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An Economic Look at the White-Collar Project Portfolio

Getting the right choices every time

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From project portfolio to economic history
Today's organizations struggle with a limited pool of resources to accomplish an exploding number of projects.

Each project makes its own claim on the organization's attention. The "mandatory" projects say they are needed to ensure the survival of the whole enterprise. New product development proclaims that without their efforts there will be no new products to market, no future for the firm. Research projects quietly insist that they must be pursued to discover essential new futures. Subtle quality improvement projects ask for small investments to streamline internal processes. Some projects promise an immediate pay-off; some plead for the time to win a long-term business benefit.

With all these projects competing for resources, assembling and maintaining a sensible collection of projects—a solid project portfolio—is a challenge for the best of organizations.

Bad current practices compound the problem. Reports from the field show a deplorable waste of resources due to poor (or non-existent) methods for choosing, reviewing, and canceling projects [1]. Often the project that sells the hardest gets the most resources and the project that best hides its poor performance receives the longest continued funding. The moribund project, in a misapplication of corporate sympathy, is put on life support when it should be put out of its misery. Meanwhile, the worthy project staggers along, often starved for resources.

Changing from no method to some method is the first critical step. But the evidence from the field again suggests that the methods employed are often haphazard and wasteful [2]. Even worse, most methods are developed in complete ignorance of important economic insights of the past half century. Several of these insights have been recognized with the Nobel Prize in Economics. Among the honored economists are Tobin (1981), Modigliani (1985), and Miller, Moskowitz, and Sharpe (1990).

Economics will not make the portfolio manager's work a great deal easier, but it will improve the results in important ways.

Economics gives a portfolio manager better questions to ask about allocating scarce resources to many competing projects. First, economics insists that we *focus on the long-term benefits of any project*. These benefits are captured in the business model of the results of the project. Second, economics explains how to *fully account for the risks of the project, the risk of the firm*, and *the risk of the markets*. Third, economics shows how to *account for the effects of payments in different years* and to summarize the results in the net present value. Fourth, economics demonstrates how to *construct a portfolio of projects.*

Economics requires that managers make consistent decisions. It exposes phony arguments. It speaks for the broad needs of all the stakeholders. It maintains a focus on the firm's mission to create value for the stockholders and to reward those who share the firm's risks. It reminds everyone of the firm's social obligation to add economic value.

In short, understanding the economic framework allows a conscientious portfolio manager to harmonize the needs of the smallest individual stakeholder with the firm's larger obligation to its shareholders and society.

Even with the help of a sound economic framework, managers must still make difficult choices with limited data and imperfect projections.

Risk and return

Understanding project portfolio economics begins with a glance at the fundamental economics of any investment. The elementary question of the investor is "Will I earn a fair return on my investment?" In order to answer that question the investor needs to know if the risk of the investment will be offset by the reward. The reward is reflected in the net present value (NPV) of the investment that, in turn, is an expression of expected rate of return and the final selling price. If the reward justifies the risk, the investor will invest; if not, the investor will go elsewhere.

When we begin a project we need to be sure that the expected reward of the project *in its full business context* is sufficient to compensate the investor for taking the risk.

When dealing with a capital investment project for the whole firm, the business model explores the result of the project—the new business activity and its profit potential. When dealing with a project buried in one division or department, the business model is more difficult to construct and the focus often shifts away from the profits of the new business back to the costs of doing the project.

We will begin our discussion with the simple, well-understood case of a capital investment project, examine how an economist would view this project, alone and in a portfolio, and then return to the less certain world of internal business projects.

The Capital Investment Project

Three attributes

A capital investment project has three interesting attributes. First, *you can learn about the firm* sponsoring the project from the firm's past financial statements. Second, *you can compare the firm's performance to other firms, to the market as a whole, and to the bond* *market.* These markets represent other possible choices for the investor. Third, *you must look ahead to see the reward.* Capital investment projects, by definition, take several years to bear fruit and so require careful consideration of how the investment will pay out over time.

To be funded, a capital investment project must expect a reward better than other projects of similar risk in the firm and in the market. It must be a reward that is worth waiting for. How do you determine this?

Intelligent investors imagine how a new project will create a new business--a new stream of benefits, costs, and net benefits--in future years.

