The Study of the Effective Factors on Dryland Wheat Inefficiency in Iran and Evaluation of the Effect of Inefficiency on Wheat Output and its Input Demand (Emphasis on 2001-2010 period)

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Abstract

Experimental studies in agriculture sector for deriving input supply and output demand is usually obtained by producers' complete efficiency default in goods production. Deriving the mentioned functions could lead to illusory results without considering inefficiency. This article has investigated the effect of economic inefficiency on output supply and dryland wheat input demand. Therefore, different inefficiencies were estimated using Dual Frontier method and provincial data in 2001-2010 period. In the next step, effective factors on economic inefficiency were investigated. Finally, irrigated wheat input supply and demand have been achieved in two scenarios (the first scenario without considering inefficiency and the second scenario with considering inefficiency).

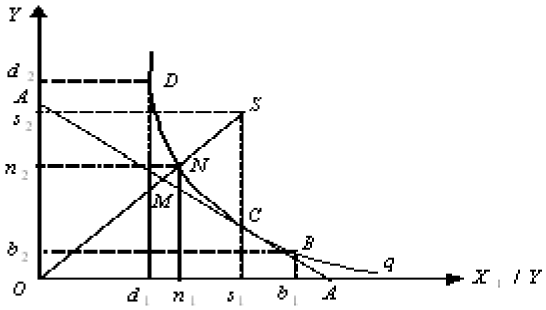
Results showed that government policy in cutting pesticides subsidies *leads to a decrease in economic efficiency and cutting the subsidies related to seeds and chemical fertilizer increases the efficiency. Moreover, considering inefficiency, farmers' reactions toward the prices have changed a lot in both supply and demand.*

Keywords: Efficiency, Dryland wheat, Bayesian method, Subsidies, Normalized profit function

1. Introduction

Increase in agriculture sector production and its share in total economy needs planning for increasing production input usage in production process or increasing producers' efficiency. Utilizing more input could not be an appropriate solution for increasing products because of economies limitations in accessing those input. In this way, continuous increase of efficiency and performance is the only long-term solution to achieve that goal. So, calculating various efficiencies is very important as the first step in determining optimum level of input utilization and their provision cost. In spite of that, experimental studies in Iran’s agriculture sector have been significantly dedicated to technical efficiency investigation and it has been neglected to calculate allocation and economical efficiencies and their effective factors. There are some reasons behind studying the effective factors on economical efficiency in farming subgroup of agriculture sector such as the presence of staples in farming subgroup of agriculture sector, large portion of farming products in agriculture sector productions and over 30% weight of farming staples in the food and beverage indexes. Among farming products, wheat thanks to the large portion in products (equal to 19.5% of total of farming products) and farming sector cultivation (55.2% of farming cultivation), being strategic, high dependency level of families to this product and paying huge subsidies to its production chain has been always considered among one of the critical products in that subgroup. Thus, with regard to the importance of the calculation of various efficiencies and lack of calculations in experimental studies and the importance of wheat, especially dryland , in Iran’s economy, first it has been considered to estimate technical, allocation and economical efficiency of that product using Cost Dual Frontier method in 2001-2010 period, then effective factors on economical efficiency have been studied utilizing Bayesian method and Mont Carlo simulation approach. Efficiency is formed by two parts including pure or physical and allocation part. Pure part is related to the firm capability in avoiding empty capacity by more output production of used input in production process and allocation part is related to the firm capability in combining input and output using optimum ratios in the defined prices level (Lovell, 1993). In spite of that, for the first time, Michel Farell introduced a method for measuring various technical, allocation and economical efficiency in 1957 which has been considered by researchers afterwards. Various efficiency could be presented as diagram 1.

Diagram 1. Schematic drawing of various efficiency



Reference: Farell (1957)

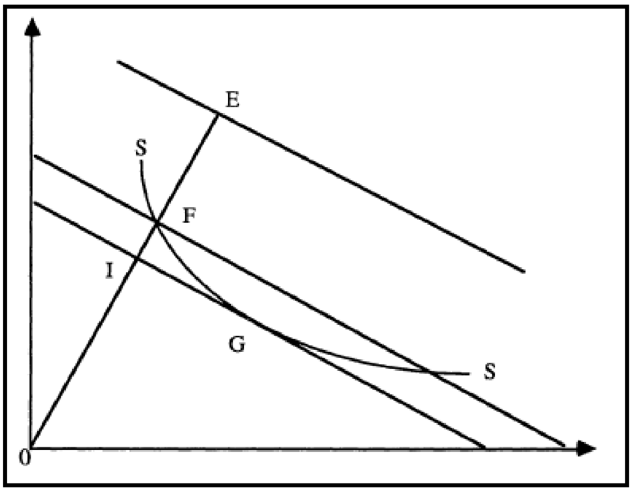
According to the diagram, definition of various efficiency could be presented as following in accordance with Farell's view:

Technical Efficiency: It is defined as the firm capability in producing maximum products from a defined set of input ($TE = \sum_i X_{it} P_i / \sum_i X_i P_i = ON / OS$),

Economical Efficiency: It is related to the firm capability in producing maximum output by selecting optimum set of input (maximum output with minimum cost in technical boundary) ($EE = \sum_i X_{ie} P_i / \sum_i X_i P_i = OM / OS$).

