MEASURING THE ECONOMIC EFFICIENCY AND TOTAL PRODUCTIVITY OF RESOURCE AND THE TECHNICAL CHANGE OF AGRICULTURAL COMPANIES IN IRAQ USING SFA AND DEA FOR THE PERIOD 2005-2017

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ABSTRACT

The research aims to measure the economic efficiency and technological change and the total productivity of resources using the parameter and non-parameter methods, for agricultural companies registered in the Iraqi stock exchange, the number of 6 companies for the period from 2005 to 2017 based on the hypothesis that the agricultural companies do not achieve economic efficiency and does not control the management of its operations, and It may be technically efficient but the size of its operations is not optimal. From non-parametric methods, the data envelope analysis method was used. Using the DEAP program, the Middle East Company achieved the highest average technical and cost efficiency of 0.62 and 0.58, respectively. The Iraqi seed production company achieved the highest average efficiency of 0.66. Using Al- Malmquist Index, the National Company for Agricultural Production achieved the highest rate of change in the total productivity of resources and the highest change in the technical efficiency respectively 1.97 and 2.28, while the Modern company for agricultural production obtained the highest technological change averaging 1.14. A stochastic frontier analysis (SFA) technique was used; logarithmic TL function was estimated using FRONT software. The maximum likelihood method (ML) shows that the capital was increased by 1%, the value of production of companies will increase by 0.22% because it helps to take advantage of the advanced technology that these companies are supposed to work to localize and support the agricultural sector. The cross-elasticity between labor and capital was 0.67 which indicates the nature of the substitution relationship between the two items, because using the technology reduces the workers. The value of sigma-squared was 0.21.

Key Words: Stochastic frontier analysis, catch - up phenomenon. Productivity. Al- Malmquist Index .

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قياس الكفاءة الاقتصادية والانتاجية الكلية للموارد والتغير التقني للشركات الزراعية المساهمة في العراق باستخدام SFA و DEA للمدة 2005 -2017

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المستخلص

يهدف البحث الى قياس الكفاءة الاقتصادية والتغير التكنولوجي والانتاجية الكلية للموارد باستخدام الطرق المعلمية وغير المعلمية للشركات الزراعية المسجلة بسوق العراق للأوراق المالية والبالغ عددها 6 شركات للمدة 2005 – 2017 منطلقا من فرضية ان الشركات الزراعية المساهمة لا تحقق كفاءة اقتصادية ولا تتحكم بإدارة عملياتها وعليه قد تكون كفؤة تقنيا لكن حجم عملياتها ليس بالمستوى الامثل . من الطرق اللامعلمية تم استخدام اسلوب تحليل مغلف البيانات وبالاستعانة بالبرنامج DEAP تبين ان شركة الشرق الاوسط حققت اعلى متوسط للكفاءة التقنية وكفاءة الكلفة بلغ 0.62, 0.58 على الترتيب اما الشركة العراقية لإنتاج البذور فحققت اعلى متوسط كفاءة تخصيصية بلغ 0.66. وباستخدام مؤشر المالمكويست تبين ان الشركة الاهلية للإنتاج الزراعي حققت اعلى معدل تغير في الانتاجية الكلية للموارد واعلى تغير في الكفاءة التقنية بلغ على الترتيب 1.97, 2.28 , بينما الشركة الحديثة للإنتاج الزراعي حصلت على اعلى تغير تكنولوجي بلغ متوسطه 1.14 . من الاساليب المعلمية تم استخدام اسلوب التحليل الحدودي العشوائي وتم تقدير دالة الانتاج اللوغارتيميةTL المتسامية باستخدام برنامج .FRONT وطريقة الامكان الاعظم ML تبين ان زيادة راس المال بنسبة 1 % فان قيمة انتاج الشركات ستزداد بنسبة 0.22 % لأنه يساعد في الاستفادة من مزايا التكنولوجيا المتطورة التي يفترض ان تعمل هذه الشركات على توطينها وتدعم بها القطاع الزراعي. كما ان المرونة التقاطعية بين العمل وراس المال بلغت 0.67 وهي تشير الى طبيعة العلاقة الاحلالية بين الموردين لان استخدام التكنولوجيا يخفض من عدد العمال. اما قيمة sigma-squared فبلغت 0.21 بمعنى هناك متغيرات توضيحية اخرى تؤثر في الكفاءة من خلال تأثيرها في المتغير العشوائي لا سيما متغيرات الادارة. من ذات الاسلوب تم حساب الكفاءة التقنية اذ كان اعلى معدل لها من نصيب الشركة العراقية لإنتاج وتسويق المنتجات.

الكلمات المفتاحية: التحليل الحدودي العشوائي، ظاهرة اللحاق بالركب، الانتاجية، مؤشر مالمكويست.

