The Effects of Three Methods of Sample Selection on Dollar Unit Sampling Bounds

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On Dollar Unit Sampling Bounds

Probability proportional to size (PPS) sampling plans which define the sample unit as an individual dollar represented in an account balance under examination have received some attention in the accounting literature of the past decade. The various research papers and statistical sampling guides which have emerged have typically supported the use of one or more of three sample selection methods; (1) unrestricted random selection, (2) systematic selection with at least one random start, and/or (3) cell selection. In addition, the Poisson distribution has frequently been employed in conjunction with these three methods of sample selection to establish an upper limit on the number of dollars in error in an auditing population. This application of the Poisson distribution in connection with systematic selection and cell selection of dollar units appears questionable under certain population conditions. It is the purpose of this research to illustrate obvious conditions under which systematic selection and cell selection of dollar units are not appropriate and to provide test results using simulation to illustrate the effects of these sample selection methods under likely audit conditions. Throughout the remainder of this paper any PPS sampling plan which defines the sample unit as an individual dollar will be referred to as a dollar unit sampling (DUS) plan.
APPROPRIATE USE OF THE POISSON DISTRIBUTION:

Unrestricted random sampling of dollar units from a population for the purpose of establishing an upper limit on the number of erroneous dollars in the population is best described by a hypergeometric distribution. Each dollar unit may be thought of as being correct or in error depending on whether the account which contains the dollar unit is correctly stated or in error. Populations normally sampled by auditors are finite and sampling is typically performed without replacement. The use of the hypergeometric distribution, however, requires extensive computation or voluminous tables. Therefore, use of the hypergeometric distribution is normally restricted to situations where a computer may be employed.

The binomial distribution provides a reasonable and slightly conservative approximation to the hypergeometric distribution when the rate of error is low in the population. The binomial distribution offers the advantage of less computation or fewer tables. To reduce either the computations or number of required tables even further, a Poisson approximation may be used. The Poisson approximation provides a good and slightly conservative approximation to the binomial distribution in cases where the sample size is "large" and where the probability of finding an error in the population is "small".

In addition, the Poisson distribution assumes that the errors in the population occur randomly and independently of each other. This assumption is violated to some degree under a dollar unit sampling plan whenever the reported book values of the individual accounts in the population are greater than one dollar. For example, if a population contained an account which was recorded at $100 when the true balance in the account was zero, the 100 erroneous dollars
or sample units would be dependent. All of the 100 sample units would belong to the same account which would determine their position in the cumulative total of book values from which the sample selection would be made. The seriousness of this problem depends upon the number and relative size of the accounts in error.

THE TRIVIAL CASE:

Consider the case of ten separate accounts receivable accounts, accounts A through J, each having a reported balance of $1,000. In a DUS context the population would be represented by the 10,000 individual dollars represented in the accounts receivable balance (ten accounts of $1,000 each). Each sample unit (i.e. dollar represented) would be identified by its position in a cumulative total of the individual account balances. To illustrate, sample unit number one would be the first dollar of account receivable A and sample unit 6,784 would be the 784th dollar of account receivable G in the worksheet below:

<table>
<thead>
<tr>
<th>Account</th>
<th>Reported Value</th>
<th>Cumulative Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>B</td>
<td>1,000</td>
<td>2,000</td>
</tr>
<tr>
<td>C</td>
<td>1,000</td>
<td>3,000</td>
</tr>
<tr>
<td>D</td>
<td>1,000</td>
<td>4,000</td>
</tr>
<tr>
<td>E</td>
<td>1,000</td>
<td>5,000</td>
</tr>
<tr>
<td>F</td>
<td>1,000</td>
<td>6,000</td>
</tr>
<tr>
<td>G</td>
<td>1,000</td>
<td>7,000</td>
</tr>
<tr>
<td>H</td>
<td>1,000</td>
<td>8,000</td>
</tr>
<tr>
<td>I</td>
<td>1,000</td>
<td>9,000</td>
</tr>
<tr>
<td>J</td>
<td>1,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>
Suppose that account D in the above example were a fictitious account. In this case all of the sample units associated with account D would be incorrectly stated (i.e. sample units 3,001 through 4,000 would all represent fictitious dollars within account D). Note that identifying an account as being fictitious in this example simultaneously identifies 1,000 contiguous sample units as representing fictitious dollar amounts. The errors are not randomly distributed throughout the population and therefore if a method of sample selection is used which might be affected by the non-random placement of the erroneous units in the population a basic assumption of the Poisson model is violated. Note that unrestricted random sampling is not affected by the non-random placement of errors in the population because the placement of the errors in the population does not affect the probability that any error or group of errors will be included in the sample.

For the purpose of illustration, assume a desired dollar unit sample of size 10 from the 10,000 dollar units represented by the ten accounts described above. If we chose to use systematic sampling with one random start we would select one number at random in the open interval 1 to 1,000 and proceed to select every one thousandth dollar throughout the population. This selection method would always result in finding one erroneous dollar unit and nine correct dollar units from the population described. Since the 1,000 erroneous dollar units are contiguous in the population and since the sampling interval is equal to 1,000, the probability of selecting zero erroneous units or more than one erroneous unit in any given sample of size ten is zero.
Cell selection, as first described by Teitlebaum (1973), would require division of the population of 10,000 dollar units into ten "cells" of equal size. One dollar unit would then be selected at random from each of the ten cells. In the trivial case under examination, each account would represent a separate cell and one dollar unit would be selected at random from each cell. The results of the sample selection would be that each possible sample of size ten would include exactly one erroneous dollar unit and nine correctly stated dollar units from the population.

Unrestricted random selection of dollar units from this hypothetical population could result in any one of eleven possible sample outcomes. The auditor could find 0, 1, 2, ..., 9, 10 errors in any given sample. Assuming sampling without replacement the probability of a specified number of errors appearing in any given sample could be computed using the following probability formula:

\[
P(x) = \frac{\binom{A}{x} \binom{N-A}{n-x}}{\binom{N}{n}} = \frac{A!}{x!(A-x)!} \frac{(N-A)!}{(n-x)!(N-A-n+x)!} \frac{n!}{N!} \frac{1}{(N-n)!}
\]

where,

\( P(x) \) = probability of selecting \( x \) errors from the population

\( A \) = the number of erroneous sample units in the population

\( N-A \) = the number of correctly stated sample units in population

\( N \) = the population size

\( n \) = the sample size

Note that this probability formula describes the hypergeometric probability density function for \( x = 0, 1, 2, ..., n \). The sampling
distributions for each of the three sample selection methods discussed in the trivial case are illustrated in Figure 1.

Continuing the example in the trivial case, assume that the auditor wished to evaluate the sample results obtained by employing the Poisson distribution. Assuming that the auditor chose the appropriate Poisson distribution with a mean equal to one, the auditor would determine the appropriate level of confidence from the distribution represented in Figure 2.

Note the similarity of the Poisson distribution in Figure 2 with the unrestricted random selection distribution in Figure 1. This similarity in distributions is the primary justification for the use of the Poisson approximation to the hypergeometric distribution in this and similar sampling cases. The auditor could make a reasonable statement as to the achieved confidence in a sampling situation using the Poisson approximation demonstrated.

A similar comparison of the Poisson distribution in Figure 2 with the sampling distributions resulting from systematic and cell selection techniques reveals a striking difference. The Poisson distribution in no way resembles the other two sampling distributions and therefore cannot be relied upon to form reasonable auditing conclusions regarding the level of confidence achieved in the sampling plan.

The area of the Poisson distribution that is of most concern to the auditor is the area under the right tail of the distribution since auditors most frequently use the Poisson values to determine an upper limit on the error rate in the population. The distributions in Figures 1 and 2 show that the area under the right tail of the
FIGURE 2

Poisson Frequency Distribution
mean = 1

Number of errors

Relative Frequency

0.3679 0.3679 0.1839 0.0613 0.0153 0.0031
Poisson distribution is greater than the corresponding area in the unrestricted random selection (hypergeometric) distribution. The significance of this relationship is that for the trivial case illustrated the Poisson distribution will yield a "conservative" approximation to the hypergeometric distribution. Also, since the sampling distributions for the systematic and cell selection methods are centered at the mean with no tails, use of a Poisson approximation would greatly understate the achieved confidence related to the sampling plan and/or overstate the possible error rate in the population. Note that a comparison of the hypergeometric distribution (also shown as the unrestricted random selection distribution) with the systematic and cell sampling distributions does not alter the conclusions. The direction of error is the same and the magnitude of the error is very close.

Very little comfort should be derived from the fact that the systematic and cell selection methods were able to predict the exact error rate in the population in every case in the trivial example. A slight change in the location of errors in the population would alter that result. This will be demonstrated in the simulations which follow.

SIMULATION TEST:

In order to determine the effect of the method of sample selection in a more realistic auditing situation, a hypothetical population of 10,000 accounts receivable accounts was constructed. Repeated sampling was then performed and the resulting sampling distributions examined.
TEST POPULATIONS:

The 10,000 simulated accounts receivable book values used in this study were obtained by using a random number generating program subroutine to generate random numbers according to a Weibull distribution. A Weibull distribution has been employed in previous research on DUS bounds by MacGuidwin, Roberts, and Shedd (1981, p. 7) for generating population book values. By assigning appropriate parameter values, a Weibull distribution may be used to achieve an L shaped distribution which is believed to be a common distribution shape in accounts receivable populations (see Neter and Loebbecke 1975, pp. 11-28).

The similarity between the distribution of book values used in this study with the empirically derived distributions employed by Neter and Loebbecke (1975) is demonstrated in table 1. The density of the Weibull distribution function employed and the values assigned to the distribution parameters are given in figure 3 below. Also, figure 4 shows a histogram illustrating the achieved shape of the distribution of book values generated. For purposes of illustration, the accounts were grouped in $600 intervals and the number of accounts within each interval plotted. Six accounts were over $45,000 and thus were not represented on the histogram.

Figure 3
Weibull probability density function

\[ f(x) = \left( \frac{A}{B} \right) \left( \frac{x-C}{B} \right)^{A-1} \exp \left[ - \left( \frac{x-C}{B} \right)^A \right] \]

where:

A = 0.5; the shape parameter
B = 900; the scale parameter
C = 1.0; the location parameter
Table 1

Characteristics of test population book values compared with prior research

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of accounts</td>
<td>10,000</td>
<td>7,026</td>
<td>4,033</td>
</tr>
<tr>
<td>Total Book Value</td>
<td>$17,961,564.81</td>
<td>$13,671,500.00</td>
<td>$7,502,957.00</td>
</tr>
<tr>
<td>Mean</td>
<td>$1,796.16</td>
<td>$1,945.84</td>
<td>$1,860.39</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>3,816.42</td>
<td>7,021.61</td>
<td>3,865.13</td>
</tr>
<tr>
<td>Skewness</td>
<td>5.4</td>
<td>7.9</td>
<td>3.2</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>46.2</td>
<td>78.1</td>
<td>11.4</td>
</tr>
<tr>
<td>Maximum Value</td>
<td>$70,825.24</td>
<td>$98,162.70</td>
<td>$24,928.60</td>
</tr>
<tr>
<td>Minimum Value</td>
<td>1.00</td>
<td>$0.10</td>
<td>$0.10</td>
</tr>
</tbody>
</table>
Figure 4

Distribution of population book values

Thousands of dollars

Number of accounts

5500
1200
700
600
500
400
300
200
100

From this set of book values, errors were seeded into the population at different rates and using different methods of seeding to achieve four test populations to be referred to as populations A, B, C, and D. Population A was obtained by selecting accounts to be considered erroneous in the population at random until approximately one percent of the dollars in the population were tainted (i.e., until the sum of the book values of the accounts considered to be in error was approximately one percent of the total book value of the simulated population). Since the "erroneous" accounts were chosen at random, an error rate of approximately one percent in terms of the number of accounts in error was also expected.