Allocation Efficiency: It is regarded as the firm capability in choosing the optimum set of input at the technical boundary with the lowest cost. It is obtained through the ratio of economical efficiency to technical efficiency according to Farell method ($AE = EE / TE = \sum_i X_{ie} P_i / \sum_i X_{it} P_i = OM / ON$). A lot of studies have been done about measuring agricultural products, especially technical efficiency such as Maganga (2012) studies about potato in Ireland, Abba Mohammad Vakili (2010) about corn in Nigeria, Poomtan (2010) about rice and corn in Thailand, Justice G. Djokoto (2012) about selected agricultural products in Ghana, Thomas Balezentis and Irena (2012) about agricultural products in Litvania, Darina Zaimova (2011) about agricultural products in Italy and Abdulai and Huffman (1998) about rice in Ghana. Further, in Iran, studies have focused significantly on measuring technical efficiency and the methods taken into account for these studies have more emphasized using time slot data. For example, we can refer to Rafati et al.'s studies (2011) about cotton, Mojaverian (2010) about agricultural products and Brimnejad (2007) about wheat. In other studies, scholars have measured technical efficiency and time slot data as the method used for their studies. On the other hand, experimental studies in agriculture sector to derive output supply and input demand are achieved by the default of producers' full efficiency in producing goods. Therefore, deriving those functions without considering inefficiency could lead to illusory results. Thus, it is necessary to estimate wheat output supply and its input demand considering inefficiency. Diagram (2) indicates the effect of various efficiencies on output and the input combination.

Diagram 2. *Inefficiency effect on output supply and input demand*



Reference: Kumbhakar (1991)

According to the above diagram, the used combination of input in E shows technical inefficiency in production, because the firm can produce the same production (SS) using less input. F indicates efficient production and each homogeneous production (SS) shows production inefficiency and finally leads to an extra demand for input. On the other hand, homologous cost (I) is the least cost for SS production. Therefore, each cost increasing more than this amount shows allocation inefficiency in input provision. Thus, although F has got technical efficiency, it has allocation inefficiency, too. G indicates technical and allocation efficiency. Accordingly, any deviation from G, changes the structure of both supply and input demand. It should be emphasized that technical and allocation inefficiencies are technological and behavioral deviations, respectively. It should be pointed out that no study has been done in this area in Iran. However, one of the most important studies in this area is to investigate inefficiency effects on output supply and input demand of Russia agriculture sector in 2002 by Carlos Arnade and Michael A. Trueblood. In this study, the reported numbers of technical and allocated efficiency of 73 provinces of Russia were calculated using Standard Non-Parametric method. Then, those inefficiencies were utilized for Russia agriculture profit function in order to estimate inefficiency effects using output supply and input demand equations system. Results indicate that inefficiency limits supply reaction in relation to price.

The main goal of this article is the ability to investigate economical (technical and allocation) inefficiency changes on farmers' price reactions. According to the given descriptions, this article is presented in two main sections. The first section is related to estimating various inefficiencies with emphasizing on economical inefficiency. Finally, the second section is devoted to inspecting inefficiency impacts on wheat output and input demand. Finally, the article refers to conclusion and recommendation for further research.

2. Materials and Methodology

Economy rating methods in efficiency estimation can be classified into two Primary and Dual method, which are related to the behavioral hypothesis using Boundary (Frontier) analysis approach. Primary method, or

Direct based on production function, is the most popular method to estimate efficient boundary although the invalidity of the model's parameters because of incompatibility is regarded as its most important problems (Coelli, 1995). Dual method enables the scholar to introduce alternative behavioral objectives (minimizing the cost or maximizing the profit), estimate the presence of some products and the most important, and estimate technical and allocation efficiencies simultaneously (Greene, 2003). Therefore, Dual method has been used to estimate the economical efficiency (Thiam et al., 2003). In this study, dryland wheat cost and production amount as well as price and the amount of production input including land (surface under cultivation and land rent), seed (amount of seed and its price), labor (used labor in plowing, tabulation, laying line, distributing fertilizer, seeding, irrigating, pesticide, and other operations and their wage for services), pesticide (including amount of herbicides , insecticide, fungicide and other pesticides and their prices), fertilizer and chemical fertilizer (including phosphate, nitrogen, potassium and other fertilizers and their price) have been used in the period of 2001-2010. The estimation of various efficiencies has been done utilizing Stochastic Translog Cost Frontier and Translog functional form. The following is the model applied in inefficiencies estimation for wheat product in equation (1).