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INTRODUCTION

Literature indicates that the most relevant word in the minds of people in management more than others is efficiency, as the concept occupies some of the thinking and management practices, so the main concern of management is to achieve efficiency which is measured by scientific methods are the most important determinants of food production in the agricultural sector and in agricultural companies in particular because the company may have good financial inputs and advanced technology, but it cannot be used in accordance with its objectives unless managed efficiently, and therefore efficiency helps a lot in diagnosing production problems, and provides solutions in accordance with the theoretical and economic experimental practices , a lot of decision-makers care about the results of these practices, as they will help determine the general interventions to improve efficiency and productivity (2). Effective companies can maintain their existence in the market in the long term if they have a degree of efficiency, and therefore efficiency is an inherent characteristic of how the company uses its inputs compared to its outputs, meaning there should be a rational exploitation of mixing inputs at the lowest cost, and if we talk about competitiveness, then even the profitable companies at the local level are considered to be inefficient at the global level, so the goal of these companies should be to manage resources in the right way and time that helps create economic value, not only to cover costs but to provide an appropriate return and at the same time not to exceed the risk limit (13). Given the decline in agricultural production, poor efficiency and marketing under the current market economy, and the urgent need to improve productivity and transfer of technologies, and to improve the industrial structure, the relationship between inputs and outputs needs to be changed, so that agricultural companies can play this role (20). Especially with the expanding of the food gap, it can be a driving force for investment that is witnessing unwillingness in the agricultural sector and can be a supplier of technologies and labor-absorbing and thus contribute to the development of the agricultural sector as it can diversify the production base and localize production techniques (3). The agricultural companies in Iraq was 18 companies in the nineties of the last century with a capital estimated at 1219.250 million Iraqi Dinars(ID), noting that the contribution of the private sector in agricultural companies rose from 17 million dinars in 1983 to 72 million dinars in 1988, due to radical changes in economic policy In Iraq, that began in 1987, which canceled most of the public sector companies and transferred ownership to the private sector, but these companies stumbled later because of the market chaos and conditions of the economic blockade and inflation, as well as the lack of scientific methods in management, as the number of these companies in 2005 reached 10 companies with capital amount 5731 million dinars and then decreased in 2018 as recorded in the Iraqi stock exchange 6 companies with a capital of 17386 million dinars (9). Agricultural companies received the attention of researchers at the local and international level, including Britton in 1976(16), who pointed out the extent to which the profits of the agricultural companies in the United States, as well as Doye 2010 who valued the performance of agricultural companies in America, explaining the difficulty of comparison of the absolute levels of measurement of agricultural companies differently and the size of companies Capital requirements and cash flows from operations are the reason for this difference. In Tanzania, Chongela and Korabandi(6) noted in 2013 that the encouraging of capital goods and skilled work is worthwhile to the economics of agri-food companies, Maliki also measured the relationship between the size of the facility and the technological progress of a group of companies in Saudi Arabia, noting that the size of the company affects technical progress(4). At the local level, Saleh and Abdul questioned whether the investment of agricultural companies in their assets less or more than necessary(18). Al-Azzi (1) also dealt with an economic analysis of the determinants of the policy of distribution profits of companies in Iraq for the duration from 1992 to 1999, Jassim(11) also noted that the rates of declared

share prices of agricultural companies are not consistent with the real price.

The research problem lies in the decrease in the number of agricultural companies with the unwillingness to enter new companies for agricultural production indicating there are problems and challenges facing these companies, including the lack of economic efficiency and the lack of rewarding returns, which shows that they have not been put on the right track, despite the passage of more than two decades since the establishment of the latest one, there is uncertainty about the role that these companies can play in the development of the agricultural sector. As well as heterogeneity and lack of understanding in decision-making because of the nature of the system of these companies Therefore, **the research aims** to measure the economic efficiency with their branches, technical and allocative of agricultural companies in Iraq for the period 2005 – 2017, estimation of technical efficiency , by Stochastic Frontier Analysis method SFA to determine the amount of inefficiency parameter for each company. Recognize the Cross- Elasticity between work and capital. Measuring the change in the total productivity of resources, measuring technical efficiency and technical change as the most important components of productivity using the Malmquist Index. **Based on the hypothesis** that agricultural companies do not achieve economic efficiency and don't control the management of their operations and therefore may be technically efficient, but the size of operations is not on the optimal level and that volumetric efficiency is the largest source of technical efficiency growth.

MATERIALS AND METHODES

To achieve the objectives of the research, data were obtained for the period 2005-2017 for the agricultural companies registered in the Iraqi stock exchange, which amounted to be 6 companies, namely, the national company for agricultural production, the Iraqi company for the production and marketing of products, the Iraqi company for the production and marketing of meat and crops, the state company for seed production and the modern company for agricultural production and middle east for agricultural production. As for the analysis method there will be three quantitative methods:

1- Data Envelope Analysis (DEA): A non-parametric mathematical method based on linear programming to measure efficiency in the decision-making unit, by determining the optimal combination of inputs. It deals with multiple inputs and multiple outputs and does not require a functional characterization. Economic efficiency with its technical and allocative branches is estimated using the DEAP2.1 program.

2-Stochastic Frontier analysis SFA: This model was introduced in 1977 by Meeusen and Broeck and can be used to measure technical efficiency after estimating the transcendental logarithmic function. The function, including technical efficiency, is estimated using FRONT.4

3-Malmquist MI: The Malmquist index is defined as the measure of change in the total productivity of elements between two time periods or between two production facilities. The Malmquist index is due to the work of Nishimiz and Pags, 1982 and (7), which is a non-parametric indicator based on boundary lines and uses data envelope analysis, calculated using the distance function (DF) (Distan Function) between the duration of the baseline and the duration of the comparison. The components of this indicator are estimated using the DEAP2.1 software.

RESULTS AND DISCUSSION

First: Economic efficiency and its components using the DEA method.

Efficiency was assessed from the input side because the breadth of companies, environmental conditions and production make input control more realistic. It also did not depend on the stability of the return to scale, because it is appropriate when all the units to be measured efficiency work at their optimum sizes and this in fact may not be achieved because of obstacles such as unfair competition and funding constraints and others. Therefore, the research resorted to the application of the variable scale return property in its three cases to separate the effect of technical efficiency and scale efficiency. The labor and capital variables were used as inputs (represented by Xi) that could affect the value of agricultural enterprises' product, as

output (such as Yi).For agricultural companies expressed as i and by making X represent the input matrix K * N, Y output matrix M*1 and using Duality in linear programming the DEA model used in terms of input and assuming VRS is as follows:

Min $i_{ʎ,\theta}\theta$

Subject to :

$-Yi+Yʎ\geq 0$

$x\ ʎ\geq -\theta x_i$

Ni $ʎ=1$,$ʎ\geq 0$Using DEAP2.1, following results was obtained

1-Technical efficiency and Scale efficiency:

Measuring the efficiency of the Scale SE of the sample farms requires measuring the technical efficiency under the constant return of the Scales as well as under the change of scale return, to obtain them requires dividing the technical efficiency under the constant of scale return, to its counterparts in shade of the change of the scale return. In observing a table number 1, we see that the efficiency of scale of the National Company for agricultural production reached an average of 0.03 during the study period, which is very weak, and which is almost inefficient due to the poor technical efficiency, given the stability of the return which averaged 0.02. It does not generate positive scale of returns and has not controlled the size of its operations and may also be attributed to weak working capital as well as the size of its investments. The scale yield indicates that in all years of study, the company has achieved increasing returns. As for the technical efficiency due to the change in return, it fluctuated between a maximum of 1, that the company was able to achieve in 2012 and 2013 and a minimum of 0.57 in the first years of research .This means that the company mixes more resources by 27% to achieve the current production while it can produce it by using 73% of the resources. As well in table 1, as for the Iraqi company for production and marketing of products, was achieved scale efficiency in an average of 0.1 which is weak and predicted problems related to the size and the possibility of managing its operations as well as due to poor technical efficiency in view of the stability of return, which averaged during the study period 0.06. It also achieved increased in returns of scale. The technical efficiency of the change in return was 0.57 which indicates that the company can produce the current amount using only 57% of the resources.

