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An Exploratory Analysis of the Determinants of Audit Engagement Resource Allocations

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Introduction

The purpose of this study was to gain a better understanding of characteristics that impact total audit work performed on domestic financial statement audits. Prior studies have investigated the determinants of audit fees (see, e.g., Elliott and Korpi (1978) and Ashton, Elliott and Willingham (1989)). A more recent study by O'Keefe, Simunic and Stein (1994) (hereafter OSS) examines how client characteristics affect both the amount and mix of labor used on financial statement audits. OSS estimated five regression equations using as the dependent variables each of four types of labor input hours and total audit fees. Our study uses the same data as used by OSS–data from the period 1986 through 1989 for 249 clients of a large international accounting firm with primary operations in the manufacturing, merchandising and high technology industries.

Our study extends the OSS and other prior studies in the following ways. OSS studied the determinants of total (domestic plus foreign) audit hours for four different personnel levels (partner, manager, senior and staff hours) and total audit fees. We limit our investigation to *domestic* audit hours for the following reasons: (1) statutory audit requirements may differ across jurisdictions, (2) differences in legal environments could affect the extent of audit work across jurisdictions, (3) differences in audit market conditions may exist across jurisdictions (e.g., fixed vs. variable fee markets), and (4) technology (e.g., audit processes) may differ across jurisdictions even within the same audit firm.[1] We expect the existence of client foreign operations will impact the quantity of domestic audit work performed. Even though domestic auditors might not perform the actual audit work on foreign subsidiaries, consolidation of these subsidiaries into a domestic parent's financial statements could lead to additional domestic audit work, especially administrative work dealing with the coordination of the full audit.

OSS estimated separate models for each of the four labor inputs mentioned above. We primarily focus on *total* domestic audit hours aggregated across all personnel

[1] For example, we know that the calculation of planning materiality for certain foreign jurisdictions differs from the domestic calculation for the firm whose data are being studied. This could directly affect sample sizes and the resulting extent of audit work performed.

Table 1

Relationship Between Client Size and Total Audit Hours–Average and (Standard Deviations)

Size Interval	Total Domestic Assets (Thousands of Dollars)	Total Domestic Sales	Domestic Audit Hours and Percent of Hours @ Rank to Total Hours									Total Domestic Audit Hours Per $1000 of Total Domestic Assets	Domestic Audit Fees Billed	Average Fee Per Hour
			Partners		Managers		Seniors		Staff		Total			
Smallest 10%	1,330 (578)	1,854 (1,958)	19.0 (15.9)	7%	47.3 (41.7)	18%	109.4 (43.0)	43%	80.9 (34.0)	32%	256.6 (106.1)	.193	15,446 (7,628)	59.96 (13.21)
10% - 20%	2,627 (322)	5,568 (2,981)	16.0 (9.0)	5%	45.0 (19.6)	13%	151.6 (56.7)	44%	135.1 (92.1)	39%	347.7 (153.9)	.132	19,123 (7,002)	57.42 (14.30)
20% - 30%	3,941 (437)	8,867 (4,857)	21.0 (8.6)	5%	56.3 (25.0)	15%	156.7 (55.8)	41%	152.3 (69.9)	39%	386.3 (119.0)	.098	20,509 (8,964)	54.35 (16.43)
30% - 40%	6,428 (1,017)	14,512 (9,331)	20.3 (12.8)	5%	53.1 (26.2)	13%	159.4 (52.2)	39%	170.8 (95.9)	42%	403.6 (140.1)	.063	25,494 (12,482)	62.20 (15.64)
40% - 50%	10,168 (1,224)	17,249 (7,913)	24.5 (13.1)	5%	66.6 (25.6)	13%	208.7 (88.5)	40%	227.4 (126.2)	43%	527.2 (224.4)	.052	35,122 (18,887)	66.33 (15.32)
50% - 60%	16,378 (2,680)	40,238 (51,871)	42.0 (40.3)	6%	86.5 (63.7)	13%	235.5 (90.4)	34%	320.6 (121.7)	47%	684.6 (266.6)	.042	44,121 (18,877)	65.80 (16.72)
60% - 70%	24,241 (2,765)	44,652 (27,061)	39.3 (25.7)	5%	105.3 (52.3)	14%	284.8 (101.1)	37%	348.7 (188.7)	45%	778.1 (300.7)	.032	49,377 (21,888)	63.88 (14.85)
70% - 80%	40,331 (7,604)	81,679 (57,829)	55.3 (33.7)	6%	131.5 (86.4)	14%	318.5 (160.7)	34%	428.8 (384.0)	46%	934.1 (585.6)	.023	60,972 (40,888)	65.73 (13.54)
80% - 90%	100,423 (43,380)	145,438 (135,024)	74.9 (42.9)	6%	162.2 (78.0)	12%	350.7 (129.2)	27%	726.2 (418.4)	55%	1314.0 (603.7)	.013	88,323 (45,921)	66.74 (13.21)
Largest 10%	1,016,002 (1,189,569)	1,407,242 (1,595,802)	292.7 (279.0)	5%	684.7 (583.1)	12%	1585.4 (1702.6)	28%	3137.1 (3695.5)	55%	5699.9 (5835.0)	.006	421,235 (418,251)	73.02 (15.82)

Note: Each size interval comprises ten percent of total sample and intervals are arrayed from ten percent of sample clients to largest ten percent.

levels. We tested (reported later) whether the four-equation modeling approach provided more explanatory power than the model estimated using aggregate hours and found no significant difference in proportion of explained variability in total audit hours.

Finally, prior studies of audit production and pricing have applied the logarithmic transformation to both the dependent variable and the client size variable (and other independent variables) to linearize the relationship between client size and total audit hours. We tested several different functional forms of the size relationship and observed that both a two-equation approach (separate linear models for small and large clients) and a linear model using the square root of client size outperform the log model for our sample data.

The remainder of the paper contains sections reporting on (1) the relationship between client size and audit hours, (2) the functional form of this size relationship, (3) the relationship between residual audit hours, after controlling for client size, and other engagement characteristics, and (4) multivariate models of total audit hours for small and large clients. The paper concludes with a summary and discussion of our research findings.

