

Financial Criteria, Capital Budgeting Techniques, And Risk Analysis Of Manufacturing Firms

Dr. Patricia Chadwell-Hatfield, Finance, Bradley University

Dr. Bernard Goitein, Director of Business and Economic Research, Bradley University

Dr. Philip Horvath, Finance, Bradley University

Dr. Allen Webster, Quantitative Methods, Bradley University

Abstract

This study examines the impact that capital budgeting considerations has on the average values of various performance measures for a sample of 118 U.S. manufacturing firms. This study also examines whether the variance of performance measures are affected by differing capital budgeting considerations. Results are analyzed with non-parametric tests for mean and variance differences. The results of this study provide mixed support for conventional financial theory and a sound basis for further investigation into current capital budgeting practices.

Introduction

Surveys regarding capital budgeting practices of managers of large corporations have been the focus of many academic studies. Researchers and managers recognize that capital expenditures are critical to the future of an organization since they have a long range impact on the firm's performance. Earlier studies by Gitman and Forrester (1977), Schall, Sundem and Geijsbeek (1978), and Klammer and Walker (1984) inquired into the capital budgeting procedures of managers. They found that managers were increasing their use of sophisticated capital budgeting techniques and are incorporating risk analysis into their capital budgeting procedures. This study presents the results of a recent survey that inquired into the financial criteria used to evaluate projects, as well as capital budgeting and risk analysis techniques employed by large and small U.S. manufacturing firms. Our

results indicate that firms tend to utilize multiple evaluation techniques and accounting measures of income to evaluate long-term investments. Although risk does appear to be of concern to managers, the results of the survey indicate that sophisticated risk analysis is not emphasized.

Data and Methodology

A questionnaire was used to solicit information regarding the capital budgeting practices of manufacturing firms. The questionnaire accompanied by a small monetary compensation, consisted of twenty-five close ended questions and one open ended question.(1) The sample was identified by a random selection of 393 U.S. manufacturing firms exhibited in Compact Disclosure. The questionnaire was sent in the Spring of 1993 to the chief fi-

nancial officers of each firm by name. The questionnaire was preceded and followed up with notification letters and reminder cards. From the 393 questionnaires mailed, 118 (30%) usable responses were received.

Studies by Gitman and Forrester (1977), Schall, Sundem and Geijsbeek (1978), Klammer and Walker (1984), Gitman and Maxwell (1987) and Klammer, Koch and Wilner (1991) specified samples of large manufacturing firms. This study differs in that the sample contains primarily small manufacturing firms. The results obtained from studies of large manufacturing firms may not necessarily be inferred to smaller manufacturing firms. Thus, it is important to examine the capital budgeting practices of smaller manufacturing firms since in the aggregate they may have greater economic impact than the larger manufacturing firms.

The results of the survey reveal that 98 firms or 84.5 percent report capital budgets less than \$50 million. Only one has a budget between \$500 million and \$1 billion, while three firms indicate budgets in excess of \$1 billion. The mean capital budget for the reporting firms is approximately \$83 million with a standard deviation of \$223 million. The median budgetary level is calculated to be about \$84 million.

Projects Exempt From Financial Analysis

The survey contained a series of questions asking if there were any projects that were exempt from financial analysis. The survey inquired whether smaller projects were exempt from formal financial analysis. There were also questions regarding any departments or individuals whose proposed projects were exempt from formal analysis. Furthermore, the survey identified any types of projects, such as essential, unusual or government mandated projects that were not formally analyzed.

1. Results

Seventy-one percent of the respondents indicated that some proposed projects were exempt from formal financial analysis. The cost of projects exempt from analysis varied from \$500 to

\$1,000,000 with the median amount of \$7500. Fifteen percent of the respondents indicated that there were some units or departments within the firm whose proposed projects were exempt from formal financial analysis, while sixteen percent indicated that there were people or positions in the firm whose proposed projects were exempt from analysis. Eight percent of the respondents do not conduct formal analysis on most or all projects considered to be unusual or novel, while 33% conduct formal analysis on only some of these projects. Seventeen percent fail to evaluate most projects considered to be essential to the survival of the firm, while 25 percent conduct analysis on only some of these projects. For projects that are mandated by regulatory agencies, 31 percent of respondents do not conduct analysis on these project while 34 percent conduct some type of analysis on some of these projects.

