# Private Equity

*Advanced Modeling Techniques for Pricing and Valuations*

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## Introduction

As capital market returns have become less stable over the last decade, increasingly investment managers have been looking to other markets to generate returns on their portfolios. This has led to an increased asset allocation into private equity and other non-capital market based assets. Aside from return generation, another perception is by adding these types of assets into a portfolio the investor is adding one which is "non-correlated" to the typical bonds and stocks capital market products in their portfolio.

Within the context of an enterprise risk management system this type of investment poses several problems with respect to trying to measure the market or credit risk of the entire portfolio:

- **Lack of information.** Obviously this is the biggest issue, all information is private. A typical equity model will take daily price history, and regress it against some series of publicly available or statistically generated indexes to determine its "sensitivity" to these indexes. This sensitivity will be used to drive the value of the firm. Without a price history, however, this exercise is impossible.
- **Measuring "Market Risk".** As an investor in a private firm, there will be disclosure of financial information, earnings projections, debt levels, etc that can be used to input into some Corporate Valuation model. These models are typically run periodically in isolation. The

aim is to come up with a model that can run in the context of the entire portfolio. Suppose for example a standard Capital Asset Pricing Model (CAPM) is used to value a public equity holding. It trades in the USA, so its single factor could be the S&P 500. The risk factor that will "drive" the risk of that equity is the S&P 500. Traditional portfolio theory suggests that any "firm specific risk" will be diversified away after a number of equities are added to the portfolio. So for this security the risk factor is the S&P 500. Similarly a US Government Bond, discounted by a Treasury Rate, will have this US Treasury Curve as its "risk factor". Moving these risk factors in a correlated manner and measuring the impact to the value of the portfolio will be main function of the risk system. In the case of the private holdings, there is no obvious common "risk factor".

- **Holding Period.** Holding period is a problem not unique to private equity and also impacts other OTC transactions and other illiquid securities. The holding period for a Value at Risk (VaR) computation indicates over what time horizon the potential losses, the VaR number, are likely to occur. In a market risk system, where equity and bond markets are changing daily, the holding period is typically in the 1 day to 10 day range. There are models that project risk over longer holding periods. As holding periods get longer other issues arise: mathematical methods of evolving risk factors through time, reinvestment of cash that is paid out, and preservation of hedges (with options or futures) that may expire to name a few.

In the context of risk management the objective is to answer the question of, "what is the market risk of my entire portfolio, under a given market scenario or scenarios" The problem is not necessarily how to value a specific private equity holding. As mentioned previously there are more detailed corporate valuation models that go into a level of granularity not feasible or warranted for a portfolio market risk system. For the purpose of the methods discussed below it is assumed that a model has been applied and a current value for the holding is available. So from a risk perspective the question becomes, how would changes to general market risk factors affect these particular holdings? The rest of this document outlines approaches which can be used to include these types of holdings into a portfolio analysis.

Much like a publicly traded equity, the privately held equity will have a value. Unlike a public equity where the value is dictated by the forces of supply and demand in an open market, the value of the private equity is determined by a corporate valuation exercise. The only real impact of this is that the exercise of valuation is far less frequent than open market trading, but the result is still a valuation.

The rest of the document outlines two potential modeling approaches to Private Equity: Custom Equations and a Factor Model Approach.

## Custom Equations

For Market Risk Management purposes the goal is to try to assign a quantifiable amount of potential losses for the Private Equity holding based on movements of financial markets in general. The firm specific potential losses will be discussed later. One approach to capture systemic risk is to model the private equity through the use of custom equations. The following is an overview of an example of a "custom expression" used to reflect a "mark to model" approach which is a bottom up approach that incorporates corporate finance information. This model requires the user to input:

- Earnings or the amount of income that the business generates per share
- Multiple (could be a PE ratio for example), or the factor by which the earnings are adjusted to represent the growth potential of the firm's income
- Net Debt, amount of debt the firm has on its balance sheet
- % Ownership

The valuation expression for the current state of the holding is represented as:

$$V_0 = [( Earnings_0 \times Multiple_0 )] - Net\ Debt_0] \times \%ownership_0$$

The last four descriptive input elements (Industry Sector, Primary Region, Size of Company, Equity ticker of Comparable Stock) in the list above are used to explain the risk and future returns of the "Earnings" and the "Multiple" variable in the valuation equation. In this model % ownership and Net Debt generally remain static over time, however, the model allows for what-if analysis on these factors. This equation is available within the IBM risk framework. Furthermore, each parameter in this equation can be linked to a "driver" that will be moved via the application of scenarios to result in a change in value of the holding. An example would be linking the earnings to the average earnings volatility of the S&P 500.

