

THE EFFECT OF PUBLIC VERSUS PRIVATE DECISION ENVIRONMENT ON THE USE OF THE NET PRESENT VALUE INVESTMENT CRITERION

Keith Richardson*

ABSTRACT. Public and private sector managers make investment decisions under uncertainty. Economic efficiency requires that managers who wish to maximize expected utility use NPV. A field test reports that a lower proportion of public managers (20%) utilize NPV than private managers (46%). This difference is significant at $p = .01$ in both logistic regression and chi-square tests for three competing, but not mutually exclusive, reasons. First, taxpayers are a primary source of capital. Taxation decisions are primarily political events and inefficiency is less likely to be disciplined by capital withdrawal. Second, it is more difficult to estimate expected benefits and costs. Third, investment decisions are often the result of political, not economic, processes. The objective may not be maximization of NPV.

INTRODUCTION AND OVERVIEW

Managers in both public and private organizations acquire capital and make investment decisions under uncertainty. Ideally, these managers seek to maximize the expected utility of the suppliers of the capital. Economic efficiency requires that decision makers use the net present value (NPV) criterion to determine which investments to select. Conventional wisdom suggests that public entities are less likely to use

* *Keith Richardson, CPA, Ph.D., is Assistant Professor, Department of Accounting, Bellarmine College. He is teaching managerial and financial accounting, and auditing. His current research interest is in cognitive decision making in accounting.*

the NPV criterion than private entities. There are three competing, but not mutually exclusive, possible explanations. First, it is argued that taxpayers are a primary source of capital in the public sector. Taxation decisions are primarily a political event, rather than a capital market event. Therefore, in the public sector, it is less likely that lack of efficiency in investment decisions will be disciplined by the withdrawal of capital, as compared to the private sector. Second, it is argued that it is more difficult to estimate the expected benefits and costs, cash flows and cash flow equivalents, for public entities. Therefore NPV techniques are thought to be of limited value in public investment decisions. In addition, there is theoretical disagreement about what the cost of capital should be for a public entity. This may also lead to less validity and lower usage of the NPV criterion in the public sector. Third, it is argued that the actual investment decisions in the public sector are the result of a political, not an economic, process. The objective of public managers may not be the maximization of the NPV of net taxpayer benefits and, if so, the NPV criterion is not appropriate for use in public sector investment decisions.

To date there are many surveys of investment criteria used in the private sector and only one survey of investment criteria used in the public sector. In a 1988 survey of private sector managers, Klammer, Koch, and Wilner (1991) found that between 41 percent and 88 percent reported using an NPV criterion, depending on the type of investment decision being made. The survey of public sector managers (Kee, Robbins, and Apostolou, 1987) found that 44 percent reported using an NPV criterion as a primary decision method.

The contribution of this study is to provide additional evidence about the comparative utilization of the NPV criterion in public and private entities. This is achieved by asking subjects to make an investment decision and observing whether or not they make decisions consistent with the NPV criterion. After controlling for subjects' knowledge about use of the NPV criterion and for individual characteristics of the subjects, this study finds that 46 percent of private managers make decisions consistent with the NPV criterion. In comparison, only 20 percent of public managers make decisions consistent with the NPV criterion. This difference is significant in logistic regression and chi-square tests at $p = .01$.

THEORY AND HYPOTHESIS DEVELOPMENT

Normative Status of NPV Investment Criterion

A primary responsibility of managers in both private (business) and in public (government) organizations is the allocation of scarce financial resources among alternative investments or programs. In both cases, managers are assumed to seek to maximize the expected utility of the suppliers of the capital. Private investors and taxpayers value efficiency. Economic efficiency requires the use of NPV investment criterion in both private and public entities. In making these investment decisions, business managers' objective is to maximize the present value of the expected net cash flows to investors. Correspondingly, governmental managers' objective is to maximize the present value of the expected net benefit to taxpayers.

Fama and Miller developed the market value rule: The market value rule holds that managers will prefer positive NPV investments over negative NPV investments. Managers who do not select positive NPV investments will not maximize firm value.

It is possible to develop an objective, operational decision criterion for management that (1) does not involve stockholder utility functions directly but (2) leads to precisely the same investment and operating decisions that each stockholder would make if he were running the firm himself ... market opportunity lines may also be interpreted as present value lines ... current market value necessarily equals present value ... Hence the injunction to management is ... to maximize the current value of the withdrawals to be provided by the firm to its current owners. (Fama and Miller, 1972: 69).

Arrow and Lind (1970), in a discussion of uncertainty and public investment decisions, state that "the issue is whether it is appropriate to discount public investments in the same way as private investments." Their paper discusses whether the appropriate discount rate is a risk-adjusted rate, the risk-free rate, or an administratively determined national policy rate. The implicit normative assumption is that the NPV of the benefits and costs in public investments should be determined. The question to be resolved is at what discount rate. NPV is the normative investment decision criteria in both the private and public sectors.

Use of NPV Investment Criterion Recommended

Educators and professionals have recommended the use of the NPV investment criterion in both private and public decision environments. In their introductory managerial accounting textbook, Garrison and Noreen express the need for the NPV criterion very simply:

It is necessary to employ techniques that recognize the time value of money. Any business leader would rather receive a dollar today than a year from now. The same concept applies in choosing between investment projects. Those that promise returns earlier in time are preferable to those that promise returns later in time. The capital budgeting techniques that recognize the above two characteristics of business investments most fully are those that involve discounted cash flows (Garrison and Noreen, 1994: 651)

Garrison and Noreen (1994: 665) further posit that “capital budgeting concepts have equal application to all types of organizations regardless of whether they are profit or nonprofit in nature.” In a paper recommending the use of cost-benefit analysis (a discounted NPV criterion) in education finance decisions, Webb (1976: 209) comments that:

As society has made increased investments in education, the public has exhibited a growing demand for schools to be accountable. Yet in the past, educators have relied primarily on non-quantifiable justifications when attempting to justify the return on increased investments in education compared to the return from other forms of public or private investments. Extended qualitative discussion of the social value of education is no longer acceptable.

