NEWS IN AVANCE
VALUATION IN LIFE SCIENCES
January 2010 - N.10

avance
Corporate Finance in Life Sciences

The Risk Premium

In the capital asset pricing model (CAPM) the cost of capital of an asset is defined as $r_A = r_f + \beta_A(r_M - r_f)$. The cost of capital equals the risk free rate plus a factor beta times the difference of the market return and the risk free rate. The formula is quite simple, but all inputs are tricky.

The least tricky is the risk-free rate. This is usually the yield (not the coupon!) of a long-term government bond. Whether it should be a ten-year bond or a five-year bond is not clear, because CAPM doesn't consider different interest rates for various maturities. Ideally, it is the yield of a zero coupon bond with maturity equal to the weighted duration of the investment, but this is already too much of theory. Take a ten-year bond and you are fine. The differences are usually not big, certainly not in view of the difficulties that come with the other two parameters.

The next parameter is the infamous beta. The beta of asset *A* is defined as follows:

$$\beta_A = \sigma_A / \sigma_M * \rho_{AM}$$

The greek letters σ stand for the standard deviation of the returns of assets *A* and *M* (*M* is the market portfolio), and ρ_{AM} is the correlation between the two. Unfortunately none of these parameters is observable (with some reservations). This, of course, complicates matters a little. The problem is that these parameters are all understood as forward-looking, i.e. what is the expected standard deviation or correlation of the assets. Prices of derivatives allow certain conclusions on what these parameters are expected to be. But this involves sophisticated financial mathematics and still is not free of doubt (derivatives deal usually with standard deviations of log-returns, CAPM only of returns). The estimation of the correlation seems particularly impossible, as this is a statistical measure that is already very hard to imagine. And to make things completely absurd the market portfolio *M* is not known. Theoretically it is the portfolio, assembled from all possible assets (including art, commodities, etc., that maximises the Sharpe ratio, i.e. the ratio between the premium $(r_M - r_f)$ and σ_M. But how should this portfolio look like? We cannot measure these quantities and compare them for the zillion possible portfolios. As a consequence of all these caveats practitioners live up to their name and, without further ado, declare the Dow Jones index (INDU) or the S&P 500 to be the market portfolio. They replace the σs and ρs by their historical statistics, i.e. they measure what the standard deviations and correlations have been in the past. With this they get some parameters to fill in the gaps in the formula. Unfortunately, historical performance is not a good indicator for future performance. Sometimes we get rather strange results like negative betas for biotech companies. But the problem of beta is left to another newsletter article.

In this article we focus on the risk premium, i.e. on $(r_M - r_f)$. And following the above lines we assume the Dow Jones index to be an indicator of the market portfolio. When measuring the annualised return of the Dow Jones index (r_M) we run into a severe problem, as we need to know over which period. Unfortunately the index does not evolve regularly. And this becomes even more awkward in times of a bear market or, like now, right after a bear market where most of the recent historical data stems from the bear market.

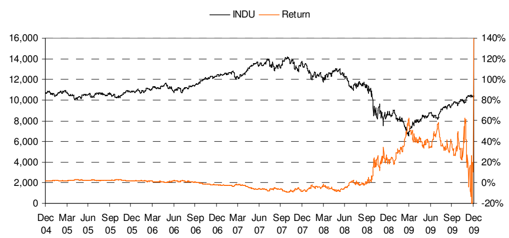

Figure 1: Dow Jones index (INDU). The orange line indicates the average rate of return calculated from the x-value to Dec 09.

Calculating the return of the Dow Jones index from March 2009 to December 2009 we receive a spectacular 62% p.a. (per annum, i.e. annualised). When calculated since October 2007 the average rate of return drops to a depressing -9% p.a.. Going back ten years we receive an average rate of 2% p.a.. In figure 1 we see that the longer the period, i.e. the more to the left, the more stable the measurement becomes, because the less it is dependent on single events or rallies. Or should we go back 100 years? Which rate should we use, if we were to use any of these, and why?

