

**A Conceptual Model for External Auditor Evaluation
of the Internal Audit Function Using Belief Functions**

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I. INTRODUCTION

The Sarbanes-Oxley Act of 2002 (hereafter SOX), has greatly enhanced the role of the internal audit (IA) function. Section 302 of SOX requires management to certify the effectiveness of disclosure controls and procedures with respect to firms' quarterly and annual reports. Section 404 of SOX requires firm management to document, evaluate, and report on the effectiveness of internal control over financial reporting, and requires the external auditor to evaluate and opine on management's assessment of internal control. This requirement may increase external auditors' reliance on the work of internal auditors when they perform the integrated audit now required under AS No. 2 (PCAOB, 2004).

For the external auditor to rely on any work performed by the IA function, the external auditor must assess the quality of the IA function (AICPA, 2003; PCAOB, 2004). The PCAOB (2004) contends that the considerable flexibility that external auditors have in using the work of the IA function should translate into a strong encouragement for companies to develop high-quality IA functions. The stronger the IA function, the more extensively the external auditor will be able to use their work (PCAOB, 2004). Even prior to the Sarbanes-Oxley Act, the external auditors evaluated the strength of the IA function with the objective of assessing the strength of the internal control structure of the client. SAS No. 65 described the relationship between external auditors and internal auditors, outlining the various ways in which the external auditor can enhance their efficiency and effectiveness by utilizing the work of the internal auditors.

There is a substantial body of accounting literature that addresses specific questions within the broad area of research concerning the external auditor's evaluation of the IA function.¹ We limit our discussion to studies that focus most directly on the external auditor's assessment of three IA quality factors—internal auditor objectivity, competence, and work performance.² Early studies of this kind were aimed at gaining a better understanding of the relative importance of each factor in the external auditor's overall evaluation, however, they did not attempt to understand the interrelationships between the factors and how the interactions between them can help auditors gain an understanding of the internal control structure of the client (Brown 1983; Abdel-Khalik et al. 1983; Schneider 1984, 1985a, 1985b; Margheim 1986; Messier and Schneider 1988; Edge and Farley 1991). Two more recent studies, Maletta (1993) and Krishnamoorthy (2002), explicitly recognized the interrelationships among these factors.

Maletta (1993) examined the decisions of external auditors to use internal auditors as assistants throughout the audit process. The study concluded that external auditors use a complex process for evaluating the attributes of the internal auditors, and the importance of any given factor is contingent upon the presence or absence of other factors. Suggesting that, whenever their inherent risk is high, external auditors will consider the work performance of internal auditors only when objectivity is high. Maletta (1993) also investigated the factors which external auditors consider when deciding whether or not to use internal auditors as assistants. Specifically, Maletta studied the impact of inherent risk on the extent to which IA

¹ See Gramling (2004) for an extensive review of research related to the internal audit function.

² Competence has been defined as the educational level and professional experience of the internal auditor and other such factors. Objectivity has been defined as the organizational status of the internal auditor and organizational policies affecting the independence of the internal auditor. Work Performance has been defined as the internal control, risk assessment, and substantive procedure performed by the internal auditor.

attributes affect auditors' decisions to use internal auditors as assistants. The study concluded that external auditors use a complex process when deciding whether or not to use the internal auditors as assistants, and also that there is a relationship between the three factors. These results indicate that when inherent risk is high, auditors consider the work performance of the internal auditors only when objectivity is high. However, there were no interaction effects between work performance and objectivity when the inherent risk was low. Further, across all the inherent risk conditions, competence was the most important factor followed by objectivity and work performance.

Krisnamoorthy (2002) studied how the three factors of objectivity, work performance, and competence interact in determining the strength of the IA function. Specifically, the study employed analytical methods based on Bayesian probability to model external auditors' evaluation of the IA function. The study recognized the limitations of a descriptive, experimental approach, used in prior studies, with no formal model guiding the research hypothesis. However, due to this limitation, the results from these studies have been mixed and inconclusive. The study concluded that it is futile to attempt a rank ordering of the factors since the factors are interrelated and no single factor can be used in isolation to make an evaluation of the IA function by the external auditors. Therefore, the use of cascaded inference structures is warranted and appropriate for evaluation of the strength of the IA function.

The primary purpose of this paper is to develop an internal audit assessment model for evaluating the strength of the IA function that includes the interrelationships among the factors in the analysis. The model is built on the three attributes of internal auditors identified by auditing standards and prior academic research (SAS 65 1991; Messier and Schneider 1988;

Krishnamoorthy 2002). This model generates an overall judgment concerning the strength of the IA function that can aid the external auditor in assessing the reliability of a client's internal control system. Since evaluating the IA function entails a process of gathering items of evidence pertaining to each attribute of the internal auditors and aggregating them to make an overall judgment, we develop the internal audit assessment model using the evidential network approach of Srivastava et al. (1996) under the belief –function framework.

This paper makes several contributions to the auditing literature. First, in response to the call by Gramling et al. (2004), our study explicitly acknowledges and incorporates into the analysis the inter-relationships between the IA quality factors. They encouraged this line of research because they recognized a gap in research concerning the processes by which the external auditors combine evidence on the three factors when deciding whether or not to rely on the work of the internal auditors.

Secondly, the belief-function framework provides a broader approach for representing uncertainties in evidence, especially when the evidence provides mixed support for the attribute or when the evidence provides only one-sided support; i.e., the evidence either supports or refutes the attribute. (Srivastava et al. 2002). It is not easy to represent such evidence in the probability framework. Moreover, the belief-function framework's interpretation of evidence is more intuitively appealing than the probability framework's interpretation. For example, suppose the auditor finds evidence about the competence of the internal auditor but wants to assign a low level of support, say 0.2, that the internal auditor is competent. Under a probability framework, this assessment would mean, by definition, the internal auditor is incompetent with 0.8 level of support, even though the auditor may believe

that the evidence provides no indication that the internal auditor is incompetent. However, under belief-functions, the remaining 0.8 degree of support represents an uncommitted belief regarding the competence of the internal auditor.

Thirdly, the Bayesian framework requires estimation of conditional probabilities by external auditors for evaluating the attributes of the internal auditors. Krishnamoorthy (2002) recognized this limitation stating that, “it might be extremely difficult for external auditors to articulate their beliefs as conditional probabilities.”(pp. 102). However, the belief- function framework does not require the estimation of conditional probabilities. Finally and most importantly, the model developed in this paper can be effectively used by external auditors as a decision aid for assessing the strength of the IA function, while planning their audit, due to its intuitive appeal and ease of use. Also, our paper can assist them in determining the extent to which they want to rely on the internal auditors’ work. We believe that our paper is the first to develop a decision aid for this purpose.

The rest of the paper is organized as follows; Section II describes the proposed internal audit evaluation model and its extensions relative to the key frameworks in prior research as an evidential network, Section III describes the results of the sensitivity analyses and also, the effects of the interrelationships between the attributes on the assessment of the strength of the IA function. Section IV presents a theoretical framework for the reliance by external auditors on the work performed by the IA function and Section V presents conclusions and directions for future research.

II. THEORY AND MODEL DEVELOPMENT

The belief-function framework is a broader framework for representing uncertainties associated with items of evidence than probability. The probability framework does not provide a natural and logical way to model uncertainties encountered in the real world. In contrast, Dempster-Shafer (hereafter, DS) theory of belief functions provides a better framework for modelling such uncertainties (see, e.g., Gordon and Shortliffe, 1990; Shafer and Srivastava, 1990; Srivastava and Mock, 2000). Moreover, there is empirical evidence showing the superiority of belief functions in mapping the uncertainty judgments. For example, in an auditing context, Harrison et al. (2002) found that 80% of the uncertainty judgments could be modelled only using belief functions. Also, Curley and Golden (1994) found that uncertainty judgment by participants in their study were logically consistent with the belief function framework.

