International Journal of Agriculture and Food Science 2024; 6(2): 01-04

ISSN Print: 2664-844X
ISSN Online: 2664-8458 IJAFS 2024; 6(2): 01-04
www.agriculturaljournals.com
Received: 02-05-2024
Accepted: 06-06-2024

Nuha Mohammad Jead
Department of Agricultural Economics and Extension, Agricultural Economics, College of Agriculture, Tikrit University, Tikrit, Iraq

Yusrah T Bakar AL- Bajari
Bajari, Department of Agricultural Economics and Extension, Agricultural Economics, College of Agriculture, Tikrit University, Tikrit, Iraq

Corresponding Author:
Nuha Mohammad Jead
Department of Agricultural Economics and Extension, Agricultural Economics, College of Agriculture, Tikrit University, Tikrit, Iraq

Estimation of the stochastic frontier production function of maize crop in Salah Al-Din governorate / Al-Dur district for the agricultural season (2020-2021)

Nuha Mohammad Jead and Yusrah T Bakar AL- Bajari

DOI: https://doi.org/10.33545/2664844X.2024.v6.i2a.193

Abstract
In order to create a model for the agricultural season (2020-2021), the study sought to estimate the random border production function of the maize crop under supplemental irrigation systems in Salah El-Din Governorate and Al-Dour district. All of the farmers that grow yellow corn in Salah Al-Din Governorate's Al-Dour district make up the research sample, which was gathered using a questionnaire form designed specifically for this purpose and provides the information needed for this investigation. A random sample of the agricultural community was taken. For the production season 2021, there were 352 farms in the Al-Dur district, and the total cultivated area was 3,750 dunums for fixed and pivotal irrigation. There were 70 farmers using pivotal irrigation, covering an area of 1000 dunams, and 42 farmers using permanent irrigation, covering an area of 700 dunams. The logarithmic transcendental production function was used in the study to describe the stochastic frontier analysis model, or SFA. Regarding the two systems, the first issue involved using the Frontier 4.1 software and the Maximum Likelihood approach to estimate the stochastic border production function in accordance with the transcendent logarithmic production function TL. As it turned out, some of the production-related factors under study were morally and positively charged, while others-like seeds-violated economic logic, as did the quantity of water provided and the number of hours worked. That technological advancements have a negative impact on agricultural output, the random variable, and, eventually, technical efficiency. Technical efficiency averaged 0.65%; this suggests that farmers can achieve a 34% improvement in production.

Keywords: Random production function, yellow corn, random border costs

Introduction

One of the parametric approaches put out by researchers Aigner and others in 1977 is the stochastic border production function. This method was created by researcher Farrell, who also devised the system for assessing and estimating efficiency in 1957.In general, it assumes the determination of the dependent variable and the independent variables, and the residuals are the result of measurement errors or inefficiency and differ This model is based on the production boundary function model, Whereas the stochastic frontier production function is the basis for deriving the stochastic frontier cost function [1]. The Cobb-Douglas function differs in the presence of the random error Fi added to the non-negative random variable Ui. This property is characterized by separating the residual Ei into two parts with a common variance equal to zero. The first part represents the random error term Vi, which in turn reflects measurement errors and may be positive or negative. The second part is the limit of inefficiency Ui, and it comes in the fact that the inefficiency is caused by the negative deviation from the boundary efficiency curve [2]. What distinguishes this part is that it gives estimates for the limit of efficiency shortfall, and thus separates it from the limit of random error, which provides the opportunity for an accurate interpretation of the difference in efficiency [3]. It was found through the basic rules of the theory of efficiency that this method represents the most efficient points and that the distance between each point and the curve represents the degree of inefficiency [4].

Research importance

1. Using advanced economic methods in the field of economics of production, such as the random bounds production function. This function is characterized by tby the significance of the outcomes that can be achieved and applied to fulfill numerous objectives.
2. The random bounds production function is the basis for deriving the stochastic bounds cost function [1]. This function is characterized by the presence of the random error Fi added to the non-negative random variable Ui, and in this way it differs from the Cobb-Douglas function, as this property distinguishes it by separating the residual Ei into two parts. They have a covariance equal to zero.

