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THE PERFORMANCE OF AGRICULTURE IN LATIN AMERICA: ANALYSING EFFICIENCY AND EFFICACY IN THE REGION*

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Abstract

The objective of this study was to analyze the performance of agricultural activities in Latin American countries based on efficiency and efficacy models using data from the decade beginning in the year 2000. We observed that, even if agricultural activity is extremely important for Latin American countries, the results show many differences for these activities as there was a different impact for each country. The regions with the highest efficiency rates are found in Uruguay, Panama, and Argentina, and those with higher efficacy values are in Argentina, Brazil, and Uruguay. The results also show that countries such as El Salvador and Paraguay need to be more thorough. Regarding the relation between the two aspects studied, it is noteworthy that efficiency positively impacts efficacy in the context of agriculture in Latin America.
Keywords: *Latin America; Data Envelopment Analysis; Index Analysis.*

EL DESEMPEÑO DE LA AGRICULTURA EN AMÉRICA LATINA: ANÁLISIS DE LA EFICIENCIA Y EFICACIA DE LA REGIÓN

Resumen

El objetivo de este estudio fue analizar el desempeño de las actividades agrícolas en los países de América Latina con base en los modelos de eficiencia y eficacia y con datos de los años 2000. Se observa que, incluso si la actividad agrícola es de importancia fundamental para los países de América Latina, los resultados muestran que existen muchas diferencias para estas actividades

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puesto que el impacto fue diferente para cada país. Las regiones con las tasas de eficiencia más altas se encuentran en Uruguay, Panamá y Argentina, y aquellas con los valores de eficacia más altos están en Argentina, Brasil y Uruguay. Los resultados también indican que países como El Salvador y Paraguay deben ser más rigurosos. Con respecto a la relación entre los dos aspectos estudiados, cabe destacar que la eficiencia tiene un impacto positivo sobre la eficacia en el contexto de la agricultura en América Latina.
Palabras clave: *América Latina; análisis de índices; análisis envolvente de datos.*

O DESEMPENHO DA AGRICULTURA NA AMÉRICA LATINA: ANÁLISE DA EFICIÊNCIA E EFICÁCIA DA REGIÃO

Resumo

O objetivo deste estudo foi analisar o desempenho das atividades agrícolas nos países latino-americanos com base nos modelos de eficiência e eficácia, com dados dos anos 2000. Observa-se que, inclusive se a atividade é de importância fundamental para os países da América Latina, os resultados mostram que existem muitas diferenças para essas atividades, visto que o impacto foi diferente para cada país. As regiões com as taxas de eficiência mais altas se encontram no Uruguai, no Panamá e na Argentina, e aquelas com valores de eficácia mais altos estão na Argentina, no Brasil e no Uruguai. Os resultados também indicam que países como El Salvador e o Paraguai devem ser mais rigorosos. A respeito da relação entre os dois aspectos estudados, cabe destacar que a eficiência tem um impacto positivo sobre a eficácia no contexto da agricultura na América Latina.
Palavras-chave: *América Latina; análise de índices; análise envolvente de dados.*

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1. Introduction

Agricultural activity is of fundamental importance to human society since it meets individuals' main needs. In this sense, agricultural practices are very valuable for the social and economic issues of organizations (Cerdá, 2003). This primary sector activity was one of the first economic tasks carried out in Latin America, for example in Brazil where these economic practices began during colonization through sugar cane cultivation and later coffee production.

It is noteworthy that besides being essential to meet the population's food needs, the agricultural sector is also responsible for generating employment and income for many people who live in these areas. Given this scenario, it is vital to know the aspects that characterize this activity (Costa, Almeida, Ferreira, & Silva, 2013). Work in the fields is one of the main sources of income and international currencies for most Latin American regions, so agricultural activity aims to maximize economic growth and, consequently, their development (Echeverría, 1998).

In this context, organizations seek to improve their performance in agricultural activities using new technologies, techniques, and means that leverage production and meet the aspirations of the general community. However, the overexploitation of natural resources by humans changes the environment in which they live, which causes resources to

become scarce. Therefore, it is essential to study the agricultural behaviour of these regions in order to determine the issues related to the performance of organizations and if society's needs are satisfied.

