VALUATION DEVELOPMENTS

NEW ISSUES IN TECHNOLOGY VALUATION

Intellectual Property Cost-of-Capital Estimation Model

A new model to estimate the cost-of-capital for intellectual property valuation projects addresses the deficiencies of the current methods.

Valuation analysts use an income-based approach for most intellectual property (IP) valuation projects. An intrinsic part of the income approach is the selection and use of a discount rate to value future anticipated cash flows on a present-value basis. The magnitude of the discount rate serves as a proxy for the risk associated with receiving the future cash flows. An inverse relationship exists between risk and value. A higher risk project will have a lower value; a lower risk project will have a higher value.

Consider the example of an asset that generates an annual payment of $1 million in perpetuity. Suppose that the value is relatively high-risk, and the analyst uses a 50% discount rate to account for the associated risk. The value of the perpetuity is $2 million.[1] Suppose that the same annual $1 million payment has a lower risk profile, such that the valuation analyst uses a 20% discount rate to account for the associated risk. In this case, the value of the perpetuity is $5 million.[2] The chart in Exhibit 1 captures the essence of this relationship for a $1 million perpetual annuity valued using discount rates from 4% to 125%.

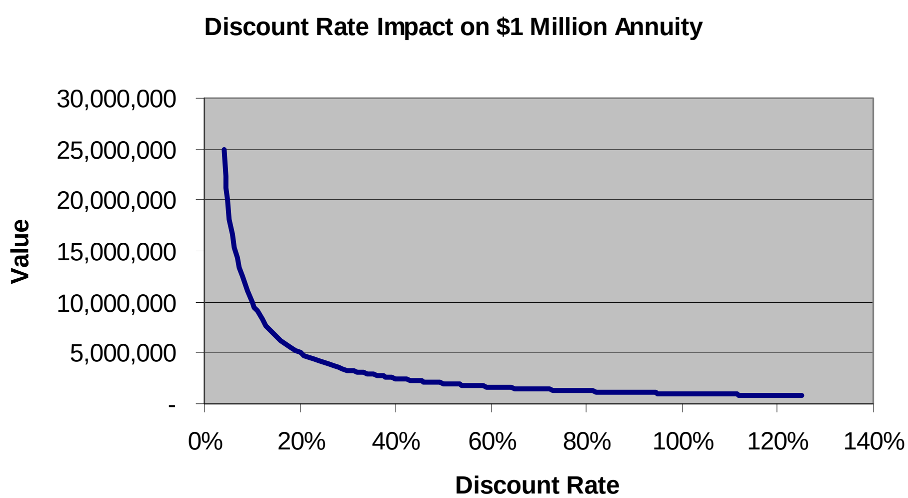

Exhibit 1. Discount Rate Impact on $1 Million Annuity

[1] Recall that the present value of a perpetuity is as follows: $1,000,000 / 50% = $2,000,000.
[2] $1,000,000 / 20 % = $5,000,000.

About This Article

The article appears in the May/June 2009 issue of *Valuation Strategies Magazine*, published by Thomson Tax & Accounting.

Pellegrino & Associates LLC specializes in the valuation of intellectual properties for a variety of purposes including tax, M&A, litigation, and investment capital.

If you would like to receive hard copies of this or other items that we publish, or if you are not on our mailing list and would like to receive future publications, please call us at (317) 566-8199 or email us:

info@pellegrinoandassociates.com.

Pellegrino & Associates, LLC
10333 North Meridian Street
Suite 150
Indianapolis, IN 46290

Voice: 317.566.8199
Fax: 317.569.7144

www.pellegrinoandassociates.com

As the chart demonstrates, a nonlinear relationship between the discount rate and value is evident. This is important because it means that value does not change consistently with the discount rate. If the analyst raises a discount rate 5%, the value impact is not constant. Instead, it depends on the starting discount rate that the analyst was adjusting and the direction of the change (i.e., lowering it or raising it from the starting discount rate). Raising the discount rate from 20% to 25% lowers the value by $1 million. However, raising the discount rate from 75% to 80% lowers the value by only $83,333.

Current valuation literature establishes these concepts well. For example, one author writes, "the discount rate should properly reflect the risks of an investment in the forecasted profit stream."[3] However, the magic question is this: How does one determine what discount rate to use for the project? Not one major source in the current literature speaks specifically as to how to do that objectively and defensibly for an IP assignment.[4] Thus, valuation analysts may fall back to methods used in other valuation disciplines such as business valuation. As a result, following current literature dutifully, the valuation analyst would calculate the discount rate using any one of the capital asset pricing model (CAPM), its variant the Fama-French Model, the arbitrage pricing model, the build-up method, or some other method. The bad news for the IP valuation analyst: For several reasons, these methods are woefully inadequate for estimating the cost of capital in an IP valuation project.

