Parametric Approach for Wheat Production in Egypt and Spain

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Abstract

This study has focused on comparison the technical efficiency of wheat production in Egypt and Spain in the time period 1995-2013. The study applies the stochastic frontier approach and the specification of Battese and Coelli (1995) for efficiency measurement. The results indicate that the mean of technical efficiency of wheat production in Egypt higher than Spain.

Key words: wheat, stochastic frontier, technical efficiency, Egypt, Spain.

Introduction

Wheat is one of the most important cereals grown successfully in Egypt. Wheat in Egypt cultivated in the old lands that found in Nile Valley and Delta; and in the new lands that have been reclaimed (Gowayed, 2009). Wheat can be grown all over Spain. In higher areas it is often the only crop possible. Wheat, as well as barley, is mainly grown as a winter crop. Sowing is done in autumn and Northern European spring-wheat varieties may be used for this purpose. In the higher areas of the central plateau, sowing in spring may be preferred because the risk of winter killing (Belderok et al., 2000). Measuring efficiency is the popular approach to understand the performance of farmers in mobilizing their resources in the given technology (Khanal et al., 2012). This paper is organized as follows: the next section deals with the methodology; section 3 indicates the data and results. The final section presents the conclusions.

Methodology

The Cobb-Douglas production function is an adequate representation for the data. The Cobb-Douglas production function can be defined as:

$$\ln y_{it} = \beta_0 + \sum_{j=1}^{n} \beta_j \ln \mathrm{x}_{jit} + \beta_t t + v_{it} - u_{it} \qquad (1)$$

where y_{it} is the wheat production of the *i-th* country at the *t-th* time period; x_{jit} is the *j-th* input of the *i-th* country at *t-th* time period; β is unknown parameter to be estimated; *t* is the time variable; v_{it} is a vector of random errors that are assumed to be independently and identically distributed iid $N(0,\sigma_v^2)$; and u_{it} is a one sided ($u_{it} \geq 0$) efficiency component that captures the technical inefficiency of the *i-th* country. The two error components (v_{it} and u_{it}) are independent of each other.

The inefficiency effect model defined by Battese and Coelli (1995) is specified as follows:

$$u_{it} = \delta_0 + \sum_{j=1}^{n} \delta_j Z_{jit} \qquad (2)$$

where u_{it} is the technical inefficiency of the *i-th* country at *t-th* time period; δ is a vector of parameters to be estimated; and Z_{jit} is a vector of variables which expected

to influence the level of technical inefficiency of the *i-th* country at *t-th* time period. This study incorporates the time variable to verify if the technical inefficiency increase or decrease in the analyzed period. The Maximum Likelihood estimates for the parameters of the stochastic frontier model, defined by equations (1) and (2) can be obtained by using the Frontier 4.1 program.

Data and results

Table 1 shows the production and area of wheat in Egypt and Spain during the time period 1995-2013. In Egypt, the wheat production increased from 5722.44 thousand ton in 1995 to 9460.20 thousand ton in 2013. The annual average percentage growth rate of wheat production for the time period 1995-2013 is 2.83%. The wheat area increased from 1055.38 thousand hectare in 1995 to 1418.71 thousand hectare in 2013. The annual average percentage growth rate of wheat area for the time period 1995-2013 is 1.66%. In Spain, the wheat production increased from 3138.70 thousand ton in 1995 to 7602.60 thousand ton in 2013. The annual average percentage growth rate of wheat production for the time period 1995-2013 is 5.04%. The wheat area decreased from 2126.40 thousand hectare in 1995 to 2121.90 thousand hectare in 2013. The annual average percentage growth rate of wheat area for the time period 1995-2013 is -0.01%.

Table 1. Production and area of wheat in Egypt and Spain (1995-2013).

	Egypt		Spain	
Year	**Wheat Production (Thousand Ton)**	**Wheat Area (Thousand Hectare)**	**Wheat Production (Thousand Ton)**	**Wheat Area (Thousand Hectare)**
1995	5722.44	1055.38	3138.70	2126.40
1996	5735.37	1017.19	6040.50	2012.40
1997	5849.13	1044.59	4676.29	2078.55
1998	6093.15	1017.28	5436.30	1912.56
1999	6346.64	999.10	5083.80	2422.40
2000	6564.05	1034.99	7293.62	2353.03
2001	6254.58	983.74	5007.70	2177.01
2002	6624.87	1029.59	6822.16	2406.64
2003	6844.69	1053.02	6290.10	2151.50
2004	7177.86	1094.74	7096.72	2175.03
2005	8140.96	1253.82	4026.69	2274.11
2006	8274.23	1286.75	5521.58	1920.23
2007	7379.00	1140.98	6436.36	1803.31
2008	7977.05	1226.65	6714.30	2067.00
2009	8522.10	1335.30	4804.77	1772.75
2010	7177.40	1287.63	5941.20	1948.07
2011	8407.13	1284.95	6876.66	1994.65
2012	8795.48	1336.23	4650.30	1758.90
2013	9460.20	1418.71	7602.60	2121.90
Mean	7228.80	1152.71	5761.07	2077.71
Rate[a]	2.83	1.66	5.04	-0.01