Performance is related to the realization and fulfilment of tasks. There are two concepts used to explain this situation: efficacy, which is related to obtaining the results; and efficiency, which focuses on the use of resources in the process, that is, the best methods so that the objectives are achieved (Mcauley, Duberley, & Johnson, 2007).

Because of environmental concerns, we created indicators that aimed to indicate the regions that are not using nature's resources properly; therefore, after analysing the results, it would be possible to create public policies to assist organizations to search for more efficient and efficacious processes in the agricultural sector (Mihaiu, Opreana, & Cristescu, 2010; Rahmati & Jalil, 2014).

The efficiency and efficacy concepts can be considered part of an open system of administration, or rather, they form a network in which one factor depends on the other, and any behavioural changes will have knock-on effects. Therefore, it is possible to infer that, in many cases, efficiency is an indispensable condition for efficacy. Efficiency is more related to the means used to achieve set objectives, while efficacy focuses on achieving the result itself (Mihaiu, Opreana, & Cristescu, 2010).

Because the reality of most Latin American countries is linked to farming and extractive activities, the analysis of efficiency and efficacy are applied to these countries. From this perspective, this research seeks to update the existing information on the topic. We focus on a more critical view of the results obtained so that they can be used in actions that minimize organizations' negative practices in terms of exploitation.

Agricultural activities do generate positive impacts on society regarding food production, but there can also be negative impacts that affect nature and lead to shortages of resources. According to Braga Freitas, Duarte, & Carepa-Souza (2004), agricultural work transforms space and has an effect on society and the environment. Therefore, studies that examine the performance of farming activities based on efficiency and efficacy models using indicators are of fundamental importance (Pinto & Coronel, 2016).

Given this situation, in order to provide a more in depth understanding on agricultural issues in Latin American, this research aims to clarify the following question: What is the performance of agriculture in Latin America from an efficiency and efficacy perspective from the year 2000? The objective of this study is to analyse the performance of agricultural activities using efficiency and efficacy models Latin America using data from the decade beginning in the year 2000.

After the introduction, this article is divided into four sections: In the second section the theoretical framework is outlined. The third section brings the methodological procedures, and in the following section the results are analysed and discussed. Lastly, the main conclusions are presented.

2. Theoretical Framework

One of employees' main objectives is to continuously achieve the company's goals by correctly using resources. One way to measure an organizations' performance is through efficiency and efficacy. We aim to achieve the desired results with a minimum use of inputs and evaluate and design ways to do this. Therefore, to manage with efficacy means to achieve the results that have been designed. On the other hand, efficiency is related to the methods used with the resources available to obtain the result. Thus, while efficacy is concerned with the results of a process, efficiency is concerned with the means, that is, what is done to obtain the results (Pinto & Coronel, 2016).

It is important to note that there may be various interpretations of the meaning of these terms; however, they both directly affect organizations, which are often efficient but not efficacious. Similarly, there may be inefficient but efficacious organizations,

that is, they meet their goals, but often use inappropriate methods (Guzmán, 2003; Mouzas, 2006).

Because these practices are related, it is essential for organizations to seek strategies to keep them synchronised, so the institution benefits from higher productivity and engagement. To make progress, it is necessary to have organizational factors in harmony within an open system, precisely because this maintains a certain degree of dependence with other factors such as efficiency and efficacy. Thus, these terms are part of the whole system, and, in order to have efficacy, efficiency should also be an essential condition (Mihaiu, Opreana, & Cristescu, 2010; Mouzas, 2006; Ozcan, 2014).

Studying the agricultural scenario while focusing on efficiency and efficacy issues is viable because the final production is illustrated by efficacy, and the means used in rural areas to boost productivity are related to efficiency. Because most of the Latin America population works in the primary sector, countries in this continent can be considered to have an underdeveloped economy. Although the industry and services sectors are growing, the primary sectors are still very strong as they provide employment and subsistence opportunities for most individuals (Cerdá, 2003).

Much of the territory in Latin America is located in the tropics, which is characterized by having extensive forests, being rich in biodiversity, and having fertile soils. So countries take advantage of these lands as much as possible, often degrading the natural landscape, cultivating different cultures inappropriately. In this sense, because of their natural richness, these countries are great agricultural producers, and, therefore, responsible for a large portion of agricultural degradation (Ramírez-Miranda, 2014).

