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Finance D42
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Memo of notes on the appropriateness of project-based cost of capital

0. Introduction

Last class we had a discussion about the appropriate discount rate (cost of capital) to apply to a new investment for a firm: should it be the risk-adjusted required rate of return *based on the risk of the project* or should it be the required rate of return *based on the riskiness of the firm*. The conversation was actually couched in terms of WACC's: should we use a project-specific WACC or should we use the company-wide WACC. But none of the discussion surrounded anything about WACC, per se: it seemed to be more fundamentally about the appropriate risk-adjusted discount rate.

I wasn't as clear as I would like to have been, indeed I wasn't even as clear as I usually am, which is usually less clear than I would like to be. In that vein, I would like to clarify what I think the relevant issues are in this discussion.

There are twelve sections that follow in my inimical, overly talky style. I hope it is useful to at least a few people.

1. Finance I outlook

For starters, let's couch the debate: Finance I teaches incontrovertably that the appropriate discount rate to apply to a project is the project-specific discount rate

incorporating the project's systematic risk. If the appropriate risk-return framework is CAPM and the project's beta risk is 0.25, and if the risk-free rate is 6% and the market risk premium is 8%, then the appropriate discount rate, based on the CAPM, would be 8% = 6% + .25(8%). If this project is being considered by a firm with a company wide beta of .25, of 1.0, of 1.25 or 3.25 does not matter. The appropriate cost of capital for this project is 8%.

Why is that the case? In Finance I, the entire course assumed perfect capital markets, which are inherently efficient capital markets (strong form, essentially) and MM inherently holds. It was also assumed that the holders of the shares of the company held diversified portfolios. The importance of the latter assumption was that the new project, as viewed from the perspective of shareholders holding diversified portfolios, gave them an incremental expected return equal to the expected return on the project and an incremental risk equal to the systematic risk of the investment (beta risk in the CAPM). The required return on the investment is a function of the incremental impact on the shareholders' portfolio risk, which is given by the project's beta, not by the firm's beta.

2. The counterargument

The counter argument goes as follows: ***if the company is to borrow to take on this project, they will do so at going rates, based on the perceived risk level of the firm. Or, if they are to attract new equity funds from the stock market, the stock market will require a rate of return commensurate with the risk level of the firm, not the risk level of the project, and so the appropriate cost of capital for the project is the firm wide cost of capital***.
Suppose that the above project is taken by a firm with a overall asset beta of 1.25, then its

CAPM required rate of return should be 16%, not 8%.

3. Perfect markets solution

Let's address this argument in perfect markets to flesh out what's going on behind the argument. Also, let's abstract away from the debt-equity issue to make it more of a pure risk/return tradeoff issue. So, we have an all-equity company with a beta of 1.25. The company's cost of capital is 16%, but there is an investment with a project beta of .25. Suppose that the project has an expected internal rate of return above 8%. They should take it, assuming there is no capital constraints. Fleshing out this example a little more, suppose that the risky company (without the new investment) generates a perpetuity of risky expected future cash flows of $100M per year. What is the value of the risky company before the new investment:

$$V_0^A = 100M/.16 = \$625M$$

Supposing this all-equity company has 10 million shares outstanding, its share price will be (efficient markets) $62.50.

Suppose the investment with .25 beta costs $100M upfront and will generate low risk expected cash flows of $10M per year in perpetuity, again for simplicity's sake. If this investment were made by your shareholders and not by you, clearly, they would value this investment as follows:

$$V_0^B = \$10M/.08 = \$125M$$

Finance I theory would argue that this is the value of this investment no matter who invests in it and it is a positive NPV investment and should be taken (positive NPV means it has an

internal rate of return in excess of its project specific cost of capital also, the IRR of the project is \$10M/\$100M = 10%, well below the 16% cost of capital for the rest of the firm).

In the Finance I/II version, let's show what the impact is on the stock price. Let's assume that you raise new equity (\$100M) in perfect capital markets and invest it in this project. Now your firm generates \$100M per year in the high-risk projects and \$10M per year in the new low-risk project. Finance I would argue that the value of the firm now is equal to $V^A + V^B = (100M/.16) + (10/.08) = \$750M$. What is the new stock price and how many shares did you have to issue to buy the investment? This is a common calculation from Finance I and II:

$P_{new}(N_{old} + N_{new}) = \$750M$ (Value of all shares total is value of all projects total.)

