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Exploring the Business Performance of Taiwan Biotech Industry: A Study of Biotech Companies Listing in Taiwan Stock Market

Ting-Yun Kuo [1*], Yale Wang [2], Fu-Min Chang [3]

[1, 2, 3] *Department of Finance, Chaoyang University of Technology, Taiwan*

Abstract

In recent years, with the efforts of Taiwan's government and researcher, the scale of Biotech Industry in Taiwan has grown significantly. A Taiwan Bio-economic program has been started in 1 JAN 2016. It hopes to train research and development talents and sales personnel, and also to sell the products overseas. Do the Companies have the efficiency with a good reputation as well as high profit? Do the companies exist high expenses with bad performance? This research wants to use Data Envelopment Analysis (DEA) to analyze 94 Biotechnology Companies business performance in Taiwan. This research takes "fixed asset", "R&D", "sales expense" as input factor and "net income" as output factor. We use BCG Matrix to distinguish benchmark companies that can be imitated. The empirical results show that about 61% companies doesn't achieve the optimum production scale in which managers should consider input reduction, and 39% good performance companies which represent the efficiency of distribution and resourcing. In addition, BCG Matrix's results present that the market share and the efficient value of the benchmark companies are higher than the average industry group, which may become the subject of imitating and learning. Those companies are Synmosa Company, Benq Medical Technology, Tensall Bio- Technology, Dynamic medical technology.

Keywords— Biotech, R&D, performance, DEA, BCG Matrix

Introduction

The development of biotechnology industry in Taiwan mainly focuses on biomedical and agricultural products. In 2014, the number of the biotech companies reach 170. However, the development is time consuming and high cost. In order to face global competition, we need to know the potentiality and strength of those companies.

We, therefore, use DEA to explore performance of biotech industry in Taiwan. In the study, 94 listed companies in Taiwan stock market are subject to be analyzed from the period of 2010-2014. The results showed there is a positive relationship among operating performance, R&D cost, marketing expenses and fixed assets. Also, it showed that R&D costs are a key factor in the company's profits and development, and marketing costs are also play the role in company's performance, which has been addressed few and is crucial to the advancement of Taiwan's biotech industry, from our belief.

Literaure Review

Many researchers have used DEA to analyze performance, like Shih-Liang Chao and Jen-Der Chang (2011) use DEA to analysis strait international container port's performance. The results show" Lianyun port" and "Ningbo port" have a good performance that represent these two ports can be a reference object. Hung-Hui Hsu(2012) use BCC model of DEA to research the top five tire industry's performance in Taiwan and the results showed "Scales of Return" is associated with the performance. Bo-Yan Huang (2014) measures 16 listed companies in food in Taiwan and finds the industry's all pure technical efficiency are higher than total technical efficiency from 2010 to 2012. Hsien-Kuang Fang et al. (2013) use Two-Stage DEA and BCG matrix to analysis Taiwan food stock market and find out that these 11 companies are best performance in 2010 from 2009 to 2011. Sueyoshia and Gotob(2011) compare "national oil companies" and "international oil companies". An important finding of their study was national oil

companies have higher efficiency than international oil companies. Montoneri et al. (2011) explore 18 new students English class relative efficiency in a Taiwan's university. Abdi et al. (2013) analyze the efficiency of orchardists, discriminate efficient orchardists from inefficient ones and identify wasteful uses of energy using DEA for orange production in Guilan province of Iran. The results indicated that out of the total number of orchardists the share of efficient and inefficient units were 73.3% and 26.7% based on BCC model. Also, the results revealed the average of technical, pure technical and scale efficiencies of orchardists were 0.894, 0.965 and 0.922, respectively.

The Model

We use DEA to analysis the performance of company and BCG Matrix to find out the benchmark companies in this study. We are using CCR model. It proposed by Charnes, Cooper, Rhodes in 1978. Each input and output of a linear combination of term entry and then the ratio between portfolio represented by the value of each assessment unit (DMU) of efficiency, the following formula:

$$RE = Max \ h_k = \sum_r \mu_r y_{rk}$$

$$s.t. \sum_i v_i x_{ik} = 1$$

$$\sum_r \mu_r y_{rj} - \sum_i v_i x_{ij} \leqq 0 \ ;$$

$$\mu_r, v_i \geqq 0$$

RE as the relative efficiency of DMU, h_k is the relative efficiency value of DMU, μ_r is the virtual multiplier, v_i is the input's virtual multiplier, y_{rj} is the output, x_{ij} is the I-th input, r as the number of output items, I as the number of input items and j as the number of DMU items. In addition, CCR dual formula shown in Equation:

$$\min h_k = \theta_k - \varepsilon(\sum_r \sigma_r + \sum_i s_i)$$

$$s.t. \sum_j y_{rj} \lambda_j - \sigma_r = y_{rk}$$

$$\sum_j x_{ij} \lambda_j - \theta_k x_{ik} + s_i = 0$$

$$s_i, \sigma_r \geqq 0; \lambda_j \geqq 0$$

s_i and σ_r are represent slack variable between the i-th input and r-th output. BCG matrix proposed by the Boston Consulting Group in 1970. For the company's market share and market growth to be divided into four categories: star, problem child, dogs, cash cow.