Hypothesis Development

Economic efficiency requires that decision makers use the NPV criterion when selecting investments. Conventional wisdom is that the public sector is less efficient than the private sector. If this is true, public managers will be less likely than private managers to use the NPV criterion when making investment decisions. If the NPV criterion is used less frequently in the public sector, there are several competing but not mutually exclusive possible explanations:

- The availability of capital in the public sector is less dependent on the efficiency of the entity. This is the market discipline hypothesis.
- The estimation and quantification of benefits and costs is more difficult in the public sector.
- Investments in the public sector are the result of a political process, not an economic process.

The Market Discipline Hypothesis

Many private sector entities acquire their capital in competitive capital markets. In addition, these firms often operate in competitive factor and labor markets. This competition implies that failure to use the NPV investment criterion results in a firm being inefficient relative to its competitors. Over time, this inefficiency decreases its return on investments made with acquired capital. If return on investment falls below the cost of capital, the acquisition of additional capital becomes more expensive, and in the limit, becomes impossible, resulting in the demise of the firm. Thus, the discipline of capital markets provides incentive for the firm to use the NPV criterion to enhance efficiency.

Public entities differ from private entities in several important respects. First, public entities receive much of their capital from taxes. There is an involuntary aspect to this capital acquisition which is determined by political as well as economic considerations. The political aspect of capital allocation weakens the relationship between efficiency and capital. Second, there is not a direct relationship between taxes collected and services provided unless user fees are charged for services. Hence, the level of consumer satisfaction is expressed politically rather than through the purchase of goods and services. Accordingly, the users of the services do not directly discipline public entities by affecting their revenues. Third, public entities often have a monopoly. Consequently, a competitive market price is not determined which makes it difficult to measure economic efficiency.

Because return on investment, profitability, does not control a public entity's access to capital, governmental (not for profit) accounting focuses on accountability, defined as compliance of actual expenditures with budgeted expenditures. Fund accounting is used in the public sector to

measure this accountability. Accrual accounting is used in the private sector to measure return on assets. In fund accounting, the entity is defined by the type of service provided. The role of the accounting system is to record and report sources and uses of fund resources and to ascertain whether the uses conform to the adopted budget. An important difference between accrual and fund accounting is that many investments in fixed assets that would be capitalized and expensed over the period benefitted, in accrual accounting, are expensed in the current period, in fund accounting. This makes the evaluation of efficiency more difficult in public entities.

Because of the differences between private and public entities, investment decisions by public entities are less likely to be disciplined by sources of capital than are the investment decisions of private entities. Lacking such discipline, and other things equal, it is hypothesized that public sector managers are less likely to use the NPV criterion than private sector managers when making investment decisions.

Estimating and Quantifying Benefits and Costs in the Public Sector

Benefits and costs in the private sector are generally events that increase and decrease funds. In the public sector, many benefits and, to a lesser extent, costs are measured in qualitative terms. These benefits and costs are often difficult to convert into monetary estimates. For example, benefits could be measured in terms of expected lives saved or level of public safety. "For public program evaluation,... it is not always clear who the decision maker is nor what are his criteria for choice.... Program effects are more difficult to translate into money values" (Thompson, 1980: 36-7). However, in a survey of cost-benefit analysis Prest and Turvey (1965: 30) maintain that in spite of the difficulties involved in measuring public benefits and costs,

an important advantage of a cost-benefit study is that it forces those responsible to quantify costs and benefits as far as possible rather than rest content with vague qualitative judgments or personal hunches. This is obviously a good thing in and of itself; some information is always better than none. Furthermore, quantification

and evaluation of benefits, however rough, does give some sort of clue to the charges which consumers are willing to pay.

Arrow and Lind (1970) state that investors in private markets choose investments that maximize the present value of returns properly discounted for the level of risk. A continuing controversy exists regarding the appropriate cost of capital to be used for discounting expected cash flows in the public sector. Arrow and Lind discuss three theoretical positions on this issue. The first is that risk should be adjusted in the same way for public and for private investments. This adjustment will help avoid the risk of over-investment in the public sector. The second is that government can better cope with risk and, therefore, the risk-free rate should be used. The last is that government authorities should establish the discount rate to be used in public sector investments. The difficulty in determining the appropriate discount rate may make it more difficult to justify using the NPV criterion in public sector investment decisions.

The difficulties involved in obtaining quantitative estimates of benefits and costs and the difficulty in determining an appropriate discount rate also generate the hypothesis that public sector managers are less likely to use the NPV criterion than private sector managers.

Political Process in Public Sector Investments

To the extent that investments in the public sector are the result of a political process, not an economic process, the objective of public sector managers may not be the maximization of the NPV of taxpayer net benefits. If market discipline is not impacting the public sector, investment decisions are not required to be made based on economic criteria. If a political objective is the dominant decision criterion in an investment decision, the estimation of benefits and costs and the calculation of their present values may not be relevant to the decision.

Webb, McCarthy and Thomas (1988: v) comment, in their text which is intended for use in graduate courses in school finance, "The financing of our nation's schools is big business. As with any business, it is concerned with two dimensions: (1) the resource dimension - how and from where the money is generated, and (2) the allocation dimension - how and to where the money is allocated." The recent emphasis on cost

reduction and efficiency in government spending may be increasing the requirement for economic justification of investment decisions relative to political justifications. Political considerations continue to be more important in the public sector than in the private sector, however.

If investments in the public sector are based on political instead of, or in addition to, economic criteria, this also generates the hypothesis that public sector managers are less likely to use the NPV criterion than private sector managers.

Reported Reasons for Not Using the NPV Criterion

In a survey of government investment decision making, Kee, Robbins, and Apostolou (1987) found that 56 percent of their subjects reported that they did not use the NPV criterion. They obtained a variety of reasons why these governmental managers do not use the NPV criterion. These include (a) political considerations, (b) qualitative aspects, (c) payback method preference, (d) difficulty in predicting cash flows, and (e) difficulty in determining cost of capital. Table 1 presents a summary of their subjects' reported reasons.