…It is simply erroneous to apply a cost of capital based on company market values against an IP asset, as the analyst would be mixing altogether unrelated items.

First, a search of the academic research yields little useful correlation between IP valuation projects and these methods, despite a substantial emphasis in current literature on using these methods for such valuations. For example, all derivations of the CAPM derive from studying changes in stock prices for a specific company against the broader, value-weighted market index. None of these methods deals with IP investment. Therefore, it is simply erroneous to apply a cost of capital based on company market values against an IP asset, as the analyst would be mixing altogether unrelated items.

Second, a company's cost of capital, as calculated using any of the aforementioned methods, represents an income portfolio that provides risk diversification. That typically is not the case for an IP project. For example, Lilly sells a variety of products. If Lilly loses patent protection on one product, such as Prozac, Lilly will likely continue to operate as a going concern because Lilly has diversified its operations such that any single product failure will not ruin the company. Contrast that with an IP project. A patent, unless it touches several distinct markets (e.g., an adhesive works equally well in the commercial construction and aerospace markets), represents a single-source income stream that may have no value if it fails in the market. Alternatively, consider a startup company focused on one product whose patent captures its essence. If the patented invention fails to fulfill a

---

[3] Cromley, "20 Steps for Pricing a Patent," J. of Accountancy (November 2004).

[4] For that matter, the same holds true for early-stage companies or other assets that lack a defined marketing program or distribution infrastructure.

…other factors become important in determining a cost of capital, including the target rate of return, the holding period, and associated management expenses.

value proposition, it has no realizable value and the company will fold because of a lack of diversification. Third, these methods lack precision to calculate a cost of capital commensurate with specific risk levels within an industry. Yet the risks associated with a project vary considerably based on the project's nature and the company monetizing the IP. For example, one study indicates that the cumulative success rate for an infectious disease therapy winning FDA approval for sale is 28.1%.[5] The same study indicates that a respiratory therapy has only a 12% probability of winning FDA approval.

Under existing cost-of-capital methods, such as the SIC-code-based build-up method or the CAPM, the analyst would attribute the same discount rate to each of these investments, despite their grossly different success rates. This is erroneous. In fact, the infectious disease therapy is more than twice as likely to get to market, and so its risk profile is lower, while its valuation would be higher, all else being the same. Moreover, a startup company will incur a higher risk than an established market player to bring the same equivalent therapy to market, which the discount rate should reflect. Existing literature does suggest that the analyst can add some "alpha" factor to the discount rate to account for the additional risk, and yet no method demonstrates an objective, empirical method to do so.[6] Thus, the analyst makes a random guess as to the possible adjustment to account for the risk differences. These random guesses lack both a theoretical model and any means to test the guess empirically.

In addition, other factors become important in determining a cost of capital, including the target rate of return, the holding period, and associated management expenses. None of the current methods accounts for these factors. In short, it is not appropriate to use these methods for an IP-based project. That is not to say that no method exists to account for all of these considerations. Instead, the next section introduces an analytical framework that considers the relevant factors of an IP project to impute an appropriate discount rate based on empirical research.

A New Model

As discussed in the prior section, existing methods for estimating the cost of capital for an IP project are inadequate. Specifically, they fail to account for the following factors that are crucial to pricing capital costs for IP projects:

- The target rate of return for the investment.
- The success rate of getting IP to the market.
- The holding period for the IP investment.
- Associated expenses for managing the investment for the holding period.

[5] DiMasi, "Risks in new drug development: approval success rates for investigational drugs." 69 Clinical Pharmacology & Therapeutics 301 (2001).

[6] Some studies exist to suggest a size premium or discount to add to a base discount rate to account for the relative size differences of companies in the market. However, this data suffers from survivorship biases and provides no insight into evaluating differences between startup or privately held companies and mature companies.

The new IP cost-of-capital estimation model presented next accounts for all of these factors. Moreover, it works for angel investors, venture capital firms, and public and private companies. The model works for IP in all stages of development, regardless of whether it is just at the idea stage, or a product is already selling in the market. The model works for every major industry and every IP type. Additionally, the model passes empirical and theoretical tests, validating its approach. Lastly, the model is relatively straightforward, providing for simple verification of results.

