The Efficiency of Audit Production and the Pricing of Audit Services: Evidence from South Korea

By

Jeong-Bon Kim, Dan A. Simunic, Michael T. Stein, and Cheong H. Yi

Current Version
Preliminary Draft, September 2005

Jeong-Bon Kim and Cheong H. Yi are at the School of Accounting and Finance, The Hong Kong Polytechnic University. Dan Simunic is at the Sauder School of Business, University of British Columbia. Michael Stein is at the Lundquist College of Business, University of Oregon. Jeong-Bon Kim and Cheong H. Yi acknowledge financial support for this project from the Area of Strategic Development (ASD) research grant, The Hong Kong Polytechnic University.

Correspondence: Mike Stein, Lundquist College of Business, University of Oregon, Eugene, Oregon 97403. mtstein@lcbmail.uoregon.edu Phone 541.346.3210

The Efficiency of Audit Production and the Pricing of Audit Services: Evidence from South Korea

Abstract

We test the relative efficiency of audit production using data envelopment analysis (DEA) for a sample of 697 audits performed by Big 4 firms (385 audits) and non-Big 4 firms (312 audits) in South Korea in 2001 and 2002. In addition to computing a DEA efficiency score (θ) for each audit, we examine audit engagement characteristics associated with θ. We find that θ increases fees per hour and decreases total audit fees, results supporting the interpretation of θ as an economically meaningful measure of audit efficiency. We also find that average efficiency *increases* with the cash rights of shareholders and *decreases* with the joint provision of MAS for Big 4 clients.

Keywords Audit production; efficiency; data envelopment analysis; audit programs

1.0 Introduction

The question of whether financial statement audits by public accounting firms are produced efficiently is of interest to both researchers and accounting practitioners. For example, relative inefficiencies in the production of specific audits could be a factor motivating auditor switches by the affected clients, while systematic differences in average efficiency across audit firms could impact on the structure of the auditing market, as relatively inefficient firms lose market share. In addition, understanding the characteristics of relatively inefficient audits can yield useful insights into the audit process and the production of audit services.

Our objectives in this research are, first, to measure the relative efficiencies of a sample of audits produced by a set of public accounting firms. We do this using data envelopment analysis (DEA). DEA enables us to calculate a client-specific parameter, θ, that measures the efficiency of audit production relative to the other audits in the sample. Prior research has validated the DEA method as a useful measure of the efficiency of audit production (Dopuch, Gupta, Simunic and Stein, 2003, hereafter DGSS).

For a sample of 247 U.S. audits produced in 1989 by one of (then) Big 6 firms, DGSS found that the weighted average billing rate per hour of auditor effort decreased as audit production became less efficient (i.e. as θ decreased). This is behaviorally consistent with clients being (at least somewhat) aware of inefficiencies in production as measured by θ, and that the public accounting firm in the sample bore at least some of the inefficiency costs.

In the current research we use DEA to measure client-specific inefficiencies and then provide further evidence on the validity of the efficiency measure by including θ as an explanatory variable in fee per hour and fee regressions. Similar to DGSS we expect that audit efficiency will be directly related to fee per hour and inversely related to audit fees. Finally, we

examine the association between various characteristics of the engagement and the efficiency measure, θ. The engagement characteristics we consider are the degree of auditor involvement in performing non-audit services for the client, the extent of time and fee pressure exerted by the client on the auditor (as measured by a 12/31 year-end indicator variable), the type of audit opinion rendered, the voting rights of share-holders, and the cash rights of share-holders.

Our sample consists of 697 audits of South Korean companies operating in a wide band of manufacturing industries for fiscal years ending in 2001 and 2002. The sample consists of three hundred and eighty-five Big 4 audits and three hundred and twelve audits performed by thirty different non-Big 4 South Korean audit firms.

Among other things, we find that the audits in our sample are performed at an average efficiency level of about 69%. That is, audit hours could, on average, be reduced by 31% without reducing audit output.[1] Consistent with our expectations we find that the efficiency measure, θ, is strongly positively associated with fees per hour and strongly negatively associated with total audit fees. Our evidence suggests that the provision of MAS by Big 4 auditors increases both fees and fees per hour and has a slight but statistically significant negative effect upon efficiency. Also for Big 4 clients we find some evidence that increased shareholder cash rights increases efficiency. None of the other characteristics available to us had a consistent impact on efficiency for the firms in our samples.

As noted above, our data consistently indicates that fees per hour increase with increases in θ. That is, *ceteris paribus*, more efficient auditors charge more per hour than inefficient auditors. These results provide additional external validity for the interpretation of θ as an economically meaningful measure of audit efficiency.

The remainder of the paper is organized as follows. We discuss the conceptual basis for our tests, the methods we use – including the details of our DEA model - and the data in section 2. Section 3 presents the results of the various analyses involved in estimating client-specific inefficiencies and examining the correlates of those inefficiency scores. A summary and conclusions are provided in section 4.

