Chapter 9

Cash Flow and Capital Budgeting

Answers to Concept Review Questions

1. Why is it important for the financial analyst to (a) focus on incremental cash flows, (b) ignore financing costs, (c) consider taxes, and (d) adjust for non-cash expenses when estimating a project’s relevant cash flows?

   a. To properly evaluate the costs and benefits of a capital investment project, a manager must be able to identify the additional cash inflows and outflows that will result solely from acceptance of the project, so only these incremental CFs are important.

   b. An analyst should ignore financing costs for individual projects, and instead should use a single weighted average cost of capital for evaluating all capital investment projects that have the same risk as the firm’s other assets. Otherwise, the analysts will be entangling investment and capital structure (the mix of long-term debt and equity) decisions.

   c. Taxes influence the capital budgeting decision because they can change the net value of cash flows received or paid out that result from accepting a project. Taxes on cash inflows reduce the value of these receipts, while tax credits and deductions that result from accepting a project increase its attractiveness.

   d. Non-cash expenses are important if these reduce the taxes that must be paid on incremental cash inflows. The most important non-cash expense for most firms is depreciation, and this deduction works to reduce the tax liabilities of profitable firms.

2. Why do we consider changes in net working capital associated with a project to be cash inflows or outflows rather than the absolute level of working capital?

Changes in net working capital are important. The company starts out with a certain amount of working capital – since it already has this, it is not relevant to the cash flow equation. If it needs to change the amount of working capital that it has, then that change is relevant.

3. For what kinds of investments would terminal value account for a substantial fraction of the total project NPV, and for what kinds of investments would terminal value be relatively unimportant?

   The higher the growth rate of cash flows, the higher the terminal value of the project. A project where cash flows level off in time will have a much smaller terminal value.

4. What is meant by a potential investment’s relevant cash flows? What are sunk costs and cannibalization, and do they affect the process of determining a proposed investment’s incremental cash flows?

   The relevant cash flows for an investment are its incremental, after-tax, cash flows, which ignore financing costs and reflect adjustments for any noncash charges, typically depreciation.
A sunk cost is a cost that has already been paid and is therefore not recoverable.

Cannibalization is the “substitution effect” that frequently occurs when a firm introduces a new product. Typically, some of the new product’s sales will come at the expense of the firm’s existing products.

While sunk costs are irrelevant and should be ignored when determining an investment’s incremental cash flows, the incremental cash outflows from existing product sales that are cannibalized by a newer product should be taken into consideration when considering a new investment.

5. A real estate development firm owns a fully leased 40-story office building. A tenant recently moved its offices out of 2 stories of the building, leaving the space temporarily vacant. If the real estate firm considers moving its own offices into this 40-story office building, what cost should it assign for the space? Is the cost of the vacant space zero because the firm paid for the building long ago, a cost that is sunk, or is there an incremental opportunity cost?

The cost for the space is the opportunity cost of not renting it out to a new tenant. It will lose the rentals it could have gained if it chooses to occupy the space with its own offices.

6. Suppose that an analyst makes a mistake and calculates the NPV of an investment project by discounting the project’s contribution to net income each year rather than by discounting its relevant cash flows. Would you expect the NPV based on net income to be higher or lower than the NPV calculated using the relevant cash flows?

NPV based on net income could be higher if the company has low depreciation and high additional working capital and ongoing capital expenditures needed for the project. NPV based on net income could be lower if the company had a substantial depreciation expense that was not added back into cash flows.

7. Embedded in the analysis of the jazz-music CD proposal is an assumption about how Classicaltunes.com’s customers will behave when they are able to choose from a new set of CDs. What is that assumption?

The company is assuming that its customers will see value in the addition of jazz CDs and will add jazz to their classical sections. Any customer’s choice to buy jazz instead of a classical CD must be embedded in the incremental cash flows.

8. What other ways might Classicaltunes.com estimate the terminal value of this project?

Classicaltunes.com could have assumed a stable perpetuity, rather than a growing perpetuity, which would have given it a lower terminal value.

9. Suppose that Congress passes a new MACRS schedule that reclassifies computers as 3-year equipment rather than 5-year equipment. In general, what impact would this legislation have on the project’s NPV?

