 1981, Price distortions in agriculture and their effects: An international comparison, American Journal of Agricultural Economics, 63(1): 8-22.

Barkely, A.P., 1992, Wheat price policy in Pakistan: A welfare economics approach, The Pakistan Development Review, 31(4) Part II: 1145-1156.

Barker, R., and Y. Hayami, 1976, Price support versus input subsidy for food self-sufficiency in developing countries, American Journal of Agricultural Economics, 68(45): 617-628.

Chaudhry, M.G., and S.A. Sahibzada, 1995, Agricultural input subsidies in Pakistan: Nature and impact, The Pakistan Development Review, 34(4): 711-722.

Croppenstedt, A., M. Saade and G.M. Siam, 2006, Food security and wheat policy in Egypt, ROA's Policy Brief.

Cuthbertson, K., S.G. Hall and M.P. Taylor, 1992, Applied econometric techniques, Philip Allan, New York.

Dickey, D.A., and W.A. Fuller, 1979, Distribution of the estimation for autoregressive time series with a unit root, The Journal of American Statistical Association, 74: 427-431.

Dickey, D.A., and W.A. Fuller, 1981, Likelihood ratio statistics for autoregressive time series with unit roots, Econometrica, 49(1):1057-1072.

Dickey, D.A., W.R. Bell and R.B. Miller, 1986, Unit roots in time series models: Tests and implications, The American Statistician, 40: 12-26.

Dorosh, P., and A. Salam, 2008, Wheat markets and price stabilization in Pakistan: An analysis of policy options, The Pakistan Development Review, 47(1): 71-87.

Dorosh, P.A., A.E. Briones, M. Shuail, and S. Abdul, 2016, Agricultural prices and trade policies, in: Agriculture and the rural economy in Pakistan: Issues, outlooks, and policy priorities, Spielman, David, Sohail Jehangir Malik, Paul A. Dorosh, and Nuzhat Ahmad (eds.). Chapter 7: 273-308, University of Pennsylvania Press on behalf of the International Food Policy Research Institute.

Ender, G., A. Wasay and A. Mahmood, 1992, Wheat price policies in Pakistan: Should there be a subsidy? The Pakistan Development Review, 31(4): 115-117.

Engle, R.F., and C.W.J. Granger, 1987, Co-integration and error correction: representation, estimation and testing, Econometrica, 55: 251-276.

Farooq, U., and M. Iqbal, 2000, Attaining and maintaining self-sufficiency in wheat, The Pakistan Development Review, 39(4): 487-514.

Ghani, E., 1998, The wheat pricing policies in Pakistan: Some alternative options, The Pakistan Development Review, 37(2): 149-166.

Government of Pakistan, 2008, Agricultural statistics of Pakistan, Ministry of Food, Agriculture and Livestock, Islamabad: Pakistan.

Government of Pakistan, 2009a, Pakistan Statistical Year Book, Federal Bureau of Statistics, Islamabad: Pakistan.

Government of Pakistan, 2009b, Economic Survey of Pakistan, Economic Adviser's Wing, Finance Division, Islamabad: Pakistan.

Hallam, D., and R. Zanoli, 1993, Error correction models and agricultural supply response, European Review of Agricultural Economics, 20: 151-166.

Harris, R., 1995, Using co-integration analysis in econometric modeling, Prentice Hall, Harvester Wheat Sheaf.

Hendry, D.F., and J.F. Richard, 1982, On the formulation of empirical models in dynamic econometrics, Journal of Econometrics, 20: 3-33.

Hendry, D.F., and N.R. Ericsson, 1991, Modeling the demand for narrow money in the United Kingdom and the United States, European Economic Review, 35(4):.833-886.

Iqbal, N., 1992, Economic analysis of the effect of wheat price distortions in Pakistan: 1975-1990, The Pakistan Development Review, 31(4):1173-1185.

Johansen, S., 1988, Statistical analysis of co-integrating vectors, Journal of Economic Dynamics and Control, 12: 223-254.

Johansen, S., and K. Juselius, 1990, Maximum likelihood estimation and inference on co-integration approach, Oxford Bulletin of Economics and Statistics, 52: 170-209.

Khan, A.H., and M.A. Qasim, 1996, Inflation in Pakistan revisited, The Pakistan Development Review, 35(4): 747–759.

Khan, N.Z., M. Ahmed and A. Rasheed, 2003, Wheat production: Saga of policy disincentive, The Pakistan Development Review, 42(1): 1-27.

Pinckney, T.C., 1989, The multiple effects of procurement price on production and procurement of wheat in Pakistan, The Pakistan Development Review, 28(2): 95-120.

Ryan, J., and S.R. Khan, 1993, The impact of the GOP's wheat pricing policy on flour prices, The Pakistan Development Review, 32(4) Part II: 823-832.

Siam, G.M., 2006, An assessment of the impact of increasing wheat self-sufficiency and promoting cash-transfer subsidies for consumers in Egypt: A multi-market model, ESA working paper 3, The Food and Agriculture Organization of the United Nations, Rome: Italy.

Thomas, R.L., 1997, Modern econometrics: An introduction, Addison Wesley, Longman Limited.

Townsend, R., and C. Thirtle, 1994, Dynamic acreage response: An error correction model for maize and tobacco in Zimbabwe, Occasional paper 7 of International Association of Agricultural Economics.