Essentially, under the probability framework, we assign probability mass, P , to each possible value of a variable where all such masses add to one. For example, suppose there are n possible values, $a_1, a_2 \dots a_n$, of variable A . Under the probability framework we assign probability mass to each value of the variable, i.e., $P(a_i) \geq 0$, such that $\sum P(a_i) = 1$. However, under the belief-function framework, we assign uncertainty, represented by m values (belief masses), and basic probability assignment function by Shafer, to not only singletons but to all other possible subsets including the entire frame $\Theta = \{a_1, a_2 \dots a_n\}$. The belief-function framework reduces to probability framework when the only non-zero m -values are for the singletons.

Belief in a subset B of a frame Θ determines the total belief one has in B based on the evidence represented through m -values. It is defined as $Bel(B) = \sum m(X)$, where X represents

a set of elements of Θ . Let us consider the following example for illustration. Suppose we have a mixed item of evidence pertaining to a specific quality factor of the IA function, say competence, with the internal auditor either being “competent” or “not competent”, with the following distribution of belief masses: $m(\text{competent}) = 0.6$, $m(\text{not competent}) = 0.3$, $m(\Theta) = 0.1$, where $\Theta = \{\text{high}, \text{low}\}$. These m -values imply that, based on the evidence, we have 0.6 level of support that the internal auditor is competent, 0.3 level of support that he is not, and 0.1 level of support that he is either competent or not competent representing the ignorance. Based on the above example, the belief that the internal auditor is competent is $\text{Bel}(\text{high}) = m(\text{high}) = 0.6$, the belief that the internal auditor is not competent is $\text{Bel}(\text{low}) = m(\text{low}) = 0.3$, and the belief that the internal auditor is either competent or not competent is $\text{Bel}(\{\text{high}, \text{low}\}) = m(\text{high}) + m(\text{low}) + m(\{\text{high}, \text{low}\}) = 0.6 + 0.3 + 0.1 = 1.0$

Plausibility in a subset B of a frame Θ defines the degree to which B is plausible in the light of the evidence. For the above example, plausibility that the internal auditor is competent is $\text{Pl}(\text{high}) = 0.6 + 0.1 = 0.7$, and plausibility that the internal auditor is not competent is $\text{Pl}(\text{low}) = 0.3 + 0.1 = 0.4$. One can express complete ignorance or lack of opinion about B by $\text{Bel}(B) = 0$ and $\text{Pl}(B) = 1$

Two or more items of evidence pertaining to a variable are aggregated using Dempster’s rule of combination. For two items of evidence, Dempster’s rule is defined as: $m(B) = \sum m_1(B_1) m_2(B_2) / K$, where m_1 and m_2 are the two belief masses pertaining to the frame Θ and K is the renormalization constant defined as: $K = 1 - \sum m_1(B_1) m_2(B_2)$. The second term in K represents the conflict. Under the situation when two items of evidence completely conflict each other, i.e., $K = 0$, the two items of evidence are not combinable.



Figure 1 depicts the conceptual model for evaluating the strength of the IA function using SAS 65 and prior academic research (AICPA, 1991); Messier and Schneider, 1988; Krishnamoorthy, 2002). In Figure 1, the strength of the IA function (S) can assume two possible values: strong and weak. The competence factor(C) can assume two possible values: the internal auditors are either competent or not competent. In a similar fashion, the work performance (W) of internal auditors may be satisfactory or unsatisfactory and internal auditors may be objective (O) or not objective.

----- Insert Figure 1 Here-----

The dotted lines in Figure 1 depict the conditional dependence among the variables in the model. Thus, the strength of the IA function depends upon C, W, and O. Furthermore, work performance is expected to depend upon competence, i.e.: a competent internal auditor is expected to exhibit better work performance. Similarly, one can also expect work performance to be dependent on objectivity since an objective and independent auditor is more likely to make judgments that improve work performance (Krishnamoorthy 2002). However, professional standards, for instance SAS 65 and prior literature, do not predict a relationship between internal auditor competence and objectivity, and therefore, we assume them to be independent.

Figures 1A, 1B, and 1C depict the three attributes for evaluating the strength of the IA function and the various items of evidences used to determine the values assigned to the attributes. This evidence has been adapted from the significant findings of prior research (Messier and Schneider, 1988; Dezoort et al., 2001).

----- Insert Figure 1A, 1B, & 1C Here -----

Figure 2 presents the evidential network for evaluating the strength of the IA function. The rounded nodes, in the figure, represent the variables in the network. These variables are competence, work performance, and objectivity. The circle with the ‘&’ inside it represents an ‘and’ relationship between the variables on the left and the variables on the right. For example, the strength of the IA function, (on the left), is connected to the three variables C, W, and O on the right through an ‘and’ relationship. This depiction implies that the IA function is strong if, and only if, all of the variables on the right are met (i.e., the internal auditors are competent, work performance is high, and they are objective).

----- Insert Figure 2 Here -----

The rectangular boxes represent items of evidence pertinent to various attributes as represented by direct linkages between items of evidence and the attributes. In order to determine the overall strength of the IA function, one needs to gather the relevant items of evidence as indicated in Figure 2, evaluate the level of support each item of evidence provides to the corresponding variable(s), and then aggregate these assessments of support in the network to determine the overall level of support for the strength of the IA function.

In Figure 2, the three variables C, W, and O are connected by two relationships - one between competence and work performance, depicted by R1, and the other between work performance and objectivity, depicted by R2. Each of these relationships is multidirectional in its influence. That is, in the case of R1, for example, if there is a belief that the internal auditor is competent, then his work performance will be satisfactory. In a similar way, if there is a belief that the work performance of an internal auditor is satisfactory, then he is assumed to be

competent. Similarly, in the case of R2, if the internal auditor is objective, his work performance will be satisfactory. On the other hand, if there is a belief that the work performance of an internal auditor is satisfactory, then he is assumed to be objective. These relationships can be modelled in a variety of ways. For instance, each of the relationships can take a fixed value; say r_1 , r_2 or r_3 . Or one can assume that the value of each relationship depends on the level of belief about the related variables. Depending on the relationship assumed between the variables, the strength of the IA function will also change.

Since the belief function calculus becomes very complex for network structures, a computer program is essential for representing beliefs in such structures. There are three computer programs currently available for representing belief functions in networks: (1) DELIEF developed by Zarley, Hsia and Shafer (1988), (2) Auditor's Assistant (AA) developed by Shafer, Shenoy and Srivastava (1988), and (3) Pulcinella developed by Saffiotti and Umkehrer (1991). Since Auditor's Assistant is more user-friendly than DELIEF or Pulcinella, we will use Auditor's Assistant to show how an external auditor can evaluate the strength of the IA function.