The project as a business
Imagine that we can convince investors to give us 70 units for a project that promises them 9%. The project has resulted in some business activity that has completed its first year. At the end of the year we have taken in some positive revenues and have paid out some incurred costs. If the remainder is positive we call it a profit. Here's an example of a typical income statement in a corporate financial report.

Accounting Category	**Amount**
Revenue	80
- Costs	43
- (Depreciation)	4
= Profit PBIT	33
- Interest	3
= Profit PBT	30
- Tax	12
= Profit (Net Income)	18

Our example begins with the revenue and subtracts different charges to arrive at a profit or loss. A few items are noteworthy. Depreciation is captured in parentheses because it is an accounting adjustment and not an actual cash payment in the present year. Profit is calculated before interest and taxes (PBIT), before taxes (PBT), and after taxes.

The final profit, sometimes called net income, is a combination of business events (revenue, costs, interest, and taxes) and an accounting convention (depreciation).

Most businesses, after complying with the legal requirements to produce the first example, also analyze their cash flow.

Cash flow
Cash flow adds some new considerations to the discussion. First, cash flow adds back the paper loss of depreciation from our first example. The result is all of the real cash we acquired this year—cash flow from operations.

Accounting Category	**Amount**
Revenue	80
- Costs	43
- (Depreciation)	4
= Profit PBIT	33
- Interest	3
= Profit PBT	30

- Tax	12
= Profit (Net Income)	18
Cash Flow	
+ Depreciation	4
= Cash flow from operations	22
- Change in working cap	2
- Change in capital spending	4
= Free cash flow 16	

Unfortunately we do not get to keep all of the cash flow from operations at the end of the year. Some of the cash was used to fund increasing day-to-day activities—the working capital. Some was spent on the equipment to keep it working—the change in capital spending.

After we deduct two real uses of our cash we are left with what economists like to call the free cash flow—the real cash left at the end of the year.

Looking at the investment
The results so far have allowed for "interest," a payment to those investors who made us a loan. But we have not yet accounted for those investors who bought stock in our project. How do we do that?

It turns out that economists like to separate all the cash results of our operation from the return we must pay to all our investors. To do so, we need to remove the interest payment from our cash flow result and then calculate the full payment to all the project investors, both loan-holders and stockholders.

Here's what the project's results look like with interest removed.

Accounting Category	**Amount**				
Revenue	80...				
- Costs	43...				
- (Depreciation)	4…				
= Profit-PBT	33...				
- Tax	13…				
= Profit	20…				
Cash Flow					
+ Depreciation	4…				
= Cash flow from operations	24...				
- Change in working cap	2...				
- Change in capital spending	4...				
= Enterprise free cash flow	18	20	19	20	20

At the end of the year we have 18 units in cash and the need to repay our investors for their initial investment in this project. (The ellipses […] indicate that we could calculate future years and estimate future cash flows.)

Why and how much did the investors invest in this project? We asked the investors for seventy units (70) and we promised them a 9% annual return. They weighed our project's risk (as represented by the firm) against other available stocks and bonds, and decided that our project was a good investment. The reward outweighed the risk.

What kind of an investment did our investors make?

Mixed investment
While our investors may have actually put up only cash, economists behave as if our investors made a "mixed" investment because corporations work best with a financial mix: money borrowed as a loan and money "borrowed" by selling stock. And because the results of any one project will blend in with the other activities of the firm, economists like to assume that new investments were made in a way that preserves the optimal mix of loans and stock.

So we will act as if our investors bought a mixed package of debt and equity (stock) that preserves the present financing mix of the firm. Because debt is lower risk (it gets paid off first in the event of trouble) it has its own interest rate. Because stock's values rise and fall in a market and because the stock owners only get paid off after the loans are repaid, the equity (stock) interest rate is higher than the loan interest rate.

For our firm, the weighted average between those two rates is 9%. (We will learn the details of this calculation later.)

That 9% figure includes:

- The loan's risk
- The inflation rate
- The tax adjustment that interest charges create
- The rate of the "zero-risk" prime rate
- The stock market's expected return and risk
- The individual firm's risk
- (And the assumption that the project itself has about the average risk of any project in the firm.)

Because we began with an investment of 70 in the project, we must pay 70 x 9% = 6.3 to our investors.

Enterprise free cash flow	18
- Annual investment charge	6.3
= Economic Value Added	11.7

Happily, we had a profitable year even after we paid our investors for the use of their money. The profit remaining is called the **economic value added**.

