USING DEA MODELS TO EVALUATE PERFORMANCE OF FISHERIES COMPANIES IN VIETNAM

[1]CHIA-NAN WANG, [2]HAN-KHANH NGUYEN

[1]Department of Industrial Engineering and Management, National Kaohsiung University of Applied Sciences, No. 415 Chien Kung Road, Sanmin District, Kaohsiung City 80778, Taiwan
[2]Department of Industrial Engineering and Management, Fortune Institute of Technology, Kaohsiung 83160, Taiwan
E-mail: cn.wang@fotech.edu.tw, khanhthanhan1412@gmail.com

Abstract- In Vietnam, fisheries sector plays an important role in the economic development. According to the report of the General Fisheries Department, the total output of fishery production in 2016 reached over 6.7 million tons [1]. However, in recent years, many causes have impacted on the competitive pressure on fisheries enterprises in terms of production, quality and production cost. This competition has influenced on Vietnamese fisheries enterprises that have had difficulties in maintaining and increasing their market share. Therefore, managers need to find out solutions and take actions to increase labor productivity, remove difficulties, and improve competitiveness. Based on the data of the leading fisheries enterprises in Vietnam, we use the DEA (data development analysis) model to evaluate the performance of these companies in the period of 2013 - 2016. Consequently, we could find a suitable solution to improve the business efficiency for fisheries enterprises in the future.

Keywords - Data envelopment analysis, Fisheries, Performance, Seafood.

I. INTRODUCTION

Vietnam approximately has an area of 3448,000 km^2, with a coastline of 3260 km. Internal waters and Territorial sea were 226.000 km^2 wide [1]. Vietnam's fisheries output has been growing steadily for 17 years with an average increase of 9.07% per year [1].

Table 1: Exports of Fishery Products of Vietnam from 2005 to 2016 (Million dollars) [1].

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Export value	2739	3348	3763	4509	4251	5034	6118	6134	6899	7922	6677	7053

The fisheries sector has focused on production of goods and has developed into a leading economic sector. With the rapid and effective growth, the fisheries sector has contributed positively to the restructuring of agricultural and rural economy, creating jobs for many laborers. However, in recent years, the shortages of raw materials and capital, along with the increase of input costs have been the obstacles for the fisheries enterprises in this tough time. Therefore, this study is conducted to assess the performance of the fisheries enterprises. The managers can rely on this research result to develop strategic solutions to enhance their competitiveness in the domestic and international market.

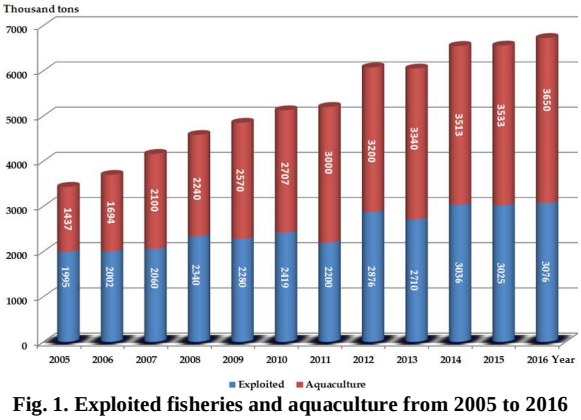


Fig. 1. Exploited fisheries and aquaculture from 2005 to 2016 [1].

We used DEA method to evaluate the performance of the fisheries enterprises. This is a non-parametric programming technique used to handle the problems of multiple inputs and outputs involving multiple decision-making units (DMUs). This method is based on Farrell's idea introduced in 1957 on the application of the Production Possibility Frontier (PPF) as the criterion for evaluating the relative effectiveness of the enterprises in the same sector. Thus, the companies that reach the limits will be considered more efficient, and the companies that do not reach PPF will be considered less efficient.

In the past, some researchers have conducted DEA studies: Saranga (2009) used DEA to identify the inefficiencies of decision making unit (DMU) in the Indian auto component industry [2]. Charles, Kumar, and Kavitha (2012) used DEA to assess the efficiency of a printed circuit board assemble line [3]. Lo and Lu have argued the reasons for using DEA models and The super – Slacks Based Measure (SBM) and Malmquist models [4].

