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Does More Educated Mean More Productive? Assessing the Effect of Education Level on the Productivity of Sample of Iraqi Farmers

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ABSTRACT: This study aims to know if it is worth investing in tomato farmers' education in Iraq. Two-stage analyses of the Data Envelopment Approach were used. In the first stage, scores of technical efficiency were obtained. In the next one, technical efficiency scores were regressed, using Tobit analysis, on educational factors to understand which factor can affect education. Data used in this study ranged from 1991 to 2016 and they were obtained from the FAO website. Results of the first stage showed that there is room for improving technical efficiency or increasing tomato output keeping the level of input the same. The second stage analysis showed that investing in increasing the basic education level of females can increase technical efficiency and eventually the output of tomatoes.

Keywords- DEA, farmers' education, investment, tomato production, technical efficiency

INTRODUCTION

Education has major importance in the labor market. Based on that, any individual who is willing to enter the job market has to have some sort of education. In agriculture, the primary income source, for most of people, is working in agricultural-related jobs in developing countries. However, in these countries, either the incentive to invest in educating farmers is very little or it's not clear if being more educated is more productive. In optimum circumstances, being more educated can enhance productivity in all profit-earning activities including agriculture. Based on that, this return can be obtained, for example, by better management and high technologies in production. Despite the widespread perceptions about the value of education in agricultural activities, there is little scientific approve to support investment in educational in agrarian-related jobs. By assessing the effect of different levels of education on economic efficiency, recommendations can be extracted in supporting investment in education, especially in rural areas. Section two of this study will be focusing on the literature review. This paper consists of the following sections. Section 2 discusses the literature review whereas section 3 shows the mathematical framework of DEA in its first and second stages. Description of data and specification of the model is in sections 4 and 5 previously. Results and conclusions are going to be in sections 6 and 7 previously.

MATERIALS AND METHODS

Literature review

To understand if it is worth investing in farmers' education, an efficiency analysis needs to be implemented. This efficiency analysis is called Data Envelopment Analysis or (DEA). This approach is completed by following two stages. In the first one, (TE) estimates is being calculated by using techniques of optimization for each DMU. After obtaining TE scores, a regression analysis is being followed to know which factor can affect TE scores positively or negatively.

Literature that tried to measure and assess if education level can affect TE is inconclusive. For example, Altaie (2019), Oladeebo & Oluwaranti, (2012), Abu & Asember, (2011), Onumah et al., (2010), Liu & Zhuang, (2000), Abdulai & Eberlin, (2001),

Al-Hassan, (2008), Khai & Yabe, (2011), showed a tremendously major positive effect of farmers education on productivity in Iraq, Nigeria, Ghana, China, Nicaragua, and Vietnam respectively. However, literature that showed no relationship between farmers' education and efficiency are not limited to Llewelyn & Williams, (1996) and Battese & Coelli,(1995) in Indonesia and India respectively. On the other hand, Fleming & Coelli, (2004) reported a negative significant impact of farmers' education on technical efficiency in Indonesia. From the literature that just showed, there are different trends in assessing the effect of education on technical efficiency. This is mainly because of the nature of the studied country itself and the difference in agricultural production technology. (Asadullah & Rahman, 2009)

Based on what has been mentioned previously, and to the best of the authors' knowledge, no study tried to access the effect of farmers' education on technical efficiency between tomato farmers in Iraqi for the period (1991-2016) taking into account tomato farmers in Iraq using two stages data envelopment analysis approach.

Data Envelopment Analysis

In this paper, a two-stage analysis is performed. In the first stage, technical efficiency scores are generated using the linear programming method. In this approach, there is no stochastic error term is specified in the optimization process. Inefficiency in this approach is attributed to deviation from the optimum outcome. In the second stage, technical efficiency scores are regressed against regressors that are believed to affect these scores. The second stage was performed to know factors that may affect and explain technical efficiency scores. The second stage was performed utilizing Tobit regression as in (McCarty & Yaisawarng, 1993) and (Chakraborty et al., 2001). Both stage 1 and 2 is performed using Stata v.12.

The linear equation technique that is followed in this study is in equation 1 and constraints a, b, c, and d. Linear programming approach is based on (Charnes et al., 1978):

$$\max_{\mu_i \ \pi} \mu_i^{VRS}$$

$$Subject\ to$$

$\mu_i^{VRS} y_i \geq \sum Y \pi$	The DMU being evaluated is equal to or greater than the weighted sum of the outputs of the other (DMUs).
$x_i \leq \sum X \pi$	Other DMUs' Inputs of weighted total are equal to or less than the inputs of the DMU being evaluated.
$\pi \geq 0$	weights that are non-negative
$\sum_{j=1}^{n} \pi_j = 1$	constraint that works for VRS.

