Multidimensional Performance of Listed Companies at the Philippine Stock Exchange

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Abstract

This paper investigates the multidimensional performance of the 26 listed firms in the services sector of the Philippine Stock Exchange for the period 1998-2007, using the DuPont System (financial) and the Super-Efficiency Data Envelopment Analysis. Empirical findings reveal a negative return on equity for the sector and the presence of outliers. We also found a statistically significant association between financial and technical performances of the sector. The study ends with specific managerial implications and recommendations for improving the firm's performance and also suggests areas for future research.

Keywords: DEA, DuPont System, Philippine services sector, Super-efficiency, technical efficiency

I. Introduction

The stock exchange plays a key role in economic development of a nation. The inflow of funds in the stock market is one efficient way of directing a needed resource into a growing economy. Baier et al.'s (2004) study showed that growth in a country is higher following the creation of a stock exchange. Economic growth increases relative to the rest of the world after a stock exchange opens. Evidence showed that higher economic growth occurred because the exchange increases the economy's efficiency, either the informational efficiency, the efficiency of physical capital's allocation or, both.

The Philippine Stock Exchange, Inc. (PSE or Exchange) is the only organized market in the Philippines licensed for trading of securities. It is committed to protecting the interest of the investing public, and developing and maintaining an efficient, fair, orderly and transparent market. The PSE plays a vital role in the financing of productive enterprises that use the funds for growth and expansion, and the creation of new jobs. It is therefore essential to the growth of the Philippine economy (PSE Investors Primer I).

As of 01 May 2007, the Philippine Stock Exchange has a total of 241 listed companies. Stocks listed in the PSE are classified into six sectors, namely: Financials, Industrial, Holding Firms, Property, Services, and Mining & Oil. Among the six sectors of PSE, this paper is focusing on the services sector because it has been the key for both gross domestic product (GDP) and employment growth in the Philippines according to the country report of the International Monetary Fund (IMF) in March 2007. The share of services in the economy has grown over the past decade to reach over 50 percent of GDP, while agriculture and industry have declined in relative importance (Fujita and Seshadri, 2007).

The measurement of the firm's performance and efficiency provides valuable information to identify the best practice frontier for benchmarking purposes towards performance improvement of the companies. It is an important part of the reform for the general welfare of the country. In the existing literature to date, there is no study on the services sector of the PSE that addresses the performance and efficiency using more reliable and accurate approaches.

The aim of this paper is to evaluate the multidimensional performance of the listed companies in the services sector of the PSE by combining three models of performance measures, namely: financial model (DuPont System), Data Envelopment Analysis Super-efficiency model, and a linkage model using the Tobit regression for the first time. Using these research models, the study offers robust empirical applications of the combined conventional and modern approaches to performance of listed companies at PSE. Moreover, findings of the study may serve as an original contribution to both theory and application of efficiency and performance as extensions and implementations of DEA and accounting models by providing new evidences which could be additions to the literature on performance management.

The rest of the paper is organized as follows: Section II provides a review of literature. Section III explains the methodology including data and variables and models. Section IV presents empirical findings and the paper ends with conclusion and future research in Section V.

II. Literature Review

Numerous methods for efficiency and productivity measures have employed Data Envelopment Analysis (DEA) and other efficiency and productivity approaches. DEA is a mathematical programming methodology, using a variety of input and output data that can be applied to assess the relative efficiency of a variety of institutions such as industrial firms, commercial banks, university, hospitals, etc. Recently the DEA approach has been used to analyze the competitiveness of industries and regions in a country or across countries (Chen et al., 2006).

Several studies had used DEA to measure the efficiency of stock exchanges. Semenick-Alam and Sickles (1998) used the linear programming techniques of Data Envelopment Analysis and Free Disposal Hull to analyze the association between two performance measures: stock market returns and relative technical efficiency, for a panel data of 11 US airlines observed quarterly from 1970-1990. Their findings disclosed that there is a relationship between efficiency news in a quarter and stock market performance in the following two months. A risky arbitrage portfolio strategy, of buying firms with the most positive efficiency news and short-selling those with the worst news during this time frame, results in zero beta risk yet yields annual returns of 17% and 18% using the two methodologies.