TABLE 1
Public Managers' Reasons for Not Using the NPV Criterion
from Kee, Robbins, and Apostolou (1987)

Reported reason for not using the NPV criterion:	% of Subjects
Political factors	27
Inability to include qualitative aspects	26
Payback method preferred	14
Cannot predict cash flows	11
Difficulty determining cost of capital	7
Other	15
Total	100

EVIDENCE TO DATE ON MANAGERS' USE OF THE NPV CRITERION

There are a number of surveys which investigate the investment criteria used by managers in companies and one survey of criteria used by public managers. The results from several recent surveys are presented in this section.

Klammer, Koch and Wilner (1991) report and compare the results of surveys of large United States firms from 1988, 1980, and 1975. The 1988 survey included one hundred companies. Chief financial officers were asked to report the investment criteria used for a variety of investment decisions including replacement, expansion of existing operations, expansion of new operations, foreign operations, abandonment, general and administrative, social expenditures, and high technology. In each study, subjects were asked to recollect the criteria they were using in two prior years. Table 2 is an excerpt from the data presented in their paper (Klammer, Koch, and Wilner, 1991: 118) reflecting the most sophisticated primary evaluation technique used. Klammer, Koch and Wilner assume that discounted cash flow (DCF) techniques are the most sophisticated. DCF techniques, properly applied, result in decisions consistent with the NPV criterion. All primary and secondary criteria used by subjects were obtained. Therefore, it is not possible, from the data, to determine if DCF techniques or other methods dominate in actual decisions made. Table 2 includes investment decision criteria for expansion of existing operations, general and administrative, and high technology as examples.

These results indicate that the use of DCF techniques, the NPV criterion, has increased over the years and is more common in expansion and high-technology investment than in investment for general and administrative operations. This study asked subjects to make computing investment decisions. Therefore, the high technology percentages may be most applicable.

Remer, Stokdyk, and Van Driel (1993), Table 3, compared the results of their 1991 and 1978 surveys of thirty-three and twenty-seven, respectively, of the largest Fortune 500 companies. Most companies, 97 percent, use NPV and internal rate of return (IRR), 90 percent, in the

TABLE 2
Most Sophisticated Investment Criteria of United States Companies
from Klammer, Koch, and Wilner (1991) - Percentage Using

	1965 ^a	1970 ^a	1975 ^a	1980 ^b	1984 ^c	1988 ^c
Expansion/New Business						
Discount Cash Flows ^d	31	49	75	71	81	87
Simple Rate of Return	33	25	12	10	5	4
Payback Period	10	16	9	5	6	4
Urgency	6	3	1	1	2	1
Other/Not Analyzed	<u>10</u>	<u>7</u>	<u>3</u>	<u>13</u>	<u>6</u>	<u>4</u>
Total Percentage	100	100	100	100	100	100
Administrative						
Discount Cash Flows ^d	14	19	32	36	36	41
Simple Rate of Return	8	9	8	4	3	4
Payback Period	11	10	6	5	9	11
Urgency	46	43	37	32	31	28
Other or Not Analyzed	<u>21</u>	<u>19</u>	<u>17</u>	<u>23</u>	<u>21</u>	<u>16</u>
Total Percentage	100	100	100	100	100	100
High Technology						
Discount Cash Flows ^d				60	68	75
Simple Rate of Return				4	1	1
Payback Period				14	11	8
Urgency				11	11	10
Other or Not Analyzed				<u>11</u>	<u>9</u>	<u>6</u>
Total Percentage				100	100	100

^a1975 survey^b1980 survey^c1988 survey^dDCF methods are consistent with the NPV criterion.

1991 survey. "The survey asked the companies to assign a weight of zero percent to 100 percent for each project evaluation method used. The percentages were meant to reflect the degree to which each method was used by that particular company. The sum of all the weights had to equal 100 percent" (Remer, Stokdyk, and Van Driel, 1993: 105). Based on the assigned weights, on average, the 1991 companies reported using a DCF

TABLE 3
Investment Criteria of Large Fortune 500 Companies
from Remer, Stokdyk, and Van Driel (1993)

	1978 (33 Companies)	1991 (27 Companies)
Percent of Companies Using Methods		
Net Present Value ^a	52	97
Internal Rate of Return ^a	100	90
Payback Period	78	64
Simple Rate of Return	30	39
Other Methods	7	21
Average Percent Weight Assigned to Method		
Net Present Value	15	41
Internal Rate of Return	<u>49</u>	<u>35</u>
Total DCF^a	64	76
Payback Period	24	12
Simple Rate of Return	9	8
Other Methods	<u>3</u>	<u>5</u>
Total Not DCF	36	25
Total	100	101^b

Surveys obtained all methods used.

^aDCF (discounted cash flow) methods are consistent with the NPV criterion.

^bThe percentages reported total to 101 percent.

criterion 76 percent of the time. Recall that DCF criteria, properly applied, result in decisions that are consistent with the NPV criterion.

Kee, Robbins, and Apostolou (1987) surveyed the capital budgeting criteria of ninety-seven cities in the United States. Table 4 presents their results. The most popular method is the benefit-cost ratio, which 40 percent use as their primary method and 17 percent use as their secondary method. Some authors define the benefit-cost ratio as discounted benefits divided by discounted costs and others define it as unadjusted benefits

TABLE 4
Capital Budgeting Criteria of Ninety-Seven Municipal Managers
from Kee, Robbins, and Apostolou (1987)⁽¹⁾

Method	Primary Method % Reporting	Secondary Method % Reporting
Benefit-Cost Ratio	40	17
Internal Rate of Return	2	7
Net Present Value	<u>2</u>	<u>14</u>
Total DCF*	44	38
Payback	13	24
Simple Rate of Return	0	4
No Quantitative Evaluation	33	23
Other	<u>10</u>	<u>11</u>
Total Not DCF	56	62
Total	100	100

- DCF (discounted cash flow) methods are consistent with the NPV criterion.

divided by unadjusted costs. To the extent that subjects in this study use the unadjusted definition, the percentage using DCF, NPV criterion, methods is overstated and the percentage not using DCF methods is understated. The study does not provide a separation of these groups.

