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APPLYING DEA MODEL TO MEASURE THE EFFICIENCY OF HOSPITALITY SECTOR: THE CASE OF VIETNAM

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ABSTRACT. Tourism industry is one of the world's largest industries with a global economic contribution of over 7.6 trillion dollars in 2016 which provides an equal or even surpasses the business volume of oil exports, and food and beverage.As the current climate of the globe, Vietnam's tourism in general, hospitality in particular has attracted investment from not only domestic enterprises but many international hospitality corporations which create a fierce competitive than ever.Identifying inefficient activities and providing improvement in whole process is crucial. The present research aims to study and evaluate the performance of Vietnam hospitality industry through 20 chosen companies that qualify criteria of Data Envelopment Analysis (DEA) model and Malmquist productivity index. It would be a useful tool in benchmarking the efficient firms and inefficient ones operating in the industry and help the former to improve their efficiency. The researcher uses 5 input variables (Cost of good sales; sales expense; operation expense; fixed assets and owner equity) and 2 output variables (Revenues and Profit after tax).DMU1 and DMU8 face with huge fluctuation in efficiency which acquires the management board to review and improve their operation process to ensure the sustainable development of the firm in current competitive market.

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1. Introduction

Nowadays, tourism industry is one of the world's largest industries with a global economic contribution of over 7.6 trillion dollars in 2016 which provides an equal or even surpass the business volume of oil exports, and food and beverage. Tourism has significant grown and various diversification to be one of the fastest growing industry. The development of national economy and encircles a growing number of new destinations encouraged the development of modern tourism. As the current climate of the globe, Vietnam's tourism in general, hospitality in particular has attracted investment from not only domestic enterprises but many international hospitality corporations which create a fierce competitive than ever.

Hospitality's benefit will go toward the development of tourist and the competition can be expected. Global hospitalities like Six Sense, Sheraton, Nikko, ect. has joined to the competition. Hotel managers agree that enhancing their performance can be their advantages and those advantages can be identified with the competitive benchmarking ([1]). As the nature of hotel service is simultaneous and perishable, how to manage the customer demands and service capacity will affect in the profitability of company ([2]). How to efficiently operate in comparation with industrial benchmark and rivals is crucial in this industry.

Identifying inefficient activities and providing improvement in whole process is crucial. The present research aims to study and evaluate the performance of Vietnam hospitality industry through 20 chosen companies that qualify criteria of Data Envelopment Analysis (DEA) model and Malquist productivity index. It would be a useful tool in benchmarking the efficient firms and inefficient ones operating in the industry and help the former to improve their efficiency

The objectives of the research are summarized as following:

b. To evaluate the efficiency of 20 listed firms in Vietnam hospitality industry using the data for the past 5 years from 2013 to 2017
c. To forecast the performance of those 20 DMUs in the next 5 years from 2018 to 2022 and then use the forecasted data an input to evaluate their performances
d. To compare the efficiency of the past and the future between the set of data 2013-2017 and the set of data 2018-2022 in order to evaluate the past-to-future performance.

2. Literature Review

The Grey System Theory, introduced by professor Deng Julong in 1988 whichis well known as beneficial tool to take uncertain system with "small sample and poor information" as the research object. Moreover, it is a useful method to forecast and has been applied successfully in many fields and present satisfaction results. Recently, the application of the systems has be successfully employed in calculating of input and output values of organizations, agriculture, meteorological, forestry and disaster predictions. The method is not complicated and be used easily. The small set of data can be used rather than a large number of data. Therefore, it is practically to apply the method in the paper.

Data envelopment analysis (DEA) is popular in new researchers which is suggested firstly in 1978 byCharnes, Cooper and Rodes. DEA is a nonparametric method in which the researcher is allowed to use multiple inputs and outputs. The inputs and outputs are combined, the relative efficiency for a whole organization or parts of an organization (or called decision-making units [DMUs]) is calculated. In a sample of DMUs, the best performing ones is identified. An efficiency frontier is, the DMUs on the frontier are efficient (best practice) and the ones that are below efficiency frontier are inefficient. The efficiency index will have values from 0 to 1 (or 0 to 100%). The result 1 implied the efficient unit and vice versa the result less than 1 represents the inefficient. The DMUs in DEA in the sample have similar activities so that a similar group of inputs and outputs can be identified. Moreover, the DMUs have to operate in a similar environment ([3]). Different from the traditional accounting method, DEA model has the benefits that it is proper to compare the relative performance between multiple performance measures ([4]). There are two approaches in DEA: (1) The input-oriented approach and (2) The out-put oriented approach. The input-oriented approach argues minimization of input for the given outputs. Meanwhile, the output-oriented approach is the maximization of outputs for the given inputs.

Table 2.1 indicates several previous studies that applied DEA model in evaluating the performance and efficiency of companies in hospitality industry in different countries and some similar industries as well.

Table 2. 1 - Table of input and output

Author	INPUT	OUTPUT
Johns, Howcroft, and Drake (1997) [5]	Available room nights, labourtimes , food and beverage costs and utilities cost	Number of room night sold, reserved cost, food and beverage revenue
Hwang and Chang (2003) [6]	Number of full-time employees, number of rooms, food and beverage department areas, operating expenses	Revenue of each divisions: room, food and beverage; and other revenue
Chiang, Tsai, and Wang (2004) [7]	Number of hotel rooms, food and beverage department areas, employees, total cost	Yielding index, food and beverage revenue, other revenue
Barros (2005) [8]	Number of full-time employees, cost of labour, rooms, hotel areas, property's book value, operation expenses, external expense	Sales revenue, Number of guests, and number of night stay
Barros and Santos (2006) [9]	Number of full-time employees, cost of labour, capital	Sales revenue, added value, earnings
Önüt and Soner (2006) [10]	Number of full-time employees, consumption of electricity, water and liquefied	Occupancy rate, sales revenue, number of guests
Chen (2007) [11]	cost of labour , cost of F&B, cost of materials	Total revenue
Davutyan (2007) [12]	Number of available beds, Number of full-time employees, operating cost	Beds sold to return customers divided by number of available beds, beds sold
Min et al. (2008) [13]	Sales expense, total labour cost, operation expenses and non-operating expenses	Revenue of each divisions: room, food and beverage; and other revenue
Barros et al. (2009) [14]	Number of full-time employees, physical capital	Sales revenue, added value
Neves and Lourenco (2009) [15]	Cost of goods and services, Current assets, net fixed assets, andowner equity,	Revenues and earnings (EBITDA)
Perrigot et al. (2009) [16]	Hotel establish ages, number of labour, Number of rooms. Number of hotel openings during the year, franchising contract: royalties in percentage, chain ranking	Sales revenue, room revenues, other revenues and occupancy rate