AA is decision-support software written in Pascal for the Apple Macintosh. Originally developed for decision-making in auditing, AA provides a graphic user interface to facilitate the construction of networks of evidence, variables, and their logical relationships. Variables appear as rounded rectangles in the diagram and have multiple possible values. For example, elsewhere in the paper, the variable Competence is described, as have two values – competent or not competent. The user can create relationships between variables under the belief function framework. However, for ease of use, AA has a built-in 'and' relationship represented by a

circle with ‘&’ in it. The ‘and’ relationship implies that the variable on the left is related through an ‘and’ relationship to all the variables on its right. Evidence appears as rectangles linked to the variables to which it pertains. A network structure arises when one item of evidence pertains to more than one variable. The decision maker inputs the level of belief in terms of m values obtained from each piece of evidence pertaining to a variable. AA aggregates the evidential support in the diagram using Shenoy and Shafer (1986) algorithms of local computation and Dempster’s rule, yielding the overall belief at each variable.

IV. SENSITIVITY AND INTERRELATIONSHIPS

The purpose of this section is to study the effects of changes in the beliefs of the variables and the interrelationships among the variables on the evaluation of the strength of the IA function. This analysis is performed using the belief-function framework and the Auditor’s Assistant software.

The Effect of Transparency in the Client Organization

In practice, it is very difficult for the external auditor to obtain direct evidence for all of the three factors; competence, work performance, and objectivity (Krishnamoorthy 2002). It may be relatively easier for the external auditor to obtain evidence about the competence of the internal auditors, however. For instance, if the internal auditors are professionally certified by AICPA or IIA, the external auditors can assign a high level of belief for the competence of the auditors. The same is the case when the internal auditors have a long record of professional experience in the auditing industry. However, the task of assessing the objectivity of the internal auditors depends on the level of transparency in the organization of the client. Brody,

Golen, and Reckers (1998) investigated the importance in the reliance decision of external auditors' conflict management styles (i.e., work around IA function style, deny problem style), recent experiences with material adjustments, and perceived communication barriers between clients and the audit firm. They found that conflict management styles and perceived communication barriers, which can be explained by the level of transparency in the client organization, were significant in explaining reliance decisions. Thus, the external auditors may not know the level of independence enjoyed by the internal auditors in the organization and therefore may not be able to effectively assign any belief to the objectivity of the auditors. For instance, it is very difficult for the external auditors to find out whether the internal auditors have easy access to the audit committee or whether the internal auditors have the ability to investigate any activity in the organization. Also, the external auditors may find it very difficult to ascertain whether the recommendations of the internal audit department are being implemented by senior management within the organization. For instance, Brody and Lowe (2000) found that internal auditors tended to take the position that was in the best interests of the company, rather than make objective assessments. Therefore, it follows that the evaluation of the strength of the IA function will depend on the extent of transparency, or openness, in the auditee organization, which eventually influences the level of objectivity of the auditors.

Table 2 and Figure 3 show the assessed strength of the IA function for differing levels of transparency, that is, differing beliefs about the levels of objectivity of the internal auditors. We first plot the strength of the IA function in an organization with a highly competent internal auditor department ($C = 0.9$) with a very good history of work performance ($W = 0.9$). We then assume a moderate level of relationship between competence and work performance ($R1 = 0.5$) and between work performance and objectivity ($R2 = 0.5$). Next, we vary the belief

in objectivity from 0 to 1 in increments of 0.10. Here, we will consider two scenarios. In the first scenario, the external auditors might have positive evidence about the objectivity of the auditors. For instance, the external auditors might be aware that the internal auditors have direct access to, and report directly to, the audit committee. On the other hand, they may find evidence, which makes them question the objectivity of the auditors. This evidence, for example, could be in the form of the incentive compensation of the internal auditors being dependent on stock prices.

----- Insert Figure 3 Here -----

As illustrated, the strength of the IA function is very moderate in a closed organization even when the internal auditors are found to be competent and their work is found to be of high quality, since there is no evidence about the objectivity of the auditors. However, the evaluation of the strength of the IA function increases rapidly as the external auditor is able to gain more insight about the objectivity of the auditors. Also, it is to be noted that if the internal auditors are not found to be objective, in cases where the external auditors have negative evidence about the objectivity of the auditors, competence and work performance have negligible effect on the evaluation of the strength of the IA function. This finding is contradictory to most of the prior research, which places objectivity as the least important of all the three factors that determine the strength of the IA function. (Schneider 1984, Margheim 1986, Edge and Farley 1991). The reasons for the contradictory finding will be discussed in the Discussions and Conclusions section of the paper.

The Effect of Leverage with the Internal Audit Department

The assessment of the work performance of the internal auditors can also pose some difficulties for the external auditors, if they are faced with an IA function that does not readily share its work with the external auditors. For instance, Campbell (1993) concluded that the reliance decision was contingent on whether the auditor's experience with the IA function was satisfactory. She also found that the level of client interest in having coordination between the external and internal auditors was a significant determinant of the reliance decision, albeit only when there was prior satisfactory experience with the IA function. Also, Felix et al. (2000) found that the availability of the IA function was a significant determinant of the reliance decision made by the external auditors. If the external auditors do not get access to all of the relevant working papers and programs of the internal audit department, or if the internal auditors are not very detailed in the process of documenting their work, it could be very difficult to assess the work performance of the internal auditors. For instance, if the audit techniques used are not sophisticated or if the sampling technique is not documented, the external auditors cannot assign a high level of belief for the work of the internal auditors. Recent regulations, such as the Sarbanes-Oxley act, have sought to remedy such a situation. Therefore, interest exists in observing the impact of different levels of beliefs about work performance on the strength of the IA function, given a high level of belief in competence and objectivity in the auditors.

Table 3 and Figure 4 analyze the effect of leverage with the internal audit department on the strength of the IA function. In Figure 4, we set the levels of competence and objectivity at 0.9 and R1 and R2 at 0.5. Then we vary the level of belief for work performance from 0 to 1 with increments of 0.10. In this analysis, as before, we consider both positive and negative beliefs about work performance.

----- Insert Figure 4 Here -----

It can be seen that even with no evidence about work performance, the strength of the IA function is moderately high at 0.652 and increases rapidly as we get to know more and more about the work performance of the internal auditors. This shows that belief in the strength of the IA function is affected more adversely by lack of knowledge about the objectivity of the auditors, as seen in Figure 3, than by lack of knowledge about the work performance of the internal auditors. Furthermore, when the work of the internal auditors is found to be sub-standard, the belief in the strength of the IA function goes down considerably.

The Effect of Interrelationships between the Variables

The strength of the relationships between the factors of competence, work performance, and objectivity is an empirical question and can only be ascertained from the expert opinions of the external auditors in practice. However, the question is important, because different strengths of interrelationships will have different impacts on the evaluation of the strength of the IA function. One of the limitations of the Krishnamoorthy (2002) study was the assumption of a perfect relationship between the variables, considered by the external auditors in determining the strength of the IA function. (e.g., $P(\sim W/\sim C, O, H) = 1$; $P(W/\sim C, O, H) = 0$). As mentioned earlier, this assumption may lead to an overestimation of the strength of the IA function. For instance, an external auditor may assign a belief value of 0.9 to the objectivity of an internal auditor. However he may not necessarily believe that the quality of his work is that high and consequently he may assign a belief value of only 0.3 to the work performance variable, implying a weak relationship between work performance and objectivity. For instance, Maletta (1993) reported that low inherent risk conditions, the IA

function quality factor interactions were not significant determinants of the reliance decision, but when inherent risk was high, he found that Objectivity and Work Performance had a significant interactive effect on the reliance decision. Also, Krishnamoorthy (2001) found that when the audit procedure reliability was low, the Work Performance evaluation was not contingent on the Competence or Work Performance of the internal auditors. However, when audit procedure reliability was high, the evaluation of Work Performance was contingent on the Competence and Objectivity of the internal auditors. To study the sensitivity of the strength of the IA function to different values of interrelationships, we assign the beliefs of 0.9 to competence and work performance and vary the belief for objectivity for both positive and negative evidence, based on four different relationship strengths. Each of the four strengths are described in Table 1 below.