Therefore, the use of DEA helps the managers make the right decisions to develop and enhance the competitiveness of a well-functioning enterprise. These issues are important and urgent for the enterprises in the current economic downturn.

II. MATERIALS AND METHODS

2.1 Data collection

After searching in the fisheries sector in Vietnam, we found 12 largest companies specializing in aquaculture and fisheries production from the website of General Statistics that are appropriate for this study as presented below:

Table 2: List of Fisheries companies.

Order	Code	Companies Name
1	DMU1	MeKong Fisheries Joint Stock Company - AAM
2	DMU2	Bentre Aquaproduct Import and Export Joint Stock Company - ABT
3	DMU3	Cuu Long An Giang Fish Joint Stock Company - ACL
4	DMU4	Namviet Corporation - ANV
5	DMU5	Bac Lieu Fisheries joint stock Company – BLF
6	DMU6	Travel Investment and Seadfood Development Corporation - DAT
7	DMU7	Hung Vuong Corporation – HVG
8	DMU8	Ngo Quyen Processing Export Joint Stock Company - NGC
9	DMU9	Vietnam Seaproducts - Joint Stock Corporation – CTCP - SEA
10	DMU10	Vinh Hoan Corporation - VHC
11	DMU11	Seafood Joint Stock Company No. 4 - TS4
12	DMU12	Danang Seaproducts Import-Export Joint Stock Corporation - SPD

Source: Synthetic by researcher [5 - 16].

The data used in this study was collected from the financial reports of the enterprises in the period of 2013 - 2016. Based on the research objectives, we decided to choose 3 input elements: Total Assets (TA); Cost of goods sold (CS); Total Operating Expenses (OE); And 2 output elements: Net Sales (NS); Profit after tax (PT). These factors play an important role in evaluating the business performance and decision-making of the managers.

Table 3: Inputs and outputs data (Currency unit: 1,000,000 VND).

DMUs	2013					2014				
	(I)TA	(I)CS	(I)OE	(O)NS	(O)PT	(I)TA	(I)CS	(I)OE	(O)NS	(O)PT
DMU1	302072	471143	54360	533487	8187	297191	395912	39885	439017	8881
DMU2	688269	432096	48068	534534	73929	656658	347984	44900	448861	77505
DMU3	718957	832858	152241	987212	5148	837341	732310	110380	854490	12312
DMU4	2811239	2210433	368409	2559210	6743	3324348	2349129	389726	2769744	60765
DMU5	479689	421383	72589	495116	3213	807520	1236454	123458	1356663	1535
DMU6	302039	428957	39728	470061	9012	346867	319924	22449	343982	11137
DMU7	9989772	6602936	880591	7688523	260430	9025124	10058267	1012894	11042964	247938
DMU8	107345	150500	18204	168601	2757	111997	233307	20975	257044	9468
DMU9	2352430	3412257	316406	3362776	35358	2100979	3232053	274302	3458744	95208
DMU10	2549617	4491391	474377	5095012	158386	4491964	5469173	471490	6292449	439152
DMU11	986537	564149	128745	703841	13862	1075198	593719	142367	754487	18447
DMU12	499443	1194424	98163	1279015	2544	460901	1529894	93123	1607750	1359
	2015					2016				
DMU1	321934	319863	32483	349631	2564	259536	253727	22856	274778	2396
DMU2	584656	356418	72432	474007	68885	649276	347201	42906	422105	47671
DMU3	1209725	976101	150707	1139475	29133	1185986	1098436	172202	1289474	23727
DMU4	3274072	2111826	347245	2494423	1524	3017406	2463127	359225	2824525	19670
DMU5	651786	735121	143304	877347	2612	617135	519104	115859	636809	6015
DMU6	796064	606331	33854	657252	21361	1095638	808639	53292	944730	25791
DMU7	15754788	13782266	990317	14901695	290553	16401844	16686108	1177635	17920847	159404
DMU8	109114	216889	20158	238669	1813	104425	201315	18801	222216	3311
DMU9	2874729	2884102	297717	3136368	195175	1772675	1296529	136715	1420534	10208
DMU10	4356963	5690816	580157	6493390	322559	4453946	6232652	478684	7303546	554624
DMU11	1290997	615823	141055	753201	7676	1306962	667851	138958	797395	7373
DMU12	449571	1403561	91664	1491469	6494	365181	1246360	71406	1315152	6712

Sources: Financial statements of DMUs [5 - 16].