This change would be an advantage to companies. They would be able to depreciate their purchases faster, meaning there will be more depreciation, less taxable income and therefore less in taxes. It is to a company’s benefit to depreciate equipment as quickly as possible. In fact, assuming it had sufficient income, it would receive the most benefit by not depreciating equipment, and simply expensing it when it occurred.
10. When a firm is faced with capital rationing, how can the profitability index (PI) be used to select the best projects? Why doesn’t choosing the projects with the highest PI always lead to the best decision?

When managers are constrained by the availability of funds and they cannot invest in every project that has a positive NPV, they face the so-called capital-rationing. Whenever managers have to choose from a set of possible investments they must choose a combination of projects that maximizes shareholder wealth, subject to the constraint of limited funds. The PI is very functional in such situations. Once managers rank projects, they select the investment with the highest PI. If the total amount of capital available has not been fully exhausted, then managers invest in the project with the second-highest PI, and so on until no more capital remains to invest. By following this routine, managers will select a portfolio of projects that in aggregate generates a higher NPV than any other combination of projects.

However, this method may not maximize shareholder wealth when capital is rationed not only at the beginning of an investment’s life, but also in all subsequent periods. This method can also lead to suboptimal decisions when projects are interdependent—that is, when one investment is contingent on another.

11. Under what circumstance is the use of the equivalent annual cost (EAC) method to compare substitutable projects with different lives clearly more efficient computationally than using multiple investments over a common period where both projects terminate in the same year?

Using equivalent annual cost is more efficient when it would take a large number of repetitions of the NPV calculations in order to find a value. For example, suppose one project lasts 11 years and a second project lasts 13 years. You would have to replicate this project over a $13 \times 11 = 143$ years in order to find a common time horizon.

12. In almost every example so far, firms must decide to invest in a project immediately or not at all. But suppose that a firm could invest in a project today or it could wait one year before investing. How could you use NPV analysis to decide whether to invest now or later?

You could compute two NPVs – now and a year from now, with appropriate changes in the cash flows. You could also look at the opportunity cost of investing now vs. later. If the company chooses to wait a year, are there projects it could fund now and still be able to receive positive NPV from the original project if it began it in a year? If so, then waiting could be the best decision.

13. Can you articulate circumstances under which the cost of excess capacity is zero? Think about why the cost of excess capacity normally is not zero.

The cost of excess capacity would be zero if there were no current or future uses for that excess capacity. For example, if sales in the original product were not expected to increase, or perhaps even decline, so therefore the original product would never be able to make use of the excess capacity.

14. What role does the human element play in the capital budgeting decision process? Could it cause a negative-NPV project to be accepted?

Managers tend to be favorably biased toward projects stemming from their own ideas. They may consciously or unconsciously manipulate the projects they favor to show
positive cash flows when in fact such results might be questionable. This optimism could cause a negative NPV project to be accepted.

**Answers to Self-Test Problems**

**ST9-1.** Claross, Inc. wishes to determine the relevant operating cash flows associated with the proposed purchase of a new piece of equipment having an installed cost of $10 million and falling into the 5-year MACRS asset class. The firm’s financial analyst estimated that the relevant time horizon for analysis is 6 years. She expects the revenues attributable to the equipment to be $15.8 million in the first year and to increase at 5% per year through year 6. Similarly, she estimates all expenses other than depreciation attributable to the equipment to total $12.2 million in the first year and to increase by 4% per year through year 6. She plans to ignore any cash flows after year 6. The firm has a marginal tax rate of 40% and its required return on the equipment investment is 13%. (Note: Round all cash flow calculations to the nearest $0.01 million.)

