

电子通路与公司绩效关联性之研究^①

涂宏任 颜婉竹 (静宜大学 国际企业学 台湾 台中 43301)

Internet-Based Electronic Channels and Business Performance

Hung-Jen Tu, Wan-Chu Yen (Department of International Business, Providence University, Tai Chung 43301)

Abstract: The stimulus of advances in Information Technology (IT), particularly the Internet, has forced firms to explore new organizational forms and deliver service innovation. Emerging Internet-based electronic distribution channels, i.e., Internet channels, might be another forms of services innovation for firms to face the market dynamics. However, empirical studies fail to provide direct evidence of whether Internet channels enhance business performance^[1]. In order to fill in the literature gap, this empirical study attempts to investigate performance implications of Internet channels in Taiwan by means of applying data envelopment analysis (DEA). Results show that operating efficiency of financial services firms following the Internet channels announcement is increased. This work therefore concludes that Internet channels have positive influence on business performance.

Key words: internet channels; data envelopment analysis (DEA); business performance; services innovation

1 Introduction

The stimulus of advances in Information Technology (IT), particularly the Internet, has forced financial services firms to explore new organizational forms and deliver service innovation. Services science, along with services innovation, is a new field and key driver of socio-economic growth that has been fostered by both practitioners and academics^[2]. Emerging Internet-based electronic distribution channels, i.e., Internet channels, might be another forms of services innovation for firms to face the market dynamics. Managing the impact of introducing an Internet channel into an existing distribution system is probably one of the greatest challenges today. The purpose of adding Internet channels is to increase and sustain competitive advantage, and to eventually enhance financial performance. However, using Internet channels provides oppor-

tunities as well as threats and the net effect is illegible^[3]. In spite of uncertainty surrounding managerial performance of multi-channel strategies, countless firms still rush to build Internet channels to access potential millions of customers directly through the Internet. This research investigates performance implications of Internet channels for financial services firms by means of applying data envelopment analysis (DEA).

DEA is a methodology for analyzing the relative efficiency and managerial performance of Decision-Making Units (DMUs). This study adopts DEA as the fundamental tool for the following reasons. First, the use of a single measure in performance evaluation ignores most interactions among various firm performance measures. DEA has been proven effective in performance evaluation when multiple performance measures are present^[4]. Second, DEA does not require a priori informa-

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tion about the relationship within multiple performance measures. This versatility allows DEA a wide range of applications for performance evaluation. In the following sections, related literature including performance evaluation of Internet channels and DEA will be depicted. The applicability of research methodology in the empirical context will be reported, followed by analysis and results. Research conclusion will be in the final section.

2 Literature Review

2.1 Performance evaluation of internet channels

Klumpes^[5] suggests that the choice of a marketing distribution channel significantly affects the firm's profitability and service quality in related markets. Due to intensified market competition and the development of IT, especially Internet technology, the channel system context is changing^[6]. The Internet-based electronic distribution channel is perhaps the most important duct for direct consumer interaction with firms as it offers the potential, not only for enhancing the quality of service innovation and reducing cost, but also for new marketing opportunities^[7]. Many firms believe that the adoption of Internet as distribution channels, achieves a high level of Customer Lifetime Value (CLV), and enhances their service innovation^[7].

Some empirical studies attempt to explore the relationship between Internet channel initiatives and firm performance. DeYoung et al.^[8] suggested that adding the Internet channel to an existing network resulted in superior bank profitability. Cheng et al.^[1] revealed that Internet channel additions announcement could increase the financial performance of the firm. Morgan-Thomas and Bridgewater^[9] found that the higher level of Internet channel usages resulted in superior firm performance. All of them found evidence to demonstrate the advantage of Internet channel initiatives in the context of online channel development. Nevertheless, few empirical studies undertake comprehensive Internet channels evaluation and provide direct evidence on their performance implications.

Maturing and stabilizing Internet technology poses a challenge to numerous firms of how to evaluate Internet channel performance^[10]. Performance evaluation of

Internet channels has become increasingly important for fine-tuning current operations and creating new strategies to keep up with competitors, especially for companies surviving the dot.com collapse^[11]. According to Wagner's et al. ^[12] conclusion, business performance is a multidimensional construct. Single measurement benchmarking may not be adequate to evaluate the performance of overall business^[11]. First, real-world businesses often face multiple inputs and outputs rather than a single output or single input. Second, "the use of single measures ignores any interactions, substitutions, or trade-offs among various performance measures" (cf.[4]), which neglects an important aspect of the microeconomic theory of resource substitutions.

