

## **Scenario Presentation and the Capital Budgeting Decision**

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*In this paper, I perform an experiment in which participants are presented with the scenario analysis for two hypothetical capital investment projects and then asked to choose between them. Information orientation (horizontal vs. vertical presentation) had no consistent impact on capital budgeting decisions. However, a consistent pattern was found for which the riskier project is preferred more frequently when the best-case scenario appears last instead of first. This indicates that information order has an influence on how scenario analysis is perceived. In particular, the experimental results suggest the existence of a recency effect in which decision-makers overemphasize the last piece of information that is presented to them.*

**Field of Research:** Capital budgeting; Behavioral finance

### **1. Introduction**

The capital budgeting decision involves determining whether the net present value (NPV) of a potential project is positive or, in the case of mutually exclusive projects, higher than that of the alternatives. Because NPV is a measure of value-added, a positive NPV implies that the project under consideration is expected to add value to the firm. Similarly, in the case of mutually exclusive projects, a higher NPV implies that the project is expected to provide more added value than its alternative(s). As noted in Ross, Westerfield, and Jaffe (2008), an NPV is computed using estimates of future cash flows and estimated required rates of return and thus itself is merely an estimate of the true value-added of a project. Consequently, the NPV of a project is more correctly portrayed as a distribution rather than as a single number.

Scenario analysis is a common method of showing the potential range of the computed NPV. Typically, three scenarios are presented to decision-makers: the best estimate of the NPV (known as the “base-case”), an optimistic estimate (often referred to as the “best-case” scenario), and a pessimistic estimate (the “worst-case” scenario). The definitions of the worst-case and best-case scenarios are flexible. These scenarios are sometimes tied to sales levels, e.g., sales 30% higher than forecast in the best-case scenario and 30% lower than forecast in the worst-case

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scenario. They also can be related to the presumed distribution of the computed NPV, e.g., the upper 25% cutoff point representing the best-case NPV and the lower 25% cutoff point representing the worst-case NPV.

The framing literature has shown that the way in which information is presented can significantly influence decision-making behavior.<sup>1</sup> One way in which the presentation of scenarios could influence the capital budgeting decision is the order in which the scenarios are presented. Serial order effects have been observed in a variety of situations, including: impression formation (Asch, 1946), evaluations of sequential information (Miller and Campbell, 1959), memory (Atkinson and Shiffrin, 1968), the arrangement of consumer choices (Lohse, 1997), portfolio selection (Levy and Levy, 2005), and the weighting of probabilities for risky choices (Lee and Terry, 2010). Another potential influence is the orientation of the scenarios (horizontal vs. vertical). Laughery, Young, Vaubel and Brelsford (1993) found that health warnings were significantly more noticeable when they were printed horizontally than when they were displayed vertically on alcoholic beverage containers.

This study examines whether the order and/or orientation of scenarios have an impact on the capital budgeting decision. This is done via an experiment in which participants are presented with the scenario analysis for two hypothetical capital investments that are mutually exclusive and then are asked to choose between them. A total of six capital budgeting situations are examined to determine if there is any consistent effect of information order and/or information orientation across the capital budgeting problems.

The existence of a significant scenario order and/or orientation effect would imply that many firms may unknowingly be making biased capital budgeting decisions and thus taking on either more risk or less risk than they would actually prefer. It would also suggest that other financial decisions, such as investors choosing between alternative stocks or mutual funds, might be similarly biased. Awareness of such effects could help both managers and individuals to make better financial decisions.

## 2. Literature Review

The phenomenon of serial order effects has been observed across a number of disciplines. Asch (1946) find that first impressions matter: the first personality traits listed for an individual influenced people's impressions about that individual significantly more than ones that were listed later. Zhao (1997) finds that television viewers displayed better brand recognition for the first advertisement that appeared during

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commercial breaks. Similarly, Lohse (1997) finds that participants tended to focus on ads that appeared first for each Yellow pages listing.

In studies of memory, participants tend to show better recall of items at the beginning and end of a list than items from the middle portion of the list. Better recall of the first few items is termed the *primacy* effect, and better recall of the last few items is called the *recency* effect (Atkinson and Shiffrin, 1968; Craik and Lockhart, 1972). Studies on the evaluation of sequential information also find primacy and recency effects (Miller and Campbell, 1959; Hock, 1984). When the arguments for one side are presented immediately after those for the other side, the side presented first tends to be favored. However, when there is a time lag between the two sets of arguments, the side presented last tends to be favored.

Recency effects have been observed within the economics and finance literature. Lee and Terry (2010) find that individuals tend to overweight the probability of the last potential outcome that is listed for each alternative when decision-making under risk. Consequently, riskier alternatives are chosen much less frequently when potential outcomes for the choices are listed from best to worst than when they are given from worst to best. De Bondt and Thaler (1985, 1987) uncover evidence of overreaction in long-term stock returns and argue that this is caused by investors overweighting recent information about stock performance. However, Fama (1998) notes that the literature on return anomalies finds just as much evidence of apparent market underreaction as overreaction, which would be expected if markets were efficient. In an experimental setting, Levy and Levy (2005) find a tendency to overweight recent returns in portfolio decisions despite participants being informed beforehand that the computer-generated returns for the assets were i.i.d. through time.