Table 1. Technical efficiency in terms of stability and change in return and efficiency of scale for the period 2005-2017

Iraqi Company for the production and marketing of products					National Agricultural Production Company				
Yield of scale	scale	vrste	Crste	year	Yield of scale	Scale	vrste	crste	year
Irs	0.069	0.59	0.041	2005	Irs	0.107	0.577	0.062	2005
Irs	0.03	0.578	0.017	2006	Irs	0.043	0.571	0.025	2006
Irs	0.075	0.479	0.037	2007	Irs	0.044	0.571	0.025	2007
Irs	0.083	0.48	0.04	2008	Irs	0.026	0.648	0.017	2008
Irs	0.08	0.591	0.047	2009	Irs	0.006	0.647	0.004	2009
Irs	0.089	0.591	0.053	2010	Irs	0.007	0.865	0.006	2010
Irs	0.087	0.669	0.058	2011	Irs	0.009	0.865	0.008	2011
Irs	0.118	0.672	0.079	2012	Irs	0.007	1	0.007	2012
Irs	0.132	0.656	0.087	2013	Irs	0.007	1	0.007	2013
Irs	0.148	0.596	0.088	2014	Irs	0.002	0.719	0.001	2014
Irs	0.176	0.598	0.105	2015	Irs	0.045	0.725	0.033	2015
Irs	0.105	0.481	0.05	2016	Irs	0.045	0.725	0.033	2016
irs	0.15	0.523	0.078	2017	Irs	0.036	0.684	0.045	2017
	0.10	0.57	0.06	Average		0.03	0.73	0.021	Average

Source: Researchers works using DEAP2.1

Table 2. shows the technical efficiency in the stability and change of return for the Iraqi company for the production and marketing of meat and crops for the period 2005 - 2017, and it is noted that the low technical efficiency in the stability of the return reflects the inability to increase production with the same proportion of resources due to scale constraints and competition, this low efficiency led to low scale efficiency, which reached in an average of 0.06, indicates that the company is away from the optimal level, but the company was able to achieve technical efficiency in term of the change in return, the average rate during the research period 0.68, which means that the company has waste of 32% and it can produce the current amount of outputs using68% of the resources, the efficiency varied between a minimum of 0.27 in 2005

and a maximum of 1 in 2014 and 2016, although this company achieved in these years revenue for business activity was less than the years 2103, 2015, 2017 this indicates that it did not succeed in mixing quantities of Its resources technically. Table 2 also included with regard to the General Company for Seed Production. Achieved technical efficiency in view of the variable return of scale averaging 0.64, which means that it needs to improve its output and the way of mixing its resources by 36% to reach the optimum level of production, this means that it has a waste of resources by 36%. In 2014, 2015 the company achieved full efficiency and that in these years achieved a profit rate of 60 and 75%, as it was able to achieve the highest revenue from its commercial activity during these two years amounted to more than 150 billion Iraqi dinars. Technical efficiency at constant return was 0.44 while the scale efficiency averaged 0.60 with increasing yields throughout the research period except full efficiency in which fixed scale returns were achieved.

Table 2. Technical Efficiency with Stability and Change in return and Scale Efficiency for the period 2005-2017

State Company for Seed Production					Iraqi company for the production and marketing of meat and crops				
Yield of scale	scale	vrst	crst	Year	Yield of scale	scale	vrst	crst	year
Irs	0.316	0.44	0.139	2005	Irs	0.366	0.27	0.099	2005
Irs	0.159	0.403	0.046	2006	Irs	0.133	0.309	0.041	2006
Irs	0.23	0.507	0.117	2007	Irs	0.033	0.497	0.016	2007
Irs	0.139	0.493	0.068	2008	Irs	0.013	0.505	0.007	2008
Irs	0.515	0.466	0.24	2009	Irs	0.005	0.638	0.003	2009
Irs	0.597	0.603	0.36	2010	Irs	0.016	0.7	0.011	2010
Irs	0.759	0.536	0.407	2011	Irs	0.016	0.67	0.011	2011
Irs	0.805	0.579	0.466	2012	Irs	0.028	0.484	0.024	2012
Irs	0.633	0.639	0.404	2013	Irs	0.046	0.975	0.045	2013
Irs	1	1	1	2014	Irs	0.024	1	0.024	2014
Irs	1	1	1	2015	Irs	0.048	0.924	0.044	2015
Irs	0.93	0.885	0.823	2016	Irs	0.028	1	0.028	2016
Irs	0.831	0.771	0.64	2017	Irs	0.039	0.571	0.022	2017
	0.60	0.64	0.44	Average		0.06	0.68	0.02	Average