Population B was obtained in a similar manner to population A by selecting the accounts to be considered in error at random. However, population B was seeded with errors until approximately ten percent of the dollars in the population were tainted.

Population C was obtained by first dividing the population into 200 cells of equal dollar amount to achieve a sample size of 200 and choosing one cell at random. The chosen cell, number 198, was represented by 76 accounts all of which were assigned errors. Additional accounts to be in error were then selected at random until approximately one percent of the dollars in the population were tainted.

Population D was obtained by first selecting one account number at random. Account number 8433 was chosen. Errors were then assigned to the accounts sequentially beginning with account number 8433 until approximately ten percent of the dollars in the population were tainted.
The results of the error seeding of populations A, B, C, and D have been presented in table 2.

**TABLE 2**

Characteristics common to all populations:

- Book value of entire population: $17,961,564.81
- Number of accounts in population: 10,000

<table>
<thead>
<tr>
<th>Population</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Book value of accounts in error</td>
<td>$194,221.03</td>
<td>$1,797,066.51</td>
<td>$183,911.31</td>
<td>$1,810,968.23</td>
</tr>
<tr>
<td>Error rate in terms of dollars</td>
<td>1.081%</td>
<td>10.005%</td>
<td>1.024%</td>
<td>10.082%</td>
</tr>
<tr>
<td>Number of accounts in error</td>
<td>116</td>
<td>996</td>
<td>133</td>
<td>1070</td>
</tr>
<tr>
<td>Error rate in terms of accounts</td>
<td>1.160%</td>
<td>9.660%</td>
<td>1.330%</td>
<td>10.700%</td>
</tr>
</tbody>
</table>

Two population error rates were desired in this research to examine the effects of the population error rate on the sample selection method. Also, since the location of the errors in the population may affect the number of errors discovered in a sample, three methods of determining the placement of the errors in the population were employed. Populations A and C each contained a moderately low rate of error and populations B and D contained a moderately high rate of error for accounts receivable populations according to prior research (see Johnson, Leitch, and Neter 1981). Populations A and B contained no systematic error pattern and
differed from each other only in the rate of error in each of the populations. Population C had 76 of its 133 erroneous accounts contiguous and the remaining 57 accounts randomly distributed throughout the population. Population D contained 1070 accounts in error, all of which were contiguous in the population. Note that the size of the error taintings seeded into the population was irrelevant in this portion of the research. For determining the distribution of the number of errors discovered in repeated sampling it is only necessary to know whether or not an error exists. The size of the error (i.e., tainting) is not relevant and thus has been ignored.

THE TEST HYPOTHESIS:

The primary purpose of this research was to examine the behavior of three sample selection methods and attempt to explain their impact on DUS bounds. Many DUS bounds use tabled values from the Poisson distribution to obtain an upper limit on the number of dollars in error in the population. However, if the sampling distribution of the number of dollars in error is not approximately Poisson, the auditor's conclusions may be adversely affected. Since the Poisson values have frequently been used in DUS, the proposed hypothesis compares the cumulative distribution of the number of errors found in actual sampling with the cumulative distribution of the number of errors expected assuming a Poisson distribution with the appropriate Poisson parameter value. Formally the hypothesis to be tested for each of the three sampling methods is as follows:
H1: S1=P1, S2=P2, ... , Sn=Pn: The sample proportion (S) for at most 1,2, ... , n errors found in the actual distribution of error frequencies is equal to the corresponding proportions of a Poisson distribution (P).

HA1: S1≠P1, S2≠P2, ... , Sn≠Pn: The sample proportion (S) for at most 1,2, ... , n errors found in the actual distribution of error frequencies is not equal to the corresponding proportions of a Poisson distribution (P).

The Kolmogorov-Smirnov test was chosen as the appropriate test to determine the significance of the results. The Kolmogorov-Smirnov test was originally designed for testing continuous distributions. Goodman (1954, p. 161), however, argued that any error obtained by applying the Kolmogorov-Smirnov statistic when the cumulative distribution function being tested was discontinuous would be in the "safe" direction (i.e., would understate the actual level of confidence). In addition, it has been suggested that the Kolmogorov-Smirnov statistic, when appropriately applied, may be more powerful than the Chi-Square statistic. This argument is based on a limited number of comparisons (see Massey 1951) and on the fact that the Chi-Square statistic often requires data to be summarized in order to provide sufficient numbers of observations in each group or class. This summarization of data results in a loss of sample information. Since the Kolmogorov-Smirnov statistic does not require any summarization it can utilize more of the information available from the sample (see Siegel 1956).

The first test consisted of drawing 500 samples of size 200 from each of the four test populations, A through D, described previously using unrestricted random selection and counting the number of tainted dollars discovered in each sample. The choice
of 500 samples was made to produce a sufficient number of observations for observing the distribution of the number of errors discovered. The number of samples was limited to 500 due to cost constraints. A sample size of 200 was selected in part to be consistent with previous research. This sample size was also selected to reflect a reasonable sample size to be employed when the auditor anticipated finding a moderate number of errors in the sample. Note that from a statistical standpoint the sample size of 200 would not normally be considered "small" and that the error rates in the populations are not extremely high. Since unrestricted random selection is really blind to the location of the errors in the population, one would expect the resulting distribution of sample errors from each of the samples drawn to be distributed approximately Poisson. This set of tests served as a control for the remainder of the experiment. This test was then repeated using systematic selection with one random start and again with cell selection, choosing one dollar unit at random from each of 200 cells of equal dollar amount.

In the hypothetical case of each account in the population having a book value equal to one dollar and the erroneous accounts being distributed randomly throughout the population there would be little, if any, difference expected between random selection, systematic selection, and cell selection. However, this is not the normal case in accounts receivable populations. Accounts vary in size, seldom being equal to one dollar, and errors may be distributed in a non-random pattern through the population. Since systematic selection and cell selection draw items evenly through the population
they would be more sensitive to non-random error patterns. This was expected to affect the distribution of the number of errors found using systematic and cell selection techniques.

Most of the accounts in the test population were small when compared to the size of the sampling interval or cell size used in this test. The average book value of an account, $1,796.16, was only two percent of the sampling interval or cell size employed. Therefore, in populations A and B where the accounts in error were randomly distributed throughout the population, the grouping of tainted dollars within accounts was not expected to have a large effect on the distribution of the number of errors found under each of the three sample selection methods examined. Note that when an account contained an error, each of the dollars in the account were considered tainted, thus, for accounts larger than one dollar there was a non-random grouping of erroneous sample units (or dollars) in the population. However, in the populations examined where the size of the individual accounts was relatively small and for the populations in which the accounts in error were randomly distributed throughout the population, the effects of this non-random grouping were minimized.

Populations C and D were extreme cases. The erroneous dollar units were grouped within these populations in such a way that entire sampling intervals or cells were filled with tainted dollar units. This non-random grouping of errors would have an obvious effect on the distribution of the number of errors found in repeated sampling. Each sampling interval or cell which has been filled with tainted dollar units would contribute exactly one error to the total number of errors discovered in a systematic or cell
sample. There would be no possibility of one sampling interval or cell contributing either zero or two errors to the total. The dispersion in the distribution of the number of errors discovered under systematic and cell sampling would therefore be expected to be less than the dispersion in the same distribution when unrestricted random sampling was employed.

RESULTS OF SIMULATION:

The results of the test of the hypothesis have been summarized in table 3. It is readily apparent from the table that random sampling, the control case, never produced a distribution of the number of errors discovered that was significantly different from a Poisson distribution. These anticipated results served two purposes. First they provided an additional check on the computer programming, and second, they provided a base from which to compare the remaining results. Also, as anticipated, both systematic and cell sampling produced distributions of the number of errors discovered that were significantly different from a Poisson distribution when applied to populations C and D.

It is evident from the simulation, and not at all surprising, that the placement of the errors in the population affects the number of errors selected in an individual sample using systematic or cell sampling. As was stated above in this paper, each sampling interval or cell which was completely comprised of tainted dollar units would contribute exactly one error to each sample drawn. The effect of this in populations C and D was to reduce the range of the number of errors discovered. Random sampling produced a range of errors
### Table 3

**Results of test of Hypothesis 1**

<table>
<thead>
<tr>
<th>Error Rate in dollars</th>
<th>Population A 1.0813%</th>
<th>Population B 10.005%</th>
<th>Population C 1.0239%</th>
<th>Population D 10.082%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected number of errors per sample</td>
<td>2.1626</td>
<td>20.010</td>
<td>2.0478</td>
<td>20.164</td>
</tr>
<tr>
<td>K-S statistic</td>
<td>.0095 .0370 .0190</td>
<td>.0259 .0974 .0393</td>
<td>.0237 .1290 .1290</td>
<td>.0297 .4557 .4037</td>
</tr>
<tr>
<td>Level of significance</td>
<td>ns ns ns</td>
<td>ns .01 ns</td>
<td>ns .01 .01</td>
<td>ns .01 .01</td>
</tr>
<tr>
<td>Number of errors in 500 samples</td>
<td>1089 1089 1077</td>
<td>9978 10183 9932</td>
<td>1059 1016 1052</td>
<td>10224 10086 10092</td>
</tr>
<tr>
<td>Mean</td>
<td>2.178 2.178 2.154</td>
<td>19.96 20.37 19.86</td>
<td>2.118 2.032 2.104</td>
<td>20.45 20.17 20.18</td>
</tr>
<tr>
<td>Skewness</td>
<td>.696 .569 .487</td>
<td>.194 -.337 .224</td>
<td>.644 .574 .782</td>
<td>.204 1.744 .293</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>.276 -.103 -.119</td>
<td>-.180 -.122 .142</td>
<td>.384 -.303 .233</td>
<td>-.246 1.044 .229</td>
</tr>
<tr>
<td>Minimum</td>
<td>0 0 0</td>
<td>9 10 10</td>
<td>0 1 1</td>
<td>9 20 19</td>
</tr>
<tr>
<td>Maximum</td>
<td>7 6 7</td>
<td>32 30 34</td>
<td>7 5 6</td>
<td>33 21 21</td>
</tr>
</tbody>
</table>

*R = Random Selection  
S = Systematic Selection  
C = Cell Selection  
K-S = Kolmogorov-Smirnov  
ns = not significant*
per sample of 0 to 7 in population C and 9 to 33 in population D.
Systematic and cell sampling produced a slightly smaller range than
random sampling in population C where one sampling interval or cell
was made up of all erroneous accounts and additional erroneous accounts
were randomly scattered throughout the remainder of the population.
However, in population D where all of the erroneous accounts were
contiguous in the population, the difference was dramatic, but
predictable. Systematic sampling produced a range of errors from
20 to 21 and cell sampling produced a range of errors from 19 to
21. The expected number of errors per sample using random sampling
was 20.164 for population D which was within the achieved range
for both systematic and cell sampling.