Analysis

In order to understand whether the input and output variable suitable for DEA, we use Eviews8.0 to test correlation between input and output. The results are shown in Table1 and it can be seen input and output correlational are both positive, therefore, suitable for DEA.

Table 1:
Test correlation of input and output results

	FIXED_ASSET	NET_INCOME	RESEARCH	SALE
FIXED_ASSET	1	0.97674	0.828328	0.31844
NET_INCOME		1	0.900031	0.396817
RESEARCH			1	0.397491
SALE				1

For operating performance for the efficiency of Taiwan's listed biotech companies analysis, we deleted the input variables less than five years and no more than half of the amount of information. Finally, we take 94 as samples obtained via Deap Version 2.1 Software the results are shown in Table2.

Table2.
94 listed biotech efficiency analysis Results

firm	Crste	Vrste	scale	
D1	0.879	0.88	0.998	irs
D2	0.997	1	0.997	irs
D3	1	1	1	-
D4	1	1	1	-
D5	0.938	1	0.938	drs
D6	1	1	1	-
D7	0.613	0.654	0.938	irs
D8	0.616	0.662	0.93	irs
D9	0.626	0.678	0.924	irs
D10	0.662	0.716	0.925	irs
D11	1	1	1	-
D12	0.756	0.85	0.889	Drs
D13	0.614	0.787	0.78	Drs
D14	0.6	0.676	0.888	Drs
D15	0.532	0.73	0.729	Drs
D16	0.398	0.855	0.466	Drs
D17	0.523	1	0.523	Drs
D18	0.452	0.891	0.507	Drs
D19	0.449	0.93	0.482	Drs
D20	0.456	0.966	0.472	Drs
D21	0.814	0.836	0.974	Drs
D22	0.75	0.829	0.905	Drs
D23	0.883	0.905	0.975	Drs
D24	0.987	1	0.987	Drs
D25	0.424	0.553	0.766	Drs
D26	0.258	0.411	0.629	Drs
D27	0.257	0.413	0.621	Drs
D28	0.241	0.411	0.588	Drs
D29	0.269	0.435	0.619	Drs
D30	0.264	0.478	0.553	Drs
D31	0.335	0.401	0.835	Drs
D32	0.295	0.392	0.754	Drs
D33	0.266	0.405	0.656	Drs
D34	0.273	0.421	0.65	Drs
D35	0.269	0.441	0.61	Drs

D36	0.832	1	0.832	Drs
D37	0.755	0.915	0.825	Drs
D38	0.711	0.883	0.805	Drs
D39	0.326	0.412	0.79	Drs
D40	0.494	0.586	0.843	Drs
D41	1	1	1	-
D42	1	1	1	-
D43	1	1	1	-
D44	0.812	1	0.812	Irs
D45	0.634	1	0.634	Irs
D46	0.576	1	0.576	Drs
D47	0.56	1	0.56	Drs
D48	0.558	1	0.558	Drs
D49	0.461	0.911	0.507	Drs
D50	0.453	0.814	0.557	Drs
D51	0.259	0.352	0.734	Drs
D52	0.227	0.358	0.634	drs
D53	0.273	0.402	0.678	drs
D54	0.284	0.427	0.664	drs
D55	0.261	0.399	0.653	drs
D56	0.937	1	0.937	drs
D57	1	1	1	-
D58	1	1	1	-
D59	0.881	0.92	0.957	drs
D60	1	1	1	-
D61	0.227	0.238	0.951	drs
D62	0.23	0.298	0.772	drs
D63	0.273	0.327	0.834	drs
D64	0.221	0.307	0.722	drs
D65	0.257	0.373	0.689	drs
D66	0.371	0.573	0.647	drs
D67	0.318	0.569	0.558	drs
D68	0.339	0.588	0.576	drs
D69	0.254	0.47	0.539	drs
D70	0.228	0.405	0.562	drs
D71	0.46	0.511	0.9	irs
D72	0.42	0.42	1	-
D73	0.469	0.479	0.978	irs
D74	0.549	0.574	0.956	irs
D75	0.589	0.633	0.93	irs

D76	0.394	1	0.394	irs
D77	0.373	0.764	0.489	irs
D78	0.417	0.537	0.777	irs
D79	0.36	0.408	0.883	irs
D80	0.368	0.408	0.903	irs
D81	1	1	1	-
D82	0.717	0.72	0.995	irs
D83	1	1	1	-
D84	1	1	1	-
D85	0.507	1	0.507	irs
D86	0.284	1	0.284	irs
D87	0.159	0.24	0.66	irs
D88	0.162	0.163	0.994	drs
D89	0.177	0.18	0.983	irs
D90	0.176	0.179	0.981	irs
D91	0.216	0.224	0.966	drs
D92	0.276	0.284	0.97	drs
D93	0.328	0.335	0.977	drs
D94	0.281	0.287	0.978	drs
mean	0.536	0.675	0.792	

The results revealed that, from the total of 94 companies, 13 units (13.4% of total units) had the pure technical efficiency score of 1. Furthermore, from the technically efficient 27 units (28.7% of total units) had the technical efficiency score of 1. Also, from inefficient units D18、D19、D20、D49、D50 have technical efficiency scores between 0.8 and 0.99. The reason is based on pure technical efficiency multiplied by the scale efficiency of technical efficiency, pure technical efficiency and calculated are relatively small, this study suggests that is because there are more units are flowing into effective enterprise.