The survey evidence that has been collected indicate that most managers use NPV criterion techniques either as their primary or secondary decision criterion. It would be useful to determine whether the selection criteria and process used by the managers actually result in the selection of investments that have positive NPVs and the rejection of investments with negative NPVs. That is, do managers actually make decisions that conform to the NPV criterion? To investigate this question, a field study was conducted to document and analyze managers' investment decisions.

STUDY DESIGN

Hypothesis and General Model

This study tests the hypothesis that managers in the public sector are less likely to use the NPV criterion when making investment decisions than managers in the private sector. The surveys of investment decision criteria indicate that many public and private managers use more than one criterion. There is, therefore, "noise" in the reported results. To date, there have been no field experiments which determine to what extent public and private managers' decisions are consistent with use of the NPV criterion and compare the decisions between these groups. This study provides a field test utilizing private and public professionals. The subjects made hypothetical investment decisions for their organizations and responded to an exit questionnaire.

The following general model was tested:

Use of NPV Criterion = f (Public Entity, NPV Criterion Knowledge, Individual Characteristics of Subject)

where NPV Criterion Knowledge and Individual Characteristics of Subject are controls for other possible influences on the use of the NPV criterion.

Logistic regression was used because it accommodates binary dependent and binary independent variables.

Logistic Regression Model

POS NPV = f (PUBLIC, BUS DEGR, RISK EDUC, RISK EXPR, RISK PREF, YRS EXPR, AGE, GENDER)

The experiment tests to what extent using the NPV criterion, choosing positive NPV investments (POS NPV), is a function of public versus private employment (PUBLIC).

The knowledge of NPV criterion control variables are holding a college business degree or not (BUS DEGR), level of education in decision making under risk (RISK EDUC), and level of risk taking experience (RISK EXPR). Differences in the level of college training, and training after college, in the use of NPV techniques are expected to influence

whether individuals use them as decision criteria. Individuals trained to use NPV criterion techniques including NPV, IRR, present value index, cost-benefit analysis, and/or cost-benefit ratio are expected to choose positive NPV investments over negative NPV investments more frequently than individuals that are not trained. Cost-benefit analysis is equivalent to NPV analysis and the cost-benefit ratio is equivalent to the present value index.

Private and public decision makers who obtain college business degrees are typically exposed to NPV techniques in several classes including, at a minimum, financial and managerial principles of accounting and introduction to finance. Governmental decision makers with degrees in public administration or education administration often have received exposure to cost-benefit analysis and the cost-benefit ratio approach, but the coverage of these topics is not universal. For example, a text on cost-benefit analysis (Thompson, 1980) and a public school finance text (Webb, McCarthy, and Thomas, 1988) explain and encourage the use of NPV techniques, but in a text and practical handbook issued by the Government Finance Officers Association (Robinson, 1991), cost-benefit analysis is only briefly discussed. Furthermore, it is described as having only limited value.

Assuming decision makers wish to use the NPV criterion, all other factors equal, it is less costly for individuals who are trained in the use of NPV techniques to use them than it is for individuals who have not been trained. The untrained individuals would be required to spend time learning the NPV techniques. Furthermore, it is less likely that individuals who are not trained will be aware of NPV techniques and/or will wish to use them.

The level of an individual's risk taking experience is also expected to influence whether or not NPV techniques are used. Managers that are extensively involved in investment decision making may seek out the best methods available and are more likely to attend seminars, read books and articles about investment methods, and ask other managers for advice. Consequently, individuals with higher levels of experience are expected to use the NPV criterion more frequently than individuals with relatively less risk taking experience.

The characteristics of subject control variables are personal risk preference (RISK PREF), years of work experience (YRS EXPR), age (AGE), and gender (GENDER). The personal risk preferences of decision makers may influence their tendency to use the NPV criterion. For example, a risk-averse individual may be more or less likely to use a NPV method than a risk-neutral individual. The direction of the relationship between risk preference and the use of NPV criterion is not predicted. The years of work experience and the age of individuals are likely to be highly correlated. It is possible that decision makers that have more years of experience and/or are older have had more time to learn about and adopt NPV techniques than their less experienced and/or younger counterparts. Conversely, it is possible that the less experienced and/or younger decision makers received training in NPV techniques in college and their more experienced and/or older counterparts did not receive NPV training in college. It is also possible that less experienced and/or younger people are more or less receptive to new ideas and methods than more experienced and/or older people. The direction of the relationship between years of experience and age and use of the NPV criterion is not predicted. Finally, it is possible that gender may have an impact on the decision criteria used. There is also no directional expectation for gender.

Experimental Methodology

A case was used to collect the data for this study. The case is included as an appendix to this paper. The case was administered to subjects by mail, with three additional cases which were for an unrelated experiment. The case is an at-work investment decision. An at-home, personal investment version of the case was mailed to the subjects in a second mailing. The results on the at-home version are very similar to those on the at-work version. Therefore, the at-home version results are not used.

A computing investment choice was used in the case because this type of decision is likely to be familiar and/or understandable to all of the subject groups. Subjects were endowed with a \$50,000 investment budget and were offered four \$25,000 investment alternatives. Their task was to choose the best two of the four available investments. Two of the investments have positive NPVs and two have negative NPVs. Selecting the two positive NPV investments is the only normatively correct decision.

The case was designed so that subjects' decision criteria could be inferred from their choices; subjects were asked to provide their criteria or reasons for accepting or rejecting each of the four projects. If subjects chose both positive NPV investments, they are assumed to have used NPV as their decision criterion. If subjects did not choose both positive NPV investments (one or both not positive NPV), they are assumed to have used a decision criterion other than NPV. This provided the dependent variable (POS NPV) for the logistic regression: 1 if positive NPV; 0 if not. Subjects' self reports were compared to their inferred decision choice criterion for consistency.