The results in the most extreme cases tested, populations A
and D, are not surprising, still it is worth noting some additional
relationships among the reported statistics in table 3. In all
cases the mean number of errors per sample is close to the expected
number of errors per sample. One sampling method did not consistently
select a higher or lower number of errors on the average than another.
The difference demonstrated above in the ranges obtained is even
more interesting when the variances are examined. In all four populations
random sampling showed the largest variance, cell sampling the second
largest, and systematic sampling the smallest variance, even when
there was no significant difference shown between the distribution
of the number of errors discovered. Also, in population B systematic
sampling produced a distribution of the number of errors discovered
significantly different from a Poisson distribution beyond the .01
level of significance.
A graphical illustration of the results obtained has been presented in figures 5 through 20. These graphs illustrate Poisson distributions with means corresponding to the number of errors expected per sample from each population followed by the achieved distributions using random, systematic, and cell selection of dollar units. These histograms graphically illustrate the smaller variance achieved using systematic and cell selection in sampling from the test populations.
Figure 5

Poisson Frequency Histogram
Mean = 2.163

Figure 6

Population A
Random Selection
Figure 7
Population A
Systematic Selection

Figure 8
Population A
Cell Selection
Figure 9

Poisson Frequency Histogram
Mean = 20.010

Figure 10

Population B
Random Selection
Figure 11
Population B
Systematic Selection

Figure 12
Population B
Cell Selection
Figure 13
Poisson Frequency Histogram
Mean = 2.048

Figure 14
Population C
Random Selection
Figure 15
Population C
Systematic Selection

Figure 16
Population C
Cell Selection
Figure 17

Poisson Frequency Histogram
Mean = 20.165

Figure 18

Population D
Random Selection
IMPACT OF SAMPLE SELECTION METHODS:

From the previous discussion and simulation results it is clear that the method of sample selection employed can be a determining factor in the number of errors discovered in a sample drawn from an auditing population. It appears that when just a few errors occur in relatively small accounts distributed randomly throughout the population that the method of sample selection is not an important factor. However, the results of the tests of significance for systematic selection applied to populations A and B suggest that as the error rate rises, systematic selection may tend to produce fewer samples with extreme values even when the erroneous accounts are randomly distributed throughout the population.

In the case where errors are grouped together in the population, systematic and cell selection methods will assure samples with a much less variable number of errors between samples. Thus, when the errors are grouped within cells or sampling intervals, as in populations C and D, systematic or cell sampling methods will yield more consistent results in terms of the number of errors discovered than random sampling. This was demonstrated by the much smaller variances found for systematic and cell selection than were found for random selection in populations C and D. Such a bunching of erroneous dollars in an accounts receivable population might occur as a result of the errors being associated with very large accounts or as a result of contiguous groups of customer accounts being maintained by different clerks of differing ability. In essence, systematic
and cell sampling plans perform a stratification of the population by the location of the sample units within the population and thus insure representation from each sampling interval or cell in the population. In cases where the auditor may suspect different results in different sampling intervals or cells throughout the population systematic or cell sampling would appear useful to insure representation evenly throughout the population.

A word of caution should be given in the case of systematic sampling. Although it consistently produced the smallest variance in the populations sampled in this simulation, there was one very important case not simulated. Consider the case where there exists a systematic pattern with respect to the location of the errors in the population and assume that the size of the sampling interval was k units. In the unusual case where the errors (or groups of errors) are k units, fractions of k units, or multiples of k units apart, the auditor would either draw a sample discovering no erroneous units or a sample with an extremely high proportion of erroneous units when compared to the true population error rate. Neither case would be representative of the population sampled.

At this point the necessary conditions for a systematic error to occur in a population of dollar units are presented. Two conditions must be met in order to have a purely systematic pattern to the dollar units in error. First, all of the individual accounts (or groups of the individual accounts) must be equal in size, and second, there must be a systematic pattern of error occurring among the accounts (or groups of accounts). If either condition is not met, the error
would not be entirely systematic with respect to the dollars in
the population. Seldom, if ever, would both criteria be expected
in an auditing population. Therefore, from the evidence presented,
systematic selection appears likely to produce the most consistent
results between samples with respect to the number of errors discovered
in most auditing populations. Cell selection also appears to be
superior in terms of consistency to random selection and would not
be affected as drastically as systematic selection by a systematic
error in the sample units.

With respect to the auditor utilizing tabled Poisson distribution
values in connection with systematic or cell selection methods,
it appears that the auditor's conclusions would tend to be conservative.
Note that in the simulation results the mean number of errors discovered
was never far from the expected number of errors reported assuming
a random selection method. However, the range and variance indicated
less dispersion than was found with random selection. Since the
tabled Poisson distribution values would allow for more dispersion
than would be achieved under systematic or cell sampling methods
the level of confidence would be understated. Put in the terms
used in SAS No. 39 (Auditing Standards Board, 1981), the risk of
incorrect rejection would be overstated. Whether this result is
to be considered good or bad depends upon the conditions surrounding
the individual audit and the individual preferences of the auditor.
Incorrect rejection of the client's reported book value usually
leads to additional audit tests thus costing the auditor time and
money on the engagement. This may not be too serious if additional
tests are easy to perform and require little additional effort. However, if it is difficult or impossible to reenter the original population and/or expensive to perform additional tests, this conservatism may be a serious problem.

SUMMARY:

In summary, the test results show that the method of sample selection may significantly affect the distribution of the number of errors drawn from an auditing population. The impact of the sample selection method on the sample results depends upon the location of the errors in the population and the population error rate. The use of tabled Poisson distribution values to statistically estimate the population error rate is not always appropriate when systematic or cell sampling are employed. However, the error introduced by using the tabled Poisson values is in the conservative direction since the upper limit on the error rate in the population will be overstated for any given level of confidence or, conversely, the level of confidence will be understated for any given upper error limit applied to the population. Although only demonstrated explicitly in the trivial case, it may be inferred that a similar problem will exist when the hypergeometric distribution is employed rather than the Poisson approximation. Whether this conservatism is detrimental depends upon the specific audit situation and the preferences of the auditor. It is noted, however, that systematic sampling and cell sampling may add additional conservatism to already conservative upper bounds on monetary error when employed with certain DUS evaluation methods.
REFERENCES


A Discussion of
The Effects of Three Methods of Sample Selection on
Dollar Unit Sampling Bounds

Neal B. Hitzig
Arthur Young & Co.
Discussant's Response to

The Effects of Three Methods
of Sample Selection On
Dollar Unit Sampling Bounds

Neal B. Hitzig
Arthur Young & Co.

Any paper that addresses the effectiveness of audit test procedures is of interest to practitioners; especially if, as is the case with this paper, it suggests that there is something inappropriate with respect to procedures that are currently being used. Although I approached this paper with considerable interest, I was disappointed. Jenne's reported results are not new. Moreover, his analysis of the one issue he does raise is, at best, superficial.

Leslie, Teitlebaum, and Anderson (see their book, Dollar Unit Sampling) have already pointed out that under cell selection, the sampling distribution is different from the sampling distribution under simple random selection of dollar units. And they have shown that the results that are obtained are in the conservative direction; that is to say, in the direction which overstates the risk of incorrect acceptance. However, Jenne's concern appears to be the risk of incorrect rejection (as defined in Statement on Auditing Standards 39) which, he asserts, is excessive under cell and systematic selection.

Jenne implies that the risk of incorrect rejection should not be ignored. I agree. However, the issue is not strictly one of audit efficiency.
An auditor who rejects the book value of a population in which errors have been detected may perform additional sampling. He may also decide to propose an adjusting journal entry. In this case, the so-called risk of incorrect rejection becomes an estimation risk, the risk that the actual amount of error that might be present in the population is outside the calculated confidence interval. Estimation risk is significant because of the possibility that an adjustment may be booked which would then actually increase the amount of error present in the population to a level that exceeds the maximum tolerable amount. Although the consequence of a rejection may be more work (as Jenne and SAS 39 suggest) or an adjusting journal entry (which has been my experience), Jenne does not further analyze the consequences of either action. He does not deal with the issue of sample extension to improve precision. Furthermore, he ignores the possibility that the auditor might propose or accept an adjustment as an alternative to additional sampling. If there is any significant issue to be raised, it is the adjustment issue. However, Jenne fails to raise it.

Even if he had raised the adjustment issue, I doubt that his experiment would have been illuminating. Jenne created error conditions and chose a sample size without establishing any benchmarks as to tolerable error, acceptable error, or risk. As to his simulated error populations, we only know the amounts of items that contain errors, not the amount of error contained in those items. Absent appropriate benchmarks or actual error amounts, any assertion that there is excessive risk associated with a procedure is speculative. If, for example, we assume that all erroneous items are overstated by their respective book values
and that the sample size used is at a discovery level, then even the most favorable of Jenne's simulated error populations would have errors aggregating to two-thirds of tolerable error, a situation which few auditors would dare ignore or consider acceptable. Under this error condition, rejection could hardly be considered incorrect.

If studies into the properties of audit test procedures are to be useful, then they should be conducted using benchmarks and with some decision framework in mind, so as to permit assessment of the ability of the tested procedure to lead the auditor to correct audit conclusions. Unless future studies are conducted within the context of a decision/action framework, I believe that they will be of scant interest to the practicing auditor.

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1 I am aware of only one study that has considered in-depth the various decision and adjustment rules that might be applied to a particular sampling procedure. This is an unpublished study conducted jointly by Arthur Young and Clarkson Gordon eight years ago in which we examined more than 130 decision and adjustment rules.
A Discussion of
The Effects of Three Methods of Sample Selection on
Dollar Unit Sampling Bounds

William L. Felix, Jr.
University of Washington
SAMPLE SELECTION METHODS
AND THE POISSON SAMPLING
DISTRIBUTION

by William L. Felix, Jr.

In evaluating monetary unit sampling, the alternatives for selection methods include random selection of monetary units, systematic selection of dollar units after one or more random starts, and the cell selection method where a random selection of a dollar unit is made within "cells" established by systematic methods. In the paper titled "The Effects of Three Methods of Sample Selection on Dollar Unit Bounds" the author sets out to provide evidence useful to auditors in choosing between these three selection methods. The methodology used is to first summarize the arguments in a simple case and then attempt to confirm the arguments in a simulation based on four populations. The paper is not entirely successful in this effort as will be pointed out in the following paragraphs.

Before critiquing the paper, it is important to note that this type of research is important. Statistical methods of any sort are at most decision aids and no method will provide a perfect fit to a practical problem. It is important that auditors and audit researchers investigate the relative costs and benefits of methods being used or considered for use. Each of the selection methods tested is used in practice and the paper presented does provide evidence. It is important for auditors to know if the choice between these methods matters and if it does, how much does it matter or does one method dominate any other audit cost or benefit consideration.

As was suggested above, the paper does not really accomplish all that was intended or needed. The results of this paper describe evidence on the effects of the three selection methods on the distribution of the
number of errors in four specific populations. In essence this evidence suggests that the number of errors obtained by systematic and cell selection methods generate a sampling distribution significantly different from a Poisson distribution when the errors are clustered. And, of course, since errors are typically assumed to attach on a percentage basis to all the dollars in a physical unit or account, such an account is a cluster. While this evidence may be a useful step, it is incomplete.

In order for the paper to be useful or "complete" the implications of the departure from a Poisson sampling distribution should be addressed. For example:

1. Monetary unit sampling is generally considered reliable in situations where no errors or very few errors are expected. Given that clustering of errors will result in departures from the Poisson distribution, is there an error rate that suggests a serious loss of power when random selection is not used? Or should random selection always be used?

2. Monetary unit sampling makes inferences based on a "priced" error rate or error amount, not the number of errors. Would simulation including the affect of error amounts affect the rate of departure from a Poisson sampling distribution.

3. An important issue not addressed in the paper is the role of evidence presented in developing monetary unit sampling methods that might be useful in populations where errors are expected. This idea is expanded in the following.

The conservatism of monetary unit sampling as increasing numbers and sizes of errors occur is due in part to the scheme used to price errors (100% tainting assumed for base-rate errors and decreasing order of ranking)
and to the use of the Poisson distribution to approximate the hypergeometric distribution. The effect presented in this paper may be another source of conservatism where systematic and cell selection are used. Since the cell selection method is often suggested as being a competitive method in the face of increasing error rates, addition evidence on the circumstances where this method generates "conservative" results is important to auditors.

It is not an original observation, but it is also worth pointing out that the results of this study are driven by four specific populations and that generalization from the four populations to auditing practice in general is difficult. As the author points out, the populations represent extremes. It is not clear how significant the effects of clustering errors would be in other populations.