Serifsoy (2007) studied the comparison between the technical efficiency and factor productivity of exchanges with different business models using DEA-Malmquist Productivity Index. He further suggested that exchanges, which diversified into related activities, are mostly less efficient than exchanges that remain focused on the cash market. However, there was no evidence that vertically integrated exchanges are more efficient. Instead, these exchanges seemed to possess a substantially stronger factor productivity growth than other business models. His findings contributed to the ongoing discussion about the drawbacks and merits of vertical integration.

Edirisinghe and Zhang (2007) evaluated the various publicly traded technology- industries in the United States using the generalized DEA model to analyze the firm's financial statements over time and to determine a relative financial strength indicator (RFSI) that is predictive of a firm's stock price return. RFSI is based on maximizing the correlation between the DEA-based score of financial strength and the stock market performance to determine optimized RFSI indicators for stock selection which are used within portfolio optimization models to demonstrate the usefulness of the scheme for portfolio risk management.

Many studies employed DEA to determine the efficiency of various industries included in the services sector such as Cullinane and Wang (2006) who measured the efficiency of container terminals in Europe; Luo and Donthu (2005) who evaluated the media spending efficiency of top 100 US advertisers; Banker et al., (2002) on the impact of IT implementation on the productivity of a public accounting firm; Shao and Shu (2004) measured the productivity growth of the information and computing technology (ICT) industries in 14 Organization for Economic Cooperation and Development countries; Cabanda and Ariff (2004) on global telecommunications using 39 sample countries in the four regional groupings; Haugland et al., (2007) on 530 Norwegian hotels included in the Dunn and Bradstreet database; and Zhu (2000) in determining a multi-factor financial performance of the Fortune 500 companies among others.

Mahadevan (2000) admitted that there is a dearth of studies on the efficiency and productivity of the services sector. Mahadevan found that Singapore's service sector showed a negative total factor productivity (TFP) growth over 1975-1994. Furthermore, results showed that Singapore's service sector's output growth is input-driven, and the poor TFP growth was caused by significant deterioration in technical efficiency, although, the service industries enjoyed positive and increasing technological progress over time.

These studies, however, utilized only one model to determine the efficiency of different industries. There are no rigorous statistical methods of adopting two or more models to determine their multidimensional performance. Moreover, there is a deficiency of studies on the productive efficiency of the services sector. As such, the results of the models combined in this study for measuring the multidimensional performance of the PSE services sector offer new and original contributions to theory and practice of the services sector performance.

III. Methodology

Data and Variables

The data of this study were taken from the published classification of companies included in the services sector of the Philippine Stock Exchange as of December 2007. There are 26 firms in our sample, which were analyzed from 1998-2007, with a total of 260 pooled data. Other sources of data were taken from the annual reports and audited financial statements of the listed companies in the services sector of the PSE which were submitted to the Securities and Exchange Commission (SEC), PSE primers, PSE monthly reports, published *Top 7000 Corporations Business Profiles 2006-2007 edition* by the Philippine Business Profiles and Perspectives Inc., and companies annual reports as published in their websites.

The financial variables were derived from the components of the extended profitability ratio of the Return on Equity (ROE) known as the DuPont System. Variables include tax burden, interest burden, operating profit margin, asset turnover and leverage ratio. Tax burden is the proportion of the company's profits retained after paying income taxes. Interest burden is the proporation of the company's pretax profit after absorbing interests. Operating profit margin is the operating profit per peso of sales. Asset turnover is the amount of sales generated for every peso's worth of assets. Leverage ratio indicates the proportion of total assets financed with debt.

The inputs are labor, fixed assets, operating expenses, and time period. The measure of the quantity of labor is based on annual accounting data for the number of employees of the firm. Fixed assets refer to the property, plant and equipment of the firm net of accumulated depreciation at the end of the year. Operating expenses pertain to the expenditures incurred in running the operations of the firm such as salaries, allowances, bonuses, travelling expenses, insurance, office supplies, communication expenses, depreciations and other overhead expenses like utility expenses and other miscellaneous expenses. The time period refers to the test period of 10 years in this study. Output variable in this study is market capitalization which is a measurement of corporate or economic size equal to the stock price times the number of shares outstanding of a public company at the end of the year.