2.0 Concepts, methods and data

Definitions, assumptions, and general approach

An efficient audit achieves the planned level of assurance with the minimum use of resources. Since clients vary in their characteristics we take a hedonic approach and measure the output of an audit as the quantity of characteristics audited. Application of the hedonic approach requires either a *ceteris paribus* assumption that all suppliers provide the same ex ante level of assurance or that differences in audit quality can be controlled within the experimental design.[2, 3]

Our analysis rests upon the relationship between inputs, audit hours, and outputs, audited client characteristics. We measure inputs as the total number of professional hours used in each audit. Prior research, Palmrose (1989), O'Keefe, Simunic and Stein (1994), Hackenbrack & Knechel (1997), has used total hours and hours by staff classification. Our data does not include staff classifications and as a consequence we use total hours. We do not believe this limitation significantly influences the results since in a multi-provider environment the use of self-reported auditor classifications would be subject to concerns for measurement error.[4]

The first step in the analysis is the selection of the set of client characteristics that determines the base level of audit effort. Prior research generally groups the drivers of audit fees (e.g., Simunic, 1980 and a large number of subsequent studies) and audit hours, into measures of client *size*, client *complexity*, and measures of audit *risk* (e.g. the risk of fraud) or client business

risk (e.g. the risk of bankruptcy). We use a similar approach in this paper. From a base set of client characteristics we systematically searched for a set of explanatory variables (from the set available to us) related to audit effort. Comparing regressions of the form:

$$\ln(hours) = \beta_0 + \beta_1\, characteristic_1 + \beta_2\, characteristic_2 + \ldots + \beta_k\, characteristic_k + \varepsilon \quad (1)$$

In addition, we desired a parsimonious model that was consistent with the size, complexity, and risk paradigm found to be important in the prior literature.

We use DEA to calculate an efficiency measure from the relationship between the set of client characteristics and total audit hours. The DEA technique provides an efficiency parameter, θ, for each audit by comparing the input-output relations for each audit with those of all other audits in the sample. DEA is a very general linear programming based method of estimating a production frontier. For example, DEA can be modified to incorporate assumptions of constant, increasing, or decreasing returns to scale, and it requires no *a priori* specification of the functional form that inefficiencies may take. While this generality is an advantage of the method, a potential weakness is its deterministic nature. That is, random variations in production are not separately modeled, but are impounded in the inefficiency measure. The DEA technology has been applied to a wide variety of industry contexts since its development by Charnes, Cooper and Rhodes (1978). DEA was first applied to auditing data by DGSS (2003).

Briefly, DEA calculates efficiency relative to a production frontier that is the envelope of sample input-output data points. The location of a specific client ("decision making unit" or DMU in DEA terminology) with respect to the production frontier is found by solving the following linear program for a particular observation of inputs and outputs, $\{x^0, y^0\}$:

$$\text{Minimize} \quad \theta$$

$$\text{Subject to} \quad y_1\lambda_1 + \ldots\ldots\ldots\ldots + y_n\lambda_n \geq y^0$$

$$x^0\,\theta - (x_1\lambda_1 + \ldots\ldots\ldots\ldots + x_n\lambda_n) \geq 0$$

$$\lambda_1, \ldots\ldots\ldots\ldots, \lambda_n \geq 0$$

where θ is the efficiency measure or "shrinkage factor" that will take on a non-negative value of $\theta \leq 1$. An efficient DMU results in $\theta = 1$. In contrast, a $\theta < 1$ denotes inefficient production as well as the percentage of inefficiency for that DMU relative to the efficient frontier. The variable y_i denotes a (column) vector of outputs that characterize DMU's 1 through n (the sample size). The variable x_i denotes a (column) vector of inputs that characterize DMU's 1 through n. Our formulation uses a single input – the total professional labor hours utilized in the audit engagement. The λ's are a set of weights (one for each sample observation) that define the production frontier. The variable x^0 denotes the vector of inputs (or in the case of a single input, a scalar) for the specific DMU whose efficiency is being estimated, while y^0 denotes that DMU's vector of outputs. This form of the DEA model assumes that production is characterized by constant returns to scale. Thus, for example, a doubling of inputs will result in a doubling of outputs. The relation between client characteristics and total hours we examine is positive and linear, and therefore consistent with the model's assumption of constant returns to scale. Finally, the linear program is solved, in turn, for each observation in the sample yielding a set of client-specific θ's along with the weights, λ's, that characterize the optimal solution to each linear program.

The final step in our analysis is to identify factors that influence efficiency and to try to distinguish efficient audits from less efficient audits. To identify factors that influence audit efficiency we estimate the following model:

$$\theta = \beta_0 + \beta_1 \, characteristic_1 + \beta_2 \, characteristic_2 + \ldots + \beta_q \, characteristic_q + \varepsilon \quad (2)$$

where q denotes elements of the set of auditor and / or client characteristics that are believed to effect audit efficiency. The characteristics, described in the data section, we use include the joint provision of audits and non-audit services, the occurrence of a modified opinion, the cash and voter rights of share-holders, and the degree of time pressure in the engagement as proxied for by an 12/31 year-end indicator variable.

Data

Since 2001, listed Korean firms have been required to disclose audit and non-audit service fees paid to incumbent auditors along with the audit hours utilized in the preparation of the current and prior two audits. This data is available on the web-based disclosure system, DART (Data Analysis, Retrieval and Transfer System), maintained by the Korea Financial Supervisory Service. We obtained financial statement data from the 2004 KIS-DATA (Korea Investors Services-DATA). Our sample consists of 697 observations of South Korean audits of manufacturing firms completed in 2001 and 2002.

3.0 Results

Our first step is to identify the client characteristics to incorporate as outputs in the DEA model. These characteristics determine the audit hours required to produce the appropriate level of assurance. After preliminary data analysis we selected the following measures of the client's size, complexity, and risk.