In summary then this paper suggests that when errors become numerous and/or are clustered, the sampling distribution for the number of errors will depart significantly from the Poisson - not an especially surprising result, but one that may be worth documenting. In its present form the results are not very useful to auditors. Left unclear by the study is whether or not the result is equally true for the priced errors used in monetary unit sampling inferences. In addition many users of monetary unit sampling emphasize its use in situation where either no errors are expected or very few (cumulative 100%) errors are expected. These policies suggest that the loss of power due to departures from the Poisson distribution would be quite small unless the expectations were wrong. However, exploring the reasonableness of these assumptions is difficult with the evidence in the paper. Evidence to explore such policies would need to document the effect of gradually increasing error rates and clustering on the probability of rejecting good populations.
Auditors' Current and Future Involvement

In Corporate Financial Forecasts

Paul Danos
Doris Holt
Eugene A. Imhoff, Jr.

The University of Michigan

The authors wish to acknowledge the financial support of the Touche Ross Foundation and the Graduate School of Business Administration, The University of Michigan, for portions of the research reported in this paper. The views and results are, however, the sole responsibility of the authors.
AUDITORS' CURRENT AND FUTURE INVOLVEMENT
IN CORPORATE FINANCIAL FORECASTS

This paper summarizes the results of a series of research projects concerning the relationship of management forecasts and the activities of the independent auditor. We draw on the results of four separate but related studies of various aspects of management financial forecasts, focusing here on the implications regarding auditor involvement. The four projects are sketched as follows:

1) Important Forecast Dimensions - This study evaluated what auditors considered to be the most relevant dimensions of corporate financial forecasts. The experiment (Danos and Imhoff [1982a]) used case studies which called for auditor evaluations of hypothetical forecasts to model the impact of important forecast attributes on auditors' "reasonableness" judgments. The experiment was the final stage of the three phase research project which relied extensively on interviews to construct the experimental materials.

The results of this study suggested that auditors considered "discoverable" information regarding an entity's forecast to be most useful in formulating their reasonableness judgments.¹ In order of importance the items of "discoverable" information were:

1) The historical accuracy of sales forecasts
2) The historical accuracy of net income forecasts
3) The relative amount of expected change in the current net income forecast
4) The sensitivity of the forecasted revenues to changes in industry activity and market share

¹By "discoverable" we mean information of past relationships that can be verified by a third party.
II) Auditor Evaluation of Forecast Systems - The second study, funded by the Peat Marwick Mitchell Foundation's Research Opportunities in Auditing program was designed to evaluate the relative importance of forecast system attributes on auditor reasonableness judgments. The interest in evaluating system attributes was based on their significance in the AICPA's Guide For a Review of a Financial Forecast [1980]. The Guide placed importance on the auditors' evaluation of forecast systems assumptions underlying a forecast, with assumptions being the products of forecast systems. The basic research question considered here was: What is the relative importance of systems attributes (vis a vis nonsystems attributes) to auditors in formulating reasonableness judgments.

To address this question a series of three experiments were conducted (Danos and Imhoff [1982b]). The results of this second study provided additional evidence to confirm the validity of the earlier study, and suggested that auditors perceived discoverable information to be more helpful than information regarding the forecast system in forming hypothetical reasonableness judgments.

III) Bond Raters Use of Financial Forecasts - The third study, funded by the Patton Accounting Center, sought to investigate the role of forecasts (and auditor involvement therein) in bond rating decisions. Earlier fieldwork had revealed that bond raters are one of two user groups (external to the corporation) that regularly received and used forecasts in making decisions that have

2Authoritative bodies and the profession have shown increased concern for the entire topic of management forecasts. See Yuji Ijiri [1980, pp. 38-41] and P. Danos and E. A. Imhoff, Jr. [1981, pp. 104-111]) for current discussions of the professional implications of auditor involvement with forecasts. In addition, the SEC ([1978], [1979], [1982]) has continued to encourage the disclosure of forecasts. The AICPA ([1980], [1982]) has also responded by issuing guides for auditors who may become involved with client forecasts.
an economic impact on the forecasting entity. This recently completed study evaluates the impact of certain key forecast attributes and auditor involvement in forecasts by analyzing raters' responses to hypothetical bond rating decisions. The experimental materials were based on realistic rating cases. Both the rating decision cases and the key manipulated forecast variables were developed in consultation with bond raters.

Two dimensions of this third study are of particular interest to auditors. First, the relative importance to bond raters of certain forecast attributes that were found to be important to auditors provide some interesting insights and comparisons. Second, the question of whether or not auditor involvement in a rater's forecast might influence the rating decision should be of interest to the profession. The empirical results from this third study (Danos, Holt, and Imhoff [1982a]), provide interesting insights into the role of forecasts in bond rating decisions, and are expected to contribute to the empirical results regarding evidence use by experts. As part of that study, a separate experiment was run to determine the impact of bond raters of auditor involvement with forecasts. Those results are reported below.

IV) **Bank Loan Officers Use of Financial Forecasts** - The fourth study which is still in process at this writing was funded by the Touche Ross Foundation and examines the role of forecasts and auditor involvement in lending decisions. Earlier fieldwork revealed lending officers to be the second of the two outside user groups (with bond raters) to regularly receive and use financial forecasts to make economic decisions about the forecasting entity. Specifically, in certain lending situations forecasts seem to play an important role in determining whether or not to grant a loan. Furthermore, independent auditors do sometimes become involved in some way with the potential borrower's
forecasts (see Danos and Imhoff [1981]). This study made use of hypothetical cases to evaluate the impact of certain key forecast dimensions on the bank lending decision process. The experimental instruments were developed in consultation with a number of loan officers following extensive interviews during earlier fieldwork.

Once again there were two dimensions considered to be of particular relevance to the auditor and to which part of the study was devoted. First, data regarding the relative importance to lenders of certain forecast attributes found previously to be important to auditors permitted comparisons of and insights into the perceptions of each group. Second, the potential contribution of the auditor as perceived by the lender was directly evaluated.

Purpose of This Study

While all of these four studies have unique areas of inquiry, they all have relevance to auditors. It is the independent auditor's role that we focus on here. In addition to summarizing auditor perceptions, we will report on the portions of studies III and IV which measured judgments of bond raters and bankers and those designed to measure the impact of auditor involvement with financial forecasts.

The remainder of this paper reports on the evidence obtained in these four studies as it relates to three specific issues:

1) To what extent is there agreement among auditors, bankers, and bond raters as to the most important attributes of an entity's financial forecast?

2) Do forecast user's perceive auditor involvement as affecting the usefulness of an entity's financial forecast?

3) What form of an auditor involvement might enhance the usefulness of a client's forecast to external users?
Important Forecast Attributes—Preferences of Auditors, Bankers and Bond Raters

Auditors, bankers, and bond raters were all asked to identify those forecast attributes that were important to them. In the case of auditors, this question was addressed by having them evaluate the reasonableness of hypothetical management forecasts. In the case of bankers, the question was in the context of a corporate forecast to be used in making a lending decision. Bond raters responded to cases where forecasts were submitted in conjunction with rating new debt issues.

Auditor assessments were obtained in conjunction with studies I and II described above. Forecast dimensions of importance to auditors were assessed and have been reported at several levels, including summaries of discussions, evaluations of ranked preferences from a list of variables, and as a part of a report of a behavioral experiment where auditors provided forecast reasonableness judgments in hypothetical case settings. To summarize these results, the single most important dimension of a financial forecast to experienced auditors who were asked to render reasonableness judgments is the track record (historical accuracy) of the entity's forecasts. Track record was demonstrated to be the most important manipulated variable in all experiments in which it was included and it came closest to being a "consensus" variable. Track record dominated the other variables examined, which included forecast systems attributes and other discoverable factors.

The only element that might be more important to the auditor in forming a judgment on management's forecast is the auditor's qualitative assessment of management's integrity, sincerity, and expertise. Unfortunately, these qualities did not lend themselves to manipulation in our experimental settings and were not considered. Had they been varied by indicating levels of attainment
(e.g., low integrity/high integrity) they most likely would have dominated all other factors. Fieldwork and debriefing questions suggest that these qualitative evaluations can swing a subjects' evaluation of management's forecast.

Other factors considered to be important to auditors in their order of importance were:

- Benchmark data (historical income statements, etc.) that would enable auditors to evaluate the amount of change being forecasted.

- Industry data to evaluate the outlook of the company's industry taken as a whole.

- The sensitivity of the company to industry activity and market share.

- The reward structure for managers as it relates to forecast accuracy.

- The amount of revision that the forecast underwent between its first and final versions.

- A feeling for the capital/labor intensity of the company and its implications on variability in performance measures.

Based on what we learned in the series of auditor experiments we developed interview instruments to use with bankers and bond raters. The results of those interviews provided us with the basis for a list of 10 key information items which were evaluated by both groups on two dimensions: The rank ordered relative preference for each type of information (from 1-10); and relative importance of each type of information on a seven-point scale ranging from not important to very important. (See Appendix A for the instrument used.)

The results, summarized in Tables I and II for 28 bond raters and 40 bankers, respectively, and above for auditors, suggest that there is a reason-

ably high degree of agreement among the three different groups as to the rela-
tive preferability of these items even though each group approached the list of information from the perspective of a different task (rating, lending, and
Table I

BOND RATER PREFERENCES FOR INFORMATION ABOUT FORECASTS

<table>
<thead>
<tr>
<th>Type of Information</th>
<th>Rank*</th>
<th>Importance**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The historical accuracy of prior forecasts.</td>
<td>2</td>
<td>5.7</td>
</tr>
<tr>
<td>2. Whether the planning system used to produce the forecast is centralized or decentralized.</td>
<td>8</td>
<td>3.2</td>
</tr>
<tr>
<td>3. The position of the people who prepared the forecast.</td>
<td>9</td>
<td>3.2</td>
</tr>
<tr>
<td>4. The soundness of the reasons given for errors in forecasts of prior years.</td>
<td>6</td>
<td>5.5</td>
</tr>
<tr>
<td>5. Your personal qualitative assessment of those preparing the forecast.</td>
<td>7</td>
<td>3.9</td>
</tr>
<tr>
<td>6. The relationship between the financial reward structure of those preparing the forecast and the accuracy of the forecast.</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>7. The relationship between the forecasted trends (e.g., 10% annual increase) and the historical trends.</td>
<td>3</td>
<td>5.7</td>
</tr>
<tr>
<td>8. The amount of detail provided in support of the forecast (e.g., schedules with the forecasts broken down by product, geographic regions, quarters, and so on).</td>
<td>5</td>
<td>5.4</td>
</tr>
<tr>
<td>9. The inherent risk associated with the industry in which the company operates and how you feel that might affect the forecast.</td>
<td>1</td>
<td>6.4</td>
</tr>
<tr>
<td>10. The inherent risk associated with the current economic conditions in the capital markets and how you feel that might affect the forecast.</td>
<td>4</td>
<td>5.6</td>
</tr>
</tbody>
</table>

*1 is most preferred and 10 is least preferred.