Target Rate of Return

To explain the model, one first needs to consider the nature of an IP investment. An investor invests resources in IP in order to generate a return on investment (ROI). However, not all investments will generate a positive ROI. Some projects will fail and the investor will lose the entire investment in the project. Other projects may meander on for years, never generating outright losses, but never achieving target returns objectives either. It is what some investors may call the "living dead." Lastly, some projects will generate successful returns well in excess of the desired target return.

…if the investor is to generate a target rate of return…the investor must account for both the expected successes and failures to generate the appropriate target rate of return.

For example, suppose an investor makes equal $1 million investments in three separate projects. In the first project, the investor loses the entire investment, generating a ROI of (100%). In the second project, the investor breaks even on the investment, generating a ROI of 0%. In the third project, the investor generates a ROI of $3 million, or 200%, for a cumulative ROI of $1 million, or 33%, as the table in Exhibit 2 demonstrates.

	Investment	Ending Value	Return %
Investment #1	1,000,000	-	-100%
Investment #2	1,000,000	1,000,000	0%
Investment #3	1,000,000	3,000,000	200%
Totals	3,000,000	4,000,000	33%

Exhibit 2. Return on Investment

Thus, if the investor is to generate a target rate of return, perhaps 15% annually, the investor must account for both the expected successes and failures to generate the appropriate target rate of return.

Holding Period

An investor invests $1 million into the portfolio and requires a 20% compound annual return on that money. The holding period is an important consideration. The longer the holding period, the longer the investment portfolio has to generate an economic return (i.e., the portfolio does not need to generate all of its returns on a compressed schedule). This lowers the implied rate of return, which lowers the cost of capital. For example, suppose an investor wishes to double his or her investment in five years. To meet this target, the portfolio would need to generate compound annual returns of 14.87%.[7] If the investor wanted to double the investment in

[7] Calculated using a financial calculator with a present value of ($1,000,000), a holding period of five years, interim payments of $0, a future value of $2,000,000, solving for the interest rate.

seven years, the portfolio would need to generate compound annual returns of 10.41%.[8]

Understanding the importance of the holding period, assume that the investor will target a seven-year holding period and seeks a 20% compound annual return. This means the investor wants to generate a 20% compound annual return on a $1 million investment and receive the proceeds at the end of Year 7. The investor would thus receive a check at the end of Year 7 for $3,583,181. Of that check, $1 million represents a return of the original investment amount. The balance represents the 20% rate of return the investor sought.

Key drivers for the model include the target ROI sought, the success rate of the investment portfolio, and the holding period.

In this example, the model assumes that the entire $1 million investment will generate a return. However, recall that not all of the portfolio investment will generate a return, as some specific portfolio projects will fail and some will break even. Thus, available capital to generate the total portfolio return will be less than the original investment. In fact, if a company has a 20% success rate, the expected value of the initial investment is $200,000.[9] That means the remaining $200,000 investment must grow over a seven-year period to $3,583,181. To do so, the $200,000 must generate a compound annual rate of return of 51.02%.[10] This fact is the key to the cost-of-capital model. By accounting for the expected success of the overall initial investment, and then solving for the compound annual rate of return needed to meet the target rate of return to the original investor, one can compute the appropriate cost of capital to use for a project, as the equation in Exhibit 3 describes.[11]

$$costOfCapital = \left(\frac{(1 + targetRate)^{holdingPeriod}}{successRate} \right)^{1/holdingPeriod} - 1$$

Exhibit 3. Cost-of-Capital Equation

Key drivers for the model include the target ROI sought, the success rate of the investment portfolio, and the holding period. Changes to any of these will adjust the portfolio's risk profile; thus, the cost of capital will automatically adjust to account for the change in the risk profile.

This model works well under different holding periods. Recall that the shorter the holding period, the less time is available to generate a favorable return. Assuming

---

[8] Calculated using a financial calculator with a present value of ($1,000,000), a holding period of seven years, interim payments of $0, a future value of $2,000,000, solving for the interest rate.
[9] $1 million * 20% probability of success = $200,000.
[10] $200,000 * (1+ 51.02%)7 = $3,583,181.
[11] Algebraically, the investment amount is irrelevant in the cost-of-capital calculation. The cost of capital would be the same regardless of whether the investment amount was $1 or $1 billion.

a success rate of 20%, a holding period of five years, and a target rate of return of 20%, the model would determine a cost of capital of 65.57%. If the holding period were seven years, the cost of capital would be 51.02%. If the holding period were ten years, the cost of capital would be 40.95%. As the holding period extends to infinity, the cost of capital approaches the target rate of return, as the chart in Exhibit 4 demonstrates.