Research problem

The reason for choosing the SFA method using (transcendental logarithmic production function) is because it is suitable for imposing the study of efficiency for farms that suffer from problems and large differences in the data, in addition to the ability to explain the variance in terms of independent variables.

Research aims: Determine the amount of the inefficiency parameter for each farm represented by the random variable (ui) by estimating the stochastic boundary production function and measuring the Technical Efficiency (TE) using the Transcendental Production Function.

Search method

The research relied on two methods, namely the descriptive and quantitative method. The descriptive method deals with the general description of the governorate under study and its importance and the importance of the yellow corn crop and its occurrence in terms of area and productivity, in addition to the social and economic characteristics of the sample. As for the quantitative side, it is economic and standard that studies the assessment of important functions.

Data sources

First - preliminary data

The research was dependent on information obtained from its sources in the field, and this information was gathered via individual interviews with farmers in order to acquire the necessary data using a questionnaire that was specifically created for this task.

Second - secondary data

Secondary data were obtained through the Ministry of Agriculture, the Ministry of Water Resources, and the Ministry of Planning and Development Cooperation, publications related to the subject of the research.

Results and discussion

The results of estimating the transcendental logarithmic production function TL according to the random parametric analysis (SFA)

The description of the model is according to the random border analysis, as the dependent variable was the quantity of maize production and the independent variables are (area, the amount of seeds, working hours, the amount of added water, the amount of pesticides, the amount of fertilizers), and the inefficiency variables represented by the management variables (educational level, family size). Supplementary irrigation experience) and Frontier 4.1 program was used to estimate the model because the (OLS) method, Although it gives the best linear and unbiased estimate of the coefficients and is used as a step in estimation, it cannot be relied upon in application to non-linear regression models. The COLS method was adopted in the second step, where the model was estimated using the ML method in order to obtain maximum likelihood estimates of the production function parameters. The results of the (superior) logarithmic production function were TL according to the (ML) method and the inefficiency model according to the random parametric analysis as shown in Table 1.

Table 1: results of the superior logarithmic production function (TL) and the inefficiency model

Parameter	Cof.	ST.	T-R.
Beta0	0.10441757	0.16406939	***0.6364231
Beta1	0.70010438	0.44014880	0.15906084
Beta2	-0.18814658	0.16918913	-0.11120489
Beta3	0.23467695	0.23065833	0.10174224
Beta4	0.34245637	0.27970115	0.12243652
Beta5	-0.99672719	0.39302049	-0.25360663
Beta6	-0.31842949	0.10446934	-0.3048066
Te effects model(inefficiency)			
Delta0	0.62494553	0.79933020	0.78183651
Delta1	-0.59744774	0.13180518	-0.45328092
Delta2	-0.32245350	0.27477434	-0.11735211
Delta3	0.25248772	0.26073446	0.96837114
Delta4	0.15159127	0.28055157	0.54033299
sigma-squared	0.68461764	0.54653937	0.12526410
Gamma	0.961536321	0.32243326	0.29821251
log likelihood function	0.52637614-		

***Source*:** From the researcher’s work using Frontier 4.1 Significant at 1%

The results of the function are interpreted as follows

1. Area X1

He value of flexibility demonstrates the positive and moral relationship between the area and the yield of yellow corn at 5%. This indicates that increasing the area planted with the crop by 1% results in a 0.70010438 percent increase in production, which is in line with the ideas of economic theory. The area is one of the most influential variables in the quantity of the product (2015), due to its importance in increasing production, and it is also important in supplementary irrigation, especially pivot irrigation, as it requires large areas.

2. Quantity of seeds x2

The value of flexibility shows the negative and insignificant relationship between the amount of seeds and production, meaning that an increase in seeds by 1% will lead to a decrease in production by 0.18814658%, and this means that the amount of seeds used by farmers exceeds the required level, which means that there is a waste in the use of the resource, in addition to the dependence of most farmers on Varieties from previous seasons as a result of poor funding, Al-Naimi [5]. It also indicates that most farmers do not rely on the recommended quantities of seeds, and this affects the growth and density of the plant, and thus is reflected in the decrease in production.

3. Amount of pesticides x3

The sign of the variable is positive and it is consistent with the economic logic and it reached 0.23467695. In general, we note the absence of agricultural guidance and counseling, which in turn negatively affected the use of this resource, in addition to the increase in its prices in the markets.