$$TC_{it} = f(Y_{it}, X_{ijt}, \beta_{ij}) + (V_{it} + U_{it}) \quad \forall \quad i = 1,\dots,N; t = 1,\dots,T; j = 1,\dots,k$$

$$V_{it} \approx i.i.d \quad N(0,\sigma_v^2); \quad U_{it} \cong N(M_{it}, \sigma_u^2); \quad M_{it} = Z_{1t}\delta \tag{1}$$

In this model, TC_{it} is total cost share of the $i^{th.}$ firm (province) in one hectare, Y_{it} is i^{th} province performance at surface level, W_{ijt} is a $k \times 1$ vector of the price of production input, β_{ij} is parameters vector, V_{it} a random variable which is regarded as normal distribution and U_{it} is a random invisible non-negative variable and is related to inefficiency. It is necessary to employ a defined consequential form for inefficiency estimation. The flexible nature of Translog cost function, the possibility of scale proportional alternation, along with change in output level and production factors, the equality of changes in final cost and production factor prices with changes in production factor demand and the homogeneity of function in relation to the changes in factors' price can be regarded as the main reasons behind the use of consequential form in this study instead of other kinds of form such as Cobb-Douglas, Leontief function, and the function with fixed substitution elasticity (Relation 2).

$$\begin{aligned} ln\,c(w,y) = \beta_0 + \sum_i \alpha_i \ln y_i + \sum_k \beta_k \ln w_j + (1/2)\sum_i \sum_j \alpha_{ij} \ln y_i \ln y_j \\ + (1/2)\sum_k \sum_l \beta_{kl} \ln w_k \ln w_l + \sum_i \sum_k \delta_{iik} \ln y_i \ln w_k + v_{it} + u_{it} \end{aligned} \tag{2}$$

The symmetry of cross-price of input and output has taken into account in estimating the model (Coelli, (1996), pp. 4-6). In order to eliminate the inflation effect on the estimated model, all variables have been changed to the real price according to 2005 price index - as a base - and these data have been utilized in estimation. A panel data structure model with Bayesian estimation method was used in order to investigate the effective factor on economical efficiency and more appropriate results analysis in those two distributions.

$$\begin{aligned}&\text{ee} = \text{f}\ (\text{TCa}, \text{TCk}, \text{TCd}, T, \text{TCKsH}, \text{TCso}, \text{TCb}, \text{TCw}, \text{TCyarane}, \text{Age}, \text{megh})\\&\text{ee} = \beta_0 + \beta_1 \text{TCa} + \beta_2 \text{TCk} + \beta_3\ \text{TCd} + \beta_4 T + \beta_5 \text{TCKsH} + \beta_6 \text{TCso} + \beta_7 \text{TCb}\\&\quad + \beta_8\ \text{TCw} + \beta_9 \text{TCyarane} + \beta_{10} \text{Age} + \beta_{11}\ \text{megh}\ + \text{U}_{\text{it}}\end{aligned} \qquad (3)$$

In this model, tc_a is land preparation cost, tc_k is planting cost, T is the technology share in total production process, tc_ksh is the chemical fertilizer cost, tc_so is pesticides cost, tc_b is seed cost, tc_w is water cost, tc_yarane is government subsidies cost for guaranteed purchase, age is the average farmers' age and megh is the average land under the cultivation of wheat.

Fare, Groskapov and Lovell showed that input scale for technical inefficiency is equal to the reversion of input distance function. Using cost minimizing dual equals to maximizing the profit. The optimization condition for each y_i in profit maximizing and cost minimizing in the presence of technical and allocation inefficiency is in the form of $p_i = \theta^{-1} \frac{\partial C}{\partial y_i} + \alpha_i , i = 1,\ldots,N$, in which α_i and θ show technical and allocation inefficiency in producing $i^{th.}$ product respectively. Profit functions and its derivations - supply and demand – can be presented by equations (4) and (5).