([a]) Annual average percentage growth rate (1995-2013)

Source: FAOSTAT and own elaboration

Table 2 shows the Ordinary Least Squares (OLS) and Maximum Likelihood Estimates (MLE) of the Cobb-Douglas stochastic frontier production function. The coefficient of area is negative and significant at OLS, while it is positive and insignificant at MLE, this may be due to the soil problems. The technical change coefficient is positive and significant at OLS and MLE. This result indicates technical

progress over time. For the inefficiency effect model, the coefficient of the time variable is positive and insignificant at MLE, indicates that there is no impact from the time variable on the inefficiency of wheat production through the period of study.

Table 2. OLS and MLE of the Cobb-Douglas stochastic frontier production function.

Variable	OLS			MLE		
	Coefficient	Standard-error	t-ratio	Coefficient	Standard-error	t-ratio
Frontier Production Function						
Constant	19.9437	1.3129	15.1901	15.6339	1.5110	10.3467
Area	-0.3005	0.0921	-3.2614	0.0182	0.1060	0.1720
Time	0.0221	0.0053	4.1775	0.0230	0.0101	2.0970
Inefficiency Effects						
Time				0.0081	0.0315	0.2586
Sigma-squared	0.0316			0.0791	0.0153	5.2367
Gamma				0.9999	0.0628	15.9135

Source: Own elaboration

Table 3 shows the annual levels of technical efficiency of wheat production in Egypt and Spain. The levels of technical efficiency of wheat production in Egypt and Spain make clear improving during the time period 1995-2013. In Egypt the minimum level of technical efficiency is 0.7849 in 2010, while the maximum level of technical efficiency is 0.9995 in 2005. The mean technical efficiency of the time period 1995-2013 is 0.9005 and the annual average percentage growth rate is 0.4604. In Spain the minimum level of technical efficiency is 0.4805 in 1995, while the maximum level of technical efficiency is 0.9933 in 2000. The mean technical efficiency of the time period 1995-2013 is 0.7160 and the annual average percentage growth rate is 2.6461.

Table 3. Technical efficiency of wheat production in Egypt and Spain (1995-2013).

	Technical efficiency	
Year	**Egypt**	**Spain**
1995	0.8873	0.4805
1996	0.8696	0.9046
1997	0.8663	0.6839
1998	0.8823	0.7782
1999	0.8984	0.7081
2000	0.9074	0.9933
2001	0.8457	0.6674
2002	0.8745	0.8869
2003	0.8827	0.8007
2004	0.9040	0.8827
2005	0.9995	0.4890
2006	0.9922	0.6573
2007	0.8666	0.7496
2008	0.9143	0.7623
2009	0.9532	0.5346
2010	0.7849	0.6449
2011	0.8985	0.7291
2012	0.9180	0.4829
2013	0.9638	0.7689
Mean	0.9005	0.7160
Rate[a]	0.4604	2.6461

([a]) Annual average percentage growth rate (1995-2013)

Source: Own elaboration

Conclusions

This paper aims to compare the technical efficiency of wheat production in Egypt and Spain during the time period 1995-2013. The data used in this study is a panel data at the level of Egypt and Spain, it represents the time period 1995-2013 and taken from FAOSTAT. The study applies the stochastic frontier approach for efficiency measurement and the Cobb-Douglas production function is used. The specification of Battese and Coelli (1995) is employed. The coefficient of area is negative and significant at OLS, while it is positive and insignificant at MLE. The technical change coefficient is positive and significant at OLS and MLE. For the inefficiency effect model, the coefficient of the time variable is positive and insignificant at MLE, indicates that there is no impact from the time variable on the inefficiency of wheat production through the period of study. The levels of technical efficiency vary among Egypt and Spain. In Egypt the minimum level of technical efficiency is 78.49% in 2010, while the maximum level of technical efficiency is 99.95% in 2005. In Spain the minimum level of technical efficiency is 48.05% in 1995, while the maximum level of technical efficiency is 99.33% in 2000. The study suggests the following recommendations, investigate the soil problems and land quality of wheat production; and improve the technology of wheat production.

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الملخص

تهدف هذة الدراسة الي مقارنة الكفاءة الفنية لانتاج القمح في مصر و اسبانيا خـــلال الفتـــرة ١٩٩٥-٢٠١٣. طبقت الدراسة طريقة [Battese and Coelli (1995)] stochastic frontier. البيانات المستعملة في هذة الدراسة في صورة panel data و مصدرها FAOSTAT و تمثل مصر و اسبانيا خلال تلك الفترة الزمنية . اوضحت نتائج الدراسة ان الكفاءة الفنية لانتاج القمح في مـــصراعلى مـــن اســـبانيا خـــلال فتـــرة الدراسة. اوصت الدراسة ببحث مشاكل التربة المتعلقة بانتاج القمح و تحسين التكنولوجيـــا المـــستخدمة فـــي عملية الانتاج.