All financial data were expressed in nominal monetary value. Unless adjusted for inflation, investment returns can be misleading especially in the long term. Any rise in inflation can have a negative effect on returns (Mobius, 2007). Thus all financial data were adjusted for inflation using the Consumer Price Index (CPI) with 2000 prices as base year to obtain real values. (http://www.census.gov.ph).

Research Models

Financial Model

Profitability ratios are among the most closely watched and widely quoted financial ratios (Megginson et al, 2007). Among the profitability ratios, ROE is a measure that most investors are greatly concerned about as it is a measure of what return the company is able to generate on the shareholders money. ROE can be decomposed to further analyze how these returns were earned and what mainly helped in generating the same. The decomposed ROE is known as the DuPont System or DuPont Analysis.

Equation 1 shows the extended DuPont System (Bodie et al., 2004) as stated:

$$ROE = \frac{\text{Net Profit}}{\text{Equity}} = \frac{\text{Net Profit}}{\text{Pretax Profit}} \times \frac{\text{Pretax Profit}}{\text{EBIT}} \times \frac{\text{EBIT}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}} \qquad (1)$$

where:

Net profit = net profit after taxes;
Equity = shareholders' equity;
EBIT = earnings before interest and taxes; and
Sales = net sales.

DEA Super-Efficiency Model

DEA is a non-parametric method and uses piecewise linear programming to calculate (rather than estimate) a sample's efficient or best practice frontier. The decision-making units (DMUs) or firms that make up the frontier envelop the less efficient firms. Technical efficiency is calculated as a score on a scale of 0 to 1 with the frontier firms receiving a score of 1 (Cooper et al., 2000; Coelli et al. 1998). Its main virtue is that it can be used to measure efficiency when there are multiple inputs and outputs, but there are no generally acceptable weights for aggregating inputs and aggregating outputs. DEA can be applied to assess the relative efficiency of a variety of institutions, using a variety of input and output data (Quey, 1996).

In recent years, variants of the basic DEA models have been expanding rapidly. An important extension has been the creation of "super-efficiency" models. These deleted domain models exclude the DMU under evaluation from the reference set, which means in the case of an efficient DMU, from the efficient frontier of the production set. The effect of this is to shrink the production set, which allows efficient DMUs to become super-efficient and to have different super-efficiency scores above 100%. It must be noted however that the scores for inefficient DMUs remain the same as in the standard DEA models (Lovell and Rouse, 2003).

A number of uses have been proposed for super-efficiency models. These include ranking of efficient DMUs (Andersen and Petersen, 1993), classification of DMUs into extreme-efficient and non-extreme efficient groups (Dula and Hickman, 1997), sensitivity of efficiency classifications (Seiford and Zhu, 1998a,b), two-person ratio efficiency games (Rousseau and Semple, 1995), overcoming truncation problems in second-stage regressions intended to explain variation in efficiency (Lovell et al, 1994), calculating and decomposing a Malmquist productivity index (Fare et al, 1994), and identifying outliers in the data (Banker et al., 1989).

This study will utilize the super-efficiency model to identify outliers in the data rather than the ranking of efficient DMUs. Outliers are a few extreme observations often caused by errors in measuring either inputs or outputs. Since extreme observations determine the production frontier in DEA models, the estimation of the frontier may be sensitive to measurement errors in the sample data. If an observation has been contaminated with noise that increases the observed output value or decreases the observed input values such that it gets rated as efficient, then it may also enter the reference set of other observations and distort their estimated efficiency scores. Such outliers may be influential in the estimation results obtained using a conventional DEA model. It is desirable, therefore, to consider a procedure that allows the identification and removal of such outliers (Banker and Chang, 2006). DEA efficiency scores are very sensitive to the presence of outliers due to its concepts of considering extremely superior performance (Sexton *et al.*, 1986).