$$\Pi^*(\theta(p-\alpha_i),w) = \max_y p'y^* - \theta^{-1} C(y^*,w) \qquad (4)$$

$$\begin{aligned}&\frac{\partial \Pi^*(\theta(p-\alpha),w)}{\partial p_i} = y_i + \sum_{i=1}^{n} p_i - \theta^{-1} \frac{\partial C(y^*,w)}{\partial y_i} \frac{\partial y_i}{\partial p_i^*} \frac{\partial p_i^*}{\partial p_i} \quad : p_i^* = \theta(p_i - \alpha_i)\\&1)\ \frac{\partial \Pi^*(\theta(p-\alpha),w)}{\partial p_i} = y_i + \sum_{i=1}^{n} \alpha_i\ \theta \frac{\partial y_i}{\partial p_i^*}\\&2)\ \frac{\partial \Pi^*(\theta(p-\alpha),w)}{\partial w_j} = \left(\frac{-x_i}{\theta}\right) + \sum_{j=1}^{n} \alpha_j\ \theta \frac{\partial y_i}{\partial w_j}\end{aligned} \qquad (5)$$

Profit function, was introduced as equation (6) utilizing Translog form.

$$\begin{aligned}\Pi(\theta\, p,w) = &\sum \beta_{it} \theta_{it} (p_{it} - \alpha_{it}) + \sum_{j=1}^{6} \beta_{jt} w_{jt} + 0.5 \sum \sum_{k=1}^{6} \beta_{ikt} \theta (p_{it} - \alpha_{it})(p_{kt} - \alpha_{kt})\\&+ 0.5 \sum_{j=1}^{6} \sum_{l=1}^{6} \beta_{jkt} w_{jt} w_{kt} + 0.5 \sum \sum_{k=1}^{6} \beta_{ikt} \theta (p_{it} - \alpha_{it}) w_{kt}\end{aligned} \qquad (6)$$

P is the guaranteed wheat price in the country provinces, w_j is production input price (land, seed, labor, pesticides, fertilizer and chemical fertilizer). The consequential form of output supply and input demand equation was introduced as equations (7) and (8).

$$y_{it} = \beta_{it}\theta_{it} + \sum_{k=1}^{6} \beta_{ikt}\theta_{it}^{\ 2}\left(p_{kt} - \alpha_{kt}\right) + \sum_{j=1}^{6} \beta_{ijt}\theta_{it} w_{kt} - \left[\sum_{k=1}^{6} \beta_{ikt}\theta_{\ it}\alpha_{kt}\right] \qquad (7)$$

$$-x_{jbt} = \beta_j\theta_{bt} - \sum_{k=1}^{4} \beta_{jk}\alpha_k\left(\theta_{bt} + \theta_{bt}^{\ 2}\right) + \sum_{k=1}^{3} \beta_{jk}\theta^2 p_{bt} + \sum_{j=1}^{4} \beta_{jk}\theta w_{kbt} + \varepsilon_{jbt}\ , \quad j = 1, \ldots, 6 \qquad (8)$$

Model estimation was done using Seemingly Unrelated Regression Estimation method (SURE). Considering the factors equality in input demand and output supply, some symmetry and equality criteria were applied to the final model. Using derivation rules and normal profit function characteristics (earning ratio), the output supply and demand were introduced in the form of cost share function (S_i). In this model, z, b, l, kh, ksh, so, p show wheat guaranteed price, pesticides, fertilizer, labor, seed, land and price, respectively. Considering the cost-share function characteristics, first output supply share equation was omitted from model and then supply equation coefficients were extracted according to the equality of the equation factors to unity.

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The first scenario: without considering inefficiency (9) and the second scenario: considering inefficiency (10)

$$\Pi(p,w)=b_o+\sum_{j=1}^{6}b_iP+\sum_{j=1}^{6}b_jP_j+0.5\sum_{k=1}^{6}b_j\left(p_j^{\ 2}\right)+0.5\sum_{j=1}^{6}\sum_{l=1}^{6}b_{jkt}P_{jt}P_{kt}+\sum_{l=1}^{6}b_{jkt}P\,P_{kt}$$

$$LnS_z=P_zX_z/\Pi=b_z+b_{zz}(Ln\,p_z)+\gamma_{zp}LnP+(1/2)b_{zb}Ln(p_b)+(1/2)b_{zkh}Ln(p_{kh})+(1/2)b_{zksh}Ln(p_{ksh})+(1/2)b_{zso}Ln(p_{s}$$

$$LnS_b=P_bX_b/\Pi=b_b+b_{bb}(Ln\,p_b)+\gamma_{bp}LnP+(1/2)b_{bz}Ln(p_z)+(1/2)b_{bkh}Ln(p_{kh})+(1/2)b_{bksh}Ln(p_{ksh})+(1/2)b_{bso}Ln(p_{s}$$