Relationship Between Client Size and Total Audit Hours

Prior studies have documented the predominance of client size as the most significant determinant of the extent of audit work performed on financial statement audits. Table 1 presents details of this size relationship for our sample of 249 audit engagements. In Table 1, the sample has been separated into ten equal intervals ranging from the smallest ten percent of the sample, as measured by total domestic assets, to the largest ten percent. For each interval, averages are presented for: client total domestic assets and total domestic sales, domestic audit hours by personnel rank and in total, total domestic audit hours per $1,000 of client total domestic assets, and domestic audit fees billed and average fee per hour.[2]

Table 1 shows that total audit hours are increasing in client size, but at a decreasing rate. For the smallest ten percent of the sample whose average assets is $1.3 million, the average time required to perform audits was 257 hours. For the largest ten percent of the sample whose average assets is $1 billion, the average time required to perform the audits was 5,700 hours. On the smallest engagements, about 1/5th of an hour of audit work is performed for each $1,000 of assets. For the largest engagements, this amount declines to six one-thousandths of an hour, or about 6 hours per $1 million in assets. The two right hand columns in Table 1 indicate that audit fees billed and average audit fee per hour both increase with client size.

Table 1 also indicates that the mix of labor hours is different for small and large clients. For the smallest clients, partners and managers performed 25 percent of the total audit work, seniors 43 percent and staff 32 percent. For the largest clients, partners and managers performed 17 percent of the total audit work, seniors 28 percent and staff 55 percent. Figure 1 illustrates the change in labor mix across the 10 size intervals.[3] The figure reveals that, except for the smallest size interval, the proportion of partner and manager time remains roughly constant as size increases. The propor-

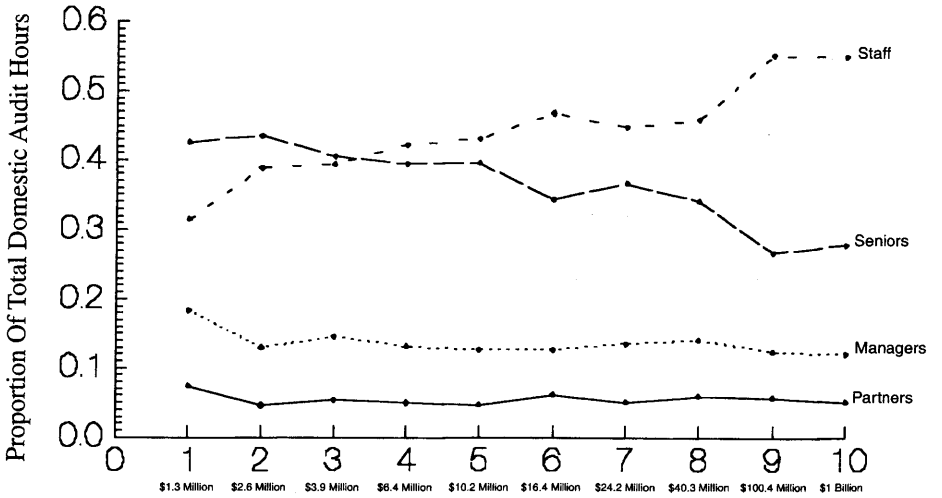
[2] For the remainder of the paper, reference to "total assets" or "total audit hours" implies domestic amounts only.

[3] OSS document this change in labor mix and test the stability of regression model coefficients across the four models. We investigate differences in models by personnel rank in a later section. However, we do not perform direct tests of the homogeneity of coefficients.

tion of staff time steadily increases with size up to $100 million in assets. Based on discussions with auditors, this phenomenon can be explained as follows.

Figure 1

Relationship Between Client Size and Proportion of Total Domestic Audit Work Performed by Different Levels of Personnel



For small clients, most of the work performed by seniors is procedural in nature–tests of details and workpaper documentation. Little time is spent by seniors in a supervisory capacity, as the audit is too small to warrant cost-effective use of staff with an intermediate layer of supervision. As clients (and audits) increase in size, the senior's role changes to one involving more supervision and less procedural work. The expected result is that by employing a greater proportion of lower-cost staff and intermediate supervision, profit is increased.[4]

In the next section, we investigate alternative functional forms of the relationship between size and total audit hours.

Functional Form of Relationship Between Client Size and Total Audit Hours

Different transformations can be employed to linearize a relationship that increases at a decreasing rate. In this section, we evaluate models of the relationship between client size and audit hours using three transformations and a two-equation approach involving the separate linear modeling of small and large engagements. Prior studies have used what we will call the *log model* to estimate the nonlinear relationship between audit hours (or total fees) and client size.[5] The log model involves taking the

[4] Auditors have expressed concern that this staff "leveraging" approach will not continue to be a profit increasing approach. Clients' internal audit operations continue to expand. The quality and accuracy of electronic processing of routine transactions has improved greatly over the last 20 years. As a result, large sophisticated clients are becoming less willing to pay for staff time involving the testing of routine transactions where audit differences seldom arise.

[5] See, for example, Ashton, Elliott and Willingham (1989) and O'Keefe, Simunic and Stein (1994).

natural logarithm of both the dependent variable (hours) and the independent variable (size), as shown in (1) below:

$$\ln(\text{Hours}) = \alpha + \beta * \ln(\text{Assets}) \qquad (1)$$

Taking the antilog of both sides of this equation shows its functional form expressed in terms of the original dependent variable, audit hours, i.e.,

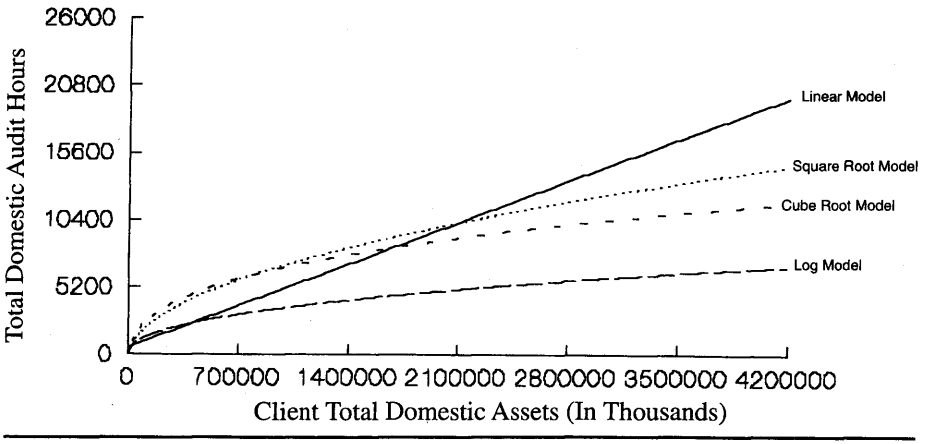
$$\text{Hours} = e^{\alpha} * (\text{Assets})^{\beta} \qquad (2)$$

When expressed as a function of hours, instead of ln(Hours), the log model contains no intercept, and involves the multiplication of a slope (e^{α}) times assets raised to the power β.[6] Therefore, the log model is similar to a no-intercept model with the independent variable being transformed by taking its nth root.[7]

We compare the explanatory power of the log model and two other transformations–taking the square root, and the cube root, of assets and leaving the dependent variable, hours, in its original form. The three functional forms, as estimated on the sample data using these three transformation methods, are depicted in Figure 2 along with a plot of the linear model.[8] As shown in Figure 2, the estimated log model dampens to the greatest extreme. The square root and cube root models fall above the linear model up to a client size of about $2 billion, after which they fall below the linear model. The log model falls below the linear model at an asset size of about $600 million.