Net present value
The investors were probably not surprised to receive a payment at the end of the year. To convince them to give us the money for the project we developed a business model for several years into the future. The free cash flow was projected to last five years.

Basic Cash Flow		**Amounts per Year**				
Enterprise free cash flow		18	20	19	20	20
Initial investment	(70)					

WACC (Weighted Average Cost of Capital) = 9%)

The investors discounted these figures at 9% (multiplied each by (1/1.09) for each year in the future) to derive the present value of the numbers. The string of discounted values shown below is called "discounted cash flow." (The initial investment was not discounted because it was paid out now.)

Net Present Value (now)		**Amounts per Year**				
Discounted cash flow	(70)	16.5	16.8	14.7	14.2	13.0
Net present value	*5.2*					

When the investors added up the present value of the future payments, the total exceeded the investment by 5.2. The investors can earn their fair interest rate of 9% and still make a little extra! A positive net present value (NPV) makes a project investment attractive to a "rational" investor.

The investors can also imagine that the cash flow pays the annual investment charge and also returns some of the investment each year.

Economic value added (each year)	**Amounts per Year**					
Initial investment	(70)					
Enterprise free cash flow		18	20	19	20	20
(Weighted Average Cost of Capital = 9%)						
Annual investment charge		6.3	5.2	3.9	2.6	1.0
Economic Value Added (EVA)		*11.7*	*14.8*	*15.1*	*17.4*	*19.0*
Current investment remaining		(58.3)	(43.5)	(28.5)	(11.0)	8.0

The investors receive the desired 9% each year and the economic value added can be used to reduce the overall amount of the current investment remaining. At the end of the fifth year, the investors had earned their 9% every year, were repaid for their original investment, and had received an extra payment of 8.

The two approaches both demonstrate that an investor will make a 9% return. The "net *present* value" of 5.2 multiplied by 1.09 five times will equal the 8.0 of surplus "current investment remaining" five years in the future.

A way to evaluate a project

By treating a capital project as a business-creating effort, our investors have a straightforward way to evaluate the capital spending projects that firms offer them. Economists verify that this approach is consistent with the actual behavior of capital markets in the economy. Among the economists who worked out the fundamental ideas on portfolio selection and capital structure are Modigliani, Miller, Moskowitz, and Tobin.

Before we leave our simple capital investment project, we will examine how to compute the weighted average cost of capital for a firm, and how the wise investor can minimize the overall risk when investing in a portfolio of projects.

The weighted average cost of capital

The weighted average cost of capital is a single percentage for the whole firm. It includes the part of the firm's investments that is debt and the part that is equity (stocks). The debt rate includes the expected inflation rate and is also adjusted for interest's effect on corporate taxes. (Under accounting rules, interest on debt is counted as a business expense.) The equity rate is adjusted for the risk of the stock market and the risk of the company in that market.

Weighted Average Cost of Capital =
Interest Rate x (1 - Tax Rate) x (Debt/(Debt + Equity)) +
Equity Rate x (Equity/(Debt + Equity))

Where the Equity Rate =
Prime Rate + Beta x (Stock Mkt. Rate - Prime Rate)

The debt part of this equation takes into account the money the firm will get back when it claims the interest as a deduction. This tax advantage has the effect of lowering the interest rate and how much the firm must pay for interest.

Why don't firms don't just borrow money and not issue stock [equity]? Concerns about the firm's corporate taxes and bankruptcy costs lead most firms to seek a combination of debt and equity. Modigliani and Miller proved that if you ignore these two concerns, the ratio of debt to equity makes no difference [3].

The equity rate is based on Sharpe and Lintner's model of how investors behave in the Capital Asset Pricing Model (CAPM) [4]. The CAPM equation assumes there is a "risk-free" bond rate that is the "prime" rate that banks will offer to their best customers. Historically, the stock market averages about 5% higher than this bond rate.
The "beta" factor measures how a firm's stock varies compared to how the stock market varies—the co-variance of the stock to the market divided by the market variance. A "beta" larger than 1.0 means the firm's price goes up and down *more* than the market (riskier and a higher rate); smaller than 1.0 means it goes up and down *less* than the market (safer and a lower rate).

