# CORPORATE INVESTMENT AND DISCOUNTING RULES

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SUMMARY. The rules in this paper are designed to take some of the mystery and complexity out of the process of making corporate investment decisions. For example, there is no need to make explicit use of beta or of the discount rate for a risky cash flow. Instead, we can estimate future cash flows under the assumption that the return on the market portfolio is equal to interest in every period prior to the cash flow, and discount these estimated cash flows at the interest rate. We should use after-tax cash flows and an after-tax interest rate. This rule suggests that investment in current coupon bonds is a matter of indifference for a corporation, but that investment in stocks of firms other than the corporation itself is not a desirable investment. When the cash flows have option elements, we can take the expected value of the truncated cash flows under the assumption that the underlying assets have zero beta, and again discount at the interest rate. What makes this work is that the growth rates assumed in projecting the cash flows appear again in the discount rates for those cash flows, and cancel. Since it doesn't matter what growth rate we use, we can make the simplest choice. We can assume that assets are expected to grow at the interest rate, either because the market return is equal to interest in each period, or because the asset betas are zero. We can then discount at the interest rate. Cash flows are hard to estimate, so we should treat estimated cash flows as very uncertain. Moreover, we should revise our estimates frequently as market prices and other indicators of the future change. In general, we should invest more in areas that have done well and less in areas that have done poorly. We should handle inflation consistently, taking account of any effects that inflation may have on the firm's taxes and keeping in mind that an inflation-increased interest rate does not necessarily represent a cost that will decrease the present value of a project. In the end, though, especially when terminal values are important, it may turn out to be better to forget about discounted cash flow methods entirely, and use a pro forma earnings statement approach to evaluating corporate investments.

# CORPORATE INVESTMENT AND DISCOUNTING RULES*

Fischer Black†

## INTRODUCTION

Corporate investment decisions are often made by simple intuitive methods.

For example, when a machine breaks down on your assembly line, you often go ahead and make the investment needed to fix it. You do not spend time on a complex analysis of the cash flows resulting from a fixed machine.

When analytic methods are used, they may take the form of a payback analysis, a discounted cash flow analysis, or a projection of the future earnings from a project which are then converted to an estimated value for the project.

When the future cash flows from a project are very uncertain, as they often are, it may not make much difference which of these methods are used. By changing its estimated cash flows, the analyst can make the project look good or bad under any of these methods, depending on how he feels about it.

Thus, when analytic methods are used, it seems best to make them as simple as possible, so that the important factors in the investment decision will not be lost in the analysis. To this end, here is a list of rules for evaluating corporate investments.

DISCOUNT CONDITIONAL CASH FLOWS AT THE INTEREST RATE

How are we[1] to discount future cash flows from an actual or proposed investment?

When the cash flows are certain, we discount them at a riskless rate with an appropriate maturity. We can estimate the discount rate by looking at the prices and yields of government bonds at various maturities, making allowances for tax factors and call features.

But what if the future cash flows are uncertain? For example, suppose that a firm is considering an investment with a cash payoff at the end of each year that depends on the market return for that year. When the market return is 10 percent, the payoff for the year is $150,000. When the market return is 20 percent, the payoff is $250,000. The payoff goes up or down by $10,000 for each percentage point increase or decrease in the market return for the year.

Each year the payoff will depend on the market return for that year but will not depend on the market returns for prior years or on anything else. The payoffs will continue to follow this pattern each year into the indefinite future. Moreover, let's assume that the short-term interest rate is constant at 10 percent per year and that the expected return on the market is somehow known to be constant at 20 percent per year.

What is the present value of the payoffs from this investment?

One procedure is to find the expected cash flows from the project and to discount them at rates that depend on the betas of the cash flows and on the expected return on the market. This procedure is correct only when the betas of the cash flows are constant in time, and it requires that we estimate several things that are hard to estimate. We must use the expected cash flow, the cash flow beta, and the expected return on the market.

