

An Advanced Capital Budgeting Application in Excel: Building a Bridge between Textbook Content and Real-World Application

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This article describes a comprehensive capital budgeting Excel model designed for use in the Finance classroom. Capital budgeting has been recognized as a complex process – one that is challenging for students to fully comprehend. The model we’ve developed allows students to simultaneously investigate and observe the impact of varying factors such as depreciation methods, tax rates, economic forecast for growth in sales and costs, and modifications in financing costs due to associated changes in capital structure and sources of project funding.

APPLICATION INSPIRATION

Teaching advanced capital budgeting concepts can be quite challenging. Major hurdles for faculty in teaching this material include (a) lacking or insufficient student prerequisite knowledge, (b) overcoming students’ inability to apply theoretical models, and (c) student difficulty in understanding how interrelated environmental factors and managerial decisions substantially alter a capital budgeting project’s evaluation outcome.

The Importance of Prerequisite Knowledge

It is widely recognized and documented that students with adequate preparation with prerequisite knowledge are able to advance their knowledge in upper-level courses. Students with prerequisite deficits may not be able to efficiently apply their backgrounds to problems presented in a finance curriculum.

The literature is rich with evidence. Dreyfus and Dreyfus (2005) demonstrate the positive impact of known facts on new learning. Jones and Roberts (2005) find students who enter upper division course work without the necessary pre-requisite knowledge and skills tend to struggle to keep up and fall behind. Sargent (2013) finds that success depends on adequate prerequisite development and tutoring. Domingo & Nouri (2016) find that transfer students earn statistically lower grades in Intermediate I, Cost Accounting, and Advanced Accounting courses in comparison to native students (students who have their prerequisites from the same institution as where they take their upper level courses). The first 4 citations are summarized from Wright & Losi (2020 – 2021). The National Academic Press (2002) reports seven principles of learning. Principle two states that, ‘Learners use what they already know to construct new understanding.’

Theoretical Models and the Real World

Theoretical and conceptual constructs taught to students in a classroom often do not fit the real world very well. Abstractness and assumptions are made to simplify the reaching of conclusions. The purpose is to get across a

simplified analytical process. These classroom tactics frequently miss the target, however, when applied to actual business scenarios.

Business is an applied discipline, however. The importance of utilizing complex business scenarios in the teaching of finance and other business disciplines is often dismissed by professors. There may be various reasons for this dismissal. Perhaps a professor feels that adding to an already topic-filled course would overburden students. Professors may feel that their own background in business is lacking, or perhaps they have no actual business experience applying their own subject matter. Traditional teaching techniques may provide more simplistic and objective scoring results, whereas application to actual business scenarios, and the grading of those types of assignments, are much more subjective. In some universities, “teaching effectiveness” is almost solely based on student feedback about the professor and the course. Many observe that students are uncomfortable being drawn outside their textbook presentations and objective testing comfort zones, and the resulting negative feedback about the course and professor lessens the opportunity for positive performance evaluations and merit pay increases.

These justifications for avoiding application to real world scenarios and extensive cases, though, do not in any way diminish the value of addressing actual business scenarios and cases. Students may not experience the exact same tasks upon their entry into professional positions after graduation, but are better able to grasp the requirements of properly analyzing real-world complexities.

We have found that one of the most effective tools in generally analyzing business scenarios is Microsoft Excel or a similar spreadsheet software program. Properly designing an analytical framework is a highly valued skill, according to the firms that recruit our graduates. In finance, a crowning analytical process, after introduction of risk and return, time value of money, and some other foundational concepts and skills, is a capital budgeting analysis. Students assess the feasibility of adding or replacing capital assets according to their perceived effect on shareholder wealth, using a variety of decision metrics. The numerous informational inputs to the capital budgeting analysis, and the nature and variability of those inputs, provides a rich learning opportunity.

The Complexities of the Capital Budgeting Process

Previous literature recognizes the complexities of capital budgeting. Brous (2007) states, “One of the most challenging aspects of teaching a capital budgeting course is connecting the wide divide between the theoretical or normative approach to capital budgeting and the applied or positive approach.”