Since company performance is a complex phenomenon requiring more than a single criterion to characterize, a number of studies suggest applying a multi-factor performance measurement model for evaluating Internet channels^[10]. The development of multi-factor performance measures, which reflects DMUs efficiency level and information technology implemented in a business level, is important to managers for knowing how far the firm can expectedly increase its multiple outputs and decrease its input level through performance improvement. The DEA approach, as concluded by Chen et al.^[13], displays seeming advantage to measure E-business operating efficiency in the retail industry. Therefore, this study proposes a DEA model to evaluate the performance of Internet channels.

2.2 Data envelopment analysis

Charnes et al.^[14] first introduced Data Envelopment Analysis (DEA) as a Linear Programming (LP) methodology for mathematically comparing different DMUs' managerial performance based on multiple inputs and outputs. The ratio of weighted inputs and outputs produces a single measure of efficiency called relative efficiency. The main advantage of the DEA approach is that, unlike other traditional performance evaluation methods, it does not require a priori assumption about the analytical form of the production function^[15]. Since the pioneering work by Charnes et al.^[14], DEA has become an increasingly popular method for measuring business efficiency. Furthermore, Jemric and Vujcic^[15] argue that DEA is a superior method for measuring business overall

performance. The basic idea of the DEA approach lies in finding the “best practice” for each DMUs. DEA identifies a set of efficient or “best practice” units (efficiency = 1) for which no other DMUs have as much or more of every output (given inputs) or little or less of every input (given outputs).

3 Methodology

3.1 Sample and data collection

This investigation defines the target population as Taiwan's physical enterprises which allow their customers to place orders both through physical as well as Internet channels. Physical financial services firms providing online services through the Internet were chosen as representatives of this population. This is particularly evident in those areas of the financial services sector where transactions do not require interpersonal interaction, with the Internet consequently serving as a new distribution channel^[16]. The decision to sample only a single industry, financial services, was mainly based on the rationale of variance reduction across industries. Besides, a number of studies about the performance measurement of financial services sector have successfully use DEA. According to the Taiwan Institute of Economic Research, Taiwan has experienced a wave of eCommerce addition in the financial services sector the past few years. This wave has been driven by the need to offer better services in order to enhance customer loyalty after Taiwan's authority deregulated the financial services sector in November of 1997. A total of 20 listed firms of the financial services industry in the Taiwan Stock Exchange Corporation (TSEC) were selected. These firms announced their online services over the period 1997–2000. Their financial data were then collected from the Taiwan Economic Journal (TEJ) database.

3.2 Variables measurement

Operating efficiency in the DEA model is defined as the ability of firms to utilize their resources to deliver maximum level service for their customers. Firms tend to maximize their outputs such as service offerings and financial performance with prudent use of existing resources. Based on existing literature, which is compiled in Table 1, this study takes two parameters as input variables (number of employees, fixed assets) and three parameters as

output variables (profit margin percentage, return on assets, days receivables). The basic mathematical formulation of DEA is shown below. The CRS model

$$\text{Min } h_o = \theta - \varepsilon \left(\sum_{i=1}^m s_i^- + \sum_{r=1}^s s_r^+ \right) \quad (1)$$

$$\text{s.t. } \sum_{j=1}^n \lambda_j x_{ij} - \theta x_{io} + s_i^- = 0,$$

$$\sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{ro}$$

$$\theta, \lambda_j, s_i^-, s_r^+ \geq 0, \quad j = 1, 2, \dots, n, \quad i = 1, 2, \dots, m, \quad r = 1, 2, \dots, s.$$

where y_{rj} is the amount of the r th output for the j th DMU; x_{ij} is the amount of the i th input for the j th DMU; λ is the weight of DMUs; s_i^- is the input slacks; s_r^+ is the output slacks; and θ is the efficiency score of the DMU₀.