Yu and Lee (2009) [17]	Full-time employees in each department: the room service department, the F&B department, number of hotel rooms, floor area in the F&B service department; cost for each service sector, shared input	Revenue of each divisions: room, food and beverage; and other revenue
Chen, Hu, and Liao (2010) [18]	Number of hotel rooms; Number of employees; floor area in the F&B service department	Revenue of each divisions: room, food and beverage; and other revenue
Hsieh and Lin (2010) [19]	Room expenses, number of employees of the room department, food and beverage cost, employees of food and beverage department; area of rooms, catering floors	Revenue of room service, food and beverage service
Hsieh et al. (2010) [20]	Number of hotel rooms; Number of employees, facilities expenses, operation expenses	Occupancy rate, sales revenue
Assaf and Magnini (2011) [21]	Number of hotel rooms; Number of employees, operational costs	Occupancy rate, sales revenue
Avkiran (2011) [22]	Number of Full-time staff, permanent part-time staff, Number of room	Sales Revenue and a double room cost
Chen (2011) [23]	Number of employees, area of floors, guest rooms, operation expenses, and depreciation expenses	Occupancy rate, number of guests and guest satisfaction index, Room revenue, other revenue
Yen and Othman (2011) [24]	Number of full-time employees, cost of labour, rooms, hotel areas, property's book value, operation expenses, external expense	No nights occupied, number of guests; occupancy rate, revenue of room service, food and beverage service
Honma and Hu (2012) [25]	Number employees, number of temporary staff, number of seats in restaurants and bars, number of rooms	Sales revenue
Manasakis et al. (2013) [26]	No. of employees, number employees, operation expenses	Sales revenues and total number of spent nights
Katarina Poldrugovac, MetkaTekavcic& Sandra Jankovic (2016) [27]	Expenses of each division: Room, Energy, F&B, labor and other	Sales revenue and occupancy rate

3. Methodologies

3.1. Collecting DMUs

The research was only conducted 20 companies whose financial reports are audited by reliable institutions and collected from Vietnam Stock Exchanges Market or company's official website from 2013 to 2017 and denoted from DMU1 to DMU20 as the order in the table 3.1. in addition, the financial result of Vietnam hospitality companies from 2013 to 2017 are also generated in the bellow table:

4. Table 3. 2 - Decision making unit

Number	Code	Company name	Denote
1	DMU1	BEN THANH TOURIST AND SERVICE JSC	BTV
2	DMU2	DONG A HOTEL CORP JSC	DAH
3	DMU3	DIC TOURIST AND TRADING JSC	DCD
4	DMU4	LANG SON EXIM TOURIST JSC	DXL
5	DMU5	COMMERCIAL AND SERVICE JOIN STOCK JSC INVESTMENT POWER	EIN
6	DMU6	HOI AN TOURIST SERVICE CO	HOT
7	DMU7	POST HOTEL JSC	NPH
8	DMU8	NINH VAN BAY TRAVEL REAL ESTALE JSC	NVT
9	DMU9	OCEAN HOTEL & SERVICE JSC	OCH
10	DMU10	PETROLEUM PHUONGDONG TOURISM JSC	PDC
11	DMU11	SAI GON HOTEL JSC	SGH
12	DMU12	THUY TA JSC	TTJ
13	DMU13	VUNG TAU INTOURCO RESORT	VIR
14	DMU14	THANH CONG TOURIST & SERVICE JSC	VNG
15	DMU15	CORPORATION TOURIST OF BARIA VUNG TAU	VTG
16	DMU16	Dak Lak Tourist Jsc.	DLD
17	DMU17	MY TRA TOURIST & SERVICE CO	MTC
18	DMU18	THE NATIONAL OIL SERVICE JSC OF VIETNAM	OSCVN
19	DMU19	DONG NAI TOURIST CO	DNT
20	DMU20	KIM LIEN TOURIST CO	KimLien

3.2 DEA - Malmquist Productivity Index

One of the standard approaches for measuring productivity that applied in many researches overtime is the Malmquist productivity index, especially when nonparametric specifications are applied to micro data. Malmquist productivity index was first proposed by Caves, Christensen and Diewert (1982) and then further modified later by Färe, Grosskopf, Lidgren and Roos in 1995. Malmquist productivity index (MPI) is a tool for measurement of productivity changes of a DMU over periods of time. It is defined as the product of "catch-up" and "frontier-shift" terms. The catch-up term is the degree of efforts that the DMU attained for improving its efficiency, while the frontier-shift term reflects the change in the efficient frontiers surrounding the DMU between the two time periods 1 and 2.

