



Belief functions briefly...

Belief Functions and Dempster's Rule

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Why Belief Functions

- Empirical Evidence (Harrison et al. 2002 and Curley and Golden 1995)
- Problems with Probability
 - Representing positive, negative, and mixed evidence
 - Representing Ignorance
 - Modeling Ambiguity
 - Excessive Demand for Conditional Probabilities
- Probability Framework is a special case of Belief-Function Framework



An Illustration of Belief Functions (Hypothetical Numbers)



30% undecided



Basic Belief Mass, Belief and Plausibility Functions for Clinton-Trump Example ($H = \sim T, T = \sim H$)

- Basic Belief Mass Function based on survey results
 - $m(H) = 0.4, m(T) = 0.3, m(\{H, T\}) = 0.3$
- Belief Functions based on survey results
 - $Bel(H) = 0.4, Bel(T) = 0.3, Bel(\{H, T\}) = 1.0$
- Plausibility Function based on survey results
 - $Pl(H) = 0.4 + 0.3 = 0.7$
 - $Pl(T) = 0.3 + 0.3 = 0.6$



Problems with Probability

Framework: Example 2

2. Problem with representing ignorance:

Suppose the auditor has to audit two major inventory locations. He or she has no information to start with that the inventory at any location is fairly stated or not ($f_i, \sim f_i$):

$$P(f_1) = 0.5, P(\sim f_1) = 0.5,$$

$$P(f_2) = 0.5, P(\sim f_2) = 0.5.$$

The probabilities that the overall inventory is fairly stated or not ($f, \sim f$) are given as:

$$P(f) = 0.5 \times 0.5 = 0.25, \text{ and } P(\sim f) = 0.75$$

Now, we can not say that we are ignorant about the state of the inventory. We have a higher probability of error.

How do Auditors Issue Going Concern Opinions? A Dynamic model using Belief Functions; Evidence from 2004 to 2015



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Vikram Desai will present the paper at the IIM Udaipur Campus



Introduction:

Rationale

- Audit reporting of going-concern uncertainties has long remained an issue of concern to legislators, regulators, and the auditing profession
- Prior studies have examined a variety of issues related to going concern opinions (GCO hereafter), including (a) factors associated with GCOs and (b) the association between GCOs and subsequent failures (Carson et al, 2013) .
- No evidence of any structured model being used by auditors to arrive at their GCO opinion
- Purpose of this paper is to address this gap in the auditing literature by developing a GCO assessment model (GCO model hereafter) using belief functions



Features of the GCO Model

- Dempster-Shafer theory (hereafter DS) of belief functions (Shafer 1976).
- Revision of Beliefs – Additional Evidence
- Explicitly model the "OR " relationship between the three factors and the auditor's decision to issue a GCO.
- Three factors: NOL, NWC, NCFO – More factors can be added withing affecting model.
- How auditors revise their beliefs for the individual factors before arriving at their decision to issue a GCO when more than one factor is present using the Shafer (1976) method or revision of beliefs.
- Big Four and Non Big Four auditors separately
- Empirical Data from 2004 to 2015