Source: researchers work using DEAP 2.1

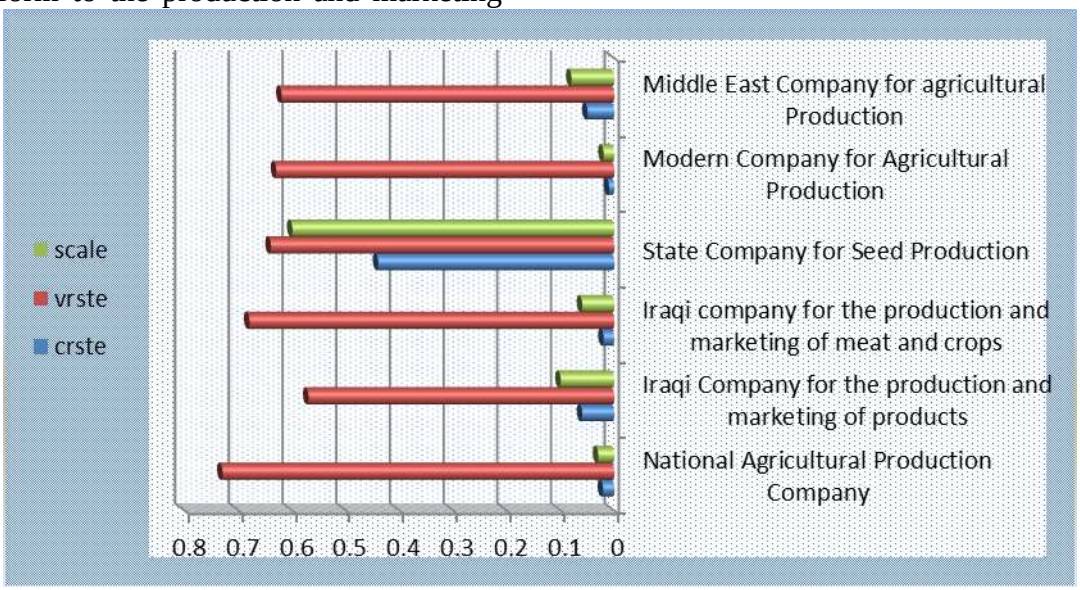
We note from Table 3 that the modern company was not efficient in terms of scale as efficiency reached 0.02 due to the weak management and lack of scientific method in managing and mixing resources. This was evident in the technical efficiency in view of the fixed return which was reflected in low scale of efficiency. However, the company was able to achieve technical efficiency in term of the change in return of scale averaging 0.63, which means that it hold up additional amounts of input by about 37% and achieved full efficiency only in 2005. As well as from Table 3. As for the Middle East Agricultural Production Company, it did not produce on the efficiency curve during the study period, which did not achieve full efficiency; rather, the average technical efficiency in the change of return is 0.62, which means that it can produce the current amount of production using only 62% of its resources. Poor technical efficiency and lack of control over the mixing of its resources was reflected in the company's inability to achieve scale efficiency, note that the company during the research period was with increasing scale returns.

Table 3- Technical efficiency in terms of stability and change in return and scale efficiency for the period 2005-2017

Middle East Company for agricultural Production					Modern Company for Agricultural Production				
Yield of scale	scale	vrst	crst	Year	Yield of scale	scale	vrst	crst	year
irs	0.068	0.794	0.054	2005	Irs	0.04	1	0.04	2005
Irs	0.057	0.793	0.046	2006	Irs	0.017	0.782	0.015	2006
Irs	0.057	0.694	0.04	2007	Irs	0.012	0.871	0.01	2007
Irs	0.062	0.676	0.042	2008	Irs	0.025	0.725	0.018	2008
Irs	0.065	0.597	0.039	2009	Irs	0.018	0.723	0.013	2009
Irs	0.092	0.599	0.055	2010	Irs	0.029	0.645	0.019	2010
Irs	0.098	0.566	0.055	2011	Irs	0.008	0.547	0.004	2011
Irs	0.137	0.591	0.081	2012	Irs	0.025	0.55	0.014	2012
Irs	0.163	0.609	0.099	2013	Irs	0.031	0.435	0.013	2013
Irs	0.085	0.559	0.047	2014	Irs	0.072	0.369	0.027	2014
Irs	0.067	0.548	0.037	2015	Irs	0.036	0.487	0.018	2015
Irs	0.067	0.548	0.037	2016	Irs	0.015	0.521	0.008	2015
Irs	0.086	0.559	0.048	2017	Irs	0.015	0.531	0.008	2017
	0.08	0.62	0.05	Average		0.02	0.63	0.01	Average

Source: Researchers work using DEAP 2.1

When comparing the companies in our search in terms of technical efficiency in terms of stability and return change, as well as scale efficiency for the period 2005 - 2017, we see that all companies did not achieve scale efficiency except the General Company for Seed Production, which was able to control the size of its operations and achieve an average scale efficiency of 60% . The result in general indicates a clear defect in the management of these companies and not keep up with the development and technical progress and did not conform to the production and marketing conditions surrounding, In terms of technical efficiency due to the stability of the return of the scale of these companies could not be technically efficient except the General Company for the seed production and this deterioration in efficiency was the cause of low in scale efficiency, but these companies were able during the research period to achieve technical efficiency more than 60% except the Iraqi Company for the production and marketing of products that achieved a lower efficiency rate.



Graph 1. Average of technical efficiency in the stability and change of return and scale efficiency of the researched companies for the period 2005 – 2017

Source: Researchers work using Excel

2. Allocative Efficiency and Economic Efficiency

Allocative efficiency means choosing the input mix that achieves the specified amount of production at the lowest possible cost and reflects the ability of the establishment to optimize the use of inputs taking into account the prices of these inputs and available production techniques (17). This reflects the ability to achieve the minimum cost of a certain level of production (19). The company has two options to either improve the selection of input combinations that lower the cost or maximize outputs for the purpose of increasing income, which must take into account prices, so this type of efficiency is called price efficiency. Economic efficiency refers to the combined effect of both technical and allocative efficiency (15). It also points to the mobilization of production elements at the best proportions that achieve the greatest amount of agricultural output with a certain amount of agricultural costs to achieve the maximum amount of net agricultural income. When introducing input prices and technology in the analyzing and calculating the allocation efficiency of the researched agricultural companies, it was found that the National Company for Agricultural Production achieved an average allocation efficiency of 0.46 during the research period. This means that it incurs an additional cost of 54%, which means that the current amount of output can be produced using only 46% of inputs. This is due to the lack of optimal resource combination that contributes in one way and another to lower costs. This efficiency has fluctuated between a minimum of 0.28 for the years 2011 and 2012 and a maximum of 0.88 for the year 2017. While the company achieved an economic efficiency of an average of 0.32 which is also

low and this decline was the result of low technical and allocative efficiency. The Iraqi company for the production and marketing of products achieved an allocation efficiency of an average of 0.84, pointing to the role of good management in the mixing of resources in a scientific manner and the application of scientific methods that reduced the amount of additional cost to 16% and this improvement in the efficiency of allocation and preceded in technical efficiency raised the average economic efficiency to 0.48, It varied between the minimum in 2006, reaching 0.44 and the maximum in 2015 was 0.52.