When this procedure works, there is a simpler procedure that will also work. The simpler procedure will sometimes work when the more complex procedure does not work. The simpler procedure involves estimating the cash flows under the assumption that the market return is equal to interest in each period and then discounting the estimated cash flows at the interest rate.

Let's go back to our example. Since the natural period of analysis for this example is a year, interest for the period is equal to the interest rate, or 10%. When the market return is equal to 10%, the payoff each year will be $150,000. Since the interest rate is 10% each year, the present value of an indefinite stream of payments, each equal to $150,000, is $1.5 million. That's the present value of the investment.

We might describe the $150,000 as the certainty equivalent of the payoff from this investment each year. Then the present value of the investment is simply the stream of certainty equivalents discounted at the interest rate.

Since the expected return on the market may change rapidly over time, and since it is very hard to estimate what it is at any given point in time, it is good that our rule does not need to make use of it. Similarly, the beta of the project or its cash flows may be hard to estimate, and may change over time. So it is nice to have a rule that does not require the use of beta.

This simple discounting rule works because both the expected future cash flows from the project and the discount rate for those cash flows depend on the betas and the expected return on the market. They depend on these factors in just such a way that the discounting process cancels the effects of these factors on the expected cash flows. If a discounting process is used that is consistent with the way in which the expected cash flows are estimated, then it will give the same answer as the simple procedure because the betas and market expected returns will cancel.

Normally, it seems simpler to estimate cash flows assuming that the market return is equal to interest each period than to estimate expected cash flows for all possible paths of the return on the market. Thus, the simple discounting rule uses inputs that are easier to obtain than the inputs to more complex rules.

GIVE ZERO VALUE TO SYMMETRIC CLAIMS ON EXCESS RETURNS

Suppose the government proposes a tax on the returns from a portfolio that takes the following form. Each year a return on the portfolio is to be calculated. The investor will subtract interest at the one year rate to give the excess return on the portfolio. This excess return may be either positive or negative. The tax is to be a constant fraction of the excess return.

It is symmetric, because when the excess return is negative, the government will give money back to the investor. So the government takes some of the gains on the portfolio and gives back some of the losses.

How should an investor feel about a tax that takes this form?

Normally, an investor should be indifferent to this kind of a tax, at least when the investor is lending or is able to obtain a secured loan at a rate about equal to the one-year interest rate. The government is taking some of the investor's expected return, but is also taking some of the investor's risk. The investor can offset this by simply starting with a larger position in the same portfolio.

For example, with taxes at a 50% rate, the investor can simply double the size of the initial portfolio and the after-tax returns to the investor will be the same as if there were no tax on the portfolio.

Since the investor must reduce lending or increase borrowing in order to increase the portfolio of risky assets, it is important that the interest rate used in the tax calculation is the interest rate the investor faces on lending or additional borrowing. When it is, the present value of the tax is zero.

Another way to see this is to note that an investor can create a portfolio with cash flows equal to the tax by borrowing to buy an appropriate amount of the original portfolio. Since the investor puts up no equity to obtain this portfolio, the present value of the cash flows from the portfolio must be zero.

With this kind of a tax, the investor is indifferent and so is the government. Although it has positive expected revenues, it will frequently require payments to taxpayers rather than payments from taxpayers.

Since it has a zero present value, it cannot be used to support government spending. It can only be used to make transfers between people who are taking more risk and people who are taking less risk in their investments.

For another example, suppose that an investment advisor has an agreement under which he receives one-half of one percent per year of the value of the portfolio being managed. Does the investment advisor have an incentive to increase the expected value of the advisory fee by increasing the beta of the portfolio?[2]

It turns out that he does not have such an incentive, because the present value of the advisory fee does not depend on the beta of the portfolio. Using the simple discounting rule described above, we estimate the advisory fees under the assumption that the return on the market is equal to interest each year. The future value of the portfolio when the return on the market is equal to interest each year does not depend on the beta of the portfolio.