Figure 2

Four Alternative Functions Estimating Relationship Between Client Size and Total Audit Hours



[6] The log model, as estimated using ordinary least squares regression, requires the assumption that errors are normally distributed, as is customary. This implies that the distribution of errors from the multiplicative model given in equation (2) is log normal.

[7] $\beta>1$ implies a relationship that is increasing at an increasing rate, and $\beta<0$ implies a decreasing relationship. Therefore, we expect $0<\beta<1$ if the size relationship is to increase at a decreasing rate.

[8] Sample data points have been excluded because most of the client data points would cluster near the y-axis in this plot. This is because a few very large clients greatly expand the plot scale. Data points are presented in Figures 3 through 8 where small and large segments of the overall sample are separately plotted together with the estimated functions.

In addition to the transformations described above, we estimated a covariance model of the size relationship–2 different linear models, one for small and the other for large clients. Determination of the size cutoff was made by examining various plots of the relationship between hours and size. We defined small clients as those 163 clients with total assets below $25 million, with the remaining 86 clients being defined as large.

Table 2 presents the model slope and the R^2 measure of goodness-of-fit for the linear, log, square root, and cube root models estimated on the total sample of 249 clients, and for the two-equation model separately estimated on the small and large samples. Models of each form are also presented for different personnel ranks.

The R^2 for the log model is not directly comparable to the R^2s for the other models because it expresses the proportion of explained variation in the log of hours whereas the others express the proportion of explained variation in original hours. So, we computed a quasi-R^2 for the log model by using the antilog of the right hand side of the estimated log model equation to estimate audit hours. Residuals were then computed using these estimates, and the resulting quasi-R^2 was computed by:

$$R^2 = 1 - (ESS/TSS) \qquad (3)$$

where ESS is the error (residual) sum of squares, or the unexplained variation in hours and TSS is the total variation in hours. The adjusted R^2 for the two-equation model was calculated using the squared residuals from a full covariance model where the model intercept and slope on size are allowed to change for large clients.[9] Since this full covariance model contains two additional independent variables, the adjusted R^2 is presented in Table 2.[10]

Table 2 shows that the two-equation model has the highest R^2s, both for total audit hours and for the four models of total hours by personnel rank. The R^2s for the linear model estimated on the total sample are very close to those for the two-equation model. The poorest model in terms of proportion of explained variation in total hours is the log model. Although the proportion of explained variation in ln(hours) is close to the other models, when we compute residuals for original hours using the antilog of this model, the proportion of explained variation significantly diminishes. The square root model performs equally as well as the two-equation model for manager hours, and almost as well for total hours and other models by personnel rank. Incidentally, the size exponent estimated from the log model ranges from .36 to .52, which is not substantially different from the square root power of .5. Presumably, the square root model fits better than the log model because it allows for estimation of an intercept, which also changes the estimated slope coefficient. Goodness-of-fit is lower for the cube root model, although it still outperforms the log model.

Figures 3 through 5 illustrate the dispersion of total audit hours around plots representing the linear model, the separate small and large client models, and the log model. Figure 3 contains the subsample of all 163 small clients. Figure 4 contains 51 of the large clients with total assets ranging from $25 million to $100 million, and Figure 5 contains the remaining 35 largest clients with assets ranging from $100 million to $4.2 billion. The plot was separated into these three segments so that we could clearly depict the points representing each client.

[9] This is equivalent to using the combined sum of the squared residuals from the small and large models as the ESS in equation (3), with the usual adjustment for two additional independent variables to derive the adjusted R^2.

[10] Both the dummy variable that captures a shift in the model intercept for large clients and the slope adjustment on assets for large clients are significant in the covariance model at the .10 level.

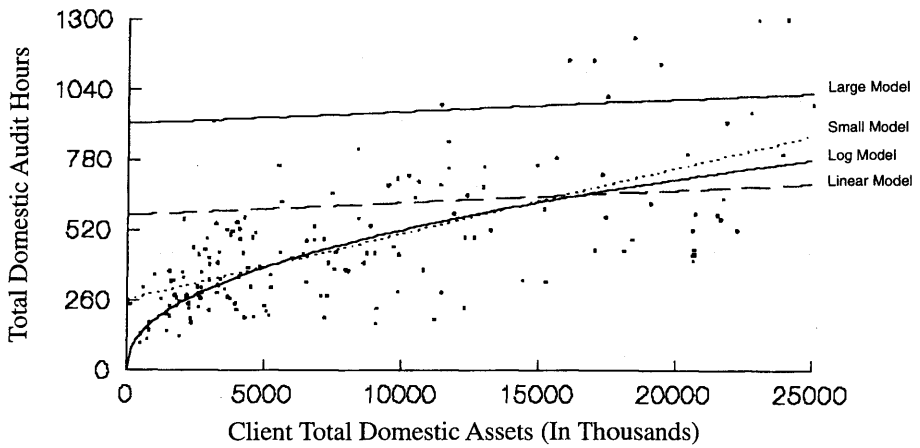
Table 2

Five Alternative Functions Estimating Relationship Between Client Size and Total Audit Hours (Models Estimated on Total Sample of 249 Audit Engagements)