Table 4. Technical Efficiency, Allocation Efficiency and Cost Efficiency for the period 2005-2017

Iraqi company for Produce and Marketing production				National Company for Agricultural production			
CE	AE	TE	Year	CE	AE	TE	year
0.467	0.791	0.59	2005	0.368	0.637	0.577	2005
0.444	0.757	0.587	2006	0.332	0.581	0.571	2006
0.463	0.965	0.479	2007	0.332	0.581	0.571	2007
0.466	0.97	0.48	2008	0.292	0.451	0.648	2008
0.473	0.801	0.591	2009	0.287	0.444	0.647	2009
0.478	0.809	0.591	2010	0.287	0.332	0.865	2010
0.484	0.723	0.669	2011	0.287	0.332	0.865	2011
0.504	0.75	0.672	2012	0.287	0.287	1	2012
0.511	0.78	0.656	2013	0.287	0.287	1	2013
0.513	0.861	0.596	2014	0.287	0.399	0.719	2014
0.529	0.885	0.598	2015	0.308	0.425	0.725	2015
0.476	0.99	0.481	2016	0.308	0.425	0.725	2016
0.503	0.962	0.523	2017	0.603	0.882	0.684	2017
0.485	0.849	0.577	Average	0.328	0.466	0.738	Average

Source: researcher work using DEAP program

We can notice from table 5 that the allocative efficiency of the Iraqi company for the production and marketing of meat and crops was low during the period of research, averaging 0.14, This is a low result indicating that the efficiency deviation from its normal level by a large extent and indicate that the company suffered from technical problems , and it could not control its costs as its costs increased during the study period from 494 million to 648 million with a deficit in the surplus of current operations was in 2016 about – 99 million and in 2014 reached -136 million and for this result economic efficiency fell to the lowest level, reaching 0.06 . The Iraqi company for seed production, achieved acceptable levels of allocative efficiency reached the lowest in 2008 as it amounted to 0.29 and then expanded the company activities so the company was able to work on the production potential curve in 2014, 2015 where achieved 100% efficiency and this is consistent with financial indicators as the highest rate Price was in 2014 it reached (7.3). The highest number of shares traded in 2015 reached about 720 million. Economic efficiency also averaged 0.45 during the period of study.

Table 5.Technical, Allocative and Cost Efficiency for the period 2005-2017

Iraqi company for seed production				Iraqi company for produce and marketing meat and crop			
CE	AE	TE	Year	CE	AE	TE	Year
0.237	0.539	0.44	2005	0.137	0.64	0.27	2005
0.139	0.345	0.403	2006	0.117	0.378	0.309	2006
0.19	0.374	0.507	2007	0.077	0.155	0.497	2007
0.143	0.291	0.493	2008	0.068	0.135	0.505	2008
0.309	0.664	0.466	2009	0.054	0.085	0.638	2009
0.426	0.707	0.603	2010	0.05	0.071	0.7	2010
0.472	0.88	0.536	2011	0.049	0.073	0.67	2011
0.501	0.865	0.579	2012	0.048	0.057	0.848	2012
0.43	0.674	0.639	2013	0.053	0.055	0.975	2013
1	1	1	2014	0.045	0.045	1	2014
1	1	1	2015	0.043	0.047	0.924	2015
0.628	0.709	0.885	2016	0.038	0.038	1	2016
0.469	0.609	0.771	2017	0.046	0.08	0.571	2017
0.457	0.665	0.640	Average	0.066	0.143	0.685	Average

Source: researcher work using DEAP program

Table 6 shows the allocative efficiency of the modern company for agricultural production, which averaged 0.30, ranging from a minimum of 0.08 for the years 2016 and 2017, which reflects the difficult situation of the company and its production decline significantly in these two years, this is evident from the decline in the stock's value of the company to 1.08 and the decline in the market value from 3060 in 2013 to 1312 in 2017 with the company's revenues decreased by a half from 666 million to 377 million with surplus of current operations only 21 million, this was

reflected in the low economic efficiency, which averaged 0.22 during the research period. Middle East Company achieved an allocative efficiency of 0.94 during the research period, meaning that it incurs an additional cost of only 6% , the company was able to control its costs and manage its operations in a way that ensures the scientific use of resources. It benefited from its conversion operations, as the company was able to achieve the optimal level of production and work with the full allocative efficiency from 2011 to 2017, as the duplicate profit rose from 24 to 33, as well as the trade rate rose to 3 during these years. This enhances the company's ability to manage its working capital which rose to 883 million, achieving a net profit of 72 million in 2017. Accordingly, the average economic efficiency was reached 0.58, this was due to the impact of technical efficiency.

Table 6. Technical efficiency, allocative efficiency and cost efficiency .

Middle East Company				The modern company for agricultural production			
CE	AE	TE	Year	CE	AE	TE	Year
0.704	0.886	0.794	2005	1	1	1	2005
0.696	0.877	0.793	2006	0.299	0.343	0.872	2006
0.551	0.794	0.964	2007	0.296	0.34	0.871	2007
0.553	0.818	0.676	2008	0.302	0.417	0.725	2008
0.55	0.921	0.597	2009	0.297	0.411	0.723	2009
0.566	0.946	0.599	2010	0.303	0.47	0.645	2010
0.566	1	0.566	2011	0.09	0.164	0.547	2011
0.591	1	0.561	2012	0.099	0.179	0.55	2012
0.609	1	0.609	2013	0.056	0.128	0.435	2013
0.559	1	0.559	2014	0.069	0.186	0.369	2014
0.548	1	0.548	2015	0.056	0.114	0.847	2015
0.548	1	0.548	2016	0.044	0.084	0.521	2016
0.559	1	0.559	2017	0.044	0.082	0.534	2017
0.548	0.941	0.625	Average	0.227	0.301	0.636	Average

Source: researchers work using DEAP program

After reviewing the results of cost efficiency and its components, when comparing the companies researched during the study period, we see that most companies achieved low levels of economic efficiency, and this reflects their low efficiency in exploiting the money invested in assets, which makes it difficult to control the management of their costs, that makes them do not achieve an Positive economics scale, which allows it to expand the size of its activities, Its technical, administrative and financial capabilities are not in line with the requirements of the agricultural sector, and profits are not consistent with the magnitude of the capital invested except the Middle East Company, which achieved the highest rate of economic efficiency. In terms of allocative efficiency, the Middle East Company was able to approach the optimum production size achieved and produced for the period 2011 - 2017 on the possible production curve, which achieved full efficiency during that period, followed by the Iraqi company for the production and marketing of products.