2.2 Data envelopment analysis model

To assess the business performance of fisheries enterprises for the period 2013-2016, we used the Supper - efficiency model (Super- SBM-Oriented) and Malmquist model.

- Super efficiency SBM model:

This model develops on SBM and introduced by Tone (2001) [17]. We use n DMUs with inputs and outputs matrices $X = (x_{ij}) \in R^{m\times n}$ and $Y = (y_{ij}) \in R^{s\times n}$, respectively. λ is a non-negative vector in R^n [17]. The vector $S^- \in R^m$ and $S^+ \in R^s$ indicate the input excess and output shortfall, respectively. SBM model in fractional form is as follow (Tone, 2001) [17]:

$$\text{Min } \rho = \frac{1 - \frac{1}{m}\sum_{i=1}^{m} s_i^- / x_{i0}}{1 + \frac{1}{s}\sum_{i=1}^{s} s_i^- / y_{i0}} \quad \text{Subject to}$$

$$x_0 = X\lambda + s^-, \qquad y_0 = Y\lambda - s^+,$$

$$\lambda \geq 0,\ s^- \geq 0,\ s^+ \geq 0. \qquad (1)$$

We optimize solutions for SBM is $(p^*, \lambda^*, s^{-*}, s^{+*})$. A DMU (x_0, y_0) is super SBM if $p^* = 1$. This condition is equivalent to $S^{-*} = 0$ and $S^{+*} = 0$, no input excess and no output shortfall in optimal solution. SBM is non-radial and deal with input and output slack. The SBM returns and efficiency measure between 0 and 1.

The best performer has efficient status and express by unity. Tone (2002) discriminate these efficient DMU and rank the efficient DMUs by super SBM model [18]. The DMU (x_0, y_0) is SBM-efficient, $p^* = 1$, super SBM model will be follow [18]:

$$Min\delta = \frac{\frac{1}{m}\sum_{i=1}^{m} \bar{x}_i / x_{i0}}{\frac{1}{s}\sum_{r=1}^{s} \bar{y}_i / y_{r0}} \text{ Subject to: } \bar{x} \geq \sum_{j=1, j\neq 0}^{n} \lambda_j x_j;$$

$$\bar{y} \geq \sum_{j=1, j\neq 0}^{n} \lambda_j y_j; \qquad \bar{x} \geq x_{i0};\ \bar{y} \leq y_{r0},$$

$$\bar{y} \geq y_0,\ \lambda \geq 0. \quad (2)$$

The previous models of DEA have been still limited in evaluating the business performance. The DEA-Solver pro 8.0 Manuel model has overcome these limitations by [19]:

When $y_{ro} \leq 0.$ $\bar{y}_r^+$ and y_{-r}^+ will be defined: $\bar{y}_r^+ = \max_{j=1,\ldots,n}\left\{y_{rj} \middle| y_{rj} > 0\right\};$

$\bar{y}_r^+ = \min_{j=1,\ldots,n}\left\{y_{rj} \middle| y_{rj} > 0\right\}$. If the output r has no positive elements, then it is defined as $\bar{y}_r^+ = y_{-r}^+ = 1$.

The term is replaced s_r^+ / y_{r0} in the objective function in the following way. The value y_{r0} is never changed in the constraints.

If $\bar{y}_r^+ > \bar{y}_{-r}^+$, the term is replaced by [8]:

$$s_r^+ \Big/ \frac{y_{-r}^+\left(\bar{y}_r^+ - y_{-r}^+\right)}{\bar{y}_r^+ - y_{r0}}. \quad (3)$$

If $\bar{y}_r^+ = \bar{y}_{-r}^+$ the term is replaced by

$$s_r^+ \Big/ \frac{\left(\bar{y}_{-r}^+\right)^2}{\mathrm{B}(\bar{y}_r^+ - y_{r0})}. \quad (4)$$

Where B is a large positive number, (in DEA-Solver B=100). In any case, the denominator is positive and strictly less than y_{-r}^+. Furthermore, it is inverse proportion to the distance $\bar{y}_r^+ - y_{r0}$. It concerns the magnitude of the non-positive output [19].