Since the economy of many Latin American countries is focused on the production of seeds, such as in Brazil, Argentina, and Mexico, they use different means and modern resources in their production cycles to increase their revenues. Thus, the productive period of many cultures negatively affects nature, causing losses of biodiversity, native vegetation, and also climate change (Pinto, Coronel, & Conte, 2014).

It should be emphasized that agricultural activities are of great relevance to society because they enable the production of food to meet the population's basic needs and develop the economy of the productive regions. It is, therefore, important for this paper to detail the performance of the agricultural activity of each country so that appropriate actions can be taken (Pinto & Coronel, 2016).

3. Methodological Procedures

This study uses a quantitative analysis of the issues in terms of efficiency and efficacy within the agricultural reality of Latin America. The efficiency model was performed using a Data Envelopment Analysis (DEA), and the efficacy model was implemented through elaborating an index used to measure this aspect. Because the analyses are based on the DEA methodology and on the calculation of the index, the work can be classified as quantitative. In addition, this study is characterized as descriptive, since the observations and analyses were carried out to record and correlate phenomena without manipulating them (Rampazzo, 2002). This is because the aspects of efficiency and efficacy were discussed within a Latin American agricultural reality.

The universe of this study is Latin America, which encompasses countries from the three subdivisions of the American continent. The countries have similar characteristics as a result of colonization, such as the language spoken (primarily derived from Latin: Spanish, French, and Portuguese).

With an area of approximately 21,069,501 km², this region is composed of twenty countries and two other dependencies (French Guiana and Puerto Rico). These countries are divided into three subdivisions of the American continent, namely South America, Central America, and North America. Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela are part of South America. Central American countries Costa Rica, Cuba, El Salvador, Guatemala, Haiti, Honduras, Nicaragua, Panama, and the Dominican

Republic are also Latin American countries. Finally, the only country in North America (included in this study) is Mexico.

The samples were filtered by the countries that have agricultural censuses published in a structured way from the year 2000 that encompass the agricultural degradation variables. Thus, the sample is restricted to ten countries: Argentina, Brazil, Chile, El Salvador, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay. More specifically, the study sample is composed of the subdivisions in each of these states/provinces/departments/ regions. Altogether, 236 subdivisions were researched and are considered as the objects of analysis.

To construct the index, 11 variables were used, which were collected in each agricultural census in the ten countries analysed (INIDE, 2001; INDEC, 2002; IBGE, 2006; INE, 2007; INEGI, 2007; DCEA, 2008; EL SALVADOR, 2008; DIEA, 2011; INEC, 2011; INEI, 2012). The variables are based on the availability of data sources and on the determinants of agriculture, which is pointed out in the literature, especially those related to labour, activity conditions, environment, economic development, and infrastructure (Costa et al., 2013; Peral, García-Barrios, & Casalduero, 2011; Silva, Gómez, & Castañeda, 2010; Wong & Carvalho, 2006).

As the results were constructed based on the concepts of efficiency and efficacy, data were separated into inputs and outputs. The input variables used for the study were: production area of agricultural activity, number of agricultural establishments, number of individuals living in households linked to agricultural activities, number of individuals working in agricultural activities, mechanization of establishments, and use of correctives and technical assistance. The output variables used were: amount of crop production, animal production, the amount of total production, the amount of production of the main product, and non-degraded production area.

Efficiency and efficacy may not be achieved together; however, their results may be interrelated. Thus, according to the literature, it is not possible, using a single methodology, to jointly measure these two aspects (Biloslavo, Bagnoli, & Figelj, 2013). Given this context, we developed two distinct techniques to evaluate these issues separately.