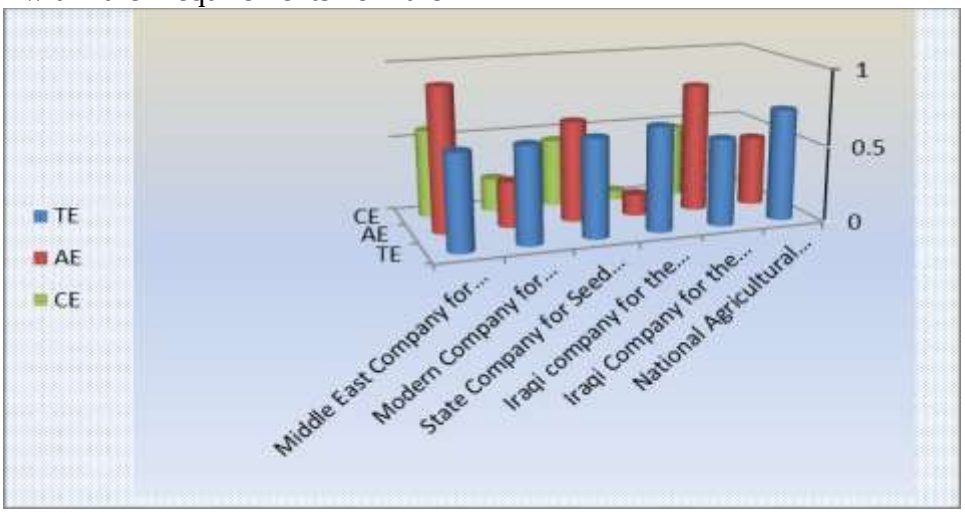


Figure 2. Averages of economic efficiency and its branches for the researched companies

Source: Researchers work using Excel

Second: Measuring Technical Change and Total Productivity of Resources

Partial concepts of each element of production are misleading because they suggest that there is a causal relationship between the output and the element to be measured, while it is only a statistical technical relationship. Therefore, in applied studies it is preferable to use the total productivity over the partial productivity indicators because the latter is affected by the different intensity of the use of production elements, more intensive use of inputs reduced their productivity, due to the law of diminishing marginal productivity. Therefore, total productivity represents the right direction in studies of productivity efficiency and methods of measurement, whether its purpose is to know the reasons for the change in the productive efficiency of the project or find indicators or measures because of the change, and as long as the production of the project depends on all the elements involved in its activity, it must be linked Between the output changes and the changes that occur from all these elements.There are many different methods used to measure and analyze productivity into its various components (7). One of the most popular of these methods is the Malmkusite index, where it can link the productivity movement between two facilities close together and is characterized by not assuming a certain productivity equation for the data used (19). Note that there is another indicator used to measure productivity called Tornqvist, but this indicator is often used in parameter studies in which the differences between the boundary curve and random errors and inefficiency values are determined together. However, in the Malmquist index, which is used in non- parametric studies the differences are given compared to the boundary curve only for all efficiency values (10). This indicator aims to measure the change in the total factor productivity between two views by calculating the average distance between each view and the production boundary curve representing a certain level of technology. This indicator is calculated as the geometric mean of two functions of distance function (12). The Malquist Productivity Index can be formulated as follows:

$$M_o(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \left[\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)} \right]^{\frac{1}{2}}$$

The amount outside the parentheses represents a change in technical efficiency (Teffch) and translates into the catching - up effect and indicates that the performance of the origin is moving for the better (the distance and proximity to the border curve is the best performance) (10). While the geometric mean of the two indicators within the parentheses measures the shifts in technology between two periods t (reference technological period) and (t + 1) is called technical change, which allows searching for the main sources of efficiency change and improvements in management practices. Change in pure technical efficiency, Pure Technical Efficiency (PTE change), or move to optimal scale (Scale Efficiency change (SEch)) (14). Based on the foregoing, the Malmquist Total Productivity Index is the product of the change in technical efficiency multiply by the technical change. **tfpch = effch *tech**

Notes from Table 7, in which the five indicators were calculated using 2017 as a technological reference year and the use of labor and capital as variables affecting productivity, It is noted that the change in the technical efficiency of the National Company for Agricultural Production averaged 2.2, which means that there is no improvement in efficiency and there is a decline in productivity in general ,note that the company during the period 2010-2014 achieved an improvement in efficiency, while the technical change of the company during the study period averaged 1.01 this indicates that there is an improvement in the technical level that may be reflected in productivity and it is simple, and there is a difference between the two periods note that the company in some years was unable to maintain the level of productivity, while the change in the total productivity of resources averaged 1.97 oscillatory between the upper limit of 3.9 in 2009 and a minimum of 0.19 in 2014.As for the Iraqi Company for the production and marketing of products, the average change in technical efficiency during

the research period is 1.28. There is no improvement in the level of efficiency and the company uses resources in the original period more than the technological period. While the technical change of the company reached an average of 1.1 and indicates a slight change in the technical level and the highest technical level achieved for the company in 2013, It is also noted that the change in the total productivity of resources averaged during the research period 1.48 means that there is an improvement in the total productivity of resources this came from one of the sources of improvement, which is the technological level as the company in general has an improvement except in 2006 in which the company was technically inefficient nor technology this was reflected in the decline in overall resource productivity that year.

Table 7. Technical change and total resource productivity for the period 2005-2017

Iraqi Company for Produce and Marketing Products					National Company for Agricultural Product					
tfpch	sech	Pech	techch	effch	tfpch	sech	pech	Techch	effch	year
1.76	1	1	1.76	1	3.403	1	1	3.403	1	2005
0.853	0.903	1	0.945	0.903	3.026	0.673	1	4.498	0.673	2006
1.153	1.11	1	1.038	1.11	3.62	0.799	1	4.532	0.799	2007
1.16	1.26	1	0.921	1.26	3.147	0.731	1	4.307	0.731	2008
1.309	1.526	1	0.858	1.526	3.908	1	1	3.908	1	2009
1.23	1	1	1.23	1	0.764	1	1	0.76	1	2010
1.654	1.107	1	1.494	1.107	0.728	1.306	1	0.558	1.306	2011
1.511	0.989	1	1.529	0.989	0.587	1.479	1	0.397	1.479	2012
2.585	1.647	1	1.57	1.647	0.449	1.158	1	0.388	1.158	2013
1.698	1.081	1	1.57	1.081	0.191	1	1	0.191	1	2014
1.213	1.14	1	1.064	1.14	3.406	0.83	1	4.106	0.83	2015
1.683	1.143	1	1.473	1.143	0.489	1.175	1	0.416	1.175	2016
1.484	1.158	1	1.287	1.158	1.976	1.012	1	2.287	1.01	mean

