

Understanding Financial Management: A Practical Guide

Guideline Answers to the Concept Check Questions

Chapter 8 Capital Budgeting

Concept Check 8.1

1. **What is the difference between independent and mutually exclusive projects?**

An *independent project* is one in which accepting or rejecting one project does not affect the acceptance or rejection of other projects under consideration. Therefore, no relationship exists between the cash flows of one project and another. A *mutually exclusive project* is one in which the acceptance of one precludes the acceptance of other projects.

2. **How do the results of the NPV technique relate to the goal of maximizing shareholder wealth?**

The NPV technique measures the present value of the future cash flows that a project will produce. A positive NPV means that the investment should increase the value of the firm and lead to maximizing shareholder wealth. A positive NPV project provides a return that is more than enough to compensate for the required return on the investment. Thus, using NPV as a guideline for capital investment decisions is consistent with the goal of creating wealth.

Concept Check 8.2

1. **What is the typical discount rate used with the NPV technique when project risk is the same as firm risk? Why?**

If project risk is identical to firm risk, the firm's weighted average cost of capital (WACC) is the appropriate discount rate. A firm's WACC represents the required rate of return on projects of average or normal risk for a firm. Analysts should use the same rate to discount when project risk and firm risk are equivalent.

2. **In theory, why is NPV the most appropriate technique for making capital budgeting decisions?**

The NPV method is theoretically the most appropriate method for making capital budgeting decisions because it measures wealth creation, which is the assumed goal of

financial management. NPV is an absolute measure of a project's profitability and indicates the expected change in owners' wealth from a capital investment. As an evaluation technique, NPV considers all expected future cash flows, the time value of money, and the risk of the future cash flows. Thus, NPV can help identify projects that maximize shareholder wealth.

3. **If a firm selects a project with an NPV of \$75,000, what impact should this decision have on shareholder wealth?**

If the estimated cash flows and discount rate are accurate, this project should increase shareholder wealth by \$75,000.

4. **If a project's NPV is positive, what does this suggest about the required versus estimated return on the project? What does this suggest about accepting the project?**

A positive NPV suggests that the estimated return on the project is greater than the required return for the project. The NPV decision rule is to accept a project whose NPV is greater than zero because this investment should increase shareholder wealth.

5. **If a project's NPV is negative, what does this suggest about the desirability of the project? Why?**

When a project has a negative NPV, the firm should reject the project. A negative NPV means that the investment should decrease the value of the firm because the estimated return is less than the required return.

6. **How does the reinvestment rate assumption of the NPV method differ from IRR? Which reinvestment assumption is generally considered to be more realistic? Why?**

Mathematically, the implied assumption of the NPV method is that the firm can reinvest any intermediate cash inflows generated by the investment at the firm's required rate of return (cost of capital). *Intermediate cash inflows* are those cash inflows received before the termination of a project. The implied assumption of the IRR method is that the firm can reinvest any intermediate cash flows at the project's IRR over its useful life. Projects may have more than one IRR, which complicates determining the appropriate reinvestment rate assumption using IRR. The IRR and firm's required rate of return often differ. Investment opportunities available elsewhere determine the required return. Thus, the NPV often relies on a more reasonable implied assumption than does the IRR.

A conceptual difficulty arises from focusing on mathematics to infer the reinvestment rate assumption. In practice, the reinvestment rate depends on the economic opportunities available to the firm. Suppose that a firm has an abundance of profitable investment opportunities available. In this situation, assuming that the firm can reinvest cash flows at a rate equal to the IRR may be reasonable. For other firms lacking an abundance of profitable investment opportunities, a more realistic assumption is that the firm can reinvest cash flows at a rate equal to the cost of capital. Knowing reinvestment rates is important especially when comparing mutually exclusive investments.

Concept Check 8.3

1. **What is the meaning of the profitability index?**

The *profitability index* (PI) is the ratio of the present value of future expected cash flows subsequent to initial investment divided by the amount of the initial investment. This measure shows the relative profitability of any investment by showing the ratio of the benefit from an investment (the present value of cash inflows) to the cost (the present value of cash outflows). Thus, the PI indicates the value for each dollar invested.

