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Auditing Symposium XI: Proceedings of the 1992 Deloitte & Touche/University of Kansas Symposium on Auditing Problems, pp. 136-140;

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Discussant's Response to "Using Regression Analysis to Assist Audit Judgments in Substantive Testing"

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I'm very pleased to have the opportunity to discuss the updated version of STAR. Many of my papers have addressed problems in analytical review in auditing and particularly regression analysis as a tool. Hearing about STAR's revision was like hearing that an old friend hadn't died after all. Thus, it was with some enthusiasm that I accepted Raj's invitation to discuss the updated, interactive version of STAR with its new bells and whistles.

My comments are divided into four basic areas and are generally favorable toward the software and the approach. Rather than being overly technical, I will try to stimulate your thinking about STAR, provide some perspective, and assess where we might go from here. First is a brief history of STAR and some STAR-related regression analysis research in auditing. Second is an analysis of what's good about STAR and what's new in the current version, and third will be some areas that need elaboration or additional thought. Finally, there is an overall evaluation of STAR and its impact.

History

As many of you know, STAR, dollar unit sampling, and the AICPA's audit risk model were developed by Ken Stringer of the former Deloitte Haskins & Sells. I began my research on regression in auditing after a 1977 conversation with Jim Loebbecke. We were discussing his research on "combined attributes and variables" sampling which was related to Stringer's "cumulative monetary amount" version of dollar unit sampling. Jim said that he had based his efforts on the presumption that Stringer was probably right, so Jim took what he knew about CMA and tried to derive what he didn't. I decided that I would try the same approach for STAR.

Using Stringer [1975], I set out to derive what must be in a regression package that could satisfy the requirements for a substantive test. My primary problem was determining what Stringer meant by the "most adverse distribution of error." Stringer [1975] gave no clues but said that STAR was designed to be effective even under that most feared of circumstances. I finally decided that that must mean that the procedure was based on the *sum* of estimated misstatements, and therefore it didn't matter how misstatements were distributed. My solution appeared in Kinney [1979]. At a conference sponsored by DHS, I found out that I had not guessed correctly about STAR but still had a useful result.

Both STAR and Kinney [1979] use an upper precision limit (UPL) on error

calculation that is then compared to a monetary precision measure (monetary precision is the magnitude of "intolerable" misstatement for the assertion or account under audit). The decision rule is:

"If UPL (Error) > MP measure, then don't rely."

There are two basic approaches to relating UPL to MP, as represented here today. They differ on how the UPL is calculated and how MP is measured. The Price Waterhouse approach is based on Kinney [1979] and calculates an UPL on total error for the year (in a time series model) using the standard error for the total. The resulting UPL for the year is then compared to a materiality or tolerable error measure for the year. Specifically, for Price Waterhouse the calculation is:

$$UPL_{AP}(E) = E + t(AP) \times SE(E) \geq MP$$

where AP denotes the analytical procedure risk level, E is sum of the estimated monthly misstatements for the year as a whole, and SE(E) denotes the standard error for total misstatement for the year.

The STAR approach of Deloitte and Touche calculates the UPL by month and compares with a monthly MP measure (see Kinney [1979] and Stringer and Stewart [1985]). STAR makes the following comparison for all values of n > 0:

$$UPL_{AF}(e) = e + t(\sqrt[n]{AP}) \times SE(e) > MF/n$$

where e is the estimated error for the month, and SE(e) is the standard error for the month. It can be shown that the STAR comparison has a unique minimum that occurs at generally small values of n. Thus, the calculation need not be made for all values of n > 0.

Research since 1975 has found the following. Regression analysis is *reliable* for the data tested (it has been tested using simulated data and actual data with simulated misstatements). That is, the actual rate of failure to indicate material misstatements does not exceed the nominal level [e.g., see Kinney and Salamon, 1982; Knechel, 1988]. Also, the procedure is "fail safe." If a precise model cannot be developed, then the SE is so large that the UPL will exceed the MP measure and the auditor is warned that there is insufficient evidence for reliance.

As to the success of field application, there is circumstantial evidence that STAR may be effective in locating potential material misstatements. Kinney and McDaniel [1989] show that the rate of correction of errors discovered in quarterly statements of Deloitte Haskins & Sells clients is about twice that for the population of Big Eight firms as a whole. While the result may be due to poor clients or to other factors, these alternative explanations do not seem likely.

In regard to auditing standards, STAR and other regression-based procedures are perhaps the only fully operational and practical means of complying with the provisions of SAS No. 56 [AICPA, 1988] for substantive evidence. Regression provides a basis for forming conditional expectations, and a means of quantifying precision and relating the result to materiality—-two difficult requirements of SAS No. 56. Ratio analysis and ARIMA models may partially satisfy these conditions, but generally they suffer from excessive standard errors and, thus, are not effective as audit evidence. Finally, STAR has an advantage under the SAS No. 31 [AICPA, 1980] approach of assessing risk at the assertions level. In contrast to tests of details which often test only a single assertion, STAR may be effective in detecting misstatements in more than one assertion and more than one account.

What's good about new STAR, and regression in auditing?

In addition to the desirable features discussed above, the new STAR approach is an improvement because of the new bells and whistles that guide the auditor in developing an acceptable model of an account. There is increased emphasis on understanding the client's business and many hints are provided to the auditors on how to better understand the business. First, the model-building exercise itself requires understanding of the basic covariation among and between financial and physical elements. Second, the new diagnostic testing can confirm or deny the auditor's preliminary understanding. For example, the auditor is directed to try to understand why an expected covariation is not observed.