- Malmquist productivity index (MPI)

Malmquist Index (MI) evaluates the performance of a company in two fixed periods of time. The "Catch – up" (C) term is related to the degree of efforts that the DMU attained for improving its efficiency, while the "Frontier – shift" (F) term reflects to change in the efficient frontiers surrounding the DMU between the two time periods 1 and 2. We denote DMU_0 at the time periods 1 and 2 by (x_0^1, y_0^1) and (x_0^2, y_0^2) respectively and use employ the following notation for the efficiency score of DMU $(x_{0,} y_0)^{t_1}$ measured by the frontier technology t_2 [20]: $\delta^{t_2}\left((x_{0,} y_0)^{t_1}\right)$, ($t_1$ = 1, 2 and t_2 = 1, 2).

The (C) effect is measured by the following formula [20]: $C = \dfrac{\delta^2((x_{0,} y_0)^2}{\delta^1((x_{0,} y_0)^1}$ (5)

The (F) effect is described as [20]: $F = \left[\dfrac{\delta^1((x_0, y_0)^1)}{\delta^2((x_0, y_0)^1)} \times \dfrac{\delta^1((x_0, y_0)^2)}{\delta^2((x_0, y_0)^2)}\right]^{\frac{1}{2}}$ (6)

(MI) is the product of (C) and (F); that is: MI = $C*F \Leftrightarrow MI = \left[\dfrac{\delta^1((x_0, y_0)^2)}{\delta^1((x_0, y_0)^1)} \times \dfrac{\delta^2((x_0, y_0)^2)}{\delta^2((x_0, y_0)^1)}\right]^{\frac{1}{2}}$ (7)

If: (C)>1, (F)>1, (MI)>1: The enterprise performs better than before.

If: (C)=1, (F)=1, (MI)=1: The enterprise performs the same as before.

If: (C)<1, (F)<1, (MI)<1: The enterprise performs worse than before.

Authors develop the output – oriented MI as well by means of the output - oriented radial DEA models.

The output oriented models take all output slacks into account but no input slacks. This is explained below within score in output orientation (O - V) [20]: $\delta^s\left((x_{0,}y_0)^s\right)=\min_{\theta,\lambda}\theta$ (8)

Subject to: $x_0^s \geq X^s\lambda$; $(\frac{1}{\theta})y_0^s \leq Y^s\lambda$; $L \leq e\lambda \leq U$; $\lambda \geq 0$ (9)

Intertemporal score in output – orientation (O – V) [20]: $\delta^s\left((x_{0,}y_0)^t\right)=\min_{\theta,\lambda}\theta$ (10)

Subject to: $x_0^t \geq X^s\lambda$; $(\frac{1}{\theta})y_0^t \leq Y^s\lambda$; $L \leq e\lambda \leq U$; $\lambda \geq 0$. (11)

Radical methods still have some limitations is the neglect of slacks. Tone has overcome this limitation with two models: SBM and super-SBM. Using these measures we develop here the nonradial and slacks - based MI. In the output-oriented case, we solve as following [20]:

SBM - O: $$\delta^t\left((x_{0,}y_0)^s\right)=\min_{\lambda,s^+}\frac{1}{(1+((\frac{1}{q})\sum_{i=1}^{q}\frac{s_i^+}{y_{i0}^s}))}$$ (12)

Subject to: $x_0^s \geq X^t\lambda;\ y_0^s = Y^t\lambda - s^+; L \leq e\lambda \leq U$; $L \leq e\lambda \leq U$; $\lambda \geq 0, s^+ \geq 0$.(13)

Where the vector $s^+ \in R^q$ denotes the output – slacks.

Super – SBM - O: $$\delta^t\left((x_{0,}y_0)^s\right)=\min_{\lambda,s^+}\frac{1}{(1-((\frac{1}{q})\sum_{i=1}^{q}\frac{s_i^+}{y_{i0}^t}))}$$ (14)

Subject to: $x_0^s \geq X^t\lambda$; $y_0^s = Y^t\lambda - s^+$; $L \leq e\lambda \leq U$; $\lambda \geq 0, s^+ \geq 0$. (15)

III. RESULTS

3.1 Pearson correlation

To apply the DEA model, the relationship between the inputs and outputs is isotonicity that means the input volume increases and the output can not fall under the same condition. The larger correlation coefficient means that there is a stronger relationship between the two variables while the lower correlation coefficient is less correlated, shown in the following table:

Table 4: The Pearson correlation coefficient [20].