----- Insert Table 1 Here -----

Table 4 and Figure 5 shows the sensitivity of the strength of the IA function to different strengths of interrelationships when there is positive evidence about one of the variables, whereas Table 5 and Figure 6 present the analyses with negative evidence about one of the variables. The top line in Figure

----- Insert Figure 5 Here -----

5 represents the maximum strength of all the relationships, i.e. it assumes perfect relationship between competence and work performance and between work performance and objectivity. It can be seen that the strength of the IA function is always high in the case of a perfect relationship between the variables, even when we have no information about one of the variables. As the relationships get weaker, the strength of the IA function declines. In fact,

when there is no relationship between the variables, the external auditors cannot assess the strength of the IA function if they do not have information for at least one of the variables.

----- Insert Figure 6 Here -----

The interesting finding in part of Figure 6, where we assess the sensitivity of the strength of the IA function to negative evidence about one of the variables, is in the case of a perfect or a strong relationship between the variables. It can be seen that the IA function is assessed to be strong, even when we have more and more negative evidence about one of the variables, until the negative belief about one of the variables equals the positive beliefs of the other variables. Once the negative belief about one of the variables exceeds 0.9, the strength of the IA function falls sharply from 0.908 to 0, in the case of the perfect relationship. This result makes intuitive sense. If the auditors are absolutely sure that the objectivity of the auditors is impaired, they will perceive the IA function to be very weak, even if they have high levels of beliefs about the internal auditors' competence and work performance. And this is in spite of the fact that they think the work performance and objectivity are perfectly co-related.

V. THEORETICAL FRAMEWORK FOR RELIANCE ON WORK OF INTERNAL AUDITORS

The purpose of this section is to propose a theoretical framework for the extent of reliance by external auditors on the work performed by the IA function of a client, based on an evaluation of the strength of the IA function. This framework would determine thresholds for the extent of reliance on the IA function by the external auditors based on varying strengths of the IA function . While, realistic determination of thresholds would require empirical testing and expert judgments of external auditors, our study aims at providing a starting point towards

the determination of such thresholds. For instance, if the external auditors, after combining all the evidence about the factors influencing the IA function using the belief function decision aid, find the strength of the IA function to be 0.8, they might decide to rely on the work of the IA function and reduce their work substantially. Research has documented that the IA function can complete in excess of 25% of the audit work necessary to complete the external audit (Abdel-Khalik et al., 1983; Schneider, 1985b; Campbell, 1993; Maletta and Kida, 1993; Maletta, 1993; Felix et al., 2001). The stronger the IA function, the higher the extent of reliance by external auditors on the work performed by the IA function. Some research has concluded that even when the strength of the IA function is low, external auditors still place reliance on the work of the IA function. Research has also documented an impact of reliance by external auditors on the work of the IA function of a client on the audit fees charged by them. For example, if involvement by the IA function in the financial statement audit were to increase from no involvement to 26.57% of the financial statement audit, the audit fee would decrease by approximately 18% or \$215,961.5.

In terms of the extent of reliance, Abdel-Khalik et al. (1983) found that the average percentage of budgeted external audit hours performed by the IA function ranged from 32.5% when the IA function reported to the controller, to 42% when the IA function reported to the audit committee. Further, Schneider (1985b) found that, on average, external auditors reduced budgeted external audit hours in the revenue cycle by approximately 38% as a result of relying on the work of the IA function. For the lowest quality IA function profile, he noted that the average reduction was 14.4%, while for the highest quality IA function profile; the average reduction was 50.6%. In contrast, Margheim (1986) found that external auditors did not reduce total budgeted audit hours (i.e. no reliance on the IA function), relative to having no

IA function, when the IA function was perceived to have low Competence/Work Performance. He did find, however, that for scenarios where the IA function was present, total budgeted audit hours declined by 18.7% as Competence/Work Performance increased from a low level to a high level. Further, Maletta and Kida (1993) found that external auditors reduced their work in the accounts receivable area by up to 28% depending on the strength of the IA function. Therefore, the belief function framework proposed by our paper provides a systematic and well-defined decision aid to the external auditors to determine the extent of reliance on the work of the IA function, based on an evaluation of the strength of the said function.

Table 6 provides the theoretical framework setting the thresholds for the extent of reliance by the external auditors, given the strength of the IA function.

-----Insert Table 6 here-----

As it can be seen from the table, the extent of reliance by the external auditors on the work performed by the IA function would depend on the strength of the IA function. For instance, say the external auditors combine all the evidence about the IA function quality factors and find that the internal auditors are highly competent ($C=0.8$), their work performance is satisfactory ($W = 0.8$), and they find the internal auditors to be highly objective in the performance of their work ($O = 0.8$). Further, based on previous knowledge about the client possessed by the external auditors, the latter assign a moderate level of relationship between the three factors ($R1 = R2 = 0.5$). After inputting all this information in the belief function framework, the external auditors find that the strength of the IA function is 0.8, implying that they have positive evidence that the quality of the IA function is excellent, they can place around 40 to 50% reliance on the work of the IA function. This reliance could

take the form of reduced budgeted audit hours or reduced audit procedures including control testing, substantive testing, and analytical testing. It is hard to imagine that the external auditors would place more than 50% reliance on the work of the IA function even if they find the IA function to be extremely strong.

VI. DISCUSSION, CONCLUSIONS, AND LIMITATIONS

In this paper, we developed a conceptual model for evaluating the strength of the IA function using the belief function framework. This approach uses the conceptual model, developed by prior research, for evaluating the strength of the IA function and it provides a theoretical model of the decision process.

The most significant contribution of this paper is that it provides external auditors with a decision aid for evaluating the strength of the IA function, without the limitation of the Bayesian framework, which requires the estimation of conditional probabilities. Furthermore, it analyzes the sensitivity of the strength of the IA function to differing levels of beliefs in objectivity and work performance and to differing strengths of relationships between the three variables determining the strength of the IA function.

Results of the sensitivity analyses reveal that objectivity is the most dominant factor in the evaluation of the strength of the IA function, contrary to most of the prior research. Even when high levels of belief in the competence and work performance of the internal auditors are present, the strength of the IA function is found to be very low when there is no information about the level of objectivity of the internal auditors. One reason for this contradictory finding, from prior research, could be the level of difficulty in obtaining evidence about the objectivity

of the internal auditors. Since it is very difficult for the external auditors to obtain evidence about the objectivity of the auditors, they rely on the factors of competence and work performance, which are relatively easier to assess. The second reason could be that the external auditors might be assuming a perfect or a strong relationship between work performance and objectivity. Therefore, when they find the work performance of the internal auditors to be of high quality, they assume that the internal auditors must be highly objective in the performance of their duties. Another finding from the analytical analyses was that when internal auditors were found to be highly competent and objective, the strength of the audit function was perceived to be quite high even when there is no evidence about the work performance of the auditors. This finding is intuitively appealing because work performance is related to both competence and objectivity and therefore the external auditors will expect high quality work from an objective and competent auditor.

As far as interrelationships are concerned, the analysis revealed that when the three variables have a strong or a perfect relationship, the strength of the IA function remains high even if we have positive or negative evidence about one of the variables, (as long as we have high levels of beliefs about the other two variables.) Thus, for instance, if we know that internal auditors are highly competent and their work performance is highly satisfactory, the strength of the IA function is perceived to be high even when we have negative evidence about the objectivity of the auditors, up to a certain level. However, this strong belief dips to zero as soon as the negative belief about objectivity is 1. That is, the external auditors are then absolutely sure that the objectivity of the internal auditors is impaired.