Thus the present value of the advisory fee does not depend on the beta of the portfolio. A higher beta will mean a higher expected future advisory fee, but also a higher discount rate. The effects of beta on the expected value of the future advisory fees and on the discounts rates will cancel, leaving a present value for the advisory fee that is independent of beta.

Again, this assumes that the advisor is lending or can borrow at a rate equal to the lending rate. If the advisor's borrowing rate is higher than his lending rate, and if he wants to take on more risk, taking on more risk through the portfolio he has managing may be a more efficient way to take risk than borrowing to buy risky assets himself.

Once we see that symmetric claims on excess returns have zero present value, we have an alternate way to derive the simple discounting rule. Suppose each future cash flow can be written as a portion that will occur if the market is equal to interest each period, plus a portion that is proportional to the excess returns on the market in one or more past periods. The first portion can be discounted at the interest rate and the second portion has a zero present value. Thus we can use the simple discounting rule on cash flows like these.

A rule that is equivalent when discounting cash flows like these is to assume that the beta of each cash flow is zero for each period. We project the cash flows assuming zero betas, and then we discount them at the interest rate. When the cash flows are symmetric, this will be equivalent to estimating the cash flows under the assumption that the market return is equal to interest each period and then discounting at the interest rate.

Note that this means a cash flow with a positive expected value can have a zero present value. In the tax example, the expected future taxes are positive, but they have a zero present value. Standard discounting procedures, because they assume a constant discount rate, would always give positive present values for cash flows like these and thus would give the wrong answers.

## DISCOUNT AFTER-TAX CASH FLOWS AT AN AFTER-TAX RATE

Until now, we have ignored taxes. For any method of discounting cash flows, it would seem natural to discount after-tax cash flows at an after-tax rate, and that turns out in fact to be the right method.[3]

The taxes that matter are corporate taxes, not personal taxes. So the after-tax rate is the interest rate after corporate taxes. This rule works no matter what we assume about personal taxes.

For example, we might assume that personal tax rates and corporate tax rates are equal, and we might look at a model in which firms do not pay dividends and there are no effective taxes on capital gains. In addition, we might assume that bankruptcy costs and other factors affecting optimal corporate assets and liabilities are zero.

In a model like this, capital structure will be a matter of indifference, and the after-tax interest rate can be taken indifferently to be the rate after corporate taxes or the rate after personal taxes. In this model, it makes no difference whether a firm buys its own debt or not, and it makes no difference if the firm buys debt of others. The present value of current coupon debt is zero.

Consider, on the other hand, a model in which personal taxes are zero. If we continue to assume that bankruptcy costs and other complicating factors are not present, then a firm will want to have as much debt as it can, since additional debt reduces corporate taxes without increasing personal taxes. If the corporate tax is to be effective, we must assume that there is a limit on the amount of debt a firm can have.

It is natural to assume this limit is related to the risk of the firm's equity. A firm will be allowed to increase its debt until the risk of its equity reaches a standard point. If the limit is set in this way, then a firm that buys the debt of others will be able to increase the amount of its own debt by an equal amount.

Thus, buying the debt of others will be a matter of indifference for a firm, even though buying back its own debt and putting its total debt below the limit would not be a matter of indifference.

In either kind of model, then, debt will have a present value of zero.

Some people say that the right way to take taxes into account is to discount after-tax cash flows at a before-tax interest rate and then take into account the present value of interest tax shields. While this may give the same answer as the method we have set out if the tax shields are computed properly, it is clearly more complex to use.

So it seems that discounting at the after-tax rate is the simplest way of handling such a cash flow. If we are using the simple discounting rule, then we will start by estimating future after-tax cash flows assuming that the return on the market in each period is equal to interest at the after-tax interest rate. We will then discount these estimated cash flows at the after-tax interest rate.