$$LnS_l=P_lX_l/\Pi=b_l+b_{ll}(Ln\,p_l)+\gamma_{lp}LnP+(1/2)b_{lz}Ln(p_z)+(1/2)b_{lkh}Ln(p_{kh})+(1/2)b_{lksh}Ln(p_{ksh})+(1/2)b_{lso}Ln(p_{so})+$$

$$LnS_{so}=P_{so}X_{so}/\Pi=b_{so}+b_{soso}(Ln\,p_{so})+\gamma_{zop}LnP+(1/2)b_{soz}Ln(p_z)+(1/2)b_{sokh}Ln(p_{kh})+(1/2)b_{soksh}Ln(p_{ksh})+(1/2)b_{sol}Ln(p_l$$

$$Ln\,S_{kh}=P_{kh}X_{kh}/\Pi=b_{kh}+b_{khkh}(Ln\,p_{kh})+\gamma_{khp}LnP+(1/2)b_{khz}Ln(p_z)+(1/2)b_{khso}Ln(p_{so})+(1/2)b_{khksh}Ln(p_{ksh})+(1/2)b_{khl}Ln(p$$

$$Ln\,S_{ksh}=P_{ksh}X_{ksh}/\Pi=b_{ksh}+b_{kshksh}(Ln\,p_{ksh})+\gamma_{kshp}LnP+(1/2)b_{kshz}Ln(p_z)+(1/2)b_{kshso}Ln(p_{so})+(1/2)b_{kshkh}Ln(p_{kh})+(1/2)b_{kshl}Ln($$

$$\Pi(\theta\,p,w)=\beta_o+\sum\beta_{it}\theta_{it}(p_t-\alpha_{it})+\sum_{j=1}^{6}\beta_{jj}P_j+0.5\sum_{j=1}^{6}\beta_{jt}(P_{jt})^2+0.5\sum\sum_{k=1}^{6}\beta_{ikt}\theta(p-\alpha_{it})^2+0.5\sum_{j=1}^{6}\sum_{l=1}^{6}\beta_{jkt}P_{jt}P_{kt}+0.5\sum_{k=1}^{6}\beta_{ikt}\theta$$

$$LS_z=(\beta_z-(1/2)\beta_{zz\theta}\theta\alpha)+\beta_{zz}\theta(Ln\,p_z-Ln\alpha_I)+(1/2)\beta_{zb}Ln(p_b)+(1/2)\beta_{zkh}Ln(p_{kh})+(1/2)\beta_{zksh}Ln(p_{ksh})+(1/2)\beta_{zso}Ln(p_{so})+(1/$$

$$Ln\,S_b=(\beta_b-(1/2)\beta_{bb\theta}\theta\alpha)+\beta_{bb}(Ln\,p_b)+\gamma_{bp}Lnp+\beta_{bb}\theta Lnp+(1/2)\beta_{bz}Ln(p_z)+(1/2)\beta_{bkh}Ln(p_{kh})+(1/2)\beta_{bksh}Ln(p_{ksh})+(1/2)\beta_{bso}$$

$$LnS_l = (\beta_l - (1/2)\beta_{ll\theta}\theta\alpha) + \beta_{ll}\theta(Ln\, p_L - Ln\alpha_I) + (1/2)\beta_{lz}Ln(p_z) + (1/2)\beta_{lkh}Ln(p_{kh}) + (1/2)\beta_{lksh}Ln(p_{ksh}) + (1/2)\beta_{lso}Ln(p_{so}) + (1/2$$

$$Ln\, S_{so} = (\beta_{so} - (1/2)\beta_{soso\theta}\theta\alpha) + \beta_{soso}\theta(Ln\, p_{SO} - Ln\alpha_I) + (1/2)\beta_{soz}Ln(p_z) + (1/2)\beta_{sokh}Ln(p_{kh}) + (1/2)\beta_{soksh}Ln(p_{ksh}) + (1/2)\beta_{sol}Ln(p_l) +$$

$$Ln\ S_{kh} = (\beta_{kh} - (1/2)\beta_{khkh\theta}\theta\alpha) + \beta_{khkh}\theta(Ln\, p_{KH} - Ln\alpha_i)(Ln\, p_{kh}) + (1/2)\beta_{khz}Ln(p_z) + (1/2)\beta_{khso}Ln(p_{so}) + (1/2)\beta_{khksh}Ln(p_{ksh}) + (1/2)\beta_{khl}$$

3. Results and Discussion

Calculations for measuring efficiency have been done by Frointier4.1 and Stat11 and for effective factors by OPENGIBS. The obtained results from various inefficiencies estimation have been brought in Table (1).