Each of the individual capital project's specific risks (the project variance) can be eliminated when the investor includes 12 or more different projects in the portfolio. "Different" here means different companies in different industries in different places [5]. (The individual project's co-variance cannot be eliminated and is included in the "beta" term in the CAPM.)

Assembling the portfolio
Economics tells investors to use the firm's WACC to find the net present value of the capital project and to choose the largest total net present value when assembling a portfolio of projects. Here is an example with five possible projects for your portfolio.

Project	Present Outflow	PV Inflow	NPV	Required Resources
Able	200	230	30	20
Baker	125	141	16	23
Charlie	175	194	19	28
Delta	150	162	12	15
Echo	150	170	17	15

Which projects should we assemble in our portfolio? If we assume that the analysis behind the net present value figures was of comparable quality in all five cases, then we want to pick the combination of projects that gives us the **largest total net present value**. In the above case, this means all five projects, because all have positive net present value.

This combination of projects has been fully evaluated for risk and still returns adequate payments to the investors. The portfolio creates overall economic value for the investors, for the firm, and for society.

In fact, when firms announce the beginning of such projects, their stock price adjusts upward to allow for the anticipated increase in value of the firm [6].

If we have a limited amount to invest in new projects, or a limited number of people who can be assigned to the projects, then what portfolio do we assemble? What if in the above example we are limited to 300 units to invest and we have only 34 people available to work on the projects?

The answer is that we should choose the combination of projects that can be done within the known constraints that will produce the largest net present value. (As a practical matter for 20-project portfolios, the best combination is easy to find with a simple computer program that looks at all the possibilities and prints out the best [7].)

When our small example is constrained, the **best portfolio is a combination of projects Baker and Charlie**. The total portfolio NPV is 35 and the number of people required is 31. We have invested all of our available resources in positive NPV projects and we have assigned 31 of our 34 people, leaving three in reserve for a project needing help later on.

If all projects were capital projects, economics provides a method for picking the best portfolio.

The Individual Project within the Firm

Individual project business model

Economics gives investors a set of rules to choose a portfolio of capital projects offered by a variety of firms. Empirical research of the past fifty years confirms that individuals, firms, and markets follow these rules. How can an internal portfolio manager choose a portfolio of projects that is consistent with these lessons?

Economics says that to remain consistent, *you must first build a business model for each project.* The model *must include the cost of financing* the project (using the firm's weighted average cost of capital).

For some managers of internal projects, building a model means looking beyond the end of the project for the first time; for others, it's routine. Example 1 and Example 2 below illustrate business models for projects that produce a product or a service.

Example 1 shows that if the project produced a product for sale, the benefit could be revenues; the costs would be the cost to make, and the profit would be the economic value added (EVA). The cumulative profit is the cumulative value of the initial investment of 70, fully reimbursed by a weighted annual cost of capital of 9%. Here's what the earlier example might look like reduced to its simplest elements:

Example 1. Business Model for a Project that Creates a Product

	Time					
	0	**1**	**2**	**3**	**4**	**5**
Benefit: revenues		80.0	110.0	140.0	120.0	100.0
Cost: mfg., taxes, etc.		68.3	95.2	134.9	102.6	81.0
Project	(70)					
Profit: EVA	(70)	11.7	14.8	15.1	17.4	19.0
Cumulative Profit	(70)	(58.3)	(43.5)	(28.5)	(11.0)	8.0

Example 2 shows that if the project produced a service such as an improved way of doing business, the benefit could be the cost savings of the improvement; the costs would be the cost to run the improvement (plus taxes and financing); and the net profit would be the net benefit of the improvement as economic value added (EVA). It might look like this:

Example 2. Business Model for a Project that Creates a Service

	Time					
	0	**1**	**2**	**3**	**4**	**5**
Benefit: cost saving		80.0	80.0	80.0	80.0	80.0
Cost to run		65.0	65.0	65.0	65.0	65.0
Project	(70)					
Net benefit: EVA	(70)	15.0	15.0	15.0	15.0	15.0
Cumulative benefit	(70)	(55.0)	(40.0)	(25.0)	(5.0)	10.0

The service pays its WACC and yields 10 extra at the end of 5 years [8].

Most projects that produce a product can fit Example 1; those that create a service can fit Example 2. The steps to create the above models include: choosing a reasonable time horizon, estimating benefits over time, estimating costs over time (including taxes and the cost of financing), and calculating profit expressed as economic value added.