If we were to use the capital asset pricing model in discounting, we would want to use the form of it that has the after-tax interest rate everywhere where the before-tax interest rate might otherwise appear. If we do that properly, we will get the same present value using the capital asset pricing model that we get using the simple discounting rule.

## INVEST IN BONDS RATHER THAN STOCKS

In the last section, we considered two simple models of capital structure. One had personal taxes at the corporate tax rate, while the other had no personal taxes. Neither had any bankruptcy costs or related factors affecting optimal corporate assets and liabilities.

Now let's talk about a more realistic model of capital structure. Let's assume that the capital structure of a firm is influenced by corporate taxes, by personal taxes, by the possibility of bankruptcy, by the way in which incentives for managers are affected, by the degree of diversification in the firm and the way diversification affects both managers and lenders, and by the costs associated with diffuse ownership of the firm's stock.

Higher corporate taxes will increase the optimum amount of debt for a firm, while higher personal taxes will decrease the optimum amount of debt.

Higher costs of bankruptcy and higher costs of avoiding bankruptcy will reduce the optimal amount of debt for a firm. When we consider management incentives, we may want to have a higher amount of debt than we would otherwise have because managers will want to avoid bankruptcy due to its effects on their personal wealth and reputation.

Of course, the more diversified a firm is, the more debt it can support, at least if this diversification is through its businesses rather than through ownership of the stock of other firms.

Diffuse ownership of the company's stock has costs because small owners of the stock have little incentive to exert the effort and spend the money needed to exercise responsible control over the firm. The more debt and the less stock a firm has, the less diffuse its ownership will be, other things equal. Thus, this factor favors a higher amount of debt for the firm.

Taking all these factors into account, there will be some optimal capital structure for the firm. In a more general context, we might say that there is an optimal asset and liability structure for the firm.

At the optimal capital structure, small changes in the firm's debt-equity ratio will have no effect on the value of the firm or the value of its stock. Thus, issuing stock to buy back debt and issuing debt to buy back stock will not affect the value of the firm or the value of the stock if done in small amounts. We assume here that the debt bought and sold in small amounts is of lower priority than the firm's existing debt.

If buying back small amounts of the firm's own debt is a matter of indifference, then buying the debt of other firms will be a matter of indifference too. This becomes a very general proposition in the current context, and does not depend on any particular simple model of capital structure.

If the firm is at an optimal capital structure, then current coupon bonds will be a zero net present value investment.

Similarly, the firm will be indifferent to buying small amounts of its own stock. Its stock will be a zero net present value investment.

However, buying the stock of other firms is worse from a tax point of view than buying the firm's own stock. The firm will have to pay taxes on 15% of its dividend income, and it may be subject to capital gains taxes as well. Thus, the stock of another firm will generally be a negative net present value investment, except in cases where the firm is preparing for a tender offer or merger proposal.

This is consistent with the fact that we see large numbers of financial institutions holding debt in the form of loans, while firms other than investment companies rarely hold the stock of other firms. Investment companies, of course, have special tax rules that reduce or eliminate the tax costs of holding shares of other firms.

Thus, any firm can be comfortable buying current coupon bonds of any maturity but should be cautious about owning the stocks of other firms as an investment.

## USE DIFFERENTIAL CASH FLOWS

One way for you to simplify the process of estimating a present value for a project is to compare the project with some other project, either in your firm or in another firm.

For example, if another firm in your industry is doing something successfully, and you feel that you can do what they are doing at a lower cost, then it seems very likely that you should do it. Your cash flows will be higher than theirs, so if it is successful for them, it should be successful for you too. Intuitively, the idea is to do things in which you have an advantage over others that are doing the same thing successfully.

Similarly, suppose that you are looking at a potential merger candidate. If the firm has traded stock, the market price of the firm's stock reflects investors' opinions about the cash flows of the firm in its current form. Unless you have strong reasons for believing that investors are mistaken, you should take the market price as a correct estimate of the present value of the firm's cash flows as it now exists.