Ln Assets	Natural logarithm of the book value of client's total assets.
CR	Client's balance sheet current ratio.

Chaebol	The Korea Fair Trade Commission (KFTC) defines a chaebol as a group of companies of which more than 30% of shares are owned by the group's controlling shareholders and its affiliated companies. The KFTC ranks business groups by total assets and identifies the 30 largest chaebols each year. Chaebol is an indicator variable = 1 when a firm is affiliated with one of the 30 largest chaebols and 0, otherwise.
Sq Subs	Square root of the number of subsidiaries.

Additional variables included in the data set and used in the audit fee and audit hour regressions are:

Debt	Client's financial leverage (total liabilities / total assets)
Foreign	% of foreign assets
MAS	Non-audit fees
If MAS	Dummy variable where 1 = client purchased non-audit services.
If Tax	Dummy variable where 1 = client purchased tax services.
Mod Opin	Dummy variable where 1 = client received other than a standard opinion.
Not Dec.	Dummy variable where 1 = client's year end is other than 12/31.
Loss	Dummy variable where 1 = client had a loss in the current year.
ROA	Return on assets defined as net income / total assets in the latest fiscal year.
Cash Rights	The percentage of equity shares owned by the controlling shareholders.
Voter Rights	The sum of the percentage of equity shares owned by the controlling shareholders and by affiliated firms.

[Table 1 about here]

Descriptive statistics for these variables are shown in Table 1. By means of comparison, Korean firms are smaller on average than U.S. firms and U.S. audit fees for equivalent sized firms are considerably greater. Relative to publicly held U.S. manufacturing firms for the same time period Korean firms appear to have lower current ratios, lower percentage of foreign assets, and to purchase much less MAS from their auditors.

While all of the client characteristics identified in the above table might, in principle, have an impact on audit production, the use of DEA requires a parsimonious model. Incorporating additional outputs into the analysis creates additional constraints that tend to increase the average value of θ and the probability that an observation lies on the efficient

frontier (i.e., as the number of inputs and outputs increases each DMU becomes more uniquely defined and therefore less comparable to other DMUs).

Analysis of client characteristics

We started our analysis by running equation (1) model separately for Big 4 and non-Big 4 clients for each of FY2001 and FY2002 using various combinations of the potential explanatory variables. Since this resulted in four separate sub-samples we report the results from these samples separately in our regression tables. We tried pooling the data within year, i.e., combining Big 4 and non-Big 4 observations, and using the Heckman model to address self-selection concerns regarding auditor choice. Unfortunately, our data included only a limited set of independent variables and we could not isolate any variables that allowed us to identify the selection model distinctly from the structural model. As a consequence, further implementation of the Heckman model would have had to rely upon the non-linearity of the inverse Mills ratio to accomplish the required identification. In light of this, our subsequent results are based upon OLS.

Table 2 reports the results from the regressions of Ln Total hours on our potential set of explanatory variables to be included in the DEA model. We also included a pooled regression for reference purposes only. As can be seen, significant variables in the models include a measure of client size (Ln Assets), two measures of client complexity (Chaebol and Sq Subs), and a measure of client business risk (CR). We selected these variables to include in the DEA model. Other potential measures of risk and complexity such as Debt, Foreign, Loss, and ROA had limited effect on total hours and, therefore, were not included in the DEA analysis. We also excluded If MAS, If Tax, Mod. Opin., Not Dec., Cash Rights, and Voter Rights since we considered them as experimental variables to be used in the subsequent analysis where we look to explain the

efficiency results. Interestingly, the fit of the model varies greatly between the Big 4 and non-Big 4 subsets. This is probably due to the ability of assets to explain hours for the Big 4 clients and its relatively weak contribution to the models for non-Big 4 clients. In part this is explained by the narrower range of asset sizes found in the non-Big 4 samples relative to the Big 4 samples.

[Table 2 about here]

Table 3 shows the results of the regression of Ln Total hours on the variables we included for the DEA model. As can be seen, the estimated model fits the Big 4 sub-samples reasonably well with Adj. R^2 = 0.53 and .522 in FY2001 and FY2002, respectively. The fit for the non-Big 4 clients is not as good with Adj. R^2 = 0.18 and .10 in FY2001 and FY2002, respectively. In all cases Ln Assets is a significant determinant of audit effort. Chaebol is significant in three of the four regressions, while Sq. Subs and CR are significant in two of the four regressions.

[Table 3 about here]

In Table 4 we use the predicted Ln Total hours from each of our Table 3 models to compare the total hours used by Big 4 and non-Big4 auditors while controlling for client characteristics. This table is motivated by the concern that client characteristics are likely to be correlated with the type of auditor selected. Here we attempt to control for these differences in client characteristics across the samples. To see how this is done consider the following matrix representations of the expected values from equation (1):

$$\hat{h}_{B4} = X_{B4}\,\hat{b}_{B4} \qquad \text{and} \qquad \hat{h}_{nb4} = X_{nB4}\,\hat{b}_{nB4} \qquad (3a)$$

$\hat{h}_{B4-nB4} = X_{nb4}\,\hat{b}_{B4}$ and $\hat{h}_{nb4-B4} = X_{B4}\,\hat{b}_{nB4}$ (3b)

where,

$\hat{h}_{\bullet}$ = expected fees,
$X_{\bullet 4}$ = the data matrix, and
$\hat{b}_{\bullet 4}$ = vector of estimated coefficients.

