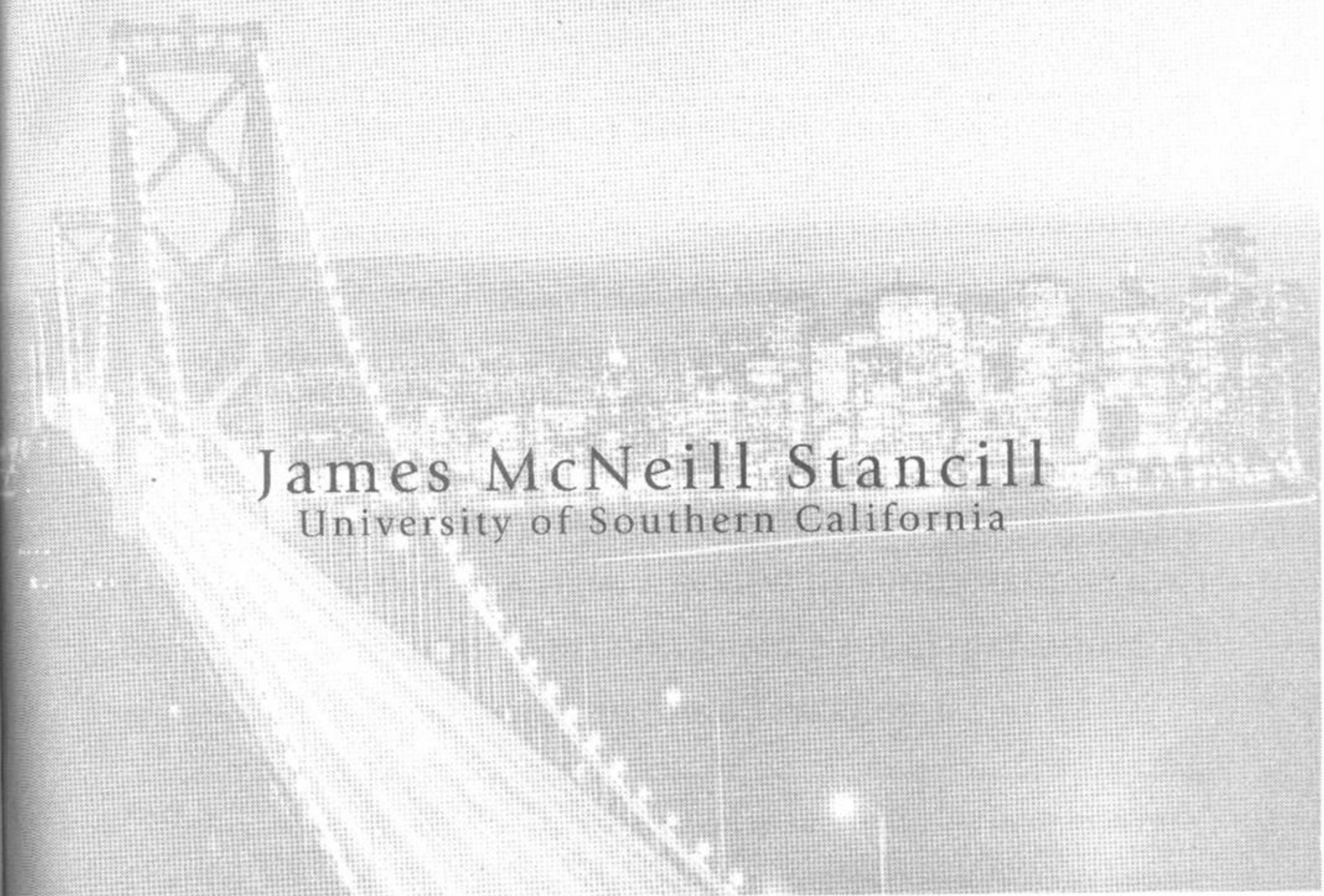
Entrepreneurial Finance

FOR NEW AND EMERGING BUSINESSES



James McNeill Stancill

University of Southern California

THOMSON

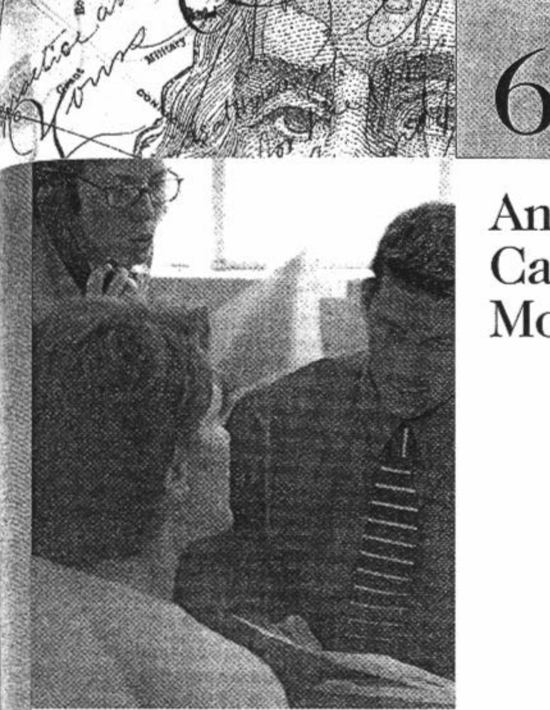
SOUTH-WESTERN

Australia · Canada · Mexico · Singapore · Spain · United Kingdom · United States

TABLE 5.2 Present Worth (Value) of an Annuity of $1

YEAR	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791
6	5.795	5.601	5.417	5.242	5.076	4.917	4.766	4.623	4.486	4.355
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868
8	7.652	7.325	7.020	6.733	6.463	6.210	6.971	5.747	5.535	5.335
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.985	5.759
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814
13	12.134	11.348	16.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.060	7.606
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.312	7.824
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022
18	16.318	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.128	8.514
25	22.023	19.523	17.413	15.622	14.094	12.783	11.654	10.675	9.823	9.077
30	25.808	22.397	19.600	17.292	15.373	13.765	12.409	11.258	10.274	9.427