Thus, for the efficiency analysis, we applied a data envelopment analysis (DEA), which is a linear programming technique that measures the efficiency of processes through input and output analysis (Banker, Charnes, & Cooper, 1984). Briefly, the DEA establishes efficiency boundaries by comparing the performance of various groups of decision makers (Decision Making Unit or DMU) and establishing those that are references to others (benchmarks). Different to other methodologies such as econometrics, the DEA is not directed to a central tendency, but rather to the borders. Therefore, according to Lins, Lobo, Silva, Fiszman, & Ribeiro (2007), the DEA optimization problem for each DMU analysed can be expressed as follows:

$$\frac{\sum_j u_j Y_{jk}}{\sum_i v_i X_{ik}} = \frac{uY_k}{vX_k} \quad (1)$$

Where:

u and v are weights or multipliers;
X_k are the inputs;
Y_k are the outputs; and

By convention, $\frac{uY_k}{vX_k} \leq 1$, which generates efficiency indices between 0 and 1.

Regarding efficacy, which verifies the results through an object of analysis, the indices that aim to quantify these results are one of the most used methods to address this aspect. Efficacy can be calculated by using an index that demonstrates matters related to the outcome of an action (Biloslavo, Bagnoli, & Figelj, 2013). There is no standard established for indexes, and the methodology to be used will vary depending on those in charge of the development. In this study, taking into account the studied reality and the absence of empirical evidence on structured efficacy analyses using indexes, the Efficacy Index (EI) used was an adaptation of rural development indices employed by Conterato, Schneider, and

Waquil (2007), Kageyama (2004), Melo and Parré (2007), and Pinto and Coronel (2016).

In order to build the Efficacy Index, all results should be taken into account, that is, only the outputs, not the inputs or the processes. The EI can be constructed using the Gross Index of Efficacy (GIE) and the transformation of the GIE to the EI. With this procedure, each output variable will be a partial indicator. The sum of these partial indexes will result in the Gross Index of Efficacy (GIE) (Kageyama, 2004; Melo & Parré, 2007; Pinto & Coronel, 2016).

$$IBE_j = \sum_{i=1} IV_j \quad (2)$$

where:

IBE_j corresponds to the Gross Index of Efficacy of the *j-th* subdivision studied;

i refers to the number of efficacy variables included in the model;

IV_j is the partial index of each variable of the *j-th* subdivision studied;

By interpolation of the GIE, considering the highest value as 100 and the lowest value as zero, we can obtain the Efficacy Index (EI). Therefore, similar to efficiency, we will analyse efficacy relatively since the scale used has its values based on the mean.

However, there is evidence that efficiency and efficacy are related, and that efficiency is a way to achieve efficacy (Mihaiu, Opreana, & Cristescu, 2010; Mouzas, 2006; Ozcan, 2014; Pinto & Coronel, 2016). Thus, we performed econometric regression analyses in order to verify the degree of influence of efficiency on efficacy of the studied reality (Greene, 2008).

By using the DEA calculation for efficiency and the EI for efficacy, there is a way of checking how agricultural efficacy is impacted by agricultural efficiency in Latin America. Therefore, the results of the data envelopment analysis are used as a *proxy* for efficiency and the results of the Efficacy Index as a *proxy* for efficacy in agriculture. The impact of efficiency on efficacy for the agricultural reality can be verified by the following regressive analysis:

$$IE_{kj} = \alpha + \beta_1 Eficiência_{kj} + \mu_{kj} \quad (3)$$

where:

IE_{kj} is the Efficacy Index of the j-th subdivision studied;

$Efficiency_{kj}$ is the level of efficiency of the j-th subdivision studied;

α is the angular coefficient;

β_1é is the angular coefficient of the relationships of the variables in the regression; and

μ_{kj} is the term of the random error.

According to equation (3), efficiency is used as the independent variable and efficacy as the dependent variable. From this equation, it was possible to verify the estimation of the model with a simple regression method. In order to check if the regression data presented heteroscedasticity and autocorrelation, we performed the White and Durbin-Watson tests. The software used for the estimations were the Statistical Package for Social Sciences (SPSS) 20.0, DEAP 2.1, and Stata 14.0, which undertook, respectively, the procedures regarding the analyses of indices, DEA, and regression analysis.

4. Analyses and Discussion of Results

4.1 Agricultural Efficiency

Based on data from the eleven input and output variables used to calculate agricultural efficiency during the first decade of 2000, we analysed the 236 objects, which were grouped according to the ten Latin American countries researched. We then obtained the mean value. Table 1 presents the agricultural efficiency of the countries.

Table 1. - Mean, number of cases, standard deviation, maximum, and minimum efficiency values for Latin American countries.