Table 1 Input and output variables for measuring efficiency using DEA — a survey

Authors	Input Variables	Output Variables
[11]	Web technology investment, corporate operating cost, number of e-commerce staff	Profit margin percentage, price earnings ratio, return on equity, return on permanent capital, days receivables, capacities, utilization, e-commerce site quality
[13]	Number of employees, inventory cost, total current assets, cost of sales	Revenue, net income
[17]	Number of employees, total operating expenses, total assets	Unique visitors, revenues
[18]	Total assets, CAPEX, employee numbers	Revenue, EBITDA, operating profit (EBIT)
[19]	Assets, equity	Net profit, rate on assets (ROA), rate on equity (ROE)
[20]	Operating expense, employees, total assets	Revenue, brokerage commission

3.3 Study design

To detect the impact of Internet channels on firm performance, this research employs a pretest-posttest study design. Data from the pre-announcement year, announcement year, and post-announcement year are examined. Another concern in DEA is the type of orientation, input or output. An output orientation assumes that DMUs have direct control over their outputs, while an input orientation assumes little control

over outputs produced. Since financial services firms cannot directly control outputs, it is more appropriate to concentrate on inputs where there is more opportunity to reduce excess consumption^[21]. Thus, an input-oriented model, assuming output-quantities to be given, is better suited to assess the performance of financial services firms.

4 Analysis and Results

Efficiency scores obtained from the DEA using CRS models are shown in Table 2. The first four columns contain firm identifiers and efficiency scores in the pre-announcement year, announcement year, and post-announcement year, respectively. The last two columns display percent changes for each firm's efficiency score. Among the twenty firms studied, efficiency scores that maintained or improved were thirteen (65%) in the announcement year and fourteen (70%) in the post-announcement year under the CRS model (see Table 2). Regarding the seven firms that showed decreasing efficiency in the announcement year, five changed over 20 percent (71% of seven firms), while four changed over 20 percent in the post-announcement year (67% of six firms). As the individual-level, firm O showed the greatest improvement (160.85%) in the announcement year and post-announcement year (249.38%), while firm G experienced the largest decrease in the announcement year (-90.51%) and firm D in the post-announcement year (-54.67%). Efficiency scores rose from a score of 0.348 in the pre-announcement year to 0.396 in the announcement year and to 0.421 in the post-announcement year on average. Overall change in efficiency scores was 34.99 percent in the announcement year and 54.70 percent in the post-announcement year.

5 Conclusion

The performance implication of Internet channels has received considerable attention in marketing literature. To address this important issue, the current investigation attempts to fill in the literature gap by using DEA. The results of DEA analysis illustrate that Internet channels do affect firm performance; that is, results show increases in average efficiency scores following Internet channel announcement. In conclusion, the research provides insights into the benefits of Internet channels for

firms. This study provides a systematic outline of performance implications of online channels and allows managers to make wiser decisions for financial services industry. In our view, firms will continue to invest in their own online channels and offer direct links to selected customers in the future. Managers should additionally take advantage of advanced IT to facilitate collaboration across the distribution channel portfolio and systematic approach to service innovation^[22].

Table 2 Efficiency scores under CRS model

DMUs	(1)	(2)	(3)	% Change	
	Efficiency scores			(1)vs.(2)	(1)vs.(3)
A	1.000	1.000	1.000	0.00	0.00
B	0.512	0.369	0.325	-27.89	-36.50
C	0.227	0.338	0.359	49.25	58.70
D	1.000	1.000	0.453	0.00	-54.67
E	0.281	0.259	0.383	-7.88	35.83
F	0.269	0.293	0.388	9.04	44.38
G	0.181	0.017	0.167	-90.51	-7.96
H	0.212	0.139	0.198	-34.78	-6.56
I	0.041	0.081	0.073	98.56	78.23
J	0.703	0.140	0.421	-80.14	-40.19
K	0.265	0.337	0.664	26.98	150.40
L	0.408	0.139	0.302	-65.94	-25.98
M	0.212	0.350	0.263	65.32	24.10
N	0.111	0.281	0.175	154.03	57.83
O	0.251	0.654	0.875	160.85	249.38
P	0.063	0.149	0.125	137.73	99.80
Q	0.218	0.459	0.378	110.11	72.92
R	0.006	0.005	0.017	-7.40	201.93
S	0.604	0.917	0.856	51.88	41.68
T	0.399	1.000	1.000	150.66	150.66
Mean	0.348	0.396	0.421	34.99	54.70
[Std]	[0.285]	[0.336]	[0.302]		

(1), (2), (3)= pre-announcement year, announcement year, and post-announcement year, respectively.