The experimental materials provided subjects with the following projections for each investment: NPV, cash flows for four years, payback period, expected return for the level of risk, and IRR. Payback period is a measure of how soon an investor recovers the original investment. Shorter payback periods are generally preferred over longer payback periods. The two investments with the fastest payback periods have negative NPVs. Risk level is a direct measure of how risky an investment is relative to the other investments under consideration. The majority of individuals is risk averse. Lower risk investments are generally preferred over higher risk investments. One of the two investments with the lowest risk level has a negative NPV. Even, consistent cash flows may be perceived as preferable to cash flows that vary from period to period. One of the two investments with relatively consistent cash flows has a negative NPV. IRR is a direct measure of the economic return on an investment. Higher rates of return are generally preferred over lower rates of return. Note that normatively correct usage of IRR dictates that only investments where IRR exceeds risk level are selected which would result in selection of the two positive NPV investments. One of the two investments with the highest projected return has a negative NPV. Therefore, selecting the two investments with the highest IRRs violates the NPV criterion.

Selecting the two investments with positive NPVs required subjects to accept the two longest payback periods, accept one of the two highest risk levels, accept a project with relatively uneven cash flows, and accept one of the two lowest IRRs. Subjects are free to use any investment criterion or strategy.

The subject groups listed in Table 5 were used. The use of these subject groups allows the separation of public versus private environment effects from effects attributed to college education in the use of NPV criterion techniques. Public school principals and governmental accountants work in a public environment; business owners and managers and Certified Public Accountants (CPAs) work in a private environment. In the logistic regression, subjects are coded 1 if public and 0 if private (PUBLIC). This parameter estimate is expected to be negative. Non-business graduates are assumed to have no or limited academic NPV training. Business graduates are assumed to have academic NPV training. The subjects are coded 1 if they have business degrees and 0 if they do not (BUS DEGR). This parameter estimate is expected to be positive.

TABLE 5
Subject Groups Used

Sector	No Business Degree	Business Degree
Public	Principals	Governmental Accountants
Private	Business Owners /Managers	Certified Public Accountants and Business Owners/Managers

An exit questionnaire was used to obtain various information about the subjects. The questions are paraphrased in Table 6. Subjects' responses provided the data for the independent variables in the logistic regression equation. The coding or scaling procedure and the predicted sign is indicated for each of the variables. The exit questionnaire is included in the appendix.

Subjects' self report of their level of education and training in decision making under risk (RISK EDUC) includes any college training and any professional training the subjects have received. The correlation between the subjects' responses on this question and their responses on business degree or not (BUS DEGR) partially measures the validity of the

TABLE 6
Exit Questions Used in Logistic Regression

Independent Variable:	Exit questions relating to the subject:	Predicted Sign:
BUS DEGR	College degrees received and college course work, coded 1 if hold business degree and 0 if not.	Positive
RISK EDUC	Education and training in decision making under risk, scaled from 1 to 5, little or none to extensive. Includes college education.	Positive
RISK EXPR	Experience making decisions under risk, scaled from 1 to 5, little or none to extensive.	Positive
RISK PREF	Personal risk preference, scaled from 1 to 5, risk averse to risk seeker.	Not Predicted
YRS EXPR	Number of years of work experience.	Not Predicted
AGE	Subject's age.	Not Predicted
GENDER	Subject's gender, coded 1 if male and 0 if female.	Not Predicted

assumption that non-business graduates have no or limited academic NPV training, and business graduates have academic NPV training.

An effort was made to obtain relatively homogeneous subjects within groups. Public accountants and governmental accountants are accounting graduates from Central Washington University in Ellensburg, Washington. Public accountants are CPAs and are employed in public accounting firms in the state of Washington. Governmental accountants are revenue agents or auditors with the Washington State Department of Revenue or the Washington State Auditor's Office. Principals are Education Administration graduates from Central Washington University.

They are principals or vice principals in primary and secondary schools in the state of Washington. This approach provided subjects in each group with similar educational backgrounds. Continuing with the approach of selecting subjects from similar backgrounds, business people are owners and/or managers of small businesses in Ellensburg, Washington.

In the case, principals made decisions for their school, governmental accountants for their agency, business managers for their companies, and public accountants for their firms. A potential criticism of this decision task is that it may not have been as familiar to principals and governmental accountants as it was to business owners and managers. The use of CPAs may have helped to reduce the impact of this potential problem. CPAs have college training and are in a private market, but they may also have limited experience with the task. Future research may use more familiar tasks, such as staffing decisions, which are made by all of these subject groups.

Principals are in a position to make some investment decisions for their schools, but more typically they make requests and recommendations for expenditures to school superintendents and school boards. Because principals are involved in the investment process, it would be to their and their students' benefit if they understood cost-benefit analysis or other DCF techniques. They would then be able to justify requests and support their recommendations using normative economic decision criteria. State auditors review the activities and make recommendations for improvement in the policies, including those relating to investment, of the agencies they audit. Revenue examiners and auditors also may make recommendations for expenditures within their organizations. CPAs make recommendations to their clients regarding client investment decisions and may train client personnel in capital budgeting techniques. They also may make investment decisions, or may request or make recommendations on investment decisions within their firm. Small business owners and managers, of course, make investment decisions.

Chi-Square Tests

Chi-square comparisons were done of (a) the proportion of public subjects to the proportion of private subjects choosing the positive NPV

investments, and (b) the proportion of no business degree subjects to the proportion of business degree subjects choosing the positive NPV investments. These tests essentially duplicate the logistic regression test. Because this study uses four distinct subject groups, the results by subject group and the results of χ^2 chi-square tests among the groups are also reported. This provides a simple presentation and comparison of the data by group.

RESULTS AND DISCUSSION

Table 7 presents a summary of the selection criteria exhibited by subjects' choices on the case. Twenty percent of the public subjects chose the investments that maximize NPV. Both of their choices had a positive NPV. A higher percentage of the private subjects, 46 percent, selected both positive NPV investments. This is consistent with the hypothesis that public sector managers are less likely to use the NPV criterion than private sector managers.