2. **Why does the profitability index fail to consider total wealth creation?**

Like the NPV method, the profitability index (PI) considers all cash flows, the timing of cash flows, and the riskiness of cash flows. However, the PI fails to consider total wealth creation because of the way PI is calculated. PI is a ratio and relative amount. By contrast, the NPV represents as a difference and is an absolute amount. Thus, PI does not indicate the total amount of wealth creation, but NPV does. In addition, projects having identical NPVs may have different PIs. In ranking mutually exclusive projects, the PI and NPV may lead to different rankings. As a ratio, the PI ignores differences in scale or size differences but the NPV does not.

3. **Why would a decision maker use the profitability index?**

A decision maker would use the PI for a project's margin of error and risk indicator. When a firm can undertake all independent and profitable projects, using the PI will lead to the same decision as the NPV. However, if the projects are mutually exclusive and have different scales, the decision maker should not use the PI. In some situations in which a firm faces *capital rationing* (a limitation on the size of the capital budget), a decision maker can use the PI as a way to select projects. For example, suppose a company has the following three projects and limits its capital budget to \$50,000.

Project	PV of Inflows	PV of Outflows (Investment)	NPV	PI
A	\$40,000	\$25,000	\$15,000	1.6
B	37,500	25,000	12,500	1.5
C	70,000	50,000	20,000	1.4

Based on the NPV, the firm should choose Project C with an NPV of \$20,000. Using the PI, the firm should select Projects A and B with a combined NPV of \$27,500. In this situation, the firm gets a greater dollar return using PI compared with NPV (\$27,500 versus \$20,000, respectively) for the \$50,000 invested.

4. **What is the relationship between PI and NPV?**

The PI and NPV approach use identical inputs but differ in their calculation. The PI is a ratio and the NPV is a difference. A project with a PI greater than 1 has a positive NPV and enhances the wealth of the owners. If a project's PI is less than 1, the present value of the costs exceeds the present value of the benefits, so the NPV is negative. If a project's PI equals 1, its NPV = 0, and the decision maker should be indifferent between

accepting and rejecting because the investment returns a dollar in present value for every dollar invested. Therefore, a direct relationship exists between the PI and the NPV.

5. **Is the higher PI of two projects always superior? Under what circumstances can this be misleading?**

For mutually exclusive projects with different scales, selecting the project with the higher PI is not always superior to the one with the lower PI because doing so may not lead to making the best decision in terms of shareholders wealth. This is because a conflict in ranking might occur between NPV and PI. For example, suppose that a firm does not face capital rationing and is considering two mutually exclusive projects, X and Y.

Project	PV of Inflows	PV of Outflows (Investment)	NPV	PI
X	\$100,000	\$80,000	\$20,000	1.25
Y	50,000	35,000	15,000	1.43

Based on the PI, the firm should choose Project Y over Project X because Project Y's PI of 1.43 exceeds Project X's PI of 1.25. Using the NPV method, however, Project X compared with Project Y contributes more value to the firm, \$20,000 versus \$15,000. Scale differences explain the difference in ranking between Project X and Y. Thus, the project with the higher PI is not always the superior choice.

Concept Check 8.4

1. **What does the IRR measure?**

The IRR measures a project's yield or expected rate of return. This return does not depend on anything except the cash flows of the project. Thus, the IRR provides a single number summarizing the merits of a project. Mathematically, the IRR is that rate of return (discount rate) that makes the present value of all expected future cash flows equal to zero. That is, the IRR is the discount rate that causes a project's NPV to equal zero.

2. **Why may using the IRR method as a decision criterion not lead to maximizing shareholder wealth? What factors can lead to misleading results when comparing the IRR with the NPV?**

If projects are independent and are not subject to capital rationing, using the IRR method in evaluating projects indicates the ones that maximize shareholder wealth. However, using the IRR method as a decision criterion may sometimes lead to selecting projects that do not maximize wealth if the projects are mutually exclusive or capital rationing exists. When evaluating mutually exclusive projects, the IRR may indicate a different decision than the NPV because of the reinvestment rate assumption. The IRR implicitly assumes reinvestment of all intermediate cash inflows at the IRR, whereas the NPV implicitly assumes reinvestment of all intermediate cash inflows at the cost of capital. This reinvestment rate assumption may lead to different decisions in selecting among mutually exclusive projects when any of the following factors apply: (1) differences in timing of cash flows among the projects, (2) differences in scale, and (3) differences in

the useful lives of the projects.