This study also identifies practical limitations that offer immediate avenues for further research. First, though the input and output variables are based on previous literatures, there are still a lack of relevant references due to the topic of Internet channels. For example, as suggested by Wen et al.^[11] “financial measures fail to represent other operational and quality-related measures of performance in eCommerce context.” Therefore, the research suggests better determining by experts who have a good understanding

of the topic, such as Delphi approach, to address the current theme. The second limitation is that only one industry in Taiwan is included in this research. As potential idiosyncratic industry and country-related properties of our data is believed to occur, the generaliability of the results needs to be assessed. Consequently, future studies involving other industries and countries might also provide worthwhile insights.

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References

- 1 Cheng JM-S, Tsao S-M, Tsai W-H, Tu HH-J. Will eChannel additions increase the financial performance of the firm the evidence from Taiwan. *Industrial Marketing Management*, 2007,36(1):50—57.
- 2 Paton RA, McLaughlin S. Services innovation: knowledge transfer and the supply chain. *European Management Journal*, 2008,26(2):77—83.
- 3 Geyskens I, Gielens K, Dekimpe MG. The marketing valuation of Internet channel addition. *Journal of Marketing*, 2002,66(2):102—119.
- 4 Chen Y, Zhu J. Measuring information technology's indirect impact on firm performance. *Information Technology and Management*, 2004,5(1-2):9—22.
- 5 Klumpes PJM. Performance benchmarking in financial services: evidence from the UK life insurance industry. *Journal of Business*, 2004,77(2):257—273.
- 6 Wu D, Ray G, Whinston AB. Manufacturers' distribution strategy in the presence of the electronic channel. *Journal of Management Information Systems*, 2008,25(1):167—198.
- 7 Choudhury V, Karahanna E. The relative advantage of electronic channels: a multidimensional view. *MIS Quarterly*, 2008,32(1):179—200.
- 8 DeYoung R, Lang WW, Nolle DL. How the Internet affects output and performance at community banks. *Journal of Banking & Finance*, 2007,31(4):1033—1060.
- 9 Morgan-Thomas A, Bridgewater S. Internet and exporting: determinants of success in virtual export channels. *International Marketing Review*, 2004,21(4/5):393—408.
- 10 King SF, Liou J-S. A framework for Internet channel evaluation. *International Journal of Information Management*, 2004,24(6):473—488.
- 11 Wen HJ, Lim B, Huang HL. Measuring e-commerce efficiency: a data envelopment analysis (DEA) approach. *Industrial Management & Data Systems*, 2003,103(9):703—710.
- 12 Wagner WP, Chung QB, Baratz T. Implementing corporate Intranets: lessons learned from two high-tech firms. *Industrial Management & Data Systems*, 2002,102(3):140—145.
- 13 Chen Y, Motiwalla L, Khan MR. Using super-efficiency DEA to evaluate financial performance of e-business initiative in the retail industry. *International Journal of Information Technology & Decision Making*, 2004,3(2):337—351.
- 14 Charnes A, Cooper WW, Rhodes E. Measuring the efficiency of decision-making units. *European Journal of Operational Research*, 1978,2(6):429—444.
- 15 Jemric I, Vujcic B. Efficiency of banks in Croatia: a DEA approach. *Comparative Economic Studies*, 2002,44(2):169—193.
- 16 AL-Hajri S, Tainall A. Adoption of Internet technology by the banking industry in Oman: a study informed by the Australian experience. *Journal of Electronic Commerce in Organizations*, 2008,6(3):20—36.
- 17 Serrano-Cinca C, Fuertes-Callén Y, Mar-Molinero C. Measuring DEA efficiency in Internet companies. *Decision Support Systems*, 2005,38(4):557—573.
- 18 Tsai HC, Chen CM, Tzeng GH. The comparative productivity efficiency for global telecoms. *International Journal of Production Economics*, 2006, 103(2):509—526.
- 19 Mostafa M. Modeling the efficiency of GCC banks: a data envelopment analysis approach. *International Journal of Productivity and Performance Management*, 2007,56(7):623—643.
- 20 Ho C-TB, Oh KB. Measuring online stockbroking performance. *Industrial Management & Data Systems*, 2008,108(7):988—1004.
- 21 Ali AI, Gstach D. The impact of deregulation during 1990-1997 on banking in Austria. *Empirica*, 2000,27(3):265—281.
- 22 Ng ICL. Service innovation: converting Pareto loss into revenue. *Journal of Revenue and Pricing Management*, 2007,6(4):279—283.