DMU_0 at periods 1 and 2 is denoted by (x_0^1, y_0^1) and (x_0^2, y_0^2). The efficiency score of DMU $(x_0, y_o)^{t_1}$ is measured by the technological frontier t_2:

$$d^{t_2}((x_0, y_0)^{t_1})(t_1 = 1{,}2 \; and \; t_2 = 1{,}2)$$

C stands for the efficiency change (Catch- up effect) and is determined by the following formula:

$$C = \frac{d^2((x_0, y_o)^2)}{d^1((x_0, y_o)^1)}$$

The technological change (frontier-shift effect) denoted by F has the formula:

$$F = \left[\frac{d^1((x_0, y_o)^1)}{d^2((x_0, y_o)^1)} . \frac{d^1((x_0, y_o)^2)}{d^2((x_0, y_o)^2)}\right]^{1/2}$$

Malmquist Productivity Index (MPI) is the product of C and F, that is, MPI = (catch-up) x (frontier-shift) or

$$MPI = \left[\frac{d^1((x_0, y_o)^2)}{d^1((x_0, y_o)^1)} . \frac{d^2((x_0, y_o)^2)}{d^2((x_0, y_o)^1)}\right]^{1/2}$$

If the Malmquist productivity index (MPI) is greater than 1 (MPI>1), it indicates progress in relative efficiency from period 1 to period 2. Productivity remains unchanged if MPI equal to 1 (MPI=1) and it demonstrate a regress when MPI is less than 1 (MPI<1).

3.3 Establishing Inputs and Outputs

Together with the financial report of hotel in Vietnam, there are five inputs chosen are cost of good sales, sales expenses, operation expenses (including electricity and labor cost), fixed assets and equity. The reasons for this range choosing as bellow:

- Cost of good sales is direct cost that contribute to goods and service of hospitality firm.

- Fixed asset is a long-term tangible piece of property that a firm owns and uses in its operations to generate income. A fixed asset is bought for production or supply of goods or services, for rental to third party or for use in the organization. It has a physical form and is reported on the balance sheet as property, plant and equipment (PP&E). In this research which related to hospitality, fixed asset is considered to be important due to the information it provides.
- Sales expenses are used for selling activities like incentive, marketing expense. in a hotel, marketing department is indirect factor to raise the sales revenue.
- Operation expenses includes energy expenses, labor cost which is direct factor which create service to provide for customer. In hotel industry, labor or quality of human resource plays a significant role to generate profit.
- Equity or owner's equity presents the owner's fund for business in various operation.

Two chosen outputs factors are considered as *sales and* profit *after tax (PAT)*.

- Sales are the transactions between parties where the buyers receive goods (tangible or intangible), services and/or assets in exchange for money. It can also refer to an agreement between the buyer and seller of the selected good or service.
- Profit after tax is defined as the net amount earned by a business after all taxation related expenses have been deducted. The profit after tax is often assessment of what a business is really earning and hence can use in its operations than its total revenues.

In the previous research, occupancy rate is a non-financial output of equation but it is not objectively provided by Vietnamese hotel company, so we cannot put it in the output variables.

4. Empirical Result and Analysia

4.1. Empirical Result

A forecast inputs/ outputs of next 5 years from 2019 to 2022 will be generated by GM (1,1) Model. A sample is presented to illustrate the procedure of GM (1,1) forecasting applied in the research. The researcher takes factor of sales revenue of Ben Thanh Tourist and Service JSC. (BTV) in period of time from 2018 to 2022 to demonstrate the calculation process and other variables are calculated in the same way.

The researcher use the GM(1,1) model for trying to forecast the variance of primitive series as follows.

First, the primitive series is created:

$$X^{(0)} = (455{,}117\ ;\ 601{,}329\ ;\ 597{,}653\ ;\ 672{,}090\ ;\ 814{,}010)$$

Secondly, perform the accumulated generating operation (AGO):

$$X^{(1)} = (455{,}117;\ 1{,}056{,}446;\ 1{,}654{,}099;\ 2{,}326{,}189;\ 3{,}140{,}199)$$

$$x^{(1)}(1) = x^{(0)}(1) = 455{,}117$$

$$x^{(1)}(2) = x^{(0)}(1) + x^{(0)}(2) = 1{,}056{,}446$$

$$x^{(1)}(3) = x^{(0)}(1) + x^{(0)}(2) + x^{(0)}(3) = 1{,}654{,}099$$

$$x^{(1)}(4) = x^{(0)}(1) + x^{(0)}(2) + x^{(0)}(3) + x^{(0)}(4) = 2{,}326{,}189$$

$$x^{(1)}(5) = x^{(0)}(1) + x^{(0)}(2) + x^{(0)}(3) + x^{(0)}(4) + x^{(0)}(5) = 3{,}140{,}199$$

Third, create the different equations of GM(1,1)

To find $X^{(1)}$ series, and the following mean obtained by the mean equation is

$$z^{(1)}(2) = \frac{1}{2}(455{,}117 + 1{,}056{,}446) = 755{,}781.5$$

$$z^{(1)}(3) = \frac{1}{2}(1{,}056{,}446 + 1{,}654{,}099) = 1{,}355{,}272.5$$

$$z^{(1)}(4) = \frac{1}{2}(1{,}654{,}099 + 2{,}326{,}189) = 1{,}990{,}144$$

$$z^{(1)}(5) = \frac{1}{2}(2{,}326{,}189 + 3{,}140{,}199) = 2{,}733{,}194$$

Fourth, solve the equations.

To find *a* and *b*, the primitive series values are substituted into Grey differential equation to obtain

$$601{,}329 + a\ x\ 755{,}781.5 = b$$

$$597{,}653 + a\ x\ 1{,}355{,}272.5 = b$$

$$672{,}090 + a\ x\ 1{,}990{,}144 = b$$

$$814{,}010 + a\ x\ 2{,}733{,}194 = b$$

Then, convert the linear equations into the form of a matrix

Let

$$B = \begin{bmatrix} -755{,}781.5 & 1 \\ -1{,}355{,}272.5 & 1 \\ -1{,}990{,}144 & 1 \\ -2{,}733{,}194 & 1 \end{bmatrix}, \hat{\theta} = \begin{bmatrix} a \\ b \end{bmatrix},\ y_N = \begin{bmatrix} 601{,}329 \\ 597{,}653 \\ 672{,}090 \\ 814{,}010 \end{bmatrix}.$$

And then use the least square method to find *a* and *b*:

$$\begin{bmatrix} a \\ b \end{bmatrix} = \hat{\theta} = (B^T y_N) = \begin{bmatrix} -0.110619605 \\ 482{,}266.0641 \end{bmatrix}.$$