Equations (3a) represent the within sample predicted hours. Here the estimated coefficients from Table 3 are applied to the actual data used to generate the estimates. Equations (3b) represent the out of sample predicted hours. For instance, $\hat{h}_{B4-nB4}$ represents the estimates of the Big 4 coefficients applied to the non-Big 4 data.

Turning to Table 4, the first line represents the sample of FY2001, non-Big 4 clients. The predicted Ln Hours B4 cell is the average of the out of sample predicted hours of the non-Big 4 clients "as if" they were audited by Big 4 auditors. That is, the first equation (3b) calculation. The next cell, Predicted Ln Hours ~B4, is the second equation (3a) calculation, the within sample predicted hours of the non-Big 4 clients for FY2001. The Difference cell represents the Big 4 predicted hours minus the non-Big4 predicted hours. It is evident that for each sub-sample the Big 4 predicted hours are greater than the non-Big 4 predicted hours.

[Table 4 about here]

This table suggests to us that the oft noted quality differences between Big 4 and non-Big 4 firms likely applies to the Korean auditing market and that the higher quality Big 4 auditors do more work. Further, it indicates that it makes sense to apply our DEA analysis within rather than across the auditor types, since in a pooled sample the DEA technology could not distinguish extra hours used to produce a higher quality audit from extra hours that are merely inefficient.

The following table reports our estimates of the efficiency parameter, θ, and also presents those reported in DGSS (2003) – for comparison:

Thetacrs	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.663	0.135	0.447	1.000
FY 2001 & B4	0.686	0.129	0.521	1.000
FY 2002 & ~B4	0.695	0.128	0.459	1.000
FY 2002 & B4	0.711	0.122	0.499	1.000
DGSS (2003)	.883	.075	.743	1.0

Our estimates demonstrate a high degree of consistency across the samples with means ranging from .66 to .71. There also appears to be considerable variance in the efficiency of individual engagements, see Figure 1. The θ values reported by DGSS are for a sample of two hundred and forty-seven U.S. audits performed by one of the (then) Big 6 firms in 1989. These θ's are uniformly higher and show less variance than those in our sample, possibly because they were performed by a single audit firm in a more highly regulated audit environment.

[Figure 1 about here]

The DEA model and basic efficiency results

Tables 5 and 6 provide evidence that the efficiency measure, θ, is significantly associated with audit pricing in the expected way, that is greater efficiency translates into higher fees per hour and lower total audit fees.

[Table 5 about here]

DGSS found that the fee realization rate in their sample of U. S. audits from a single (then) Big 6 firm was positively associated with θ. Table 5 reveals even stronger correlations (T-

values, not reported, range from 7 to 11) than those found in DGSS that efficient audits result in higher fees per hour. Since the dependent variables in Table 5 are audit fees in 1,000 won units (approximately $1 dollar U.S.) we can see that a 10% increase in efficiency would result in an approximate increase in average fees per hour of $22 U.S. for model (1) firms (non-Big 4, FY2001) and $10 U.S. for model (4) firms (Big 4, FY2002).

While efficiency increases fees per hour, the other strong predictor of fees per hour, Chaebol membership, consistently decreases fees per hour across the samples. The provision of MAS services also tends to increase fees per hour for Big 4 clients.

[Table 6 about here]

Table 6 provides further evidence on the effect of θ on the pricing of audits. Here we find that efficient audits provide a competitive advantage in the form of the ability to reduce audit fees. Looking, for example, at the coefficient on Thetacrs in model (1) of Table 6 indicates that a 10% increase in efficiency results in an approximate 5.5% reduction in the audit fee. Model (3), also non-Big 4 clients, shows a very similar result. Comparing the Big 4 and non-Big 4 models in Table 6 we see that non-Big4 firms pass on less of the efficiency savings than Big 4 firms. This could indicate that in Korea during FY2001 and FY2002 the client market served by the Big 4 was especially competitive.

All of the samples demonstrate relatively high goodness of fit statistics, typical of audit fee models reported in many other studies, with the control variables Ln Assets and Sq Subs providing the most consistent association with audit fees. However, since the distribution of our fee per hour variable has a long right tail, we reran the analysis, including the calculation of θ,

excluding observations in which the fese per hour variable fell outside the 5 and 95 percentiles of its cumulative distribution. The results, not tabulated, are strongly consistent with the results reported in Tables 5 and 6 and show even stronger θ effects on pricing than those reported in the tables.

Correlates of efficiency in audit production

Our next step is to investigate the characteristics of audit engagements that may be associated with efficiencies in production. Specifically, we consider the following factors: the provision of MAS services, the rendering of a modified opinion, fiscal year-end, and shareholder rights.

[Table 7 about here]

Performance of non-audit services for the client

A principle justification for allowing public accounting firms to perform non-audit services for audit clients is the argument that economies of scope from joint production can make auditors more efficient. We test this argument using the Ln of MAS fees. Surprisingly, we find that audit efficiency *decreases* with the amount of MAS provided by Big 4 firms. This result may be due to the fact that few Korean firms purchase MAS from their auditor and therefore the purchase of MAS could indicate firms with either operating or accounting difficulties.