**7-point scale, where 1 is "not important" and 7 is "very important."
Table II

LENDING OFFICERS' PREFERENCES FOR INFORMATION ABOUT FORECASTS

<table>
<thead>
<tr>
<th>Type of Information</th>
<th>Rank*</th>
<th>Importance**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The historical accuracy of prior forecasts.</td>
<td>1</td>
<td>5.9</td>
</tr>
<tr>
<td>2. Whether the planning system used to produce the forecast is centralized or decentralized.</td>
<td>9</td>
<td>2.9</td>
</tr>
<tr>
<td>3. The position of the people who prepared the forecast.</td>
<td>8</td>
<td>4.4</td>
</tr>
<tr>
<td>4. The soundness of the reasons given for errors in forecasts of prior years.</td>
<td>7</td>
<td>5.3</td>
</tr>
<tr>
<td>5. Your personal qualitative assessment of those preparing the forecast.</td>
<td>5</td>
<td>5.1</td>
</tr>
<tr>
<td>6. The relationship between the financial reward structure of those preparing the forecast and the accuracy of the forecast.</td>
<td>10</td>
<td>3.7</td>
</tr>
<tr>
<td>7. The relationship between the forecasted trends (e.g., 10% annual increase) and the historical trends.</td>
<td>4</td>
<td>5.4</td>
</tr>
<tr>
<td>8. The amount of detail provided in support of the forecast (e.g., schedules with the forecasts broken down by product, geographic regions, quarters, and so on).</td>
<td>2</td>
<td>5.7</td>
</tr>
<tr>
<td>9. The inherent risk associated with the industry in which the company operates and how you feel that might affect the forecast.</td>
<td>3</td>
<td>6.0</td>
</tr>
<tr>
<td>10. The inherent risk associated with the current economic conditions in the capital markets and how you feel that might affect the forecast.</td>
<td>6</td>
<td>5.3</td>
</tr>
</tbody>
</table>

*1 is most preferred and 10 is least preferred.
**7-point scale, where 1 is "not important" and 7 is "very important."
attesting), one of which (attestation) was an unfamiliar task setting. We also noted that the three groups were very different in terms of their feedback in their task settings. Auditors have had no feedback since they have not provided public evaluations of forecasts, and bond raters get relatively diffuse feedback regarding rating decisions (which have been said to lag rather than lead the market price adjustment process in most instances of existing debt). Only bankers get rather specific and complete feedback on the appropriateness of their lending decisions.

The primary benefit from these evaluations is that they point to an inter-group consensus on the importance of certain variables. They also provided a basis for formulating more specific hypotheses for future experimental work.

Track record information is perceived to be one of the most important forecast attributes by all three groups. While bond raters considered industry risk information to be more important, track record scored very high. Other factors of significance were: industry risk; the benchmark information provided by the relationship between historical and forecasted data; and the details supporting the forecast. Bond raters also considered the current economic conditions in the capital markets to be relevant, more so than bankers. This might have been expected given the more general nature of bond raters credit evaluation activities. In summary, a reasonably high degree of agreement as to the preferability of the various information items seems to exist.

Both bankers and bond raters also considered most items of information to be important inputs to their respective decision. Variables that were generally considered to be less than moderately important included: data regarding management's reward structure; the organization structure of the planning system (centralized or decentralized); the participants in the
preparation of the forecast and the qualitative assessment. As noted in Tables I and II, most variables listed were generally considered to be more than moderately important.


Auditor Involvement—Its Impact on Bond Rating and Lending Decisions

The second issue of interest was the potential impact of auditor involvement with forecasts on bond rating and lending decisions. This issue was examined in two different ways. In the bond rater study, a separate experiment was administered to determine the impact on the bond rating decision of auditor involvement with a forecast. The corporate setting used in the experiment involved a BBB (or a Baa) risk class bond issue. This is the lowest investment grade class, therefore one for which auditor involvement might provide maximum comfort to bond raters. The experiment involved two dichotomous treatments which can be summarized as follows:

Treatment A - Forecast type (Strong - Weak)

Treatment B - Auditor Involvement (Attested - Nonattested)

It was expected that the combination of forecast type and auditor involvement would result in an interactive effect on the rater’s confidence in the BBB rating being proposed in the background data of the case.

The case resembled a summarized version of actual rating case data available to bond raters, with data provided in a logical sequence. This case was constructed with the assistance of experienced raters other than those participating in the experiment. As shown below the between subjects design called for each of 28 bond raters to read the first part of the case, make a judgment about the rating of the new issue, read more data which included one of the treatments, and make a final judgment. (See Appendix B for the case material used.) The analyzed response was the change in the rater judgment, that is, if the first elicitation was 60 and the second 80, the analyzed response was 20.
Design (Between Subjects, n = 28)

Auditor Involvement

<table>
<thead>
<tr>
<th>Forecast Type</th>
<th>Attest</th>
<th>Non-Attest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Rater Group 1 n = 7</td>
<td>Rater Group 2 n = 7</td>
</tr>
<tr>
<td>Negative</td>
<td>Rater Group 3 n = 7</td>
<td>Rater Group 4 n = 7</td>
</tr>
</tbody>
</table>

Elicited Responses (before and after forecast data)

My belief is that in 100 cases where the facts were identical to those described for WFC, a rating of BBB would be given ________ times.

Please write a few phrases which characterize WFC and support your evaluation of its new bond issue.

As the results summarized in Table III suggest the level of auditor involvement had no significant effect on the raters' judgments. However, the forecast type was significant at about the $\alpha = .07$ level.

A clearer picture of the meaning of the statistical tests can be obtained by the narrative responses elicited along with the numeric ones analyzed in Table III. Table IV lists the full written comment, made after the second numeric elicitation, in support of the subject's evaluation. As can be seen, none of the subjects in Groups 1 and 3 takes comfort in the auditor involvement, and subjects in Groups 2 and 4 do not complain about lack of auditor involvement.

In general we conclude that industrial bond raters do not place much importance on whether the forecast is independently "reviewed" by the auditor.
Table III

ANOVA RESULTS OF BOND RATER EXPERIMENT

<table>
<thead>
<tr>
<th>ANOVA Results</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Forecast Type</td>
<td>424.32</td>
<td>1</td>
<td>424.32</td>
<td>3.33*</td>
</tr>
<tr>
<td>B - Auditor Involvement</td>
<td>54.32</td>
<td>1</td>
<td>54.32</td>
<td>.43</td>
</tr>
<tr>
<td>C - A x B</td>
<td>60.03</td>
<td>1</td>
<td>60.03</td>
<td>.47</td>
</tr>
<tr>
<td>Within Cell</td>
<td>3,062.29</td>
<td>24</td>
<td>127.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3,600.96</td>
<td>27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at α = .07
Table IV

SUBJECTS' WRITTEN COMMENTS AFTER FORECAST TREATMENT

Raters Group 1 (Positive Forecast and Attested)

- "Auditor's comment provides little assurance."
- "Although projections show favorable trends, industry risk considerations would prevent giving a better rating until the company had established a track record at a higher level of performance."
- "Projections, while showing some improvements, do not indicate major changes from past performance which might support strong "BBB" rating."
- "Projections do not take into account the inherent cyclical and highly competitive nature of the industry—not realistic."
- "I would not attach any significance to the auditors review of the forecasts. I would question the significant improvement in margins."
- "Reasons for extent of improvement noted in forecast not altogether obvious. Increases in margins and returns especially questionable in light of inherent cost pressures."
- "Dramatic improvement in ratios just too hard to believe. Projections may have been in conformity with guidelines, but doubt there could be such a fundamental growing in either the industry or in the company's future."

Raters Group 2 (Positive Forecast and Non-Atttested)

- "Most ratios remain relatively unchanged with the exception of fixed charge coverage, which shows good improvement. Such dramatic improvement in operating performance would be suspect."
- "There is nothing inherent in the business that would enable the company to attain margins and return as indicated."
- "Do not see any support for projected improvement."
- "As consumer spending rebounds clothing purchases will pick up, as most people have probably delayed purchasing. Costs can be improved with introduction of apparel cutting machines, and expansion of higher priced suits, an apparently sound niche."
- "Again, the positive trend indicated carries little weight without knowledge of the plans and strategies which went into the forecast."
- "Optimistic forecast assumed in initial rating."
- "The rating could be a weak "A" based upon the projected improvement if we had confidence in these projections."
Table IV (continued)

Raters Group 3 (Negative Forecast and Attested)

- "Lack of significant progress in improving margins, returns in favorable industry environment forecasted is negative."

- "Similar to previous rating, the earning trend was slightly higher, but the debt/equity ratio also rose. A "BBB" rating would be applied."

- "The projected improvement in margins is improvement in view of the comment on the assumptions. Retail store operations could impact margins by rental increases expected. Debt levels seem to be reasonable going forward."

- "Debt at much higher levels leaves reduced financial flexibility. Returns are still quite favorable though. Becomes much more of a borderline case. Less likely to give benefit of doubt with higher leverage."

- "Leverage and fixed charge coverage decline somewhat but remains satisfactory. Cash flow average remains good. Financial flexibility changes some but not significantly."

- "Company is obviously forecasting a strong increase in earnings to go with the increased use of debt. Capitalization does not get back to new "BBB" quality over the five years. While other ratios hold up, because of competitive nature of industry and uncertainties, unlikely to believe improvement in other ratios."

- "Stability continues. Slow improvement but this debt issue, although increasing leverage does not change much else too much."

Raters Group 4 (Negative Forecast and Non-Attested)

- "Serious decline in operating margins, big increase in leverage add risk."

- "Forecast not particularly credible- continual improvement year by year in industry that should have some susceptibility."

- "No comfort in high leverage, while margins remain low and cash flow/total debt only barely adequate."

- "While the company expects improved returns on capital and thereby improve other financial protection measures, uncertainty as to future industry trends suggests more conservative expectations. Despite management reasonable past projection accuracy, we should not expect that returns will improve as forecast."

- "Already aggressive leverage projected to get still higher."

- "Ratios still appear like a "BBB" just not as strong as historical ones. More aggressive use of debt in future. However, company is gradually going to be reducing it in future. Accordingly, most ratios start showing upward improvement again in 1983."

- "Most ratios recover by '84, but debt levels are still high. Total view of the company doesn't change much over projected period indicating that the industry won't change too much either. Perhaps there's more strength than previously perceived."
These results do not necessarily hold true for other types of rating situations, such as municipals, and should be generalized with caution. Casual evidence from municipal bond raters has suggested that auditor involvement in forecasts included in feasibility studies (for projects such as hospitals, stadiums, bridges, etc.) is extremely useful and important to the rating decision.

The evaluation of auditors' contribution to corporate forecasts in bank lending situations was investigated with questions which asked 40 bankers to estimate the impact of auditor involvement in forecasts on lending decisions. This was asked after lending officers had read cases about individual corporations that were applying for a loan. The corporate cases were designed to represent borrowers who were most likely to submit forecast information.

Fieldwork had revealed that this group included borrowing entities with sales in the $20 - $35 million dollar range. This subset represents companies that would normally not be issuing public debt. The results, summarized in the top half of Table V, suggest that auditor involvement would have a positive effect on lending officers' evaluations of financial forecasts of a potential borrower. (See Appendix C for the instrument used.) As summarized in the bottom half of Table V, 47% of the loan officers indicated that an auditor's review of the forecast would have "moderately increased" the likelihood in their mind that the loan under consideration would be "fully serviced." In general, loan officers considering loans from companies in this size range are much more positive about the potential contribution of the auditor than bond raters were for companies issuing new investment grade public debt. This should not necessarily be considered an inconsistency in the attitudes of all bankers and all bond raters since the nature of their respective corporate cases varied considerably. It does suggest that the forecast review function is most relevant

---

3 Full service was defined to be no significant departures from the scheduled interest and principal payments.
Table V

LENDING OFFICERS PERCEPTIONS OF THE EFFECTS OF AUDITOR ATTESTATIONS TO FORECASTS OF LOAN APPLICANTS

<table>
<thead>
<tr>
<th>Effects on Evaluations of Forecasts Themselves</th>
<th>Percentage of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong Positive Effect</td>
<td>16</td>
</tr>
<tr>
<td>Moderate Positive Effect</td>
<td>65</td>
</tr>
<tr>
<td>No Effect</td>
<td>19</td>
</tr>
<tr>
<td>Moderate Negative Effect</td>
<td>0</td>
</tr>
<tr>
<td>Strong Negative Effect</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effects on Evaluations of Likelihood of Full Service on Loan</th>
<th>Percentage of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Increases Likelihood</td>
<td>0</td>
</tr>
<tr>
<td>Moderately Increase Likelihood</td>
<td>47</td>
</tr>
<tr>
<td>No Effect</td>
<td>53</td>
</tr>
<tr>
<td>Moderately Decreases Likelihood</td>
<td>0</td>
</tr>
<tr>
<td>Strongly Decrease Likelihood</td>
<td>0</td>
</tr>
</tbody>
</table>
among audit clients in the $20 - $35 million sales size range, which obviously does not include those with significant publicly traded debt.