Use the two coefficients a and b to generate the whitening equation of the differential equation:

$$\frac{dx^{(1)}}{dt} - 0.110619605 \times x^{(1)} = 482{,}266.0641.$$

Find the prediction model from

$$X^{(1)}(k+1) = \left(X^{(0)}(1) - \frac{b}{a}\right)e^{-ak} + \frac{b}{a}$$

$$X^{(1)}(k+1) = \left(455{,}117 - \frac{482{,}266.0641}{-0.110619605}\right)e^{0.110619605} + \frac{482{,}266.0641}{-0.110619605}$$

$$= (4{,}814{,}796.860)e^{0.110619605} - 4{,}359{,}679.806$$

Substitute different values of k into the equation:

$$k = 0 \quad X^{(1)}(1) = 455{,}117$$
$$k = 1 \quad X^{(1)}(2) = 1{,}018{,}303$$
$$k = 2 \quad X^{(1)}(3) = 1{,}647{,}365$$
$$k = 3 \quad X^{(1)}(4) = 2{,}350{,}009$$
$$k = 4 \quad X^{(1)}(5) = 3{,}134{,}841$$
$$k = 5 \quad X^{(1)}(6) = 4{,}011{,}475$$
$$k = 6 \quad X^{(1)}(7) = 4{,}990{,}648$$
$$k = 7 \quad X^{(1)}(8) = 6{,}084{,}356$$
$$k = 8 \quad X^{(1)}(9) = 7{,}305{,}994$$
$$k = 9 \quad X^{(1)}(10) = 8{,}670{,}527$$

Derive the predicted value of the original series according to the accumulated generating operation and obtain

$$\hat{x}^{(0)}(1) = x^{(1)}(1) = 455{,}117 - \ for\ year\ 2013$$
$$\hat{x}^{(0)}(2) = x^{(1)}(2) - \ x^{(1)}(1) = 563{,}186 - \ for\ year\ 2014$$
$$\hat{x}^{(0)}(3) = x^{(1)}(3) - \ x^{(1)}(2) = 629{,}062 - \ for\ year\ 2015$$
$$\hat{x}^{(0)}(4) = x^{(1)}(4) - \ x^{(1)}(3) = 702{,}643 - \ for\ year\ 2016$$
$$\hat{x}^{(0)}(5) = x^{(1)}(5) - \ x^{(1)}(4) = 784{,}831 - \ for\ year\ 2017$$
$$\hat{x}^{(0)}(6) = x^{(1)}(6) - \ x^{(1)}(5) = 876{,}633 - \ for\ year\ 2018$$
$$\hat{x}^{(0)}(7) = x^{(1)}(7) - \ x^{(1)}(6) = 979{,}173 - \ for\ year\ 2019$$
$$\hat{x}^{(0)}(8) = x^{(1)}(8) - \ x^{(1)}(7) = 1{,}093{,}707 - \ for\ year\ 2020$$
$$\hat{x}^{(0)}(9) = x^{(1)}(9) - \ x^{(1)}(8) = 1{,}221{,}638 - \ for\ year\ 2021$$
$$\hat{x}^{(0)}(10) = x^{(1)}(10) - \ x^{(1)}(9) = 1{,}364{,}533 - \ for\ year\ 2022$$

The other input and output factors' forecasting results will be carried out same as the above process. The results of all DMUs from 2018 to 2022 could be acquired and the detailed numbers are generated in the table 4.1 to 4.5 respectively:

Table 4.1. ***Financial data of decision-making units 2018***

DENOTE	I (COGS)	I (SALES EXPENSES)	I (OPERATION EXPENSE)	I (EQUITY CAPITAL)	I (FIXED ASSET)	O (REVENUE)	O (PROFIT AFTER TAX
DMU1	32,908,616	32,908,616	32,908,616	32,908,616	32,908,616	32,908,616	32,908,616
DMU2	13,478,159	47,923	209,550	26,711,591	41,077,064	17,825,572	2,639,877
DMU3	76,576,376	802,055	132,735	1,357,945	5,424,210	548,536	(2,160)
DMU4	483,545	55,537	132,735	14,095,615	582,156	17,757,563	418,969
DMU5	9,162,200	61,518	600,414	13,824,261	705,966	8,950,675	155,308
DMU6	6,060,193	1,181,491	1,029,223	4,872,856	3,765,479	8,046,307	335,272
DMU7	42,334	4,466	12,848	1,236,428	1,948	34,135	15,871
DMU8	4,788,941	992,087	3,287,557	38,014,824	8,803,001	9,747,591	4,601,632
DMU9	28,121,728	6,317,735	12,613,506	52,338,060	58,484,432	53,715,440	(7,762,659)
DMU10	2,887,402	17,091	222,029	6,591,606	5,915,483	3,456,240	394,069
DMU11	1,193,309	-	314,599	10,513,538	1,820,995	2,393,822	992,115
DMU12	2,441,583	1,720,458	115,510	5,709,437	501,977	4,605,586	274,796
DMU13	1,763,348	-	692,579	3,960,691	2,839,775	2,782,695	348,412
DMU14	37,453,279	382,746	1,269,673	8,568,309	9,799,291	12,423,095	345,689
DMU15	3,334,348	1,390,279	2,425,122	7,386,611	5,098,755	6,958,109	9,656
DMU16	2,654,787	38,652	360,443	3,260,395	3,260,395	7,124,050	(28,570)
DMU17	1,329,496	130,241	263,803	2,339,723	2,035,763	1,850,575	37,359
DMU18	9,886,471	1,978,471	626,407	3,988,739	1,634,898	12,610,975	983,349
DMU19	9,886,471	1,978,471	2,007,085	4,381,002	1,634,898	12,610,975	531,090
DMU20	6,381,260	23,930	329,038	1,655,251	555,370	6,381,260	291,194