**a.** Find the relevant incremental cash flows for years zero through 6.

**b.** Using the cash flows found in part a, determine the NPV and IRR for the proposed equipment purchase.

**c.** Based on your findings in part b, would you recommend that Claross, Inc. purchase the equipment? Why?

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Investment</td>
<td>-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue (+5%/yr)</td>
<td>15.80</td>
<td>16.59</td>
<td>17.42</td>
<td>18.29</td>
<td>19.21</td>
<td>20.17</td>
<td></td>
</tr>
<tr>
<td>Expenses (+4%/yr)</td>
<td>12.20</td>
<td>12.69</td>
<td>13.20</td>
<td>13.72</td>
<td>14.27</td>
<td>14.84</td>
<td></td>
</tr>
<tr>
<td>EBDT</td>
<td>3.60</td>
<td>3.90</td>
<td>4.22</td>
<td>4.57</td>
<td>4.94</td>
<td>5.33</td>
<td></td>
</tr>
<tr>
<td>-Depreciation</td>
<td>2.00</td>
<td>3.20</td>
<td>1.92</td>
<td>1.15</td>
<td>1.15</td>
<td>0.58</td>
<td></td>
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<tr>
<td>EBT</td>
<td>1.60</td>
<td>0.70</td>
<td>2.30</td>
<td>3.42</td>
<td>3.79</td>
<td>4.75</td>
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<tr>
<td>-Taxes (40%)</td>
<td>0.64</td>
<td>0.28</td>
<td>0.92</td>
<td>1.37</td>
<td>1.52</td>
<td>1.90</td>
<td></td>
</tr>
<tr>
<td>EAT</td>
<td>0.96</td>
<td>0.42</td>
<td>1.38</td>
<td>2.05</td>
<td>2.27</td>
<td>2.85</td>
<td></td>
</tr>
<tr>
<td>+Depreciation</td>
<td>2.00</td>
<td>3.20</td>
<td>1.92</td>
<td>1.15</td>
<td>1.15</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Total Cash Flow</td>
<td>-10</td>
<td>2.96</td>
<td>3.62</td>
<td>3.30</td>
<td>3.20</td>
<td>3.42</td>
<td>3.43</td>
</tr>
</tbody>
</table>

**NPV at 13%**

3.21

**IRR**

24%

Accept the project because the NPV is greater than zero and the IRR is greater than 13%

*Depreciation schedule*
ST9-2. Atech Industries wishes to determine whether it would be advisable for it to replace an existing, fully depreciated machine with a new one. The new machine will have an after-tax installed cost of $300,000 and will be depreciated under a 3-year MACRS schedule. The old machine can be sold today for $80,000 after taxes. The firm is in the 40% marginal tax bracket and requires a minimum return on the replacement decision of 15%. The firm’s estimates of its revenues and expenses (excluding depreciation) for both the new and old machine (in $thousands) over the next 4 years are given below.

<table>
<thead>
<tr>
<th>Year</th>
<th>New Machine Revenue</th>
<th>Expenses(excl. depr.)</th>
<th>Old Machine Revenue</th>
<th>Expenses(excl. depr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$925</td>
<td>$740</td>
<td>$625</td>
<td>$580</td>
</tr>
<tr>
<td>2</td>
<td>990</td>
<td>780</td>
<td>645</td>
<td>595</td>
</tr>
<tr>
<td>3</td>
<td>1,000</td>
<td>825</td>
<td>670</td>
<td>610</td>
</tr>
<tr>
<td>4</td>
<td>1,100</td>
<td>875</td>
<td>695</td>
<td>630</td>
</tr>
</tbody>
</table>

Atech also estimated the values of various current accounts that would be impacted by the proposed replacement. They are shown below for both the new and old machine over the next four years. Currently (at time 0) the firm’s net investment in these current accounts is assumed to be $110,000 with the new machine and $75,000 with the old machine.

**NEW MACHINE**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash</th>
<th>Accounts Rec.</th>
<th>Inventory</th>
<th>Accounts Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$20,000</td>
<td>90,000</td>
<td>80,000</td>
<td>60,000</td>
</tr>
<tr>
<td>2</td>
<td>$25,000</td>
<td>95,000</td>
<td>90,000</td>
<td>65,000</td>
</tr>
<tr>
<td>3</td>
<td>$30,000</td>
<td>110,000</td>
<td>100,000</td>
<td>70,000</td>
</tr>
<tr>
<td>4</td>
<td>$36,000</td>
<td>120,000</td>
<td>105,000</td>
<td>72,000</td>
</tr>
</tbody>
</table>

**OLD MACHINE**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash</th>
<th>Accounts Rec.</th>
<th>Inventory</th>
<th>Accounts Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$15,000</td>
<td>60,000</td>
<td>45,000</td>
<td>33,000</td>
</tr>
<tr>
<td>2</td>
<td>$15,000</td>
<td>64,000</td>
<td>48,000</td>
<td>35,000</td>
</tr>
<tr>
<td>3</td>
<td>$15,000</td>
<td>68,000</td>
<td>52,000</td>
<td>38,000</td>
</tr>
<tr>
<td>4</td>
<td>$15,000</td>
<td>70,000</td>
<td>55,000</td>
<td>40,000</td>
</tr>
</tbody>
</table>
Atech estimates that after 4 years of detailed cash flow development, it will assume in analyzing this replacement decision that the year 4 incremental cash flows of the new machine over the old machine will grow at a compound annual rate of 2% from the end of year 4 to infinity.