Correlation coefficient	<0.2	0.2÷0.4	0.4÷0.6	0.6÷0.8	>0.8
Degree of correlation	Very low	Low	Medium	High	Very high

According to the convention in Table 4, the results of Table 5 showed that the correlation between the inputs and outputs in this study is appropriate. Specifically, the positive correlation coefficients (positive) indicated that the results of this study were highly reliable.

Table 5: Correlation coefficient.

	2013					2014				
	TA	CS	OE	NS	PT	TA	CS	OE	NS	PT
TA	1.0000	0.9018	0.9578	0.9184	0.8726	1.0000	0.9755	0.9965	0.9789	0.7319
CS	0.9018	1.0000	0.9719	0.9974	0.8776	0.9755	1.0000	0.9766	0.9995	0.7599
OE	0.9578	0.9719	1.0000	0.9819	0.8719	0.9965	0.9766	1.0000	0.9786	0.6959
NS	0.9184	0.9974	0.9819	1.0000	0.8978	0.9789	0.9995	0.9786	1.0000	0.7752
PT	0.8726	0.8776	0.8719	0.8978	1.0000	0.7319	0.7599	0.6959	0.7752	1.0000
	2015					2016				
TA	1.0000	0.9840	0.9524	0.9823	0.7259	1.0000	0.9900	0.9837	0.9866	0.3829
CS	0.9840	1.0000	0.9701	0.9997	0.8090	0.9900	1.0000	0.9844	0.9995	0.4829
OE	0.9524	0.9701	1.0000	0.9752	0.8374	0.9837	0.9844	1.0000	0.9856	0.4727
NS	0.9823	0.9997	0.9752	1.0000	0.8162	0.9866	0.9995	0.9856	1.0000	0.5099
PT	0.7259	0.8090	0.8374	0.8162	1.0000	0.3829	0.4829	0.4727	0.5099	1.0000

Source: Calculated by researcher.

3.2 Performance rankings

The results in Table 6 showed that the number of effective companies in turn was 8, 8, 9, 7 and the number of ineffective companies was 4, 4, 3, 5 in the period of 2013 - 2016. The average score in this period was as follows: 1.3878; 1.1646; 1.1941; 1.0210. These numbers explain the Super-SBM

model can distinguish DMUs with differences on their scoring.

Table 6: Summary of super–SBM results.

	2013	2014	2015	2016
No. of DMUs in Data	12	12	12	12
No. of DMUs with inappropriate Data	0	0	0	0
No. of evaluated DMUs	12	12	12	12
Average of scores	1.3878	1.1646	1.1941	1.0210
No. of efficient DMUs	8	8	9	7
No. of inefficient DMUs	4	4	3	5
No. of over iteration DMUs	0	0	0	0

Source: Calculated by researcher.

According to Table 7, the scores and rankings of fisheries enterprises tended to change drastically each year. Specifically, DMU9 was ranked from 11/12 in 2013 to 9/12 in 2014, top 5 in 2015, 12 in 2016. This reflected the fierce competition of the fisheries market.

Table 7: Scores and rankings.

DMUs	2013		2014		2015		2016	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
DMU1	0.9791	9	0.8599	10	0.7705	11	0.7918	8
DMU2	3.8133	1	2.1118	1	2.2131	1	1.4261	3
DMU3	1.0072	6	0.8196	12	0.8196	10	0.7859	9
DMU4	0.8372	12	1.0027	6	1.0055	7	0.6709	11
DMU5	0.8496	10	0.8540	11	1.0062	6	1.0131	5
DMU6	1.0042	7	1.0535	4	1.2033	4	1.0530	4
DMU7	1.0000	8	1.0000	7	1.0000	8	1.0000	6
DMU8	2.6154	2	1.8462	2	2.0122	2	1.6892	1
DMU9	0.8418	11	0.9390	9	1.0456	5	0.6473	12
DMU10	1.5144	3	1.0000	7	1.0000	8	1.0000	6
DMU11	1.0083	5	1.0100	5	0.7269	12	0.7146	10
DMU12	1.1833	4	1.4788	3	1.5263	3	1.4605	2

Source: Calculated by researcher.