The findings of this research have several implications for audit judgment research, in experimental or archival settings, for the examining of the evaluation of the internal audit function. The need for such empirical studies has gained greater urgency in the light of recent regulations such as the Sarbanes-Oxley act, which require the external auditors to rely more and more on the work of the internal audit department, with the goal of evaluating the internal controls in the organization. The importance of each of the three factors, and the interrelationships, can be explicitly considered when designing experiments. Specific hypotheses can also be developed to test the predictions of the models developed in this paper.

In addition to the usual limitations that accompany similar studies, the first major limitation of the study is the lack of empirical evidence available to support the findings of the model. Second, the variables in the model are assumed to be discrete and binary. Third, this paper only addresses the evaluation of the strength of the IA function, with a special emphasis on the interrelationships of the variables that are most important in the evaluation process. It does not, however, examine the effect of the evaluation on the decisions of the external auditors to reduce their audit work or to use internal auditors as assistants. Lastly, this research develops a normative model and therefore does not take into account contextual or environmental factors, which might alter the predictions of the model.

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Figure 1.

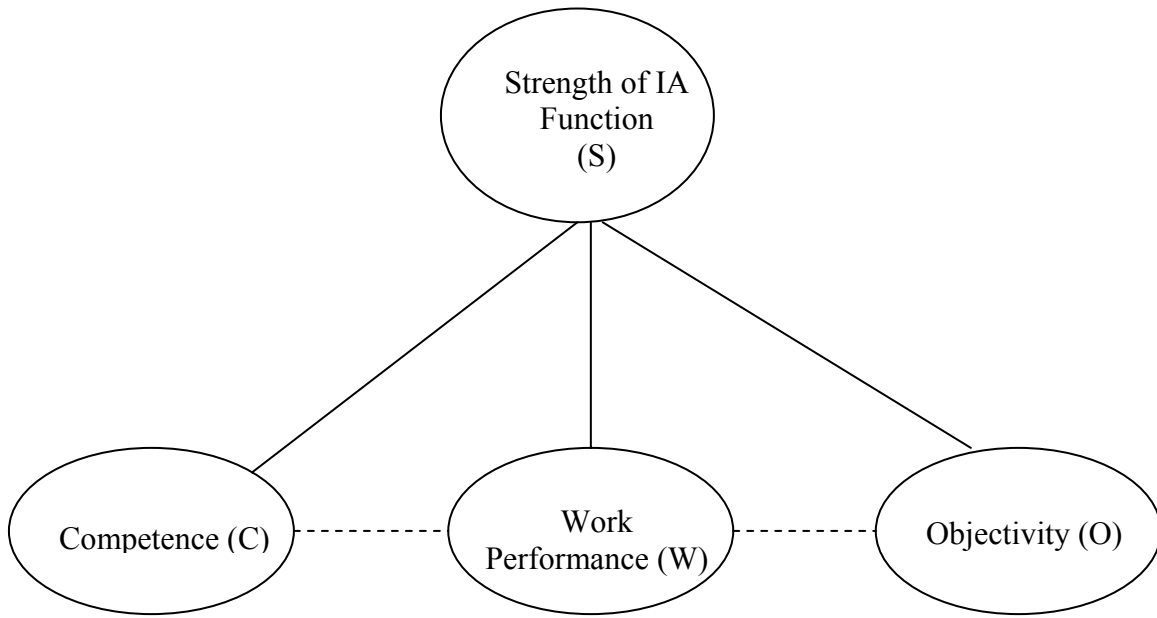


Figure 1 A Competence

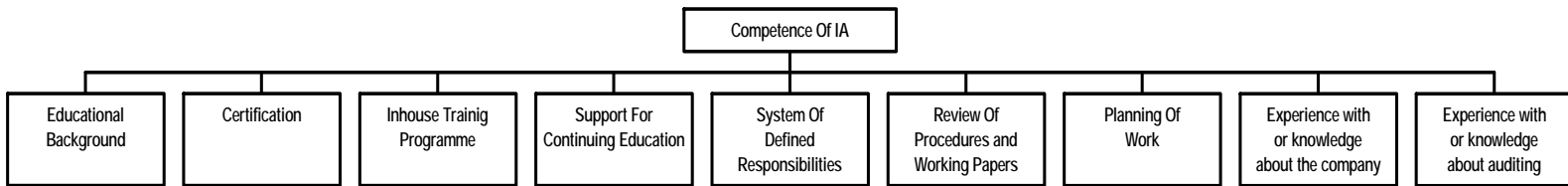


Figure 1B - Objectivity

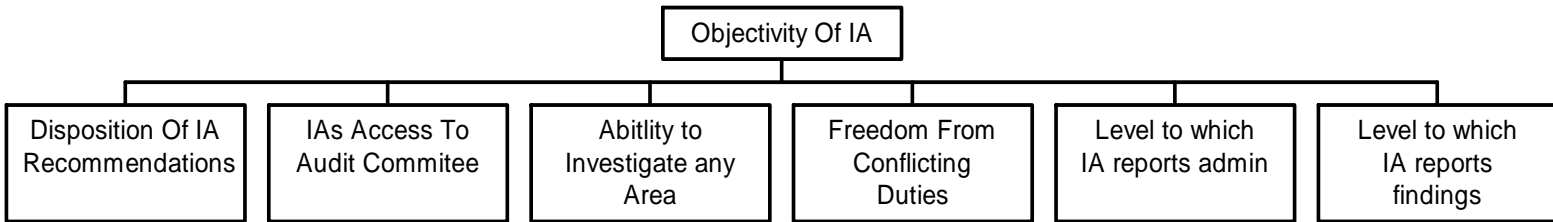


Figure 1 C - Work Performance

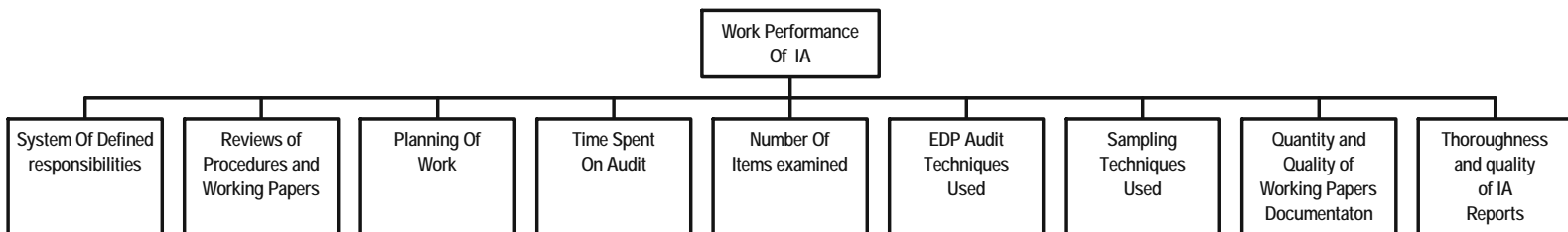


Figure 2.