	Linear Model		Log Model		Antilog of Log Model			Square Root Model		Cube Root Model		Two-Equation Model		
	Slope	R-Sq	Slope	R-Sq	Slope	Exponent	Quasi R-Sq	Slope	R-Sq	Slope	R-Sq	Small Slope	Large Slope	Adj. R-Sq
Total Audit Hours	.0046	.82	.4406	.76	8.9990	.44	.55	7.2378	.75	80.5705	.66	.0242	.0044	.83
Total Partner Hours	.0002	.75	.4480	.62	.4199	.45	.55	.3561	.73	4.0147	.66	.0012	.0002	.76
Total Manager Hours	.0005	.74	.4132	.61	1.4993	.41	.56	.7969	.76	9.0476	.70	.0027	.0004	.76
Total Senior Hours	.0012	.72	.3635	.67	6.8582	.36	.44	1.9192	.66	21.3648	.58	.0076	.0012	.73
Total Staff Hours	.0027	.76	.5161	.71	1.7826	.52	.53	4.1656	.68	46.1434	.59	.0127	.0026	.77

Figure 3

Relationship Between Client Size and Audit Hours for 163 Clients with Total Domestic Assets Less Than $25 Million

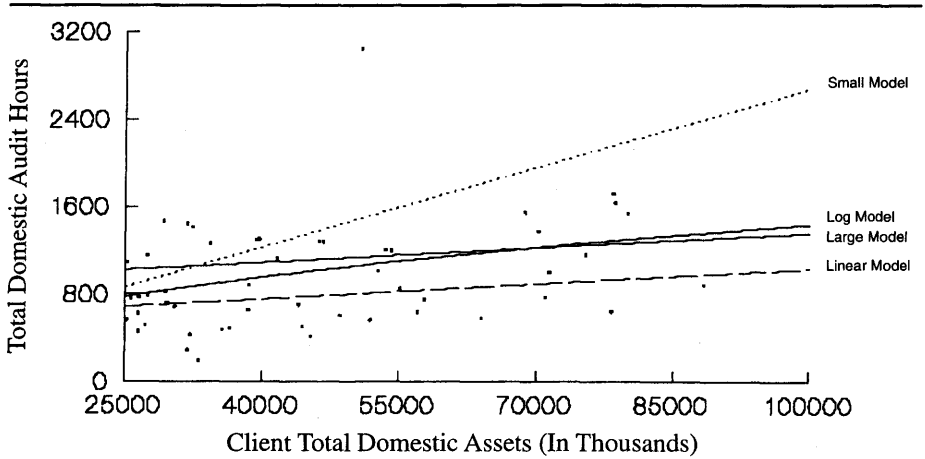


Legend: Large Model Fit on 86 Clients with Over $25 Million in Total Domestic Assets
Small Model Fit on 163 Clients with Total Domestic Assets Less Than $25 Million
Log Model is Antilog of Log Model
Linear Model Fit on All 249 Client Observations

Figure 3 shows that the log model and small model follow essentially the same path through the center of the client data points. The log model passes through the origin whereas the small model has an intercept at about 264 hours. The ratio of the

Figure 4

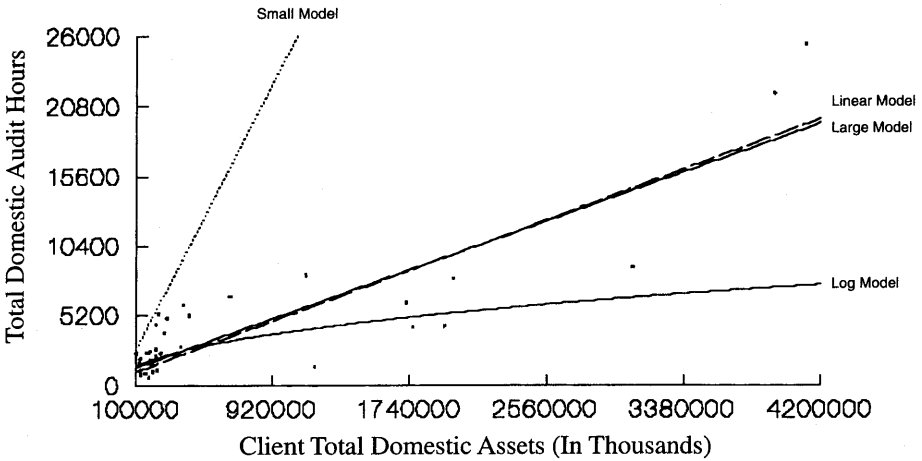
Relationship Between Client Size and Audit Hours for 51 Clients with Total Domestic Assets Between $25 Million and $100 Million



Legend: Large Model Fit on 86 Clients with Over $25 Million in Total Domestic Assets
Small Model Fit on 163 Clients with Total Domestic Assets Less Than $25 Million
Log Model is Antilog of Log Model
Linear Model Fit on All 249 Client Observations

Figure 5

Relationship Between Client Size and Audit Hours for 35 Clients with Total Domestic Assets Over $100 Million



Legend: Large Model Fit on 86 Clients with Over $25 Million in Total Domestic Assets
Small Model Fit on 163 Clients with Total Domestic Assets Less Than $25 Million
Log Model is Antilog of Log Model
Linear Model Fit on All 249 Client Observations

small model to log model residual sums of squares is .98 for these 163 small clients, which confirms that the small model minimally outperforms the log model over this size range. Clearly, both the linear model and the large model tend to overestimate hours for small clients.

Figure 4 shows that the small model, when extended into the large client range, significantly overestimates total audit hours. The large model has roughly the same slope as the linear model, but its intercept is about 350 hours higher. The log model is closer to the linear model when client size is just over $25 million, and it passes through and closely approximates the large model toward the upper end of this range where size approaches $100 million in assets. The ratio of the large model to log model residual sums of squares is 1.14 over this range, indicating that the log model has a better fit over the lower range of large client sizes.

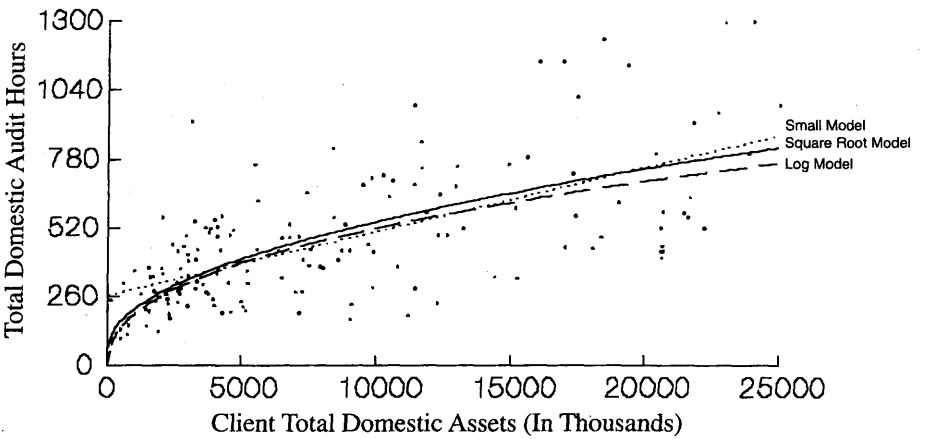
Figure 5 shows that the log model significantly dampens at the extreme upper end of the range of large clients, indicating that it is not descriptive of the relationship between size and hours for the very largest audit clients. The linear model and the large model trace similar paths over this upper range for the largest clients. The ratio of the large model to log model residual sums of squares is .36, confirming the inferiority of the log model in this upper range of size.