Future Auditor Contributions to Client Forecasts

This section discusses the potential contributions of auditors in the area of financial forecasts. Our beliefs here must be qualified by the statement that we have no evidence regarding the cost side of the cost/benefit analysis that must be conducted before any new auditor services are deemed feasible.

We draw the following observations from our results presented above (and those on forecasting presented elsewhere).

1. The AICPA's Guide for a Review of a Financial Forecast indicates that auditors' forecasts must evaluate the merits of the forecast system and the underlying forecast assumptions produced by the system as they pertain to the forward looking data.

2. Auditors have established their comparative advantage in the area of independent verification of management's historical financial information, which leads them to a solid understanding of most aspects of an entity's planning and control system.

3. Auditors often benefit substantially by evaluating an entity's forward looking data in conducting the analytical review of a client's financial statements.

4. A forecast may be viewed as one in a series, with the current forecast being compared to previous forecasts. In addition the accuracy of past forecasts can be documented.

5. Those external users (participating in our research) that are involved with decisions having an economic effect on the firm rated track record and industry risk as very important factors affecting their decision making.

It appears to us that in some instances the contribution of the auditor from explicitly evaluating the current forecast for future periods may not be significantly greater than the contribution from assessing track record of accuracy and industry risk. If industry risk is defined in terms of the underlying uncertainty in the future earnings of all entities in an industry,
then the historical track record of forecasts at both the individual entity level and the industry level would appear to be the intersection of users' interest and auditors' comparative advantage. Hence, we suggest a reconsideration of the auditors' involvement with forward looking data as suggested in the AICPA's Guide. We expect to gather empirical evidence in the near future regarding auditors' contribution to the informed use of forward looking data by reporting on past forecast accuracy of individual entities and the industry in which the entity operates vis-à-vis auditors evaluating the current forward looking data per se. A corollary contribution would be for auditors to make a statement about the consistent use of forecast generating systems. Past forecast accuracy can be extrapolated into the future only to the extent that the past system is still in place. The same is true of industry forecasting systems. In summary, we think that auditors can contribute to the rational use of forecasts in ways that are compatible with their comparative advantages. These contributions may augment or substitute for statements evaluating the reasonableness of current forecasts.
REFERENCES


, Release No. 6413 (Securities Act of 1933), (Sec, June 24, 1982).
The following are ten items of information concerning financial forecasts. Please indicate your opinions about these types of information as follows: 1) Order your preferences for the information types from one to ten in the column titled ranking where 1 is the most preferred information. Whether or not you currently obtain the information, the question here is your relative preferences for these types of information. 2) Rate the importance of each type of information to the actual bond rating (bank lending) decision on the accompanying one to seven scale.

Read all of the types of information before making any rankings. Use each rank (1-10) once only.

<table>
<thead>
<tr>
<th>RANKING</th>
<th>TYPE OF INFORMATION</th>
<th>SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>The historical accuracy of prior forecasts.</td>
<td>not important</td>
</tr>
<tr>
<td>2</td>
<td>Whether the planning system used to produce the forecast is centralized or decentralized.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>3</td>
<td>The position of the people who prepared the forecast.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>4</td>
<td>The soundness of the reasons given for errors in forecasts of prior years.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>5</td>
<td>Your personal qualitative assessment of those preparing the forecast.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>6</td>
<td>The relationship between the financial reward structure of those preparing the forecast and the accuracy of the forecast.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>7</td>
<td>The relationship between the forecasted trends (e.g., 10% annual increase) and the historical trends.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>8</td>
<td>The amount of detail provided in support of the forecast (e.g., schedules with the forecasts broken down by product, geographic regions, quarters, and so on).</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>9</td>
<td>The inherent risk associated with the industry in which the company operates and how you feel that might affect the forecast.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>10</td>
<td>The inherent risk associated with the current economic conditions in the capital markets and how you feel that might affect the forecast.</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>
Appendix B

Experiment Materials:

Pages 1-5  Background Data—Common to all treatments.
Page 6    Treatment 1:  Forecast-Positive, Auditor Involvement—Attestation.
Page 7    Treatment 2:  Forecast-Positive, Auditor Involvement—None.
Page 8    Treatment 3:  Forecast-Negative, Auditor Involvement—Attestation.
Page 9    Treatment 4:  Forecast-Negative, Auditor Involvement—None.
WOVEN FABRICS CO.

Introduction to the Company and Its Industry

Woven Fabrics Co. (WFC), is a company classified in the apparel manufacturing industry. WFC has been in operation for over 70 years and its 8,400,000 shares of common stock are traded on the New York Stock Exchange. In its last fiscal year WFC reported sales of $815,000,000 primarily from the manufacturing of men's tailored clothing. WFC's sales volume places it as the 7th largest apparel manufacturing company analyzed in that industry by Standard and Poor's Industrial Surveys. Other firms in the industry include Blue Bell, Inc., Levi Strauss, Cluett Peabody, and Phillips-Van Heusen. The industry information below will be followed by company-specific information.

Industry Outlook

The outlook for the apparel manufacturing industry is favorable. One popular industry publication had the following comments concerning the future of the apparel industry as a whole. "The long-term outlook for the industry remains favorable with U. S. producers regaining some of their stature in the domestic market and substantially increasing their presence on the world scene. While the industry will continue to be affected by cyclical swings in the economy, the impact of these swings will be mitigated." Industry projections by financial analysts indicate a 10% increase in sales in the next year. Changes to computerized cutting equipment and other technological advances will continue to provide some growth in productive capacity. The industry has shifted away from casual apparel to more tailored styles of clothing, causing some shifts in market
share within the industry. According to industry analysts, sales increases will be offset by higher raw material and labor costs. Modest gains are expected in overall industry earnings.

Company Description and Outlook

WFC is a major manufacturer in the men's tailored clothing industry with about a 10% market share. Last year WFC experienced sales of $815,000,000 in the following lines of business.

<table>
<thead>
<tr>
<th>Lines of Business</th>
<th>Sales</th>
<th>Operating Profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speciality Stores (Retail men's and women's clothing)</td>
<td>54%</td>
<td>60%</td>
</tr>
<tr>
<td>Apparel Manufacturing</td>
<td>46%</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

The company represents a well-known quality name in men's clothing, with about 60% of its sales dollars from high priced ($200 to $500) brand name suits. Operations consist of seven manufacturing divisions and one retail division. The seven manufacturing divisions each have several plant sites where their respective brand names are produced, while the retail division includes 275 retail stores throughout the U. S.

The eight divisions are all treated as independent entities and profit centers. Each division has its own production, marketing, sales, and finance staff who make the major decisions for that division. Corporate headquarters provides some services to all divisions, including recently added market research services.
WFC, because it is in a very labor intensive industry, has been able to adjust labor use to endure economic cycles without reporting a loss. Labor costs run about 30% for the industry and slightly higher for WFC. WFC's higher than average concentration in hand-made merchandise requires relatively more direct labor input and results in the slightly higher labor costs. WFC employs over 20,000 people. The major components of cost are labor and materials.

A popular investment publication rates the company as average in terms of its safety as an investment and below average in terms of its relative stock price performance expected over the next 12 months.
WFC is in the process of being rated for a new 10 year senior debt issue which will mature in 1992. Your department has received all of the required historical financial information and other data required for a rating decision. An experienced colleague of yours has worked on the rating analysis. Your colleague's recommendation is to rate this issue BBB. The historical information evaluated by your colleague is summarized in the following profile:

RATING METHODOLOGY PROFILE

INDUSTRIALS

COMPANY: Woven Fabrics Co.

ANALYST: (Colleague) DATE: June 30, 1982

| 50 | INDUSTRY RISK |
| 60 | ISSUER'S INDUSTRY POSITION |
| 55 | MARKET POSITION |
| 55 | ISSUER'S INDUSTRY POSITION |
| 60 | OPERATING EFFICIENCY |
| 50 | MANAGEMENT EVALUATION |
| 50 | ACCOUNTING QUALITY |
| 50 | EARNINGS PROTECTION** |
| 55 | FINANCIAL LEVERAGE AND |
| 60 | ASSET PROTECTION** |
| 50 | CASH FLOW ADEQUACY** |
| 50 | FINANCIAL FLEXIBILITY** |

RATINGS:

| CP | EXISTING | RECOMMENDED |
| Sr. Debt | NONE | NONE |
| Sub. Debt | NONE | NONE |
| Pfd. | NONE | NONE |

NEW ISSUE DESCRIPTION:

A 10 year $20,000,000 senior unsecured debt issue

**Note that this is a historical profile only.
In addition to the profile, you are presented with the following summary of key financial ratios and financial data:

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Pretax Interest Coverage</td>
<td>5.8x</td>
<td>5.7x</td>
<td>6.7x</td>
<td>6.1x</td>
<td>4.4x</td>
</tr>
<tr>
<td>Cash Flow/Total Debt</td>
<td>40.4</td>
<td>39.9</td>
<td>47.0</td>
<td>42.2</td>
<td>34.2</td>
</tr>
<tr>
<td>Pretax Return on Average Long-Term Capital Employed</td>
<td>18.8</td>
<td>18.6</td>
<td>19.4</td>
<td>18.6</td>
<td>17.5</td>
</tr>
<tr>
<td>Operating Income/Sales</td>
<td>10.2</td>
<td>9.8</td>
<td>10.3</td>
<td>10.4</td>
<td>10.2</td>
</tr>
<tr>
<td>Total Debt/Capitalization Including Short-Term Debt</td>
<td>38.8</td>
<td>39.1</td>
<td>39.6</td>
<td>40.4</td>
<td>41.5</td>
</tr>
</tbody>
</table>

Your colleague has made the following notes regarding the historical data for this rating case.

**Rating Notes:**

- The company appears to have a good financial control system.
- Top management team has been in place for some time and appears to work well as a group.
- Financial reports have been prepared on a consistent basis over all periods summarized.

Please complete the rating evaluation worksheet on the next page.
In addition to the historical data, the company has more recently provided forecasted financial statements for the next 5 years. The following is a summary of forecasted key financial ratios which assume that the proposed debt has been issued.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Pretax Interest Coverage</td>
<td>7.5x</td>
<td>7.4x</td>
<td>7.8x</td>
<td>8.2x</td>
<td>9.4x</td>
</tr>
<tr>
<td>Cash Flow/Total Debt</td>
<td>42.1</td>
<td>45.8</td>
<td>46.6</td>
<td>49.9</td>
<td>50.7</td>
</tr>
<tr>
<td>Pretax Return on Average</td>
<td>18.9</td>
<td>19.6</td>
<td>20.1</td>
<td>21.9</td>
<td>23.7</td>
</tr>
<tr>
<td>Long-Term Capital Employed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Income/Sales</td>
<td>10.8</td>
<td>12.0</td>
<td>14.1</td>
<td>15.2</td>
<td>15.8</td>
</tr>
<tr>
<td>Total Debt/Capitalization</td>
<td>38.2</td>
<td>37.1</td>
<td>36.8</td>
<td>36.1</td>
<td>35.4</td>
</tr>
<tr>
<td>Including Short-Term Debt</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**AUDIT REPORT ON FORECAST**

- The independent auditors of WFC have issued a report concerning WFC's forecasts. The report indicates that the auditors have reviewed the forecasts and the assumptions underlying the forecasts. The auditors have judged the forecasts to be reasonable and to have been prepared in conformity with the applicable guidelines for such forecast presentations.