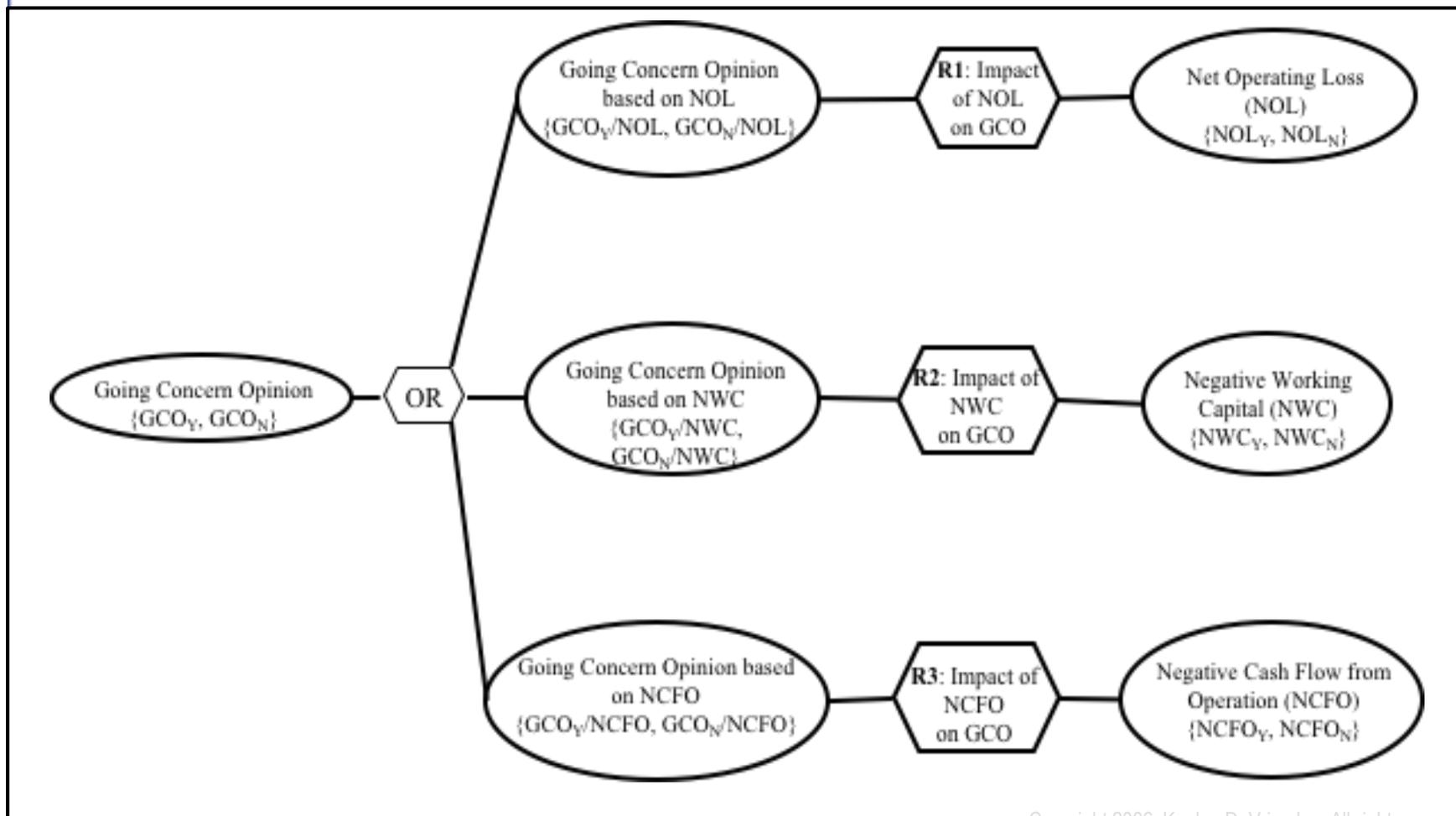


Contribution

- Modelling the “OR” relationship between the three financial statement factors- Effective.
- Measuring belief revisions by auditors enables us to open the “black box”- auditors inflate their belief when more than one factor
- Specifically identifies and differentiates the judgment behavior of Big Four auditors and Non-Big Four auditors
- Big Four auditors exhibit better judgment as compared to Non-Big Four auditors
- Higher incidence of Type I and Type II errors



GCO Assessment Model





Testing the “OR” relationship

- Examine the influence of the presence of more than one factor at the same time on the GCO decision.
- Overall belief to issue a GCO when : Three factors > Two factors > One Factor
- Reason is that auditors are expected to issue more GCOs' to companies which have two corroborating factors present than to companies which have only one factor present.