Figures 3 through 5 indicate that the two-equation model and the log model are approximately equivalent in terms of proportion of explained variation in audit hours for all but the very largest clients. The two largest sample clients "swamp" the models in that total hours are more than twice that of any other sample client. The log model is the least sensitive to these two observations. In fact, the sum of the two squared residuals for these observations when estimated using the log model (in antilog form) account for 82 percent of the residual sum of squares from that model in this upper size range. We investigated the sensitivity of results to these two "mega-clients" by

temporarily dropping them from the sample and recomputing the R^2s for all models. Both the two-equation and log models explain 69 percent of the total variation in audit hours for the remaining 247 clients. The linear model explains 62 percent of total variation, which is significantly lower than the two-equation and log models. The square root model had the best fit on this truncated sample with an $R^2 = .76$.

Figure 6

Relationship Between Client Size and Audit Hours for 163 Clients with Total Domestic Assets Less Than $25 Million



Legend: Small Model Fit on 163 Clients with Total Domestic Assets Less Than $25 Million
Log Model is Antilog of Log Model Fit on 247 Client Observations
Square Root Model Fit on 247 Client Observations

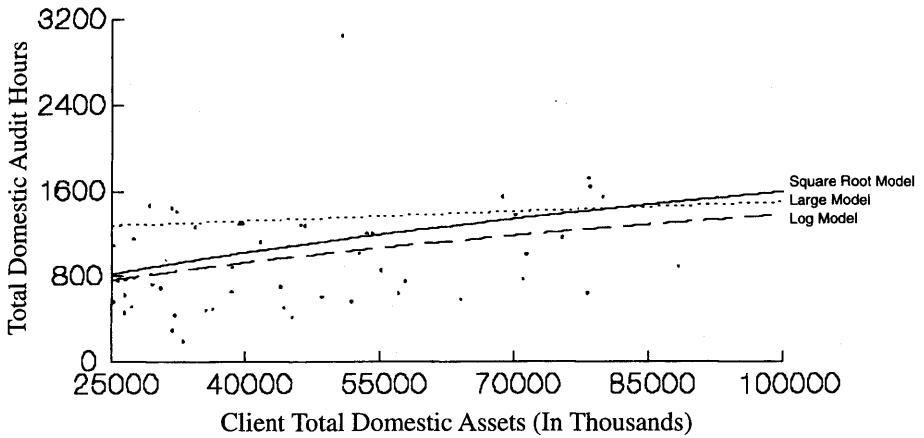
Figures 6 though 8 illustrate the dispersion of actual total audit hours around plots for the separate small and large client models and the log and square root models when estimated on the truncated sample of 247 observations. All three models appear nearly identical for the subset of 163 small clients depicted in Figure 6. In Figure 7, the square root and log models appear similar for the subset of 51 clients with assets between $25 million and $100 million. The large model appears to slightly overestimate hours within this range. For the remaining 33 large clients with assets greater than $100 million, the square root model depicted in Figure 8 appears to outperform the other two models.

Based on the analyses presented in Table 2 and Figures 3 through 8, we make the following observations. First, R^2s should be cautiously interpreted when transformations are made to a dependent variable, as in the case of the log model. Reliance on the proportion of explained variation in the transformed dependent variable may be misleading. Second, the estimated two-equation model fits the relationship between client size and audit hours at least equally as well as the log model, and better when the largest clients are not truncated from the sample. Third, the square root model significantly outperforms both the two-equation and log models for all but the largest "mega-clients".

We utilize the two-equation model for our remaining analyses of the impacts of other engagement characteristics on residual audit hours because it explains the largest proportion of total variation in the complete sample. We do not wish to exclude "mega-clients" from our analysis because other characteristics may explain some of

Figure 7

Relationship Between Client Size and Audit Hours for 51 Clients with Total Domestic Assets Between $25 Million and $100 Million

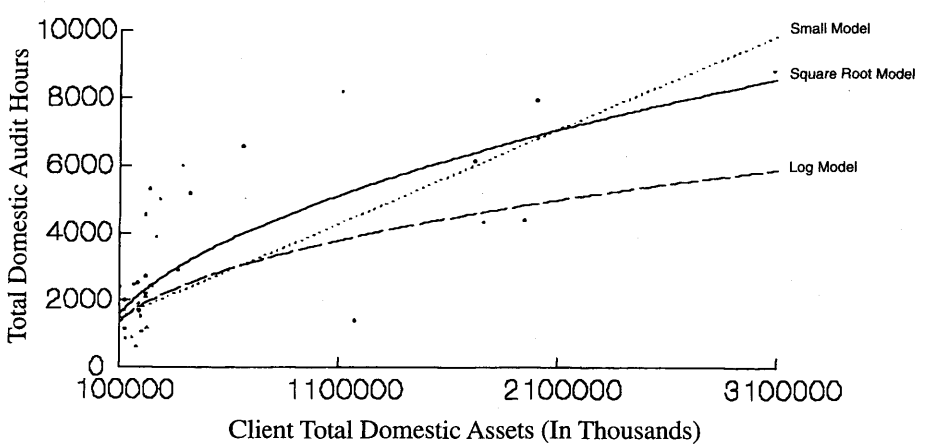


Legend: Large Model Fit on 84 Clients with Total Domestic Assets Greater Than $25 Million
Log Model is Antilog of Log Model Fit on 247 Client Observations
Square Root Model Fit on 247 Client Observations

their residual variance. However, we recognize that the square root model may provide slightly better control for the effect of client size on audit hours for the majority of clients in the sample. In the next section, we analyze the relationship between other engagement characteristics and residual audit hours after controling for client size using the two-equation model.