$P_{new}N_{new} = \$100M$ (Cost of investment has to be raised in equity issue.)

Solving for P_{new} and N_{new} we get $P_{new} = \$65$ and $N_{new} = 1.53846$ M new shares. Notice the stock price increased because you are investing in a positive NPV investment (\$125M value is in excess of \$100M cost).

4. Does the perfect markets solution address the counterargument? How?

What is the required return on the firm's shares after the new investment? They will have expected cash flows of \$110M per year in perpetuity and the market value of the firm is \$750, so the new expected rate of return (if the above story is right) is $E(r_e) = \$110/\$750 = 14.666667\%$. The market's expected (indeed their required) rate of return has gone down for the stock overall because the firm is now a portfolio of the higher risk and lower risk assets.

In fact, if the value of the risky assets is \$625 and if the value of the low risk asset is

$125, what would we expect the new beta of the firm to be after the new investment? The firm is a portfolio of the two invesments and the beta of a portfolio is the value weighted average of the betas of the assets in the portfolio: New beta of the firm = (625/750)(1.25) + (125/750)(.25) = .833333(1.25) + .1666667(.25) = 1.0833334. The new CAPM required rate of return on the equity of the firm should be 6% + 1.0833334(8%) = 14.66667%, same as the expected return.

The counter argument says that if the firm is to raise money to take this investment, they will charge a required rate of return commensurate with the risk level of the firm to buy the equity. That is true, but in an efficient market, they can see that the firm is less risky than it used to be, that its appropriate beta will be 1.0833334, not 1.25 anymore. When buying the new shares, they anticipate that the firm will generate $110M per year in perpetuity, which they will value by discounting this $110M per year at 14.66667% and will get a corporate value of $750M. To come across with $100M in the equity issue you have to give them a fraction of the equity of the firm equal to $100M/$750M = 13.3333% of the shares. So the original 10M shares must equal 86.66667% of the total number of shares, which must be 11.53846154M shares at a price of $750M/11.53846154M shares = $65 per share, the same as above. Shareholders earn the net present value of the project, which is positive.

What did we show in the last two paragraphs? The shareholders charge a required rate of return on the shares that is commensurate with the risk of the firm, as per the counter argument, but they assess the risk of the combined assets (old and new). This is reasonable, because they are buying the stock of the company, not the project itself. But the value of the project is used in the analysis to arrive at the portfolio weights to determine the new discount

rate. That discount rate (14.6667%) is higher than the project discount rate (8%), but that doesn't change the NPV of the project, which is still $25M or $2.50 per original share, which is based on the 8% discount rate.

5. The robustness of the perfect markets arguments

The above argument does not depend on the size of the project, although the NPV and the size of the impact on shareholders' wealth obviously does. To see this, make the above investment cost $10M (rather than $100M) and earn $1M per year indefinitely (rather than $10M) and work through the numbers. The essence of the conclusion is the same: the appropriate discount rate for the project is 8%, not 16%, even though the shareholders will require a return on the *shares* commensurate with the risk of the shares.

The above argument is also not sensitive to the perpetuity assumptions which simply make it easy to calculate the present value of future cash flows. Nor is the conclusion sensitive to the all-equity firm assumption, nor the no-tax assumption. This argument goes through in the Modigliani-Miller model with no-taxes or with corporate and personal taxes, whether there is debt in the capital structure already, whether the funds from the project are raised via debt or equity or whether the funds were available as excess cash inside the firm. The basic conclusion would hold under all these scenarios.

6. Importance of information costs/agency costs assumptions to perfect markets conclusions

What, then, are the key assumptions being made in the above argument? The two key

assumptions that are being used in the above analysis are 1. Efficient markets and 2. No information asymmetries leading to adverse selection or moral hazard costs in financing and investment decisions. The way the efficient markets assumption being used is pretty clear: when the company announces the new investment decision, the NPV of the project (using 8% discount rate) can be assessed by the market, the impact on the firm's equity beta can be assessed and the market can see that the value of the shares is $65 per share and they are happy to pay that to buy the new shares.