YEAR	12%	14%	16%	18%	20%	24%	28%	32%	36%	40%	45%	50%
1	0.893	0.877	0.862	0.847	0.833	0.806	0.781	0.758	11.735	0.714	0.690	0.667
2	1.690	1.647	1.605	1.566	1.528	1.457	1.392	1.332	1.276	1.224	1.165	1.111
3	2.402	2.322	2.246	2.174	2.106	1.981	1.868	1.766	1.674	1.589	1.493	1.407
4	3.037	2.914	2.798	2.690	2.589	2.404	2.241	2.096	1.966	1.849	1.720	1.605
5	3.605	3.433	3.274	3.127	2.991	2.745	2.532	2.345	2.181	2.035	1.876	1.737
6	4 111	3.881	3.685	3.498	3.326	3.020	2.759	2.534	2.339	2.168	1.983	1.824
7	4.564	4.288	4.031	3.812	3.605	3.242	2.937	2.678	2.455	2.263	2.057	1.663
8	4.968	4.631	4.344	4.078	3.837	3.421	3.076	2.786	2.540	2.331	2.108	1.922
9	5.328	4.146	4.617	4.303	4.031	3.566	3.184	2.868	2.603	2.379	2.144	1.948
10	5.651	5.216	4.833	4.414	4.193	3.682	3.269	2.930	2.650	2.414	2.368	1.965
11	5.988	5.453	5.020	4.656	4.327	3.776	3.335	2.978	2.683	2.438	2.185	1.977
12	6.194	5.660	5.197	4.793	4.439	3.851	3.387	3.013	2.708	2.456	2.196	1.985
13	6.424	5.842	5.342	4.910	4.533	3.912	3.427	3.041	2.727	2.468	2.204	1.990
14	6.628	6.002	5.468	5.008	4.611	3.962	3.459	3.061	2.740	2.470	2.210	1.093
15	6.811	6.142	5.575	5.092	4.675	4.011	3.483	3.076	2.750	2.484	2.214	1.995
16	6.974	6.265	5.669	5.162	4.730	4.033	3.503	3.088	2.758	2.489	2.216	1.997
17	7.120	5.373	5.749	5.222	4.775	4.051	3.518	3.097	2.763	2.492	2.218	1.998
18	7.250	6.467	5.818	5.273	4.812	4.080	3.529	3.104	2.767	2.494	2.219	1.999
19	7.366	6.550	5.877	5.316	4.844	4.097	3.539	3.161	2.770	2.496	2.220	1.999
20	7.461	6.623	5.929	5.353	4.870	4.110	3.546	3.113	2.772	2.497	2.221	1.999
25	7.840	6.873	6.097	5.467	4.948	4.147	3.564	3.122	2.776	2.499	2.222	2.000
30	8.055	7.003	6.177	5.517	4.979	4.160	3.569	3.124	2.778	2.500	2.222	2.000



6 An Entrepreneurial Capital Budgeting Model

In the previous chapter we discussed growing the firm. One of the main ways of growing by internal means is capital budgeting. As a review, we discussed the traditional capital budgeting approach and noted that while it may be quite appropriate for large companies, it could be a disaster for new and emerging companies like the ones we deal with. In this chapter we expand the model to take into account more than one discriminant—rate of return—and develop an entrepreneurial capital budgeting model.

WHAT MAKES AN "ENTREPRENEURIAL" MODEL DIFFERENT?

Conventional financial wisdom takes the approach that all one has to do to select a capital budgeting proposal is to make sure that the proposal has a positive net present value or, alternatively, that the proposal has an Internal Rate of Return greater than the firm's cost of capital.

Some years ago, a friend of mine took over a fairly high-tech firm that was struggling. The first thing he did was to get an evaluation of the proposals the company had in its research pipeline. One particular proposal, a piece of computer peripheral equipment, had an unusually attractive Internal Rate of Return. "Let's do it!" the new chief executive exclaimed. Here indeed was a proposal that had a better rate of return than the firm's cost of capital, however calculated. The only trouble with this proposal was that it had a time shape of the cash flow that was the quintessence of a "Mañana" deal. It had a very heavy *negative cash flow* in the early periods, and only after a considerable investment of money and time would it have a positive cash flow. And cash flow was the major problem the company faced.

When management asked their bank for more money, they were rather emphatically declined. The company tried to generate the funds internally and, later, with an issue of convertible bonds, but it was not enough. Some time thereafter the company filed for bankruptcy. How could this happen? Didn't management do as they were supposed to do? They invested in a proposal that had a great rate of return—much greater than its cost of capital.

With General Motors it wouldn't matter that the proposal took quite a bit of cash, but with this company it made a great deal of difference. Management forgot about the time shape of the cash flow. This incident had a major impact on the way I look at capital budgeting; it brought the realization that there are more things to examine in a proposal than just its rate of return. The time shape of the cash flow must be included in the analysis for a middle-market or entrepreneurial firm. The implicit assumption that enough money would be available—assumed with usual capital budgeting models for major companies—simply is not correct.

Remembering the lesson that Harry Markowitz taught us over 40 years ago: What about the risk of getting a rate of return for a *set* of proposals? Would considering proposals in a set or group rather than individually make any difference in the proposals selected? In order to answer these queries, it is necessary to consider more than just one discriminant; it is necessary to consider multiple discriminants.

If one were doing the capital budgeting in order to fill the earnings gap, as discussed in Chapter 5, why not explicitly consider the expected earnings that a set of proposals would produce? Obviously, making earnings is not as important to a developing firm as its cash flow; you run on cash, not *earnings*. It would still be useful to see if a set of proposals could fill the earnings gap as management would hope. If we can add the time shape of the cash flow to the model, we can also add earnings.

GETTING STARTED: FORMAT FOR COMPARISON

Before describing the mathematical/computer model, let me reassure the non-mathematical/computer person that it is necessary to develop this model formally and then we can talk about the lessons that can be learned from the model and how we can use it even if we don't computerize it.

In order to use this model (consideration of a set of proposals) it is necessary to present all proposals in exactly the same format. This is done in order to be able to add column totals; this process also makes it easier to organize the data needed for a proposal. Each proposal should be presented with an Income Statement, a Balance Sheet, and a Cash Flow Statement. Each statement should have a high, a low, and a most likely estimate. Furthermore, each statement should have the same time periods: a "time zero" column (t_0), with the first year expressed quarterly and yearly after that for however long the project will last.[▲] Additionally, each proposal will have both a very brief write-up describing the proposal and then a longer description. The brief description could be, preferably, a one-sentence statement. Once the proposals are presented in this format, the next step would be to obtain the Internal Rate of Return (IRR) for *each version* of a proposal.

CALCULATING A PROPOSAL'S INTERNAL RATE OF RETURN

One of the most confusing aspects of capital budgeting for many people is the question "What cash flow do you discount?" Fortunately, we have an answer for that in that we have Cash Flow Statements, for all proposals. Refer to Item 7, the Net Change in Cash and Money Market Securities, which is the cash flow that is discounted to time zero (t_0), in order to get the IRR for each version of a proposal. When doing this, however, you may feel that you are violating one of the tenets of finance: Separate the financing from the investing decision. But this premise is not valid when a proposal brings along its own financing.

For example, if a firm is contemplating the construction of a new building for expansion, and it fully intends to secure long-term financing for the project, why not calculate that proposal's IRR *with the financing in place*? Or, a proposal may involve buying a piece of machinery on which the manufacturer offers financing of two-thirds of the purchase price, and the firm intends to accept that financing. It doesn't make sense to view the rate of return on either proposal as though the firm were going to use all equity financing. Admittedly, in any large organization, it might make sense to separate the financing from the investment as the firm may have access to unlimited funds at rates lower than subordinate divisions can get, but a developing firm cannot make this assumption.