Figure 8

Relationship Between Client Size and Audit Hours for 33 Clients with Total Domestic Assets Over $100 Million



Legend: Large Model Fit on 84 Clients with Total Domestic Assets Greater Than $25 Million
Log Model is Antilog of Log Model Fit on 247 Client Observations
Square Root Model Fit on 247 Client Observations

Relationship Between Residual Audit Hours and Other Engagement Characteristics

In order to investigate the association between characteristics other than size and total audit hours, we computed residuals from the two-equation size model and coded each residual as negative or positive for both the small and large models. Negative residuals indicate the size model overestimates hours and positive residuals indicate underestimation of hours. Next we examined the association between other engagement characteristics and residual signs for the small and large clients. Significant associations provide preliminary indications of the existence of other characteristics that may help explain over- or underestimation of audit hours based on size alone. For example, consider two clients of approximately the same size, with one having significant foreign operations and the other having no foreign operations. If the existence of foreign operations necessitates more audit work, we would expect total audit hours to be greater for the client with foreign operations. Assuming both of these observations influenced the intercept and slope of the size model, it is reasonable to expect that the model would overestimate hours for the client with only domestic operations, and underestimate hours for the client with foreign operations.

Twenty-seven engagement characteristics were investigated in the manner described above–17 qualitative indicators and ten continuous measures. Table 3 reports the association between the 17 qualitative characteristics and residual signs for small and large clients, and for the total sample taken as a whole. Characteristics have been grouped into the following categories: client complexity, client controls and assistance, risk characteristics[11] and audit characteristics. For each qualitative characteristic, Table 3 reports the proportion of clients with negative residuals exhibiting the characteristic, the proportion of clients with positive residuals exhibiting the characteristic, and the probability for a Pearson χ^2 test for significant differences in observed and expected frequencies. Characteristics whose proportions are significantly different for negative and positive residuals at the .05 level have been highlighted in Table 3.

Table 3 indicates that qualitative client complexity measures are significantly correlated with residual audit hours for large clients, but not for small clients. A significantly higher proportion of large clients with positive residuals exhibit the existence of foreign operations, of a partially or fully decentralized accounting and financial control system, and of a high degree of operational complexity, as compared with large clients with negative residuals. For example, sixty-three percent of those large clients with positive residuals have a high degree of operational complexity, compared to only 22 percent of large clients with negative residuals.

Table 3 indicates that neither quality of, and extent of reliance on, client internal controls nor client assistance are significantly associated with residual audit hours for either small or large clients. However, several risk characteristics appear to affect total audit hours. A significantly greater proportion of large clients that are public companies have positive residuals.[12] A significantly larger proportion of small clients with excessive employee turnover have positive residuals. A higher proportion of large clients with low overall inherent risk have negative residuals, and a higher proportion

[11] This paper does not investigate the issue of whether, or how, auditor business risk impacts audit fees. See Bell, Lansdman, and Shackelford (1994) for a detailed analysis of this related topic.

[12] Obviously, many of the client and audit characteristics could be assigned to more than one category. For example, a public company typically is a more complex client than a private company, e.g., SEC filings would require additional audit work. However, we include this characteristic in the risk category for obvious reasons.

Table 3

Relationship Between Residual Audit Hours and Client and Audit Characteristics — Qualitative Variables (Sample Proportions Reported for Subsets of Clients with Negative vs. Positive Residual Audit Hours)

Engagement Characteristics	163 Small Clients Neg.	Pos.	Prob.	86 Large Clients Neg.	Pos.	Prob.	All 249 Clients Neg.	Pos.	Prob.
Client Complexity									
Client Has Foreign Operations (DFOROPS)	4%	11%	.103	**24%**	**45%**	**.039**	**11%**	**23%**	**.009**
Client's Accounting & Financial Control Is Partially or Fully Decentralized (DCENTRAL)	11%	14%	.579	**24%**	**51%**	**.011**	**15%**	**27%**	**.023**
Client's EDP Environment is Complex (DEDP)	5%	5%	.954	29%	38%	.382	13%	17%	.411
Operational Complexity, as Measured by the Number and Location of Operating Units and Diversification of Product Lines, is Fairly or Very Complex (DCOMPLEX)	2%	6%	.258	**22%**	**63%**	**.000**	**9%**	**26%**	**.000**
Client Controls & Assistance									
Client Has Poor or Virtually No Controls (DCTRL)	8%	10%	.646	7%	3%	.377	7%	7%	.962
Reliance on Internal Controls is Moderate to Extensive (DICRELY)	3%	4%	.770	22%	20%	.843	9%	10%	.930
Assistance from Internal Audit is Moderate to Extensive (DIAST)	1%	1%	.867	17%	13%	.528	7%	5%	.689
Client Assistance is Moderate to Extensive (DCLNAST)	69%	61%	.278	74%	70%	.687	71%	64%	.273
Risk Characteristics									
Client Is Public Company (DPUBLIC)	8%	15%	.125	**15%**	**58%**	**.000**	**10%**	**30%**	**.000**
Client Is New Company (DAGE)	3%	4%	.770	2%	0%	.348	3%	3%	.909
Client's Employee Turnover is Not Low (DTURN)	**42%**	**58%**	**.049**	36%	57%	.061	**40%**	**58%**	**.007**
Overall Inherent Risk is Low (LOWIRISK)	36%	26%	.179	**57%**	**23%**	**.001**	**43%**	**25%**	**.003**
Overall Inherent Risk is High (HIIRISK)	**3%**	**11%**	**.048**	2%	5%	.476	**3%**	**9%**	**.041**
Consolidated Shareholders' Equity is Negative (DEQUITY)	9%	11%	.621	4%	3%	.641	7%	8%	.828
Audit Opinion is Other Than Unqualified (DOPIN)	21%	26%	.409	13%	15%	.794	18%	22%	.425
Audit Characteristics									
Audit Procedures Primarily Performed Subsequent to Client's Fiscal Year-End (DTIMING)	100%	97%	.108	74%	62%	.267	91%	84%	.111
Number of Overtime Hours for Engagement is Moderate to High (DOVER)	18%	28%	.163	**40%**	**84%**	**.000**	**26%**	**48%**	**.000**

Boldface Indicates Pearson Chi-Square Test is Significant at the .05 Level.