Myers-Majluf and the adverse selection problem

When a firm announces a new investment decision and that they want to finance the investment with funds from a new equity issue, however, what happens to the stock price? Generally it falls. Why? Presumably the management thinks the value of the firm will be higher with the new project than without it. Does the market fail to recognize the NPV of the new project? No. This is the Myers-Majluf model you probably studied in Finance II. The market thinks the NPV of the new project is probably positive, what they can't believe is that you would use equity to finance it if the current value of the stock were appropriate priced or undervalued. So they make the inference that the reason you want to finance this investment with equity means that the equity is overvalued. Is this market inefficiency? No, it is a semi-strong form efficient response to the fact that the market knows that management is better informed about the value of assets/projects in place. This is the adverse selection problem.

Stockholder/bondholder conflicts and moral hazard costs

A similar set of problems occurs with firms that borrow. The lender may worry that the borrower will not act in the lender's best interest once the loan is in place. You guys talked about the asset substitution problem, the underinvestment problem, the bait and switch problem, etc., in Finance II. These problems are usually of the moral hazard variety. They can make it difficult for some firms to get debt financing, or to get it at an appropriate risk-adjusted rate of interest.

The common implications of the Myers-Majluf type framework are things like: it may be optimal for a firm to carry financial slack, because both of the above problems cause external financing to be more expensive than internal financing. It also suggests that, if the adverse selection costs of issuing equity exceed the moral hazard costs of issuing debt and you haven't sufficient internal funds and you have a project with a sufficiently large NPV, you would prefer to finance it with debt than equity.

You can also use models like the above to show a hedging motive for managers that is value creating. Appropriately hedging certain risks can reduce the need to access external capital markets to fund your investment strategy; this can save the company the expense of incurring these adverse selection costs and/or moral hazard costs, which may be superior to not hedging, depending on the costs of the hedging program in place. I realize that I am being very sloppy with respect to the structure, assumptions, etc. of these models, because a complete treatment would be prohibitively lengthy.

If, in our example, new equity had to be raised, but the market were to believe that the shares were overvalued because we were issuing equity, we would have to trade off the loss in stock price (due to the signal which is not true in this instance) against the NPV of the new

project. We could forego issuing equity and instead issue debt to take the project, which would save us on adverse selection costs, because we probably don't have as much ability to issue overvalued debt, but we will perhaps face costs in the debt market as well. We are a pretty risky firm, and they may not believe us when we say we won't increase risk later once their debt is in place. If they charge a higher rate to compensate lenders for the expected moral hazard costs, then that is an additional cost of taking the project. Also, even if we had *internal funds* to make the investment, in the presence of external financing costs for future funds needs, we may wait until later for an even better NPV investment, which we may have to forego later if we don't have internal funds.

7. APV framework

So, the world becomes much more complicated in the presence of information/agency costs. But, is it the case that we should use the company wide cost of capital to assess the NPV of the new project? The factors that make external financing (equity especially) expensive are very difficult to quantify and insert into the cost of capital for a project or a firm. It is probably more intuitive to think of them from an APV standpoint. In our example, the NPV of the project should have been $25M with no financing related costs. The APV with financing related costs (let's assume there are no financing related benefits) would be:

APV = NPV with no costs considered - PV of financing side costs

APV = $25M (NPV @ 8%, not 16%) - PV of financing side costs

If the financing side costs exceed $25M, the project won't be taken. Is this because the cash flows should be being discounted at 16% (at which the NPV would be negative --- you can

check)? No, the 16% is irrelevant.

To finance the investment with equity would be sending a signal of overvaluation which you do not think is true, which is potentially very costly. To finance the investment with debt may be expensive if debtholders believe you may take the opportunity to act against their interests later. The interest in excess of what it "should be" could more than offset the NPV. Lastly, even if the project can be paid for internally, it still uses up valuable slack, increasing the likelihood that you will have to access external markets at a later date (incurring the above costs) for a project with an even bigger NPV than this one. The costs associated with any of these options are real and can be sizeable, but none has anything directly to do with the 16% cost of capital for the firm.

8. Should firms invest in very risky assets because they seemingly cover the company cost of capital?

To see this in stark contrast, suppose that, instead of a low risk project, you had considered a very high risk project. Suppose it had a beta of 2.0, with a commensurate project specific cost of capital of (CAPM): 6% + 2.0(8%) = 22%. Suppose the investment costs $100M and returns a very risky $20M per year (20% expected return) in perpetuity. Should the company take this project? No. It has a negative NPV. But its expected return exceeds the company's 16% rate and, in fact exceeds the new company's required equity return including the new investment (check if you want). But it will reduce shareholders' wealth, even in the absence of information/agency related costs --- they, in fact will make the APV even worse.