Countries	Mean	Ranking	Number of cases	Standard Deviation	Maximum	Minimum
Uruguay	60.41	1º	19	2.61	69.00	54.27
Panama	56.24	2º	12	10.70	74.52	35.86
Argentina	56.09	3º	23	3.49	66.48	51.16
Nicaragua	54.60	4º	15	5.70	70.64	50.08
Brazil	51.23	5º	27	9.50	72.48	34.16
Chile	50.39	6º	52	11.49	100.00	1.01
Mexico	47.80	7º	32	2.43	49.63	36.9
Peru	44.12	8º	25	6.42	60.09	30.46
Paraguay	39.08	9º	17	14.36	57.96	0.00
El Salvador	37.11	10º	14	5.57	42.78	24.47
Latin America	49.70	-	236	0.07	100	0

Source: Elaborated by the authors.

Table 1. shows that the mean obtained for the countries in Latin America is 49.70%. Moreover, it is noticeable that there is a great disparity in each country's mean efficiency values; there is a difference of approximately 23% between the countries with the highest and lowest efficiency values. This fact can be justified because some countries such as Uruguay and Panama use techniques to minimize the negative effects of agricultural production (Reveles, 2006).

On the other hand, Argentina, which has the third-largest mean, is a country highly involved in agricultural activities, so there are strong effects on the environment due to the use of agricultural correctives and other techniques to increase productivity. For this reason, it is essential to develop public policies to minimize the negative impacts and to develop sustainably and relate good performance with efficiency (Stuker, 2003; Theis & Fernandes, 2002).

Table 2. presents the regions with the highest and lowest agricultural efficiency values.

Analysing Table 2, there is a great disparity in the agricultural efficiency values. There is a gap of approximately 64% between the highest value obtained for Tocopilla, which is a subdivision of Chile, and Madre de Dios, a Peruvian province that has a 36.93% efficiency rate. This result shows that there is no homogeneity in values within each country as some regions may be more governed by public policies, which improves the techniques, methods, and procedures used to achieve their objectives.

The satisfactory results of some Latin American regions can be explained by the concentration of some public policies that assist in the recovery of agricultural land, which results in progress without harming the environment. This shows that the scenario in Latin American countries is heterogeneous; thus, each country has multiple and complex particularities (Ramírez-Miranda, 2014; Reveles, 2006).

4.2 Agricultural Efficacy

Based on the output variables used to calculate agricultural efficacy in the 2000s, we analysed the 236 objects. Efficiency was grouped according to the ten Latin American countries, and the mean value was obtained. Table 3 presents the countries in terms of agricultural efficacy.

Table 3. shows that the Latin American mean for efficacy is 58.57%. Moreover, Argentina is at the top of the ranking of countries that have a greater

Table 2.–Highest and lowest mean efficiency values of Latin American regions and countries.

Region	Country	Efficiency	Region	Country	Efficiency
Tocopilla	CL	100.00	Alto Paraguay	PAR	0.00
Panama	PAN	74.52	Antofagasta	CL	1.01
Sao Paulo	BR	72.48	Presidente Hayes	PAR	7.88
Masaya	NCA	70.64	Chañaral	CH	15.16
Alagoas	BR	70.14	Sonsonate	EI	24.47
Artigas	URU	69.00	La Libertad	EL	28.67
Tucuman	AR	66.48	Ucayal	PER	30.46
Tierra del Fuego	AR	65.69	Loreto	PER	32.38
Veraguas	PAN	65.04	Ahuachapan	EI	32.42
Rivas	NR	63.88	San Salvador	EL	33.31
Los Santos	PAN	63.87	Amapá	BR	34.16
Chiriquí	PAN	63.02	Cuscatlan	EL	35.35
Salto	URU	61.67	Paraguari	PAR	35.70
Parana	BR	61.62	San Pedro	PAR	35.73
Flores	URU	61.51	San Martín	PER	35.81
Canelones	URU	61.49	Bocas del Toro	PAN	35.86
Colonia	URU	61.01	Aysen	CL	36.14
Tacuarembo	URU	60.47	Roraima	BR	36.62
Lavalleja	URU	60.43	Colima	MEX	36.90
Treinta y Tres	URU	60.40	Madre de Dios	PER	36.93

Source: Elaborated by the authors.

