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Returns to scale pattern and efficient firm size in the public accounting industry: an empirical investigation

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This paper employs Data Envelopment Analysis to investigate returns to scale patterns and efficient firm size in the public accounting industry in the USA post-Sarbanes–Oxley Act. Using contemporary survey data from *Accounting Today*'s top-100 accounting firms for the years 2003 and 2004, our results indicate that the very largest accounting (first tier) firms display constant returns to scale, whereas approximately half of the smaller (second tier) firms exhibit increasing returns to scale. These findings suggest that while very large firms are optimally scaled, there still are economic efficiencies to be gained through expanding the size of nearly half of the second-tier accounting firms. Results for the remaining second-tier firms show either constant or decreasing returns to scale, indicating that they are either already optimally sized or that they should consider contraction. The results for the second-tier firms remain qualitatively unchanged when the first-tier firms are excluded from the estimation.

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1. Introduction

Accounting firms present a natural experimental study of efficient firm size because the public accounting industry in the USA is comprised of numerous small firms and only four very large firms, commonly referred to as the 'Big-4'. Additionally, there has been a recent wave of merger activity within the USA accounting industry (Hood, 2005). Many of the recent mergers and acquisitions among accounting firms have been ascribed to the goal of reaching economies of scale (Banker *et al*, 2003). These mergers, acquisitions and expansions, in addition to recent failures, have changed the face of the accounting industry forever. Further, a new regulatory setting in the USA, created by the Sarbanes–Oxley Act of 2002 (SOX) and fuelled by adverse public opinion, adds to the flux. In these exciting times, it would be easy to overlook a very important question: Are the leading public accounting firms economically efficient with respect to their size in the post-SOX era? This paper presents an investigation of this essential and timely question by applying a non-parametric Data Envelopment Analysis (DEA) to a database derived from *Accounting Today*'s 2004 and 2005 contemporary surveys of the top-100 US accounting firms (for the years of 2003 and 2004).

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An economically efficient operation is foremost a matter of reaching the firm's optimal productive scale size. DEA finds a measure of the optimal productive scale size based upon comparisons of average productivities within the sample group. In order to maximize the average productivity, one would increase the scale size of operations if increasing returns to scale were prevailing, and decrease the scale size if decreasing returns to scale (DRS) were prevailing. A measurement of constant returns to scale (CRS) would indicate that the company has already reached its most productive size (Banker, 1984).

Accounting firms can be divided, according to size, into the following four tiers: Tier 1: the Big-4; Tier 2: the next 120 largest firms (by revenue); Tier 3: other firms with greater than 10 members of the American Institute of Certified Public Accountants; and Tier 4: the approximately 45 000 smallest firms (Shamis, 2000). Because data on other categories are not available, we investigate only the top-100 firms (most of the firms in the first two tiers). Using post-Sarbanes–Oxley contemporary survey data on these top-100 accounting firms for years 2003 and 2004, we employ DEA to measure efficient firm size. Both years' returns to scale characteristics are found for the entire sample set, for only the first-tier firms and for only the second-tier firms.

The next section of this paper elaborates on the presence of oligopoly in the public accounting industry and briefly reviews the recent changes in the public accounting industry along

with a discussion on economies of scale within the industry. Section 3 presents our research design including descriptions of sample data, DEA and both the inputs and outputs of accounting firms. In Section 4 we present and discuss the empirical results of the returns to scale characteristics and efficient firm size. Finally, we conclude by explaining the implications of this research.

2. The public accounting industry oligopoly

The public accounting industry

Since 1896, when the state of New York passed the first US law allowing for Certified Public Accountants, the accounting industry has been largely self-regulated (Zeff, 2003). But 100 years of professional history was changed when the mistakes of the few destroyed the lives of the many and caused the collapse of Arthur Andersen, a multi-national, multi-billion dollar audit firm. Congress reacted with the SOX, which created the Public Company Accounting Oversight Board (PCAOB) and changed the accounting industry forever. The PCAOB now sets the standards for auditing and related attestation services provided to publicly traded companies. Three major changes directly affect the audits of publicly traded corporations. First, firms providing audits are prohibited from providing nine types of non-audit services to their audit clients, including information systems (design, implementation and compilation); actuarial; internal audit; management and expert services. Second, clients must now provide an assessment of the effectiveness of their internal control system over financial reporting. Finally, the auditor must attest to managements' assertions concerning their financial accounting system's internal controls (SOX, Section 404). These changes are important to the current study because the first compliance dates for Section 404 began for fiscal years ending on or after November 15, 2004 and our sample data are from both pre-compliance (2003) and post-compliance (2004) years.