The Banker-Gifford (BG) model (Banker and Gifford, 1988) is employed for identifying and removing outliers in this study. The first step in the BG method identifies as outliers those observations whose super-efficiency score exceeds a pre-specified screen level (Banker et al., 1989). In the second step, the observations identified as outliers are removed, and a conventional DEA model, such as the Banker, Charnes, and Cooper (BCC) model is estimated with the remaining observations. This second-stage efficiency estimates is referred as the BG-SE (super efficiency) estimates.

This study uses the variable returns to scale (VRS) super-efficiency DEA model for the reason that these firms are not uniformly operating at optimal scale due to factors such as size, age, technology, financial constraints, and industry's market structure, among others. The input-oriented model is also utilized because the stock exchange inputs can be influenced more directly by the management than the outputs, which are predominantly influenced by market demand (Serifsoy, 2007).

The VRS super-efficiency input-oriented DEA model can be expressed as (Chen et al., 2004, p.340):

$$\min \theta_o^{\text{VRS-super}}$$

$$\text{s. t.} \sum_{\substack{j=1 \\ j\neq 0}}^{n} \lambda_j x_{ij} \leq \theta_o^{\text{VRS-super}} x_{io} \qquad i = 1,2,\ldots,m$$

$$\sum_{\substack{j=1 \\ j\neq 0}}^{n} \lambda_j y_{rj} \geq y_{ro} \qquad r = 1,2,\ldots,s$$

$$\sum_{\substack{j=1 \\ j\neq 0}}^{n} \lambda_j = 1$$

$$\theta_o^{\text{VRS-super}} \geq 0$$

$$\lambda_j \geq 0 \qquad j \neq 0 \qquad (2)$$

where: n DMUs { DMUj: j = 1, 2, ……., n};
s output measures y_{rj} (r = 1, 2, ……., s);
m input measures x_{ij} (i = 1, 2, ……., m); and
the DMU_o under evaluation is excluded from the reference set.

IV. Empirical Results

Financial Performance

The DuPont System was applied on a per firm per year basis for the test period 1998-2007. Table 1 shows the average of the different components of DuPont as well as the average ROE per firm. The study reveals that the services sector registers a negative ROE of -24.58 percent. It means that the sector has been giving a negative return to the common stockholders' investment. Further analysis reveals that the negative return could mostly be impugned to the negative operating profit margin of -40.85 percent. It connotes that the firms in the sector, on the average, have been operating at a loss. The operating loss is further aggravated by a high income tax of 47.01 percent of the net profit. This is derived by deducting the tax burden of 52.99 from 100 percent, where the tax burden is the proportion of the firm's profits retained after paying income taxes. Interest expense, on the other hand, is only 1.05 percent of the profit before tax. This is also derived by deducting the interest burden of 98.95 from 100 percent, where the interest burden measures the proportion by which interest expense reduces profits.

Another component that contributes to the negative return is the low efficiency ratio. This ratio is an indicator of management's operating efficiency. Result shows that the sector used only 53.64 percent of its assets to produce revenue. The assets therefore were under utilized. This signifies that there was an over-investing to produce the service revenue. This result is similar to the study of Cabanda and Ariff (2002) which showed that the asset turnover of the Philippine's telecommunication industry has significantly decline after privatization of PLDT.

Table 1
Financial Performance of the Services Sector (%)
(1998 – 2007)