2. Discussion

Financial theory suggests that all projects should be formally analyzed. However, in practice there are a number of firms that fail to analyze projects unless the cost is above some fixed amount. Failure to analyze small projects may have a significant impact on firm value. Collectively, small projects consume a significant portion of a firm's capital budget. The opportunity cost of investing in a number of small projects is not having the funds to invest in a larger capital project. Thus, it is important that all projects be analyzed to ensure that resources are being used effectively. Our results indicate that the vast majority of businesses violate theory by exempting some projects from financial analysis because of the individual projects' relative low cost.

Although a majority of the firms do not tend to exempt projects from analysis due to influences by departments or positions, or because the project is unusual or novel, there are still some firms in our survey that exempt these projects from financial analysis. Furthermore, a significant portion of the firms do not conduct financial analysis on mandated projects. Even though these projects are required by government, they should be subjected to formal analysis in order to consider all vi-

Table 1
The Relative Importance of Favorable Criteria and Hurdle Rates for Project Acceptance

Criteria	Do Not Use For Outright Rejection Or Acceptance	Do Use For Outright Rejection Or Acceptance	Specific	Range	Specific	Acceptance	Important	Somewhat Important	Important	Not Used
PB	53%	39%	39%	1.5 to 15 yrs	27%	.25 to 10 yrs	65%	29%	3%	3%
ARR	50%	41%	62%	0% to 33%	40%	15% to 50%	63%	26%	3%	9%
IRR	47%	39%	64%	5% to 33%	43%	15% to 50%	72%	18%	1%	9%
NPV	69%	88%					50%	31%	3%	16%

Although a majority of the firms do not tend to exempt projects from analysis due to influences by departments or positions, or because the project is unusual or novel, there are still some firms in our survey that exempt these projects from financial analysis. Furthermore, a significant portion of the firms do not conduct financial analysis on mandated projects. Even though these projects are required by government, they should be subjected to formal analysis in order to consider all viable alternatives. Failure to analyze all projects may lead to poor decision-making.

Factors Considered In Financial Analysis

The second portion of the survey sought to determine the techniques considered to be important when evaluating proposed projects. The survey lists the payback period (PB), average rate of return (ARR), net present value (NPV) and internal rate of return (IRR) as project valuation techniques. Respondents were asked to rank the use of each technique as either important, somewhat important or not important for project evaluation. Firms were also able to indicate if they did not use a particular technique. The results are shown in the first portion of Table 1.(2)

1. Results

The results of the survey indicate that firms tend to use multiple evaluation procedures. A high IRR was cited as important in determining project acceptance by 72 percent of the firms surveyed. A short payback period was also popular, as it was cited by 65 percent of the firms as important in determining project acceptance. Although a high NPV was cited as important by 50 percent of the firms surveyed, it had the least enthusiastic response. Sixteen percent of the firms surveyed do not use the NPV criterion compared to only 3 percent that failed to use the PB or 9 percent that do not use the IRR or ARR.

2. Discussion

The academic literature has repeatedly demonstrated the benefits of using sophisticated capital budgeting techniques [Klammer (1972), Gitman and Forrester(1977), Schall, Sundem and Geijsbeek (1978), Gitman and Maxwell (1987)]. These surveys have indicated that in the past three decades firms are using increasingly sophisticated capital budgeting techniques. Numerous studies have illustrated the problems associated with the PB, ARR and IRR. Despite these shortcomings, managers still use one or more of these techniques to evaluate potential investments. Managers suggest that the results of these methods can be easily understood by individuals with little or no background in finance [Bower and Lessard (1973)]. Fur-

thermore, managers contend that the PB and ARR are easy to calculate and that the former can also be used as an indicator of risk and liquidity. The longer the payback period, the riskier the project since it allows for more time for some event to occur that may interfere with the success of the project. Also, the longer the payback, the more time it will take to receive cash from the project that may be needed to fulfill cash obligations.