Complying with Section 404 has increased the resources required for the auditor to complete an audit as each public company's financial statement audit must be integrated with an audit of managements' assertion over the effectiveness of internal controls. Additionally, restricting non-audit services has caused audit clients to seek such services from firms other than their auditors. Both these factors have combined to cause changes in the accounting industry. Also, the demand for Section 404 compliance services by the largest corporations has strained even the 'Big-4' firms' resources, causing large firms to drop clients who provide the firm with either less profit or more risk. Thus, many smaller corporations, previously serviced by the 'Big-4', are being forced to seek services from second-tier firms. This sifting of clients within the industry, combined with an increased demand for services, has led to greater merger and acquisitions activities within the second-tier firms (Hood, 2005), particularly during 2004 (the first year of Section 404 compliance for the largest corporations). Indeed, over one-third of the second-tier firms were involved in mergers during the year. The average expansion of the second-tier included in our sample, from 2003 to 2004, was 13% (Hood, 2005).

Economies of scale within the industry

When any firm can increase their average revenues or decrease their average costs through expansions, potential for greater economies of scale exists; therefore, the concept of scale economies is a firm-level concept (Gold, 1981). A production unit's returns to scale are generally measured in terms of increasing, constant or decreasing returns to scale. Increasing returns to scale would mean that increasing the scale of operations would improve efficiency. CRS would mean that the unit has optimized its size, and DRS would be a warning of excessive size. Although economies of scale measurements are interesting in any industry, they become vital when an industry comes under government scrutiny due to high degrees of market concentration within a few firms. Therefore, economies of scale research could help determine if the presence of so few very large firms within the accounting industry is an outcome consistent with a natural economic occurrence, namely the growth to the optimally efficient firm size. Little research has been performed on scale economies in the accounting industry, with the exception of Banker *et al* (2003), who documented the existence of scale economies among accounting firms before the enactment of the SOX.

The United States General Accounting Office (GAO) recently conducted an extensive study of accounting firms and they concluded that the accounting industry is dominated by a 'tight oligopoly' (GAO, 2003). But the existence of a natural oligopoly can be supported where scale efficiencies exist (Shin and Ying, 1992; Berger *et al*, 1993; Cummins and Weiss, 1993; Mitchell and Onvural, 1996; Chang and Mashruwala, 2006). Thus, an economies-of-scale study of the accounting industry is extremely timely. The GAO (2003) study employed a pure price competition model and found that concentration within the accounting industry was consistent with a price competitive model. The present study finds such concentrations are also consistent with optimal scale economies.

The presence of scale economies is not unexpected in the industry. Providing audit and other accounting services to large multi-national firms requires technical expertise and global resources that are neither common nor cheap. Both the expertise and the infrastructure required is so extensive that the most likely explanation for the former Big-8 merging into five firms was the pursuit of economies of scale to meet the international demand for services (GAO, 2003). Further, the audits of certain industries are currently dominated by one or two of the first tier, indicating that some industries require quite specific concentrations of resources. For instance, Ernst & Young audits 60.7% of assets in the general building contractors industry and PricewaterhouseCoopers audits

76.4% of the petroleum and coal products industry's assets (GAO, 2003). Only these very large, specialized firms have access to the technical expertise required to provide services to very large corporations within certain industries. 'Big-4' firms may enjoy disproportionately large improvements in efficiencies due to minimum efficient scale requirements and the leveraging of their technological resources (Eccles and Gladstone, 1995).

3. Research design

Data and sample

Each year *Accounting Today* conducts a survey of the 100 largest accounting firms. Only domestic US operations are included in the survey and data from foreign holdings are excluded. Our sample CPA firms were derived from *Accounting Today*'s annual surveys for the years 2003 and 2004. After excluding observations for non-CPA firms (such as American Express Inc., Padgett Business Services and H&R Block) and firms with missing values, our final sample consisted of 87 CPA firms including three first-tier firms and 84 second-tier firms.