	Tax burden	Interest burden	Operating Profit margin	Asset turnover	Leverage ratio	ROE
DGTL	58.72	76.02	21.20	13.72	1023.60	13.25
GLO	78.76	64.40	50.65	34.82	250.68	22.42
LIB	79.01	87.16	-103.03	6.03	195.58	-8.36
PLDT	101.17	39.63	30.71	36.10	441.91	19.64
ATS	104.06	-6.48	6.00	84.48	197.63	-0.68
ATI	78.19	58.12	52.25	41.01	201.74	19.64
ICT	72.35	48.65	43.31	44.69	316.72	21.57
KPM	75.40	89.85	16.18	34.62	127.87	4.85
LSC	71.07	48.09	10.81	59.81	212.37	4.69
ABS	56.13	74.13	22.54	57.50	179.12	9.66
MBC	67.10	54.31	7.03	78.71	174.46	3.52
MB	66.82	87.64	19.46	51.87	278.41	16.46
BHI	-465.58	77.23	-45.36	42.74	163.09	113.69
ION	86.99	92.37	4.98	114.22	170.63	7.80
MUSX	93.78	88.19	-4.80	107.32	-245.47	10.46
IS	98.52	651.68	24.13	51.61	59.57	47.63
WEB	99.85	83.13	-293.91	17.83	144.17	-62.71
DHC	-54.05	-32.22	11.13	34.24	200.76	1.33
GPH	71.48	100.00	34.30	40.37	131.87	13.05
MJC	49.14	-2.68	33.21	30.94	313.05	-0.42
PRC	70.39	88.62	39.97	19.28	162.10	7.79
PEP	100.11	100.00	-1054.12	3.41	116.33	-41.82
WPI	51.80	442.78	10.05	23.98	208.45	11.52
ECP	119.61	102.30	-14.75	67.63	199.53	-24.35
MAC	93.85	-24.75	15.14	31.61	119.09	-1.32
SEVN	53.12	84.44	0.70	266.02	220.65	1.85
Mean	52.99	98.95	-40.85	53.64	214.00	-24.58

The final component of the ROE is the leverage ratio which indicates how management has decided to finance the firm. The result shows that the sector has a leverage ratio of 214 percent. This indicates that for every two pesos of assets there is a peso of equity, which means the sector financed approximately one-half of its assets with equity and the other half with debt. On the other hand, the study of Won (2007) found out that the increase in ROE was due to the increased financial leverage.

The sector's negative return on equity is greatly affected by those firms which experienced the slowdown in the semiconductor industry, the lack of capital requirement to operate and grow the business, and the losses in the mining and oil sector which resulted in the restructuring or reorganization of such firms by shifting their operations into information technology, communications and Internet services (within the period of this study). Thus, the losses that these firms incurred in their previous line of businesses were included in the data of the study which affected greatly the financial performance of the sector.

The sector's negative ROE is parallel to the study Zeitun and Tian (2007) of the 167 Jordanian companies which registered a negative ROE mean of 14.2 percent for the period 1989-2003. The banking sector in 2003 also registered a negative ROE of 2.5 percent on the average as recorded by the top 300 Asian banks, with the Japanese banks registered an overall return on equity of negative 17 percent and were largely responsible for the overall poor performance posted by the Asian region according to *The Asian Banker 300*. Moreover, the study of Fama and French (1992) concluded that when current earnings are negative, they are not a proxy for the earnings forecasts embedded in the stock price.

Efficiency Analysis of the Services Sector (SE-DEA)

Table 2 presents new findings of the input oriented super-efficiency DEA under the VRS model. It shows that there are 11 firms in specific years that have technical efficiency scores greater than 100 percent, implying that these firms are super-efficient. Under the BG model, the first step is to identify the outliers which are the observations whose super-efficiency score exceeds a pre-specified screen level. Our study adopted a pre-specified screen level of 1.6 or 160 percent (Banker et al., 1989). As a result, there are seven (7) outliers identified in the observation. Notable outliers are the TE of IS in the years 2000 and 2007. Such technical efficiency scores were derived because the original values of fixed assets as an input are smaller compared with other firms. On the other hand, TEL in 2007 registered a technical efficiency score as "big" because its output, which is market capitalization, is bigger compared with the other firms in the study.

In the second step, the observations identified as outliers are removed, and a conventional DEA model which is now called as the BG super-efficiency (BG-SE) is estimated with the remaining observations.