Table 3. - Mean, number of cases, standard deviation, maximum, and minimum efficacy values for Latin American countries.

Countries	Mean	Ranking	Number of cases	Standard Deviation	Maximum	Minimum
Argentina	75.15	1º	23	6.34	83.73	60.40
Brazil	73.64	2º	27	12.89	100.00	43.15
Uruguay	67.17	3º	19	7.39	78.64	40.36
Mexico	62.58	4º	32	8.63	77.56	36.63
Nicarágua	56.98	5º	15	5.31	64.75	46.87
Panama	54.63	6º	12	15.65	78.85	28.51
Peru	54.32	7º	25	6.98	67.03	41.44
Chile	51.57	8º	52	13.34	68.24	0.00
Paraguay	49.68	9º	17	11.58	69.27	21.30
El Salvador	31,41	10º	14	5.64	38.63	21.18
Latin America	58.57	-	236	9.37	100.00	0.00

Source: Elaborated by the authors.

efficacy. This is because this country's economy is based on agricultural activities, and it has a high degree of efficacy. It is noteworthy that the next three positions are occupied by Brazil, Uruguay, and Mexico. These countries have a strong relationship with agribusiness as they have a larger area of land directed to this activity (Reveles, 2006; CEPALSTAT, 2015).

Furthermore, it appears that Panama has the highest standard deviation; thus, we can infer that that some regions of this country have alternate positions regarding the efficacy index, with the best and worst degrees of efficacy. El Salvador is in the last position with the lowest efficacy level. This can be explained by the fact that this country does not have an economy that is strongly linked to the agricultural sector. It has other sources of income, especially related to the beverages, furniture, and cement industries (El Salvador, 2016).

The highest and lowest agricultural efficacy values of the analysed regions are presented in Table 4.

Table 4. shows a high variety (approximately 65%) in the values of the subdivisions of the countries that have the highest and lowest efficacy. Therefore, there is a high level of heterogeneity among nations. For Brazil, about 40% of the states are positioned among the regions that have the highest efficacy values, and the first seven positions are actually occupied by Brazilian states. In addition, no Brazilian region has a lower rate of efficacy, which highlights the great use of technologies this country employs.

Table 4. - Maximum and minimum mean efficacy values of Latin American regions and countries.

Region	Country	Efficacy	Region	Country	Efficacy
Sao Paulo	BR	100.00	Iquiqui	CL	0
Parana	BR	89.18	Antofagasta	CL	5.25
Mato Grosso do Sul	BR	86.65	Chañaral	CL	17.32
Minas Gerais	BR	86.57	Sonsonate	EL	21.18
Alagoas	BR	86.21	Alto Paraguay	PAR	21.30
Goias	BR	85.66	Cuscatlán	EL	23.62
Rio Grande do Sul	BR	84.87	La Libertad	EL	25.78
Buenos Aires	AR	83.73	San Salvador	EL	25.79
Chubut	AR	83.63	Ahuachapan	EL	26.81
Santa Cruz	AR	82.75	Comarca Kuna Yala	PAN	28.51
Mato Grosso	BR	82.49	Presidente Hayes	PR	30.32
Pernambuco	BR	82.05	La Paz	EL	31.24
La Lampa	AR	81.15	Ilha de Pascoa	CL	32.11
Rio Negro	AR	80.99	Bocas del Toro	PAN	32.62
Cordoba	AR	80.61	Morazán	EL	33.58
Santa Fe	AR	80.30	San Vicente	EL	34.11
Bahia	BR	80.01	Chalatenango	EL	34.89
Panamá	PAN	78.85	Arica	CL	35.29
Artigas	URU	78.64	Cabañas	PAN	35.36
Mendoza	AR	78.06	Usulután	PAN	35.62

Source: Elaborated by the authors.

From this data, it is possible to infer that even if agricultural activities are of fundamental importance in these countries, there is a lot of divergence between regions. This is the case of Panama, which has regions with high and low efficacy levels. This could be because more effective public policies are implemented in some regions (Ramírez-Miranda, 2014; Reveles, 2006).

