

## **Budget Size and Risk Perception in Capital Budgeting Decisions of German Managers**

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*In this research we examine the capital budgeting practices of corporate managers in Germany. We find among German firms, managerial perception of the firm's risk level relative to its competitors has some impact on the use of capital budgeting techniques and procedures, especially when it comes to the usage of payback, reliance upon past and personal experience, and the use of sensitivity analysis. However, firm size has a much more significant impact on how managers approach the capital budgeting process. We find clear differences between managers of large and small firms when it comes to their use of formal capital budgeting procedures and the usage of DCF techniques.*

Field of Research: Finance, Economics, Resource Allocation

### **1. Introduction**

One of the three major decisions made by managers is the decision to invest in fixed assets. Investments in fixed assets involve large capital outlays and the consequences of these investments decisions impact a firm's operations for a very long time. Therefore a variety of quantitative and analytical techniques are applied by managers in project selection to enable them to make good decisions in this area.

### **2. Literature Review**

It is widely accepted that discounted cash flow methods are the best way to evaluate capital budgeting proposals. While several decades ago discounted cash flow methods may not have been widely used (Istvan, 1961) more recent studies (Kim, Crick and Kim, 1986) suggest that increasingly firms are adopting discounted cash flow analysis. Much of the empirical research on capital budgeting practices adopted by corporate managers is based on US data (See for example Mukherjee and Hingorani, 1999.) A few studies such as those by Payne, Heath, and Gale (1999), Jog and Srivastava (1995) and Kester et. al (1999), examine capital budgeting practices followed by firms in different countries such as Canada, Australia, Hong Kong, Indonesia, Malaysia, Philippines and Singapore. This study examines managerial behavior and preferences with respect to the capital budgeting decision using a sample of German firms. Our unique sample and the results of our analysis help to fill a gap in finance literature and provide useful information to managers contemplating German collaborations.

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### 3. Methodology and Research Design

Using the approach suggested by Payne, Heath, and Gale (1999), we partition our sample by firm size as well as managerial perception of the risk level of the firm relative to its competition. We use descriptive statistics, some non-parametric tests, and a probit regression to analyze our data. The specific hypotheses we examine are whether firm size and managerial perception of the risk level of the firm relative to its competitors affect the choice of capital budgeting method by managers in German firms. Our hypotheses are stated simply as follows:

Hypothesis I:

H<sub>0</sub>: There is no difference between managers of small and large German firms in

- their application of formal capital budgeting evaluation procedures
- their ranking of the importance of various capital budgeting techniques
- how they determine the hurdle rate for capital budgeting decisions
- how they adjust for risk level on individual projects.

Hypothesis II:

H<sub>0</sub>: There is no difference in managerial behavior based on managerial perception of a firm's risk level relative to its competitors, in

- their application of formal capital budgeting evaluation procedures
- their ranking of the importance of various capital budgeting techniques
- how they determine the hurdle rate for capital budgeting decisions
- how they adjust for risk level on individual projects.

A multiple choice survey form was prepared in English, translated into the German language, and mailed to a sample of five hundred German firms that covered a broad spectrum of industries. Our final analysis is based on the responses we received from sixty-six firms, though one firm did not respond to all questions. The response rate to our survey is comparable to that obtained by previous researchers working in the area (Payne, et. al, 1999.) Our survey instrument allowed for indicating managerial preference in the choice of capital budgeting criteria, the method of risk assessment used, and managerial perception of risk.. Firms were classified as large or small based on the size of their capital budget. Firms with a capital budget in excess of 10 million euros were classified as large firms and those with a capital budget below 10 million euros were classified as small firms.

### 4. Discussion of Findings

Tables 1 and 2 summarize the responses received from managers to the question "For which type of projects do you conduct formal capital budgeting procedures. Since managers were asked to check off all answers that apply, the percentages in the column may not add up to one hundred percent as the responding manager might have checked more than one answer.