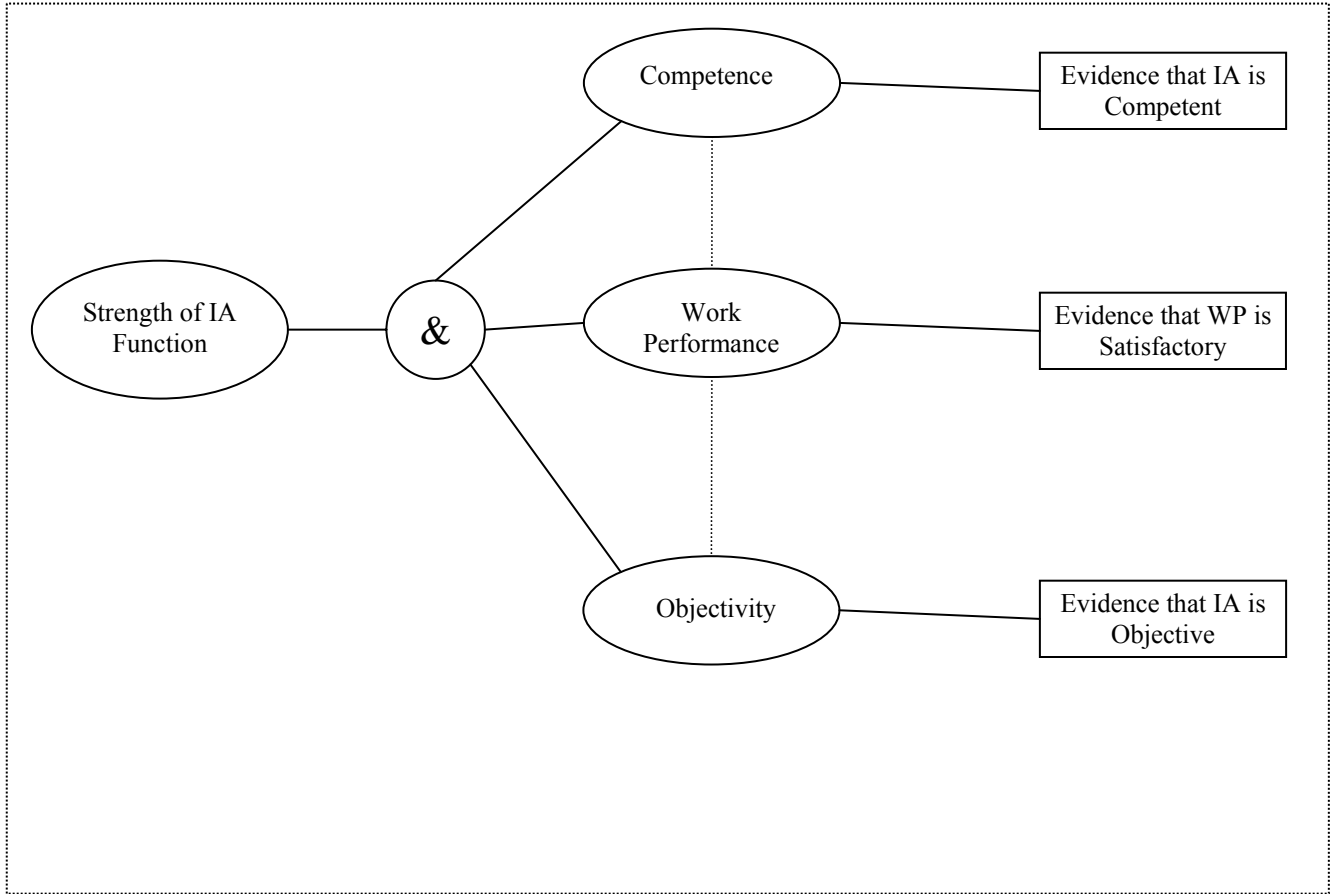


Figure 3- Effect of Transparency on the Strength of the IA Function

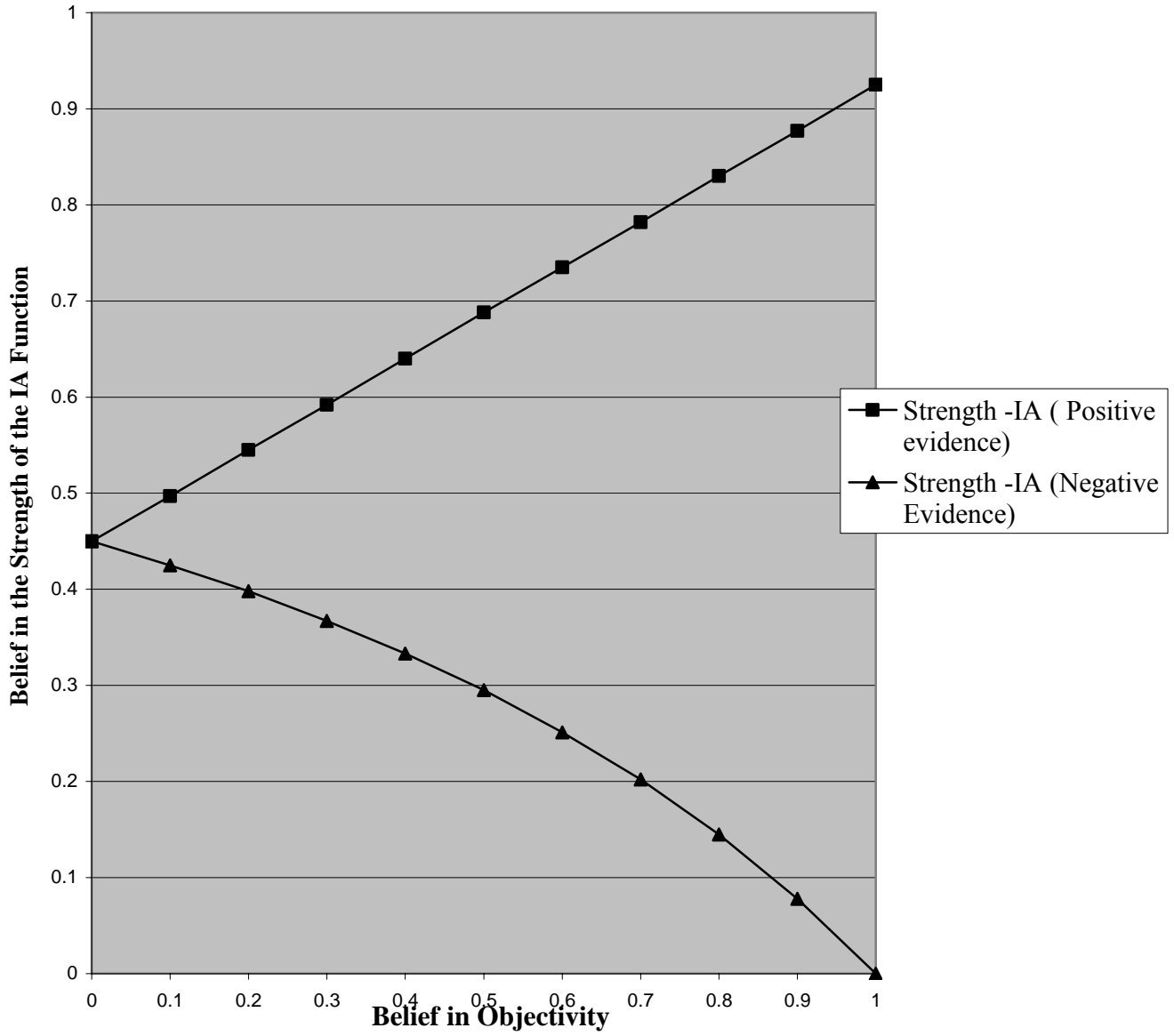


Figure 4 -Effect of Leverage on the Strength of the IA Function

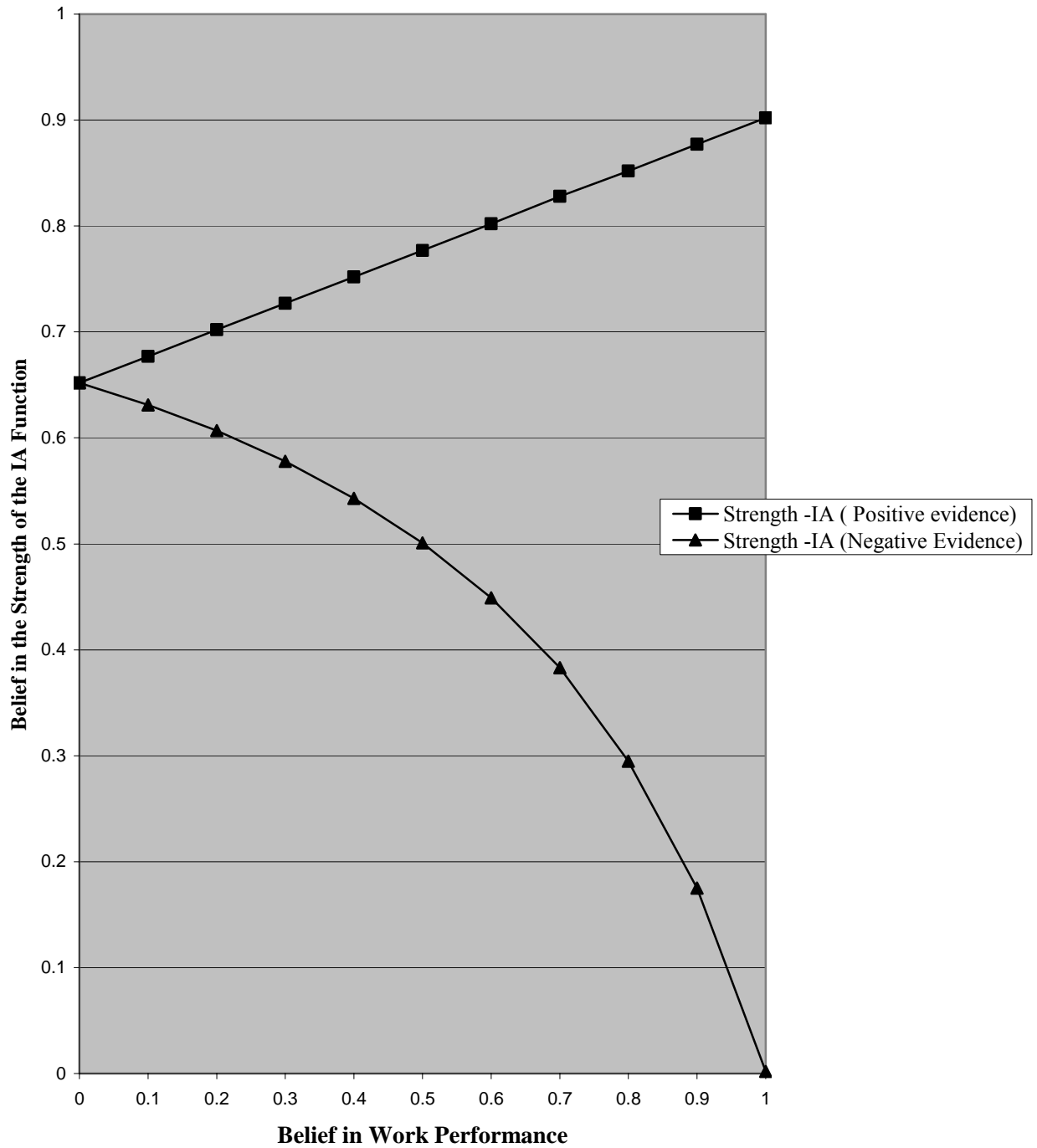


Figure 5- Effect of Interrelationship- Positive Evidence

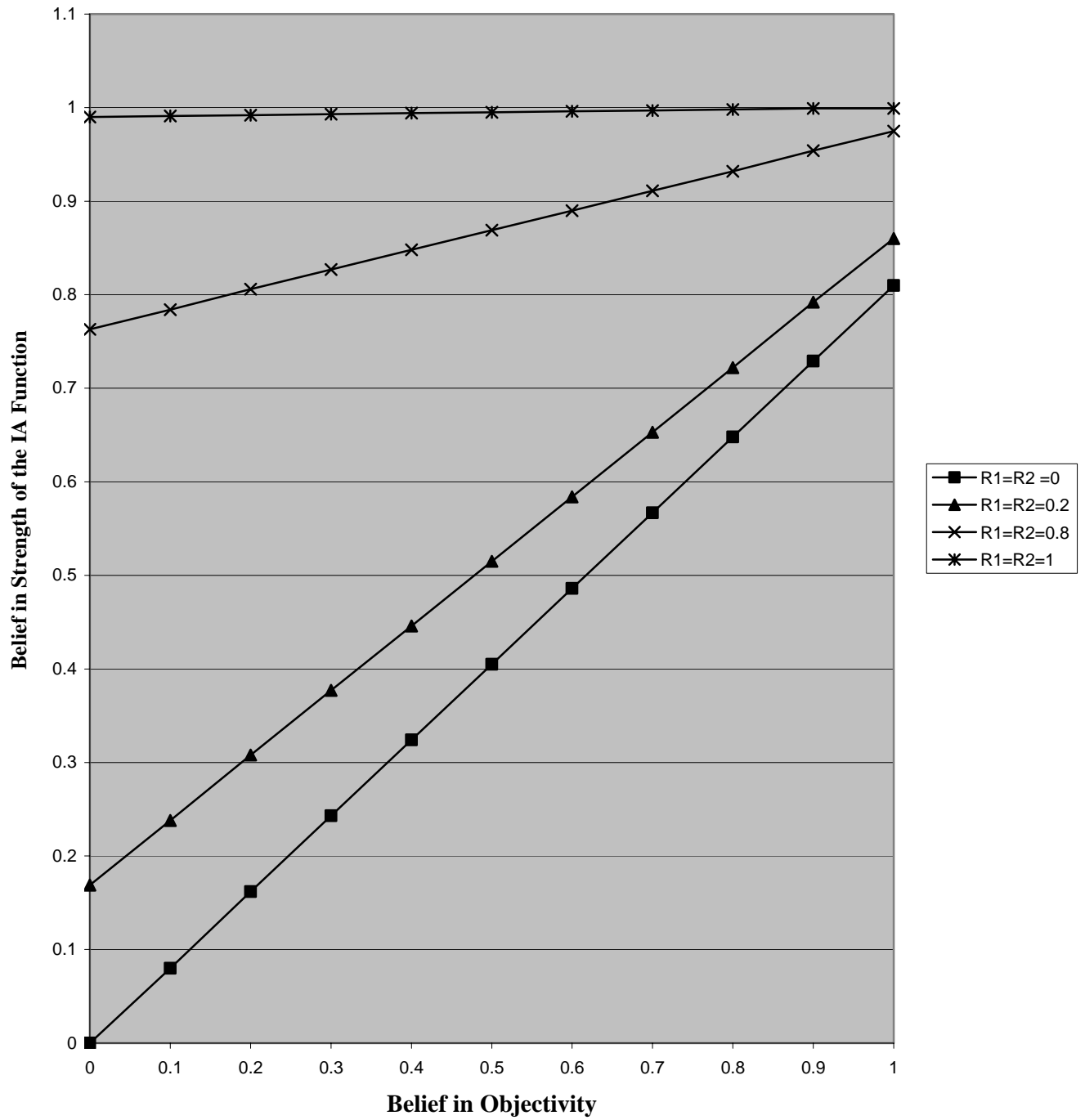


Figure 6- Effect of Interrelationship- Negative Evidence

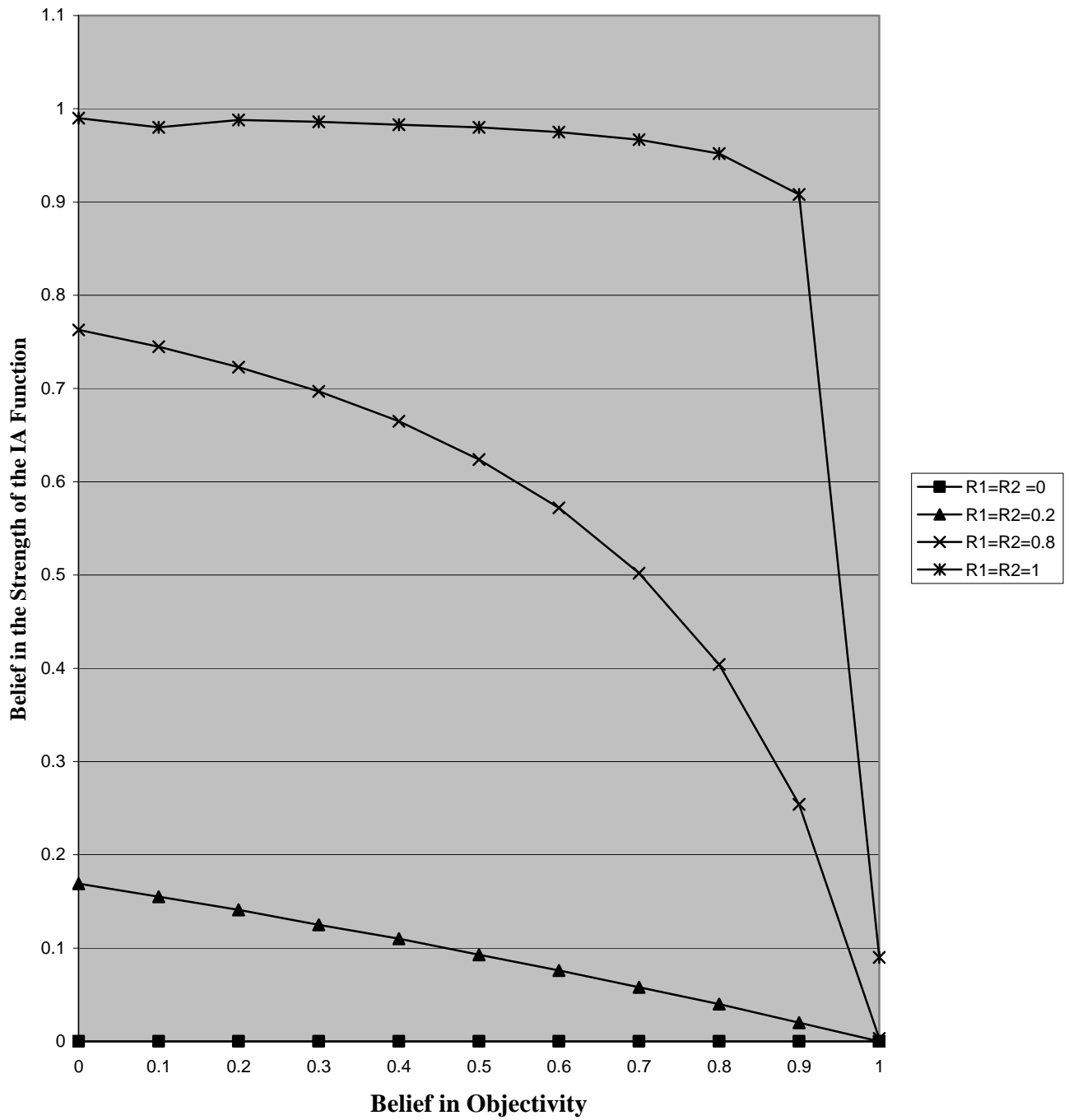


Table 1.

Description of strength of relationships between C, W, and O

Relationship	Description
$R1 = R2 = 0$	No relationship
$R1 = R2 = 0.2$	Weak relationship
$R1 = R2 = 0.8$	Strong relationship
$R1 = R2 = 1$	Perfect relationship

Table 2.

Effect of Transparency on the strength of the IA function

R1 = R2 = 0.5; C = 0.9; W = 0.9

O	Strength(IA)- Positive Evidence	Strength(IA)- Negative Evidence