Table 4.2. ***Financial data of decision-making units 2019***

DENOTE	I (COGS)	I (SALES EXPENSES)	I (OPERATION EXPENSE)	I (EQUITY CAPITAL)	I (FIXED ASSET)	O (REVENUE)	O (PROFIT AFTER TAX
DMU1	37,098,046	1,890,424	2,615,960	11,466,654	2,850,215	42,572,760	981,061
DMU2	21,412,310	53,533	229,447	39,762,448	57,698,449	27,611,697	4,412,162
DMU3	68,177,527	725,295	124,253	1,333,963	5,484,919	486,002	(2,272)
DMU4	432,150	53,533	124,253	14,329,849	649,092	19,072,378	492,506
DMU5	12,158,274	62,712	605,491	14,007,484	678,952	9,033,212	169,854
DMU6	6,229,626	1,851,392	1,252,261	4,905,668	3,618,884	8,493,387	278,994
DMU7	46,613	4,359	12,831	1,306,662	656	32,394	16,405
DMU8	4,991,351	976,854	3,225,616	38,288,765	6,531,108	10,084,064	7,736,101
DMU9	31,027,610	6,744,248	13,857,607	52,755,069	62,891,546	61,426,778	(8,089,791)
DMU10	2,964,553	11,267	190,777	6,789,405	5,928,333	3,541,795	609,336
DMU11	1,321,688	-	317,410	15,698,135	1,689,007	2,854,516	1,945,718
DMU12	2,363,252	1,829,433	118,395	8,232,072	441,592	4,616,801	272,509
DMU13	1,797,353	-	847,900	3,994,845	2,770,284	2,859,928	327,333
DMU14	98,443,453	506,905	1,456,691	9,160,646	10,956,611	16,671,791	498,003
DMU15	3,300,936	1,449,366	2,653,246	7,303,900	5,231,296	7,135,472	9,271
DMU16	2,627,426	38,730	372,926	3,180,629	3,180,629	6,972,281	(16,456)
DMU17	1,402,484	138,824	309,527	2,343,045	2,024,305	2,015,901	42,898
DMU18	12,235,304	2,016,607	847,652	4,199,560	1,530,489	14,777,243	1,220,173
DMU19	12,235,304	2,016,607	2,054,724	4,691,514	1,530,489	14,777,243	590,032
DMU20	6,711,212	24,138	218,970	1,385,341	459,497	6,711,212	241,473

Table 4.3. Financial data of decision-making units 2020

DENOTE	I (COGS)	I (SALES EXPENSES)	I (OPERATION EXPENSE)	I (EQUITY CAPITAL)	I (FIXED ASSET)	O (REVENUE)	O (PROFIT AFTER TAX
DMU1	41,820,811	1,927,365	2,826,492	11,535,781	2,705,067	47,552,493	972,973
DMU2	34,017,037	59,799	251,234	59,189,743	81,045,496	42,770,341	7,374,271
DMU3	60,699,858	655,882	116,312	1,310,405	5,546,309	430,596	(2,390)
DMU4	386,217	51,601	116,312	14,567,975	723,724	20,484,545	578,951
DMU5	16,134,074	63,931	610,612	14,193,136	652,972	9,116,510	185,761
DMU6	6,403,796	2,901,122	1,523,632	4,938,702	3,477,997	8,965,309	232,162
DMU7	51,325	4,254	12,813	1,380,886	221	30,741	16,957
DMU8	5,202,316	961,855	3,164,843	38,564,681	4,845,548	10,432,152	13,005,660
DMU9	34,233,763	7,199,555	15,224,416	53,175,401	67,630,760	70,245,150	(8,430,709)
DMU10	3,043,766	7,427	163,924	6,993,140	5,941,210	3,629,468	942,196
DMU11	1,463,879	-	320,246	23,439,442	1,566,584	3,403,871	3,815,907
DMU12	2,287,434	1,945,311	121,351	11,869,299	388,472	4,628,044	270,242
DMU13	1,832,013	-	1,038,055	4,029,293	2,702,493	2,939,305	307,529
DMU14	258,752,069	671,340	1,671,255	9,793,932	12,250,612	22,373,540	717,427
DMU15	3,267,857	1,510,964	2,902,829	7,222,116	5,367,283	7,317,356	8,901
DMU16	2,600,346	38,808	385,840	3,102,814	3,102,814	6,823,745	(9,479)
DMU17	1,479,478	147,973	363,177	2,346,372	2,012,912	2,195,997	49,259
DMU18	15,142,176	2,055,478	1,147,038	4,421,524	1,432,748	17,315,624	1,514,033
DMU19	15,142,176	2,055,478	2,103,495	5,024,033	1,432,748	17,315,624	655,516
DMU20	7,058,225	24,348	145,722	1,159,444	380,174	7,058,225	200,241

Table 4.4. Financial data of decision making units 2021

DENOTE	I (COGS)	I (SALES EXPENSES)	I (OPERATION EXPENSE)	I (EQUITY CAPITAL)	I (FIXED ASSET)	O (REVENUE)	O (PROFIT AFTER TAX
DMU1	47,144,808	1,965,028	3,053,969	11,605,324	2,567,311	53,114,705	964,952
DMU2	54,041,754	66,798	275,089	88,108,905	113,839,670	66,250,982	12,324,995
DMU3	54,042,336	593,112	108,879	1,287,264	5,608,385	381,507	(2,514)
DMU4	345,167	49,738	108,879	14,810,058	806,937	22,001,272	680,569
DMU5	21,409,977	65,172	615,775	14,381,248	627,985	9,200,576	203,158
DMU6	6,582,836	4,546,045	1,853,810	4,971,958	3,342,594	9,463,452	193,192
DMU7	56,514	4,151	12,796	1,459,326	74	29,173	17,528
DMU8	5,422,198	947,087	3,105,214	38,842,585	3,595,001	10,792,256	21,864,655
DMU9	37,771,215	7,685,600	16,726,037	53,599,081	72,727,100	80,329,479	(8,785,994)
DMU10	3,125,096	4,896	140,851	7,202,988	5,954,115	3,719,311	1,456,888
DMU11	1,621,367	-	323,107	34,998,261	1,453,036	4,058,950	7,483,687
DMU12	2,214,048	2,068,528	124,381	17,113,585	341,741	4,639,314	267,993
DMU13	1,867,341	-	1,270,854	4,064,038	2,636,362	3,020,885	288,923
DMU14	680,112,603	889,116	1,917,424	10,470,997	13,697,439	30,025,286	1,033,533
DMU15	3,235,111	1,575,181	3,175,889	7,141,247	5,506,805	7,503,876	8,545
DMU16	2,573,546	38,887	399,202	3,026,902	3,026,902	6,678,373	(5,460)
DMU17	1,560,700	157,725	426,126	2,349,704	2,001,582	2,392,183	56,563
DMU18	18,739,663	2,095,099	1,552,167	4,655,220	1,341,249	20,290,038	1,878,664
DMU19	18,739,663	2,095,099	2,153,422	5,380,121	1,341,249	20,290,038	728,268
DMU20	7,423,180	24,560	96,976	970,383	314,545	7,423,180	166,050