4. Quantity of fertilizer x4

The sign of the fertilizer variable of 0.34245637 matches the economic logic, showing the positive relationship between the fertilizer and the amount of output, meaning that an increase in fertilizer use by 1% will lead to an increase in the output by 0.342%.

5. Number of working hours X5

The indication of the number of human working hours, amounting to 190.996727, did not match the economic logic, indicating the inverse relationship between work and production.

6. Amount of added water x6

The variable has a negative and insignificant relationship with the yield of maize through the negative sign of its elasticity value, which means that increasing the amount of irrigation water given to the maize crop of water by 10% will lead to a decrease in maize production by 0.31%, and this reflects the effect of the amount of water use of water and dependence on traditional irrigation methods that lead to waste of water and a decrease in the output [6]. As for the significance of the variables, despite the fact that the statistical significance is not important in the functions estimated by the ML method, this is due to the fact that the parameters estimated in this way are efficient and coherent to the limits of the error Ui and small in size relative to the community estimates taken from it [2].

Table 2: Technical Efficiency (TE) of the study sample according to SAF. Random border analysis

TE	Firm	TE	Firm	TE	Firm	TE	Firm
0.915	91	0.586	61	0.614	31	0.417	1
0.743	92	0.518	62	0.315	32	0.824	2
0.250	93	0.762	63	0.571	33	0.851	3
0.343	94	0.816	64	0.625	34	0.758	4
0.383	95	0.824	65	0.618	35	0.682	5
0.767	96	0.623	66	0.648	36	0.578	6
0.358	97	0.914	67	0.794	37	0.914	7
0.682	98	0.838	68	0.760	38	0.629	8
0.849	99	0.663	69	0.760	39	0.613	9
0.907	100	0.346	70	0.902	40	0.720	10
0.933	101	0.495	71	0.933	41	0.895	11
0.0.775	102	0.471	72	0.251	42	0.901	12
0.640	103	0.739	73	0.236	43	0.818	13
0.585	104	0.713	74	0.740	44	0.847	14
0.886	105	0.901	75	0.646	45	0.681	15
0.932	106	0.716	76	0.438	46	0.716	16
0.869	107	0.826	77	0.760	47	0.374	17
0.614	108	0.769	78	0.673	48	0.414	18
0.832	109	0.662	79	0.638	49	0.384	19
0.828	110	0.656	80	0.897	50	0.839	20
0.283	111	0.345	81	0.718	51	0.887	21
Men	0.656	0.409	82	0.768	52	0.871	22
		0.219	83	0.758	53	0.789	23
		0.574	84	0.888	54	0.819	24
		0.830	85	0.856	55	0.673	25
		0.837	86	0.346	56	0.779	26
		0.359	87	0.529	57	0.793	27
		0.218	88	0.326	58	0.841	28
		0.693	89	0.268	59	0.543	29
		0.903	90	0.294	60	0.772	30

***Source*:** From the researcher's conclusion based on the technical efficiency results obtained by SAF. Method

Then, the production function (TL) was used to estimate technical efficiency, and the results of the estimate were fixed in Table 2

From Table 2 it can be seen that the highest value of technical efficiency was achieved in the farm (41), which reached 93%, which means that the farm approached the level of full efficiency, being among the sample farms with a certain value the highest performance achieved number of inputs, which means that the farm produces this amount of output with only 93% of the inputs or less, while the lowest efficiency achieved in the farm (83) was 21%.This means that the farm that achieves this value must use 21% of the inputs or less in order to reach the stage of efficiency and produce a certain amount of output.

Farmers can raise their output by 34% without utilizing financial resources in the production process, as evidenced by the sample level's average technical efficiency of 66% [7]. This shows that the establishments produce the same previous product using fewer resources-roughly 34% of the resources used-and that the sample loses some economic resources, resulting in additional costs of 34% of the resource costs. Thus, it is evident that not all of the sample farms produced on the production possibilities curve and instead deviated from it in varying degrees. Neither farm was able to reach 100% economic efficiency. This suggests that these establishments have the potential to produce at the level required while utilizing fewer financial resources to accomplish higher levels of production [8].