Similarly, if a proposal involves receivables and inventory and the firm intends to borrow against these assets, the proposal should reflect this and not pretend that this type of financing would not be used. In most cases, it would seem like the inclusion of "bring-along financing" would result in a *higher* rate of return than if all equity financing were assumed. But this is beside the point. *If* the proposal's IRR is greater because of this inclusion—and this is the way the firm intends to act—why would it want to evaluate the proposal as though it did *not* intend to accept the financing offered? By including this "bring-along financing," I am not, however, suggesting that *all* financing—for example, the working capital financing needed over and above this "bring-along financing"—should be likewise included.

▲ Later, there will be a discussion of how to compute the optimal tenure for a proposal.

DERIVING THE IRR

Once the IRRs for the three versions of the proposal are derived what results is a low IRR, a high IRR, and a **modal IRR**—because the "most likely" version is really a mode. And indeed it should be a modal estimate. People do not think in terms of *means* but rather modes when the distribution is skewed. When the distribution is "normal," the mean and the mode are equal, so it does not matter. But it would be foolhardy to assume that *all* capital budgeting cash flow distributions are normal. In fact, it would seem that most proposals would have a skewed distribution, either right or left. We do need a *mean* value in order to work with most probability tables, but we can define the mean if we know the range and modal value. To do this, we employ a Beta distribution to calculate the mean value, e_i, of the IRR of the i^{th} proposal. Thus the "mean IRR" (or the Expected Rate of Return, ERR, or e_i) can be approximated by the following:

$$e_i = (a_i + 4m_i + b_i)/6$$

a_i = the IRR for the "low" version

b_i = the IRR for the "high" version

m_i = the IRR for the "most likely version"

The Standard Deviation is given by:

$$\sigma_i = \sqrt{\frac{(b_i - a_i)^2}{3}}$$

For example, if a proposal had an a_i of 10 percent, a b_i of 40 percent, and a m_i of 15 percent, then its *mean* IRR would be:

$$[10 + 4(15) + 40]/6 = 18.3\%$$

Since this distribution is skewed to the right, the mean is *greater* than the mode. People who derive the financial data that goes into a proposal do not have to *estimate* the mean in this situation, thanks to this handy formula. The standard deviation for this mean would be:

$$\sigma_i = \sqrt{\frac{(40 - 10)^2}{36}} = 5\%$$

Now that we have the ERR, (e_i) for a single proposal and its standard deviation, σ_i, we can proceed to the next step.

STEPS IN THE COMPUTER MODEL

STEP 1

Once we have the ERR for each proposal, we can start to form sets and begin the model. The model will take all permutations and combinations of all the proposals and calculate the "Expected Rate of Return for a Set of Proposals" or what we will call $\overline{R}$. Thus:

$$\text{Opt. } \overline{R} = \sum_{i=1}^{n}\left(e_i\frac{w_i}{K}\right) + \left(\frac{K - \sum_{i=1}^{n} w_i}{K}\right)\rho$$

$\overline{R}$ = the rate of return for a *set* of proposals

e_i = the ERR for a single proposal, i

w_i = the "Time Zero" (t_0) value of Item 7, Net Change in Cash, for the i^{th} proposal

K = the amount of capital available for capital budgeting

ρ (rho) = An "Opportunity Cost" for money not invested in proposals

Now for an explanation of the model. The first part of the equation above merely says that you want to get the weighted ERR for a set of proposals. The present computer model for this simply calculates all permutations and combinations; it would seem that this problem is a natural for an integer (linear) programming (IP) model, but considering the relatively small number of proposals that a firm would have and considering the speed of today's computers, it hardly seems necessary to use an IP technique.

Weighting the Proposals' ERR

It would not make any sense to simply take an *unweighted* mean of a set of proposal's ERRs, because proposals come in all sorts of sizes. How to weight these proposals when combining them is an open question. I have chosen to weight these proposals by the percentage of the firm's capital budget (K) that a proposal requires initially. For example, if a firm had $1 million for its capital budgeting, and a proposal used $100,000 as its initial or going-in cost, then that proposal would be weighted at 10 percent. Naturally, the initial or "going-in cost" may be only the tip of the iceberg, so to speak. A proposal may require large amounts of additional capital once it is started. This is true, but it is something that will be accounted for in a third discriminant—the time shape of the cash flow. Admittedly, this confuses the weighting process, but until a better way comes along, the weighting will be done according to the amount of initial capital a proposal uses.

The Second Part of the Objective Function

It is entirely likely that when a set is formed, that set might require more *initial capital* than the firm has available ($\Sigma w_i > K$). This is accounted for in the second *step* of the model, but what if the set takes *less* than K ? This entirely possible eventuality is accounted for in the second part of the objective function. In this expression, the sum of the w_i's ("going-in costs") is subtracted from K and this amount is divided by K in order to get it weighted properly. This amount is then invested at a rate of ρ. This is the "opportunity cost" of money in the developing firm.

For example, if a firm has redundant money market securities—money that it does not need in the business at the moment—then its *rho* would be the rate of return it is making on those money market securities. Or, suppose that the firm does not have any such money market securities and is, instead, borrowing from a bank at 12 percent. For this firm, it appears that its opportunity cost of money is at least 12 percent. And if the firm feels that it is "loaned up" at its bank, but if it had more money available, it could expand sales and profitably invest in more receivables or inventory. In this case, the firm may feel that it has an opportunity cost of something like 30 or more percent! Whatever percentage the firm uses, this will be its *rho*. And keep in mind that one *set* of investment proposals would be to invest *all* of K at this rate of *rho*. So, this rate of *rho* is a kind of cut-off rate of return; if a *set* of proposals does not earn at least this rate, then it would not be acceptable.▲ Its rate of return would have more risk than *rho* and less return. Remember, this admonition applies to the rate of return for a *set* of proposals ($\bar{R}$), *not* for any individual proposal. So, to summarize the first equation, $\bar{R}$ is the rate of return for a set of proposals which includes the weighted rate of return for the individual proposals in the set, $e_i\frac{w_i}{K}$, *plus* the weighted rate of return for the money left over.

STEP 2

The next step is simply a constraint that you do not spend more money than you have. This is shown in the equation:

$$\Sigma w_i \leq K, \text{ your capital budget}$$

The w_i's are readily available from Item 7 (Net Change in Cash), Time Zero (t_0) column of the Cash Flow Statement for each proposal.

STEP 3

In this step we take account of the time shape of the cash flows of the *set* of proposals. Because we have as input for each proposal a Cash Flow Statement with

▲ Some might like to call this rate the firm's "cost of capital." I prefer to simply call it an "opportunity cost" since it is just that, and this avoids the troublesome problem of trying to calculate a "cost of capital" for the firm in question, especially if the firm is privately held.

the first year expressed quarterly, we can algebraically add the amounts in Item 7 of the Cash Flow Statement to see, in each quarter, what the implications would be to the firm's cash account *if* that set of proposals were accepted. If the amount in a given quarter is *positive*, there is no worry. But if the amount in a quarter is *negative*, this could have serious implications for the company's cash position. Fortunately, there is a rather simple way of testing to see if a negative amount for any one quarter would exceed the amount of money the firm would have available to service a set of capital budgeting proposals in a manner of speaking. But just comparing the mean cash balance for a set of proposals ($\bar{X}$) to A (the amount of cash available for the quarter) would be statistically inappropriate because $\bar{X}$ is merely the *mean* dollar amount of a distribution with a positive standard distribution.▲ We can check to see if $\bar{X}$ is statistically significantly different from A, however, with a simple one tail *mean difference test*. Thus:

$$\left(\frac{A_{1-4} - \bar{X}_{1-4}}{S_{1-4}}\right) \leq Y_p$$

Where A_{1-4} is a subjectively set dollar amount (actually a negative dollar amount) that management feels could be devoted to servicing the negative cash requirements of a set of proposals for each quarter, 1–4.