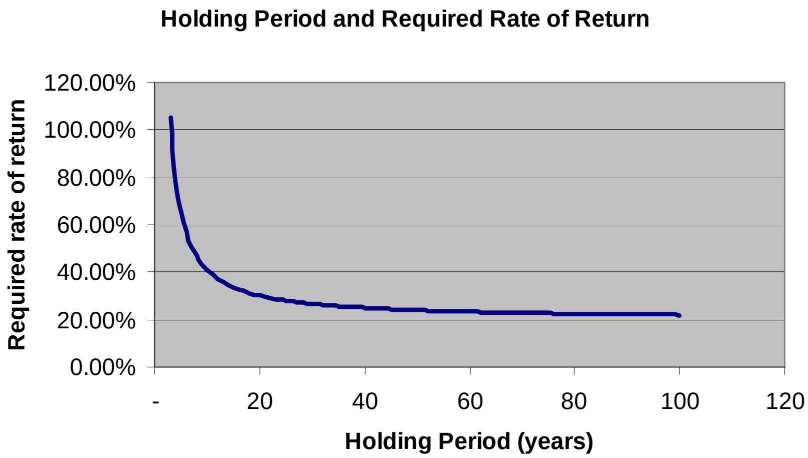

Exhibit 4. Holding Period and Required Rate of Return

As the holding period extends to infinity, the cost of capital approaches the target rate of return.

Project Success Rates

The model works well under different success rates for projects. Recall that infectious disease therapies have an approval success rate of 28.1%. Assuming a target rate of return of 20% and a five-year holding period, the required cost of capital to reach the investment objective is 54.68%. Now contrast that with respiratory therapy, which exhibits a 12.0% success rate. In that situation, the cost of capital rises dramatically, to 83.38%, to account for the increased risk that the therapy will fail to gain approval for sale in the market. The success rate bears an exponential relationship to cost of capital as the chart in Exhibit 5 demonstrates, using a five-year holding period and a target rate of return of 20%. The chart shows that the greater the success rate for the portfolio in converting the original investment to a ROI, the lower the required cost of capital.

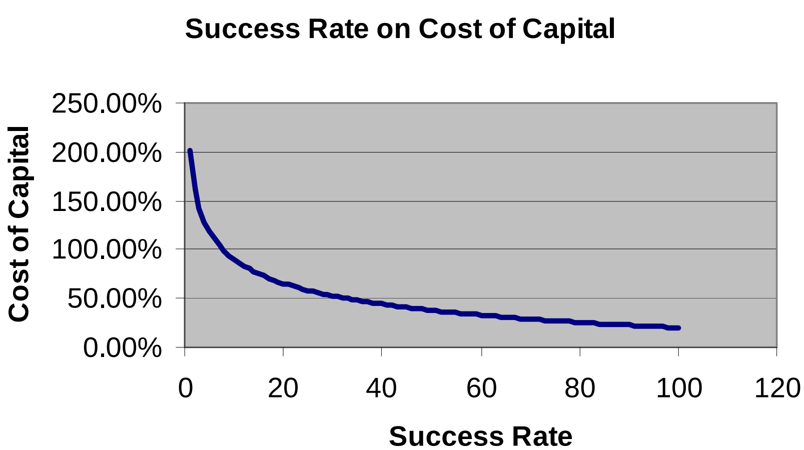

Exhibit 5. Success Rate on Cost of Capital

The greater the success rate for the portfolio in converting the original investment to a ROI, the lower the required cost of capital.

Target Returns

Lastly, the model works well as the investor changes the desired ROI. Assuming a success rate of 20%, a holding period of five years, and a target rate of return of 20%, the model would determine a cost of capital of 65.57%. If the investor changes the target ROI from 20% to 15% (perhaps due to a loosening credit market), the resulting cost of capital reduces to 58.67%. If the investor changes the target ROI from 20% to 25% (perhaps due to a tightening credit market), the resulting cost of capital increases to 72.47%. A direct linear relationship exists between the target return and the resulting cost of capital, as the chart in Exhibit 6 demonstrates. The chart shows that investor demands for higher returns for the initial investment increase the cost of capital directly.

A direct linear relationship exists between the target return and the resulting cost of capital.