Presumably, the firm is a merger candidate because you believe you can change its operations in some way, such as integrating them with your operations, which will increase the firm's cash flows. If you find the present value of the increased cash flows, that will suggest the amount that you should be willing to pay as a maximum premium to acquire this firm.

For another example, suppose you have a division that is not doing very well and you decide you'd like to consider selling the division. The price you get will normally depend on the present value of the division's cash flows in the hands of the buyer.

What makes a division a good candidate for sale is that the cash flows in the hands of someone else will be much higher than the cash flows in your hands. You may be able to get, through the sale price, a share of the present value of these increased cash flows.

However, if your firm is better able to handle the division than other potential buyers, it doesn't make sense to sell it no matter how poorly it is doing. It may pay to liquidate it, but if you can do better with the division than anyone else can, it will not generally pay to sell it.

Thus, some of the factors often considered in buying and selling divisions are not really relevant. Past growth in the division's sales is not relevant in itself, because the price paid will reflect that past growth and any future growth that is expected. The division's market share is not relevant because the higher the market share, the higher its price will be.

Not even the skill of the managers is relevant, as a first approximation. If they stay with the division, they will generally want compensation reflecting their contributions. If their compensation fully reflects their contributions, there won't be any left for you.

A decision on the optimal size of a firm is another case where the use of differential cash flow analysis may pay. An expansion that increases the size of the firm will generally have both positive and negative effects. As the size of the firm increases, the differential effects of further expansion will generally turn less positive or more negative. When the differential effects of the expansion are zero and about to turn negative, the firm has reached its optimal size, at least for the moment.

ASSUME BETAS ARE ZERO FOR OPTIONS

The simple discounting rule, as described above, says you should estimate cash flows assuming the market return is equal to interest each period, and then discount them all at the interest rate.

The simple discounting rule is equivalent to the following rule. Assume the growth rates for the cash flows are what they would be if the betas of the underlying assets were zero. Estimate the cash flows under this assumption and then discount at the interest rate.[4] This is equivalent for symmetric cash flows to estimating the cash flows under the assumption that the return on the market is equal to interest in each period prior to the cash flow.

The simple discounting rule in its original form would not work on cash flows that have option elements, because they are not symmetric.

For example, an option to buy the market in one year at a price that is higher than today's price by more than the interest rate will have value today. Under the simple discounting rule, it would appear not to have value. If the market return is only at the interest rate, the option will end up out of the money, so it will be worthless at year end.

What will work for this option is to assume that the expected return on the market is equal to the interest rate, while the variance of the market remains unchanged. We look at the possible values of the option at the time it expires under this assumption, take the expected value of that range of possible values, and then discount the result at the interest rate.

Thus we find the distribution for the market return under the assumption that the market has a zero beta, truncate that distribution, take the expected value of the truncated distribution, and discount at the interest rate.

Using this method, the total risk of the asset underlying an option will affect the value of the option, but the beta of the asset, which will always be taken to be zero, will not affect the value of the option. This is consistent with what we know from option pricing theory, where total risk matters in finding the price of an option, but beta does not matter.

For a more down-to-earth example, assume that we are looking at a movie production firm and the firm is thinking about the fact that a new movie, if successful, will probably be followed by a sequel. The firm has an option to produce the sequel if the first movie is successful.

The success of the first movie depends on economic conditions generally and therefore will be correlated with the return on the market. In valuing the option to make the sequel, though, we will assume that the returns from the first movie will be independent of the market. We will hold the total risk of the first movie the same, but will assume that its returns are independent of the return on the market, and thus that it has zero beta. We will find the possible future values of the option to make the sequel under this assumption, and will then discount the expected value of that option at the interest rate.

## TREAT ESTIMATED CASH FLOWS AS VERY UNCERTAIN

People worry a lot about how to discount cash flows. In general, though, uncertainty about what the cash flows will be dominates uncertainty about how to discount them.