So, the perfect markets model is wrong --- it ignores important financing side benefits and costs that are relevant in the real world --- but the response that we should not use project specific costs of capital and should instead use company wide costs of capital does not follow. In John Le Carre's outstanding series about the spy-master George Smiley, the protagonist is confronted with the fact that something about what is being done is wrong and must respond "...My being wrong does not make you right." I don't feel quite as disconsolate as Smiley in this case, because I don't believe the perfect markets assumptions hold anyway and the entire course concerns the application of corporate finance principles in imperfect markets anyway.

9. Practical examples of the above analysis

The counter argument has many manifestations. A high tech company, say Genentech, evaluates an investment in grocery store chains. Grocery store chain investments, while not being super low risk due to lot of competition and low margins, are substantially lower risk than Genentech. Let's assume that the grocery store chain is our new investment from before and Genentech is the original firm. If Genentech looks at the new investment and sees it as a positive NPV investment, should they take it? Genentech shareholders are going to look at the shares as being riskier shares than the investment, and require a higher return than the return on the investment, so the counter argument says the discount rate should be higher and that Genentech shouldn't invest in the grocery chain because its expected rate of return will not exceed Genentech's cost of capital (16%).

I agree that Genentech should not invest in the grocery store chain, but for different reasons. First, I don't think that Genentech will view a grocery store chain investment as a

positive NPV investment, even using the appropriate cost of capital; and if they do, they should recompute their numbers. The reason the investment would be negative NPV is that Genentech should not expect to be able to generate the cash flows that would generate a positive NPV from grocery stores *because they have no expertise in running grocery stores*. Using the 16% discount rate will get you the same answer but for the wrong reason.

I should have suggested, rather than a lower risk project, that Genentech consider a higher risk project --- consider the highest beta project they could consider. Let's say its something like Netscape, and highly levered enough to have beta of 2.00. If its required rate of return were, say, 22% and its expected return were, say, 20%, should Genentech invest in this business? By the counter argument, it earns more than Genentech investors are "looking for" and they should be happy to have 20% rates of return. Clearly, from my perspective Genentech should not make this investment: not only is it negative NPV at its correct discount rate, but even if its NPV were zero, *tbey have no expertise in running computer software/Internet publishing/Internet access firms*. Their cash flows that they expect from this investment should end up with a negative NPV investment *at the 22% discount rate*. That doesn't mean, however, that it will look like a negative NPV at 16%. Making this investment because it clears a 16% discount rate will be bad for your shareholders. Their stock price will go down by the true NPV of the investment.

10. Should a company invest some funds in low risk assets, like T-bills

I tried to take the logical extreme at the low risk end and ask, if Genentech invests in T-bills, is this negative NPV because their cost of capital is 16%. I was trying to get at the

pretty obvious point that the NPV of buying T-bills is pretty close to zero. Unfortunately, there is the very reasonable belief people have that companies shouldn't be investing large amounts in T-bills: that instead they should pay these funds to shareholders to invest for themselves. In fact, the argument you usually hear is that shareholders can do better with these funds than the management can. But we have to be careful here also: in perfect markets (no taxes or transactions costs), it is a matter of indifference whether the company invests in T-bills or if it pays out the funds which are invested by shareholders in T-bills.

The argument that the shareholders require 16% on the stock is not relevant ... management could put the funds into a stock fund with a 16% expected return. In a perfect markets context this would still be a wash.

There is a simple tax reason for not wanting corporate treasurers to invest funds in taxable investments on behalf of shareholders: the corporate tax rate is often in excess of the shareholder's personal tax rate they would pay on the same investment. But, for argument's sake, let's abstract from tax issues to the information concerns.

The sources of benefit and cost of a firm keeping a liquid fund of excess cash are similar to the asymmetric information/agency costs arguments used above. Many firms have very large amounts in excess cash; these funds are invested, generally, in low risk, liquid securities. Michael Jensen's agency cost of free cash flow theory argues that managements of firms that generate large free cash flow is that managers don't have sufficient incentive to pay these funds out to shareholders and will withhold too much of this cash from shareholders to invest where the managers would prefer. They may make excessive investments in purely diversifying ventures or they may empire build or may over invest in their own business

relative to the economic attractiveness of such investments. To whatever extent these investments are negative NPV investments (at the appropriate cost of capital), these investments hurt the shareholders. Companies with very low debt and a large amount of excess cash may become takeover candidates not purely because of the cash account, but because of what these facts perhaps signal about the efficiency of management of the firm in question.