Other types of presentation effects have been noted. Laughery, Young, Vaubel and Brelsford (1993) find that health warnings are significantly more noticeable when they are printed horizontally than when they are displayed vertically on alcoholic beverage containers. Diacon and Hasseldine (2007) find that individuals are more likely to choose an equity-based fund over a fixed-interest fund when past performance is charted using fund value rather than annual returns.

### 3. Methodology

A total of 544 undergraduate finance students at Ryerson University participated in the study. Each student completed an anonymous questionnaire consisting of three capital budgeting problems. Each problem presented the scenario analysis for two mutually exclusive capital investments (that were labeled as projects A and B) and then asked the

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student to choose between these two projects. Participants were told that the two alternative projects were identical in terms of their initial cost, timeframe, and cost of capital; the only difference was the mean and variance of the normal distribution for the estimated NPV of the projects. The worst-case NPV was defined as the value at which there was only a 25% chance that the actual NPV was below that amount. Similarly, the best case NPV was defined as the value at which there was only a 25% chance that the actual NPV was above that amount. The instructions to the questionnaire emphasized that the three capital budgeting problems were to be treated as being independent of each other.

Each questionnaire presented the three scenario analyses in one of four possible formats. Two of the formats had the scenarios displayed horizontally, with the best-case scenario listed first in one case (HF) and presented last in the other (HL). For the other two formats, the scenarios were presented vertically, in one case with the best-case scenario reported first (VF) and in the other case with it given last (VL). The four possible presentations for one of the capital budgeting problems are shown in Figure 1.

A total of six capital budgeting problems were studied in the experiment. These are provided in Table 1. For each problem, the riskier project had both a higher NPV in the best-case scenario and a lower NPV in the worst-case scenario than did the other project. Thus, the two projects were clearly distinguishable in terms of the risk associated with the estimated NPV. In the fourth capital budgeting problem, the two projects had identical base-case NPVs and so differed only in terms of risk. The riskier project had a higher base-case NPV than did the safer project in the other five problems, and so a positive risk and return tradeoff was present for the two potential capital investments.

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**Figure 1: Potential presentations of the scenarios for capital budgeting problem 1.**

	Best-case NPV	Expected NPV	Worst-case NPV
Project A	\$50,000	\$10,000	-\$30,000
Project B	\$35,000	\$5,000	-\$25,000

(HF)

	Worst-case NPV	Expected NPV	Best-case NPV
Project A	-\$30,000	\$10,000	\$50,000
Project B	-\$25,000	\$5,000	\$35,000

(HL)

	Project A	Project B
Best-case NPV	\$50,000	\$35,000
Expected NPV	\$10,000	\$5,000
Worst-case NPV	-\$30,000	-\$25,000

(VF)

	Project A	Project B
Worst-case NPV	-\$30,000	-\$25,000
Expected NPV	\$10,000	\$5,000
Best-case NPV	\$50,000	\$35,000

(VL)

The three capital budgeting problems that appeared on each questionnaire were determined by random selection. Within each questionnaire, the labeling of the two projects as A and B within each problem and the order in which the three problems were presented were randomized. Counter-balancing was done to ensure that there were an equal number of responses for each experimental condition. Thus, there were 272 total responses for each capital budgeting problem, consisting of 68 responses for each presentation format (HF, HL, VF, and VL) for each capital budgeting problem. Furthermore, of the 68 responses for each presentation format, 34 of these had the riskier capital investment as project A and 34 of these had it as project B. Sufficient time was provided to complete the questionnaires so that no participant felt any time pressure.<sup>2</sup>

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**Table 1**  
**Experimental Conditions**

Capital budgeting problem	Project A (riskier)			Project B (safer)		
	Worst-case NPV	Base-case NPV	Best-case NPV	Worst-case NPV	Base-case NPV	Best-case NPV
1	-\$30,000	\$10,000	\$50,000	-\$25,000	\$5,000	\$35,000
2	-\$20,000	\$25,000	\$70,000	-\$10,000	\$20,000	\$50,000
3	-\$30,000	\$20,000	\$70,000	-\$20,000	\$10,000	\$40,000
4	\$0	\$40,000	\$80,000	\$10,000	\$40,000	\$70,000
5	\$5,000	\$45,000	\$85,000	\$20,000	\$40,000	\$60,000
6	\$0	\$50,000	\$100,000	\$10,000	\$40,000	\$70,000

The worst-case NPV was defined as the value at which there was only a 25% chance that the actual NPV was below that amount. Similarly, the best case NPV was defined as the value at which there was only a 25% chance that the actual NPV was above that amount. The base-case NPV presents the best estimate of the actual NPV. The estimated NPV of both was assumed to be normally distributed.