Table 4

Relationship Between Residual Audit Hours and Client and Audit Characteristics — Continuous Variables (Means Reported for Subsets of Clients with Negative vs. Positive Residual Audit Hours)

Engagement Characteristics	163 Small Clients			86 Large Clients			All 249 Clients		
	Neg.	Pos.	Prob.	Neg.	Pos.	Prob.	Neg.	Pos.	Prob.
Client Complexity									
Percentage of Foreign to Total Assets (FORASST)	**0.23%**	**2.51%**	**.018**	4.11%	7.58%	.203	**1.53%**	**4.32%**	**.016**
Percentage of Foreign to Total Sales (FORSALES)	**0.18%**	**2.11%**	**.015**	5.09%	9.68%	.164	**1.83%**	**4.81%**	**.021**
Total Number of Separate Audit Reports for This Engagement (TREPORTS)	**1.4**	**1.9**	**.020**	3.9	5.3	.479	2.2	3.1	.224
Audit Characteristics									
Number of Years as a Client (CLYRS)	8.3	8.8	.758	12.5	13.4	.690	9.7	10.4	.559
Number of Years Current Partner Has Worked on This Engagement (PTRTOT)	4.2	4.3	.952	5.1	4.7	.699	4.5	4.4	.884
Number of Years Current Manager(s) Has Worked on This Engagement (MGRTOT)	2.4	2.7	.510	3.4	3.0	.453	2.8	2.8	.986
Number of Years Current Senior(s) Has Worked on This Engagement (SNRTOT)	1.7	1.6	.520	1.8	2.4	.104	1.8	1.9	.537
Number of Calendar Days Between Client's Fiscal Year-End and Date of the Audit Report (URGENCY)	67.2	78.4	.121	62.7	53.3	.184	65.7	69.4	.492
Domestic Audit Fees Billed Divided by Domestic Audit Hours (FEEPERHR)	62.42	59.25	.208	67.28	69.61	.430	64.05	62.95	.579
Risk Characteristics									
Book Value of Total Liabilities Divided by Total Assets (LEVERAGE)	.747	.687	.554	.590	.622	.534	.694	.664	.662

Boldface Indicates t-test for Differences in Means is Significant at the .05 Level.

clients with low overall inherent risk have negative residuals, and a higher proportion of small clients with high inherent risk have positive residuals.

Finally, Table 3 indicates that timing of the performance of audit procedures, i.e., whether significant interim work is performed, does not appear to significantly impact residual audit hours from the size models. However, a significant amount of overtime is spent by the engagement team on large clients with positive residuals.

Table 4 reports means for characteristics measured on continuous scales for clients with negative and positive residuals, and the probability from t-test 's for significant differences in observed means.[13] Characteristics whose means are significantly different for negative and positive residuals at the .05 level have been highlighted. Table 4 indicates that none of the characteristics measured on continuous scales are significant for large clients. Three client complexity characteristics are significant for the small client subsample. These are: percentage of foreign to total assets, percentage of foreign to total sales, and the number of separate audit reports issued for the engagement. For each of these complexity measures, small clients with positive residuals have significantly larger means.

OSS test for auditor learning effects by evaluating the incremental contributions of a set of dummy variables capturing the tenure of the audit firm with the client. They find no evidence of the effect of audit firm learning on total audit hours. We supplement their learning tests by investigating the tenure of current *audit personnel,* as opposed to audit firm tenure. In Table 4, we report tests for significant differences in the mean number of years personnel have worked on the current audit engagement for clients with negative and positive size-model residuals. The learning hypothesis would imply that audits being staffed by the same personnel for several years should take less time to complete, compared to audits with a less experienced engagement team. The section in Table 4 labeled "Audit Characteristics" reports the mean number of years partners, managers, and seniors have worked on the current engagement. These average experience measures are not significantly different for clients with negative and positive residuals, regardless of size, indicating that familiarity with the client's operations does not result in a reduction of audit hours.

Summarizing to this point, preliminary tests for identifying engagement characteristics impacting total audit work performed indicate that client complexity and certain audit risk characteristics are significantly associated with residual audit hours after controlling for client size. No initial evidence exists that quality of client internal controls, level of client assistance on the audit, or other audit characteristics (except overtime) significantly impact total work performed on financial statement audits. In the next section, we report the results of tests of multivariate models of total audit hours.

Analysis of Multivariate Equations of Total Audit Hours for Small and Large Clients

The analyses presented in the previous section provide a preliminary indication of those engagement characteristics other than client size that might provide significant incremental explanatory power in multivariate models of total audit hours. In this section, we report the results of our specification of a final model of total audit hours. We also investigate those engagement characteristics most significantly associated with the allocation of audit hours for different personnel ranks.

[13] Pooled within-groups standard deviations are used where warranted.

Table 5
Multivariate Models for Total Domestic Audit Hours and Hours by Personnel Rank (Signed Coefficient t Statistics and Model R-Squares)

Client & Audit Characteristics	Total Domestic Audit Hours		Partner Hours	Manager Hours	Senior Hours	Staff Hours
	Slope	t-Statistic	Signed t-Statistics			
Large Clients						
Total Domestic Assets (In Millions)	1.06	3.33	**1.31 (NS)**	**1.72 (NS)**	**.56 (NS)**	3.30
Total Number of Separate Audit Reports	78.45	4.91	8.12	5.22	5.79	**.81 (NS)**
Low Inherent Risk (Shifts Intercept)	–669.83	–3.10	**–1.26 (NS)**	**–.94 (NS)**	**–.65 (NS)**	–3.14
High Operational Complexity (Shifts Intercept)	738.05	3.24	2.40	2.33	**1.85 (NS)**	2.20
Slope Adjustment on Total Domestic Assets for Public Cos. with Foreign Operations	3.60	12.00	6.27	5.52	6.90	9.55
Sub-Model R-Square	.94		.87	.83	.83	.90
Small Clients						
Total Domestic Assets (In Millions)	23.08	11.00	5.36	6.96	9.16	9.87
Total Number of Separate Audit Reports	16.12	**1.61 (NS)**	**1.46 (NS)**	**.81 (NS)**	**1.14 (NS)**	**1.42 (NS)**
Public Company (Shifts Intercept)	118.95	2.74	5.01	5.88	**.99 (NS)**	**1.25 (NS)**
Percentage of Foreign Sales	8.72	3.20	2.50	3.52	3.05	**1.81 (NS)**
Slope Adjustment on Total Domestic Assets for Clients with High Inherent Risk	20.90	3.16	**.54 (NS)**	3.76	**1.03 (NS)**	3.33
Sub-Model R-Square	.54		.31	.44	.40	.46
Combined Model R-Square	.95			.95		

(NS) = Not Significant at the .05 Level.

Table 5 reports our final multivariate models of total audit hours for small and large clients. We tested many combinations of engagement characteristics, including interactions among characteristics, using our analyses of residual hours to guide our choices. However, we did not limit our search for significant incremental variables to those significant variables identified in the preliminary residual analysis. All of the 27 engagement characteristics were given a chance to enter the final model in various forms.