(a) Find the incremental operating cash flows (including any working capital investment) for years 1 to 4 for Atech’s proposed machine replacement decision.

(b) Calculate the terminal value of Atech’s proposed machine replacement at the end of year 4.

(c) Show the relevant cash flows (initial outlay, operating cash flows, and terminal cash flow) for years 1 to 4 for Atech’s proposed machine replacement.

(d) Using the relevant cash flows from part (c), find the NPV and IRR for Atech’s proposed machine replacement.

(e) Based on your findings in part (d), what recommendation would you make to Atech regarding its proposed machine replacement?

**NEW MACHINE**

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>-300,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue</td>
<td>925,000</td>
<td>990,000</td>
<td>1,000,000</td>
<td>1,100,000</td>
<td></td>
</tr>
<tr>
<td>-Expenses(excl. depr.)</td>
<td>740,000</td>
<td>780,000</td>
<td>825,000</td>
<td>875,000</td>
<td></td>
</tr>
<tr>
<td>-Depreciation*</td>
<td>99,990</td>
<td>133,350</td>
<td>44,430</td>
<td>22,230</td>
<td></td>
</tr>
<tr>
<td>EBT</td>
<td>85,010</td>
<td>76,650</td>
<td>130,570</td>
<td>202,770</td>
<td></td>
</tr>
<tr>
<td>EAT [(1-0.40) x EBT]</td>
<td>51,006</td>
<td>45,990</td>
<td>78,342</td>
<td>121,662</td>
<td></td>
</tr>
<tr>
<td>-W/C Investment**</td>
<td>20,000</td>
<td>15,000</td>
<td>25,000</td>
<td>19,000</td>
<td></td>
</tr>
<tr>
<td>(1)Operating CF</td>
<td>31,006</td>
<td>30,990</td>
<td>53,342</td>
<td>102,662</td>
<td></td>
</tr>
</tbody>
</table>

**OLD MACHINE**

A/T Sale Proceeds +80,000

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>625,000</td>
<td>645,000</td>
<td>670,000</td>
<td>695,000</td>
<td></td>
</tr>
<tr>
<td>-Expenses(excl. depr.)</td>
<td>580,000</td>
<td>595,000</td>
<td>610,000</td>
<td>630,000</td>
<td></td>
</tr>
<tr>
<td>-Depreciation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>EBT</td>
<td>45,000</td>
<td>50,000</td>
<td>60,000</td>
<td>65,000</td>
<td></td>
</tr>
<tr>
<td>EAT [(1-0.40) x EBT]</td>
<td>27,000</td>
<td>30,000</td>
<td>36,000</td>
<td>39,000</td>
<td></td>
</tr>
<tr>
<td>-W/C Investment***</td>
<td>12,000</td>
<td>5,000</td>
<td>5,000</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>(2)Operating CF</td>
<td>15,000</td>
<td>25,000</td>
<td>31,000</td>
<td>36,000</td>
<td></td>
</tr>
<tr>
<td>INCR. CF[(1)-(2)]</td>
<td>-220,000</td>
<td>16,006</td>
<td>5,990</td>
<td>22,342</td>
<td>66,662</td>
</tr>
</tbody>
</table>

* New Asset Depreciation

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate</th>
<th>Cost</th>
<th>Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.3333</td>
<td>$300,000</td>
<td>$ 99,990</td>
</tr>
<tr>
<td>2</td>
<td>.4445</td>
<td>300,000</td>
<td>133,350</td>
</tr>
<tr>
<td>3</td>
<td>.1481</td>
<td>300,000</td>
<td>44,430</td>
</tr>
<tr>
<td>4</td>
<td>.0741</td>
<td>300,000</td>
<td>22,230</td>
</tr>
</tbody>
</table>

** New Machine Working Capital Investment
\[ NWC = \text{Cash} + \text{Accounts Receivable} + \text{Inventory} - \text{Accounts Payable} \]

\[ \Delta NWC = NWC - \text{[Prior year's NWC]} \]