This study focuses on the production correspondence between service revenues generated and human resources employed by public accounting firms. As described earlier, there are three service outputs: Accounting and Auditing (A&A), Tax Services (TAX), and Management Advisory Services (MAS). A&A represents both accounting services (compilations, special reports, reviews, etc) and audit engagements. TAX incorporates all tax related services such as research, planning and preparation work. MAS encompass a variety of management assistance services including consulting, information services, and systems design and development. Each service output is measured in millions of dollars of revenue. There are four inputs considered in this study. The first three input variables represent the human resources of the firms. Each variable is quantified by the number of personnel in the related positions: PARTNERS is the number of partners, owners and/or shareholders; PROFESSIONALS is the number of other professionally qualified staff who are not partners; and OTHERS is the number of all other employees not included in either of the first two input variables (AICPA, 2003, 2004). Professionally qualified staff includes staff accountants, senior accountants and managers who perform accounting and other services offered by the firm. Clerical and support personnel such as those who perform the firm's administrative, secretarial and record keeping functions are classified as OTHERS.

The information included in the *Accounting Today*'s surveys does not contain any data on capital inputs, thus slightly limiting the usefulness of the database (Banker *et al*, 2003). Indeed the primary capital outlays in such a service industry are for offices and office equipment; since the number of branches is reported in the surveys, we use the number of branch offices (OFFICES) as the fourth input variable to proxy for the capital input of CPA firms. This fourth input variable is a noisy one, which does not take into account the wide variance in branch size, but is the only measure available. Subsequent sensitivity analysis shows that dropping this proxy does not affect our results in any significant way.

Descriptive input/output statistics for the sample data are provided in Table 1. The median values of all size-related variables are much smaller than the mean values, indicating that the data are skewed to the right. The high standard deviations verify that the top-100 public accounting firms vary greatly in their size and composition reflecting the large differences between the first-tier firms and the other sample firms. The descriptive statistics for the service revenues indicate that A&A constitutes approximately 41% of the total revenue generated, followed by TAX (31%) and MAS (28%) for both 2003 and 2004. Among only the first-tier firms A&A revenues constitute an even larger percentage of total revenues (47% for 2003 and 49% for 2004). The next 15 largest firms had average revenues from A&A services of only 36% for 2003 and 38% for 2004 (Hood, 2005). The relative size of the first-tier firms skews the percentage of A&A revenues, again demonstrating the vast differences in the firms.

Data envelopment analysis

Data Envelopment Analysis is fast becoming the most accepted method for determining how efficiently a firm or decision-making unit uses its given inputs to produce outputs (Chandra *et al*, 1998; Emrouznejad *et al*, 2008). It has even been called 'a standard non-parametric approach to productivity analysis' (Liu *et al*, 2006). Efficiency is measured relative to the efficiency of other firms in the data set using a non-parametric model. This method has the significant advantage of not requiring the specification of a functional relationship. Thus, DEA provides a standardized measure of efficiency without requiring *a priori* weighting of inputs and outputs or even specification of the distributional form. This removes the need for the large numbers of assumptions that are often made when using other deterministic parametric techniques. Instead, weights are selected that maximize the weighted inputs/outputs to provide a unit with its highest possible efficiency score (Cooper *et al*, 2006). Empirical evidence provides the target production rate. If there is at least one firm operating at a higher level of efficiency, the question becomes one of moving the less efficient firms closer to this frontier. The obvious advantage is that the goal is a proven, realistic one provided by the industry itself.

DEA has been widely used to estimate production functions by relating the inputs consumed to the outputs produced. It is also used to estimate the inefficiency exhibited by actual observations, such as in producing less outputs than the maximum possible for a given level of inputs. In accounting literature, Chang *et al* (2008), Feroz *et al* (2005) and Dopuch *et al* (2003), among others, employ DEA to estimate the productive efficiency of CPA firms or audit engagements.