Modified Opinion

A modified audit opinion could either increase or decrease the number or hours used in the audit and thereby have an inverse effect upon efficiency. The argument for increasing audit effort is if the incidence of modified opinions is associated with clients having high inherent or control risk. Auditors with such clients would require additional effort before rendering an

opinion. Alternatively, auditors could use a modified opinion as a defensive measure for high-risk clients. In this case, modified opinions could be associated with more efficient audits since auditors have determined it is more effective to modify the opinion rather than expend the excess resources needed to acquire sufficient evidentiary material. We find a strong positive association in one of our four models.

Extent of client imposed time pressure on the audit

Audit production is highly judgemental and unobservable to financial statement users. In this context, if a client is seen by the auditor to be highly sensitive to increases in the amount of work done by the auditor, the efficiency of audit production can be expected to increase. We test for this effect using a December 31 year-end as a proxy for time pressure. Since 90% of the clients in our sample have 12/31 year-ends we expect there to be greater time pressure for 12/31 clients and less for non 12/31 clients. Therefore we predict there to be a negative association between efficiency and our Not Dec. variable. None of our models show a statistically significant time pressure effect.

Shareholder Rights

We have two measures of shareholder rights: Cash Rights and Voter Rights. Our expectation is that increased shareholder rights will increase efficiency. The argument is that greater shareholder rights is likely to result in generally more efficient management and management controls within the client's organization. In turn, stronger management would render the client's financial statements easier to audit, *ceteris paribus*. We find a positive relationship between Cash Rights and audit efficiency for Big 4 clients. We do not find any relationship between θ and Voter Rights in our samples.

4.0 Conclusion

In this paper, we test the efficiency of audit production using data envelopment analysis for a sample of 697 audits performed by Big 4 and non-Big 4 firms in Korea with FY2001 and FY2002 year-ends. In addition to computing an efficiency score, θ, for each audit, we examine audit engagement characteristics associated with θ, as well as the relationship between audit efficiency and audit pricing.

We find that, on average, audits are produced at about a 69% efficiency level. That is, audit labor hours could, on average, be reduced by about 31% without changing the quality of output. We also find that Big 4 auditors use more audit hours than non-Big 4 firms, a result consistent with the evidence in the literature that Big 4 auditors provide a higher level of assurance.

Our evidence indicates that efficiency in production increases audit fees per hour while decreasing total audit fees. These result further verify the interpretation of the DEA measure, θ, as an economically meaningful measure of audit efficiency. Further the data suggests that efficient auditors pass some of the time savings on to their clients by reducing audit fees. These results are consistent with a competitive model of audit markets in which costs are a key element of competitive behavior.

Surprisingly, we find that audit efficiency decreases slightly with the joint provision of MAS for Big 4 clients. The existence of an apparent diseconomy of scope argues against the basic justification for allowing the joint performance of auditing and non-audit services by public accounting firms. It should be noted, however, that non-audit services are a much lower proportion of audit fees in our sample than is the case in the United States in recent years.

Finally, we also find some evidence of a small increase in efficiency associated with higher levels of shareholder rights. A result suggesting that good corporate governance is likely to extent to good controls over financial reporting.

To conclude, we believe that our research sheds light on important aspects of the performance of modern audits that have seen little research to this point, and consequently, are not well understood. Replications and extensions to other data sets from other countries would appear to be worthwhile.

Endnotes

[1] Briefly, output in the DEA analysis is measured by the size and complexity of the client, while the input is the total number of auditor labor hours utilized in the engagement.

[2] Since the quality of audit output is unobservable, it would obviously be impossible to measure efficiency in production without the assumption of constant assurance across a firm's clients. However, this assumption is reasonable since clients would be unwilling to pay more for an unobservable increase in audit quality over and above the quality level implied by the audit firm's brand name at that time. Moreover, a large body of empirical evidence is consistent with two audit quality levels being available in audit markets - a base level of assurance produced by non-Big 5 firms, and a higher than base level of assurance produced by Big 5 audit firms. If this condition does not hold, then any differences in average efficiency across audit firms within the Big 5 and non-Big 5 groups that we observe could, instead, be interpreted as differences in average audit quality.

[3] We recognize that individual audit firms applying DEA techniques as a benchmarking tool to measure relative efficiencies of their own portfolios of audits could refine our analysis by further investigation of supposedly "inefficient" (low θ audits). That is, there could be special circumstances, such as the need to produce a higher than normal level of assurance in response to unusual risks or the existence of unusual client characteristics, that result in unusually high effort levels. In our research, we cannot query respondents as to any such characteristics outside of those measured in the survey instrument.

[4] For example, partners in Big 5 firms typically function quite differently from partners in non-Big 5 firms, with the latter being far more likely to be involved in the day-to-day work on audit engagements, functioning like the managers and seniors in a Big 5 firm. As another example, the "up or out" staff policies of Big 5 firms make it unlikely that a person can remain a "career senior", while this is fairly common in non-Big 5 firms.

References

Blokdijk, H., F. Drieenhuizen, D. Simunic, and M. Stein. 2003. Determinants of the Mix of Audit Procedures: Key Factors that Cause Auditors to Change What They Do, working paper, University of British Columbia. Available at http://ssrn.com/author=90523.

Charnes, A., W.W. Cooper, and E. Rhodes. 1978. Measuring the Efficiency of Decision Making Units. *European Journal of Operations Research*, pp. 429-444.

Dopuch, N., M. Gupta, D. Simunic, and M. Stein. 2003. Production Efficiency and the Pricing of Audit Services, *Contemporary Accounting Research*, Vol. 20, pp. 47-77.