Mahoney and Kelliher (1999) state “Some of the difficulties in modeling these long-term investment decisions include trying to estimate the amount and timing of the future cash flows, the discount rate, future cost savings, the tax rate, and any residual value.”

APPLICATION DEVELOPMENT

Our model is developed in Microsoft Excel®, although other advanced spreadsheet software could also be used.

Past research describes the effective use of spreadsheet software in the business classroom. Craft (2003) demonstrates the usefulness of Excel for students completing Monte Carlo simulations, and Erfle (2001) describes how students use Excel to analyze data to provide support for decision making in a Managerial Economics course. Gregorowicz and Hegji (2002) present several examples of how computer spreadsheets are used to teach International Economics.

“With the help of this very visual medium, students can gain a better understanding of abstract concepts and their practical applications.” (MacDougall and Fellows 2006).

While we recognize the value of spreadsheets for developmental exercises that may be abstract or oversimplified, we find that students benefit greatly from using spreadsheets to address actual business data and decision processes.

Before introducing the capital budgeting model, we recommend sufficient exposition of foundational topics, such as depreciation methods, calculating the weighted average cost of capital (WACC), and the capital budgeting metrics of NPV and IRR. Then, more advanced concepts and techniques can be introduced (Table 1).

Table 1. Coverage of Foundational Material

Depreciation
<ul style="list-style-type: none"> * A review of depreciation' * A discussion of straight-line versus accelerated depreciation methods with examples. * Development of the MACRS schedule. * Demonstration of how depreciation expenses create a 'tax shield'.
Weighted Average Cost of Capital (WACC)
<ul style="list-style-type: none"> * A discussion of the WACC and a demonstration of how it is calculated. * A demonstration of using Hamada's equation to compute a levered Beta. * Computing the cost of debt using standard deviation of equity to determine a 'spread' over the risk-free rate of return. * Computing the cost of debt using the interest coverage ratio to determine a 'spread' over the risk-free rate of return. * Using market value versus book value to compute weights of capital components.
Net Present Value (NPV)
<ul style="list-style-type: none"> * A discussion of NPV and a demonstration of how it is calculated. * A discussion of the NPV decision criteria. * A demonstration of using Excel functions to compute the NPV. * A demonstration of how to create and interpret an NPV profile.
Internal Rate of Return (IRR)
<ul style="list-style-type: none"> * A discussion of IRR and how there is no closed end form for its solution * Computing IRR using Excel tool, including Goal Seek and the IRR function. * A discussion of nonconventional cash flows and the associated multiple IRR problem.

We find that this is necessary since upper division finance students may not have adequately developed foundational skills or might not have retained these necessary skills. Transfer and Graduate students are particularly susceptible to deficiencies; while one institution may have a well-integrated skill development curriculum, students with lower-level preparation from junior colleges or other universities may not have been adequately introduced to this material in previous classes or curriculum.