Theory recommends the NPV approach over other capital budgeting techniques since it consistently selects those projects that maximize shareholders' wealth. The NPV of a project represents the expected increase in the value of the firm as a result of adopting the project. Thus, the NPV technique is consistent with the goal of wealth maximization. However, practitioners seem to place less emphasis on the NPV than any of the other capital budgeting techniques. The NPV considers the timing and magnitude of all of the cash flows and assumes that these cash flows from the project are reinvested at the firm's required rate of return. Since this required rate of return relies on the opportunity cost of equal-risk investment opportunities available elsewhere, this reinvestment rate assumption is much more reasonable than the IRR's reinvestment rate assumption.

Although the PB, ARR and the IRR may be easier to use and to communicate to those outside the financial units of the company, relying on these techniques to evaluate projects can lead to the acceptance of projects that will not maximize the value of the firm. Thus the use of these inferior techniques may imply the existence of an agency cost. Managers may be foregoing value maximizing investments in exchange for using techniques that are more widely understood and accepted by those individuals outside of the financial units. However, encouraging all managers to use the NPV technique will provide optimal long-term investment choices that will fulfill the objective of wealth maximization.

Hurdle Rates and Cutoffs

The survey also contained seven questions regarding the absolute cutoffs used by firms when

implementing investment analysis. Managers were asked if they used a hurdle for outright rejection or immediate acceptance of a proposed project for each of the capital budgeting techniques. If a hurdle was used, then managers were asked to disclose the hurdle or to specify if the hurdle was project specific.

1. Results

The results of these inquiries are also summarized in Table 1. Fifty-three percent of the respondents stated that they did not reject a project based on a low payback. Thirty-nine percent of those surveyed indicated that they did reject or accept projects outright based on the PB. While the cutoff for the PB is project specific for 39 percent of the firms using the PB to determine outright rejection, the remaining firms indicate that paybacks ranging from 1.5 years to 15 years was cause for rejection, with a median cutoff of 3 years. Twenty-seven percent of the respondents that use the PB for immediate acceptance indicate that the cutoff is project specific. Those that report fixed cutoffs offer a range of 1/4 of a year to 10 years with a median response of 1 year.

Respondents were asked the same questions regarding cutoffs for the ARR. Fifty percent of the respondents indicated that projects were not immediately rejected due to a low ARR. However, 41 percent of the respondents indicated that an unfavorable ARR did lead to outright rejection. Sixty-two percent of the firms indicated that the cutoff for outright rejection was project specific, while the remaining sample cited cutoffs ranging from 0 to 33 percent, with a median response of 10 percent. Likewise, 40 percent of the respondents indicated that the ARR for immediate acceptance was project specific. Those respondents that used specific cutoffs for immediate acceptance indicated that cutoffs ranging from 15 percent to 50 percent were required, with a median of 25 percent.

Forty-seven percent of the respondents reported that they do not reject projects outright based on the IRR, while 39 percent of those surveyed did reject projects based on a low IRR. For those that allowed for outright rejection based on

IRR, 64 percent stated that the cutoff was project specific while the remaining firms indicated that the cutoff ranged from 5 percent to 33 percent. A project specific cutoff rate is required for immediate project acceptance by 43 percent of those respondents that make outright decisions based on the IRR. The remaining firms in the category specified IRRs of 15 percent to 50 percent.

Respondents do not value the NPV technique for determining project acceptance as much as the IRR, ARR or the PB. For example, 69 percent of those surveyed indicated that they did not immediately reject a project because its NPV is below some pre-determined value. Furthermore, 88 percent of the respondents said that they did not immediately accept a project even if the NPV was above a specified level. Thus, the results provide evidence that the analysis procedures used by firms is quite a departure from those procedures emphasized by academe as theoretically superior.

The chief financial officers in the sample were asked a series of questions regarding the discount rate used to calculate the NPV. Twenty-one percent of the respondents indicated that the discount rate used was project specific while other respondents stated that the discount rate used varied from 5 percent to 25 percent, with about one-third of the respondents using a discount rate between 10 percent and 12 percent. Respondents were asked if they raise the hurdle rate for projects with significant technological uncertainties. Most responses were negative while 43 percent of those surveyed indicated that they do increase the hurdle on occasion for some of their riskier projects.