For example, Apple Computer recently introduced a new model called Lisa. It has many features that were not in the company's existing computers, including a substantial amount of built-in software and a much fancier display unit. As a result, it is priced higher than competitive machines such as those produced by IBM. Finally, it is aimed at the business market, whereas Apple's previous computers were used more in the home market than in the business market and were used more in small businesses than in large businesses.

What will the future cash flows from this project be? The uncertainty is enormous. It may be that large firms will snap up the computer in large numbers and it will be a smash hit. On the other hand, it may be that competitors will swarm in with comparable machines at lower prices, or that no machines like Lisa will sell well.

The uncertainty is so great that it hardly seems worth making detailed projections of cash flows. One might as well rely on intuition.

In fact, in situations like this, one of the most common uses of analytic methods for finding present values is to justify a decision that has already been made. Once you have decided on a discounting method, you can construct your cash flows so that the project seems favorable or unfavorable depending on which way you would like the decision to go. With a project like Lisa, who is to say your projected cash flows are wrong?

Another common problem with cash flows is overoptimism on the part of the people projecting the cash flows.

Cash flows are usually estimated by lower level managers who are familiar with the details of the production and marketing processes that will be used. But while those managers are in the best position to make detailed cash flow estimates, they are also personally involved with the decision. The initial idea for the project probably came from those same managers, so it is likely that for the average project under consideration, the cash flows have been overestimated. The managers have already thrown out as unpromising projects for which they underestimated the cash flows.

By rights, cash flow estimates should be revised frequently.

Market prices are the present values of cash flows and market prices can change substantially from day to day, from week to week, or from month to month. It seems logical that cash flow estimates should change by about the same proportion that market prices change. This will give present values which jump around the way market prices do.

If the projects being estimated are small new projects, or involve substantial option elements, then it is possible that the cash flows for these projects should jump around even more than market prices do.

One should be suspicious of cash flow estimates that remain constant from week to week when economic conditions relevant to the project are changing substantially from week to week.

Yet another potential problem in estimating cash flows is simple ways of extrapolating the past into the future. It is especially dangerous to project rapid past growth into the indefinite future. Rapid growth always levels out and sometimes reverses itself.

In sum, there is no reliable way to estimate future cash flows. Since estimated cash flows are so uncertain, it doesn't pay to be too precise in the rest of the process of making decisions about corporate investments.

INVEST MORE WHERE THINGS HAVE GONE WELL

Although it doesn't pay to project rapid past growth into the indefinite future, it does pay to invest more in sectors of the economy or in parts of your company where things have gone well in the past. When a part of your business has been doing well, it is likely that there are many opportunities for further investment in the business that will be profitable.

For example, the computer program VisiCalc has been an enormous success for personal computers. When the first versions started to be successful, the company that produced the program developed many variations on it, and started writing much more elaborate documentation than had been written in the past. These investments paid off in additional sales of VisiCalc much more than investments in a typical new program would have paid off.

Past success can be measured in many ways: by return on book equity in the area under consideration, or by an increase in the market price of the company's stock if most of its business is in that area. The stock price, of course, is looking at the future as well as at the past. So it may be an especially good indicator of companies for which further investments are warranted.

A company whose stock price has been rising should probably increase its estimated cash flows for projects that it has under consideration and a company whose stock price has been falling should probably decrease its estimated cash flows. Sometimes, of course, an area that has been doing poorly simply needs major investments to pull it out of its slump. More often, though, pouring new money after old would be a bad idea.

It's always important to watch out for the influence of luck. Success can easily be more a matter of luck than of skill in picking areas to invest in. But when an initial investment has been successful, even if it was lucky, it will usually still pay to make further investments in that area in order to maximize the benefits of the original lucky investment.

USE MARKET PRICES WHEN AVAILABLE

Since cash flows are so difficult to estimate, it's important to use any tools that may help us in making such estimates. Normally, it appears that the market price of a firm's stock reflects most or all of the available information about the firm and its future. Thus, if we went to estimate the value of a firm that has traded stock, it's hard to beat just taking the current market price of all the firm's stock.