Inflation of Beliefs

- Presence of more than one factor could be either enhancing or decreasing the individual impacts
- Adjusting the corresponding m-values similar to Shafer's approach of discounting of beliefs (Shafer 1976).
- Where the influence is enhancing, we inflate the value of $m(\text{true})$ and deflate $m(\text{false})$ the same amount.
- GCO model : all the three financial statement factors are corroborating factors and therefore strengthen the auditor's decision to issue a GCO.



Hypothesis H1

- When companies have both NOL and NWC, we argue that auditors are likely to enhance the impacts of both NOL and NWC before arriving at an overall belief to issue a GCO.
- Assume that Θ ($1 \geq \Theta \geq 0$) represents the enhancement parameter

H1a: Overall belief to issue a GCO to companies which have two of the three factors present will be higher than Overall belief to issue a GCO to companies which have only one factor present.

H1b: Auditors are more likely to inflate their beliefs for the individual factors when more than one factor is present.



Hypothesis H2

- When companies all three factors present, we argue that auditors are likely to enhance the impacts all three factors before arriving at an overall belief to issue a GCO.
- *H2a: Overall belief to issue a GCO to companies which have all the three factors present will be higher than Overall belief to issue a GCO to companies which have only two factors present or which have only factor present.*
- *H2b: Auditors are likely to inflate their beliefs for the individual factors when all the three factors are present.*



Auditor Size and Conservatism

- Mixed findings on the association between size of the audit firm and audit opinions (Carson et al, 2013).
- Two competing theories :“Deppockets” (Deangelo 1981) versus “competence” (Craswell et al. 2002)
- For the GCO decision, recent studies find that Big Four clients are significantly less likely to receive GCOs (Reichelt and Wang 2010; DeFond et al. 2011; DeFond and Lennox 2011; Numan and Willekens 2011) compared to Non-Big Four clients.

H3a: Non-Big Four auditors are likely to issue more GCOs' as compared to Big Four auditors when two or more factors are present



Auditor Size and Quality

- Quality of audit judgement is not necessarily related to conservatism
- Geiger and Rama (2006) found that Big Four auditors have lower going concern misclassification rates as compared to Non Big Four auditors.
- Lennox (1999c) finds that the Big Four auditors have lower misclassification error rates than those of Non-Big Four auditors
- Defond et al (2018) found that Non Big Four auditors might overestimate the risk of litigation and SEC enforcement and issue conservatively biased audit reports. However, rather than improving reporting accuracy, this leads to a higher rate of Type I errors.

H3b: Big Four auditors are more likely to inflate their beliefs for the individual factors when two or more factors are present as compared to Non-Big Four auditors.



Sample

- Compustat :36,405 financially distressed companies from June 1, 2004 to May 31, 2015.
- Six Subsamples
- Two additional sub samples
- Audit Analytics to identify companies which received GCOs' and clean opinions.
- Frequency ratios for GCOs' and Non GCOs' for all the sub samples by dividing the companies which received GCOs' by the total number of companies and by dividing the companies which did not receive GCOs' by the total number of companies in the sub sample.



Table . Panel A. Frequency Ratios of Companies with GCOs' for all audit firms

Size of Audit Firm	ALL				
Factor	Companies which received GCOs'(D)	Companies which did not receive GCOs'(E)	Total(F)	Frequency ratio for companies with GCOs(D/F)	Frequency ratio for companies with No GCOs(D/F)
Net/Operating Loss (A)	7348	21195	28543	0.26	0.74
Negative Working capital(B)	5656	9591	15247	0.37	0.63
Negative Cash-flow from operations (C)	6847	14703	21550	0.32	0.68
A & B	5312	4307	9619	0.55	0.45
B&C	4890	2574	7464	0.66	0.34
A&C	6546	12354	18900	0.35	0.65
A&B&C	4686	2362	7048	0.66	0.34