> $\bar{X}_{1-4}$ is the *mean* cash balance for a *set* of proposals for each quarter, 1 to 4, derived by adding the mean cash balance for each proposal in a set.
>
> S_{1-4} is the standard deviation of this cash balance mean.
>
> Y_p is the number of standard deviations that $\bar{X}$ is below the available amount of money. We can then use this number Y_p to find the area in the tail of a normal distribution as shown in Exhibit 6.1.

If, for example $\bar{X}_1$ were \$400,000, A_1 were \$600,000, and the standard deviation were \$200,000, there would be approximately a 15 percent chance that the *actual* cash balance for that set of proposals for the first quarter would be greater than minus \$600,000. In this case Y_p would be equal to 1 and from Exhibit 6.1, a standard deviation (Y) of 1 means that there is a probability of 0.1587 that the actual change in the cash balance would be greater than A_1. In short, it is necessary to check to see if $\bar{X}$ is *statistically significantly different* from A with a certain probability. In this example, if management specified that they were willing to take a 15 percent chance of going below A (hurting the company's cash balance) in any one quarter, then that set would pass this "cash insufficiency" test for the quarter in question. Obviously, management is in a position to specify the chance they are willing to take of hurting or killing the

▲ If X were a straight line projecting upward, it would have a standard deviation of zero. This would be, indeed, a strange distribution. One should not make the mistake of assuming that just because X is less than A, there is *no* probability of the *actual* amount being greater than A.

EXHIBIT 6.1 "Right Tail" Area under the Normal Probability Distribution

(Y REFERS TO THE NUMBER OF STANDARD DEVIATIONS FROM THE MEAN OF A NORMAL DISTRIBUTION WITH A MEAN OF ZERO AND A STANDARD DEVIATION OF ONE.)

Y	0.00	0.05
0.1	0.4602	0.4404
0.2	0.4207	0.4013
0.3	0.3821	0.3632
0.4	0.3446	0.3264
0.5	0.3085	0.2912
0.6	0.2743	0.2578
0.7	0.2420	0.2266
0.8	0.2119	0.1977
0.9	0.1841	0.1711
1.0	0.1587	0.1469
1.5	0.0668	0.0606
2.0	0.0228	0.0202

company's cash balance based on what resources the company has available *if* A is broached. For example, if the firm has an unused line of credit at its bank, the company's management might be willing to take a larger chance of exceeding A than if the company's management felt strapped for cash or, simply had no outside means of obtaining more cash quickly.

STEP 4

Step 4 deals with the question of why we are doing this capital budgeting in the first place. You will remember from the last chapter that we are talking about *growing the firm*. By this we mean "filling the earnings gap." But up to this point this model has not even touched on the matter of earnings. True, we do not want to calculate a proposal's rate of return using earnings, but it would be quite informative to know whether or not a set of proposals is providing the earnings necessary to fill the earnings gap. Do we have that information? Indeed we do.

All we have to do is to calculate a **mean earnings** for each proposal and then *add* these mean earnings when we make up a set. The sum of these mean earnings would then be the mean earnings for a set, which is precisely what we want when we are looking to see if a set of proposals fills the earnings gap. Once we get this mean earnings ($\overline{X}'$) and the standard deviation of the mean ($\overline{S}'$), we can then compare this mean to that amount of earnings that we need to fill the earnings gap, called E. Then we can use a **mean difference** test similar to what we did in Step 3. Thus:

$$\left(\frac{X' - E}{S'}\right) \geq Y_p$$

In this equation we can calculate Y and then by referring to Exhibit 6.1, we can see if the *mean earnings* (X') are statistically significantly greater than E, the amount of earnings that we specified as being needed to fill the earnings gap.

Note that we are treating earnings for the year instead of quarterly, as we did for the cash balance. While we might not want to use yearly data for cash (you need to know your situation sooner or more often), it does not seem prudent to use quarterly data for earnings. Why throw out an otherwise good set of proposals just because the set has insufficient earnings for a particular quarter, yet has sufficient earnings for the year as a whole. On the other hand, if some management wants to check *quarterly* earnings the data is available and the technique is the same as for the Step 2.

STEP 5

Up to this point we have not mentioned the risk of getting the rate of return for a set (R). For a number of years, I, like most academics in finance, was thinking that we needed to calculate the risk of getting the rate of return for *each* proposal and compare this to some standard. It was then that I remembered the point that Harry Markowitz made in his famous work on portfolio management.▲ This was the fact that in a portfolio of securities, it was possible to have *less* risk of getting the rate of return on a *set* of securities than one might have on any one security in that portfolio. The reason for this was simply the concept of **covariance**, defined as equaling the Coefficient Correlation × the standard deviation of the rates of return $_{i...n}$. This concept of covariance is often forgotten.

In a set of capital budgeting proposals we do not care if we minimize the risk of getting the rate of return, as in a portfolio of securities, because we would like for *all* the proposals in a set to go up if they can. Thus we do not want the coefficient of multiple correlation to be used where it runs from 1 to −1. What we want is a measure of dependence/independence that runs from 1 to zero.▲▲ We will call this the **Index of Diffusion** (d) and we will then multiply this coefficient by the risk of getting the rates of return, weighted, for the proposals in the set to get what is called the **Coefficient of Diffusion** (D) for a set. Thus:

$$D = d\sum_{i=1}^{n}\left(\sigma_i \frac{w_i}{K}\right)$$

Deriving the Index of Diffusion

To derive d, the Index of Diffusion, it is necessary to look at the proposals in a set and subjectively estimate d. If the proposals in the set seem to be quite tied into one another, the d would be given a number close to 1, perhaps .9 or .85 or .95. Or, if the proposals seem to be quite independent of each other, then d would be close to zero: .1 or .15 or .05. If the proposals seem to be somewhat

▲ The source of my remembering was an article by James VanHorne, "Capital Budgeting Decisions Involving Combinations of Risky Investments," *Management Science* (October 1966) B84–91.

▲▲ I wish to thank my colleague Professor Dolores Conway for suggesting this approach.

dependent to each other, perhaps a d of .5 or .6 or .4 would seem appropriate. The way the computer model is written currently, when all the permutations and combinations are calculated, the sets that pass through the first four screens are then presented in a way that gives the analyst a one-sentence statement about each proposal in the set. This is the reason that two explanatory statements are presented with each proposal: a reasonably complete explanation of the proposal and then the short, possibly one sentence, description sufficient for the analyst to recognize the proposals in the set. The analyst is then able to make an assessment of the *combined* risk of getting the rate of return for the proposals in a set.