We could estimate future cash flows and try to discount them, but unless we have special information not reflected in the stock price, it is unlikely that we are going to do better than just taking the total value of the firm's stock.

If we do have special information, the best way to use it is probably to estimate the present value of the special factors that we believe are not reflected in the stock price, and then add those to the firm's stock price. In doing this, though, it's important that we try to assure ourselves that the special factors that we take into account are really not known by the market. If they are known, then it may be that the effect of these special factors is offset by other special factors that we don't know about.

If we are trying to value something less than a whole firm, such as an oil property or a piece of real estate, then it is more difficult to use the market price of the firm's stock as a guide. However, if similar properties have sold in the recent past, then we can look at the attributes of those properties, compare them with the property we are interested in, and estimate the value that our property would have if sold under similar circumstances.

This is probably a more reliable method than trying to project the future cash flows of the property and discounting. When the property we want to value differs from any property that has recently sold, however, we will have to try to project at least the differential cash flows and discount those.

If we want to estimate future interest rates, then there is no need to ask economists. The best estimates come from the market interest rates on government bonds of various maturities.

We can make separate estimates of tax-exempt interest rates using tax-exempt bonds. When working with tax-exempt bonds, though, it's important to keep in mind that the interest rates we see are interest rates on risky bonds. Tax-exempt bonds generally have a substantial risk of default.

If we want to estimate the future prices for agricultural commodities, then there is no need to go to an agricultural economist. We can simply use the futures or forward prices for those commodities.

For most applications, we can use the futures prices even if the expected prices for the commodities are known not to be the expected values of the futures prices. If commodities futures prices are generally higher than the spot prices they are estimating because of some sort of risk premium, then that same risk premium will come into a discounting process whenever the futures prices are used as part of a procedure to estimate the present value of the cash flows. The discounting will cancel the premiums.

Thus, we can generally use the futures prices as if they were known future spot prices.

Another use for market prices is in revising estimates of future cash flows. For this we can use the level of the stock market as a whole and the price of our own firm's stock. If we are working with a proposed project that is more closely related to another firm's business than to our current business, then we can use the price of that firm's stock.

Whenever these prices rise, we will increase our estimated cash flows; and whenever these prices fall, we will reduce our estimated cash flows. The effect of this will be that when these market prices rise, we will be more likely to go ahead with any given project, and when these market prices fall, we will be less likely to go ahead.

Firms often base their decisions to issue stock on the P/E ratio in relation to past P/E ratios, or the ratio of price to book value, perhaps related to past P/B ratios. Since accounting figures have many arbitrary elements in them, these comparisons may not mean much in themselves.

But the net effect of these procedures is to make it less likely that the firm will issue stock and go ahead with certain investments when the stock price has been falling than when it has been rising. Thus, these procedures do seem sensible, at least when they are explained in words a little different than the words usually used.

For a concrete example, suppose that a firm is considering a project that is squarely within its present line of business.

It might make sense to make the estimated cash flows for this project linear functions of the firm's stock price. In fact, if it is a small project or a new area within the firm's business, it might make sense to have the cash flow go up and down in percentage terms by more than the stock price does. If the cash flows are made to depend explicitly on the stock price in this way, then it will be easy to update the cash flow estimates as economic conditions change.

## HANDLE INFLATION CONSISTENTLY

Inflation and interest rates move consistently together. On average, a one percent increase in inflation means a one percent increase in interest rates, and a one percent decrease in inflation means a one percent decrease in interest rates; though at times the change in interest rates and the change in inflation may be far apart.

The relation betwen inflation and after-tax interest rates, though, is quite different. The after-tax interest rate seems to move less than the inflation rate, at least in the short run.

If cash flows are estimated in constant dollars, then we should discount using real interest rates. Real after-tax interest rates are often negative, however, we should be discounting using a negative real interest rate. It may be easier to project the cash flows in actual dollars and to discount them using nominal interest rates.