Given the initial *valuation expression* of the company, when the *scenarios are run* the focus is on the changes in value of the company.

This expression would then become:

$$\Delta Value = [(\Delta Earnings \times \Delta Multiple) - \Delta Net\ Debt] \times \Delta\%Ownership$$

On a day to day basis, clients can certainly provide changes to debt or ownership levels, but those are in the hands of the company and investor respectively. The changes in Earnings and Multiples will be what will drive the change in the value of the company under different scenarios. Earning and multiples are driven by client selected common factors such as those related to:

- Industry Sector
- Primary Region
- Size of Company
- Equity ticker of Comparable Stock

These common risk factors can be correlated to other risk factors and asset classes within the portfolio.

The equation can also be adjusted to reflect more complex corporate valuation models that include taxes, depreciation, etc. Keep in mind however that the aim is to measure risk, so specific corporate valuation parameters are less important than the common risk factors with the other asset classes of the portfolio.

**Custom Equation Example:**

In the example, the aim is to model a privately held technology company. The first step is for the client to assign an observable market index (or multiple indexes) to drive the future value of the "Earnings" and "Multiple" variables. For example, the client may provide information that the private equity's industry sector is "technology", the company behaves similarly to "large capitalized" companies in the sector and the company is based in the United States. A process would use this information to attach a US Large Cap Technology (e.g. LCTUS) index to the earnings (1+Earnings)=f(LCTUS). The client may also believe that a comparable company would be "Apple", then the multiple would be tied to the growth of Apple, (1 + Multiple) = g(APPL). Using custom equations clients can provide any observable piece of market data information to drive both earnings and returns. The result is a bottom up model whose "mark to model" value is scenario dependant and reflects beliefs on leverage and risk factor volatility and correlation.

The future valuation would be driven by the following equation:

$(1+ earning_s) = f( I_{1s},....I_{ns}) \text{ and } (1 + multiple_s) = g( I_{1s},....In_s)$

*To determine a scenario dependent mark to model value* $V_S$ *for 1 ....n indices and 1 .....s scenarios.*

Additionally, clients can view aggregated risk since the risk factors driving the earning potential and multiple are correlated to other risk factors (public and private) in the portfolio.

## Factor Models

Putting debt aside for the moment, a "multi-factor" model can be applied to represent the changes in value of the firm. The difference with this and a traditional factor model for public equities is that the assignment of "beta's" or "sensitivities" will be more of an estimate than something derived from observed data. The benefits of using a factor model are that any factors can be assigned to represent common risk factors, and can include a variable to represent a controllable portion of specific risk which the common factors cannot explain. While it is entirely up to the user to map a private equity to a single or multiple public indexes, combinations of two index families to represent the market driven component have been used:

- **Dow Jones Economic Sector Indexes** — Basic Materials, Consumer Cyclical, Consumer Non-cyclical, Energy, Financial, Healthcare, Industrial, Telecom, Technology, Utilities
- **Dow Jones Style Indexes** — Value Small/Medium/Large Cap, and Growth Small/Medium Large Cap

Using one index from each family to drive the Earnings and Multiple components of the equation have found to be reasonable proxies based on information available. As a stakeholder in the firm, a monthly or quarterly history of this company's value should be available. While in most cases this isn't enough to run a meaningful regression, it will give the owner an idea of how well the indexes above represent the growth of the firm. There are some very beneficial features of a flexible factor model. There are several public indexes, ETF's, funds, etc in the market place that can be used as common risk factors. While IBM can provide a default assignment of risk factors by no means would this always be appropriate.