Table 1 Descriptive statistics on outputs and inputs ($N = 87$)

Variables	*Mean*	*Std dev*	*25%*	*Median*	*75%*
Year 2003					
REVENUES	$248 million	$1,019 million	$22 million	30 million	$55 million
A&A%	41.0	13.3	35	42	49
TAX%	31.4	8.8	25	32	36
MAS%	27.6	149	18	25	36
EMPLOYEES	1282	4643	155	237	406
PARTNERS	125	406	19	25	54
PROFESSIONALS	865	3165	105	153	264
OTHERS	292	1097	30	48	89
OFFICES	12.2	21.5	2	5	11
Year 2004					
REVENUES	$264 million	$1,048 million	$25 million	$31 million	$74 million
A&A%	41.4	13.3	34	43	5
TAX%	30.8	8.1	26	3	35
MAS%	27.9	141	20	26	34
EMPLOYEES	1390	4844	170	238	483
PARTNERS	128	401	18	27	56
PROFESSIONALS	938	3320	117	163	364
OTHERS	324	1137	31	43	119
OFFICES	13.9	25.7	2	5	11

Note: N = Number of public accounting firms in the sample; REVENUES = Total revenues expressed in million dollars; A&A% = Proportion of A&A revenues; TAX% = Proportion of TAX revenues; MAS% = Proportion of MAS revenues; EMPLOYEES = Total number of employees; PARTNERS = Number of partners; PROFESSIONALS = Number of professionals; OTHERS = Number of other employees; OFFICES = Number of offices.

The accounting industry presents a unique environment for DEA application and analysis in at least two regards. First, CPA firms employ multiple inputs (three categories of human resources and one capital input) to deliver multiple services outputs (A&A, TAX and MAS services). DEA can conveniently handle the multiple inputs and multiple outputs production setting. Second, data on input and output prices of CPA firms are not publicly available. But, DEA does not need these data to estimate returns to scale characteristics. There are several different DEA models used in practice (Seiford, 1996; Chandra *et al*, 1998). Since we are interested in estimating characteristics of returns to scale and efficient scale size, we employ both the BCC model (Banker *et al*, 2003) and the CCR model (Charnes *et al*, 1978) of DEA.

The DEA model identifies an 'efficient frontier' that is used as a benchmark against which each firm's efficiency is compared (Cooper *et al*, 2006). As indicated earlier, firms with missing values were excluded from the sample. Thus, each of our final sample firms offers all of the three output services. Since KPMG no longer offers MAS, there are only three first-tier firms that were included in our study and KPMG was removed from our analysis.

Let $Y_j = (y_{1j}, y_{2j}, y_{3j}) \geqslant 0$ and $X_j = (x_{1j}, x_{2j}, x_{3j}, x_{4j}) \geqslant 0$, $j = 1, \ldots, N$ be the observed output and input vectors generated from an underlying production possibility set $T = \{(X, Y) |$ outputs Y can be produced from inputs $X\}$ for a sample of N CPA firms. The inefficiency $\theta_j \geqslant 1$ of an observation $Y_j \in T$, measured radially by the reciprocal of Shephard's (1970) distance function, is obtained by solving the following BCC model.

$$Max \quad \theta_j = \theta \tag{1.0}$$

$$s.t. \quad \sum_j \lambda_j x_{ij} = x_{i0} \qquad \forall i \tag{1.1}$$

$$\sum_j \lambda_j y_{ij} = \theta y_{r0} \quad \forall r \tag{1.2}$$

$$\sum_j \lambda_j = 1 \tag{1.3}$$

$$\theta, \lambda_j > 0 \tag{1.4}$$

The above θ_j is estimated under the assumption that the production set exhibits variable returns to scale and is labelled as θ_j^v. However, if the production set exhibits CRS, then θ_j can be obtained from the linear program in (1) after dropping the constraint (1.3) as in the CCR model and is labelled as θ_j^c.