2. Discussion

Results indicate that some firms use a specific criterion for outright rejection or acceptance of a project. Perhaps this is done in order to immediately eliminate those projects that appear to be most unacceptable. However, approximately one-half of the firms in our sample do not rely on specific criterion to determine immediate rejection or acceptance. This supports the contention that many of the firms use multiple evaluation techniques when analyzing long-term investments and

do not appear to rely on a specific criterion to eliminate project choices. However, since studies have demonstrated that the PB, IRR and ARR do not directly measure the wealth created by the investment, then perhaps there are no advantages in using multiple evaluation techniques. Practitioners have argued that the PB, IRR and ARR are easier to understand. However, if no information regarding wealth maximization can be derived from these techniques, they are of little value. In fact, reliance on these techniques could lead to the selection of a project that conflicts with the NPV recommendations and the goal of wealth maximization.

Risk Analysis

As discussed in the previous section, most firms tend to have project-specific hurdle rates. This provides some evidence that the risk of the project is considered in the investment analysis. Thus, several questions were included in the survey to determine if risk is incorporated in project analysis.

1. Results

As seen in Table 2, the results indicate that in practice many firms are implementing different discount rates based on the risk of the project. The results indicate that management tends to consider downside risk although few firms consider it of great importance. Seventy-nine percent of the respondents indicated that they do consider it at least "somewhat" important to analyze whether a project will perform worse than expected. However, only 26 percent of those surveyed considered this downside risk to be important. Managers were also asked to assess the importance of low undiversifiable risk in project analysis. Forty-eight percent of the respondents considered undiversifiable risk to be somewhat important while only 16 percent considered it to be very important. These results are not consistent with previous literature that indicates that a majority of firms are concerned with risk analysis [(Gitman and Forrester (1977), Klammer and Walker (1984) and Gitman and Maxwell (1987)]. The managers in this survey indicated that risk is a consideration as reflected in

the project specific hurdle rates. However, when the managers were asked direct questions regarding risk, their concern for risk analysis was less pronounced. For example, the majority of managers indicated that undiversifiable risk is not a significant factor in capital budgeting analysis. Upside risk is even less emphasized. Forty-nine percent of the respondents indicated that upside risk was somewhat important while 41 percent indicated that it was not important at all or was not used in their firm. Other risk factors that do not appear to be of significant importance include whether or not the project is easy to manage and whether the project presents few technological uncertainties.

2. Discussion

The literature suggests that risk should be a key consideration in the capital budgeting decision. As stated previously, the implementation of different discount rates implies that managers are incorporating risk in their long-term investment decisions. Theory suggests that the opportunity cost of capital should be used as the discount rate for project evaluation. Furthermore, the Capital Asset Pricing Model supports the notion that risk differences among divisions or subsidiaries may necessitate the use of different discount rates based on differing levels of risk. Thus, it does appear that managers are implementing different discount rates based on the risk of the project. However, the broader questions regarding risk indicate that managers consider risk analysis to be of moderate importance.

Risk analysis is critical in the proper evaluation of capital projects. If risk is ignored, then the implicit assumption is that all projects considered are of equal risk and that this risk is the same as the risk for the firm as a whole. Thus, in order to achieve wealth maximizing decision making, it is necessary to adjust the analysis to account for the varying degrees of risk among projects.

Subjective Factors

Since some firms do not tend to rely on a specific cutoff for project acceptance or rejection, this may indicate that there are other factors that

influence project selection. Thus, the next portion of the survey examines other factors that management may consider in long-term investment analysis.

1. Results

Table 3 provides a summary of the results. Respondents indicate a strong emphasis on whether or not top management is committed to the project (77%) and whether or not the project is aligned with the future direction of the firm (93%). Fifty-seven percent of respondents indicate that having a project sponsor is important in determining project acceptance. Another factor of importance is whether the proposed project fits in the capital budget for the year. These results are consistent with the findings of investment decisions in energy efficiency technologies reported by Goitein (1989).