3.3 Components of the Malmquist Productivity Index

3.3.1 Catch - up efficiency change

Results of Table 8 and Figure 2: The results showed that in the period 2013 – 2016, there were little changes in the efficiency as well as the management of the fisheries enterprises in Vietnam.

Table 8. Catch-up efficiency.

Catch-up	'13=>'14	'14=>'15	'15=>'16	Average
DMU1	0.8782	0.8960	1.0277	0.9340
DMU2	0.5538	1.0479	0.6444	0.7487
DMU3	0.8137	1.0000	0.9589	0.9242
DMU4	1.1975	1.0029	0.6672	0.9559
DMU5	1.0052	1.1783	1.0069	1.0634
DMU6	1.0491	1.1422	0.8751	1.0221
DMU7	1.0000	1.0000	1.0000	1.0000
DMU8	0.7059	1.0899	0.8395	0.8784
DMU9	1.1154	1.1135	0.6191	0.9493
DMU10	0.6603	1.0000	1.0000	0.8868
DMU11	1.0017	0.7197	0.9831	0.9015
DMU12	1.2497	1.0321	0.9569	1.0796
Average	0.9359	1.0185	0.8816	0.9453
Max	1.2497	1.1783	1.0277	1.0796
Min	0.5538	0.7197	0.6191	0.7487
SD	0.2171	0.1212	0.1537	0.0905

Source: Calculated by researcher.

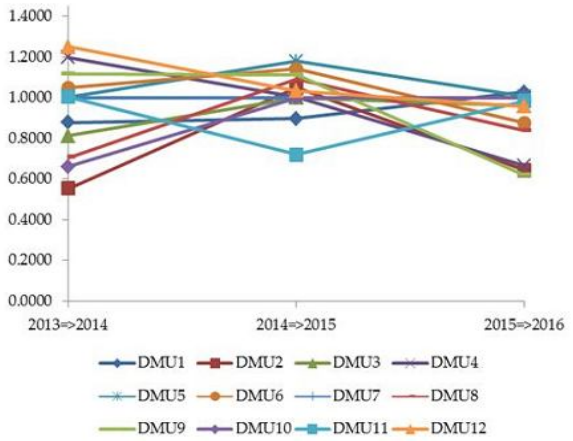


Fig. 2. Catch - up efficiency.

3.3.2 Frontier – shift

The results of the analysis in Table 9 and Figure 3 showed the change in the conversion of the fishery companies from 2013 to 2016. Accordingly, the enterprises were less likely to change in terms of technology. The effect of the renovation of this period in 2014 - 2015 was sharply reduced, the 2015-2016 period tended to increase insignificantly. This showed that the fisheries enterprises needed to change the technology of farming, fishing, production and processing in the future to improve the competitiveness.

Table 9: The MPI frontier – shift.

Frontier	'13=>'14	'14=>'15	'15=>'16	Average
DMU1	1.0298	0.9791	1.0297	1.0129
DMU2	1.6087	0.7999	1.1246	1.1777
DMU3	1.0108	0.9698	1.1154	1.0320
DMU4	1.0623	0.9731	1.2889	1.1081
DMU5	1.0363	0.9966	0.9313	0.9881
DMU6	1.1206	0.9454	1.0455	1.0372
DMU7	0.9946	0.9733	1.0000	0.9893
DMU8	1.1997	0.8823	1.1629	1.0816
DMU9	1.0702	0.8629	1.2472	1.0601
DMU10	1.1632	1.0124	1.0737	1.0831
DMU11	1.0789	0.9917	0.8505	0.9737
DMU12	1.0571	0.9454	1.0525	1.0183
Average	1.1194	0.9443	1.0769	1.0468
Max	1.6087	1.0124	1.2889	1.1777
Min	0.9946	0.7999	0.8505	0.9737
SD	0.1655	0.0636	0.1233	0.0588

Source: Calculated by researcher.