Constant returns to scale prevail if $\theta_j^v = \theta_j^c$, else DRS prevail if $\sum_j \lambda_j^* > 1$ and increasing returns to scale prevail if $\sum_j \lambda_j^* < 1$ (Banker, 1984; Cooper *et al*, 2006). For an observation exhibiting non-CRS, its projected efficient scale size of inputs may be obtained by $x_{io}^* = (x_{io})/\sum_j \lambda_j^*$ (Banker, 1984), where x_{io} is the observed input value, λ_j^* is the optimal value as determined by DEA and $1/\sum_j \lambda_j^*$ is the projected efficient scale size factor representing the magnitude of adjustment necessary from existing operating size to the frontier (efficient) scale size (Banker, 1984; Banker *et al*, 1996). Note that since the linear program in (1) excludes slack variables from its formulation, it does not consider the potential for slack. As a result, the target of efficient scale size could be

Table 2 Returns to scale characteristics of the sample firms

Groups of sample firms	*Returns to scale characteristics*			
	CRS	*DRS*	*IRS*	*TOTAL*
Panel A: Year 2003				
First-tier firms	3	0	0	3
Second-tier firms	14	22	48	84
Panel B: Year 2004				
First-tier firms	3	0	0	3
Second-tier firms	19	26	39	84

Note: CRS: Constant returns to scale; DRS: Decreasing returns to scale; IRS: Increasing returns to scale.

dominated by another unit. Also, note that the comparison is of the scale size of the target, which is not the same as the unit of those deemed inefficient.

4. Results and discussion

Using three outputs (A&A revenues, TAX revenues and MAS revenues) and four inputs (PARTNERS, PROFESSIONALS, OTHERS and OFFICES), relative inefficiencies of public accounting firms were estimated using DEA for each of the two sample years separately.

Returns to scale characteristics

The sample firms' returns to scale characteristics are presented in Table 2. This table classifies the results by first- and second-tier firms. All three first-tier firms presented exhibit CRS in both years indicating that they have grown to their most efficient size.

The 2003 returns to scale characteristics for the second-tier firms (Panel A) show that 14 firms exhibited CRS and thus have achieved their most efficient size and 22 firms showed DRS. Forty-eight of the 84 next largest firms, after the first tier, displayed increasing returns to scale (IRS), justifying the continuing mergers and acquisitions in the industry in the post-SOX era. Panel B shows the firms returns to scale characteristics for 2004. The number of firms characterized by CRS increased from 14 to 19 and the number exhibiting increasing returns to scale decreased from 48 to 39. Both mean and median firm size (Table 1) increased, implying that some firms have exploited scale economies by expanding their operation size. This result is expected due to the increasing merger activities during the sample period. There are 26 DRS firms that may benefit from contracting operations.

Efficient firm size

The mean efficient scale size factors are presented in Table 3. A factor of 1.00 indicates that the firms are currently operating at their most efficient scale size. This is the expected factor for all constant return of scale firms. The factors (Table 3: Panel A and Panel B) for both years imply that the three first-tier firms included in the study are currently operating at an optimally

Table 3 Mean efficient scale size factor

Group of sample firms	$1/\sum_j \lambda_j^*$
Panel A: Year 2003	
First-tier firms	1.000
CRS group of second-tier firms	1.000
DRS group of second-tier firms	0.547
IRS group of second-tier firms	2.068
Panel B: Year 2004	
First-tier firms	1.000
CRS group of second-tier firms	1.000
DRS group of second-tier firms	0.594
IRS group of second-tier firms	1.728

Note: CRS: Constant returns to scale; DRS: Decreasing returns to scale; IRS: Increasing returns to scale.

efficient scale size. This finding should help alleviate fears of any additional 'Big-4' consolidations, which would further limit competition within the industry (such as those expressed in the 2003 GAO report), as further consolidation may not be economically efficient.

When the mean efficient scale size factor varies from 1.00, the direction of that variance indicates whether the firm should contract or expand, and the size indicates by what percentage firm size should change to reach scale efficiencies. For instance, in 2003 and 2004 (Table 3: Panel A and Panel B) the DRS group of second-tier firms exhibit factors of 0.55 and 0.59, respectively, which shows, on average, DRS group firms should downsize by approximately 45 (=1–0.55) to 41 (=1–0.59) percent to achieve their most efficient operation scale size.