Table 1. Dryland wheat inefficiency average in 2001-2010 period in terms of Iran's provinces

Item		Technical	Allocation	Economical	Item		Technical	Allocation	Economical
1	Golestan	0.16	0.11	0.26	13	Fars	0.4	0.53	0.7
2	Mazandaran	0.17	0.16	0.3	14	Kordestan	0.35	0.57	0.71
3	Tehran	0.24	0.13	0.34	15	Markazi	0.34	0.57	0.71
4	Semnan	0.29	0.26	0.47	16	Ilam	0.44	0.53	0.71
5	Charmahal	0.3	0.32	0.51	17	Esfahan	0.31	0.59	0.72
6	Ardebil	0.2	0.48	0.58	18	Zanjan	0.4	0.61	0.75
7	Kermanshah	0.3	0.45	0.59	19	Qazvin	0.33	0.65	0.75
8	Azarbaijan Gharbi	0.24	0.5	0.61	20	Azarbaijan Sharqi	0.42	0.58	0.75
9	Lorestan	0.37	0.4	0.61	21	Khoozestan	0.48	0.62	0.78
10	Gilan	0.43	0.36	0.62	22	Khorasan	0.28	0.72	0.79
11	Kohgilooieh	0.42	0.48	0.67	23	Bushehr	0.53	0.85	0.93
12	Hamedan	0.37	0.5	0.67					
All Country average		Technical Inefficiency: 30%		Allocation Inefficiency: 51%			Economic Inefficiency: 67%		

Reference: Research calculations

As one of the most important effective factors on efficiency analysis is environmental variety in Iran's provinces, ignoring that factor could result in an incorrect estimation of provinces condition when comparing them to each other. Therefore, by considering some variables such as rain, cold weather, altitude and the data of Iran province geography, the provinces of Iran were divided into four zones of Mountain Mediterranean (first zone includes Azarbaijan Sharqi and Gharbi, Ardebil, Kermanshah, Kordestanm Hemedan, Charmahal-o-Bakhtiari, Kohgilooieh va Boierahmad), Temperate Mediterranean and Mountain (Second zone includes Mazandaran, Gilan, Golestan, Ilam and Lorestan), Dry Temperate (Third zone includes Khorasan, Yazd, Semnan, Qazvin, Zanjan, Khozestan va Bushehr) and desert and semi-desert hot and dry region (Fourth zone includes Markazi, Fars, Tehran and Esfahan). Hereafter, the results derived from estimations were evaluated according to each zone and in terms of dryland and irrigated wheat.

In the first zone, Ardebil (80%) and Azarbaijan Sharqi andKohgilooieh va Boierahmad (58%) has maximum and minimum technical efficiency level respectively, Charmahal-o-Bakhtiari (68%) has the maximum allocated efficiency and Kordestan (43%) has the minimum of that kind. Moreover, Charmahal-o-Bakhtiari (49%) and Azarbaijan Sharqi (29%) have got the maximum and minimum economical efficiency respectively. In the second zone, Golestan has assigned to itself the maximum levels of technical (84%), allocation (89%) and economical (74%) efficiency. Ilam has got the minimum level of technical (56%), allocation (47%) and economical (29%) efficiency in this zone. In the third zone, Khorasan (72%) and Bushehr (47%) have minimum and maximum technical efficiencies respectively. In addition, Semnan and Bushehr have got maximum and minimum allocated and economical efficiencies respectively. In the fourth zone, Tehran owns maximum level of various efficiencies, Fars has the minimum level of technical efficiency (60%) and Esfahan has the minimum level of allocated (41%) and economical (28%) efficiencies. Investigation results of effective factors have brought in Table2.

Table 2. Estimation results of effective factors on the technical efficiency of Iran's farmers' dryland production

Variables	Description	Coefficients	Variables	Description	Coefficients
Beta[0]	Intercept	–9.7	Beta[6]	Pesticides cost	0.04
Beta[1]	Preparation cost	–0.08	Beta[7]	Seed cost	–1.17
Beta[2]	Planting cost	1.01	Beta[8]	Landfall	0.07
Beta[3]		–0.31	Beta[9]	Price subsidies	0.7

Beta[4]	Technology share	–0.01	Beta[10]	Age	1.38
Beta[5]	Chemical fertilizer share	–0.33	Beta[11]	Land scale	2.34

Reference: Research calculations

Estimation results showed that planting, pesticides, landfall, government subsidies for guaranteed purchase, farmers' average age and the land under cultivation scale had positive influence on efficiency and the rest had negative effects. According to the above table, the elimination of pesticide subsidies has decreased the efficiency. In one hand, seed and chemical fertilizer subsidies elimination increases the efficiency. Therefore, government policy about production subsidies elimination has not had the same consequences. Increasing the scale - thanks to providing necessary background to use scale advantages- is one of the most important methods to increase the economical efficiency of dryland wheat production in Iran. Finally, negativity of the share coefficient of land preparation cost, on one hand and the positivity of the scale coefficient, on the other hand, can prove this fact that scale advantages are not utilized optimally even in large scale farms. Table 3 indicates the estimation results of normalized profit function.