**Additional Note**

- The historical track record of management indicates that their forecasting accuracy has been about average for all companies in this industry.

Please complete the rating evaluation worksheet on the next page.
In addition to the historical data, the company has more recently provided forecasted financial statements for the next 5 years. The following is a summary of forecasted key financial ratios which assume that the proposed debt has been issued.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Pretax Interest Coverage</td>
<td>7.5x</td>
<td>7.4x</td>
<td>7.8x</td>
<td>8.2x</td>
<td>9.4x</td>
</tr>
<tr>
<td>Cash Flow/Total Debt</td>
<td>42.1</td>
<td>45.8</td>
<td>46.6</td>
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<td>50.7</td>
</tr>
<tr>
<td>Pretax Return on Average Long-Term Capital Employed</td>
<td>18.9</td>
<td>19.6</td>
<td>20.1</td>
<td>21.9</td>
<td>23.7</td>
</tr>
<tr>
<td>Operating Income/Sales</td>
<td>10.8</td>
<td>12.0</td>
<td>14.1</td>
<td>15.2</td>
<td>15.8</td>
</tr>
<tr>
<td>Total Debt/Capitalization Including Short-Term Debt</td>
<td>38.2</td>
<td>37.1</td>
<td>36.8</td>
<td>36.1</td>
<td>35.4</td>
</tr>
</tbody>
</table>

Additional Note

The historical track record of management indicates that their forecasting accuracy has been about average for all companies in this industry.

Please complete the rating evaluation worksheet on the next page.
In addition to the historical data, the company has more recently provided forecasted financial statements for the next 5 years. The following is a summary of forecasted key financial ratios which assume that the proposed debt has been issued.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Pretax Interest Coverage</td>
<td>5.4x</td>
<td>5.5x</td>
<td>5.8x</td>
<td>5.9x</td>
<td>6.1x</td>
</tr>
<tr>
<td>Cash Flow/Total Debt</td>
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<td>38.7</td>
<td>39.9</td>
<td>40.8</td>
<td>43.3</td>
</tr>
<tr>
<td>Pretax Return on Average Long-Term Capital Employed</td>
<td>17.8</td>
<td>17.9</td>
<td>18.3</td>
<td>18.5</td>
<td>19.4</td>
</tr>
<tr>
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<td>10.5</td>
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<tr>
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<td>48.6</td>
<td>48.4</td>
<td>47.0</td>
<td>45.6</td>
<td>44.4</td>
</tr>
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</table>

**AUDIT REPORT ON FORECAST**

The independent auditors of WFC have issued a report concerning WFC's forecasts. The report indicates that the auditors have reviewed the forecasts and the assumptions underlying the forecasts. The auditors have judged the forecasts to be reasonable and to have been prepared in conformity with the applicable guidelines for such forecast presentations.

**Additional Note**

The historical track record of management indicates that their forecasting accuracy has been about average for all companies in this industry.

Please complete the rating evaluation worksheet on the next page.
In addition to the historical data, the company has more recently provided forecasted financial statements for the next 5 years. The following is a summary of forecasted key financial ratios which assume that the proposed debt has been issued.

<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>Pretax Interest Coverage</td>
<td>5.4x</td>
<td>5.5x</td>
<td>5.8x</td>
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<td>19.4</td>
</tr>
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<td>9.0</td>
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</tr>
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<td>48.4</td>
<td>47.0</td>
<td>45.6</td>
<td>44.4</td>
</tr>
</tbody>
</table>

Additional Note

The historical track record of management indicates that their forecasting accuracy has been about average for all companies in this industry.

Please complete the rating evaluation worksheet on the next page.
REGARDING AUDITOR INVOLVEMENT WITH FORECASTS:

Assume that the forecasted financial data for DPI and WMI represent summaries of completed forecasted financial statements which have been reviewed by the companies' independent auditors. The auditors' reports indicate that the auditors have reviewed the forecasts and the assumptions underlying the forecasts. The auditors have judged the forecasts to be reasonable and to have been prepared in conformity with the applicable guidelines for such forecast presentations.

1. What impact, if any, would this auditor involvement have on your evaluation of the forecasted data? (Circle one).

<p>| | | | | |</p>
<table>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Strong Negative Effect
Moderate Negative Effect
No Effect
Moderate Positive Effect
Strong Positive Effect

Briefly Explain:

________________________________________________________________________
________________________________________________________________________

2. How would this auditor involvement affect your final judgment on the brown Loan Evaluation Worksheet? (Circle one).

<p>| | | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Strong Decrease Likelihood of Full Service
Moderate Decrease Likelihood of Full Service
No Effect
Moderately Increase Likelihood of Full Service
Strongly Increase Likelihood of Full Service

Briefly Explain:

________________________________________________________________________
________________________________________________________________________
A Discussion of
Auditors' Current and Future Involvement
In Corporate Financial Forecasts

Thomas L. Curless
Price Waterhouse
DISCUSSION OF PAPER ON "AUDITOR'S CURRENT
AND FUTURE INVOLVEMENT IN CORPORATE
FINANCIAL FORECASTS"

Thomas L. Curless

INTRODUCTION

I am discussing this paper from the perspective of one who has spent over twenty years as a member of the public accounting profession. During those two decades of experience, I have devoted over one-half of my time to serving Price Waterhouse clients in the banking industry, mainly large New York money-center bank holding companies. I have served for the past five years as the Chairman of our firm's Banking Industry Services Group with national technical support and practice development responsibilities for Price Waterhouse's clients in the banking industry. Thus, I feel that I bring a fairly high degree of knowledge and experience in both public accounting and in the banking industry to bear in discussing this excellent paper on the subject of how independent auditors, bank lending officers and bond raters view the relationship of independent auditors with management financial forecasts.
The purpose of this study is to focus on the role of the independent auditor in attesting to financial forecasts prepared by management. It also attempts to measure the impact and effect of auditor involvement with financial forecasts on both bank lending officers and bond raters. Finally, the study concludes with a recommendation as to how independent auditors might change their current involvement and reporting upon management financial forecasts so that their role might be deemed to be more useful to the principal users of such forecasts.

PERSONAL VIEWS ON OBSERVATIONS AND FINDINGS OF STUDY

Auditor's Preferences

In terms of auditors' preferences of important forecast attributes, the authors state that, "the single most important dimension of a financial forecast to experienced auditors... is the track record... of the entity's forecast." As an independent auditor, this finding of the study did not surprise me in the least since we are accustomed to attesting to historical accounting and financial data of various corporate and other entities. Accordingly, the closer that we can come to vouching for past results, as compared with those forecasted or budgeted, the more comfortable we are with reporting upon the end product. We auditors are obviously less comfortable when given the challenging responsibility of reporting upon the reasonableness of a forecast of an entity's future financial performance. The past is known and the future is fraught with uncertainty, but we realize
that the future is of much greater interest to creditors, investors and others than is the past.

I fully agree with the authors’ belief that the auditor’s qualitative assessment of management’s integrity, sincerity and expertise is important to the auditor in forming a judgment on management’s forecast. This is very similar to the auditor's assessment of the so-called control environment of an entity whose financial statements he is examining in accordance with generally accepted auditing standards. In his assessment of the control environment to determine the extent to which he can rely on an entity's system of internal accounting control, the auditor gives serious consideration to such qualitative factors as the integrity of and his prior experience with the management in terms of their living up to representations previously made and putting into effect procedural and other changes recommended by the auditor. Obviously, these qualitative factors assume even greater importance to the auditor when he is faced with the task of attesting on the reasonableness of management's forecast of an entity's future financial performance. The point is that if an auditor does not trust the management or has reason to believe that the management of an entity has not been either forthright or completely honest with him in the past, he is not likely to wish to become associated with a financial forecast prepared by that management, which will be relied upon by third parties. In addition, the entity's expertise and past experience in preparing reasonably accurate budgets and forecasts are other very important factors to the auditor.
Relative Preferences of Bond Raters and Bank Lending Officers

I found nothing surprising in the tables included in the study that displayed the rankings of relative preferences expressed by both bond raters and bank lending officers for certain types of information about forecasts. As indicated, "the historical accuracy of prior forecasts" was rated as No. 1 by 40 bank lending officers and as No. 2 by 28 bond raters and both groups considered this type of forecast information to be highly important. Since auditors also consider this attribute to be very important, track record was found to be one of the most important forecast attributes to all three groups.

Impact of Auditor Involvement on Bond Rating & Lending Decisions

Turning to the impact of auditor involvement on bond rating and lending decisions, the study concludes, based upon an analysis of the results of various case studies completed by participants, that, "in general, loan officers considering loans from companies in this size range (annual sales of $20-35 million) are much more positive about the potential contribution of the auditor than bond raters were for companies issuing new investment grade public debt."

Here again, I would have expected this conclusion in view of the difference in the degree of sophistication and in the size of the corporate entities dealt with by bond raters and bank lending officers in the case studies. The bond raters were dealing with an apparel manufacturing company (WFC) that had been in business for over 70 years whose shares were traded on the New York Stock Exchange and that reported sales of $815 million in its last fiscal year. Thus, WFC is a large, well established, publicly-held company employing over 20,000
people with a reasonably sophisticated financial control and management accounting system. As a public company, WFC is required to report its financial condition, changes in financial position and the results of its operations to its shareholders and to the SEC on a quarterly basis. In addition, it has a long history of preparing reasonably accurate forecasted financial information both for the internal use of management as well as for interested outside parties such as lending banks and bond raters. In these circumstances, it is easy to understand why the bond raters participating in the case studies attached very little significance to the auditor's review of the company's forecast. They did not feel the need for the additional assurance provided by the auditor's review and report on the company's forecast. As a result of the company's long history, its sophisticated systems and accounting procedures, and the bond raters' generally favorable experience with the accuracy of the company's forecasts of its financial performance over many years, the bond raters apparently felt comfortable with the financial forecasts as supplied by company management.

In sharp contrast to the situation described above, bank lending officers were dealing with a relatively small, untried and untested potential corporate borrower that normally would not be issuing public debt. Obviously, a company of this size does not have either the personnel or the financial control and accounting systems that are as sophisticated as those employed and utilized by WFC. Accordingly, bank lending officers, in making their decision whether or not to extend credit to this small business, were looking for all the help
that they could get. One obvious and available source of assistance to them outside of the company is the company's independent auditor who could review and report upon management's forecast information. In this case, bank lending officers felt the need for the additional assurance provided by the auditor on the reasonableness and accuracy of forecast information supplied by the small company, and they placed a high degree of importance on the auditor's attestation of such forecast.

**Possible Future Auditor Contributions to Client Forecasts**

With regard to future auditor contributions to client forecasts, the authors suggest, "a reconsideration of the auditors' involvement with forward looking data..." The authors believe that auditors might make a greater contribution by reporting on past forecast accuracy of individual entities and on the industry in which the entity operates rather than reviewing and reporting upon current forecast data per se.

While many auditors might be pleased with the authors' suggestion as to a change in their current role in reviewing and reporting upon forward looking data since the suggested task would be easier to accomplish and would tend to limit their liability to third parties, I do not believe that the suggested change would necessarily be in the public interest. I think that the auditor's present attest role with respect to certain types of forecast information does have significant value to investors, creditors and other users. For example, the authors acknowledge that auditor involvement in forecasts included in feasibility studies (for projects such as hospitals,
stadiums, bridges, etc.) is extremely useful and important to municipal bond raters. I believe that the same holds true for prospective investors in limited partnership tax shelters, a substantial group, who tend to rely heavily upon auditors' attestation of forecasts of future income, deductions and cash flow included in SEC filings. As indicated in the study, bank lending officers place heavy reliance upon the auditors' attest function with respect to forecast information supplied by smaller businesses when they apply for loans.