0	0.450	0.450
0.1	0.497	0.425
0.2	0.545	0.398
0.3	0.592	0.367
0.4	0.640	0.333
0.5	0.688	0.295
0.6	0.735	0.251
0.7	0.782	0.202
0.8	0.830	0.145
0.9	0.877	0.078
1	0.925	0

Table 3.

Effect of Leverage on the strength of the IA function

$$R1 = R2 = 0.5; C = 0.9; O = 0.9$$

W	Strength(IA)- Positive Evidence	Strength(IA)- Negative Evidence
0	0.652	0.652
0.1	0.677	0.631
0.2	0.702	0.607
0.3	0.727	0.578
0.4	0.752	0.543
0.5	0.777	0.501
0.6	0.802	0.449
0.7	0.828	0.383
0.8	0.852	0.295
0.9	0.877	0.175
1	0.902	0

Table 4.

Effect of Inter-Relationships on the strength of the IA function(Positive Evidence)

C = 0.9; W = 0.9

W	R1=R2=0	R1=R2=0.2	R1=R2=0.8	R1=R2=1
0	0	0.169	0.763	0.990
0.1	0.080	0.238	0.784	0.991
0.2	0.162	0.308	0.806	0.992
0.3	0.243	0.377	0.827	0.993
0.4	0.324	0.446	0.848	0.994
0.5	0.405	0.515	0.869	0.995