Table 3. The estimation results of normalized profit function

	Variables	Coefficients	**p value**		Variables	Coefficients	**p value**
Profit function without considering efficiency	lspz	-4.913721	0.000	Profit function considering efficiency	nlspz	-1.87244	0.000
	lspb	3.181352	0.057		nlspb	-0.924003	0.304
	lspl	1.083624	0.000		nlspl	1.018095	0.000
	lspso	-1.780364	0.000		nlspso	-0.231139	0.615
	lspkh	-0.3694441	0.207		nlspkh	0.7295715	0.014
	lspksh	5.380637	0.005		nlspksh	0.9097546	0.263
	lspz2	0.4748705	0.000		nlspz2	0.2669807	0.000
	lspb2	0.6499002	0.002		nlspb2	0.3281506	0.001
	lspl2	0.1524528	0.000		nlspl2	0.1489575	0.014
	lspso2	0.4819239	0.000		nlspso2	0.3599333	0.000
	lspkh2	0.3598502	0.000		nlspkh2	0.4007348	0.000
	lspksh2	0.6522481	0.003		nlspksh2	0.2552199	0.001
	lspzpb	-0.5328763	0.000		nlspzpb	-0.307948	0.000
	lspzpl	-0.1119075	0.005		nlspzpl	-0.204739	0.000

	lspzpso	-0.4447281	0.000		nlspzpso	-0.639144	0.000
	lspzpkh	-0.5171365	0.000		nlspzpkh	-0.668319	0.000
	lspzpksh	-0.5273209	0.000		nlspzpksh	-0.271446	0.000
	lspbpl	-0.03586	0.408		nlspbpl	-0.149466	0.004
	lspbpso	-0.4156999	0.000		nlspbpso	-0.432108	0.000
	lspbpkh	-0.4910474	0.000		nlspbpkh	-0.486973	0.000
	lspbpksh	-0.3464054	0.087		nlspbpksh	-0.827345	0.000
	lsplpso	-0.2237944	0.000		nlsplpso	-0.178543	0.002
	lsplpkh	-0.137203	0.001		nlsplpkh	-0.21341	0.000
	lsplpksh	-0.0406075	0.357		nlsplpksh	-0.119455	0.029
	lspsopkh	-0.414342	0.000		nlspsopkh	-0.669931	0.000
	lspsopksh	-0.4139304	0.000		nlspsopksh	-0.410776	0.000
	lspkhpksh	-0.4905679	0.000		nlspkhpksh	-0.471783	0.000
	_cons	21.50031	0.000		_cons	2.920234	0.000

Reference: Research calculations

Table 4. The estimation results of share functions from input profit in dual scenarios

First Scenario	Variables	Coefficients	**P- Value**	Second Scenario	Variables	Coefficients	**P- Value**
share from land profit without considering efficiency	lspz	0.4748705	0.000	share from land profit considering efficiency	Nlspz	0.2669807	0.000
	lspb	-0.5328763	0.000		Lspb	-0.307948	0.000
	lspl	-0.1119075	0.005		Lspl	-0.204739	0.000
	lspso	-0.4447281	0.000		Lspso	-0.639144	0.000
	lspkh	-0.5171365	0.000		Lspkh	-0.668319	0.000
	lspksh	-0.5273209	0.000		Lspksh	-0.271446	0.000
seed profit without considering efficiency	lspz	-0.5328763	0.000	share from seed profit considering efficiency	Lspz	-0.307948	0.000
	lspb	0.6499002	0.002		Nlspb	0.3281506	0.001