Table 1  
Summary of Responses by Firm Size

Firm Size	Small	Large	Total
<i>Panel A. Types of Projects</i>			
All Replacement Projects	30% **	10.71% **	13.64%
All Expansion Projects	30%	33.93%	33.33%
Projects Valued Over a Certain Amount			
Replacement Projects	70%	69.64%	69.70%
Expansion Projects	70%	62.50%	63.64%
Other Projects	30%	41.07%	39.39%
<i>Panel B. Importance of Techniques</i>			
Payback Period	2.875 (1)	4.528 (4.5)	
Discounted Payback Period	4.625 (5.5)	3.387 (3)	
Accounting Rate of Return	3.500 (3)	4.538 (4.5)	
Internal Rate of Return	3.438 (2)	3.038 (2)	
Modified Internal Rate of Return	5.063 (7)	5.000 (7)	
Net Present Value	3.875 (4)	2.726 (1)	
Other	4.625 (5.5)	4.783 (6)	

\*\* significant at the .10 level  
(ranking indicated in parentheses)

Results in Panel A of Table 1 show that thirty percent of managers of small firms have a formal capital budgeting evaluation procedure for all replacement projects and all expansion projects while only approximately eleven percent of managers of large firms had a formal capital budgeting evaluation procedures for all replacement projects and about 34 percent of large firm managers had a formal capital budgeting procedure for all expansion projects. So, the results indicate that large firm managers treat replacement projects more routinely, while smaller firm managers with perhaps more limited resources, do a thorough evaluation and review of replacement projects.

Panel B of Table 1 shows that managers in small firms rank payback as the most important criterion while large firm managers rank net present value as the most important criterion. Both large and small firm managers ranked internal rate of return as the second most important criterion. It is interesting to note that while net present value received a rank of 4 among small firm managers, payback received a rank of 4 among large firm managers. The results of Panel B of Table 1 show that managers in firms with smaller capital budgets are less likely to use discounted cash flow techniques for capital budgeting evaluation. This finding is consistent with prior evidence from US data.

Table 2  
Summary of the Responses by Risk Level

Risk Level	Low Risk	High Risk	Total
<i>Panel A. Types of Projects</i>			
All Replacement Projects	10.53% *	37.50% *	13.85%
All Expansion Projects	33.33%	37.50%	33.85%
Projects Valued Over a Certain Amount			
Replacement Projects	71.93%	62.50%	70.77%
Expansion Projects	64.91%	62.50%	64.64%
Other Project	38.60%	50%	40 %
<i>Panel B. Importance of Techniques</i>			
Payback Period		4.318 (4)	4.250 (5)
Discounted Payback Period		3.536 (3)	3.667 (3)
Accounting Rate of Return		4.427 (5)	4.167 (4)
Internal Rate of Return		3.045 (2)	3.500 (2)
Modified Internal Rate of Return		5.027 (7)	4.833 (7)
Net Present Value		2.845 (1)	3.167 (1)
Other		4.800 (6)	4.417 (6)

\* significant at the .05 level

Results presented in Panel A of Table 2 show that, as expected, formal capital budgeting procedures are more likely to be adopted by managers when they perceive their firm as being of higher risk relative to its competitors, than they are when managers perceive their firm to be of the same or lower level of risk than its competitors. In firms that are not categorized as high risk, formal capital budgeting evaluation procedures are used most often for projects of larger value (64.91 percent of high value expansion projects and 71.93 percent of the high value replacement projects). The results presented in Panel B of Table 2 show that managerial perception of firm risk does not appear to influence the ranking of the choice of method much with only slight differences in the ranking between the two groups. For both high risk and low/average risk firms, managers ranked the net present value method first, internal rate of return second, discounted payback third, and modified internal rate of return last.

Table 3  
Summary of Risk Assessment Technique by Firm Size

Firm Size	Small Firms	Large Firms	Total
<i>Panel A. Determination of Hurdle Rates</i>			
Do Not Use Discounted Cash Flow	20% **	5.36% **	7.58%
Cost Of Debt	30%	28.57%	28.79%
WACC Of Capital	10%	17.86%	16.67%

Previous Experience	0%	7.14%	6.06%
Depends Upon Project Financing	20% *	3.57% *	6.06%
Premium Over the Risk-Free Rate	30%	23.21%	24.24%
Other	10%	30.36%	27.27%

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*Panel B. Adjustment for Risk Level on Individual Projects*

Adjust the Hurdle/Discount Rate	50%	48.21%	48.48%
Adjust the Projected Cash Flows	10% **	39.29% **	34.85%
Make No Adjustments	30% **	10.71% **	13.64%
Adjust the Required Payback Period	30%	30.36%	30.30%
Other	0% **	21.43% **	18.18%

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*Panel C. Assessment of Risk Level on Individual Projects*

Assume It's The Same As The Company As A Whole	30%	14.29%	16.67%
Quantify Based On Experience Of Other Companies That Engage Only In Core Business	10%	7.14%	7.58%
Quantify Based On Personal Experience	50%	62.50%	60.61%
Use Sensitivity Analysis	10% *	46.43% *	40.91%
Other	10%	8.93%	9.09%