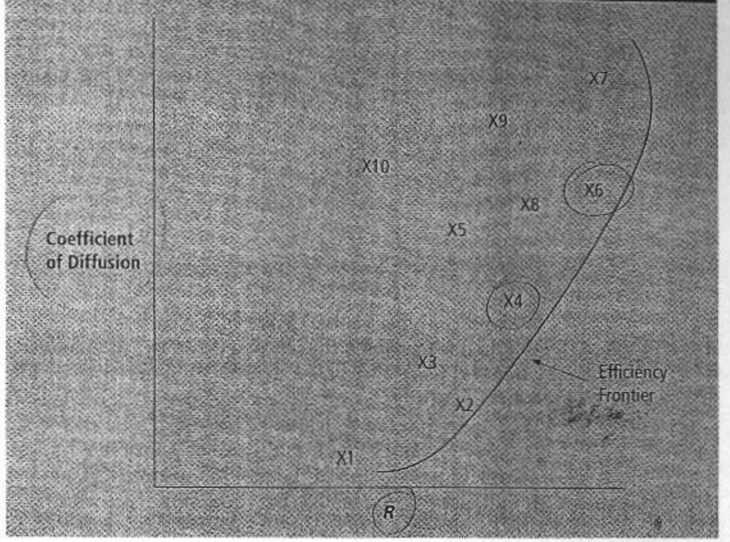
For example, if a firm had a fairly flat organization and had four branches in cities in the four corners of the country—say Los Angeles, Seattle, New York, and Atlanta—and if a set came up with five proposals, four of which were from the Seattle branch, this would seem to mean that there was a high degree of *dependence* between proposals, or a d of, say, .90. If something happens to the Seattle market, all four of the proposals would be in trouble. Contrast that with the situation of five proposals in a set, one each in New York, Atlanta, and Los Angeles, and two proposals in Seattle. Or, in a one-plant situation, all the proposals in the possible set are such that they are quite independent from one another. Of course, one might logically argue that because all the proposals were in the one company, that all sets had a high degree of risk. While this is conceptually true, it might be argued that there are *shades* of dependence/independence that are relevant here.▲

Thus, D is now the risk of getting the rate of return for a set of proposals. This concept has very interesting implications for a set of proposals. For example, suppose that a firm has a host of really low-risk proposals, all quite interrelated. Management might think that by carefully screening each proposal they are actually *reducing* the risk to the company. But if these proposals are interdependent, the d for that **set** would be quite high, possibly .9 or .95. This means that the *product* of d and the sum of the σ's would result in a Coefficient of Diffusion that could be quite high—even though the component proposals are quite low in risk of getting the rate of return.

Another example would be the case where the firm has a set of proposals that, individually, are really high risk. That is, the proposals have a high risk of getting the rate of return for each proposal. At first blush, one would think that that *set* would be a risky set, but suppose these proposals are quite *independent* of each other. Because of this variation of the concept of covariance, which we are calling Coefficient of Diffusion, the d in this case would be actually quite small, .1 or .15 or .05. Therefore, when you multiply the rather large sum of the (large) σ's by a rather *low* Index of Diffusion (d), the Coefficient of Diffusion is now quite small, or at least reasonable. Understanding this principal can be

▲ I think it would be a mistake to try to refine the process of obtaining the d by mathematical means. We are dealing with something that is quite subjective and to try to make it more "scientific" would be specious.

EXHIBIT 6.2 Map Showing Different Sets Plotted Against Their Coefficient of Diffusion (D) and Their Rate of Return ($\bar{R}$)



most useful in the real world of financial management for it tends to be somewhat counterintuitive.

Plotting the Sets

Once the d of each proposal in the sets is determined, and the Coefficient of Diffusion is calculated for each set that screens through the first four steps, the surviving sets can then be plotted on a map the relates the Coefficient of Diffusion of a set (D) with the expected rate of return for a set ($\bar{R}$). See Exhibit 6.2

In this figure we see the various possible sets, *X1. . . X10*, sets that passed through the first four steps, plotted against their Coefficient of Diffusion and their $\bar{R}$. The line that envelopes the outside sets is called the **Efficiency Frontier.** The only sets that should be selected lie on or close to this Efficiency Frontier. For example, *X3* would not be selected because *X2* has *a higher* rate of return and a *lower* risk. Similarly, *X4* and *X9* have approximately the same $\bar{R}$ but *X9* has much higher risk of getting this rate of return. Which set should management select? This depends on their preference for risk and return—which , of course, depends on the condition of the firm and management's desires. Offhand, it appears that *X4* or *X6* would be the most likely sets selected. *X4* has less $\bar{R}$ than *X6*, but it also has less risk of getting that rate of return. *X6* has more $\bar{R}$ than *X4*, but it has *proportionately* more risk. So take your choice!

Accuracy of the Estimate

While it might seem to some that *subjectively* estimating d, the Index of Diffusion, would be quite questionable, in practice the effect is not particularly bad. For example, if $X2$ had an estimated d that was more than it should have been, the locus of $X2$ would have been somewhat higher than it is shown. But it would not be a lot higher if the d were only .25 instead of .15. $X2$ would still be relatively better than $X3$, for example, and in the overall map its relative position would be about the same. Remember, even though d is estimated in the calculation of the Coefficient of Diffusion, nothing happens to $\bar{R}$. Therefore, any error in estimating d will only be reflected in an *upward* or *downward* movement in the position of the set on the map.

Using the Model Without a Computer

Up to this point, the discussion of the entrepreneurial multiple-discriminant model has presumed the use of a computer model to select sets of proposals and then place them on a map relating the Coefficient of Diffusion and $\bar{R}$. While it is true that computers have pervaded every aspect of the workplace, the lesson that can be learned from this model can be applied even *without* a computer—even if the firm utilizes *ad hoc* capital budgeting procedures. The complete explanation of the model was necessary to establish the theoretical foundation for the model, but the commonsense aspects of the model can—and should—be used by any manager who is passing judgment on capital budgeting proposals. To illustrate this, let's walk through the model.

Ideally, the company should do its capital budgeting at periodic times so that a number of proposals would be available for selection. But life being what it is in new or emerging firms, there may be a practice of *ad hoc* capital budgeting, or examining individual proposals as they come up. Remember, however, that even if we have only one proposal for consideration, the "other" proposal is the firm itself.

STEP 1

When examining a proposal the first question that presumably would be asked is, What is the expected rate of return? Whatever the answer, this proposal would be judged by the ERRs of other proposals submitted recently. For example, if someone said that the ERR was only 12 percent, the logical reply might be "Why even present it? If it were, for instance, 45 percent this would be a different matter."

STEP 2

Next, the question to ask is, What is the "going-in cost"? How much will it cost to get started with this proposal? If the amount is within the budget of the company, then proceed to the next step.