Large project, small portfolio

After building a business model of the result of the project, the internal project portfolio manager must find a way to adjust for the project's risks.

Small project, large portfolio

If a new project is large in relation to the size of the firm and the size of the project will significantly alter the firm's statistics, the portfolio manager's calculations should imitate those of a mutual fund manager deciding whether to add a new stock to the mutual fund portfolio. The manager must know the beta and the debt/equity ratio for both the new stock (project) and the current portfolio. With this information the manager can decide to change the portfolio. (Note that the method includes searching stock (project) histories for similar past stocks (projects) in order to estimate a project's beta. Details on these calculations are sketched in an attachment at the end, but beyond our scope here [9].)

The most common challenge for managers of internal white-collar project portfolios is a new project whose size is small in relation to the size of the firm. Such a project will not significantly alter the statistics for the firm and the portfolio calculations should preserve the externally derived firm's WACC. Small new projects have internally generated analyses of risk but seldom have data from the external marketplace or precise estimates of beta [10]. So the internal projects' risks must be accounted for in an informal way *that preserves the firm's overall WACC* [11].

A simple informal method

When adding a small project to a large portfolio you should *choose a simple method to rate your project's risk.* The seven-step, informal method described below ranks the candidate projects based on risk and matches the risk-ranked candidates with the range of possible weighted average costs of capital (WACCs) in a way that preserves the firm's overall WACC. Other informal methods are possible. You should choose a simple method that everyone in your firm can use in their day-to-day work.

First, using your informal rating system, assign risks to each individual project and order the candidates on their risk. Any method that leads to a simple relative ranking will do—a risk description in words, 10 point scales, a weighted table of risk factors, or some other method you can consistently apply [12].

The example below shows the present portfolio and the candidate projects arranged from very high risk (vh) through medium (m) to very low (vl). The candidate projects are small relative to the present portfolio. The present portfolio is already underway and is not being analyzed in this process.

The candidates are: Able, a new product development project; Baker, a research project; Charlie, a process improvement project; Delta, a second new product development; and Echo, a second process improvement project. In the following example the whole firm's WACC of 9% was used to compute the PV Outflow, the PV Inflow, and NPV.

Project	PV Outflow	Risk	Adjusted WACC	PV Inflow	NPV	Required Resources
Old Portfolio	3000	m	9%	4000	1000	300
Able	200	vh	?	230	30	20
Baker	125	h	?	141	16	23
Charlie	175	m	?	194	19	8
Delta	150	l	?	162	12	15
Echo	150	vl	?	167	17	15

Second, determine the range of WACC's from the lowest-risk project to the highest-risk project. In the example we will chose a range from 7% to 11% (inclusive), a range of five percentage points. You might assume a larger or smaller range. For example, high-risk new projects may need to return 20% to their initial investors, so a risk range might extend from the 5% risk-free low rate to a 20% high rate, a range of sixteen percentage points.

Third, adjust your ranked projects up or down from the central WACC. For example, from lowest risk to highest risk you might assign:

9% - 2% = 7% to the lowest fifth
9% - 1% = 8% to the second lowest fifth
9% - 0% = 9% to the middle fifth
9% + 1% = 10% to the second highest fifth
9% + 2% = 11% to the highest fifth

Fourth, check to be sure that the portfolio's weighted average (use the PV Outflow's, the investments, for weighting) remains about the same as the original WACC for the firm. (If not, make some appropriate adjustments in your added percentages). Unless you have overwhelming evidence to the contrary, you should assume that your candidates, on the average, have the same overall risk as the firm.

Project	PV Outflow	Risk	Adjusted WACC	Adjusted PV Inflow	Adjusted NPV	Required Resources
Old Portfolio	3000	m	9%	4000	1000	300
Able	200	vh	11%	?	?	20
Baker	125	h	9.4%	?	?	23
Charlie	175	m	9%	?	?	8
Delta	150	l	8%	?	?	15
Echo	150	vl	7%	?	?	15

The portfolio has been modified to reflect individual projects' risk. The WACC was raised for the high-risk projects, lowered for the low risk projects, and not changed for the medium projects. Baker's WACC was tweaked to bring the candidates' weighted average close to 9%.