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\* significant at the .05 level

\*\* significant at the .10 level; WACC = Weighted Average Cost of Components

Panel A of Table 3 presents the summary of the responses to the question "For capital budgeting methods requiring discounted cash flows or a hurdle rate, how do you determine the appropriate rate?" Managers were asked to check off all choices that apply and hence the percentages do not add up to one hundred percent. Due to an oversight when the survey instrument was translated into the German language, cost of equity was not listed separately as one of the possible responses, so the category listed as other in Tables 3 and 4 includes the response of cost of equity. We find a difference between the responses given by managers of firms with a small capital budget versus the responses given by managers of firms with a large capital budget. Twenty percent of small firm managers reported that they do not use discounted cash flow whereas the corresponding percentage for large firm managers was only a little over five percent. Managers of small firms and large firms chose cost of debt in approximately equal percentages. Large firm managers chose weighted average cost of capital about twice as often (17.86 percent) as small firm managers (10 percent). Small firm managers used the subjective approach (responding with 'depends on project financing') more often than large firm managers.

Panel B of Table 3 shows how small and large firm managers made adjustments for the risk level of individual projects. In this question also, since managers were asked to check all the responses that apply, the percentages do not add up to one hundred percent. Both large and small firm managers tended to adjust the hurdle rate or discount

rate about half the time (48.21 percent to 50 percent.) and adjusted the required payback period about thirty percent of the time. It was interesting to note that while large firms managers reported that 39.29 percent of the time they made adjustments to the projected cash flows, the response rate for small firm managers was only 10 percent. Small firm managers reported making no adjustments 30 percent of the time while the corresponding response rate for large firm managers was 10.71percent. So overall there appears to be some difference between how large and small firm managers in German firms make adjustments for the risk level of individual projects. Panel C of Table 3 shows how managers of small and large firms assess risk levels of individual projects. Once again, managers were allowed to select more than one response so the percentages do not total to one hundred percent. German managers of small and large firms alike tend to quantify risk based on their personal experience. This was the response given by 50 percent of the small firm managers and 62.50 percent of large firm managers. Thirty percent of small firm managers assume the risk level of the projects is the same as the firm as a whole while large firm managers selected this response only 14.29 percent. Only ten percent of small firm managers use sensitivity analysis, but the usage was much higher (46.43 percent) for large firm managers.

Table 4 shows the impact of managerial perception of firm risk relative to its competitors on the responses to the capital budgeting evaluation process. In Panel A, in responding to determination of hurdle rate, a noteworthy finding is that in high risk firms no managers reported that they would use weighted average cost of capital or choose a rate depending upon project financing. Weighted average cost of capital appears to be the method of choice in 19.30 percent of the low and average risk firms. Another interesting finding is that German managers did not use discounted cash flow in 25 percent of the high risk firms. Cost of debt was the method of choice in 29.82 percent of the low and average risk firms and 25 percent of the high-risk firms. Panel B shows the summary of responses to the question "how do you adjust for risk level on individual projects?" It appears that in 49.12 to 50 percent of low risk and high risk firms, the favored method of adjustment is to adjust the hurdle rate or discount rate. In 35.08 to 37.50 percent of the 'low' risk and 'high-risk firms, the favored method of adjustment is to adjust the projected cash flows, and in 14.03 to 12.50 percent of the low risk and high-risk firms, the favored method of adjustment is to make no adjustment at all. So it appears for all these methods, the German manager's perception of the firm's risk level does not make much of a difference.

Table 4  
Summary of Risk Assessment Technique by Risk Level

Table 4

Risk Level	Low Risk	High Risk	Total
<i>Panel A. Determination of Hurdle Rate</i>			
Do Not Use Discounted Cash Flow	5.26% *	25% *	7.69%
Cost Of Debt	29.82%	25%	29.23%
WACC Of Capital	19.30%	0%	16.92%
Previous Experience	5.26%	12.50%	6.15%
Depends Upon Project Financing	7.02%	0%	6.15%
Premium Over the Risk-Free Rate	26.32%	12.50%	24.62%
Other	26.32%	37.50%	27.69%
<i>Panel B. Adjustment for Risk Level on Individual Projects</i>			
Adjust the Hurdle/Discount Rate	49.12%	50%	49.23%
Adjust the Projected Cash Flows	35.08%	37.50%	35.38%
Make No Adjustments	14.03%	12.50%	13.85%
Adjust the Required Payback Period	26.31% *	62.50% *	30.77%
Other	17.54%	25%	18.46%
<i>Panel C. Assessment of Risk Level on Individual Projects</i>			
Assume It's The Same As The Company As A Whole	17.54%	12.50%	16.92%
Quantify Based On Experience Of Other Companies That Engage Only In That Business	7.02%	12.50%	7.69%
Quantify Based On Personal Experience	59.65%	75%	61.54%
Use Sensitivity Analysis	38.60%	62.50%	41.54%
Other	10.53%	0%	9.23%