Perhaps the firms of most interest are the ones in the IRS group. These second-tier firms should expand to reach maximum efficiencies of scale and, on average, the firms in the IRS group should enlarge about two and a half times their current size to achieve their optimally efficient operation scale size. The factor for 2003 was 2.068 and for 2004 it was 1.728 (Table 3: Panels A and B). Although a firm twice the size of the largest firm in the Tier 2 group would be significantly less than half the size of the smallest of the 'Big-4' firms, such a firm would still provide a new source of competition within the market. At this point a practitioner's viewpoint should be noted; a senior partner at one of our sample firms indicates that the projected efficient scale size may not be feasible for every firm, but is intuitive and provides a good reference for accounting firms seeking targets of acquisitions/mergers.

Sensitivity analysis

Prior studies on audit fees document that the 'Big-4' firms command a premium for both audit and non-audit services (Francis and Stokes, 1986; Craswell *et al*, 1995) possibly due to their size and expertise. Thus, we re-estimate DEA models with all the 'Big-4' firms excluded. Our results for the second-tier firms remain qualitatively unchanged. Additionally, O'Keefe *et al* (1994, p. 245) maintain that capital

inputs are of only second-order importance. Accordingly, they removed the office variable and used only hours of labour in their study, ignoring capital inputs altogether, which appears to be justified in a labour driven industry. Further, accounting firms are personal service companies and thus, by definition, generate the majority of their income through the performance of services (IRC § 269A) (United States Code). Recent national surveys indicate that employee costs and partner compensation account for 75% of the revenues, while capital costs are less than 7% for accounting practices with revenues in excess of one million dollars (Texas Society of Certified Public Accountants, 2003, 2004). Thus, we evaluate the robustness of our results by excluding the number of offices (the fourth input) form our DEA estimation models. Again, our results (not reported here, but available upon request) are qualitatively unchanged.

5. Conclusion and implications

Rapid changes within the accounting industry have altered the environment in which accounting firms operate. These changes began with mergers and acquisitions within the largest firms until five firms dominated the market. Accounting irregularities at Enron then led to the collapse of Arthur Andersen and ultimately to the passage of a law, the Sarbanes–Oxley Act providing government regulation of publicly traded company audits as well as a government mandated investigation of public accounting firms Additionally, after the demise of Arthur Anderson, one of the country's largest accounting firms, the concern that a tight oligopoly exists in the industry was confirmed.

We use data derived from *Accounting Today*'s annual surveys of the top-100 accounting firms to investigate both returns to scale pattern and efficient firm size in the years 2003 and 2004. DEA models are presented and used to analyse the sample firms. Our model measures how efficiently the top-100 accounting firms employ human resources to produce service revenues. Mean efficient scale size factors are provided. The results are presented for both first-tier firms and second-tier firms. First tier results provide assurance that these firms have reached their optimal operation size. In contrast, second tier results indicate that there are still operational efficiencies to be gained by expanding the size of over half these smaller firms.

Our findings suggest that the mergers and acquisitions among the largest firms in the post-SOX era were justified by the pursuit of economies of scale. However, because these accounting firms are personal service companies, which cannot be publicly traded, detailed merger and acquisitions data are not available making it impossible to track firm growth in detail. That is, the cause of growth cannot be definitively determined. Nevertheless, our results provide some indication that the first-tier firms have now achieved optimal operation scale size, confirming the empirical evidence that they are no longer growing as rapidly as the rest of the industry. Further, we show that the rapid merger and acquisitions activities that the top second tier accounting firms are currently enjoying are justified and can be expected to continue.

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Data availability—Data is publicly available; a list of sample accounting firms is available upon request.

References

Accounting Today (2004, 2005). Top 100 tax and accounting firms.

AICPA (2003, 2004). Annual reports to division of CPA firms.

Banker RD (1984). Estimating most productive scale size using data envelopment analysis. *Eur J Opl Res* **17**: 35–44.

Banker RD, Charnes A and Cooper WW (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Mngt Sci* **30**: 1078–1093.

Banker RD, Chang H and Cooper WW (1996). Equivalence and implementation of alternative methods for determining returns to scale in data envelopment analysis. *Eur J Opl Res* **89**: 473–481.

Banker RD, Chang H and Cunningham R (2003). The public accounting industry production function. *J Account Econ* **35**: 255–281.