Table 2
Efficiency Analysis of the Services Sector
using the Super-Efficiency DEA (%)
(1998 – 2007)

FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
DGTL	8.42	10.10	2.35	1.58	1.48	2.29	6.58	2.64	5.77	4.25
GLO	10.28	19.50	36.33	36.52	33.64	83.47	75.55	39.29	79.73	135.90
LIB	1.02	1.71	0.97	0.71	0.70	0.71	2.35	9.09	9.09	9.09
TEL	43.03	44.71	46.85	11.85	7.25	37.47	56.52	56.62	82.53	big
ATS	5.72	4.40	6.63	5.27	5.54	5.30	4.58	3.50	4.01	3.95
ATI	1.06	2.16	2.40	2.08	2.61	2.29	2.52	3.01	9.60	9.29
ICT	14.16	14.64	2.72	7.68	8.64	11.18	34.00	35.98	81.28	262.30
KPM	6.17	8.32	9.63	0.51	0.59	0.54	0.94	6.23	8.30	16.25
LSC	0.45	0.45	0.96	0.86	0.73	0.90	1.09	0.98	1.04	3.18
ABS	38.75	100.46	63.04	23.43	13.81	25.84	17.29	9.31	20.31	38.59
MBC	0.23	0.24	0.22	0.44	2.15	3.81	11.43	8.82	9.05	7.78
MB	91.47	60.61	25.83	23.69	20.25	13.55	14.20	8.18	5.56	4.46

BHI	5.61	4.50	3.70	3.77	3.33	3.08	3.33	2.00	1.54	1.39
ION	54.28	37.38	57.84	17.85	0.54	0.46	0.51	0.60	1.77	0.57
MUSX	33.68	66.96	40.52	2.08	5.00	6.67	6.67	6.90	7.14	6.67
IS	100.00	100.00	63540.52	100.00	250.00	66.67	100.00	100.00	100.00	6065.46
WEB	20.00	196.30	12.17	2.11	3.84	21.92	18.41	32.65	79.20	301.92
DHC	21.72	4.47	3.46	2.24	0.97	1.16	11.86	1.12	0.93	13.01
GPH	12.21	14.34	19.47	13.23	18.92	19.98	17.73	11.97	6.56	8.85
MJC	3.90	3.65	3.31	10.14	10.98	24.44	9.25	7.61	8.71	25.37
PRC	11.11	24.33	13.22	22.20	22.06	15.38	8.35	9.90	10.08	10.56
PEP	6.99	16.64	18.18	25.00	25.00	25.00	66.67	66.67	66.67	125.66
WPI	12.20	3.52	0.55	0.49	0.43	0.67	0.19	0.27	1.00	2.03
ECP	0.24	0.34	0.49	0.62	1.28	3.45	14.29	50.00	28.57	32.05
MAC	37.47	127.64	0.66	14.64	0.68	1.52	39.12	16.65	24.86	68.43
SEVN	2.33	1.47	4.02	3.50	0.53	0.28	0.14	0.12	0.37	0.47

Table 3 shows new derived findings of the conventional input-oriented VRS-DEA known as the BG-SE model after removing the outliers. Our results show that the performance of these listed companies in the services sector from 1998-2007 had not reached the efficiency level. The over-all efficiency score of the sector ranged from 2.88-95.62 percent. The average technical efficiency of the services sector for the 10-year period is 24.84 percent, which is way below the desired efficiency level of 100 percent. This means that these services firms have to possibly reduce their input usages by 75.16 percent without reducing the current output to be efficient. This finding is parallel with the study of Thore et al., (1996) and Abad et al., (2004) that the firms under study posed an over-all technical efficiency of below the frontier, though there were DMUs who achieved efficiency for most of the years, and while others were consistently inefficient year after year.