STEP 3

If the firm can afford the "going-in cost" (equal to Item 7, Net Change in Cash, for the t_0 time period or the firm's cash balance that could be utilized), then the next question is whether or not the proposal will hurt the firm's cash position in the upcoming year—and beyond, if need be—if it were accepted. What is the *time shape of the cash flow* for this proposal? Is it a real *Mañana* type of deal (see page 124), such as a research and development type of proposal, or is it something like the "smooth and steady" cash flow pattern that is characteristic of a cost-saving proposal such as a new conveyor system. Would the firm's cash balance be able to absorb a real negative cash balance for the proposal for the first few quarters—or beyond?

Doing *ad hoc* capital budgeting is not the best approach although it is extremely pragmatic. And this third step is a good illustration as to why it is useful—and important—to consider a number of proposals at one time. If two or more proposals were presented at the same time, the negative *time shape of the cash flow* of one proposal might be offset by the good cash flow of another proposal(s). This may be thought of as the **Portfolio Effect** of the model. So, in the vernacular, this third step asks the question, Are we going to kill the company's cash flow if we accept this proposal?

STEP 4

Next it is useful to ask, If we accept this proposal, will we be helping to reach our earnings goal necessary to fill the earnings gap? How much importance is placed on this criterion depends on the company itself. Is the company privately owned or is it publicly owned? What are the earnings of the other proposals we have accepted in this period? Although earnings are important—and ultimately the *raison d'être* for the whole capital budgeting process—they are not the same as cash flow in that without cash the firm could be forced into a grave position. If a proposal has a really good ERR, and an *acceptable time shape of the cash flow*, it may be that the firm can take it, knowing that the earnings will come sometime—assuming that is not too distant.

STEP 5

Doing *ad hoc* capital budgeting would seem to negate the important fifth step, the notion of the risk of getting the rate of return. We called this the Coefficient of Diffusion for a set of proposals. But what does one do if there is only one proposal to consider? As mentioned above, the answer to this conundrum is that there is *always a second proposal: the firm itself*. In fact, it is wise to consider the firm itself when estimating d in the Coefficient of Diffusion. So it is possible to ask questions like "Is this proposal like the last few proposals we have accepted? And if we take this proposal will we exacerbate or help the overall risk for the company?" If the proposal under consideration is quite like the last four or five proposals accepted, it does not take much imagination to realize that taking another similar proposal would be rather like putting all of one's eggs in the same basket. What if something happens to that division? Or that product line? Or . . .

The Practical Importance of the Model

While the use of a (somewhat) mathematical, entrepreneurial capital budgeting model might seem incongruous relative to the rest of the book, I hope that I have succeeded in showing the importance of *each* step in the model. It would be a lot easier to say, as practically all the textbooks do, that all you have to do with respect to capital budgeting is to accept all proposals that have a rate of return greater than the firm's cost of capital. But to do so would be to forget such important considerations as the *time shape of the cash flow* of a proposal. If the firm takes on a proposal that has such a negative time shape of cash flow that it will put the firm's very existence into question, would it console the manager to say "but the proposal has a return greater than the firm's cost of capital"? What difference does it make if the proposal has an excellent ERR if, by taking it, the firm faces a grave cash insufficiency? Perhaps in General Motors it would not be necessary to worry about such things, but in the real world of managing a developing firm, if management forgets its cash flow, it will most likely be in dire straits.

Likewise, the Coefficient of Diffusion, introduced in this chapter, is an extremely important notion for all capital budgeting decision makers.

The risk of getting the rate of return of individual proposals should not be considered individually.

The covariance principal that Harry Markowitz wrote about 40 years ago should not be forgotten. When the risk of an individual proposal is considered by itself, this notion is violated. A *portfolio* of securities may include securities that have way too much risk in and of themselves, but when placed in the context of a portfolio, the risk is quite acceptable. Only by considering *sets* of capital budgeting proposals together are we able to take advantage of this covariance idea. And trying to manipulate a cost of capital by using higher rates for certain situations, such as cost-saving proposals or, new, creative proposals, still does not do the same thing as considering the proposals in a *set* and considering that set's Coefficient of Diffusion.

Decisions in Evaluating Proposals

It would be absurd to say that *all* situations are covered in this Entrepreneurial Capital Budgeting model. There will always be cases that do not fit the model. For example, there may be situations in which the company can lease the capital asset rather than buy it. Let's consider that possibility.

THE LEASE-BUY DECISION

For many capital budgeting decisions, management has the option of leasing some asset—a piece of equipment or, perhaps, a building—instead of buying the asset that is part of the proposal. How should this decision be made? And should the decision be made before submitting the proposal to the model? The best way to handle this decision is to submit the proposal in *two* versions, one as a "buy decision" and one as a "lease decision." But these versions must be submitted as *mutually exclusive proposals*. If one version is accepted in a set, then it would not be possible to accept the *other* version of the proposal in the same set. In this way the portfolio effect is brought into play. For example, in the *buy* version, let's say the ERR of the proposal is better than it is for the *lease* version. But the time shape of the cash flow for the buy version is distinctly inferior (meaning that it has a larger cash drain) than the lease version. So, in some sets (ones with a cash problem), it would be better to include the proposal as a *lease* version rather than as a *buy* version. Or, the opposite might be true. This points out again the desirability of considering proposals in *sets* and not individually. For example, the buy version might be quite superior in terms of ERR, to the lease version. But if considered in isolation, this version of the proposal might be rejected because of the adverse *time shape of the cash flow* or, possibly, because it takes excessive "going-in cost" (w_i). Coupled with other proposals, however, the higher ERR proposal version might be acceptable. This would be the same situation as a proposal with a poor ERR but with other favorable characteristics: low "going-in cost," favorable *time shape of the cash flow*, or impressive positive earnings. Again the importance of the "portfolio" effect is emphasized.

ABANDONMENT VALUE

Another factor is the optimal length of time that a proposal should run. Is there a way to calculate when a proposal should be terminated? And if so, would this calculation make a difference in the rate of return for that proposal?

Fortunately, there is a relatively simple way to do this. It is called the **calculation of abandonment value**. (See Exhibit 6.3.) All one has to do is to estimate for each proposal at the end of each year a value that could be recovered *if* that proposal were terminated. This means that all receivables would be collected,

EXHIBIT 6.3 Illustration of IRR without Abandonment Value

CASH FLOWS FOR A PROPOSAL

TIME IN YEARS

	t_0	1	2	3	4	5	6	7
IRR = 55%	($45)	$20	25	35	30	40	25	20
ABANDONMENT VALUE =		$40	45	50	65	70	60	30

THE IRR FOR THE PROPOSAL IS 55% WITHOUT INCLUDING ABANDONMENT VALUE.

EXHIBIT 6.4 Illustration of IRR if Abandonment Value Is Considered at End of First Year

CASH FLOWS FOR A PROPOSAL

	Time in Years							
	t_0	1	2	3	4	5	6	7
IRR = 55% W/O AV	($45)	$20	25	35	30	40	25	20
Abandonment Value =		$40	45	50	65	70	60	30
IRR if Abandoned =		33	49	57	60	61	59	57%

all inventory sold, any machinery disposed of in the most profitable way, and all liabilities paid. If this value were then placed beneath Item 7 (Net Change in Cash), on the Cash Flow Statement, then it is possible to calculate an IRR using this value as a type of "scrap value," in the traditional sense. Merely taking the cash flows at the end of each time period results in an IRR of 55 percent. But if the project were terminated after the first year, and the abandonment value at the end of the first year was taken into consideration the IRR is 33 percent. Exhibit 6.4 illustrates this.