Fifth, using each project's adjusted WACC, calculate each project's Adjusted PV Inflow and Adjusted NPV, (The PV Outflow is not adjusted in this example because the candidate investments are all current.) When you have finished, the internal projects' highest risk and lowest risk have been incorporated into the internal calculation of net present value of each individual project while the firm's overall WACC has been preserved.

Project	PV Outflow	Risk	Adjusted WACC	Adjusted PV Inflow	Adjusted NPV	Required Resources
Old Portfolio	3000	m	9%	4000	1000	300
Able	200	vh	11%	225	25	20
Baker	125	h	9.4%	138	13	23
Charlie	175	m	9%	194	19	8
Delta	150	l	8%	165	15	15
Echo	150	vl	7%	172	22	15

Sixth, choose the combination of candidate projects with the largest NPV. The Adjusted WACCs lower the Adjusted NPVs for the risky projects and the raise the Adjusted NPVs for safer projects. If resources for new projects are limited to 300 investment units and 33 people, the choice for the best candidates has shifted to Delta and Echo, with a total Adjusted NPV of 37 and a resource total of 30.

Seventh, after you have selected candidates based on their relative risks, you should add them to the current portfolio. In the portfolio, you should make the conservative formal assumption that all projects have the firm's WACC of 9%. (You might want to preserve a note on their lower risk status–the "l" and "vl" in the table below).

Project	PV Outflow	Risk	Adjusted WACC	Adjusted PV Inflow	Adjusted NPV	Required Resources
Old Portfolio	3000	m	9%	4000	1000	300
Delta	150	l	9%	162	12	15
Echo	150	vl	9%	170	17	15

The portfolio modified for individual project risk
In summary, this simple, informal method allows you to:

- Use the internally assessed differences in project risk
- Select the best new candidates for the portfolio
- Preserve the influence of the externally derived WACC

(This method blurs the distinction between the candidate project's risk variance and co-variance with the market. We used the informal method because we lacked the internal data to calculate the co-variance.)

The Full Portfolio Review of Small Projects

The full portfolio review
You can use the same method to reassess the entire current portfolio to be sure all projects continue to have a positive net present value and remain the best possible combination of choices.

To understand the process, consider a current portfolio with five current projects and five candidate projects. The one new feature is a distinction between the PV Outflow and the Current Investment. The PV Outflow is the present value of the total investment in the project and a good estimate of its size. The Current Investment is the amount required from your current funds and, if your funds are constrained, the amount you must spend optimally.

Step 0 in the process is to revise and update the business model for every old project.

Steps 2 through 5 make sure that the current internal informal risks have been assessed and the projects' PV Outflows, WACCs, PV Inflows, and NPVs have all been adjusted. Use the PV Outflow to weight each project and adjust the WACCs so their weighted average is close to the firm's 9% [13].

Project	PV Outflow	Risk	Adjusted WACC	Adjusted PV Inflow	Adjusted NPV	Required Resources
Old Port A	300	vh	11%	325	25	30
Old Port B	200	h	10%	220	20	23
Old Port C	100	m	9%	115	15	8
Old Port D	200	l	8%	235	35	25
Old Port E	300	vl	7%	340	40	35
Able	200	vh	11%	225	25	20
Baker	125	h	9.4%	138	13	23
Charlie	175	m	9%	194	19	8
Delta	150	l	8%	165	15	15
Echo	150	vl	7%	172	22	15

Because all the projects have positive NPVs all should be selected. But if you are constrained to 360 units for current investments and to 153 people for project work, you must choose a limited combination of projects for the portfolio. The table below shows the necessary data on your two constraints, Current Investment and Required Resources, and the Adjusted NPV that you wish to maximize.

Project	Current Investment	Adjusted NPV	Required Resources
Old Port A	0	25	30
Old Port B	5	20	23
Old Port C	10	15	8
Old Port D	0	35	25
Old Port E	40	40	35
Able	200	25	20
Baker	125	13	23
Charlie	175	19	8
Delta	150	15	15
Echo	150	22	15

When you select that combination of projects that yields the largest total NPV you select **all the old projects and Delta and Echo**. We invest 355 of our 360 units and assign 151 of 153 people. Note that old projects are appealing to continue because they still yield solid NPVs with little or no current investment. New projects, on the other hand, require significant initial investments and must be selected with care.