Table 8 presents the percentages or means and standard deviations, for the variables included in the logistic regression and in the regression

TABLE 7
Subjects' Selection Criterion Summary of Results (N = 129)
(In Percentage)

	Public (N = 61)	Private (N = 68)
Payback Period	18.0	10.0
Risk Level	8.0	0
Consistent Cash Flows	20.0	15.0
Highest IRRs	31.0	25.0
Other	<u>3.0</u>	<u>4.0</u>
Total Not NPV	80.0	54.0
Positive NPVs	<u>20.0</u>	<u>46.0</u>
Total	100.0	100.0

TABLE 8
Descriptive Statistics

Variables in Logistic Regression Model: (POS NPV is the dependent variable)		Percentage or Mean ^a	Standard Deviation
POS NPV	Chose Both Positive NPV Investments (Yes = 1; No = 0)	33.1%	
PUBLIC	Public versus Private (Public = 1 ; Private = 0)	47.1%	
BUS DEGR	Business Degree - College (Yes = 1 ; No = 0)	66.9%	
RISK EDUC	Risk Education - Self-report ^b (Little or None = 1 to Extensive 5)	2.331	1.136
RISK EXPR	Risk Taking Experience - Self (Little or None = 1 to Extensive 5)	3.248	1.113
RISK PREF	Personal Risk Preference - Self (Risk Averse =1 to Risk Seeker 5)	2.793	.939
YRS EXPR	Years of Work Experience	12.223	8.868
AGE	Subject's Age	38.843	8.803
GENDER	Subject's Gender (Male = 1; Female = 0)	69.4%	

^a Percentage or mean is presented as appropriate.

^b This includes education in decision making under risk included in college business degrees. n = 121

models. According to the responses, 33 percent of the subjects chose both positive NPV investments, 47 percent of the subjects are public managers, and 67 percent of the subjects have college business degrees.

Table 9 presents the correlation coefficients comparing the logistic regression variables. The selection of both positive NPV investments (POS NPV) is negatively correlated with employment in government, -.276. This result is also consistent with the hypothesis.

Results Through Logistic Regression

Table 10 presents the logistic regression results. The model chi-square is 20.108 and the model is significant at the .01 level.

TABLE 9
Correlation Coefficients - Logistic Regression Model

	PUB LIC	BUS DEGR	RISK EDUC	RISK EXPR	RISK PREF	YRS EXPR	AGE	GEN DER
POS NPV	-.276 ^a	.083	-.035	-.046	-.089	.078	-.106	.123
PUB LIC		-.111	-.115	-.301 ^a	-.039	-.406 ^a	-.061	-.128
BUS DEGR			.485 ^a	-.017	-.230 ^b	-.096	-.405 ^a	-.161 ^c
RISK EDUC				.291 ^a	-.045	.033	-.232 ^a	-.155 ^c
RISK EXPR					.289 ^a	.466 ^a	.317 ^a	.165 ^c
RISK PREF						.088	.128	.141
YRS EXPR							.645 ^a	.273 ^a
AGE								.283 ^a

See Table 8 for descriptions of the variables.

p-values are indicated by a = .01; b = .05; and c = .10.

Government versus private environment (PUBLIC) is significant at the .006 level. The parameter estimate is negative, as predicted. A significantly lower percentage of the subjects in the public sector used NPV as their decision making criterion as compared to private subjects. This result supports the hypothesis that public sector managers are less likely to use the NPV criterion than private sector managers.

None of the other independent variables are significant at the .05 level. It is particularly interesting that possessing a college business degree (BUS DEGR) did not have a significant effect on the use of NPV. Apparently, for these subjects, college business education is not a significant factor in determining whether or not individuals use NPV as their decision criterion. The same result is found for self-reported Table 10, with business degree (BUS DEGR) (correlation coefficient = .485). This supports the validity of the assumption that subjects with business degrees are trained in the use of the NPV criterion; likewise, those without business degrees are not. In the logistic regression model, only public versus private is a significant predictor of whether or not an individual will select positive NPV investments.

The p-value for age is .101. The parameter estimate is negative. This indicates that older subjects may be less likely to use the NPV

TABLE 10
Logistic Regression for Predicting Selection of
Positive Net Present Value Investments

	Parameter Estimate	Standard Error	Wald Statistic	p-value ⁽¹⁾	Predicted Sign
PUBLIC	-1.208	.484	6.239	.006	Negative
BUS DEGR	.310	.562	.305	.290	Positive
RISK EDUC ⁽²⁾	-.206	.220	.871	.175	Positive
RISK EXPR	-.258	.236	1.196	.137	Positive
RISK PREF)	-.152	.237	.415	.520	None
YRS EXPR	.044	.039	1.285	.257	None
AGE	-.066	.040	2.687	.101	None
GENDER	.736	.496	2.203	.137	None
Intercept	2.817	1.556	3.276	.070	
Model Chi-square = 20.108					
p-value = .010					

Notes: See Table 8 for descriptions of the variables.

Dependent Variable: POS NPV, chosen both positive net present value investments (Yes = 1; No = 0)

Independent variables:

Public (Yes = 1; No = 2); Business degree (Yes = 1; No = 2);

Risk education (Low = 1; High = 5); Risk experience (Low = 1;

High = 5); Risk preference (A = 1; S = 5); Gender (Male = 1; Female = 0).

1. One-tail or two-tail test as appropriate.

2. This includes education in decision making under risk included in college business degrees. n = 125

criterion than their younger counterparts. It is interesting that years of work experience does not attain significance although age and work experience have a correlation coefficient of .645.