If this process is continued, each year dropping down and including the abandonment value at the end of that year, and excluding the remaining years, it is possible to derive the IRR for that strategy. Exhibit 6.4 also illustrates this.

By going beyond the fifth year, the abandonment value decreases, as does the IRR with abandonment value included. Note that by including abandonment value it is possible to get a larger IRR. Five years is the optimal time.

TECHNOLOGICAL OBSOLESCENCE AND DEVELOPMENT

In some industries—computers and bio-science, for example—technology moves so fast that any proposal that promises cash flows beyond some time (3 or 4 years, perhaps) would seem quite impractical. What to do in this case? Simply delete any cash flows beyond the arbitrary cut-off date. This puts a heavier burden on the early years' cash flow, but this is consistent with reality.

The opposite of this situation exists in industries such as the pharmaceutical industry, in which projects may take years to come to fruition. In this case, considering only the first years' cash flow seems quite inadequate. In this case, it is imperative that future years' cash flows be taken into account in using the model. The model does not do this in the present form; to do so would involve modeling the firm in the second year (and, if necessary, still another year or two.) This is necessary because of the cash flow and earnings assumptions. The reason it is necessary to model the performance of the firm is because in the second year another set of proposals would be undertaken and these proposals would influence the firm's cash flow, just as this year's set of proposals would influence this year's cash flow.

SUMMARY

In Chapter 5, it was suggested that there is a need for more than one discriminant in capital budgeting. The three discriminants that were offered in this chapter are the "time shape of the cash flow," the projected earnings, and a measure of risk of getting the rate of return called the "Coefficient of Diffusion."

In contrast to the situation with large corporations, an entrepreneurial company presents special circumstances. For one thing, the time shape of the cash flow, if significant in a negative way, may actually lead to a **cash insufficiency** or worse. This may happen to large companies, but there is much more likelihood of it in smaller, developing firms. The estimate of a set's earnings is useful to see if they can help close the company's "earnings gap."

The other significant addition to the usual capital budgeting model is the risk of getting the rate of return, which we called the Coefficient of Diffusion. This has implications for many managerial decisions. Basically it says that if you add all the risks of getting the rate of return for individual proposals, you can multiply this sum by something called the Index of Diffusion. This index ($1.0 < d < 0$) indicates the relationship of the proposals in the set to each other—and the firm itself. If the proposals are independent, then this Index is close to (but not equal to) zero; if they are highly related, the Index is closer to one. (This is a variation of covariance that Markowitz reminded us to use.) This means that a company can accept proposals involving greater risk of getting the rate of return if the proposals are independent.

Even if the reader never uses a computer to get the optimum set, the model is useful for allowing a manager to ask significant questions about a proposal if the capital budgeting is done on an *ad hoc* basis.

The appendix reviews classic models that a manager is likely to encounter in the course of time—and asks the question "What's wrong with this model?"

QUESTIONS FOR DISCUSSION

1. Take a hypothetical capital budgeting proposal and submit it to the five steps involved in the model.
2. Why doesn't the Entrepreneurial Capital Budgeting model use "cost of capital" to evaluate proposals?

6

CHAPTER REVIEW

Appendix: Alternative Capital Budgeting Models

There are many other capital budgeting models in existence, too many to recap here. But there are two classic models that illustrate what I believe to be errors in logic.

The Hertz Model

This model was developed in the heyday of academic interest in capital budgeting, the 1960s and 1970s. This model, developed by David Hertz, is actually a three stage model developed in two papers.▲

THE FIRST STAGE

In the first stage, a proposal is submitted such that there are nine probability density functions which collectively describe the project. These nine variables are shown in Exhibit 6.5.

EXHIBIT 6.5 Illustration of the Nine Variables in the Hertz Model

▲ David B. Hertz, "Investment policies that pay off," *Harvard Business Review* January–February 1968, 96 ff. and David B. Hertz, "Risk analysis in capital investment," *Harvard Business Review* September–October 1979, 169 ff.

Note that the first four variables really represent Sales, which we entered directly in the entrepreneurial multiple discriminant model. Other variables also are interesting. For example, Hertz has the capital investment as a distribution where we use a point estimate of this for each scenario of a proposal. If one were to consider the investment as the *total* capital investment needed for a proposal, then, in fact, it would be a "distribution." Of course, a "point estimate," that is a straight line projecting upward, is *per se* a distribution. But by "distribution" I mean of the kind shown in Exhibit 6.5. Also, note that Hertz has two variables for what we are calling the "abandonment value." And where we are using point estimates of this "abandonment value," he considers this a variable.

Using a random number generator, a point is picked on each distribution. This, then, defines a *version* of the proposal. By discounting the cash flows associated with the respective versions, one obtains an IRR for that version. If this is done many times it is possible to plot a distribution of these IRRs. This is the process called "Monte Carlo Simulation." By taking the mean of this distribution of IRRs, the mean or Expected Rate of Return (ERR) is found.

THE SECOND STAGE

Once the distribution of IRRs is accomplished, it is possible to make a "cumulative probability distribution" for *each* proposal (Exhibit 6.6).

Then "risk screens" are formed for low-risk proposals, medium-risk proposals, and high-risk proposals. For example, a "low-risk" *screen* might be a 90 percent chance of making at least a 12 percent IRR and a ten percent chance of making at least 20 percent IRR. Once these profiles are derived, and assuming capital rationing, sets are formed from the proposals in each risk pile. Once these sets are formed, they are now plotted on a map that relates the Coefficient of Variation (the *relative* standard deviation to whatever is the independent

EXHIBIT 6.6 Illustration of a Cumulative Probability Distribution

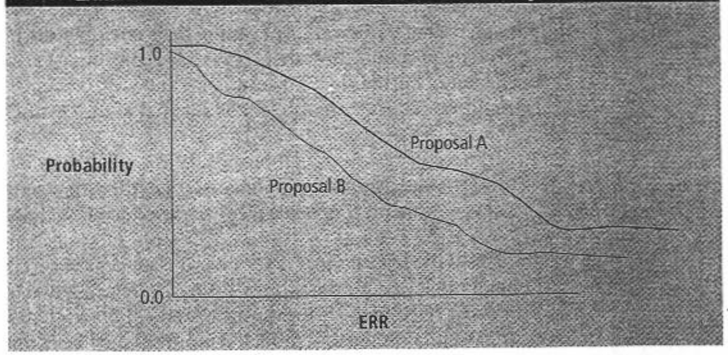
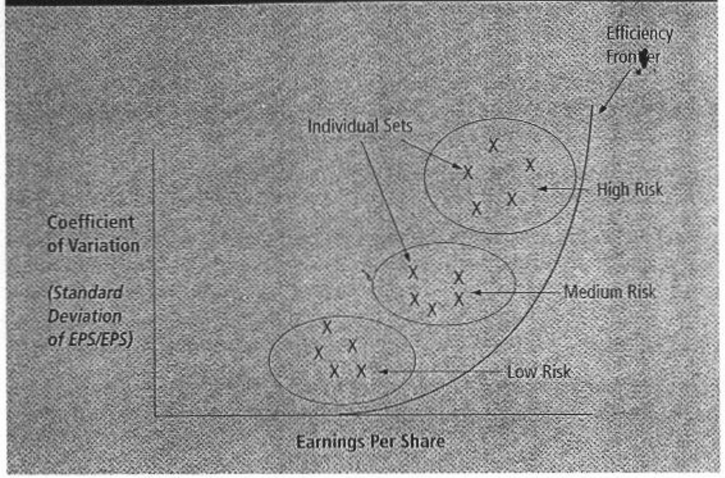