Conclusion

We have seen that economics has brought several helpful ideas to the task of allocating scarce resources to competing white-collar projects. Economics has shown us that we should:

- *Focus on the long-term benefits of any project* by capturing these benefits in the business model of the results of the project
- *Fully account for the risks of:*
  - *The specific project* by diversifying over 12 or more projects
  - *The firm* by including the beta value for the firm in the weighted average cost of capital (WACC)
  - *The markets* by including both the equity and bond rates in the WACC.
- *Account for the effects of payments in different years* by discounting at the WACC to obtain the present value of a future payment, and by summarizing the results in the net present value
- *Construct a portfolio of projects* by maximizing the total net present value—within existing constraints.
- *Adjust for differing project risks in small internal projects* by an informal method that is consistent with the firm's externally derived WACC.

All of these lessons are supported by a consistent theory and the empirical results from financial markets for the past fifty years.

Economics shows a portfolio manager how to make difficult choices and how to create a portfolio of projects that makes the best use of scarce resources. This portfolio integrates the manager's obligation to maximize stakeholder value and the firm's obligation to create value for its shareholders and society.

Notes

1. When 300 managers across the country were asked for factors causing problems on their projects, the most common answer was "inadequate resources." (See Taylor.) In a our survey, 278 respondents doing project work in ten companies said that only "seldom" was it true that "In our organization we have an adequate number of people to work on our current projects." (See Nevison, February 2000). These numbers speak to a failure of portfolio selection and management. What the ideal might look like is described by Nevison (in Knudson, 2001).
2. For a description of an organizational failure to adequately consider risk in project selection, see (Westney in Knudson, 2001). Only a small minority of our clients have an adequate, ongoing, process for flexibly redeploying people to critical projects.
3. This result is one of the more famous findings in finance in the past fifty years. In their words, "The average cost of capital to any firm is completely independent of its capital structure and is equal to the capitalization rate of a pure equity stream of its class." Quoted in (Copeland and Weston, 1988, page 437).
4. The Capital Asset Pricing Model is a central tenet of modern finance theory. (See Copeland and Weston for a detailed introduction and Young and O'Byrne for an up-to-date commentary on its strengths and weaknesses.)
5. Details on the analytical proof and supporting empirical results by Fama are available in (Copeland and Weston, 1988, pages 184-186).
6. Markets react in two days to either positive or negative announcements. See McConnell and Muscalrella (1985) as referenced in (Copeland and Weston, 1988, page 48).
7. These techniques can employ either brute force or linear programming algorithms. See the program "Diet" for an easy-to-understand brute force approach. See the program "Simplex" for a linear programming solution. Both programs are in (Chapter 8 of Nevison, 1981).
8. If you believe the cash payment (not the EVA) of 12, for example, will continue forever, the value of the infinite flow of benefits discounted at 9% is 12/.09 = 133. The derivation of this formula should appear in any elementary text in finance or calculus. (See Thomas, 1979, pages 381-2). So the cumulative benefit in the example could be the net present value of 133 + 10 = 143 (in year 5), or 143 / (1.09)^5 = 93 (today).
9. Briefly, the method is: compute the portfolio return with its current debt/equity mix and weighted average beta; compute it again with the new stock added, the debt/equity mix adjusted, the beta adjusted; keep the stock if it improves the portfolio. (See Copeland and Weston pages 460, et. seq.)
10. You can derive a beta from the projected future cash flow and the anticipated market growing at S&P 500 historical rates of 11% a year with a 15% standard deviation. This method is of limited value because you must compare a market rising at 11% and a variance of .15^2 to a limited number of fluctuating project future free cash flows. Experts agree that betas are best derived by analogy from historical sources.
11. The WACC in 2001 ranges from 8%–11% for most large U.S. corporations. (Nationality is important because bond rates vary among the industrialized nations.) For a recent source of these WACCs and related figures, see (Young and O'Byrne, 2001, pages 166, et. seq.).
12. A great variety of methods appear in practice. Crawford cites ten companies whose methods include scoring tables, words in categories, strategy tables, probabilistic scenarios, and target strategy ratings. Almost all methods include a financial component, technical considerations, and strategic concerns. (See Crawford in

Knudson, 2001, Table 3.3). For additional ideas, see (Cooper, 1993, Smith and Reinertson, 1998, Wheelwright and Clark, 1992). Oak Associates has recently derived a table for its client practice to "verify" the NPV results on the projects that are candidates for the portfolio. (See *Chartering Winning Projects*, 2001)

13. When reassessing the whole portfolio, the calculation of the Adjusted WACC, the PV of the Outflow (used to weight the project in the portfolio), and the NPV can require repeated calculation before they converge to stable values. To solve these iterative challenges quickly, use a simple Excel spreadsheet and re-calculate until the results stabilize.