Hackenbrack, K. and W.R. Knechel. 1997. Resource Allocation Decisions in Audit Engagements. *Contemporary Accounting Research*, pp. 481-499.

O'Keefe, T., D. Simunic, and M. Stein. 1994. The Production of Audit Services: Evidence from a Major Public Accounting Firm. *Journal of Accounting Research*, pp. 241-261.

Palmrose, Z. 1989. The Relation of Audit Contract Type to Audit Fees and Hours. *The Accounting Review*, July, pp. 488-99.

Simunic, D.A. 1980. The Pricing of Audit Services: Theory and Evidence. *Journal of Accounting Research*, pp. 161-190.

Table 1. Descriptive Statistics

Thetacrs	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.663	0.135	0.447	1.000
FY 2001 & B4	0.686	0.129	0.521	1.000
FY 2002 & ~B4	0.695	0.128	0.459	1.000
FY 2002 & B4	0.711	0.122	0.499	1.000

Assets (1,000's won)	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	443,024	954,674	17,641	7,781,042
FY 2001 & B4	1,474,729	5,557,696	14,502	50,255,428
FY 2002 & ~B4	523,696	2,614,618	8,270	33,141,470
FY 2002 & B4	1,834,880	6,979,690	7,602	62,637,404

Ln Assets	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	18.963	1.253	16.722	22.811
FY 2001 & B4	19.345	1.618	16.526	24.677
FY 2002 & ~B4	18.861	1.231	15.965	24.260
FY 2002 & B4	19.395	1.681	15.880	24.897

Audit Fees (1000's won)	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	61,025	43,281	19,390	300,000
FY 2001 & B4	102,239	136,243	15,000	1,334,000
FY 2002 & ~B4	55,336	30,999	18,900	260,000
FY 2002 & B4	102,569	136,295	12,875	1,212,000

Audit Fees 1000's / hour	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	216.7	300.6	32.64	2,750
FY 2001 & B4	139.7	161.3	24.22	1,123
FY 2002 & ~B4	190.3	208.9	27.5	1,767
FY 2002 & B4	119.3	121.5	18.38	937.5

Audit Hours	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	533	518	24	3,360
FY 2001 & B4	1,219	2,264	40	27,500
FY 2002 & ~B4	496	387	30	2,576
FY 2002 & B4	1,273	2,207	32	25,600

Ln Audit Hours	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	5.900	0.923	3.178	8.120
FY 2001 & B4	6.522	1.043	3.689	10.222
FY 2002 & ~B4	5.918	0.821	3.401	7.854
FY 2002 & B4	6.624	0.975	3.466	10.150

# of Subs	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.938	2.450	0.000	21.000
FY 2001 & B4	2.277	6.915	0.000	71.000
FY 2002 & ~B4	1.054	1.838	0.000	10.000
FY 2002 & B4	4.168	11.112	0.000	84.000

Table 1. Descriptive Statistics, continued

Chaebol	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.110	0.314	0.000	1.000
FY 2001 & B4	0.169	0.376	0.000	1.000
FY 2002 & ~B4	0.102	0.303	0.000	1.000
FY 2002 & B4	0.189	0.393	0.000	1.000

Foreign	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.060	0.155	0.000	0.778
FY 2001 & B4	0.054	0.163	0.000	0.845
FY 2002 & ~B4	0.043	0.133	0.000	0.735
FY 2002 & B4	0.060	0.168	0.000	0.784

Current Ratio	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	1.748	1.297	0.061	7.520
FY 2001 & B4	1.580	1.302	0.196	8.960
FY 2002 & ~B4	1.831	1.362	0.098	8.105
FY 2002 & B4	1.636	1.403	0.379	11.581

Debt / Assets	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.228	0.294	0.007	1.841
FY 2001 & B4	0.201	0.205	0.002	1.398
FY 2002 & ~B4	0.183	0.229	0.001	1.812
FY 2002 & B4	0.156	0.131	0.002	0.696

% Loss	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.317	0.467	0.000	1.000
FY 2001 & B4	0.318	0.467	0.000	1.000
FY 2002 & ~B4	0.222	0.417	0.000	1.000
FY 2002 & B4	0.253	0.436	0.000	1.000

Non Audit Fees	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	3,261	10,883	0	83,457
FY 2001 & B4	49,749	205,786	0	2,314,000
FY 2002 & ~B4	11,036	81,568	0	1,020,000
FY 2002 & B4	52,521	264,755	0	3,204,000

ROA	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	-0.044	0.456	-4.524	0.816
FY 2001 & B4	0.015	0.173	-1.374	1.207
FY 2002 & ~B4	0.028	0.241	-1.232	1.509
FY 2002 & B4	0.023	0.228	-1.438	1.346

If MAS	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.097	0.296	0.000	1.000
FY 2001 & B4	0.185	0.389	0.000	1.000
FY 2002 & ~B4	0.114	0.318	0.000	1.000
FY 2002 & B4	0.189	0.393	0.000	1.000

Table 1. Descriptive Statistics, continued

If Tax	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	0.124	0.331	0.000	1.000
FY 2001 & B4	0.185	0.389	0.000	1.000
FY 2002 & ~B4	0.150	0.358	0.000	1.000
FY 2002 & B4	0.158	0.366	0.000	1.000