On the other side of the fence is the Myers-Majluf model that gives a very good reason to preserve some financial slack, either excess cash or easily available borrowing power. Their argument is that a firm which will be coming into positive NPV investments at later, perhaps random, dates, can not know what market conditions will be like then. They also don't know what their own performance will be between now and then. If external financing can be substantially more expensive than internal financing, then it may be in the interest *of the shareholders* to maintain some slack in the form of excess cash.

Should a firm like the latter, with future positive NPV investments that they may not be able to finance internally, keep some cash on hand, let's say in T-bills? Where is the money going to come from to be put into T-bills? Either they don't have excess cash now or they do. Let's assume they don't have any excess cash. Should they borrow at current rates (certainly above the T-bill rate) or, worse, issue equity and put the proceeds in T-bills? This may seem like a slam-dunk "No," but it is not. If market conditions are such that they are getting very good terms in either the debt or equity markets, the answer may be yes. Very many small, high-tech firms that have done IPO's in the '90's have put the funds in short-term, low risk securities while they wait for investment projects to come on board. Why

didn't they wait to issue equity when they needed the money and forego the "opportunity cost" of investing a "too low" a rate in the interim. They thought terms in the equity market were fair or attractive at that point in time and could not count on terms remaining so favaorable at later dates. But the rationale for having the slack invested in T-bills is not that they are earning a great rate of return, but that the slack is valuable because it allows them to forego uncertain later costs of external financing. They are not earning sub-par rates of return on their investments (especially since their tax rates are often low also).

Next, what about the company that already has some excess cash and is worried about being able to finance future NPV investment opportunities externally. Should they invest in T-bills (or similar instruments). Perhaps, for the same reason as above. Is the value of additional slack positive or not? Depends on how much they have, their possible level of future positive NPV investment alternatives, and the degree to which they are suffering from free cash flow agency conflicts.

11. What if the company has outstanding debt it could pay down?

Suppose the firm has excess cash of $50M. It could put it into Treasuries and earn 6% pre tax, 4% after tax. Alternatively, they have a mortgage loan (@8% pre tax, and assume it is an extremely low risk mortgage) that they could prepay in part or in whole without penalty. Let's assume that they have good reason to have some financial slack for reasons like the above. Should they pay off part of the loan or should they invest in Treasuries?

If they pay off part of the mortgage loan they are, in effect, lending. They are lending at an after tax rate of (their tax rate is 33.33% according to the above numbers) 8%(1-.33333)

= 5.33%. Shouldn't they prefer to lend at 5.33% (pay down mortgage) rather than lend at 4% (Treasuries), given they are similar risk? Maybe not, because the invested cash can be used without going to external capital markets for future positive NPV investments. If we pay off the mortgage, we have presumably more debt capacity, but we don't know what will happen between now and when we may need the money for a positive NPV investment. If we have bad earnings or if the stock market is low or there is a recession and external capital markets are very expensive, it would have been better to have invested at the lower rate and have the internal funds available.

What if the outstanding debt is a credit facility? Say it is a $500M credit facility with similar risk as the Treasuries, but if we pay it down by $50M, the available room in the credit facility is still available to us. So if we find a positive NPV investment requiring the money, we can simply borrow it on the facility. Then I would argue that if paying down the facility earns you 5.33% and investing in Treasuries earns 4%, you should pay down the facility.

12. Conclusion

The appropriate way to think about the cost of capital for a project is the project's cost of capital. If there are other financing side benefits and costs associated with making an investment, such as the fact that it uses up valuable slack or adds to valuable slack or it reduces or increases agency costs of debt or agency costs of free cash flow, these should be considered next in the context of an APV framework, and the project should only be taken if the APV of the project is postive, after these considerations are made. Using the company wide cost of capital is the wrong way to think about the problem, is overly focused on

perceived market inefficiency and not directed towards the real problem at hand, which the market may well understand very well. Attacking the problem the wrong way will sometimes get you the right answer, e.g., that Genentech shouldn't invest in the grocery store chain, but will sometimes get you the wrong answer, e.g., that the grocery store chain should invest in Genentech or that Genentech should invest in Netscape.

I hope you had as much fun with this as I did!