4.3 Effects of Efficiency on the Agricultural Efficacy in Latin America

In order to verify whether efficiency is a way to achieve efficacy, we estimated the regression analysis. Table 5 presents the relationship between efficiency and efficacy.

Table 5. - Results of the estimation of the regression model by the Least Square Method (LSM) using the Robust Standard Errors (VCE) with the dependent variable as the agricultural efficacy.

Variable	Coefficient	T statistic	Significance
const	12.8442	2.0188	0.0446
Agricultural Efficiency	0.918187	7.0252	0.0001**
		Adjusted R^2 = 0.393405	

Source: Elaborated by the authors.
Note: Values with two asterisks (**) denote significant coefficients at 5%, and values with three asterisks (***) denote significant coefficients at 1%.

For this study, the data presented heteroskedasticity and autocorrelation. Therefore, it was necessary to perform the OLS regression with standard errors consistent with heteroskedasticity and autocorrelation (VEC) (Greene, 2008). The R^2 shows the explanatory power of this model, and it indicates that 39.34% of agricultural efficiency is related to agricultural efficacy. In aspects related to the significance, it appears that they are viable since the variables presented significance values lower than 0.05 in relation to the dependent variable, which means that the coefficient between the two variables could be studied. In addition, the coefficient has a positive value, and because it is statistically significant, it proves the relationship (we propose) between efficiency and efficacy (Mihaiu, Opreana, & Cristescu, 2010; Mouzas, 2006; Ozcan, 2014; Pinto & Coronel, 2016).

When we explore the value of the regression coefficient, it is clear that greater efficiency values cause higher rates of efficacy in Latin American agricultural activity. Therefore, the study shows that a 1% increase in agricultural efficiency in Latin America leads to a leverage of 0.91% in efficacy in Latin America.

Given this scenario, it is clear that efficacy is directly related to efficiency. Thus, evidently an improvement in the means of these activities favours the final results, which means that performance of the sector can be further improved.

Thereafter, the agricultural sector is of fundamental importance for many countries in Latin America that base their economies on agricultural activities. Accordingly, it is necessary to invest more in the improvements of the techniques and procedures, so that, as a consequence, the agricultural objectives are achieved more successfully and at lower costs, thus intensifying the agricultural sector.

5. Final Considerations

Efficiency and efficacy are extremely important in the study of administration. When these subjects are applied to other issues, such as agricultural activity, they become even richer since they expand a theory to different areas, as in the case of this research. Efficiency emphasizes the means and the procedures used to achieve a result, and efficacy focuses on the result itself. Thus, this study aimed to analyse efficiency and efficacy based on empirical issues that are reinforced by the literature on this subject.

As a result, this study shows that although the agricultural activity is of fundamental importance for the countries in Latin America, there is a wide amplitude of results for these activities since they generate a different impact for each country. In this sense, the

study shows that the regions with the highest efficiency levels are in Uruguay, Panama, and Argentina, and the regions with the highest efficacy values are in Argentina, Brazil, and Uruguay. These results are due to historical concentrations that made these countries have greater involvement with agriculture and, consequently, the need to increasingly improve their methods.

Also, the results indicate the need for countries such as El Salvador and Paraguay to plan more as they presented low rates for the studied aspects compared to other regions. This shows that they require more intense public policies to contribute to the improvement and development of their regions. These parameters prove that this study has added to the debate on agricultural issues.

Furthermore, the theoretical understanding of efficacy and efficiency proves, in practice, that efficiency is directly related to efficacy. This study contributes by corroborating this point and demonstrates that these aspects are intertwined and that results can be improved by improving the processes, that is, the efficiency of the means can generate better results.

This research was limited to a short period of time; however, we observed that the measurement of efficiency and efficacy using the variables selected is an approximation because it is very difficult to actually measure efficiency and efficacy in agricultural activity. In addition, the study sample was restricted to ten countries in Latin America, making it impossible to draw conclusions for the whole of Latin America.

Therefore, for future research, the study of efficiency and efficacy could be carried out for longer periods of time. We also suggest studying aspects of efficiency and efficacy in other regions of the world so that in the future it would be possible to compare realities and verify if the hypothesis that efficiency induces efficacy can be confirmed or disproven in different environments.

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