Table 1. Panel B. Frequency Ratios of companies with GCOs' for Big Four firms

Size of Audit Firm	Big Four audit firms				
Factor	Companies which received GCOs'(D)	Companies which did not receive GCOs'(E)	Total(F)	Frequency ratio for companies with GCOs(D/F)	Frequency ratio for companies with No GCOs(D/F)
Net/Operating Loss (A)	995	12321	13316	0.07	0.93
Negative Working capital(B)	450	6111	6561	0.07	0.93
Negative Cash-flow from operations (C)	802	7240	8042	0.10	0.90
A&B	421	1740	2161	0.19	0.81
B&C	293	651	944	0.31	0.69
A&C	776	6145	6921	0.11	0.89
A&B&C	281	572	853	0.33	0.67



Table 1. Panel C. Frequency Ratios of companies with GCOs' for Non Big Four firms

Size of Audit Firm	Non Big Four audit firms				
Factor	Companies which received GCOs'(D)	Companies which did not receive GCOs'(E)	Total(F)	Frequency ratio for companies with GCOs(D/F)	Frequency ratio for companies with No GCOs(D/F)
Net/Operating Loss (A)	6353	8874	15227	0.42	0.58
Negative Working capital(B)	5206	3480	8686	0.60	0.40
Negative Cash-flow from operations (C)	6045	7463	13508	0.45	0.55
A&B	4891	2567	7458	0.66	0.34
B&C	4597	1923	6520	0.71	0.29
A&C	5770	6209	11979	0.48	0.52
A&B&C	4405	1790	6195	0.71	0.29



Table 2. GCO model for all Audit Firms

Size of Audit Firm	Frequency ratio for companies with GCOs	Aggregated Predicted Beliefs for GCOs [Bel GCO_Y]	Belief Inflation / (Discount) Parameter Value (θ)	Belief Inflation (Deflation) For $m(GCO_Y)$		
				Net Operating Loss (NOL)	Negative Working Capital (NWC)	Negative Cash Flows From Operations (NCFO)
Net/Operating Loss (A)	0.26	0.26	NA	NA	NA	NA
Negative Working Capital(B)	0.37	0.36	NA	NA	NA	NA
Negative Cash-flow from Operations (C)	0.32	0.32	NA	NA	NA	NA
A&B	0.55	0.53	0.018	5%	3%	NA
B&C	0.66	0.57	0.11	NA	19%	23%
A&C	0.35	0.50	(0.34)	(34%)	NA	(34%)
A&B&C	0.67	0.68	0	0% ¹	0%	0%



Table 3. GCO model for Big Four Audit Firms

Size of Audit Firm	Frequency ratio for companies with GCOs	Aggregated Predicted Beliefs for GCOs [Bel GCO_Y]	Belief Inflation / (Discount) Parameter Value (θ)	Belief Inflation (Deflation) For $m(GCO_Y)$		
				Net Operating Loss (NOL)	Negative Working Capital (NWC)	Negative Cash Flows From Operations (NCFO)
Net/Operating Loss (A)	0.07	0.07	NA	NA	NA	NA
Negative Working Capital(B)	0.07	0.07	NA	NA	NA	NA
Negative Cash-flow from Operations (C)	0.10	0.10	NA	NA	NA	NA
A&B	0.19	0.14	0.03	43%	43%	NA
B&C	0.31	0.16	0.09	NA	122%	83%
A&C	0.11	0.16	(0.34)	(34%)	NA	(34%)
A&B&C	0.32	0.22	0.05	60%	60%	41%



Table 4. GCO model for Non-Big Four Audit Firms

Size of Audit Firm	Frequency ratio for companies with GCOs	Aggregated Predicted Beliefs for GCOs [Bel GCO_y]	Belief Inflation / (Discount) Parameter Value (θ)	Belief Inflation (Deflation) For $m(GCO_y)$		
				Net Operating Loss (NOL)	Negative Working Capital (NWC)	Negative Cash Flows From Operations (NCFO)
Net/Operating Loss (A)	0.42	0.42	NA	NA	NA	NA
Negative Working capital(B)	0.60	0.60	NA	NA	NA	NA
Negative Cash-flow from operations (C)	0.45	0.45	NA	NA	NA	NA
A&B	0.66	0.77	(0.20)	(20%)	(20%)	NA
B&C	0.71	0.78	(0.15)	NA	(15%)	(15%)
A&C	0.48	0.68	(0.36)	(36%)	NA	(36%)
A&B&C	0.71	0.87	(0.32)	(32%)	(32%)	(32%)