3. **Under what conditions can a project have more than one IRR?**

The typical capital budgeting project has a negative cash flow initially followed by a series of positive cash flows. Under this conventional cash flow pattern, there can only be a single, unique IRR. A project can have zero or more than one IRR if it has a non-conventional cash flow pattern, meaning that the cash flows change between negative and positive more than once. For example, a cash flow pattern of - + - - would have two sign changes (from minus to plus and from plus to minus). In this situation, there are two possible IRRs, one for each sign change. There are at most as many IRRs as there are sign changes.

4. **What reinvestment rate assumption does IRR implicitly make?**

The IRR method implicitly assumes reinvestment of all intermediate cash inflows at the IRR. This does not mean, however, that the firm can actually reinvest such cash inflows at the IRR. This assumption may not be realistic especially for projects in which the IRR is considerably higher than the firm's cost of capital.

Concept Check 8.5

1. **Why is the MIRR an improved measure of relative profitability compared with the IRR?**

The MIRR is an improved measure of a project's true profitability because it modifies the reinvestment rate assumption of IRR to provide a single and more realistic reinvestment rate. The MIRR all avoids the multiple-IRR problem that may result from non-conventional cash flows by using a single reinvestment rate. However, the MIRR has received limited acceptance in practice because of its failure to resolve the issue of conflicting rankings and theoretical inferiority to the NPV.

2. **What is the typical reinvestment rate used in calculating the MIRR? Why?**

The MIRR procedure generally uses the company's cost of capital as the assumed reinvestment rate and financing rate. The rationale for using the cost of capital as the reinvestment rate is that it provides a conservative estimate of the IRR. That is, a firm may not earn its IRR on other investments, but it should earn returns at least equal to its cost of capital. When a firm cannot generate projects that have returns greater than its cost of capital, it should not invest them and potentially return funds to the suppliers of capital.

3. **What advantages does the MIRR have over the IRR when making capital budgeting decisions?**

The MIRR method provides a reinvestment rate assumption that is generally more conservative and realistic than the IRR technique. Thus, MIRR provides a better indicator of a project's true profitability or rate of return. In addition, the MIRR avoids the

multiple-IRR problem. Both the MIRR and IRR may not give value-maximizing decisions when used to compare mutually exclusive projects and to choose projects under capital rationing.

Concept Check 8.6

1. **What supplementary information does the payback period provide beyond discounted cash flow techniques such as NPV or IRR?**

The payback period provides information about the amount of time that a firm needs to recover its initial investment in a capital budgeting proposal. The payback period provides a type of break-even measure. Such information may be important in a case where economic situations change and the firm may have to abandon a project. The payback period also serves as a crude measure of liquidity and project risk.

2. **If a project has a payback period of 3.5 years, what does this mean?**

A payback of 3.5 years means that the firm needs 3.5 years to obtain enough net cash inflows to cover its initial investment outlay. Thus, the firm recovers its initial investment in 3.5 years.

3. **What decision rule applies when using the payback period to evaluate independent and mutually exclusive projects?**

The payback method uses an arbitrary cutoff date or maximum payback period as the measure of determining whether a project is acceptable. Generally, shorter payback periods are better than longer ones. For independent projects, the decision rule is to accept all projects with a payback period less than or equal to cutoff period specified by a decision maker. If projects are mutually exclusive, the decision rule is to accept the project with the shortest payback period only when the payback period is less than or equal to the maximum payback period.

4. **Why do some decision makers use the payback period to evaluate projects?**

Several factors explain the persistence of the payback method. Decision makers choose the payback period to evaluate projects because it is intuitive, simple to compute, and easy to understand. In some instances, managers may be unfamiliar with sophisticated techniques so they rely on the payback. The payback period provides some information on the risk of the investment because near cash flows are generally less risky than distant cash flows. Finally, the payback period provides a crude measure of liquidity.