\* significant at the .05 level; WACC = Weighted Average Cost of Components

A noteworthy difference is found in the adjustment made to the payback period. In 62.5 percent of high-risk firms, the managers responded that they would choose to adjust the payback, while this response was chosen in only 26.31 percent of the low to average risk firms. In Panel C of the same table, we notice a difference in the response to how managers assess the risk levels on projects. While for high risk firms, 75 percent of managers responded that they would quantify the risk level of a project based on personal experience, only 59.65 percent responded in this manner for low to average risk firms. Likewise, for high-risk firms 62.5 percent of managers responded they would use sensitivity analysis, while only 38.60 percent of managers in low to average risk firms responded they would use sensitivity analysis.

Table 5  
Results of Probit Regressions Using Various Dependent Variables

Firm size is a dummy variable that takes a value of 1 for large firms and a value of 0 for average and small firms. Risk level is a dummy variable that takes a value of 1 for high-risk firms and a value of 0 for low risk firms.

Dependent Variable	Constant	Firm Size	Risk Level	Log Likelihood Test for Model Fit
<i>Dependent Variable Is Method Of Adjusting For Risk. This Is An Indicator Variable, 0 If the Method Is Not Used, And 1 If the Method Is Used</i>				
Do Not Use				
Discounted Cash Flow	-1.0271 (.0125)	-.7290 (.0752)	.2011 (.3365)	2.06 (.3571)
Cost of Debt	-.5887 (.0725)	.0374 (.4660)	-.4394 (.1080)	1.59 (.4516)
WACC	-.5887 (.0725)	.0374 (.4660)	-.4394 (.1080)	1.59 (.4516)
Previous Experience	-1.9907 (.0000)	* *	.8939 (.0475)	3.03 (.0818)
Depends Upon				
Project Financing	-1.1229 (.0065)	-1.0794 (.0295)	.6303 (.1265)	4.14 (.1265)
Premium Over the Risk-Free Rate	-.7259 (.0385)	-.1726 (.3455)	.1662 (.3130)	.38 (.8250)

\* regression was not possible because the variable predicted perfectly

Results of our probit regressions to test the impact of firm size and managerial perception of firm risk on the method of adjusting for risk are presented in Table 5. Overall, the results show some support for the concept that the size of a firm's capital budget affects the method by which capital budgeting decisions are made by managers of the firm. The signs of the coefficients are as expected with larger budget firms, indicating a significant impact of decisions related to 'do not use discounted cash flow' and 'depends on project financing'. For both situations, larger budget firms were significantly less likely to report using those methods. The positive coefficients of the 'cost of debt' and 'weighted average cost of capital' variables indicate that larger budget firms are more likely to use these methods but the coefficients are not significantly different from zero.

The risk level coefficients in general do not show significant differences between firms rated as above average risk except for the 'previous experience' coefficient. The

positive and significant coefficient indicates that managers of firms perceived as being riskier than the competition, tend to depend more on previous experience in making capital budgeting decisions than do managers of firms viewed as being less risky relative to the competition. The negative coefficients for 'cost of debt' and 'weighted average cost of capital' indicates that managers in firms perceived as being more risky are less likely to use cost of debt and weighted average cost of capital for making capital budgeting decisions and the coefficients might be considered marginally significant with a p-value of .108.

## 5. Conclusion

Our overall conclusion is that managerial perception of a firm's risk level relative to its competitors has some impact on the use of capital budgeting techniques and procedures in Germany, especially when it comes to the usage of payback, reliance upon past and personal experience, and the use of sensitivity analysis. However, the size of a firm's capital budget has a much more significant impact on how German managers approach the capital budgeting process. We find clear differences between large and small budget firms when it comes to their use of formal capital budgeting procedures and the usage of DCF techniques. The authors acknowledge the contribution of Lander Foundation and Dean Royce Caines towards this research project. We also thank Drs. Janet Payne and Tarun Mukherjee for sharing their capital budgeting survey instrument with us.

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