2. Discussion

Theory proposes that all projects with positive NPVs should be accepted. However, our survey results as well as those of previous surveys [Gitman and Forrester (1976), Gitman and Maxwell (1987), Klammer, Koch and Wilner (1991)] indicate that most firms operate under conditions of capital rationing. These earlier studies indicate that management may implement capital rationing for several reasons. Management may refuse to obtain additional capital since the sale of stock may shift the balance of control. Additional debt issues may be costly with undesirable restrictions imposed by creditors. Thus, managers may be willing to give up growth opportunities in order to avoid problems associated with raising additional outside capital. Furthermore, Litzenberger and Joy (1975) argue that management will implement capital rationing in order to control the growth of the corporation. Although this may be an expensive way to control growth, the authors report that managers prefer this method to other alternatives. The results of this survey are consistent with these earlier findings. The vast majority of the firms surveyed indicate that it is at least somewhat important that the project fit into the capital budget for the year in order to be considered for acceptance. Thus, the results indicate that there are a

number of qualitative factors that determine project acceptance. Ranking these projects in order of their attractiveness may be difficult due to a lack of consistent standards for project acceptance. As a result, it is likely that some projects that are not value maximizing may be accepted due to project sponsorship while projects that are value maximizing may be rejected due to capital rationing and lack of sponsorship.

Financial Criterion Used For Proposed Project Analysis

The survey asked managers to identify the financial criterion that is used to evaluate proposed projects. Respondents were asked to determine the percentage of projects that were evaluated on the basis of operating income, earnings after taxes, cash flow, cash flow from operations and free cash flow.(3) This was followed by a series of questions asking managers to indicate whether they used accounting measures of income or cash measures more or less frequently in 1992 than in 1991.

1. Results

The results for the first set of questions are reported in Table 4. The most commonly used criterion is the impact that the proposed project will have on operating income. Forty-nine percent of those surveyed indicated that this income measure was used for 81 percent to 100 percent of the proposed projects. Only 8 percent of the firms surveyed indicated that they did not use operating income as a criterion. Conversely, only 24 percent of the respondents indicated the use of free cash flow for project evaluation, with 38 percent reported that free cash flow was not a criterion used at their firm. Other cash flow measures were reportedly used more frequently. For example, cash flow and cash flow from operations is used for almost all projects by 35 percent and 32 percent of the respondents, respectively. However, many firms tend to use income measures as opposed to cash flow measures when evaluating proposed projects.

Managers were also asked whether they

used accounting income estimates and cash flow estimates more or less frequently in 1992 than in 1991. Table 5 gives the results of this series of questions. The majority of the sample firms used the same criteria in 1992 as in 1991. Interestingly, 23 percent of the firms reported that they used operating income more in 1992 than in 1991 as opposed to 16 percent of the firms reporting that they used free cash flow projections more in 1992 than in the previous year. Furthermore, 40 percent of the firms surveyed do not use free cash flow as an evaluation criteria, whereas only 9 percent of the firms fail to use operating income.

2. Discussion

Theory suggests that cash flow measures should be used when evaluating proposed investments. However, our results suggest that many managers tend to use accounting income projections when evaluating proposed investments rather than cash flow measures. Furthermore, there was a tendency for the firms in this sample to emphasize operating income more in 1992 than in 1991. These results conflict with an earlier study by Schall, Sundem and Geijsbeek (1978) that indicated that 62 percent of the firms in their sample used cash flow measures to evaluate projects. Their study also noted that the most common definition used for cash flow was net income adjusted for non-cash items. Studies have demonstrated that accounting income projections are often very different from cash flow projections [Stern (1974), Kroll (1985)]. Accounting treatments of depreciation, working capital and deferred taxes can lead to major differences between accounting income and cash flow. Thus, managerial decisions based on accounting measures may lead to poor decision making thereby failing to maximize firm value.

Summary and Conclusions

The results of the capital budgeting survey are somewhat inconsistent with previous studies. One reason for this difference may be due to our selected sample. Our sample differed from earlier studies in that we surveyed firms of all sizes as opposed to surveying only large manufacturing firms. The results indicate that a significant num-

Table 2
Risk Factors Considered in Project Analysis

Risk Factors	Important	Somewhat Important	Not Important	Not Used
Low probability performance will:				
Be worse than expected	26%	53%	17%	4%
Be better than expected	10%	49%	33%	8%
Project presents few technological uncertainties	26%	54%	16%	4%
Easy to manage	20%	38%	34%	8%
Low Un-diversified risk	16%	48%	18%	19%