EXHIBIT 6.7 Illustration of Hertz's "Efficiency Frontier"



variable) to expected Earnings Per Share. In this case, the risk coefficient, called the Coefficient of Variation is: Standard Deviation of EPS/Earnings Per Share.

THE THIRD STAGE

In Exhibit 6.7, there are shown sets of low-risk, medium-risk, and high-risk proposals. The only set that should be chosen in each grouping is the set that lies closest to the "efficiency frontier." Any other set would have more risk or less earnings per share.

What's wrong with this approach? By placing the proposals in individual piles according to their risk (of getting their rate of return), you are denying the Markowitz portfolio effect that comes with considering *all proposals in a set*. This is a denial of the idea behind covariance and with reference to the entrepreneurial multiple discriminant model it is a denial of the Coefficient of Diffusion.

By accepting *any* and *all* proposals in a set, it may be possible to get a better return with less risk of getting that return than if proposals were screened for risk first.

This is the reason that I do not use the concept of cost of capital. In conventional models, if a proposal does not have a return equal to or greater than the firm's cost of capital—however measured—it is rejected. But in the Entrepreneurial Capital Budgeting model, a proposal may be accepted because it has a time shape of cash flows that is beneficial to a set, or it may have unusually

good earnings, or, by inclusion, the overall Coefficient of Diffusion might become acceptable where it otherwise would not be—***even if it had an ERR less than the cost of capital.***

WESTON'S CAPM MODEL

Among many financial economists there is a feeling that "financial laws"—that is, principles—that are valid in the investments field are equally valid in any other field of finance, such as corporate finance. When the Capital Asset Pricing Model came onto the screen, a prominent finance professor, J. Fred Weston, tried to show how the CAPM could be used in capital budgeting. This model is a one-stage model.▲

The central idea behind the model is this: If the ERR for a proposal is equal or greater than the required rate of return (RRR) for that proposal, then the proposal should be accepted. The trick is how to get the ERR and the RRR. To get the ERR you make four forecasts of the proposal. Then, he says, you ask the economics department of the firm to determine the probability of the four versions (or scenarios). If you then take the IRR for each version and multiply by the probability of achieving that version and then adding the products you get the ERR for the proposal.

The RRR is determined from using the CAPM:

$$E(R_j) = R_f + [E(R_m) - R_f]\beta_i$$

Where $E(R_j)$ is the required expected return on a security or real investment▲▲ and R_f is a risk-free interest rate. $E(R_m)$ is the expected return on a broad-based market index (a portfolio of securities or real assets.) Presumably, this "market index" is the Standard and Poor's 500 Index. The β_i is a measure of the volatility of the individual security relative to market returns. β_i is measured by the ratio of the covariance of the returns of the individual security with the market returns divided by the variance of market returns.

Thus:

$$\beta_i = \frac{Cov_{i,m}}{Var_m}$$

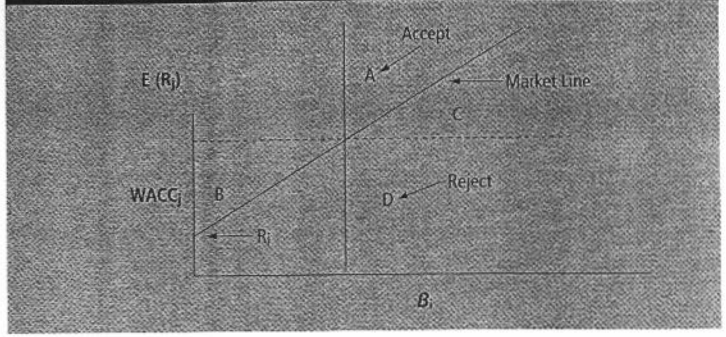
The effect of this model may be shown graphically in Exhibit 6.8. Weston has a rather ingenious way of deriving the covariance of the proposal to the market index▲▲▲ but this means that if the proposal is a new conveyor system, for example, then the variance of this proposal would be compared to the

▲ J. Fred Weston, "Investment Decisions Using the Capital Asset Model," *Financial Management* Spring 1973, 25–33.

▲▲ *Ibid.* p. 25.

▲▲▲ See the paper for details of the calculation.

EXHIBIT 6.8 Illustration of Weston's Use of Investment Hurdle Rates



variance of, for instance, the Standard and Poor's Index. This seems bizarre to me, but this is not what I think is wrong with this model. In this depiction, Proposal *A* would be acceptable both because it has a better return than required from its β, and because it has a return better than its WACC. But if you use the firm's Weighted Average Cost of Capital, *B* would not be chosen. It would be chosen if you use the "Market Line." *C* would not be chosen because it has a lower rate of return than dictated by its β and *D* would be rejected because it fails on *both* criteria.

By screening individual proposals for risk, however, you are denying the idea expressed in the Coefficient of Diffusion—and, of course, *covariance* which is the basis of the Coefficient of Diffusion.

Proposals *B*, *C*, and *D* might be perfectly acceptable if taken in a set, especially if more than one factor is used as a discriminant. In short, like Hertz's model, this model also fails to take account of the *portfolio effect.*

7

Capital Structure and Leverage

Most textbooks treat the subject of financial leverage (also known as trading on the equity, because return on borrowed money exceeds costs) under the title of "Theory of the Capital Structure" or some such term. The chapter title was chosen to include the topic of financial leverage in the same chapter as operating leverage because they both have a similar effect on the firm's Income Statement. This is not to say that they themselves are similar.

It has sometimes been said that you grow a company on its equity. This means that in order to grow, a company has to have sufficient equity to support the debt that comes before it on the Balance Sheet. Taking on debt and contracts that resemble debt, such as lease contracts, is usually associated with, and sometimes needed for, the growth of a company. Internal growth through capital budgeting was discussed in Chapters 5 and 6. In this chapter we discuss the rationale for how much debt—or fixed charges—a firm can have relative to its equity (and cash flow). In short, we are discussing the company's Debt/Equity (D/E) ratio.

What Is Leverage?

Whenever a fixed charge is introduced into an Income Statement, **leverage** results. Leverage means that there will be a *more than proportional change* in the Net