**Year 1**  
\[ \Delta NWC = \$20,000 + \$90,000 + \$80,000 - \$60,000 - \[\$110,000\] = \$20,000 \]

**Year 2**  
\[ \Delta NWC = \$25,000 + \$95,000 + \$90,000 - \$65,000 - \[\$130,000\] = \$15,000 \]

**Year 3**  
\[ \Delta NWC = \$30,000 + \$110,000 + \$100,000 - \$70,000 - \[\$145,000\] = \$25,000 \]

**Year 4**  
\[ \Delta NWC = \$36,000 + \$120,000 + \$105,000 - \$72,000 - \[\$170,000\] = \$19,000 \]

***Old Machine Working Capital Investment***

\[ NWC = \text{Cash} + \text{Accounts Receivable} + \text{Inventory} - \text{Accounts Payable} \]

\[ \Delta NWC = NWC - \text{[Prior year's NWC]} \]

**Year 1**  
\[ \Delta NWC = \$15,000 + \$60,000 + \$45,000 - \$33,000 - \[\$75,000\] = \$12,000 \]

**Year 2**  
\[ \Delta NWC = \$15,000 + \$64,000 + \$48,000 - \$35,000 - \[\$87,000\] = \$5,000 \]

**Year 3**  
\[ \Delta NWC = \$15,000 + \$68,000 + \$52,000 - \$38,000 - \[\$92,000\] = \$5,000 \]

**Year 4**  
\[ \Delta NWC = \$15,000 + \$70,000 + \$55,000 - \$40,000 - \[\$97,000\] = \$3,000 \]

\[
\text{b. Year 5 Operating CF} = \$66,662 \times (1+.02)^1 = \$67,995
\]

\[
\text{Terminal Value at end of Year 4} = \frac{\$67,995}{0.15 - 0.02} = \$523,038
\]

\[
\text{c. Relevant Cash Flows}
\]

\[
\text{Total Year 4 CF} = \$66,662 + \$523,038 = \$589,700
\]

\[
\begin{array}{c|c}
\text{Year} & \text{Cash Flow} \\
\hline
0 & -\$220,000 \\
1 & 16,006 \\
2 & 5,990 \\
3 & 22,342 \\
4 & 589,700 \\
\end{array}
\]

\[
\text{d. NPV @ 15\%} = \$150,301
\]

\[
\text{IRR} = 31.92\%
\]

\[
\text{e. Atech should undertake the proposed machine replacement because the NPV of} \\
\$150,301 \text{ is greater than } \$0 \text{ and the IRR of 31.92\% is above the firm's 15\% required} \\
\text{return.}
\]

**ST9-3.** Performance, Inc. is faced with choosing between two mutually exclusive projects with differing lives. It requires a return of 12\% on these projects. Project A requires an initial outlay at time 0 of $5,000,000 and is expected to require annual maintenance cash outflows of $3,100,000 per year over its 2-year life. Project B requires an initial outlay at time 0 of $6,000,000 and is expected to require annual maintenance cash outflows of $2,600,000 per year over its 3-year life. Both projects are acceptable investments and provide equal quality service. The firm assumes that the replacement and maintenance costs for both projects will remain unchanged over time.

\[
\text{a. Find the NPV of each project over its life.}
\]

\[
\text{b. Which project would you recommend based on your finding in part a? What is wrong} \\
\text{with choosing the best project based on its NPV?}
\]
c. Use the equivalent annual cost (EAC) method to compare the two projects.

d. Which project would you recommend based on your finding in part c? Compare and contrast this recommendation with the one you gave in part b.

\[
\begin{align*}
\text{Project A NPV} &= -$10,239,158 \\
\text{Project B NPV} &= -$12,244,761 \\
\text{EAC for Project A} &= $6,058,490 \\
\text{EAC for Project B} &= $5,098,094
\end{align*}
\]

b. Project A would be recommended because it has the lower cost NPV. The problem with this comparison is that Project A provides service for only 2 years versus Project B’s 3-year service life.

c. Project B is preferred based on its lower EAC, which means that when costs are viewed on an annual basis it is less expensive than Project A. This recommendation is superior to the one made in part b because by looking at annual cost it resolves the issue of differing service lives when the replacement and maintenance costs are assumed unchanged over time.