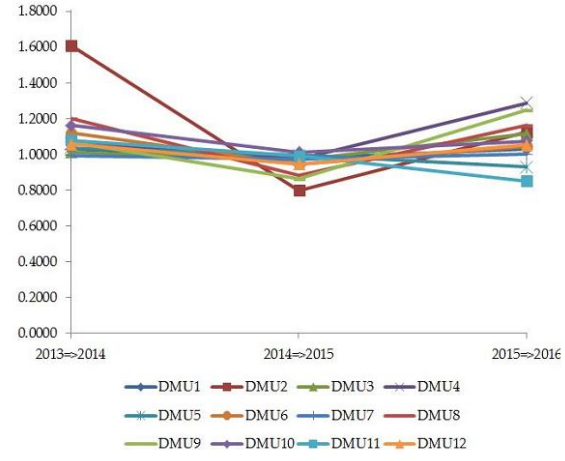


Fig. 3. The MPI frontier shift.

3.3.3 The Malmquist productivity index

The MPI was the most important factor in assessing the performance of the companies in the fisheries sector. The results in Table 10 and Figure 4 showed that in the period 2013 - 2014, many companies performed more efficiently 6/12 DMUs (MPI > 1): DMU4, DMU5, DMU6, DMU9, DMU11, DMU12. But 6/12 DMUs was ineffective (MPI <1): DMU1, DMU2, DMU3, DMU7, DMU8, DMU10. In the period of 2014 - 2015, there was 9/12 DMUs operating inefficiently (75%): DMU1, DMU2, DMU3, DMU4, DMU7, DMU8, DMU9, DMU11, DMU12 indicating that this was a difficult period for the fisheries enterprises in Vietnam. In the period of 2015 – 2016, there was 7/12 DMUs operating ineffectively (MPI <1): DMU2, DMU4, DMU5, DMU6, DMU8, DMU9, DMU11 indicating that this was still a difficult period.

Table 10: The MPI change over the period 2013 – 2016.

Malmquist	'13=>'14	'14=>'15	'15=>'16	Average
DMU1	0.9044	0.8772	1.0582	0.9466
DMU2	0.8909	0.8382	0.7247	0.8179
DMU3	0.8225	0.9698	1.0696	0.9539
DMU4	1.2721	0.9759	0.8600	1.0360
DMU5	1.0417	1.1742	0.9377	1.0512
DMU6	1.1757	1.0799	0.9150	1.0568
DMU7	0.9946	0.9733	1.0000	0.9893
DMU8	0.8469	0.9616	0.9763	0.9282
DMU9	1.1938	0.9608	0.7721	0.9756
DMU10	0.7681	1.0124	1.0737	0.9514
DMU11	1.0808	0.7137	0.8362	0.8769
DMU12	1.3210	0.9758	1.0071	1.1013
Average	1.0260	0.9594	0.9359	0.9738
Max	1.3210	1.1742	1.0737	1.1013
Min	0.7681	0.7137	0.7247	0.8179
SD	0.1847	0.1153	0.1169	0.0801

Source: Calculated by researcher.

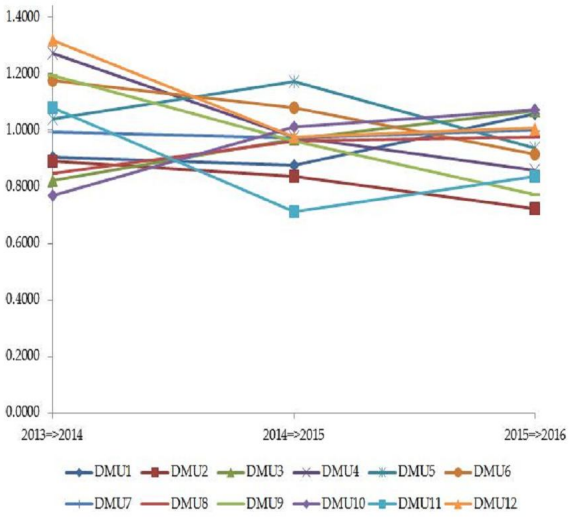


Fig. 4. The Malmquist productivity index

CONCLUSIONS

Based on the results of the analysis and evaluation of the business performance of the fisheries enterprises in this study, the managers found the solutions to maintain a stable source of raw materials, ensure the quality for the enterprise, help to change the business situation. Thereby, the managers could stabilize the source of goods, ensure production stability, reduce costs to contribute to the efficiency of the enterprises in the future. In addition, other researchs are needed to incorporate different methods to enhance the competitiveness and maintain a significant position in the fisheries sector.

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