0.6	0.486	0.584	0.890	0.996
0.7	0.567	0.653	0.911	0.997
0.8	0.648	0.722	0.932	0.998
0.9	0.729	0.792	0.954	0.999
1	0.810	0.860	0.975	0.999

Table 5.

Effect of Inter-Relationships on the strength of the IA function(Negative Evidence)

C = 0.9; W = 0.9

W	R1=R2=0	R1=R2=0.2	R1=R2=0.8	R1=R2=1
0	0	0.169	0.763	0.990
0.1	0	0.155	0.745	0.980
0.2	0	0.141	0.723	0.988
0.3	0	0.125	0.697	0.986
0.4	0	0.110	0.665	0.983
0.5	0	0.093	0.624	0.980
0.6	0	0.076	0.572	0.975
0.7	0	0.058	0.502	0.967
0.8	0	0.040	0.404	0.952
0.9	0	0.020	0.254	0.908
1	0	0	0.003	0.090

Table 6.

Theoretical framework for the extent of reliance by external auditors on the work of the IA function

Strength Beliefs (IA)	Quality Rating	Extent of Reliance
0 – 0.2	Low	0 -10%
0.2 – 0.4	High Low	10- 20%
0.4 – 0.6	Moderate	20 – 30%
0.6-0.8	High	30 – 40%
0.8 -1.0	Excellent	40 – 50%