5. **What are the disadvantages of the payback method as a capital budgeting technique?**

The payback period provides no well-defined decision criteria to indicate whether an investment increases the firm's value. Instead, decision making rests on an arbitrary standard for the payback period. Thus, no connection exists between an investment's payback period and its profitability. The payback method does not consider all cash

flows because it ignores cash flows occurring after the payback period. Therefore, the payback method may result in a bias towards accepting short-term projects and rejecting long-term investments. The payback method ignores the timing of cash flows within the payback period. Finally, the payback method ignores the riskiness of future cash flows.

Concept Check 8.7

1. **If a project has a discounted payback of 4.0 years, what does this mean?**

A discounted payback of 4.0 years means that a firm needs 4.0 years for the estimated, discounted future cash flows of a project to equal its initial investment.

2. **What major advantage does the discounted payback have over the regular payback period?**

The major advantage of the discounted payback over the regular payback period is that the discounted payback calculates the length of time required to recover the initial investment from the present value of the expected future cash flows. Unlike the regular payback, the discounted payback period considers the time value of money during the payback period. The discounted payback method, however, ignores all the cash flows after that date. Although the discounted payback period provides a better measure of recouping the initial investment when compared to the standard payback method, it provides a poor compromise between payback and NPV.

3. **Can a project be acceptable based on the discounted payback period but be unacceptable using the NPV method? Why or why not?**

No. If a project is acceptable using the discounted payback method, it will also be acceptable using the NPV method. The discounted payback period measures a time-specific break-even point. The discounted net cash flow is greater than zero causing the entire project to have a positive NPV.

4. **Under what conditions will the discounted payback method result in the same accept/reject decisions as the NPV?**

The *discounted payback period* represents the point in time at which the accumulated discounted cash flows equal the amount of the initial investment. As long as the cumulative discounted net cash flow is greater than zero by the end of a project's life, a discounted payback period exists. The firm should accept the project because it has a positive NPV. However, the discounted payback method is inconsistent with shareholder wealth maximization because the method ignores some cash flows that contribute to the present value of investment. That is, this method ignores those cash flows beyond what is necessary for the investment's discounted payback.

Concept Check 8.8

1. **What is the difference between an absolute and a relative measure of project attractiveness? Give an example of each.**

An absolute measure of project attractiveness, such as NPV, shows the total present value of dollar return to the firm. NPV calculations result in a dollar amount, which is the incremental value to shareholders' wealth. For example, a project might have a higher positive NPV due to a larger initial investment but a lower PI than another mutually exclusive project with a smaller initial investment. The absolute measure gives the correct rankings of mutually exclusive investment projects that will maximize the value of the firm.

A relative measure of project attractiveness provides a way of comparing capital investments relative to some base amount. The profitability index is a relative measure and shows the present value of return for each dollar of initial investment. Therefore, PI does not reflect differences in investment scale because it ignores the size of the project. For example, a project might have a higher PI because of a lower initial investment but a lower NPV when comparing two mutually exclusive projects.

2. **What is the relationship between NPV and PI? Under what circumstances do these techniques give the same accept-reject decision?**

NPV and PI use identical inputs to evaluate capital investments, but each technique combines the inputs differently. The NPV is a difference but the PI is a ratio. In addition, the NPV is an absolute measure of profitability but the PI is a relative measure. Assuming independent project with or without capital rationing, these methods result in identical accept-reject decisions. For example, accepting an investment whose NPV is greater than \$0 is consistent with accepting an investment having a PI greater than 1.0.

Potential conflicts between NPV and PI arise in ranking mutually exclusive projects requiring different investment amounts. This is a scale or size problem. Under such circumstances, the two methods may result in different accept-reject decisions. For example, one project may have a higher PI but a lower NPV compared with another with a lower PI but a higher NPV. This conflict in ranking results from the different amounts of investments. Thus, the investment having the higher PI does not necessarily increase the value of owners' wealth more than one with a lower PI. This is not the case for the project with a higher NPV. When evaluating mutually exclusive projects with or without capital rationing, NPV and PI do not always result in consistent rankings and may result in conflicting decisions.