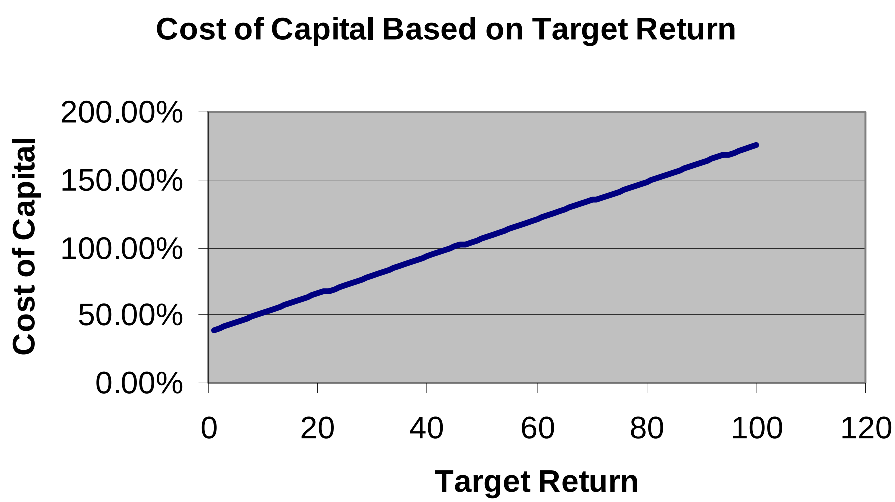

Exhibit 6. Cost of Capital Based on Target Return

Investment Expense

Target returns to investors should always represent the net cash returned to them. Thus, any items that reduce the amount of cash that could go to an investor, such as investment expenses, represent a drag on the realized investment returns. Thus, for an investor to achieve target return objectives, the realized rate of return from the successful portfolio projects must be even higher to account for portfolio management fees. If the investment portfolio represented management by a venture capital firm, fees would include an annual maintenance fee, typically about 2%, and a carried interest (i.e., profit share of investment gains), typically 20% of the investment profits.

For example, suppose a venture capitalist raises $10 million, has a target rate of return of 20%, expects a 20% success rate over a five-year holding period, and operates under an arrangement that pays it 2% of the fund amount as a management fee and a 20% carried interest. Under that target return, the investors expect to receive at the end of Year 5 $24,883,200: $10 million representing the initial investment, and $14,883,200 representing a 20% annual return on the original investment over a five-year period. The venture capitalist will have to generate that return with a realized investment amount of $2 million after considering the success rate on the initial investment.[12] Because the venture capitalist will receive 2% annually to operate the fund, total management expenses will be $1 million over the life of the fund,[13] which means that the investment must generate an additional $1 million to cover the fund's expenses and still meet the target return objectives. Thus, the $2 million investment must now generate $25,883,200 over five years. In order to do so, the venture capitalist's investments would have to generate a return of 66.88%.

The return does not account for the carried interest, which is the profit component that accrues to the venture capitalist for its investment acumen. The carried interest is the profit component of the investment, which as shown previously is $14,883,200. However, do not forget that the venture capitalist has $1 million in management fees to cover as well. Thus, actual profit that represents the basis for the carried interest is $15,883,200. To get a net return of $15,883,200 after a 20% carried interest, the model has to gross up returns and then subtract out the profit to the investor. The formula to do so is shown in Exhibit 7.

$$carriedInterestAmount = \frac{(targetInvestmentReturn + managementFee)}{(1 - carriedInterest\%)} - (targetInvestmentReturn + managementFee)$$

$$carriedInterestAmount = \frac{(\$14{,}883{,}200 + \$1{,}000{,}000)}{(1 - 20\%)} - (\$14{,}883{,}200 + \$1{,}000{,}000)$$

$$carriedInterestAmount = \frac{(\$15{,}883{,}200)}{(80\%)} - \$15{,}883{,}200$$

$$carriedInterestAmount = \$19{,}854{,}000 - \$15{,}883{,}200$$

$$carriedInterestAmount = \$3{,}970{,}800$$

Exhibit 7. Carried Interest Formula

The $3,970,800 carried interest adds to the total returns the $2 million that investment must generate, which now is $29,854,000. To generate the target return after accounting for management fees and the carried interest, the venture capitalist will have to generate a compound annual rate of return of 71.71% over the five-year holding period, which is the true cost of equity for an investment by this venture capitalist. Thus, a valuation analyst would use this cost of capital as a discount rate for the valuation.

Adding management expenses into the original equation complicates the formula somewhat, but it is still quite usable despite these complications. Exhibit 8 contains the revised cost-of-capital formula accounting for both the recurring management fee and the carried interest amount calculated previously.

---

[12] The $10 million fund net of the 20% success rate.