Table 3
DEA Technical Efficiency of the Services Sector using the BG-SE (%) (1998 – 2007)

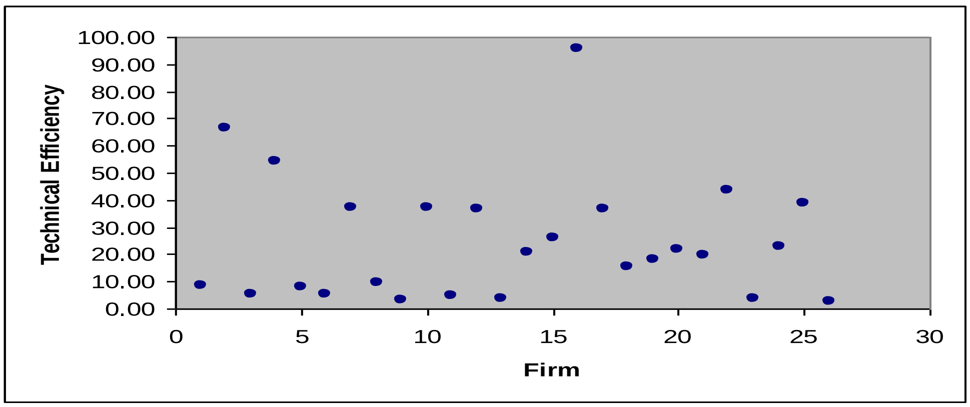
FIRM	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	AVE.
DGTL	13.79	19.06	3.83	2.64	2.33	4.25	12.21	5.16	11.54	9.33	8.41
GLO	21.21	39.26	64.27	61.41	58.84	94.87	83.98	56.13	86.13	100.00	66.61
LIB	3.51	5.54	3.46	1.42	0.93	0.82	5.32	10.44	10.30	10.22	5.20
TEL	54.14	58.34	51.92	21.07	13.96	46.13	68.02	75.77	100.00	*	54.37
ATS	9.48	7.32	11.01	8.70	9.15	8.81	7.45	5.56	6.26	6.13	7.99
ATI	1.70	2.72	3.04	2.73	3.30	2.97	3.45	4.29	15.93	14.85	5.50
ICT	27.59	25.63	4.49	14.94	16.33	21.95	69.13	54.51	100.00	*	37.17
KPM	9.88	12.49	14.61	2.84	3.93	3.73	5.09	10.39	11.90	19.27	9.41
LSC	0.53	0.53	0.64	0.60	0.57	0.63	3.78	3.94	4.94	14.01	3.02
ABS	45.04	100.00	75.45	25.43	15.13	25.84	17.69	10.63	20.31	38.59	37.41
MBC	0.71	0.59	0.58	0.69	2.47	4.04	11.47	9.04	9.42	8.78	4.78
MB	94.54	69.34	45.97	39.66	39.63	24.94	23.80	12.12	8.15	6.84	36.50
BHI	7.93	5.58	4.72	4.90	3.69	3.08	3.33	1.50	1.41	1.32	3.75
ION	56.32	39.34	64.66	21.17	3.01	4.54	4.80	3.39	7.72	3.96	20.89
MUSX	51.92	100.00	64.66	2.21	5.00	7.32	7.14	6.90	7.14	7.43	25.97
IS	100.00	100.00	*	100.00	*	90.34	95.20	85.32	98.48	*	95.62
WEB	12.00	*	23.40	6.99	10.43	51.41	29.93	57.54	100.00	*	36.46
DHC	33.35	18.57	15.50	12.18	0.67	0.70	31.33	7.66	9.18	25.92	15.51
GPH	14.79	17.25	23.88	16.73	22.96	24.45	21.94	16.32	10.86	13.36	18.25
MJC	15.82	15.41	6.86	17.15	21.39	37.03	24.12	17.93	19.86	42.32	21.79

PRC	16.77	29.56	18.69	26.87	26.34	20.34	13.27	15.14	15.49	15.23	19.77
PEP	10.04	21.36	18.18	25.00	25.00	26.13	68.51	69.68	70.07	100.00	43.40
WPI	16.42	5.30	2.15	1.01	1.30	2.11	0.50	1.10	2.39	3.68	3.60
ECP	0.23	0.30	0.69	0.63	1.29	2.13	11.39	68.64	43.02	100.00	22.83
MAC	47.09	100.00	0.96	20.92	6.21	8.58	46.09	24.64	32.99	100.00	38.75
SEVN	3.94	3.03	6.38	5.86	2.42	1.94	0.93	0.49	1.85	1.91	2.88
Mean	25.72	31.86	21.20	17.07	11.85	19.96	25.76	24.39	30.97	29.23	24.84

* outliers

Figure 1 shows the position of each firm along the frontier at 100 percent technical efficiency. It could be noted that all firms fall below the frontier. Furthermore, 89 percent of these firms have technical efficiency scores below fifty percent and 11 percent or equivalent to 3 firms have their technical efficiency above fifty percent, with only one firm nearest to the frontier.