Table 4.5. Financial data of decision making units 2022

DENOTE	I (COGS)	I (SALES EXPENSES)	I (OPERATION EXPENSE)	I (EQUITY CAPITAL)	I (FIXED ASSET)	O (REVENUE)	O (PROFIT AFTER TAX
DMU1	53,146,575	2,003,427	3,299,752	11,675,287	2,436,571	59,327,529	956,998
DMU2	85,854,367	74,616	301,210	131,157,506	159,903,649	102,622,345	20,599,393
DMU3	48,115,006	536,350	101,921	1,264,531	5,671,156	338,014	(2,644)
DMU4	308,480	47,944	101,921	15,056,164	899,718	23,630,302	800,023
DMU5	28,411,119	66,438	620,983	14,571,854	603,955	9,285,418	222,185
DMU6	6,766,881	7,123,632	2,255,540	5,005,438	3,212,462	9,989,274	160,763
DMU7	62,226	4,051	12,779	1,542,221	25	27,684	18,118
DMU8	5,651,373	932,545	3,046,709	39,122,491	2,667,197	11,164,790	36,758,085
DMU9	41,674,200	8,204,458	18,375,766	54,026,138	78,207,476	91,861,505	(9,156,251)
DMU10	3,208,598	3,228	121,025	7,419,133	5,967,049	3,811,379	2,252,739
DMU11	1,795,798	-	325,994	52,257,143	1,347,717	4,840,100	14,676,872
DMU12	2,143,017	2,199,551	127,487	24,674,985	300,631	4,650,612	265,763
DMU13	1,903,351	-	1,555,863	4,099,082	2,571,848	3,104,729	271,442
DMU14	1,787,630,738	1,177,536	2,199,853	11,194,869	15,315,139	40,293,928	1,488,917
DMU15	3,202,692	1,642,127	3,474,635	7,061,284	5,649,953	7,695,151	8,204
DMU16	2,547,022	38,966	413,027	2,952,848	2,952,848	6,536,099	(3,145)
DMU17	1,646,380	168,119	499,985	2,353,041	1,990,317	2,605,895	64,950
DMU18	23,191,844	2,135,483	2,100,385	4,901,267	1,255,593	23,775,387	2,331,112
DMU19	23,191,844	2,135,483	2,204,535	5,761,447	1,255,593	23,775,387	809,093
DMU20	7,807,007	24,774	64,536	812,150	260,245	7,807,007	137,697

Because the smallest value is – 9,156,251 USD which is forecast value of factor profit after tax of DMU9, all values will be scale up USD10,000,000 for carrying the DEA model.

4.2 Forecasting Accuracy

The predicting data of DMUs for next 5 years from 2018 to 2022 generated by GM (1,1) model is used as inputs for DEA – Malmquist to study the performance of them in future. Since the study mentioned in previous chapter, forecasting data should be accuracy to ensure that result of future data and upcoming analysis. Therefore, MAPE (Mean Absolut Percentage Error) is employed to calculate forecasting error between the two sets of data. The results are summarized in the following table:

Table 4. 1 MAPE 2013-2017

Denote	**DMU**	**Average MAPE (%)**
BTV	DMU1	5.16%
DAH	DMU2	11.30%
DCD	DMU3	15.06%
DXL	DMU4	9.50%
EIN	DMU5	10.40%
HOT	DMU6	5.65%
NPH	DMU7	10.76%
NVT	DMU8	13.43%
OCH	DMU9	10.49%
PDC	DMU10	12.46%
SGH	DMU11	9.06%
TTJ	DMU12	5.71%
VIR	DMU13	2.65%
VNG	DMU14	12.68%
VTG	DMU15	1.72%
DLD	DMU16	2.05%
MTC	DMU17	2.46%
OSCVN	DMU18	2.96%
DNT	DMU19	1.78%
KimLien	DMU20	9.75%
Average MAPE		**7.75%**

The result of average MAPE is only 7.75 which proves that G(1,1) model is qualified to apply to forecast the future value of DMUs in this research.

4.3 Pearson Correlation

The Pearson correlation is conducted to confirm the relationship between input and output. Pearson test confirms that the lower correlation implies the less correlated and higher correlation implies the closer correlated between two variables. The correlation value is always from -1 to 1. The closer to -1 and 1 is correlation, the more perfect is linear relationship formed.

Tables from 4.6 to 4.15 confirm that the correlations comply well with the earlier condition of the DEA model as their correlation coefficients show strong positive associations. Hence, it proves that the input and output are chosen appropriately. And there is no elimination of any variable.