In that regression analysis, a set of TE scores is going to be regressed against factors that are believed to affect these scores. In our case, variables in the second stage are levels of education for tomato farmers in Iraq between 1991 and 2016. The second stage is being utilized to know which level of education can affect TE scores.

Data

The purpose of this piece is to know if it is worth investing in farmers' education between tomato farmers in Iraq for the period between 1991 and 2016. The conceptual model is defined in equation 1 for the DEA approach. To describe this relationship conceptually, a brief description of the data must be shown.

In this paper, time-series data were used for tomato farmers in Iraq for the period 1991-2016 (STAT, 2022). Tomato production has a relatively short period of production and, on average, is a very profitable crop (Abdulai & Eberlin, 2001) (A. Mudhi & H . Omran, 2012).

Literature that studies the effect of different sorts of variables affecting investment towards farmers' education is inconclusive. Based on variables used, this study utilized standard variables in the first stage representing as follows:

Table 1. Variables used in the first stage and second stage

	Variables
Dependent variable	The yield of Tomato (hg/ha)
Independent variables (first stage)	Harvested area (ha)
	population (1000 person)
	Net national income (current US $)
	Employment in Ag (% female employed)
	Employment in Ag (% male employed)
Independent variables (second stage)	enrolment rate, primary education, female (%)

	enrolment rate, primary education, male (%)
	enrolment rate, secondary education, female (%)
	enrolment rate, secondary education, male (%)

Model Specification

Specification of the model in the first stage (production function) is as follows:

$y_t = f(harv_t, popu_t, nni_t, empaf_t, empam_{t,})$ (2)

And equation (3) is the second stage analysis equation adopted in both DEA approach

$te_t = f(prif_t, secf_t, prim_t, secm_t)$ (3)

Variables in stages 1 and 2 are defined in table 2.

Table 1. Definition of variables in the first and second stage of the effect of education on the efficiency of tomato production in Iraq

Variable name	Definition	
First stage analysis variables		
y_t	The yield of Tomato (hg/ha)	Dependent variable
$harv_t$	Harvested area (ha)	Independent Variables
$popu_t$	Population (1000 person)	
nni_t	Net national income (current US $)	
$empaf_t$	Employment in Ag (% female employed)	
$empam_{t,}$	Employment in Ag (% male employed)	
Second stage analysis variables		
te_t	dependent variable and technical efficiency.	Dependent variable
$prif_t$	enrolment rate, primary education, female (%)	Independent Variables
$secf_t$	enrolment rate, primary education, male (%)	
$prim_t$	enrolment rate, secondary education, female (%)	
$secm_t$	enrolment rate, secondary education, male (%)	

RESULTS AND DISCUSSION

Results of the first stage

The first stage in this paper is utilizing the production function. Table 3 is showing technical efficiency scores.

Table 3. Technical Efficiency scores were obtained in the first stage by using Stata v.12

Years	VRS_TE
1991	0.2969
1992	1.0000
1993	0.8273
1994	0.7190
1995	0.8486
1996	0.8305

1997	0.7470
1998	0.7297
1999	0.7205
2000	0.7470
2001	0.5809
2002	0.6354
2003	1.0000
2004	0.6960
2005	1.0000
2006	1.0000
2007	0.6983
2008	1.0000
2009	0.7491
2010	0.6839
2011	0.7857
2012	1.0000
2013	0.9719
2014	0.7942
2015	0.8479
2016	0.7351
Average	0.7940

From table 3, we can conclude that the average technical efficiency for the 26 years from 1991 to 2016 was about 0.80. This means that the output of tomatoes can increase by 0.20 keeping the level of inputs the same. This would also mean that there is room for improvement.

In the second stage, which is the crux of this piece, the following estimators are obtained:

Table4. Results of 2nd stage analysis utilizing DEA and Tobit analysis (n=26)

Variable type	VARIABLES	
Net enrolment rate, primary, female (%)	$prif_t$	2.2216 **
		(0.0.6381)
Net enrolment rate, secondary, female (%)	$secf_t$	1.0601**
		(0.4162)
Net enrolment rate, primary, male (%)	$prim_t$	-2.2109**
		(0.6824)
Net enrolment rate, secondary, male (%)	$secm_t$	1.4981
		(0.7662)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Results showed in table 3 is showing a significant effect of females in the production process. Increasing the level of education of the female workforce in primary and secondary can increase technical efficiency by 2.2% and 1% respectively. However, doing the same for a male factor will lower technical efficiency score especially in primary school education. For the secondary education for male, the effect was not statistically significant.

CONCLUSION

What can be concluded from the first stage is that there is room for improvement which is something promoting in which it can increase the output of tomato keeping the level of inputs the same.

In the second stage, investment towards women's education seems reasonable since the majority of the workforce in tomato fields in Iraq are women. For males' education, the sign is negative may be because they became more reluctant to work in agriculture-related activities when their level of education increased.

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