[13] $10 million fund * 2% * 5 years = $1 million.

$$costOfCapital = \left(\frac{(1+targetRate)^{holdingPeriod} + annualManagementFee\% * holdingPeriod + carriedInterestAmount}{successRate} \right)^{1/holdingPeriod} - 1$$

Exhibit 8. Cost of Capital Formula

As an interesting sidebar, some venture capitalists charge higher carried interest fees. For example, Charles River Ventures charges a 30% carried interest,[14] well above an industry norm of 20%. Assuming the same success rate of 20% and a five-year holding period, Charles River Ventures has increased the required rate of return from 71.71% to 75.61%, as the $2 million net invested capital must now generate $33,404,571 instead of $29,854,000.

Exhibit 8 contains the revised cost-of-capital formula accounting for both the recurring management fee and the carried interest amount calculated previously.

The Benefits of Empirical Evidence

A theoretical model is good only if it models reality within some measure of error. The obvious implication is that using data based on real-world observable circumstances makes for a better approximation of true value. Proponents of the CAPM and its derivatives point out quickly that real-world data drives the results that valuation analysts use. However, as already discussed, the utility of those results for an IP assignment is dubious at best, despite their empirical roots.

By analogy, one can show empirically that a Fortune 500 company has a lower cost of capital that correlates negatively with the number of McDonald's Big Macs that its employees consume. However, correlation does not equal causation. Moreover, recall that IP's cost of capital is not directly observable in the market. That said, this model does provide for consideration of several forms of empirical evidence to drive the ultimate cost of capital.

First, from a theoretical perspective, it is easy to prove the model with simple algebra, based on the inputs. If the model were wrong, the results generated would not satisfy the target return objectives or cover associated expenses needed to manage the investment, based on the projected success rate.

Second, the model allows the analyst to set the cost of capital based on target returns of funds. When a fund manager sells an interest in its fund, it typically will issue a target rate of return on the investment. The market that invests in the fund explicitly accepts the projected target rate of return in exchange for the investment. That target rate of return for the fund thus becomes the basis for the targeted return to use in the model. Alternatively, consider the case of a public company that makes continued investments in research and development. Using a cost-of-capital model such as the CAPM or information from public filings, one could determine the company's cost of capital or its hurdle rate. That rate would thus become the target rate one would use for the model. Third, the model allows the analyst to select the holding period for the investment explicitly. If the length of

[14] Metrick, *Venture Capital and the Finance of Innovation* (John Wiley, 2007).

time for a drug to make it through a pharmaceutical company's pipeline to market is ten years, the ten-year indication is what the valuation analyst uses for the holding period for the model. If a venture capital fund projects a seven-year holding period to its investors, the seven-year holding period is the one to use in the model. In both examples, the model is using empirical evidence to drive the resulting output.

Fourth, the model allows the analyst to set the expected success rate for the total investment explicitly. The analyst can do so by using historical data from either the fund's own investment success rate or the broader market. For example, recall that infectious disease therapies have a 28.1% historical success rate of making it through the clinical trial process and on to final market approval, while respiratory therapies have a 12.0% historical success rate. Empirical evidence drives success rate statistics directly. Thus, using it would reflect empirical observation explicitly.

Lastly, the model allows the analyst to account for the expected expenses associated with the investment management explicitly. For a company, these expenses would likely be zero. For a fund, they would reflect what the fund's prospectus indicates. Thus, if a venture capital fund expects a 2% management fee with a 20% carried interest, the analyst can program that directly into the model. Again, this data has an empirical basis that reflects what the analyst observes directly in the market.

In short, the model is a simple calculator, easily provable with algebra. Using empirically derived inputs should provide an analyst with an empirically based cost of capital suitable for an IP project.

…the model is a simple calculator, easily provable with algebra. Using empirically derived inputs should provide an analyst with an empirically based cost of capital suitable for an IP project.

Model Extensions

The model in its basic state includes several baseline assumptions that should work well for many instances. First, the model presumes all capital is ready for investment in the first month. This may not be true in all cases. Often, investors may supply capital over several months or years. The model, however, extends well to support this structure. The net effect of such a structure would be to lower the required rate of return for the projects. For example, suppose an investor will provide $10 million in capital and seeks a ten-year holding period, a 28% success rate, and a target rate of return of 15%, with no management fees or carried interest. The cost of capital is 30.57%.

Suppose, however, that the investor provides the $10 million over two years, with $5 million added in the first year, and $5 million added in the second year. The net effect would be a reduction of the cost of capital to 29.69%, primarily because the investments must return a lesser amount, due to the second $5 million covering only nine years' worth of compound annual returns at a 15% target rate of return to the investor, instead of ten years' worth. The schedule in Exhibit 9 captures those cash flows and the required rate of return.