The large client model presented in Table 5 contains a set of client complexity measures, including size, and a low inherent risk indicator variable. All variables are incrementally significant at the .05 level and coefficient signs are consistent with our intuition. The model indicates resources are allocated to large audit engagements in the following manner. For each $1 million in total assets, one hour is added to total audit hours. Each audit report issued for a large engagement results in the addition of 78 hours to the audit. On average, if a large client is rated as exhibiting low inherent risk, total audit hours decline by 670.[14] On average, if the client exhibits a high degree of operational complexity, 738 hours are added to the audit. Finally, for those large public clients with foreign operations (22 percent of our sample of 86 large clients), total audit hours increase by about five for each $1 million in total assets. The large client model explains 94 percent of the total variation in total audit hours for the 86 large clients.

The lower section of Table 5 reports our final model estimated on the 163 small clients. As with the large client model, this model contains a set of client complexity measures, including size, and an inherent risk indicator variable (slope adjustment on size for high, instead of low, inherent risk). All variables are incrementally significant at the .05 level except for total number of separate audit reports (t-test probability = .11), and all coefficient signs are consistent with our intuition. The model indicates resources are allocated to small audit engagements in the following manner. For each $1 million in total assets, 23 hours are added to total audit hours. Each audit report issued for small engagements results in the addition of 16 hours to the audit. On average, if a small client is a public company, total audit hours increase by 119. For each percentage point of foreign sales to total sales, audit hours increase by nine. Finally, for those small public clients with high inherent risk, total audit hours increase by about 21 for each $1 million in total assets. The model explains 54 percent of the total variation in total audit hours for the 163 small clients.[15]

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[14] Dummy variables that shift the model intercept capture "average" effects on hours for the entire subset of clients exhibiting the characteristic. In reality, the effect would likely vary across engagements depending on the size of the client and the existence of other engagement characteristics. For some characteristics our model only includes a term that captures the intercept shift because additional variables that attempt to capture related slope changes were not statistically significant.

[15] Table 5 indicates that the large model explains a much higher proportion of total variation in hours for the 86 large clients as compared to the proportion of total variation explained with the small model for the 163 small clients. We can only guess as to why this is true. One explanation is that the two "mega-clients" discussed in an earlier section contribute a large proportion of the total variation in hours for large clients, and influence model fit to the extent that much of this variation is explained. We dropped the two largest clients from the large sample and re-estimated the final large model. The R^2 dropped to .79, still significantly higher than for the small model. Based on discussions with auditors, we suspect the principal cause for higher unexplained variability in hours on small clients relates to the high degree of variability in the quality of the accounting support function within small clients. Some small clients have implemented high quality reporting systems, and others have not. For those clients who have poor systems or none at all, a large portion of the total audit work involves accounting work. This characteristic is virtually nonexistent for large clients.

The R^2 for the full two-equation model is .95 (adjusted R^2 = .94).[16] If we delete the two "mega-clients" from the large sample, the R^2 for the full two-equation model drops to .84 (adjusted R^2 = .84), but the coefficient signs and significance levels are unaffected. We also estimated the full two-equation model using the square root of assets as the client size measure. The R^2 for this model (not shown is Table 5) is .89 when estimated on the full sample of 249 clients, and .88 when estimated on the truncated sample of 247 clients. These results indicate that the two-equation model with total assets used as the client size variable performs slightly better than the two-equation square root model for the full sample of 249 clients, but the two-equation square root model performs slightly better on the truncated sample of 247 clients.

Table 5 also reports the t-statistics for coefficients in separate models of partner, manager, senior and staff hours. Client size for those large clients that are not public companies with foreign operations is not significant in determining the allocation of partner, manager and senior hours. Size most significantly impacts the allocation of staff hours for large clients. The same phenomenon exists for the low inherent risk characteristic for large engagements–staff hours are the only hours that are significantly reduced. Partner, manager, and senior hours are significantly increased by the total number of separate audit reports, but staff hours are not significantly affected by this characteristic. For large clients with a high degree of operational complexity, allocations of hours for all four personnel ranks are significantly positively impacted, but for seniors only marginally (t-test probability for seniors = .06). Allocations of hours for all personnel ranks is significantly impacted by size for those large public clients with foreign operations.

For small clients, Table 5 indicates that allocations of hours for all personnel ranks are significantly impacted by client size. The total number of separate audit reports does not significantly impact allocations of hours for any rank of personnel. Sixty-nine percent of the sample of 163 small clients have only one audit report, whereas 74 percent of the large clients have more than one audit report. We included the variable in the small client models because it was marginally significant for the total hours model (p = .11) and because the preliminary analysis of residual hours (reported above) indicated significance. Partner and manager hours are significantly higher for publicly traded small companies, but allocations of senior and staff time are not significantly impacted by this characteristic. For each percentage point of foreign sales to total sales, audit hours for partners, managers and seniors are significantly increased, but not for staff. Finally, allocations of hours for managers and staff are significantly impacted by client size for those small clients with high inherent risk, but not allocations of hours for partners and seniors.

In order to investigate whether the use of separate models by personnel rank might explain more of the variation in total audit hours, we estimated total hours using these separate models for small and large clients, and computed the proportion of total variation in total audit hours explained by the aggregate estimates. Estimated hours for each personnel rank were first summed for each sample client, yielding an estimate of total audit hours. Residuals were then computed by subtracting these estimates from actual hours. The squared residuals were then summed and the R^2 for total audit hours was computed using equation (3) given above. As indicated in Table 5, this R^2 is .95 and is not significantly different from the R^2 resulting from application of the total hours model without concern for personnel ranks. In fact, the residual sums of squares for both approaches are almost identical.

[16] See footnote 9.

Summary

In this study, we investigated the association between many audit engagement characteristics and quantity of work performed on domestic financial statement audits to better understand the determinants of audit resource allocations. We observed that for a sample of 249 manufacturing, merchandising, and high technology clients, different characteristics appear to impact quantity of audit work performed for small and large engagements. For small engagements with total assets up to $25 million, client size, ownership status, the percentage of foreign to total sales, and whether the client exhibits high inherent risk appear to significantly impact the quantity of work. For large engagements with total assets over $25 million, client size, the total number of audit reports, a high degree of operational complexity, whether the client exhibits low inherent risk, and whether the client is a public company with foreign operations appear to significantly impact the quantity of work.

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