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Appendix: How to Add a Big Project to a Small Portfolio

Directions

1. Assemble the economic constants.
    - The Risk-free bond rate—the prime rate, historically 6%.
    - The forecast market growth rate, historically 11%.
2. Assemble the initial portfolio measures.
    - The corporate tax rate
    - The initial debt financing in the initial portfolio
    - The initial equity financing in the initial portfolio
    - The initial portfolio's leveraged Beta
    - The initial portfolio's weighted average cost of capital
3. Un-leverage the portfolio.
    - The unleveraged equity rate = WACC(current) / (1 - (Corp. tax rate x Debt/(Debt +Equity))
    - Portfolio unleveraged Beta = Beta(leveraged)/(1+(1- Corp. Tax Rate)Debt/Equity))
4. Assemble the candidate project's measures.
    - The candidate Beta (unleveraged if calculated from cash flows)
    - Candidate debt financing
    - Candidate equity financing
    - Candidate projected net cash flows
5. Calculate the combined weighted, but unleveraged, Beta for the new portfolio.
    (Use the total investments for the weighting.)
6. Calculate the combined unleveraged equity rate.
7. Re-leverage the combined portfolio.
    - The re-leveraged combined portfolio equity rate
    - The re-leveraged combined portfolio weighted average cost of capital
8. If the candidate project's net present value is positive using the combined WACC, include the project in the portfolio.

(For additional details, consult: Copeland, Thomas E., and J. Fred Weston, (1988). *Financial Theory and Corporate Policy, Third Edition*, Reading, MA: Addison-Wesley, p. 460, et. seq.)

Please see the worked example on the next page.

Example:

1. Assemble the economic constants.

6.0% Risk-free (prime) rate (inflation rate embedded)
11.0% Forecast market growth = risk-free bond + 5%

2. Assemble the initial portfolio measures.

42.0% Corporate tax rate
28,000 Initial debt
23,000 +Initial equity sold
51,000 =Total initial investment

1.00 Beta(current and leveraged) for portfolio
11.0% Equity rate(current) = risk-free + beta(leveraged) x (market - risk-free)
6.87% Weighted Average Cost of Capital(current) = risk-free x (1-Corp.tax rate) x part debt + equity rate x part equity

3. Un-leverage the portfolio.

8.9% Equity rate(unleveraged) = WACC(current) / (1 - (Corp. tax rate x Debt/(Debt +Equity))
0.59 Portfolio Beta(unleveraged) = Beta(leveraged)/(1+(1- Corp. Tax Rate)Debt/Equity))

4. Assemble the candidate project's measures.

1.00 Candidate Beta (unleveraged from cash flows)
15,000 Candidate debt
15,000 +Candidate equity sold
30,000 =Total candidate investment
Net cash flow
8000 8000 8000 8000 8000

5. Calculate the combined weighted, but unleveraged, Beta for the new portfolio.

43,000 New total debt = Initial debt + Candidate debt
38,000 New total equity = Initial equity + Candidate equity
81,000 New total investment
0.74 Combined weighted Beta = (Initial Invest/New Total Invest)*Portfolio Beta(un-leveraged) + (Candidate Invest/New Total Invest)* Candidate Beta (un-leveraged)

6. Calculate the combined unleveraged equity rate.

9.7% New equity rate(un-leveraged) = risk-free + Combined weighted beta x (market - risk-free)

7. Re-leverage the combined portfolio.

12.12% Equity rate(leveraged) = New equity rate + (1 - Corp. tax rate) x (equity rate - risk-free)x Debt/Equity
7.54% New Weighted Average Cost of Capital = risk-free x (1 - Corp. tax rate) x new part debt
+ Equity Rate(leveraged) x new part equity

8. If the candidate project's net present value is positive using the combined WACC, include the project in the portfolio.

2,173 Net Present Value (using the new weighted average)

About the Author

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