Hypotheses

- H1a supported and H1B partially supported
- H2a supported and H2B not supported
- H3a and H3b supported
- “Or” relationship is effective in measure auditor’s belief to issue a GCO
- While Non-Big Four auditors are more conservative in issuing GCOs’ as compared to Big Four auditors, the latter exhibit better judgment as compared to the former while issuing a GCO



Cost-Benefit Function

- AF = Audit Fee charged by the external Auditor, assume 'p' to be the profit margin, i.e. $AF = (1+p)*AC$
- AC = Audit Cost of external auditor.
- FB = Future benefits computed as the present value of the next five years annual cash flow of $(AF - AC)$ discounted at 'r'.
- L = Litigation Cost and regulatory costs when the auditor has given no GCO (Clean opinion) but the company did go bankrupt within a year.
- $Bel(B)$ = belief of the auditor after analysing the GCO factors that the auditor should issue a GCO



Table 5. Going Concern Cost Benefit Function

Action	Assessment Based on Auditor's Judgment that Company will go Bankrupt within a Year, Bel(B)	Assessment Based on Auditor's Judgment that Company will not go Bankrupt within a Year, [1 - Bel(B)]	Expected Benefit
Action A1: Give GCO	(1) Correct Decision: Benefit = AF - AC	(2) Wrong Decision: Benefit = AF - AC	(AF-AC)
Action A2: Give No GCO	(3) Wrong Decision: Benefit = AF - AC - L	(4) Correct Decision: Benefit = AF - AC + FB	$(AF-AC - L)*Bel(B)+(AF-AC+FB)*(1-Bel(B))$



Figure 2. Benefit to Big Four Auditor for Giving Clean Opinion instead of GCO as a Function of Litigation Cost for a given Belief, Bel(B), that Client Will Go Bankrupt.