Success Rate	28%
Target Rate of Return	15%
Management fee	0%
Carried interest	0%

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Beginning Balance	-	5,750,000	12,362,500	14,216,875	16,349,406	18,801,817	21,622,090	24,865,403	28,595,214	32,884,496
Investment	5,000,000	5,000,000	-	-	-	-	-	-	-	-
Dividends	-	-	-	-	-	-	-	-	-	-
Annual Return	750,000	1,612,500	1,854,375	2,132,531	2,452,411	2,820,273	3,243,313	3,729,810	4,289,282	4,932,674
Total Investment	5,750,000	12,362,500	14,216,875	16,349,406	18,801,817	21,622,090	24,865,403	28,595,214	32,884,496	37,817,170

Total Needed Deal Return	37,817,170
Expected Value of Investment	2,810,000
Necessary Rate of Return	1245.81%
Annualized rate (compound)	29.69%

Exhibit 9. Schedule Based on Investor Providing $10 Million Over Two Years

Next, the model presumes that all dividends and the return of capital occur in the last year. However, like capital infusions, extending the model to allow for a faster return on capital is no problem. For example, suppose an investor will provide $10 million in capital and seeks at a ten-year holding period, a 28% success rate, and a target rate of return of 15%, with no management fees or carried interest. However, the investor receives a return of capital in Year 6 of $5 million. The net effect is that it would lower the cost of capital to 28.83%. The cost of capital is reduced primarily because the investor would have fewer years to wait to receive the return of some capital and dividends, as the schedule in Exhibit 10 demonstrates.

Success Rate	28%
Target Rate of Return	15%
Management fee	0%
Carried interest	0%

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Beginning Balance	-	11,500,000	13,225,000	15,208,750	17,490,063	20,113,572	17,380,608	19,987,699	22,985,854	26,433,732
Investment	10,000,000	-	-	-	-	-	-	-	-	-
Dividends	-	-	-	-	-	(5,000,000)	-	-	-	-
Annual Return	1,500,000	1,725,000	1,983,750	2,281,313	2,623,509	2,267,036	2,607,091	2,998,155	3,447,878	3,965,060
Total Investment	11,500,000	13,225,000	15,208,750	17,490,063	20,113,572	17,380,608	19,987,699	22,985,854	26,433,732	30,398,791

Future Target Investor Value	
Total Needed Deal Return	35,398,791
Expected Value of Investment	2,810,000
Necessary Rate of Return	1159.74%
Annualized rate (compound)	28.83%

Exhibit 10. Schedule Based on Investor Receiving $5 Million Return of Capital in Year 6

Additionally, the model presumes a simplified success rate over the life of the investment portfolio. However, an analyst can extend this model to account for a more complex algorithm to determine the success rate, and integrate that into the model accordingly. For example, suppose the investment includes two projects, one that consists of a $1 million investment that provides a 25% success rate, and a second that consists of a $5 million investment with a 15% success rate. The analyst could then calculate and use a weighted average success rate of 16.67%, as the table in Exhibit 11 demonstrates.

Investment Amount	Success Rate	Weight	Factor
1,000,000	25%	16.67%	4.17%
5,000,000	15%	83.33%	12.50%
6,000,000		100.00%	16.67%

Exhibit 11. Weighted Average Success Rate Calculation

Back to the Roots

The model reduces to a target rate of return with perfect execution and an indefinite holding period. To illustrate, consider again the example of an investment that has a target rate of return of 20%, a 20% success rate, a holding period of five years, and no additional management expenses. Under this example, the model would calculate a per-investment cost of capital of 65.57%. Now, suppose the investor has a 100% investment success rate instead of a 20% rate (e.g., a drug company would bring every drug therapy it attempts to market successfully). That would drive the cost of capital down to 20%, the target rate of return. This makes sense because an extra premium needed to account for any investment losses is unnecessary.

Now consider the original example's fact pattern again. This time, the holding time is 500 years, which for practical purposes is infinite. The cost of capital is now 20.39%. Notice that the cost of capital goes way down, though it is not entirely erased because the remainder of the investment (20% of the original principal) still must cover the 80% loss of the investment principal, which takes time. With enough time, the model would converge to the target rate of return. This demonstrates, for the worst case, that an analyst has the precision of current methods for estimating the cost of capital for an IP project. However, for most cases, the analyst should be able to use the model to produce a cost of capital that more closely represents the facts at hand. This should result in a more precise value opinion.