Berger A, Hunter W and Timme S (1993). The efficiency of financial institutions: A review and preview of research past, present, and future. *J Bank Financ* **17**: 221–249.

Chandra P, Cooper WW, Li S and Rahman A (1998). Using DEA to evaluate 29 Canadian textile companies – Considering returns to scale. *Int J Prod Econ* **54**: 129–141.

Chang H and Mashruwala R (2006). Was the Bell system a natural monopoly? An application of data envelopment analysis. *Ann Opns Res* **145**: 251–263.

Chang H, Choy H, Cooper W and Lin M (2008). The Sarbanes–Oxley Act and the production efficiency of public accounting firms in supplying accounting auditing and consulting services: An application of data envelopment analysis. *Int J Services Science* **1**: 3–20.

Charnes A, Cooper WW and Rhodes E (1978). Measuring the efficiency of decision making units. *Eur J Opl Res* **2**: 429–444.

Craswell A, Francis JR and Taylor L (1995). Auditor brand name reputations and industry specializations. *J Account Econ* **20**: 297–322.

Cooper WW, Seiford LM and Tone K (2006). *Introduction to Data Envelopment Analysis*. Springer Science and Business Media, Inc.: New York.

Cummins J and Weiss M (1993). Measuring cost efficiency in the property-liability insurance industry. *J Bank Financ* **17**: 463–481.

Dopuch N, Gupta M, Simunic D and Stein M (2003). Production efficiency and the pricing of audit services. *Contemp Account Res* **20**: 47–77.

Eccles R and Gladstone J (1995). *KPMG peat marwick: The shadow partner*, Harvard Business School Case 9-492-002.

Emrouznejad A, Parker B and Tavares G (2008). Evaluation of research in efficiency and productivity: A survey and analysis of the first 30 years of scholarly literature in DEA. *Socio Econ Plan Sci* **42**: 151–157.

Feroz E, Kim S and Raab R (2005). Analytical procedures: A data envelopment analysis approach. *J Emerg Technol Account* **2**: 17–31.

Francis JR and Stokes DJ (1986). Audit prices, product differentiation, and scale economies: Further evidence from the Australian market. *J Account Res* **24**: 383–393.

Gold B (1981). Changing perspectives on size, scale and returns: An interpretive survey. *J Econ Lit* **XIX**: 5–33.

Hood D (2005). The year of merging vigorously. *Accounting Today*: *Top 100 Firms* (March), 3.

Liu W, Sharp J and Wu Z (2006). Preference, production and performance in data envelopment analysis. *Ann Opns Res* **27**: 105–127.

Mitchell K and Onvural N (1996). Economies of scale and scope at large commercial banks: Evidence from the Fourier flexible function form. *J Money Credit Bank* **28**: 178–199.

O'Keefe T, Simunic D and Stein M (1994). The production of audit services: Evidence from a major public accounting firm. *J Account Res* **32**: 241.

Sarbanes–Oxley Act of 2002 (2002). Public Law No. 107–204, Sections 404 and 701.

Seiford LM (1996). Data envelopment analysis: The evolution of the state of the art (1978–1995). *J Prod Anal* **7**: 99–137.

Shamis G (2000). At the crossroads: Consolidation and the MDP pave a new path. *Ohio CPA J* (July–September): 74–76.

Shephard RW (1970). *Theory of Cost and Production Functions*. Princeton University Press: Princeton, NJ.

Shin R and Ying J (1992). Unnatural monopolies in local telephone. *Rand J Econ* **23**: 171–183.

Texas Society of Certified Public Accountants (2003, 2004). *Management of an Accounting Practice Survey*. Texas Society of Certified Public Accountants: Dallas.

United States Code Title 26, Subtitle A, Chapter 1, Subchapter B, Part IX, § 269A. Personal service corporations formed or availed of to avoid or evade income tax.

United States General Accounting Office (GAO) (2003). *Public accounting firms mandated study of consolidation and competition.* Report to the Senate Committee on Banking, Housing, and Urban Affairs and the House Committee on Financial Services. July 2003. GAO-03-864.

Zeff S (2003). How the U.S. accounting profession got where it is today: Part I. *Account Horizons* **17**: 189–205.

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