Results Through Chi-square Tests

Table 11 presents chi-square comparisons of (a) the proportion of public subjects to the proportion of private subjects choosing the positive

NPV investments and (b) the proportion of non-business degreed subjects to the proportion of business degreed subjects choosing the positive NPV investments. These tests essentially duplicate the logistic regression test. Twenty percent of the public subjects selected both positive NPV investments as compared to 46 percent of the private subjects. This difference is significant at $p = .002$. Twenty-six percent of the non-business degreed subjects selected both positive NPV investments as compared to 37 percent of the business degreed subjects. This difference is not significant ($p = .23$).

Table 11 also presents a summary of subject's responses by subject group and the results of chi-square tests between the groups. Only 13 percent of the public, no business degree subjects (Principals) selected both positive NPV investments as compared to 42 percent of the private, no business degree subjects (Business/No Business Degree). This

TABLE 11
Between Group Comparisons - Chi-square Results (N = 129)

Panel A: Analysis by Public or Private and by Business Degree or Not

Net Present Value	<u>Public</u>		<u>Private</u>		<u>No Business Degree</u>		<u>Business Degree</u>	
	Total	%	Total	%	Total	%	Total	%
Not Positive	49	80.3	37	54.4	31	73.8	55	63.7
Positive	<u>12</u>	<u>19.7</u>	<u>31</u>	<u>45.6</u>	<u>11</u>	<u>26.2</u>	<u>32</u>	<u>36.8</u>
Total	61	100.0	68	100.0	42	100.0	87	100.0

	<u>Public</u>	<u>No Business Degree</u>
Private		
- Chi Square	9.719	
- P-Value	.002	
Business Degree		
- Chi Square		1.430
- P-Value		.232

TABLE 11 (Continued)

Panel B: Analysis by Subject Group

Net Present Value	<u>Principals</u>		<u>Government Accountants</u>		<u>Business No Business Degree</u>		<u>CPAs/Business with Business Degree</u>		<u>Total</u>	
	Total	%	Total	%	Total	%	Total	%	Total	%
Not Positive	20	87.0	29	76.3	11	57.9	26	53.1	86	66.7
Positive	<u>3</u>	<u>13.0</u>	<u>9</u>	<u>23.7</u>	<u>8</u>	<u>42.1</u>	<u>23</u>	<u>46.9</u>	<u>43</u>	<u>33.3</u>
Total	23	100.0	38	100.0	19	100.0	49	100.0	129	100.0

	<u>Principals</u>	<u>Government Accountants</u>	<u>No Business Degree</u>
Government Accountants			
- Chi Square		1.027	
- P-Value		.311	
No Business Degree			
- Chi Square		4.546	2.054
- P-Value		.033	.152
CPAs/Business with Business Degree			
- Chi Square		7.795	4.977
- P-Value		.005	.026

difference is significant at $p = .033$. Twenty four percent of the public, business degree subjects (Governmental Accountants) selected both positive NPV investments as compared to 47 percent of the private, business degree subjects (CPAs and Business with Business Degree). This difference is significant at $p = .026$. Public versus private showed an effect on the selection of positive NPV investments with and without college business degrees.

Only 24 percent of the business degree subjects in the public environment (Governmental Accountants) selected both positive NPV investments as compared to 13 percent of the no business degree subjects in the public environment (Principals). This difference is not significant ($p = .311$). Forty-seven percent of the business degree subjects in the

private environment (CPAs and Business with Business Degree) selected both positive NPV investments as compared to 42 percent of the no business degree subjects in the private environment (Business - No Business Degree). This difference is also not significant ($p = .720$). The absence or presence of a business degree showed no significant effect on the selection of positive NPV investments in both the public and private environments. Forty-two percent of the private, no business degree group (Business - No Business Degree) selected both positive NPV investments as compared to only 24 percent of the public, business degree subjects (Governmental Accountants). This difference is not statistically significant, however ($p = .152$).

Comparison of Results with Previous Survey Studies

Only 20 percent of the public subjects chose investments that maximized NPV. Forty-six percent of the private subjects selected both positive NPV investments. These sample results provide evidence that the NPV criterion may be used less in actual decisions than the survey results discussed earlier imply. Most companies surveyed reported that they use NPV and/or IRR, and the majority reported that one or both of these NPV criterion methods were a primary criterion. Forty-four percent of governmental managers reported an NPV criterion method as a primary criterion, and 38 percent reported an NPV criterion method as a secondary criterion (Table 4). It may be that other criteria dominated NPV for many of these subjects in both public and private environments.

SUMMARY AND CONCLUSION

This study provides evidence that a relatively lower proportion of public managers utilize the NPV criterion than private managers. Twenty percent of public managers and 46 percent of private managers made decisions consistent with the NPV criterion. The difference between these groups is significant at $p = .01$. This study controlled for subjects' knowledge about the NPV criterion and for a variety of individual characteristics of subjects.

Control variables that measured subjects' knowledge level were holding a business degree or not, a self report of risk education in general, and a self report of risk experience. None of these variables is

significant in logistic regression results. The finding that education in the use of the NPV criterion does not have a significant effect on the use of the NPV criterion in either the public sector or the private sector was not expected. The expectation was that knowledge about the NPV criterion would significantly increase the use of the criterion.

The individual characteristics control variables were risk experience, risk preference, years of work experience, age, and gender. None of these variables is significant in logistic regression results. It is interesting that experience, in general, did not lead to increased use of the NPV criterion. There is limited evidence that a lower proportion of older individuals may use the NPV criterion as compared to younger individuals ($p = .10$).

The proportion of subjects that made investment choices that were consistent with the NPV criterion in the study were lower than the proportion that survey studies have indicated use the NPV criterion. This was true for both public and private subject groups.

One possible interpretation of these results -- a relatively lower proportion of public managers utilize the NPV criterion than private managers, and none of the control variables achieved significance -- is that there is more market discipline in the private sector than in the public sector. The availability of capital in the private sector is more dependent on the efficiency of the entity than in the public sector. This discipline may have resulted in a higher level of usage of the NPV criterion in the private sector. Two competing possible explanations for why the NPV criterion was used less in the public sector are that the estimation and quantification of benefits and costs is more difficult in the public sector than in the private sector, and investments in the public sector are the result of a political process, not an economic process. These three explanations are not mutually exclusive because any or all of them may explain the results. The study design does not allow for separation of these possible explanations.