3. **How does an increase in the firm's required rate of return affect a project's IRR and NPV?**

An increase in a firm's required rate of return (cost of capital) has no effect on a project's IRR because solving for the IRR does not require knowing the cost of capital. However, such an increase would result in a higher *hurdle rate* (the minimum acceptable rate of return), which could lead to rejecting a project. The decision rule for the IRR is to invest in a project if it provides a return greater than the cost of capital. Calculating the NPV requires knowing the cost of capital. An increase in the required rate of return lowers the

NPV. Thus, increasing the required rate of return could lead to rejecting a project based on its NPV. That is, the NPV could change from positive to negative with an increase in the cost of capital.

4. **What are the reinvestment rate assumptions of NPV, PI, IRR, and MIRR?**

When using the NPV, PI, and MIRR, the implied assumption is that the firm can reinvest any intermediate cash inflows generated by the investment at the firm's required rate of return (cost of capital). When using the IRR, the implied assumption is that the firm can reinvest funds at the IRR.

5. **What are the similarities and differences in decision rules when using NPV versus IRR?**

For independent projects with conventional cash flows and no capital rationing, the NPV and IRR generate the same accept-rejected decision. Thus, the decision rules are similar for investment projects. The decision rule for NPV is to accept the project if the NPV is positive and reject the project if the NPV is negative. The decision rule for IRR is to accept the project if the IRR equals or is greater than the required rate of return and reject the project if the IRR is less than the required rate of return. Technically, the firm should be indifferent between accepting and rejecting a project with an NPV equal to zero or an IRR equal to the cost of capital because such an investment would not change shareholder wealth. The cost of capital is the discount rate for the NPV and the hurdle rate for the IRR.

For mutually exclusive projects with no capital rationing, the decision rules are similar if no conflicts exist between the NPV and IRR methods. Under these conditions, the decision rule is to accept the project with the highest positive NPV or the highest IRR that is greater than the required rate of return. If conflicts exist when ranking mutually exclusive projects, the decision rules for NPV and IRR differ. If a conflict in ranking occurs, the decision rule is to accept the project with the highest positive NPV instead of the project with the highest IRR that is greater than the hurdle rate.

6. **Do discounted cash flow techniques give the same accept-reject decision when evaluating independent projects with conventional cash flows? Why or why not?**

When evaluating independent investment projects with conventional cash flows and assuming no capital rationing, the NPV, PI, IRR, and MIRR give identical accept-reject decisions. The discounted payback period may not provide the same accept-reject decision as these other discounted cash flow techniques because the basis of accepting or rejecting a project is maximum payback period set by management.

Concept Check 8.9

1. **What are three major reasons for conflicts in rankings among DCF-techniques for mutually exclusive projects?**

Conflicts in rankings especially between the NPV and IRR, of mutually exclusive projects are due largely to their differing assumptions about reinvestment of the cash inflows they

generate. These conflicts in the ranking of a given project by NPV and IRR also result from differences in the initial investment (size or scale), cash flow patterns, and life spans (unequal lives). Generally, the greater the difference among these factors, the greater is the likelihood of conflicting rankings.

2. **Given the following information, which mutually exclusive project is preferred when using the PI approach? Which project is preferred using the NPV approach? Which project should management accept? Why?**

	<u>Project A</u>	<u>Project B</u>
PV of net cash flows	\$70,000	\$130,000
Initial investment	50,000	100,000

Project A has a PI ratio of 1.4 ($\$70,000/\$50,000$), while Project B yields a PI ratio of 1.3 ($\$130,000/\$100,000$). Using the PI approach to evaluate these two mutually exclusive projects, Project A is better because it has a higher PI than Project B. Project A yields a NPV of \$20,000 ($\$70,000 - \$50,000$), while Project B yields a NPV of \$30,000 ($\$130,000 - \$100,000$). Using the NPV method, a firm should select Project B over Project A because it will add \$10,000 more in owners' wealth. Assuming no capital rationing, management should accept Project B because it maximizes shareholder wealth and adds the most value to the firm given only these two projects.

3. **What are the reinvestment rate assumptions of the NPV, PI, IRR, and MIRR methods?**

When using the NPV, PI, and MIRR, the implied assumption is that the firm can reinvest any intermediate cash inflows generated by the investment at the firm's required rate of return (cost of capital). When using the IRR, the implied assumption is that the firm can reinvest funds at the IRR. *Intermediate cash inflows* are those cash inflows received before the termination of a project.