Furthermore, the diagnostic approach is extended through consideration of omitted variables. Specifically, the program tests for discontinuity (or changed parameters since the base period), autocorrelation, heteroscedasticity, and abnormal residuals. In each case, the auditor is given hints as to what the pattern that violates regression assumptions might mean in terms of an improperly specified model. For example, the auditor is directed to consider whether there are patterns over time such as a positive residual followed by a negative residual. This pattern may indicate a cutoff problem. Also, it gives guidance about omitted causal or structural variables.

Beyond auditing applications, there are several additional uses of STAR and the auditor's skills in using STAR. A partial list includes: interim reviews of financial information, preparation and review of forward-looking information, and incorporation in a client's integrated internal control system [COSO 1991]. In fact, the latter two can be combined in developing client forecasting systems useful in formulating plans or budgets for the future and then providing early warning that things aren't working out as planned. The regression model could be used by the client to direct attention to implementation problems (including errors and fraud), to revise the planning model estimates, or to revise the model itself by including variables that had been omitted. Such a system should be helpful in business operation as well as in demonstrating to others that controls are good [Kinney, Maher and Wright, 1990].

Finally, I pose a question for professors and practitioners alike (I don't expect an answer now, but I am curious about your thoughts). Given all of the advantages of STAR, why hasn't this product and approach been advertised? Regression analysis seems to offer solutions to several problems of auditors and offers considerable benefits to clients. Why hasn't D & T advertised it? Why don't public accounting firms in general advertise their leading edge technologies? Why isn't it useful to advertise audit excellence to clients, financial statement users, audit committees, and prospective employees?

What needs elaboration?

As to limitations of STAR and the Stewart and Thornton [1992] paper, I have three general comments. The first relates to the paper and how it could be made more useful for professors who are interested in giving their students perspective on practical application of tools such as regression analysis (Scott and Wallace [1992] provide some insights in this regard). The second concerns the guidance in SAS No. 56 and its incorporation in STAR, and the third involves questions about STAR itself.

As a teacher, I would appreciate answers to three questions about the appli-

cation of STAR in practice. First, what is the distribution of the ratio of the standard error of the regression to monetary precision? This ratio relates the precision of the estimate measured in dollars (SE) to allowable imprecision also measured in dollars (MP). I believe that the distribution of SE/MP would be more useful than correlation coefficients since, in the former, both the numerator and denominator are measured in dollars instead of proportion of variation explained. It would be especially useful to see the distribution of SE/MP across accounts, clients, and industries. Second, what is the mix of internal, external, non-financial, and indicator variables across accounts, clients and industries? This knowledge would allow professors to assess the importance of internal variables in designing analytical procedure research projects and to see how sophisticated the practice models are. Realistic classroom examples could then be developed. Third, what have STAR's costs been— training costs, implementation costs, and the costs of making the transition for staff auditors from Deloitte & Touche?

As one interested in auditing standards, I am torn between the use of regression diagnostics to better understand the client's business vs. signalling possible misstatements. This same concern was expressed in the recent Expectations Gap Roundtable [Blocher and Loebbecke, 1992], and in a presentation at this conference two years ago [Kinney and Haynes, 1991]. The approach taken in STAR is consistent with SAS No. 56, para. 21, which focuses the auditor on explaining unexpected results in terms of non-error causes. Basically, para. 21 says that if UPL exceeds MP, then the auditor should first consider whether the model is wrong (auditor mistake), then ask management for an explanation. If both of these fail, then the auditor is directed to consider accounting misstatement as the possible cause. Since behavioral research has shown that auditors may focus unduly on nonerror causes identified by either of the first two foils, they may underweight the probability of error or fraud. This problem is not unique to STAR, but STAR's focus on understanding the client's business may increase the tendency.

Turning now to STAR itself, I note two issues that provide food for thought. First, stepwise regression includes the variable(s) that best fit the data during the base period. Each period, by chance, certain variables will exhibit particularly good fits in explaining the dependent variable even when there is a truly causal variable available. The best fitting variables in the base period may not exhibit much explanatory power in the prediction (audit) period. Thus, STAR may to some degree select randomly irrelevant variables. An alternative is a theoretical basis for the model in each application. The model (or perhaps an industry model) might be developed once and updated through appropriate consideration of omitted variables. A theoretically-based model would require more skill in model building, but may be more precise in the long run.

Second, a reading of SAS No. 31 in conjunction with SAS No. 56 raises an evidence integration issue that has not been adequately addressed. The issue is how to combine evidence across assertions and across accounts. There are at least two levels of analysis for integrating results using regression as an analytical procedure. Within an application, care must be taken to account for the lack of independence due to use of the same regression equation to estimate multiple components of an account balance [see Kinney, 1979] Across applications, there is the problem of how to combine results. Since STAR uses an investigation rule that considers the "most adverse distribution of error," it may provide

protection in signalling possible misstatement when a material amount of misstatements is spread over several accounts that are audited using STAR.

Overall

STAR was a very useful tool in 1975. It has led to considerable research and to SAS No. 56. It holds much promise in the 1990s as a tool for substantive testing in auditing as well as many other areas of client services and direct use by the clients themselves.

The new "bells and whistles" should add value through better understanding of clients' businesses, and increased value as a substantive audit tool. Furthermore, its potential as an analytical tool seems even greater now than it did in 1975.

I'm delighted that the technique has survived the merger, and competitive and cost pressures. I hope that other firms will consider its use as an audit and business tool.

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