Table 3
Subjective Factors Considered in Project Analysis

Subjective Factors	Important	Somewhat Important	Subjective Factors	Not Important
Top management	77%	18%	5%	0%
Project has sponsor	57%	35%	6%	3%
Project fits in capital budget	49%	34%	15%	2%
Project aligned with firm's future	93%	7%	0%	0%

Table 4
Percent of Projects for Which Criterion is Computed

Criterion	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%	Not Used
Operating income	6%	3%	17%	17%	49%	8%
Earnings after taxes	11%	7%	18%	15%	32%	17%
Cash flow	8%	3%	17%	26%	35%	11%
Cash flow from operations	5%	4%	17%	26%	32%	16%
Free cash flow	7%	4%	11%	15%	24%	38%

Table 5
Usage of Criterion in 1992 as Compared to 1991

Criterion	Used More	Same	Used Less	Not Used
Operating income	23%	63%	5%	9%
Earnings after taxes	18%	56%	8%	18%
Cash flow	19%	65%	3%	14%
Free cash flow	16%	43%	1%	40%

ber of firms in our sample do not formally analyze some proposed projects. The findings also suggest that most firms tend to employ multiple evaluation techniques when analyzing proposed projects. It appears that those techniques that are the most problematic but more intuitively appealing tend to be the ones most emphasized in practice. However, the financial literature stresses the use of the net present value in order to meet the goal of wealth maximization. Most respondents also reported a number of alternative measures considered to be important in project selection. These measures include top management commitment, sponsorship, correspondence with the strategic direction of the firm and the size of the capital budget. Again, emphasis on these factors may lead to a project selection that is not wealth maximizing.

Some of the respondents of the survey appear to give consideration to risk in project analysis as evidenced by the use of project specific hurdle rates. However, the sophistication of risk analysis is insufficient. Risk is incorporated into project analysis by use of project specific hurdle rates. Robichek and Myers (1966) discuss the problems associated with risk adjusted discount rates. The implicit assumption underlying the use of a constant risk adjusted discount rate is that risk increases over time and thus the discount rate imposes a relatively severe burden on long-term projects. This creates a bias toward the acceptance of short-term projects. Other methods, such as the certainty equivalent method is superior in that it separates risk from the time value of money. Thus, long-term projects are not penalized by the increasing risk assumption associated with risk adjusted discount rates. Furthermore, respondents indicated that the undiversifiable risk associated with a project is not considered to be of great importance. However, this should be the most relevant type of risk to equity investors.

The last portion of the survey inquired into the financial criteria used to evaluate proposed projects. Results indicate that accounting measures of income are stressed as opposed to cash flow measures. The financial literature suggests that in order to be consistent with the maximization

of shareholders' wealth, projects should be evaluated by estimating the future expected free cash flow. Furthermore, a number of studies have discussed the differences in free cash flow estimates and accounting measures. Project selection based on the evaluation of accounting income may not lead to the selection of the project that would maximize firm value. Managers are encouraged to evaluate accounting measures often times due to reward systems that are linked to accounting outcomes. Perhaps managerial reward systems should be restructured to promote cash flow maximization rather than short-run accounting profits.

In summary, it is evident that managers feel that project analysis is important. However, many of the tools used for analysis are not consistent with those tools presented in financial theory. To improve long-term investment decision making, financial managers should rely less on IRR, PB and ARR and more on the NPV. Furthermore, managers should evaluate projects based on free cash flow and utilize some of the sophisticated risk measurement techniques discussed in the financial literature.

Implications For Future Research

Capital budgeting processes are based on carefully developed financial models. However, the results of this study reveal a number of subjective factors used by managers to evaluate proposed investments. Further research regarding the human side of capital budgeting would be an interesting focus for future research. Benefits could be derived by studying the subjective processes used by managers to determine if managers accept projects that are not value maximizing due to the "buying psychology" used in the capital budgeting process.(4)□

Endnotes

1. A copy of the questionnaire is available upon request.
2. The responses for extremely important and very important categories are combined in Table 1.
3. Cash flow was defined on the survey as

earnings after taxes plus depreciation. Free cash flow was defined as cash flow from operations plus cash flow from investments as computed in the FASB 95 cash flow accounting statement.

4. "Buying psychology is a term used in industrial marketing to describe the subjective factors used in the buying decision (Bonoma, 1982).

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