Table 4. 6. Correlation coefficient 2013

	COGS	SALES EXPENSES	OPERATION EXPENSE	EQUITY CAPITAL	FIXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	0.2600	0.0118	0.0402	0.0911	0.0198	0.1703
SALES EXPENSES	0.2600	1.0000	0.7352	0.8324	0.7104	0.8123	0.8735
OPERATION EXPENSE	0.0118	0.7352	1.0000	0.8156	0.7452	0.8539	0.8434
EQUITY CAPITAL	0.0402	0.8324	0.8156	1.0000	0.8850	0.8381	0.8921
FIXED ASSET	0.0911	0.7104	0.7452	0.8850	1.0000	0.6227	0.7515
REVENUE	0.0198	0.8123	0.8539	0.8381	0.6227	1.0000	0.9156
PROFIT AFTER TAX	0.1703	0.8735	0.8434	0.8921	0.7515	0.9156	1.0000

Table 4. 7. Correlation coefficient 2014

	COGS	SALES EXPENSES	OPERATION EXPENSE	EQUITY CAPITAL	FIXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	0.2343	0.0904	-0.0025	0.1016	0.0505	-0.1021
SALES EXPENSES	0.2343	1.0000	0.8323	0.6870	0.6726	0.8217	-0.7957
OPERATION EXPENSE	0.0904	0.8323	1.0000	0.8062	0.8456	0.7739	-0.9894
EQUITY CAPITAL	-0.0025	0.6870	0.8062	1.0000	0.8333	0.7424	-0.7460
FIXED ASSET	0.1016	0.6726	0.8456	0.8333	1.0000	0.6132	-0.8230
REVENUE	0.0505	0.8217	0.7739	0.7424	0.6132	1.0000	-0.7203
PROFIT AFTER TAX	-0.1021	-0.7957	-0.9894	-0.7460	-0.8230	-0.7203	1.0000

Table 4. 8. Correlation coefficient 2015

	COGS	SALES EXPENSES	OPERATION EXPENSE	EQUITY CAPITAL	FIXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	0.2107	-0.0014	-0.0277	0.0483	0.0105	0.0769
SALES EXPENSES	0.2107	1.0000	0.8204	0.6763	0.6628	0.6466	0.1385
PERATION EXPENSE	-0.0014	0.8204	1.0000	0.9400	0.8725	0.6454	-0.2134
EQUITY CAPITAL	-0.0277	0.6763	0.9400	1.0000	0.8499	0.6655	-0.3462
FIXED ASSET	0.0483	0.6628	0.8725	0.8499	1.0000	0.4731	-0.1748
REVENUE	0.0105	0.6466	0.6454	0.6655	0.4731	1.0000	0.2546
PROFIT AFTER TAX	0.0769	0.1385	-0.2134	-0.3462	-0.1748	0.2546	1.0000

Table 4. 9. Correlation coefficient 2016

	COGS	SALES EXPENSES	PERATION EXPENSE	EQUITY CAPITAL	IXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	0.2970	0.1834	0.0597	0.1903	0.1770	-0.2140
SALES EXPENSES	0.2970	1.0000	0.8827	0.6186	0.6957	0.7956	-0.7954
PERATION EXPENSE	0.1834	0.8827	1.0000	0.8139	0.8506	0.8320	-0.8946
EQUITY CAPITAL	0.0597	0.6186	0.8139	1.0000	0.8293	0.7135	-0.6195
FIXED ASSET	0.1903	0.6957	0.8506	0.8293	1.0000	0.6900	-0.7823
REVENUE	0.1770	0.7956	0.8320	0.7135	0.6900	1.0000	-0.6654
PROFIT AFTER TAX	-0.2140	-0.7954	-0.8946	-0.6195	-0.7823	-0.6654	1.0000

Table 4. 10. Correlation coefficient 2017

	COGS	SALES EXPENSES	PERATION EXPENSE	EQUITY CAPITAL	IXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	0.2738	0.0782	0.1658	0.2289	0.2283	-0.0705
SALES EXPENSES	0.2738	1.0000	0.5854	0.6972	0.7026	0.7681	0.0229
PERATION EXPENSE	0.0782	0.5854	1.0000	0.6625	0.6444	0.5513	0.7644
EQUITY CAPITAL	0.1658	0.6972	0.6625	1.0000	0.9313	0.8728	0.1421
FIXED ASSET	0.2289	0.7026	0.6444	0.9313	1.0000	0.7571	0.1400
REVENUE	0.2283	0.7681	0.5513	0.8728	0.7571	1.0000	0.0368
PROFIT AFTER TAX	-0.0705	0.0229	0.7644	0.1421	0.1400	0.0368	1.0000

Table 4.11. Correlation coefficient 2018

	COGS	SALES EXPENSES	PERATION EXPENSE	EQUITY CAPITAL	IXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	0.2980	0.3054	0.1616	0.3360	0.2457	0.1812
SALES EXPENSES	0.2980	1.0000	0.9777	0.4537	0.4661	0.5485	0.8969
PERATION EXPENSE	0.3054	0.9777	1.0000	0.5956	0.5894	0.6744	0.8136
EQUITY CAPITAL	0.1616	0.4537	0.5956	1.0000	0.8376	0.8329	0.2441
FIXED ASSET	0.3360	0.4661	0.5894	0.8376	1.0000	0.8638	0.1923
REVENUE	0.2457	0.5485	0.6744	0.8329	0.8638	1.0000	0.2097
PROFIT AFTER TAX	0.1812	0.8969	0.8136	0.2441	0.1923	0.2097	1.0000

Table 4. 12. Correlation coefficient 2019

	COGS	SALES EXPENSES	PERATION EXPENSE	EQUITY CAPITAL	IXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	0.1606	0.1695	0.0740	0.2340	0.2927	-0.1422
SALES EXPENSES	0.1606	1.0000	0.9058	0.5273	0.5455	0.7524	-0.6269
PERATION EXPENSE	0.1695	0.9058	1.0000	0.6972	0.6597	0.7924	-0.6064
EQUITY CAPITAL	0.0740	0.5273	0.6972	1.0000	0.8241	0.6996	-0.0339
FIXED ASSET	0.2340	0.5455	0.6597	0.8241	1.0000	0.7172	-0.3054
REVENUE	0.2927	0.7524	0.7924	0.6996	0.7172	1.0000	-0.4332
PROFIT AFTER TAX	-0.1422	-0.6269	-0.6064	-0.0339	-0.3054	-0.4332	1.0000