THE APPLICATION WITH PARTIAL SCREENSHOTS

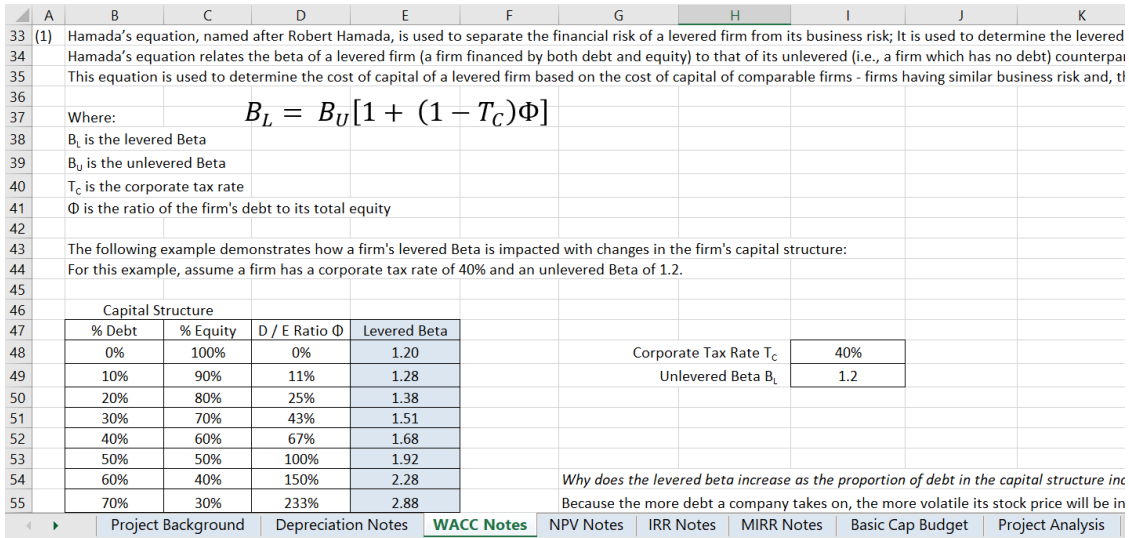
The first worksheet in the workbook contains introductory material, describing capital investment and giving some examples. It introduces the capital budgeting methods, and lists data for the sample project used in the rest of the workbook. The second worksheet presents a refresher (hopefully a refresher, unless students haven't retained background from prior courses) on straight-line and accelerated depreciation methods, including MACRS.

Figure 1: Screen Shot of Worksheet 2

	A	B	C	D	E	F	G	H	I	J	K	
25	EXAMPLE 1 - Straight line depreciation with no salvage value						EXAMPLE 2 - Straight line depreciation with salvage value					
26												
27	A firm purchases \$12,000 worth of office furniture.						A firm purchases a \$30,000 delivery truck, with an expected life of 10 years.					
28	They will depreciate the entire cost over the next 7 years.						After 10 years, the truck will be worth \$3,000, its salvage value.					
29												
30	Asset Life (years):		7				Asset Life (years):		10			
31	Asset Cost:		\$12,000				Asset Cost:		\$30,000			
32	Salvage Value:		\$0				Salvage Value:		\$3,000			
33	Depreciable Base:		\$12,000				Depreciable Base:		\$27,000			
34												
35	STRAIGHT LINE DEPRECIATION				STRAIGHT LINE DEPRECIATION							
36		Year	Depreciation Expense	Accumulated Depreciation	Book Value		Year	Depreciation Expense	Accumulated Depreciation	Book Value		
37		0			\$12,000		0			\$30,000		
38		1	\$1,714	\$1,714	\$10,286		1	\$2,700	\$2,700	\$27,300		
39		2	\$1,714	\$3,429	\$8,571		2	\$2,700	\$5,400	\$24,600		
40		3	\$1,714	\$5,143	\$6,857		3	\$2,700	\$8,100	\$21,900		
41		4	\$1,714	\$6,857	\$5,143		4	\$2,700	\$10,800	\$19,200		
42		5	\$1,714	\$8,571	\$3,429		5	\$2,700	\$13,500	\$16,500		
43		6	\$1,714	\$10,286	\$1,714		6	\$2,700	\$16,200	\$13,800		
44		7	\$1,714	\$12,000	\$0		7	\$2,700	\$18,900	\$11,100		
45							8	\$2,700	\$21,600	\$8,400		
46							9	\$2,700	\$24,300	\$5,700		
47							10	\$2,700	\$27,000	\$3,000		
	Project Background Depreciation Notes WACC Notes NPV Notes IRR Notes MIRR Notes Basic Cap Budget Project Analysis											