…for most cases, the analyst should be able to use the model to produce a cost of capital that more closely represents the facts at hand. This should result in a more precise value opinion.

Examples

Applying the model in real-world situations is straightforward. Two examples appear below, one to determine the cost of capital for a public company and the other to determine the cost of capital for a venture capital fund. Both examples are for the same project; however, the examples will show dramatically different results for each case.

Public Company

Consider the case of Lilly, whose beta, as of this writing, is 0.77.[15] Using a risk-free rate of 2.61%[16] and a historical equity risk premium of 7.10%, Lilly's cost of capital would be as follows:

$$costOfEquity = riskFreeRate + beta * equityRiskPremium$$
$$costOfEquity = 2.61\% + 0.77 * 7.10\%$$
$$costOfEquity = 8.08\%$$

Now suppose that Lilly needs to determine the cost of capital for a new cancer therapy that is just about to enter clinical trials. Industry statistics indicate that oncology therapies at this stage have a 15.8% success rate. It expects to generate a return over a ten-year holding period. In this situation, Lilly would use a cost of capital of 29.98% to value its project.

---

[15] http://finance.yahoo.com.

[16] As of the time of this writing for a ten-year Treasury note.

Next, suppose Lilly is in a drug discovery phase. Drug companies may test 1,000 compounds in order to arrive at a final marketable drug. This represents a 0.10% success rate. Under such a situation, Lilly should use a cost of capital of 115.65% to value its project, as it will need to generate substantial returns based on a minuscule residual investment in order to meet its target returns.

Venture Capitalist

Consider the case of a venture capitalist, which for the 20-year period ending 9/30/07, generated average returns of 16.4%; this is the target rate to use for the model. The venture capitalist is making the same type of investment in a cancer therapy as Lilly, at the same development stage. Thus, the venture capitalist investment carries the same success rate. However, empirical evidence suggests that venture capitalists have current average holding periods of eight years.[17] Most venture capitalists charge a 20% carried interest for their fund management,[18] a 2% annual fee, and have an average fund size of $166 million.[19] In this example, the venture capitalist would use a cost of capital of 50.52% to value its project, which is about 70% higher than Lilly's cost of capital for the same project.

Most venture capitalists charge a 20% carried interest for their fund management, a 2% annual fee, and an average fund size of $166 million.

Suppose the venture capitalist invests at the drug discovery phase. Like Lilly, this represents a 0.10% success rate. Under such a situation, the venture capitalist should use a cost of capital of 183.41% to value its project, which is about 58% higher than Lilly's cost of capital for the same project.

Of course, the key differences between Lilly and the venture capitalist include a higher target return, a shorter holding period, management fees, and a carried interest. These increase the cost of capital to the venture capitalist, as it requires a higher return to cover its cost of capital and expenses.

Conclusion

IP valuation projects typically rely on an income-based approach for valuation. Important in the process is the determination of an appropriate cost of capital to use for discounting purposes. While current literature expresses the importance of the cost of capital on value, existing cost-of-capital estimation methods for IP-based projects are woefully inadequate. They reflect simplifying assumptions and draw from a sample space that is unrelated to the core assets under review. Further, they lack precision below an industry level. Thus, a valuation analyst has little recourse except to generate a risk-adjusted cost of capital, based on empirical data, to support the nature of an investment and associated success rates objectively.

The model presented in this article addresses the deficiencies of the current cost-of-capital estimation methods. It considers factors crucial to investment projects,

[17] Schachter and Hoyem, "High Anxiety or Great Expectations," Venture Capital J. (10/1/08).
[18] Note 14, supra, p. 32
[19] National Venture Capital Association 2008 Yearbook, p. 9.

including the target rate of return for the IP, the success rate for getting the IP to the market, the holding period for the IP investment, and associated expenses to manage the investment over the holding period. The model changes the cost of capital dynamically based on these inputs, reflecting a higher cost of capital as the IP risk profile increases.

The model is easily validated, from both a theoretical and empirical basis. Analysts can use simple algebra to prove the mathematical foundations of the model. Further, all exogenous inputs to the model are observable empirically. Thus, any results from the model will reflect an empirical basis, again verifiable in the market mathematically. The model also extends easily to support different holding periods, timing of capital transfers, success rates, and other factors.

With perfect information, the model reduces to the current state of the art and precision for cost-of-capital estimation methods. However, in most cases, the valuation analyst should be able to use the model to produce a cost of capital that more closely represents the facts at hand. This should drive a value opinion of greater precision.