Furthermore, most companies (about 61%) were decreasing returns to scale, the main reason is due to the assessment unit of production are too big, so that all aspects of the production is difficult to obtain effective coordination, thereby reducing the production efficiency, affecting the overall efficiency of the company, managers should controls allocation of resources, the effectiveness of the respective inputs to produce at the optimum point, to achieve the best performance and the performance, so if can improve the efficiency of enterprises, will be positive for the company even help companies improve efficiency and the competitiveness of enterprises. In this study, Taiwan's biotech industry is divided into three categories: the field of medical equipment, pharmaceutical field, the field of application of biotechnology. Analysis based on the results of this study suggests that skill in the pharmaceutical field and application of Health should continue to expand the scale of production, to improve the efficiency of decision-making units. Application of biotechnology in the field of medical equipment and a small section should downsize, reduce the input of resources, which can improve the operational efficiency of enterprises.

Business efficiency values can be seen by their allocation and efficiency of resources invested, put forward to improve the outside, must also learn efficient company, therefore, this study used BCG matrix, with market share and industry growth rate to derive the benchmark enterprise, so that the low efficiency of business can learn to follow so as to achieve better the output and overall efficiency improvement

As part of the pharmaceutical companies in the 2013-20014 years successfully developed a new drug, resulting in 2014 revenues increased sharply, affecting the results of the analysis, this study reject some of this extreme value, BCG matrix analysis of the results are shown in Table3.

Table 3:
The results of the BCG Matrix

problem child	Star
8,24,2,36,31,56,58,13,15,27,30,40,43,47,52,57,44,51,50,37,72,71,41,90,79,86,89,61,64,62,48, 82, 70,77,18,60	3,12,21,1,34,46,83,33,88,92,75,7,23,11,4,5,6,45,59,74,26
Dog	Cash cow
20,25,17,29,68,65,84,93,14,9,39,32,49,53,38,54,78,80,87,91,73,67,81,63	22,35,16,55,19

As can be seen from Table 3 the benchmark enterprise is St.Shine, DYACO, CCPC, GRAPE KING BIO, YSP, STANDARD, SINPHAR, Johnson, HI-CLEARANCE, LOTUS, Level, Microlife, excelsior, Orient, Rossmax, Adimmune, Tcmbio, medfirst, TaiDoc, Formosalab, Share-Hope. Most are pharmaceutical companies, And the food and health food have the highest ratio, there are 11 enterprises in 2010 the top 30 biotech profit chart, represents these companies not only high-profit growth rate also improved, it can be used as an object to be learning industry. It is classified into the dog's business area are SciVision, Polylite Taiwan, HEALTH & LIFE, MicroBase, bioptik, okbiotech, bionime, ebmtech, Chunghwa, maywufa, feridmurad, yungzip, T.L.Biotech, DR.Chip Biotech, phytohealth, goldenbiotech, sunmaxbiotech, naturewise, cvc-tech, GenomeIB, glyconex, GGA, Dr.Wells, tlcbio, this type of business has low market share and low growth expected business, relative to other types of companies need to improve and learn. This study suggests that this type of business can use centralized policy to focus on the market segment of small differences, thereby creating corporate profits.

Conclusions

The study after the empirical analysis found that medical equipment field efficiency values were significantly higher than the other two areas, the reason is appropriate proportion of R & D costs in the medical field, and the number of employees has a positive impact on the development of new products, the results imply that the number of employees of medical equipment, the more established long time, both companies will generate significant impact. But in recent years, home health and sports rampant, rehabilitation care needs getting attention, so that enterprises continue medical equipment output sports and fitness equipment and home medical equipment, also makes profit increase. Because of Pharmaceutical sector's long development time, in particular, to the uncertainty success of future drug, so that when the annual higher investment and costs, they would not improve on reward., this study suggests that should continue to expand production scale, to enable enterprises to improve efficiency value. The results also show that the field of application of biotechnology in cosmetics proportion is higher than the food biotechnology and environmental biotechnology class.

This study suggests that in recent years due to the rise of cosmetic medicine, led the biotech cosmetics market demand, while domestic biotech business in order to brand awareness, also join the R & D investment ranks.

This study suggests that biotechnology applications in addition to investment in class biotech cosmetics, should focus on the development of improved agricultural, because Taiwan's society there is a demand in recent years, people have attached great importance to food safety, the Food and Agriculture Further Taiwan value beyond medicine and medical equipment categories, plus Taiwan's agricultural biotech technologies is a leading global technology, so this cut to boost overall efficiency will be more significant.

This study has some proposal to Taiwan's biotechnology industry: Businesses have to change the traditional thinking, new business models, access, biotechnology coupled with big data and into customers living area.

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