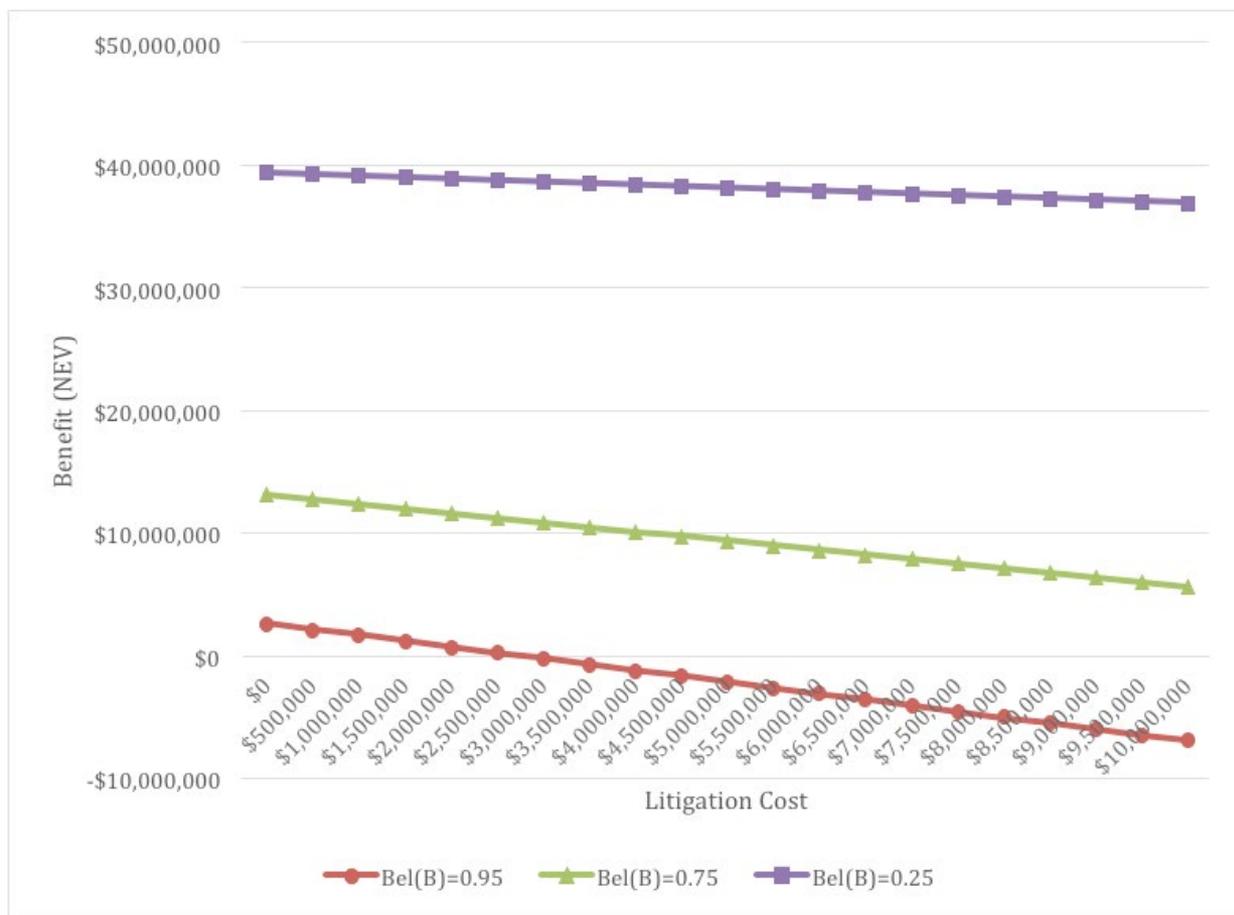
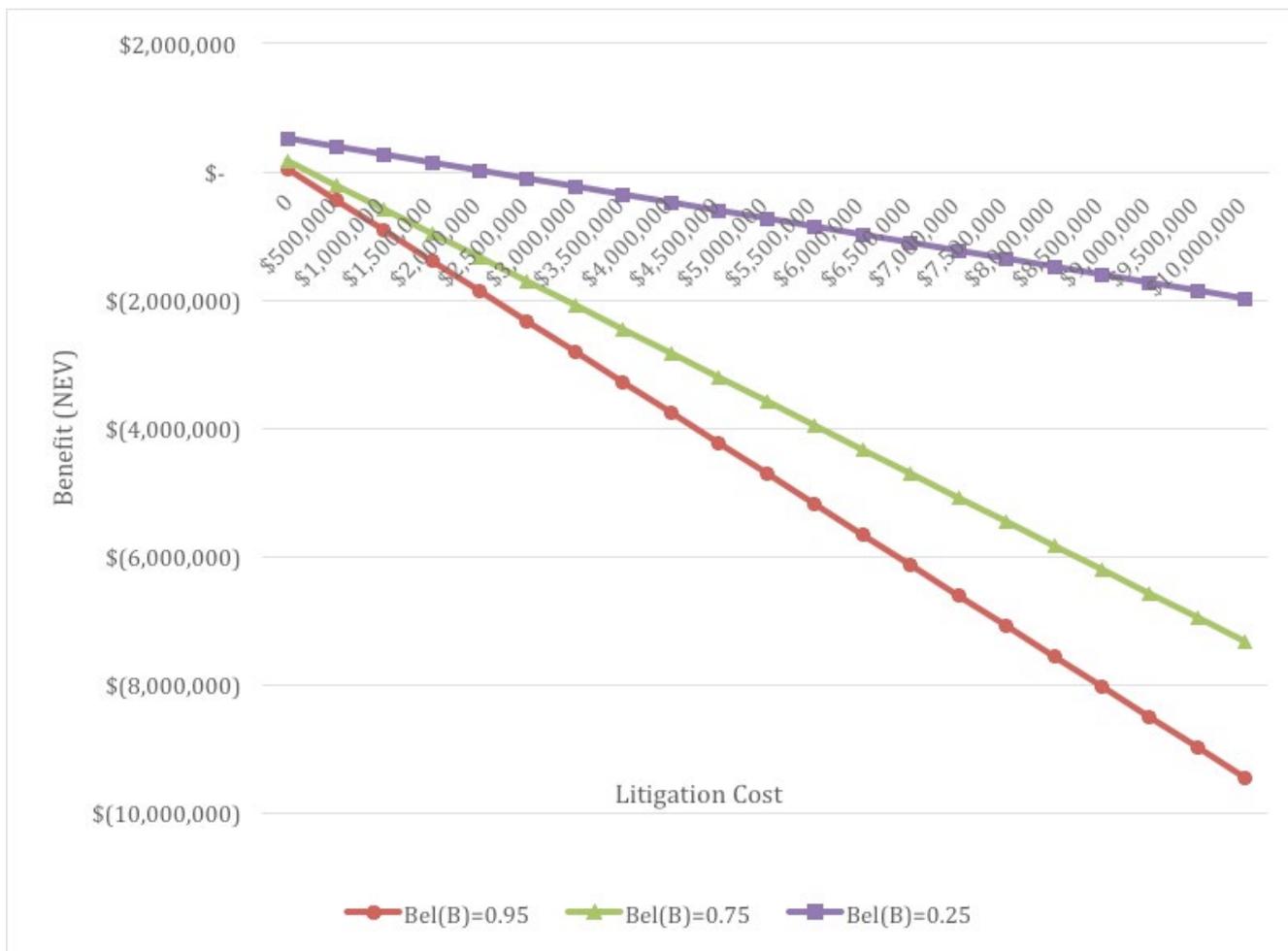