Voter Rights	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	44.312	20.196	3.800	94.800
FY 2001 & B4	43.961	18.046	0.700	94.200
FY 2002 & ~B4	46.074	19.609	3.900	95.600
FY 2002 & B4	48.145	19.604	1.800	99.900

Cash Rights	Mean	Std. Dev.	Min	Max
FY 2001 & ~B4	31.601	17.513	0.000	95.700
FY 2001 & B4	32.098	18.041	0.000	79.800
FY 2002 & ~B4	31.522	18.017	0.000	71.800
FY 2002 & B4	32.613	18.241	0.000	79.900

Table 2. Regression of the Ln of total hours on explanatory variables

Variable	(1)	(2)	(3)	(4)	(5)
Ln Assets	0.164*	0.320***	0.107	0.214***	0.218***
CR - 2	0.123**	0.029	0.092**	0.093**	0.076***
Chaebol	0.692**	0.008	0.582**	0.314**	0.375***
Debt/Assets	0.112	0.256	0.196	0.477	0.177
Foreign	-0.398	-0.184	-0.305	-0.242	-0.297
If Mas	-0.049	0.528***	0.049	0.474***	0.322***
If Tax	-0.295	-0.045	0.073	0.081	-0.006
Mod opin	-0.047	-0.010	-0.599	-0.152	-0.109
Not Dec	0.097	-0.447	0.082	-0.280	-0.111
Sq Subs	0.107	0.128**	0.032	0.059	0.092***
Cash rights	-0.007	-0.008**	-0.002	-0.007**	-0.005***
Voter rights	-0.002	0.003	-0.005	-0.000	-0.002
Loss	-0.400**	-0.061	-0.231	0.339**	-0.086
ROA	-0.013	0.313	0.290	0.911**	0.217
Big 5					0.461***
Constant	1.763	-0.070	3.060**	1.296	1.083*
N	145.000	195.000	167.000	189.000	696.000
R^2 adj.	0.187	0.560	0.106	0.585	0.461

legend: *p<.1; ** p<.05; *** p<.01, two-tailed tests – robust standard errors

Notes:

1. Samples: (1) FY2001 & ~B4, (2) FY2001 & B4, (3) FY2002 & ~B4, (4) FY2002 & B4, (5) Combined sample.
2. CR2 equals 15 – current ratio, used to create a positive relationship with hours and fees.

Table 3. Regression of Ln of total hours on output variables used in DEA model

Variable	(1)	(2)	(3)	(4)
Ln Assets	0.168**	0.385***	0.115*	0.249***
CR – 2	0.102*	0.025	0.058	0.075**
Sq Subs	0.064	0.141***	0.041	0.097**
Chaebol	0.572**	0.068	0.482**	0.443***
Constant	1.461	-1.336	3.031**	0.731
N	145.000	195.000	167.000	190.000
R^2 adj.	0.181	0.530	0.101	0.522

legend: *p<.1; ** p<.05; *** p<.01, two-tailed tests – robust standard errors

Notes:
1. Samples: (1) FY2001 & ~B4, (2) FY2001 & B4, (3) FY2002 & ~B4, (4) FY2002 & B4
2. CR2 equals 15 – current ratio, used to create a positive relationship with hours and fees.

Table 4. Within and out of sample comparisons of predicted total hours across data subsets.

Client Sample	N	Predicted Ln Hours B4	Predicted Ln Hours ~B4	Difference	T-Value Two-tailed test
FY 2001 & ~B4	145	6.326507$^{\&}$	5.900014$^{\#}$	.4264927	7.3490***
FY 2001 & B4	195	6.522019$^{\#}$	6.033453$^{\&}$	.4885667	7.2909***
FY 2002 & ~B4	167	6.381488$^{\&}$	5.917994$^{\#}$	.4634939	10.9506***
FY 2002 & B4	190	6.624436$^{\#}$	6.056439$^{\&}$	.5679973	9.4617***

Notes:
1. H_0: Predicted hours within sample = predicted hours out of sample
2. ***, p < .001, two tailed test of H_0 with unequal variances
3. $^{\#}$, within sample prediction
4. $^{\&}$, out of sample prediction

Table 5. Regression of fee/hour on mitigating / explanatory variables

Variable	(1)	(2)	(3)	(4)
Ln Assets	45.72*	13.04	39.98**	2.342
CR – 2	-56.35**	-1.466	-37.85***	-4.329
Chaebol	-508.1***	-369.1***	-248.1***	-194.8***
Debt/Assets	33.13	3.191	34.17	-38.06
Foreign	-89.35	-7.517	-150.8*	-7.034
If Mas	110.1	62.92***	-17.02	41.02*
If Tax	-14.53	31.18*	-7.03	13.39
Mod opin	45.35	46.75	-16.27	-24.63
Not Dec	-17.59	60.67	4.303	58.17
Sq Subs	-156.2***	-49.09***	-114.5***	-32.85***
Cash rights	.3179	.1639	-.3265	-.3029
Voter rights	-.7731	-.4211	.1745	-.4595
Loss	4.521	-11.78	18.47	22.85
Thetacrs	**2,282*****	**1,508*****	**1,645*****	**1,081*****
Constant	-1,384**	-1,038***	-1,186***	-549.3***
N	145	195	167	189
R^2 adj.	.6179	.7179	.6844	.6011

legend: *p<.1; ** p<.05; *** p<.01, two-tailed tests – robust standard errors

Notes:
1. Samples: (1) FY2001 & ~B4, (2) FY2001 & B4, (3) FY2002 & ~B4, (4) FY2002 & B4
2. CR2 equals 15 – current ratio, used to create a positive relationship with hours and fees.