Figure 1
DEA Technical Efficiency Scores of Firms in the Services Sector (1998 – 2007)



Linkage between financial and efficiency

The linkage between the financial performance and technical efficiency using SE-DEA is examined. Specifically, the Tobit regression was used to test the association between technical efficiency as dependent variable and the component financial ratios of DuPont system as independent variables. Following Chilingerian (1995), we used the Tobit regression model instead of ordinary least squares (OLS), because the efficiency score falls between the interval 0 and 1. The Tobit model is suggested as an appropriate multivariate statistical model considering the characteristics of the distribution of efficiency measures (Grosskopf, 1996). As such, Tobit is used to test the null hypothesis that there is no significant relationship between technical performance (SE-DEA) and the financial performance (DuPont System) of the listed companies in the service sector of PSE.

Table 4 shows the existence of a linkage between the financial and technical efficiency performances. Our result affirms that there is a significant association between the technical efficiency using SE-DEA and financial performance. The model has a log likelihood ratio of 9.41 and found significant at 10% probability level. Further, interest burden is found to be statistically significant and has a positive association with the technical efficiency. The positive sign indicates that an increase in interest burden(lowering the interest expenses) increases the technical efficiency. This result affirms the same finding of Perrigot and Barros (2008).

Table 4
Test of Linkage between Technical Efficiency and Financial Performance using Tobit Regression

Variables	z-Statistic	Prob.
Dependent: TE (SE-DEA)		
Independent:		
Tax Burden	0.462236	0.6439
Interest Burden	2.85134	0.0044*
Operating Profit Margin	-0.535175	0.5925
Asset Turnover	-0.806423	0.42
Leverage Ratio	-0.228559	0.8192
Log likelihood ratio	**9.418013**	**0.093508****

**significant at .05 probability level*
***significant at .10 probability level*

V. Conclusion

The study evaluates the multidimensional performance of the 26 listed companies in the services sector of the Philippine Stock Exchange (PSE) over the period 1998 to 2007. Our findings show that the over-all financial performance of the services sector was negative due to the negative operating profit margin and lower efficiency ratio.

This paper also reports new findings from the application of Super-Efficiency DEA that there were outliers in the data set. After the removal of outliers, the sector registered an average technical efficiency of 24.84 percent: a below frontier performance. We further found a significant association between the technical efficiency and financial performance. We can conclude that both SE-DEA and financial models (DuPont System) could be the performance models found to be suitable for the services sector of the PSE.

New reported findings serve as an effective guide for the firm's management decision-making process as regards the evaluation of the over-all performance of each firm. Firms' management should focus on income statement for maximizing profitability and on balance sheet for increasing asset utilization and also leverage for improving the sector's negative return. Technical efficiency results from DEA could also serve as a guide for managers in making the right decisions regarding input savings to increase the firms' efficiency performance. The study recommends that the firm's management of the services sector must be prudent in the use of their input resources and should focus their attention on the relationship between resources and their desired outputs. Further, DEA findings show that firms need to limit exposure of their labor, fixed assets and operating expenses to their desired level to be more efficient and productive without reducing the required outputs.

The study did not examine all the other dimensions of performance measurement approaches. Due to data limitation of variables used in the study, future research should also consider other combination of input-output mix to verify the present findings of this study. Although this current research has offered a robust and bias free analysis of the services sector, it can still be extended and further investigated using some innovative approaches like the third-stage DEA which is tuning the stochastic frontier analysis (SFA) results to be used in DEA (Tone and Tsutsui, 2006) and bootstrapping technique in DEA (Ray, 2004), among others. This present limitation of our research will open more areas in service sector performance for future investigation.

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