NOTES

1. In a telephone conversation, Robert Kee indicated that apparently some government managers use discounted values and some use unadjusted values in calculating the benefit-cost ratio. He did not

know what proportion of the subjects in this study used each definition. Kee, Robbins and Apostolou were unaware of this dual definition when they designed the survey instrument.

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APPENDIX

Note: The italicized print identifies the case and indicates how the responses were categorized. The italicized print was not printed on the set given to subjects.

Present Value Criterion - At-Work Investment Case

Please assume that your firm (company, agency, or school) has \$50,000 available for investment in computing equipment, computing programs and staff-training projects. You are responsible for evaluating competing projects and deciding which to invest in. You have four different projects to choose from. All would be beneficial, but each requires a \$25,000 investment, so you will select only the best two.

You have quantified the benefits from each of the projects. The projected income and cash flows (net benefit), payback period, risk level, internal rate of return, and net present value, for each project, are presented on the following page. Note that the investments will be made on January 1, Year 1; all have four year lives; and the total profit (net benefit) on each is \$5,000. Assume that you have made all of the estimates personally or they have been made by experts whose judgments you trust.

Please indicate which two projects you prefer and what criteria you used to make your decisions by answering the questions on the attached response sheet.

The following definitions may be helpful:

- Payback period is the number of years required to recoup the \$25,000 investment in the project.
- Return expected for a project's risk level is the return that is normally earned on investments with similar levels of risk.
- Internal rate of return is the yield of the project over its life. Also referred to as time-adjusted rate of return.
- Net present value is the difference between the present values of the cash inflows and cash outflows from the project discounted at the risk level of the project.

PROJECTED DATA SHEET

Investment	Start	Year 1	Year 2	Year 3	Year 4	Total
PROJECT #1	(25,000)					(\$25,000)
Net income and cash flow		10,000	13,750	3,750	2,500	30,000
Total investment	(25,000)	10,000	13,750	3,750	2,500	5,000
PROJECT #2	(25,000)					(25,000)
Net income and cash flow		11,250	6,250	6,250	6,250	30,000
Total investment	(25,000)	11,250	6,250	6,250	6,250	5,000
PROJECT #3	(25,000)					(25,000)
Net income and cash flow		17,500	6,750	250	5,500	30,000
Total investment	(25,000)	17,500	6,750	250	5,500	5,000
PROJECT #4	(25,000)					(25,000)
Net income and cash flow		0	21,750	8,250	0	30,000
Total investment	(25,000)	0	21,750	8,250	0	5,000

Project	Payback Period	Risk Level	Internal Rate Return	Net Present Value at a discount rate of			
				11. %	8%	10%	9%
Project #1	2.3 years	11.0%	10.0%	\$442			
Project #2	3.2 years	10.0%	8.7%		\$330		
Project #3	3.1 years	10.0%	11.1%			\$432	
Project #4	2.4 years	9.0%	8.4%				\$323

RESPONSE SHEET

Please indicate which two projects you accept and which two you reject.

INVESTMENT PROJECT #1 Accept ___ Reject ___

Please give your criteria or reasons for accepting or rejecting:

INVESTMENT PROJECT #2 Accept ___ Reject ___

Please give your criteria or reasons for accepting or rejecting:

INVESTMENT PROJECT #3 Accept ___ Reject ___

Please give your criteria or reasons for accepting or rejecting:

INVESTMENT PROJECT #4 Accept ___ Reject ___

Please give your criteria or reasons for accepting or rejecting:

<i>Summary of Projects</i>						
#	<i>Payback</i>	<i>Risk Level</i>	<i>IRR</i>	<i>NPV</i>	<i>Selection Criteria:</i>	
1	2.3 Yrs	11.0%	10.0%	(\$442)	<i>Payback (Fastest)</i>	1, 4
2	3.2 Yrs	8.0%	8.7%	\$330	<i>Risk Level (Lowest)</i>	2, 4
3	3.1 Yrs	10.0%	11.1%	\$432	<i>Consistent Cfs</i>	1, 2
4	2.4 Yrs	9.0%	8.4%	(\$323)	<i>Highest IRRs</i>	1, 3
					<i>Positive NPVs</i>	2, 3
					<i>Mixed</i>	3, 4

EXIT QUESTIONNAIRE

The following questions relate to the cases. Your responses will be very helpful in analyzing the results of the experiment. Any comments and suggestions which you would like to offer will be appreciated. Please circle the number which best reflects your impressions.

- How would you describe the dollar amounts in the case?
Small Amount 1 2 3 4 5 Large Amount
- How would you describe the amount of information supplied in the case?
Not Adequate 1 2 3 4 5 Very Adequate
- How confident are you about your decisions in the case?
Not Confident 1 2 3 4 5 Very Confident
- How realistic and representative, of the types of decisions that individuals or professionals make, is the task in the case?
Not Realistic 1 2 3 4 5 Very Realistic
- How much experience do you have in making decisions under risk?
Little or None 1 2 3 4 5 Extensive
- How much education or classroom and seminar training do you have in making decisions under risk? Specifically: risk-return, expected values or utilities, present-values, probabilities, and risk evaluation and assessment.
Little or None 1 2 3 4 5 Extensive
- How would you describe your personal attitude toward risk, your risk preference?
Risk Averse 1 2 3 4 5 Risk Seeker

8. How many years of accounting (business, education, administration) work experience do you have? _____ years
9. What is your level in your firm (company, agency, school)? _____
10. How large is your firm?
Big 6 __ Regional __ Local __ (company, agency, school)
11. Please indicate your age. _____ years
12. Please indicate your gender. 1 - Male 2 - Female
13. Please list your college degrees and course work you have done:
School Major Dates
14. Approximately how much time did you spend completing the cases and the questionnaire? _____ minutes

Thank you, again. Your time and effort is greatly appreciated.