The auditor's association with clients' forecast information is a relatively new phenomenon and his role is still evolving. Auditors have not yet had a great deal of experience in reviewing and reporting upon their clients' forecasts of future financial performance. I am confident that, as auditors and users gain additional experience in the future with forecast information, improvements in the auditors' approach, review techniques and reporting will be achieved. However, I believe that the author's suggestion to narrow and limit the auditors' role solely to reporting upon an entity's and industry's forecasting track record would be a backward step and would fail to meet the public's expectations and needs.

**CONCLUSION**

In summary, I have generally agreed with the authors of this study with regard to the four key findings and conclusions set forth below:

1. The single most important dimension of a financial forecast to experienced auditors is the track record of the entity's forecast.
2. Qualitative assessments of management's integrity, sincerity and expertise, which are difficult to measure empirically, are also very important to the auditor in forming a judgment on management's forecast.

3. The relative preferences expressed by bond raters and bank lending officers for certain types of information about forecasts and their relative importance were as expected.

4. Bank lending officers tend to place more reliance on and to consider more important the auditors' involvement with forecasts made by small potential corporate borrowers than bond raters do when rating new debt of a large, publicly-held company.

Finally, I disagreed with the authors' suggestion as to a change in the auditor's role and responsibility in the future with respect to his involvement with clients' financial forecasts on the basis of my view that the suggested change would not be in the public interest.
A Discussion of

Auditors' Current and Future Involvement

In Corporate Financial Forecasts

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DISCUSSION OF AUDITOR'S CURRENT AND FUTURE INVOLVEMENT IN CORPORATE FINANCIAL FORECASTS

Auditor involvement with corporate financial forecasts is an important issue facing the auditing profession. Corporate financial forecasts are believed to be an important source of information to individuals using corporate financial statements. So strong is this belief that the Securities and Exchange Commission (SEC) [1978] requires corporate financial forecasts and further has publicly stated its position [SEC, 1979] that it is desirable to have public auditor involvement with these forecasts. Danos, Holt, and Imhoff [1982] summarize the results from two previous published studies by Danos and Imhoff [1982a, 1982b] and provide additional, partial results from two research projects. All of these empirical studies were undertaken to study auditor involvement with corporate financial forecasts.

A difference exists in the reported research in that the focus of the research projects allows them to be divided into two sets of studies. The first set is composed of the two Danos and Imhoff studies [1982a, 1982b]. In these two studies, the focus is the set of variables which could or would be utilized by auditors in evaluating the reasonableness of corporate financial forecasts. The second set is the results reported by Danos, Holt, and Imhoff [1982] in the paper presented at this conference. These two research projects focus on (1) the importance or preference for corporate financial forecasts and (2) the effect of auditor involvement with corporate financial forecasts.

Both of the latter two research projects use individuals who meet the Financial Accounting Standards Board (FASB) [1978] requirement for sophisticated users—i.e., knowledgeable individuals willing to spend the time necessary to understand financial statements. While the FASB did not intend for this
criteria to apply to auditor involvement with corporate financial forecasts, selecting such individuals does indicate that these individuals are aware of, and could utilize, alternative financial information.

My remarks are divided with three parts: (1) auditor factors, which attempts to focus two findings of importance from the Danos and Imhoff studies in a different way; (2) importance of auditor involvement in corporate financial forecasts, and (3) information about forecast preparation.

**Auditor Factors**

As Danos and Imhoff [1982b, p. 31] report:

The single most important difference observed in the discussions with auditors and managers was the importance management placed on the negotiation process. In every corporation interviewed, the forecasts were described as being to some degree dependent on negotiations among the managers who participated in the forecast decision.

The subject auditors' ability to make reasonableness judgments grounded on "discoverable" information was fairly high in the policy capturing study Danos and Imhoff [1982a] which related reasonableness decisions to quantifiable variables. The importance of quantifiable, discoverable variables was also found in the interviews of auditors concerning corporate forecast systems in Danos and Imhoff [1982b]. The role of negotiation was not mentioned by these auditors although they seemed to understand other aspects of the forecast system. Danos, Holt and Imhoff therefore needed some way to account for their reliance on discoverable variables. One way is to postulate a reliance on a subjective evaluation of management integrity.

Management integrity can mean that managers do not knowingly present information in such a fashion to mislead the users of the information (e.g., fraudulent behavior as defined and illustrated in the Sorenson, Grove and Selto [forthcoming] paper presented at this symposium).

Management integrity in the forecasting context must also mean that managers desire to, and do, provide their best estimate of future events from
the negotiation process. There is evidence that managers' subjective decision making and negotiation may enhance such a forecast. Basu and Schroeder [1977], in a study at American Hoist and Derrick found that the consensus on managers concerning future sales as determined from a Delphi process consistently outperformed forecasts derived via other methods. More study is needed concerning the effects of negotiation by managers on forecasts for two reasons. First, managers' goals when making the forecasts may not be to predict the future (see the comments later in the paper about budgets and forecasts). Thus, some information about managers' goal when preparing forecasts is needed. Second, negotiation is not the same as the structured Delphi process even when the managers' goal is accuracy of prediction of future events. A Delphi process is designed so as to eliminate personality dominance and superior/subordinate relationships because of their potential for interjecting bias. Thus, some understanding of whether this potential for bias materializes in the negotiation process is needed.

Such a reliance on subjective evaluation of management integrity does not, it appears, meet the goals sought by the SEC [1979] or enumerated by the AICPA [1980, 1982]. While subjective evaluation of management integrity may be an important factor, auditors utilizing this factor are adding their association to the results of a negotiation process based upon subjective "evidence." Thus, auditors may be taking on more risk.

Seemingly, Danos, Holt and Imhoff recommend that the auditor's role should be the calculation and verification of objective items, such as (may be limited to) the accuracy of past forecasts and perhaps the existence (and functioning) of a forecast system [Danos, Holt, and Imhoff, 1982, p. 17-18]. This seems logical given the potential for increased costs to auditors. Ijiri [1980] discusses the increased costs to firms from publishing forecasts. All of these, both direct and indirect, seem applicable to auditing firms who become associated
Importance of Auditor Involvement in Corporate Financial Forecasts

Some evidence exists that bank lending officers desire and request financial projections in accounting form. There is further some evidence that, failure to provide such financial projections would result in delaying the loan decision. Bank lending officers have resources available to prepare their own independent projections. (see Stephens [1980]). We don't have a good understanding of how this data is used in bank lending decision processes. Also, we don't have evidence as to whether the projections will affect decisions. The desire for collection of management projections may be nothing more than a requirement imposed by bank examiners. The requirement for and effect on decisions of bond raters is contained within their paper [Danos, Holt, and Imhoff, forthcoming, p. 12].

Danos, Holt, and Imhoff have made an important beginning in our understanding of the part auditor involvement might play in decisionmaking. The first study elicited bond rater probabilities about bond ratings. These results indicate that it would play almost no role in bondrating for profit making corporations issuing investment grade securities. Citing casual evidence concerning forecasts for projects in the non-profit sector they note that this result should be used with caution. The results from bank lending indicate some usage but this is based on prior indications by decision-makers rather than their "experimental" decisions. Statistical relationships between variables and decisions have been inconsistent in upholding such prior relationship findings.

In general, their results are provocative and illustrate the need for more research in this area. After all, unless auditor involvement in corporate financial forecasts yields benefits by improving decisions about the extension
and allocation of credit (or some other decision), they should not be undertaken since their cost must be greater than zero. The evidence provided by Danos, Holt, and Imhoff is mixed.

The next section discusses the auditor involvement in corporate financial forecasts as if it had been determined that auditor involvement in corporate financial forecasts had been determined to be beneficial. Specifically, auditor involvement in auditing the items of information included in the Danos, Holt, and Imhoff study will be examined under this assumption.

Information About Forecast Preparation

The preferences of both bond raters and bankers was to receive information about the historical accuracy of prior forecasts (2nd in preference by bondmakers and 1st by bank lending officers). This indicates a desire by both these groups for this information. Note, however, that the information may be available to both groups when the situation is an ongoing relationship--i.e., the bond raters and bank lending officers would have the forecasts and results (financial statements) from prior periods which they could compare.

Another highly preferred variable, the relationship between the forecasted trends and the historical trends (3rd for bond raters, 4th for bank lending officers) would be similarly available. The amount of detail (5th by bond raters, 2nd in preference by bank lending officers) would seem to be independent of auditor involvement.

Thus, three of the most highly preferred forecast information variables for bond raters and bank lending officers don't seem to benefit from auditor involvement in situations where there are ongoing relationships. The remaining preferred forecast information items in the top five don't seem amenable presently to auditor involvement on an objective basis, that is, the auditor has no comparative advantage in evaluating industry and economic conditions.
All of the comments applicable to preference rankings apply to information importance ratings, partly because there is only one change in the type five forecast information items between preferences and information importance in each user group.

This leaves only the new bondrating and bank lending situations. The auditor's involvement here would seemingly be limited to being associated with the historical accuracy of prior forecasts. This appears to require that auditors add to their audit requirements the collection of a forecast signed by management in all situations where a forecast was not made public. When a forecast was made public, obtaining a copy of that forecast would suffice. Auditor involvement in new bondrating or bank lending relationships would then involve only the forwarding of the forecast.

The auditor would still have some difficulty in even this reduced involvement, however, because these firms might be confusing forecasts and budgets.¹ Thomas V. Fritz of Arthur Young & Company has stated (as reported in Ijiri [1980, p. 45]):

Budgets [as reliable forecasts of performance] are not necessarily managements' estimates of the most likely results. In many cases budgets reflect managements' desires or philosophies.

Thus, auditors may not be able to accept budgets as forecasts for delivery to bondraters and bank lending officers when future circumstances so demand. The proper activity of auditors, including how they might obtain forecasts in these circumstances, requires further study.

¹Auditors are already utilizing forward looking data for auditing [Danos and Imhoff, 1981] and are required to look at budgets when reviewing interim statements under SAS 24 (1979). This is different as auditors may be required to separate forecasts from budgets.
Conclusion

The research reported in Danos, Holt, and Imhoff has added to our knowledge of factors utilized by auditors in reasonableness judgments about corporate financial forecasts, the limitation of the auditors role in making such judgments, the importance of auditor involvement in decisionmaking by bond raters and bank lending officers, and the types of information about corporate financial forecasts desired by these user groups. The differences between their interpretation and the interpretation in my discussion is a matter of degree. Their results are persuasive about the factors used by auditors in making reasonableness judgments and the limitations of the auditor's role. My call for further research to indicate a benefit from auditor involvement with corporate financial forecasts is only slightly stronger; I benefit in this area from my role as discussant and critic. It is only in the last area, the potential for positively affecting the auditor involvement from specific processes, assuming a benefit exists, that our recommendations must differ.

Danos, Holt and Imhoff, using their results, still find a role for auditor involvement in corporate financial forecasts in supplying forecast error data, although this role they foresee is different from that envisioned by the SEC and AICPA. My interpretation, based upon their results, is for an even more restricted role, maintaining and supplying company financial forecasts for new bondrating and bank lending situations.

This restricted role may not, however, be politically feasible. Thus, I'm left with the uncomfortable role of interpreting empirical results in one fashion and foreseeing that we will not be able to make policy choices based upon the results. The only possible future result is that more research in this area is necessary because of the SEC mandate.
REFERENCES