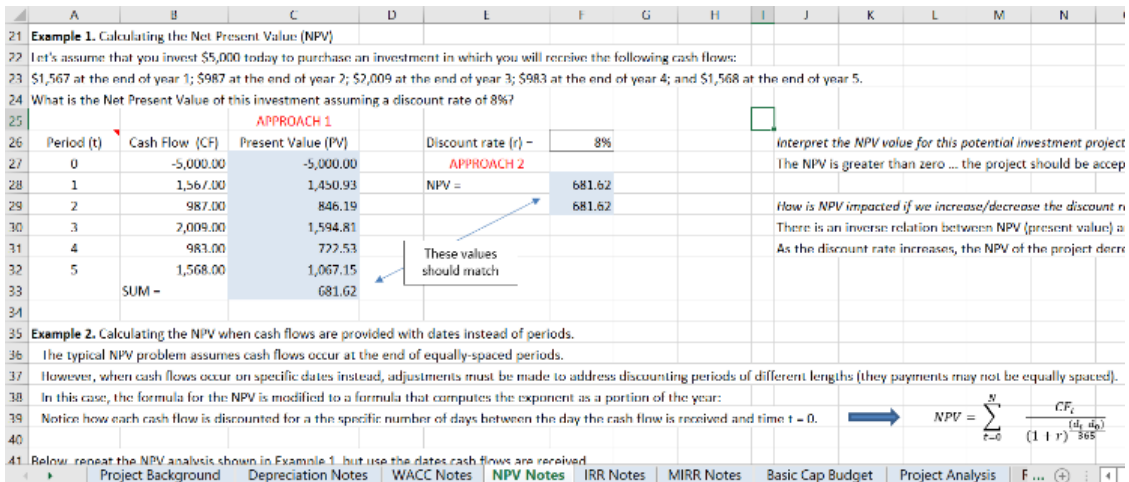
The third sheet in the workbook addresses the cost of capital for the firm. Some simplifying assumptions are made in order to include theoretical discussion of levered betas and the effect of leverage on the firm's risk. A variety of methods for calculating cost of debt and cost of equity for the sample firm are presented. Weights for the WACC are presented in both market value and book value weights in order to spark discussion of the relative merits of each.

Figure 2: Screen Shot of Worksheet 3



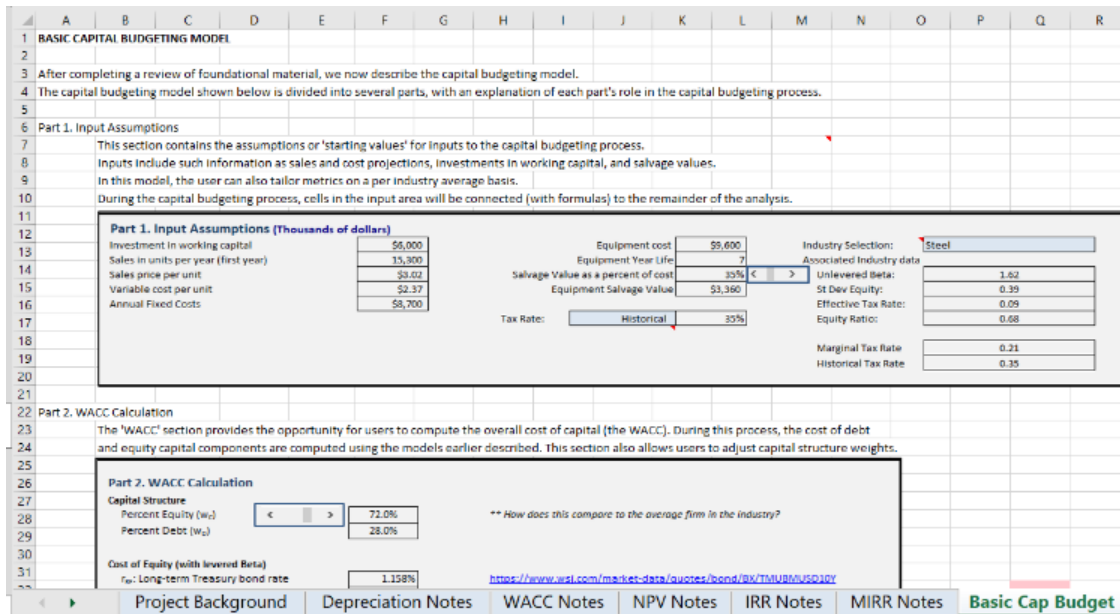
Worksheet four of the workbook presents the NPV analysis in detail, including the NPV profile. This provides a discussion segue' into the detailed IRR method on worksheet five. The drawbacks of the IRR method are discussed and demonstrated, including the multiple IRR problem when nonconventional cashflows are involved. Worksheet six presents the MIRR method. Comparisons may easily be made between the three methods with the workbook.