4. **What does the term "crossover rate" mean? Why is this rate important in evaluating mutually exclusive projects?**

A *crossover rate* is the discount rate at which the NPV profiles of two projects intersect and produce identical NPVs. Knowing the crossover rate when analyzing mutually exclusive projects permits identifying discount rates that result in conflicting versus consistent rankings between NPV and IRR. If the discount rate is below the crossover rate, conflicts occur between the rankings of the NPV and IRR of mutually exclusive projects. If the discount rate is above the crossover rate, the NPV and IRR yield the same ranking and no conflict in the ranking occurs. Thus, the presence of conflicting rankings of mutually exclusive projects depends on the discount rate.

5. **Which DCF technique, NPV, PI, IRR or MIRR, is theoretically superior when evaluating mutually exclusive projects of differing size or differing cash flow patterns? Why?**

On a purely theoretical basis, the NPV method is the superior approach when evaluating mutually exclusive projects of differing size or differing cash flow patterns. There are several reasons for NPV being the preferred approach when evaluation capital investments. Of these four techniques, using NPV is the most consistent with achieving

the goal of wealth creation. This is because NPV measures the amount by which a capital investment creates wealth. In addition, using NPV implicitly assumes that the firm reinvests any intermediate cash inflows generated by an investment at its cost of capital. Using IRR implicitly assumes reinvesting intermediate cash inflows at the IRR. Compared with the IRR, the cost of capital tends to be a more conservative and realistic rate at which the firm can reinvest intermediate cash inflows. Finally, the NPV approach avoids potential problems that may cause a project with non-conventional cash flows to have zero or more than one IRR.

6. **What are two methods for evaluating mutually exclusive projects with unequal lives?**

Two procedures available for selecting among mutually exclusive projects with different useful lives are the replacement chain method and the equivalent annual annuity method. The *replacement chain method* strings together as many short-term projects as necessary until all projects have a common life. For example, comparing a 4-year project with an 8-year project would involve doubling the short project so that it will take the same amount of time as the long project. Thus, the two projects have a common life. The *equivalent annual annuity approach* assumes that the firm can repeat the projects forever. After converting the cash flows from each project into annuities, the analyst compares the annuities with each other.

7. **If two mutually exclusive projects with unequal lives have equal NPVs, which project will have the higher equivalent annual annuity? Why?**

If two projects have equal NPVs but unequal lives, the project with the shorter life will have a higher equivalent annual annuity (EAA) because the total NPV generated occurs over a shorter period. Therefore, the decision rule is to accept the project with higher EAA.

8. **How does the equivalent annual annuity (EAA) differ from the equivalent annual charge (EAC)?**

The EAA measures the cash inflows relative to the project's life, while the EAC measures the cash outflows over the project's life. The EAA involves projects with both costs and benefits (cash inflows and cash outflows), while the EAC involve cost-only projects. The decision rule is to accept the project with the highest EAA, and to accept the project with the lowest EAC.

9. **What are the decision rules for determining the optimal abandonment value of an asset?**

Firms abandon projects for various reasons such as a result of changing costs (cash outflows) and/or benefits (cash inflows) over a project's life. If a firm can realize some abandonment value upon terminating a project, the firm should abandon the project at the point that maximizes the NPV of all cash benefits, including abandonment value/salvage value. Another decision rule is to abandon a project when the abandonment value is greater than the present value of all cash flows beyond the abandonment year, discounted to the abandonment decision point. This rule is technically incorrect because it ignores future abandonment opportunities.

10. **How does a project's economic life differ from its physical life?**

A project's *economic life* is the length of time that the project will continue to produce cash inflows that outweigh its cash outflows. A project's *physical life* is the amount of time that a project will be in existence. A firm should continue with a project as long as it is contributing economic value to the firm, and not necessarily stick with a project until its physical life expires.

Concept Check 8.10

1. **What is the meaning of the term "capital rationing"?**

Firms often operate under certain constraints when it comes to making capital budgeting decisions. *Capital rationing* refers to a limit on the amount of spending on capital budgeting projects. This limit forces firms to choose among capital investments with positive NPVs.

2. **What are some common reasons for capital rationing within a firm?**

Capital rationing results from capital market conditions and management policy. Thus, capital rationing may result from either an externally or internally imposed constraint. Capital suppliers may refuse to provide capital beyond some specific amount. The imposition of constraints on a firm's ability to raise needed funds could result from loan or indenture provisions.