Figure 3. Benefit to Non-Big Four Auditor for Giving Clean Opinion instead of GCO as a Function of Litigation Cost for a given Belief, Bel(B), that Client Will Go Bankrupt.





Conclusions

- “OR” relationship between the financial statement factors is effective in representing the behaviors of auditors while issuing a GCO.
- When two or more factors are present, auditors are more likely to inflate their beliefs for the individual factors before arriving at an overall belief to issue a GCO.
- Non-Big Four audit firms are much more conservative while issuing GCOs’ as compared to Big Four audit firms.
- Big Four audit firms appropriately inflate their beliefs when two or more factors are concerned , whereas Non-Big Four audit firms behave counterintuitively and actually deflate their beliefs for the individual factors before arriving at an overall belief to issue a GCO.
- Big Four audit firms are willing to tolerate much higher litigation costs as compared to Non-Big Four audit firms.

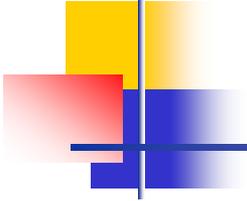


Upcoming Projects

- Desai, Vikram, Desai Renu, Kim, Joung , and K. Raghunandan .Going Concerns Issues Disclosed in Audit Reports, To be submitted to Accounting Horizons.
- Desai, Vikram, Kim, Joung , and Srivastava , Raj . How do Auditors Issue Going Concern Opinions? A Dynamic model using Belief Functions; Evidence from 2004 to 2015. Final Draft Complete. To be submitted to The Accounting Review.
- Desai, Vikram, Kim, Joung , and Raghunandan , K . Opinion Shopping for going concern Opinions: Evidence from 2004 to 2015. Final Draft Complete. To be submitted to Auditing : A Journal of Theory and Practice



QUESTIONS AND FEEDBACK?



The End