Table 6. Regression of fee on mitigating / explanatory variables

Variable	(1)	(2)	(3)	(4)
Ln Assets	0.262***	0.355***	0.212***	0.385***
CR – 2	0.049***	0.011	0.024	0.009
Chaebol	0.319***	0.214**	0.218***	0.323***
Debt/Assets	-0.000	-0.066	0.234**	0.076
Foreign	0.065	0.053	-0.342**	0.187
If Mas	0.161*	0.275***	0.049	0.150*
If Tax	-0.058	0.081	-0.014	0.041
Mod opin	0.340***	0.080	0.147	-0.103
Not Dec	-0.022	-0.049	-0.075	-0.110
Sq Subs	0.109***	0.071**	0.083**	-0.011
Cash rights	0.000	0.001	0.000	-0.001
Voter rights	-0.002	-0.002	-0.001	-0.005*
Loss	-0.030	-0.020	-0.028	0.081
Thetacrs	**-0.546****	**-0.724****	**-0.568*****	**-1.257*****
Constant	5.706***	4.564***	6.899***	4.614***
N	145.000	195.000	167.000	189.000
R^2 adj.	0.767	0.821	0.625	0.816

legend: *p<.1; ** p<.05; *** p<.01, two-tailed tests – robust standard errors

Notes:
1. Samples: (1) FY2001 & ~B4, (2) FY2001 & B4, (3) FY2002 & ~B4, (4) FY2002 & B4
2. CR2 equals 15 – current ratio, used to create a positive relationship with hours and fees.

Table 7. Regression of Theta on DEA outputs plus explanatory variables.

Variable	(1)	(2)	(3)	(4)
Ln Assets	-0.016	-0.007	-0.007	0.005
CR – 2	0.017***	0.002	0.020***	-0.007
Chaebol	0.180***	0.246***	0.092***	0.166***
Sq Subs	0.060***	0.023***	0.062***	0.026***
Ln MAS	**0.003**	**-0.004****	**0.000**	**-0.006*****
Mod Opin	0.029	0.004	0.136***	-0.002
Not Dec	-0.011	0.052	-0.011	0.008
Cash Rights	0.000	0.001*	0.000	0.001**
Voter Rights	0.001	-0.000	0.000	-0.000
Constant	0.666***	0.736***	0.534***	0.623***
N	145.000	195.000	167.000	190.000
R^2 adj.	0.375	0.517	0.325	0.500

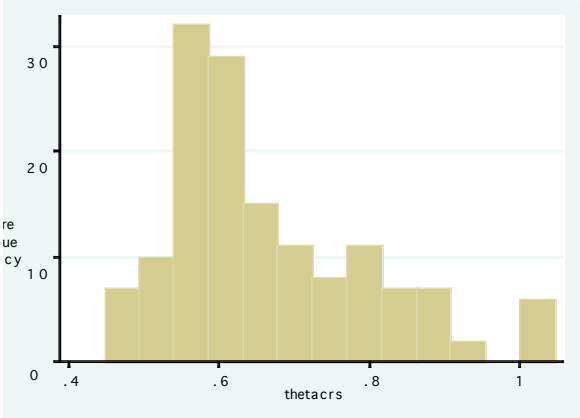
legend: *p<.1; ** p<.05; *** p<.01, two-tailed tests – robust standard errors

Notes:

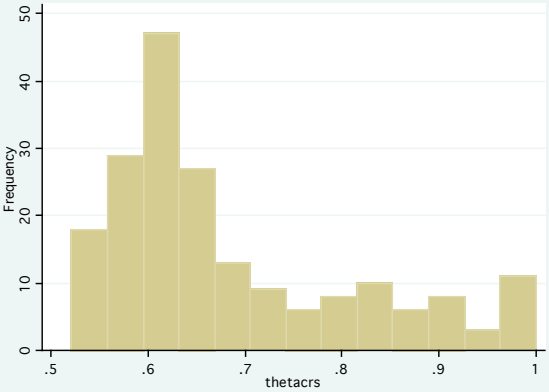
1. Samples: (1) FY2001 & ~B4, (2) FY2001 & B4, (3) FY2002 & ~B4, (4) FY2002 & B4
2. CR2 equals 15 – current ratio, used to create a positive relationship with hours and fees.

Figure 1. Histograms of Theta by sub-sample

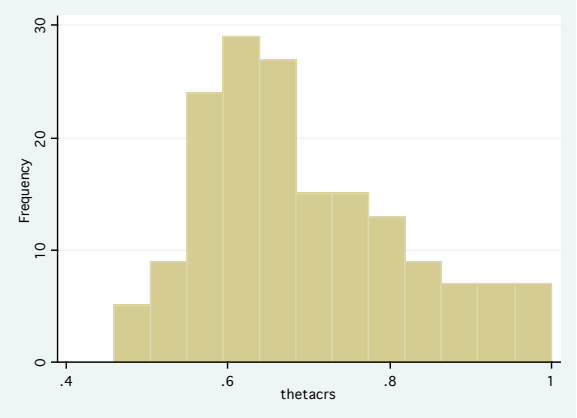
Theta for ~B4, 2001



Theta for B4, 2001



Theta for ~B4, 2002



Theta for B4, 2002