Managers may limit the size of the firm's capital budget for many reasons.

- Instead of funding all investments with positive NPVs, managers may use capital rationing to control the amount and direction of growth.
- Managers may use capital rationing to limit their reliance on external financing instead of funding all investments with positive NPVs.
- Managers may limit the capital budget as a means of controlling risk. For example, rapid growth and risk often go hand in hand.
- Management-imposed capital rationing serves as a surrogate method for dealing with non-monetary constraints such as scarce resources involving managers and others with specialized skills.
- Capital rationing creates competition for funds that may result in better investment proposals making their way through the capital budgeting system. Managers may be less likely to submit overly optimistic (biased) cash flow forecasts if they are aware that others in the organization hierarchy will vigorously challenge their assumptions and forecasts.

3. **How does capital rationing affect project selection?**

Capital rationing limits the total amount of capital investment for a period. This budget constraint increases the likelihood that the firm will select those projects providing the best strategic means of achieving the goal of creating wealth. Risk-averse managers

may impose capital rationing to avoid accepting low-NPV projects with high downside risk. This is especially important considering the difficulty in estimating the cost of capital.

4. **What is the preferred method for choosing among indivisible projects under capital constraints? Explain why.**

Under reasonable simplifying assumptions, the preferred method for choosing among indivisible projects is to accept a combination of projects that maximizes NPV within the budget constraint. This approach is preferred because NPV shows the net benefit realized by the firm from adopting selected capital budgeting projects.

Concept Check 8.11

1. **What are two reasons for the superiority of the NPV method in evaluating capital investment projects?**

The NPV method is the best approach in evaluating projects because it measures the amount by which a capital investment creates wealth. This is because the NPV is an absolute measure of a project's worth. In addition, NPV has a more realistic reinvestment rate assumption than IRR. It implicitly assumes reinvestment of intermediate cash inflows at the required rate of return. Both reasons supporting the superiority of the NPV method assume that managers invest the cash flows from the investment for the benefit of shareholders. In summary, no other capital budgeting technique does a better job of measuring wealth creation than the NPV method.

2. **Which capital budgeting techniques are increasing in popularity? Which are decreasing in popularity? Why?**

Survey results suggest an increased use of more sophisticated capital budgeting techniques. The use of discounted cash flow techniques, specifically NPV and IRR, has increased in popularity over time. Several reasons may explain increasing popularity of these methods such as the widespread use of personal computers with spreadsheet programs that reduce the knowledge and effort required to calculate discounted cash flow measures and increased familiarity of managers with these techniques. NPV has been the dominant method taught in business schools for many years and many financial managers hold business degrees, especially MBAs. The popularity of the IRR is mostly likely because it is a measure of yield and is easy to explain to people who do not have formal training in finance. Since financial managers often deal in yields, some may be slightly more comfortable dealing with the IRR than NPV. Methods declining in popularity include the use of the payback period, although still popular, and the accounting rate of return. The rationale for this decline in popularity likely results from several factors including their simplicity and failure to consider the time value of money. In addition, the accounting rate of return uses accounting income instead of the cash flows.

3. **Which capital budgeting methods do managers of large firms use the most? Why?**

Managers of large firms tend to use more than one technique to evaluate a project. The primary methods used are the IRR and NPV, but large firms continue to use the payback method as a secondary technique, despite its shortcomings. Managers use several methods to evaluate the acceptability of a project because each method provides useful information about a project.

4. **Why do small firms use DCF techniques less often than large firms do?**

Small firms tend to use DCF techniques less often than do large firms for several reasons. First, managers may prefer the simplicity of such methods as the payback method. Second, some top managers may lack familiarity with more sophisticated techniques. Third, small firms, especially severely capital-constrained firms, may place a high priority on recovering their investment in a short period. Unless an investment project provides a positive cash flow early in its life, the firm may go out of business before the expected future cash flows materialize. Fourth, small firms may have more unpredictable projects than do large companies. Fifth, some small firms may have goals other than creating wealth. Finally, the cost of developing and maintaining a sophisticated capital budgeting system may outweigh its benefits.