Figure 3: Screen Shot of Worksheet 6



The Basic Capital Budget tab contains an exposition of each piece of the dashboard. We describe each input and demonstrate how the input data can be altered to see the effect of changed input variables.

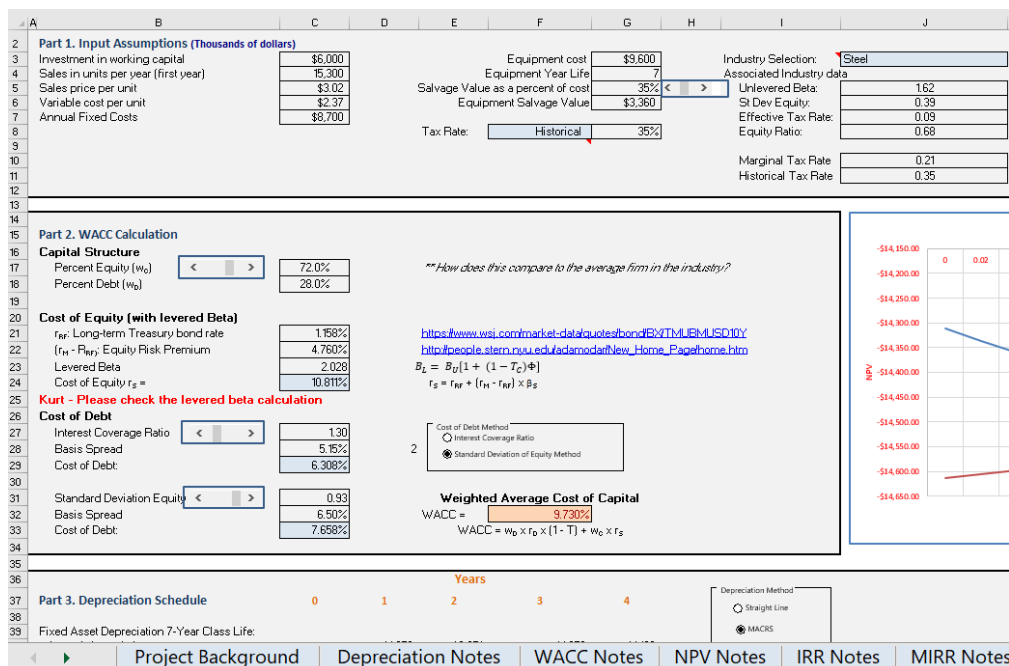
Figure 4: Screen Shot of Capital Budgeting Worksheet



The WACC section shows how weights, component capital costs, and WACC is calculated, and how the different assumptions about each element can be asserted. In the Depreciation section, various methods can be employed to determine depreciation inputs for calculating the net operating profit after tax (NOPAT). Section 5 shows the calculations for NOPAT and the adjustment for net operating cash flow (NOCF). Section 6 utilizes all three capital budgeting metrics to assess the financial feasibility of the project. Finally, the ability of management to incorporate future business initiatives is discussed, with a control board for some common real option alternatives.

The Project Analysis tab is a summary dashboard that displays all of the specifications and can be effectively used as a demonstration sheet in class.

Figure 5: Screen Shot of Dashboard



The Application Workbook is valuable for professors who would like to have a fairly comprehensive coverage of capital budgeting and its inputs, with the capability of demonstrating how changes in the inputs, assumptions, or methods change the outputs.

The workbook is available for use by instructors. If you would like to use the application, kindly send an email from your university account to Dr. Mary Fuck at mcf012@shsu.edu.

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