Source: Researchers work using Malmquist indicator

From Table 8 we can see. When calculating the change in technical efficiency, the Iraqi company for the production and marketing of meat and crops was not efficient in throwing its resources technically, ranging from a maximum of 3.4 in 2006 and a minimum of 0.9 in 2009 the year saw an improvement in efficiency, while the company's technical efficiency rate was 1.81. It also notes the technical change at the rate of 0.94 this indicates a decline in the technological level of the company, the company did not benefit from technical changes it is ranged between a minimum in 2008 of 0.4 and a maximum in 2013 of 2.18. The change in total resource productivity reached 1.66 during the research period that indicates an improvement in total resource productivity. The Iraqi Company for Seed Production improves its efficiency when comparing the two technological periods as the rate of change in technical efficiency is 0.63, which means that it uses fewer resources in the second period of the first period and that there is an improvement in productivity. The technological change, which indicates an improvement in the maximum efficiency between the periods t + 1, t, it shows that the units with the best efficiency rates have improved or decreased between the periods and therefore note that the average technical change at the level of the sample was 1.42, that means there is a technological progress of the company but also some years such as 2006-2009 had a decline in the technological level and the inability to maintain the level of productivity over time. While the total productivity of the resources could not benefit from the phenomenon of catching - up and did not benefit from the improvement in the technical and technological components but declined as it average 0.75 during the research period.

Table 8. Technical change and total resource productivity for the period 2005-2017

Iraqi Company for Seed Production					Iraqi Company for Produce and Marketing Meat and Crops					
tfpch	sech	pech	techch	effch	tfpch	sech	pech	techch	effch	year
1.076	1	1	1.076	1	2.92	1	1	2.982	1	2005
0.562	0.884	1	0.635	0.884	3.4	1	1	3.4	1	2006
0.59	0.807	1	0.731	0.807	1.812	0.659	1	2.75	0.659	2007
0.3	0.474	1	0.633	0.474	0.837	0.459	1	1.826	0.459	2008
0.57	0.61	1	0.934	0.61	0.876	0.896	1	0.977	0.896	2009
0.683	1	1	0.683	1	1.216	1	1	1.216	1	2010
0.542	1.113	1	0.487	1.113	1.322	1	1	1.322	1	2011
0.802	2.032	1	0.394	2.032	1.046	0.868	1	1.205	0.868	2012
0.662	1.671	1	0.396	1.671	2.879	2.181	1	1.32	2.181	2013
1.857	5	1	0.371	5	0.677	0.515	1	1.315	0.515	2014
0.571	0.729	1	0.784	0.729	1.682	0.77	1	2.184	0.77	2015
0.817	1.8	1	0.454	1.8	1.268	0.995	1	1.275	0.995	2016
0.752	1.426	1	0.631	1.426	1.666	0.945	1	1.8143	0.9455	mean

Source: Researchers work using Malmquist indicator

Table 9 shows that the change in the technical efficiency in the modern company for agricultural production ranged between a maximum of 1.68 in 2009 and a minimum of 0.54 in 2012 and an average of 1.68, indicating a decrease in efficiency levels and that the company was not technically efficient in mixing its resources and that it hold on more resources in the technological period. Technological change averaged 1.63, fluctuated between 4.9 - 2014 and 0.39 in 2007. The change in the total productivity of resources amounted to 1.37 which indicates an improvement in productivity, benefiting from the technological change that took place in the company. The Middle East Company for Agricultural Production was not technically efficient as the rate of change in efficiency during the research period was 1.77 and it incurs additional cost for using more resources during the second period. The total productivity of resources is 1.84.

Table 9. Technical change and total resource productivity for the period 2005-2017.

Middle East for Agricultural Production					The Modern Company for Agricultural Production					
tfpch	sech	pech	techch	Effch	tfpch	sech	pech	techch	effch	year
1.758	1	1	1.758	1	1.678	1	1	1.678	1	2005
1.384	0.967	1	1.432	0.967	2.031	1.287	1	1.578	1.287	2006
1.069	0.735	1	1.454	0.735	0.613	0.396	1	1.551	0.396	2007
0.928	0.631	1	1.471	0.631	0.723	0.418	1	1.728	0.418	2008
1.625	1.075	1	1.511	1.075	0.417	0.247	1	1.689	0.247	2009
1.83	1	1	1.83	1	0.917	1	1	0.917	1	2010
2.222	1.029	1	2.16	1.029	0.57	1	1	0.57	1	2011
2.46	1.148	1	2.143	1.148	1.361	2.51	1	0.542	2.51	2012
3.815	1.852	1	2.06	1.852	2.333	4	1	0.583	4	2013
1.481	0.76	1	1.949	0.76	3.15	4.964	1	0.635	4.964	2014
1.314	0.864	1	1.521	0.864	0.912	0.555	1	1.644	0.555	2015
2.241	1.107	1	2.025	1.107	1.392	2.185	1	0.637	2.185	2016
1.843	1.014	1	1.776167	1.014	1.341	1.630	1	1.146	1.630	mean

Source: Researchers work using Malmquist indicator

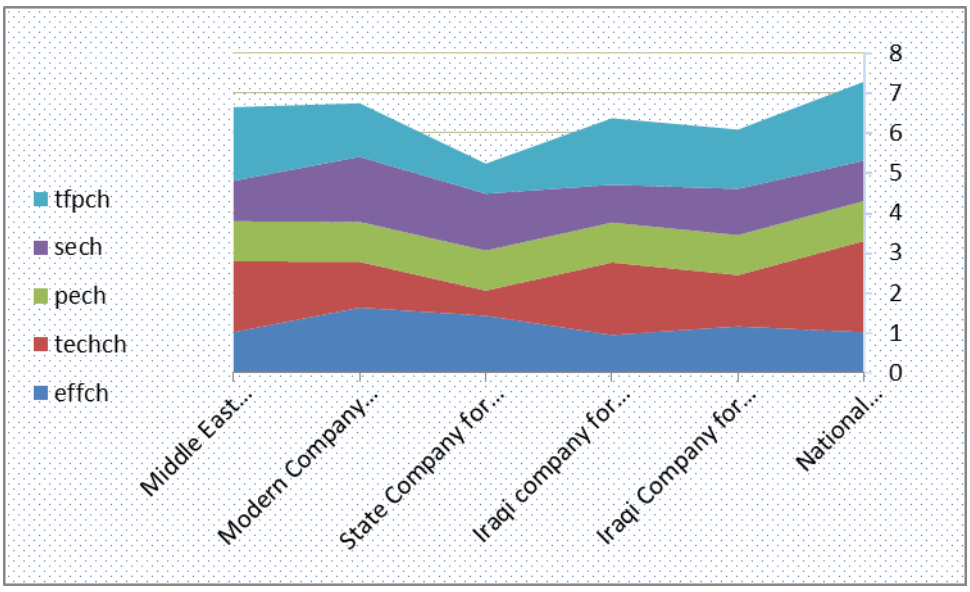


Figure 3. Average technical change and total resource productivity of the researched companies during the study period