Beyond flexibility in the assignment of risk factors, there is an ability to include an additional portion of risk to the factor model that would represent firm specific risk. Users can add an estimate of how much of the risk is publicly accounted for by indices and how much is company specific. For example, a Telecom company is being modeled with a Mid Side Value classification. It could be specified that it will move lockstep with the DJUSTL and DJUSVM indexes, or will have a Beta = 1 to both. However, while it moves lockstep it could also be specified that those movements only explain 50% of the movement in the value of the firm. The other 50% would be attributable to anything else specific to that firm, management decisions, execution of projects, etc. Including this 50% firm specific risk component will make the investment more volatile and risky individually, at the portfolio level these risks will be mitigated by diversification. The specific risk component can be represented to follow one of a number of parametric distributions (normal, lognormal, passion) or empirical distributions. Given that often large investments are made in a relatively small amount of private holdings, firm specific risk is still relevant and must be accounted for.

Of equal importance one must try and capture the debt of the private equity holding within the analysis, as debt will dramatically increase the risk of any equity investment. Here is an example that looks at the public markets and compares Sprint, AT&T, and Verizon, all US telecom companies with similar business models:

| | S | VZ | T |
|---|---|---|---|
| Market Cap | 17B$ | 125B$ | 200B$ |
| Revenue (annual) | 35B$ | 120B$ | 129B$ |
| EBITDA | 5.072B$ | 29.4B$ | 30.5B$ |
| Debt/Assets | 41.1% | 23.9% | 24% |
| Volatility (360d) | 63% | 17% | 16.9% |

Using the past year volatility as a proxy for risk this shows while Sprint's market capitalization is significantly smaller than Verizon and AT&T, both the debt and the volatility are significantly higher than the other two firms. Ultimately, the impact of higher debt levels and the structure of the debt can indicate increased risk as a shareholder within the company.

Within the factor model framework there are two options for incorporating the risk from debt into the equation. One could be to include a more volatile debt "factor" and the other method could be to allocate a higher percentage to the specific risk component of the company.

### Factor Model Example:

$$V^i_{te} = V^i_{ts} \bullet e^{\sum_j^n \beta \bullet \ln(x^i_{te} / x^i_{ts})} \bullet e^{\sqrt{\tau} \bullet \varepsilon_{ts}}$$

In this equation:

$V^i_{ts}$ = Spot Price or Current Value (and the V we are computing is the "expected" value)

$e^{\sum_j^n \beta \bullet \ln(x^i_{te} / x^i_{ts})}$ = term that is the expected returns of the indexes attached (in the case of a private equity, an index for Earnings and one for Multiple)

Note: The term ß = 1 is set for both indexes but the client could be allowed to control this and set a stronger beta to either of the drive indexes, but the standard set up would be to set this to 1. This is the case where if data were available a specific beta could be derived.

$e^{\sqrt{\tau} \bullet \varepsilon_{ts}}$ = is a term that can be used to incorporate firm specific component to the model, a volatility is input by the user, this is then used to sample from a normal distribution

## Holding Periods and Lock-ups

Another issue to consider for private equity relates to holding period and lock-ups, specifically when it relates to risk management when calculating a Value at Risk (VaR). Typically, it takes a significant amount of time to unwind a private equity holding as there is no liquid market in which to do so. This would indicate a significantly longer holding period for this asset class, 3 months – 1 year.

Because the models above are assigning common risk factors that are liquid, these holdings can be incorporated into a daily simulation. While not applicable directly to the asset class, it will allow a client to incorporate this asset class into their total portfolio for whatever holding period is deemed adequate for the business as a whole. It would be a good idea to also consider longer holding period analysis, both VaR and Stress Testing specifically for this illiquid asset class.

## Conclusion

The main difference between the two approaches is that custom equation approach uses a corporate finance approach, with flexibility to build your own equations, to try and compute a value for the private market security. While the factor model approach tries to compute value based on the securities sensitivity to that of other publicly available risk factors.

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Produced in the United States of America
January 2013



YTW03310-USEN-00