When dividing the levels of technical efficiency, it was found that 21.62% of the farmers were limited to their technical efficiency between 21-50 and this is due to the good use of resources such as seeds and the amount of fertilizer compared to other farms, while 8 farms achieved efficiency that was limited to between 51-60 and constituted 7.20% of the sample farmers and that 17.11% of the total sample achieved technical efficiency levels that ranged between 70 - 61, while 21.62% of the sample farmers achieved technical efficiency limited to between 80 - 71, and that the highest technical efficiency was achieved for the yellow maize farmers category, more than 81 and for 36 farms, at a rate of 32.43%. In general, it can be said that the sample farmers generally achieve a technical efficiency of more than 32%, and we conclude, through the TL function, a positive effect of some studied variables on production, with the exception of the variables seed, working time, etc. amount of added of water, which goes against economic logic and is due to non-compliance with the recommended quantities of seeds and the amount of water added. We recommend conducting further studies that diagnose the determinants of the level of technical efficiency, ways to improve it, taking into account the economic and social factors surrounding production conditions, and studying the (optimal) efficiency in some farms and the reasons that have led to their achievement and their application as applied models that inefficient farms can follow. To achieve full efficiency [9].

Table 3: Levels of technical efficiency and preparation of farmers at each level

Percentage%	the number	Technical Proficiency Level
21.62	24	50 - 21
7.20	8	60 - 51
17.11	19	70 - 61
21.62	24	80 - 71
32.43	36	and more - 81

***Source*:** From the researcher's work based on the results of technical competence obtained by SAF. Method

Conclusion

The stochastic frontier analysis (SFA) of maize production under supplemental irrigation in Salah El-Din Governorate's Al-Dour district reveals several insights. The logarithmic transcendental production function highlighted that while the area cultivated and the amount of fertilizer positively impact production, the quantity of seeds and added water negatively affect yields, reflecting inefficiencies and potential resource mismanagement. Technical efficiency averaged 66%, indicating that farmers could potentially improve production by up to 34% without additional resource investment. This underlines a significant opportunity for enhancing production efficiency by optimizing resource use and addressing inefficiencies. The analysis emphasizes the need for further research into factors affecting technical efficiency and practical strategies to improve it, particularly through better adherence to recommended practices and improved irrigation methods.

References

1. Coelli TJ, Rao DSP, O'Donnell CJ, Battese GE. An introduction to efficiency and productivity analysis. Springer Science & Business Media; c2005.
2. Bauer PW, Berger AN, Ferrier GD, Humphrey DB. Consistency conditions for regulatory analysis of financial institutions: a comparison of frontier efficiency methods. J Econ Bus. 1998;50(2):85-114.
3. Ahmed NM. Estimating the technical efficiency of vegetable farms in Lattakia Governorate using the great border production function. Tishreen Univ J Res Sci. Stud - Biol Sci. Ser., 2018, 40(2).
4. Al-Youssef A, Shaaban ASA, Suleiman AH, Mazid A, Khoja S, Naal Y, *et al*. Assessment and analysis of the technical efficiency of wheat farms in Al-Bab region using stochastic frontier analysis (SFA). Aleppo Univ Res Journal, Agric Sci. Ser. 2015;115:149-172.
5. Al-Niamy S, Ahmed Z. Estimating technical efficiency of wheat farms under supplementary irrigation using the stochastic frontier approach (sampling area: Tellkef District). Mesopotamia J Agric. 2012;40:54-62.
6. Naji NS. Quantitative estimation of the yellow maize crop production function in Iraq for the period 1986 - 2003. Karbala Univ Sci. J, 2011, 9(3).
7. Al-Samarrai HT, Zenzel SGA. The production function of the wheat crop irrigated by spraying in Salah al-Din Governorate for the productive season 2015-2016, the science district, an applied model. Tikrit Univ J Agric Sci. 2017;71(6):82-83.
8. Al-Saati A-RA-H, Al-Osaimi MH. Estimating the cost function of Islamic banks and commercial banks, a comparative study. King Abdulaziz Univ Journal, Islam Econ Arab, 1995, 7.
9. Abdulla WAQ, Khairi AM, Khaled MM, Hamad MS. Estimating the cost function and economies of scale for the yellow corn crop in Babil Governorate - an applied model. Iraq Agric Sci. J, 2016, 45(7).