Third: Technical Efficiency Using SFA method: It is a parameterized method that takes into account random error and requires predetermination of the model used, the possibility of inefficiency in the inaccurate characterization of the model and also requires econometrics as a method of estimation (8). This method has the ability to form a model that explains the relationships and determinants of inefficiency at one stage, and is used to measure the level of technical and allocative efficiency of the farm and then economic efficiency (4). It is estimated using the transcendental logarithmic function, which is one of the most widely used functions because of its superiority over other productive functions . The production function of translog for K and L items can be represented by the following formula:

$$LNQ = B_0 + B_1 LNL + B_2 \text{LNK} + B_3 \text{LNL}^2 + B_4 \text{LNK}^2 + B_5 \text{LNL LNK} + (Vi - Ui)$$

Where: Q= the agriculture output value . L = labor , K = the capital (IQD)

The process of estimating the transcendental logarithmic production function goes through three stages. The first uses the ordinary least squares (OLS) method to obtain unbiased linear parameters except the fixed parameter. Correction Ordinary Least Square (COLS) is then used to obtain unbiased linear parameters including the constant element and in third step the maximum probability estimates of the parameters of the random boundary production function can be obtain , using the Maximum Likelihood method ML , estimated using FRONT software. 4.1. Table 10.

Table 10.Transcendental logarithmic output function parameters

Parameters	ML	COLS	OLS
B_0	0.29	0.36	0.36
B_1	0.23	0.21	0.21
B_2	0.22	0.29	0.29
B_3	0.11	0.11	0.11
B_4	0.48	0.66	0.66
B_5	0.67	0.57	0.57
sigma-squared	0.21	0.11	0.92

Source: The researcher's work using FRONT.4

It is evident from the estimated function that the intersection term of the function varied according to the estimation methods and thus became an unbiased linear estimator. The sign of the parameters of labor and capital agreed with the logic of economic theory, as the increase of labor by 1%, the value of production in agricultural companies increased by 0.23%, because working in agricultural companies must have a degree of efficiency that comes from training and the development of potential and the expansion of technical use, the quality and skill of the work is important because some companies specialize in the production of certain goods need to work in line with the nature of this specialization. If the capital increase by 1%, the value of production increases by 0.22%, because it helps to take advantage of the advantages of advanced technology, which these companies are supposed to work to localize and support the agricultural sector, because there is no doubt that the use of modern technologies in its pot will achieve Increase in production.

The cross-labor elasticity between labor and capital expressed in B5 was 0.67 and indicates the nature of the Substitution relationship between two sources because the use of technology reduces the number of workers. The value of sigma-squared was 0.21, meaning there are other explanatory variables that affect efficiency through their influence on the random variable, especially management variables. The logarithmic TL function, which was estimated in three ways, was used to calculate the technical efficiency of agricultural companies for the period 2005-2017 and using FRONT.4 program. Table 11 shows its results, which shows that the lowest level of technical efficiency was in the Iraqi company for the production and marketing of meat and crops, which reached 0.05 in 2005, while the highest value of efficiency was in 2010 to the stocks of the State Company for seed production, which amounted to 0.87, it means that the company can produce the current amount using only 87% of inputs. As for the average, we note that the lowest average was in the modern company for agricultural production was 0.26 and the highest average was the stocks of the State Company for Seed production, which was 0.65. But in 2017 to find out the latest activity of companies found that the Iraqi company for the production and marketing of products achieved the highest average technical efficiency of 0.60.

Table 11. Technical efficiency averages according to Stochastic Frontier Analysis SFA

2017	MEAN	YEAR	MAX.	YEAR	MIN.	The Company
0.55	0.40	2015,2016	0.68	2009	0.11	National company for Agricultural production
0.60	0.55	2015	0.67	2006	0.24	Iraqi company for produce and marketing product
0.23	0.32	2013	0.73	2005	0.05	Iraqi company for produce and marketing meat and crop
0.55	0.65	2010	0.87	2006	0.29	State company for seed production
0.09	0.26	2006	0.54	2016	0.08	Modern company for agricultural production
0.35	0.45	2005	0.62	2015, 2016	0.26	Middle east company for agricultural production

Source: The researcher's work using FRONT. Program

One of the important **conclusions** that came out of the research proved that his hypothesis that agricultural companies does not have economic efficiency and there is waste of resources, and that they did not choose the optimal mix that achieves production at the lowest cost, which made the companies hold - up additional cost the largest extra expenses was in the Iraqi company for the production and marketing of products. When calculating the average distance between each company and the boundary production curve, which represents a certain level of technology, there is an improvement in the total productivity of resources resulting from improved technical change rather than a change in technical efficiency. The cross-elasticity between labor and capital expressed in B5 was 0.67 and indicates the nature of the substitute relationship between the two elements because the use of technology reduces the number of workers and this allows the company to replace the production elements, with some options available to producers to replace between the elements of production. The value of sigma-squared was 0.21, meaning there are other explanatory variables that affect efficiency through their influence on the random variable, especially management variables. When comparing the efficiency results with the SFA and DEA methods, there was a difference in the estimation results, because the parameter methods are more advanced compared to the non-parameter methods, it assesses efficiency on the basis of economic improvement and allows the parameter method to integrate both technical and allocative efficiency and SFA. Accordingly, the research **recommends** following the scientific method in the management of these companies results in a right decision based on a quantitative method specifying the real objectives of these companies and the changes that occur in the level of production and competition, so that a clear policy is addressed to address this slowness so that these companies play an important role in meeting the rules and requirements of the market and that the state has a clear role in the formulation of this policy through support and control. Companies should limit their production activities to one direction without bifurcation, especially those that did not have some efficiency. They should choose profitable activities and go to liquidation other activities.

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