	lspl	-0.03586	0.408		Lspl	-0.149466	0.004
	lspso	-0.4156999	0.000		Lspso	-0.432108	0.000
	lspkh	-0.4910474	0.000		Lspkh	-0.486973	0.000
	lspksh	-0.3464054	0.087		Lspksh	-0.827345	0.000
share from labor profit without considering efficiency	lspz	-0.1119075	0.005	share from labor profit without considering efficiency	Lspz	-0.204739	0.000
	lspb	-0.03586	0.408		Lspb	-0.149466	0.004
	lspl	0.1524528	0.000		Nlspl	0.1489575	0.014
	lspso	-0.2237944	0.000		Lspso	-0.178543	0.002
	lspkh	-0.137203	0.001		Lspkh	-0.21341	0.000
	lspksh	-0.0406075	0.357		Lspksh	-0.119455	0.029
share from pesticides profit without considering efficiency	lspz	-0.4447281	0.000	share from pesticides profit without considering efficiency	Lspz	-0.639144	0.000
	lspb	-0.4156999	0.000		Lspb	-0.432108	0.000
	lspl	-0.2237944	0.000		Lspl	-0.178543	0.002
	lspso	0.4819239	0.000		Nlspso	0.3599333	0.000
	lspkh	-0.414342	0.000		Lspkh	-0.669931	0.000
	lspksh	-0.4139304	0.000		Lspksh	-0.410776	0.000
share from fertilizer profit without considering efficiency	lspz	-0.5171365	0.000	share from fertilizer profit without considering efficiency	Lspz	-0.668319	0.000
	lspb	-0.4910474	0.000		Lspb	-0.486973	0.000
	lspl	-0.137203	0.001		Lspl	-0.21341	0.000
	lspso	-0.414342	0.000		Lspso	-0.669931	0.000

	lspkh	0.3598502	0.000		Nlspkh	0.4007348	0.000
	lspksh	-0.4905679	0.000		Lspksh	-0.471783	0.000
share from chemical fertilizer profit without considering efficiency	lspz	-0.5273209	0.000	share from chemical fertilizer profit without considering efficiency	Lspz	-0.271446	0.000
	lspb	-0.3464054	0.087		Lspb	-0.827345	0.000
	lspl	-0.0406075	0.357		Lspl	-0.119455	0.029
	lspso	-0.4139304	0.000		Lspso	-0.410776	0.000
	lspkh	-0.4905679	0.000		Lspkh	-0.471783	0.000
	lspksh	0.6522481	0.003		nlspksh	0.2552199	0.001

Reference: Research calculations

The most important results of production input share estimation before and after considering efficiency are as follow:

By considering inefficiency in the model, there was an increase in intercept, share demand functions from land profit, pesticides, and fertilizer while there was a decrease in share demand functions from seed, labor, and chemical fertilizer profit. In addition, there was a decrease in share coefficient of each input from profit in relation to its price has been with the exception of fertilizer. These results indicate that by considering inefficiency, farmers' reaction to alteration in input price is limited.

We cannot introduce a specific rule with regard to the relation of input share changes from profit with other input price alterations. Supply share function can be acquired using demand share function coefficients (Table 5).

Table 5. The obtained results from the estimation of the wheat supply share from profit with and without considering inefficiency

Scenario Number	Intercept	lspksh	Lspkh	lspso	Lspl	lspb	lspz
The First	-1.59	2.15	2.68	2.41	1.38	2.34	2.64
The Second	1.32	2.83	2.76	2.95	1.29	2.85	2.8

Reference: Research calculations

By looking at the above table, the intercept of supply share function has increased. Moreover, regarding input price, all signals were in accordance with expectations and after considering inefficiency as well, all coefficients increased with the exception of labor price. This indicates that more intensified supply reaction should be adopted against input price alterations. As technology does not have an appropriate position in dryland wheat efficiency, labor has got an important role in its production and therefore supply reaction function has become more limited by considering model inefficiency.

4. Summarization and policy recommendations

According to the negative effects of disregarding inefficiency in estimating the price reaction functions of agricultural products, this study has investigated the consideration of the effects of inefficiency on the share of wheat output supply and demand for its input during 2001-2010 period. Thus, the various inefficiencies were estimated first by using dual boundary method and provincial data. In the next step, factors affecting economical inefficiency were evaluated using Bayesian method. Results showed that government policy on eliminating the pesticides subsidies led to a decrease in economical inefficiency and an increase in seed and chemical fertilizer. Then, the share functions of dryland wheat input supply and demand were obtained in the frame of two scenarios - the first scenario without considering inefficiency and the second scenario with considering inefficiency- and on the basis of Seemingly Unrelated Regression method. In order to do this, the mentioned functions were derived from normal profit function of the dryland wheat producers using microeconomic theorem specially "Hotelling's Theorem". According to the results of the study, the below recommendation could be utilized by the policymakers with regard to Iran's economy in agriculture sector.

1. All research done in the agriculture field in order to obtain output supply or demand for input should not take the producer's full efficiency as default. As the result of this study depicted, the inconsideration of inefficiency can change coefficients and farmers price reactions in the supply and demand field.

2. Policymakers should pay more attention to technical inefficiency to face inefficiency because it has got the most effect on output supply and demand for input.

3. By considering inefficiency in the model and change in farmers' price reactions in one hand, and the negative technology share in economical efficiency on the other hand, the necessity for palnning is unavoidable to increase capital share in wheat production process.

4. According to the results, it is suggested that the government re-establish seed and chemical fertilizer subsidie

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