## 4. Findings

The proportion of respondents who preferred the riskier project is shown in Table 2 by presentation format for each of the six capital budgeting problems. Before focusing on the issue of scenario presentation, two general observations should be made. First, a majority of respondents preferred the riskier project in the five problems in which the riskier project had a higher base-case NPV than the safe one. Only in the problem in which the two projects had the same base-case NPV did respondents tend to prefer the safer project. This indicates that the students put more weight on the base-case NPV than on the other two scenarios when deciding between the two projects. Because the base-case NPV represents the best estimate of the actual NPV, it should logically receive more weight than the other estimates and our results indicate that this in fact was the case. Second, the order in which the two projects were presented (as projects A and B) did not have any significant impact on the decisions made by students. Consequently, the results for the two project orderings were combined when examining the impact of scenario presentation.

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**Table 2**  
**Percentage of Respondents Choosing the Riskier Project**

Capital budgeting problem	Scenario presentation			
	HF	HL	VF	VL
1	70.6%	82.4%	77.9%	86.8%
2	64.7%	66.2%	67.6%	69.1%
3	75.0%	85.3%	73.5%	80.9%
4	27.9%	30.9%	30.9%	39.7%
5	55.9%	64.7%	48.5%	50.0%
6	51.5%	54.4%	51.5%	60.3%

HF = horizontal display with best-case scenario listed first; HL = horizontal display with best-case scenario listed last; VF = vertical display with best-case scenario listed first; VL = vertical display with best-case scenario listed last.

Everything else equal, students chose the riskier project more frequently in all six capital budgeting problems when the best-case scenario was presented last than when it was provided first. This result was found both when the scenarios were oriented horizontally and when they were oriented vertically. Using a non-parametric binomial test, this effect is highly significant ( $p < .001$ ). Thus, scenario order has a statistically significant impact on capital budgeting decisions in our experiment.

This result implies a consistent pattern in which participants put more weight on the best-case scenario (which was higher for the riskier project) when it was presented last and conversely put more weight on the worst-case scenario (which was lower for the riskier project) when it appeared last. This suggests the existence of a recency effect in which respondents overemphasized the last scenario that was presented to them when making their capital budgeting decisions.

The impact of information orientation was less clear. For four of the six capital budgeting problems (1, 2, 4 and 6), respondents chose the riskier project more often when the scenarios were oriented vertically rather than displayed horizontally. In the other two problems, it was the safer project that was selected more often when the scenarios were oriented vertically rather than horizontally. This pattern was independent of scenario order. A non-parametric binomial test revealed that the impact of scenario orientation impact on the capital budgeting decision was not statistically significant ( $p = .194$ ). Furthermore, no obvious commonalities were found amongst the four problems in which vertical orientation of the scenarios favored the riskier project or between the two problems in which this orientation of scenarios favored the safer project. No significant

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interaction was found between the effect of scenario order and the effect of scenario orientation on the capital budgeting decision.

### 5. Conclusion

This study examined whether the order and/or orientation of scenarios have an impact on capital budgeting decisions. An experiment was conducted in which participants were presented with the scenario analysis for two hypothetical capital investments that were mutually exclusive and then asked to choose between them. No significant impact of scenario orientation on capital budgeting decisions was found. In contrast, a significant scenario order effect was found in which participants put more weight on the best-case scenario when it was presented last and conversely put more weight on the worst-case scenario when it appeared last. This pattern held irrespective of whether the scenarios were oriented horizontally or vertically. This result suggests the existence of a recency effect in which individuals overemphasize the last scenario that is presented to them when making capital budgeting decisions.

The existence of a significant scenario order effect implies that firms may unknowingly be making biased capital budgeting decisions and thus taking on either more risk than they would prefer (if they list the best-case scenario last) or less risk than they would want (if they list the worst-case scenario last). It would also suggest that other financial decisions, such as investors choosing between alternative stocks or mutual funds, might be similarly biased. Awareness of such an effect could help both managers and individuals to make better financial decisions.

A limitation of the current study is that, although the number of participants was relatively large, only six capital budgeting situations were examined. It would be useful to conduct follow-up studies that consider a wider range of capital budgeting situations both to examine the robustness of the recency effect in scenario order that was identified in this experiment and to determine whether any pattern in the effect of scenario orientation on capital budgeting decisions emerges when a wider range of problems are considered. A second caveat that should be mentioned is that the observed recency effect in scenario presentation was relatively small in absolute magnitude. However, the mere existence of this effect demonstrates that financial decisions can be influenced in subtle ways. More research should be conducted to determine whether serial order effects exist for other types of financial decisions, such as choosing in which mutual fund to invest, or for common non-financial decisions that are made by corporate managers. Finally, it would be useful to determine whether this recency effect is in related in any way to framing, as this might shed additional light onto the underlying causes of the two phenomena.



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## Notes

1. Kühberger (1998) and Levin, Schneider, and Gaeth (1998) provide reviews of the framing literature.
2. Svenson and Benson (1993) have found that responses to decision problems are affected by time pressure. In particular, conventional framing effects disappeared when participants were put under significant time pressure.

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