Table 4. 13. Correlation coefficient 2020

	COGS	SALES EXPENSES	PERATION EXPENSE	EQUITY CAPITAL	IXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	0.0376	0.0861	0.0304	0.1510	0.2398	-0.0629
SALES EXPENSES	0.0376	1.0000	0.8935	0.3862	0.4328	0.6811	-0.5096
PERATION EXPENSE	0.0861	0.8935	1.0000	0.5470	0.5512	0.7493	-0.4604
EQUITY CAPITAL	0.0304	0.3862	0.5470	1.0000	0.8510	0.6913	0.2533
FIXED ASSET	0.1510	0.4328	0.5512	0.8510	1.0000	0.7468	-0.0658
REVENUE	0.2398	0.6811	0.7493	0.6913	0.7468	1.0000	-0.2555
PROFIT AFTER TAX	-0.0629	-0.5096	-0.4604	0.2533	-0.0658	-0.2555	1.0000

Table 4. 14. Correlation coefficient 2021

	COGS	SALES EXPENSES	PERATION EXPENSE	EQUITY CAPITAL	IXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	-0.0101	0.0399	-0.0058	0.0874	0.2049	-0.0409
SALES EXPENSES	-0.0101	1.0000	0.8530	0.2162	0.3065	0.5597	-0.3953
PERATION EXPENSE	0.0399	0.8530	1.0000	0.3708	0.4389	0.6768	-0.3315
EQUITY CAPITAL	-0.0058	0.2162	0.3708	1.0000	0.8758	0.6976	0.4465
FIXED ASSET	0.0874	0.3065	0.4389	0.8758	1.0000	0.7912	0.1196
REVENUE	0.2049	0.5597	0.6768	0.6976	0.7912	1.0000	-0.0761
PROFIT AFTER TAX	-0.0409	-0.3953	-0.3315	0.4465	0.1196	-0.0761	1.0000

Table 4. 15. Correlation coefficient 2022

	COGS	SALES EXPENSES	PERATION EXPENSE	EQUITY CAPITAL	IXED ASSET	REVENUE	PROFIT AFTER TAX
COGS	1.0000	-0.0164	0.0227	-0.0297	0.0480	0.1919	-0.0448
SALES EXPENSES	-0.0164	1.0000	0.7701	0.0648	0.1816	0.3946	-0.3049
PERATION EXPENSE	0.0227	0.7701	1.0000	0.2107	0.3329	0.5756	-0.2408
EQUITY CAPITAL	-0.0297	0.0648	0.2107	1.0000	0.8907	0.7249	0.5323
FIXED ASSET	0.0480	0.1816	0.3329	0.8907	1.0000	0.8434	0.2355
REVENUE	0.1919	0.3946	0.5756	0.7249	0.8434	1.0000	0.0708
PROFIT AFTER TAX	-0.0448	-0.3049	-0.2408	0.5323	0.2355	0.0708	1.0000

5. Conclusion

In conclusion, the research employs DEA Model and Malmquist Production Index model to study and evaluate performance of past-to-future performance of 20-listed company in Vietnam hospitality industry. At beginning, researcher collects data of 20 qualified listed companies (Decision Making Unit) with 2 sets of data: the original set of data and the future set of data. The original set of data is collected on vietstock.vn, cophieu68.com and website of companies where their financial reports are audited by reliable institution. The researcher uses 5 input variables (Cost of good sales; sales expense; operation expense; fixed assets and owner equity) and 2 output variables (Revenues and Profit after tax). The association level of those variables is examined by Pearson Correlation and the result confirms the close correlated relationship among variables which is qualified to the requirement of DEA model. Then DEA-Malmquist is applied first time to analysis the original data set (past data from 2013 to 2017) in order to evaluate performance of DMUs in the past. Next, the future data set is generated by employed GM (1,1). The error of forecasting model is calculated by Mean Absolute Percentage Error (MAPE). The average MAPE of all DMUs is 7.75% which is in acceptant range (less than 10%). The forecast data will be input for DEA-Malmquist model to evaluate performance of DMUs in next 5 year from 2018 to 2022.

In the first-time employing DEA model with the past data, the average score of all DMUs is 1.053 score. The most efficient company is DMU1 (average score is 1.053), however, it inconsistently performs during studying period. In the first two period of time from 2013 to 2015, DMU1 (BTV) has the highest score 1.051 and 1.140 respectively. In the other hand, DMU8 (NVT) is the least efficient firm from 2014 to 2015. Ninh Van Tourist experienced loss in period time from 2014 to 2015 due to their huge investment to real estate investment and development, but the real estate market was in deep crisis at that time. Together with the down trend of the world economy, Ninh Van Tourist made consecutive losses. Interestingly, period of year 2015 to 2016 experiences a converse trend where DMU1 is the lease efficient firm with 0.878 score and DUM8 is the most one with 1.209 score. The down trend of DMU1 is since the event of oil rig Haiyang Shi You 981 in Southeast Sea between Vietnam and China in July 2015 cause the dramatically reduce in Chinese visitors. Ben Thanh tourist should diversify their target customers avoid the similar event rather than mostly relying visitors from any one country. Sai Gon Hotel JSC (DMU11) as its MPI score has tendency to reduce and be the least efficiency in period 2016 to 2017 which requests its management board to improve as soon as possible in order not to be kick out of the market.Although the overall trend of hospitality industry is table, DMU1 and DMU8 face with huge fluctuation in efficiency which acquire the management board to review and improve their operation process to ensure the sustainable development of the firm in current competitive market.

According to the result of second time DEA – Malmquist Production Index, the future performance of all DMUs is more consistent efficiency than the past ones. DMU1 seems to have outstanding performance from the past up to future data recorded, however, the declining tendency occurs in the last intervals. It raises the attention to management board of Ben Thanh Tourist and Service JSC to review its performance and operation frequently to ensure their advantages in hospitality industry. DMU9 (OCH) and DMU14 (VNG) are potential to perform better in future. The rest DMUs are stable within score interval from 0.969 to 1.054.

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