Using either method, if we ignore taxes, the rate of inflation should have no effect on the present value of the new project. Higher inflation will mean higher cash flows and a higher discount rate, and these two effects will cancel.

When we do take taxes into account, then a change in inflation may have some effect on the present value of the project.

For example, some people believe that with higher inflation, corporate taxes are increased more than taxes on other kinds of capital. This means that projected after-tax corporate cash flows should go up by less than the rate of inflation. After-tax interest rates will also be going up at less than the rate of inflation, so it's not clear how inflation will affect the present value of a project.

Others, however, argue that Congress is usually quick to change tax laws to adjust to inflation and that any effect of inflation on corporate taxes is apt to be minor and short-lived. There is also a possibility that Congress will change the tax structure in the future in such a way as to substantially reduce taxes on capital, including corporate taxes. In fact, some argue that recent changes in the tax law have already reduced corporate taxes to zero or below for most new projects. The chance that such changes in corporate taxation will be made may well be related to the inflation rate.

To some extent, we can see in the structure of interest rates on both taxable and tax-exempt bonds the likelihood that the market places on changes in tax laws of this sort. If projected interest rates on tax-exempt bonds are about equal to projected interest rates on taxable bonds of the same quality, then the market expects that taxable bonds will not be taxed beyond the point in time at which the projected interest rates are equal.

As a first approximation, then, changes in expected inflation should have no impact on estimated present values. It is not clear, as a second approximation, how inflation will be related to present values.

Perhaps the market's reaction to changes in the rate of inflation can guide us toward a second approximation. When the market does not react to unexpected changes in the rate of inflation, we can stay with the first approximation. When the market does react, we can use the strength and direction of its reaction as a guide.

In the recent past, higher inflation has been related to lower market values. So long as that relation persists, we should probably reduce our estimated cash flows whenever the rate of inflation goes up.[5]

## USE PRO FORMA EARNINGS STATEMENTS INSTEAD OF DISCOUNTED CASH FLOWS

Often, when discounting estimated cash flows, we don't treat purchase of capital equipment or plant in the same way as other cash flows. We may smooth out these purchases so that they create a more regular pattern of cash flows.

But this is just the kind of smoothing that we do in estimating the earnings of a firm, or the contribution to earnings of a project. If we are going to do this kind of smoothing, why don't we go all the way and use all the kinds of accrual accounting that are used by accountants in producing financial statements?

If we do this, then we can evaluate a project by estimating a normalized earnings figure and multiplying it by an appropriate price-earnings ratio.

We often estimate a normalized earnings figure as of some point in the future, so we will want to discount it to the present again using the interest rate.

For a long-lived project, discounting cash flows usually involves stopping at some moderately distant point, estimating a residual value and then discounting the residual value along with the other cash flows. The residual value is often estimated using some version of the earnings method anyway. So why don't we go all the way to a pro forma earnings approach rather than trying to work with cash flows at all?

In practice, I believe that working with a project's contribution to earnings is as common a method of project evaluation as the use of the discounted cash flow procedure.

For most projects, a pro forma earnings statement approach may, in fact, be easier to use than a discounted cash flow approach; though if each is properly done, they should give the same answer. Thus we may not have to worry about how to estimate and discount cash flows, since we may not want to discount cash flows at all.

## FOOTNOTES

[*] This is based in part on Black (1982), which contains more detailed analysis of the "simple discounting rule." I am grateful to Richard Ruback for extensive discussions of several of these topics.

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[1] Compare my "simple discounting rule" with Ross (1978). In some cases, my rule follows from his rule.

[2] This example is analyzed correctly by Margrabe (1976).

[3] Ruback (1982) shows that this is the right method.

[4] This rule is derived by Cox and Ross (1976).

[5] Modigliani and Cohn (1979) argue that this negative relation between inflation and stock prices may have been due to inconsistent handling of inflation by investors.

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