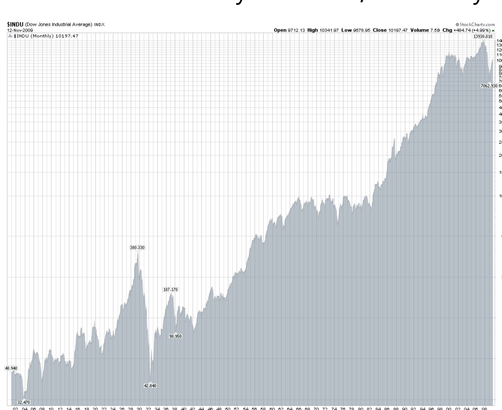

Figure 2: Dow Jones since 1902 in log-scale (chart from stockcharts.com).

Let's go back to the actual meaning of the risk premium. It is the expected excess return of the market portfolio over the risk-free rate. Until now we have only measured the realised return. The expected return is unfortunately not observable. The risk premium is expected to be clearly positive as investors take risk, which should be rewarded with superior return, on average. But why did the prices drop? Next to many reasons it is generally assumed that the risk premium has increased, i.e. investors ask for more reward when taking risks; they have become more risk averse. This in turn leads to higher discount rates and consequently lower values. Makes sense! But how do we get to this superior risk premium? Historical data is obviously not a good guide. We cannot take even the very long-term r_M as a good proxy, because in a crisis the risk premium is obviously higher than average. But how can we estimate this r_M?

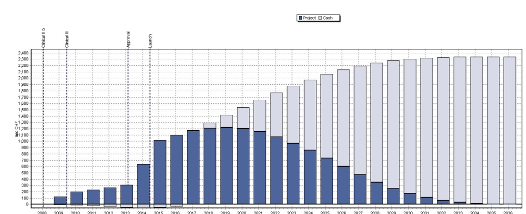

Figure 3: Value development of a project with 10% discount rate. Calculated with ri:val.

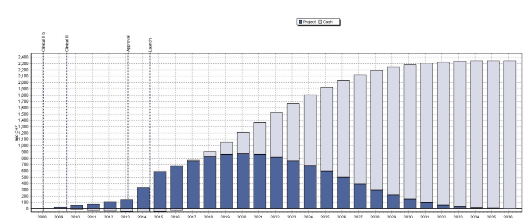

Figure 4: Value development of a project with 18% discount rate. Calculated with ri:val.

Approaching this questions figures 3 and 4 give a good impression of the influence of a higher risk premium ceteris paribus (we assume that the beta does not change in view of a bull or a bear market, although one can argue that assets become all correlated in a bear market, but this is another discussion). A higher risk premium leads to a higher discount rate and therefore to lower values. But at the end of a project, the realised money will be the same, because it does not depend at all on the discount rate but only on the cash flows. While in the case of a 10% discount rate the initial value is CHF 113 Mio, an 18% discount rate leads to a value of only CHF 20 Mio. But at the end of the life cycle in both cases the project value has turned into CHF 2,340 Mio cash. This is quite amazing and should help us in the following reasoning: The cash flow estimates should not really change because of the crisis (for healthcare and moreover long-term estimates this probably holds true, for consumer goods rather not). Therefore the drop in value is uniquely linked to the higher discount rate. But since the risk free rate is close to zero nowadays and the beta is also assumed to be more or less independent on the crisis, the change must all be due to the increased risk premium. And this can be explained as follows:

1. We are currently – supposed that the worst is behind us – recovering from the crisis.
2. This means that the market portfolio will grow stronger than average to regain its mean level again.

The situation looks as illustrated in figure 5. The equilibrium of the market portfolio growths steadily, but the actual realisation of the market portfolio is sometimes over, sometimes under the equilibrium (unfortunately we never know when it's over or under). We can say that we give the market portfolio a certain time to catch up, maybe one or two years, and this represents the expected return of the market portfolio.

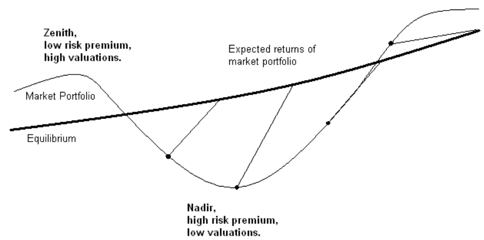

Figure 5: Economic cycles and expected return of market portfolio to catch up.

This theory, and above all figure 5, is just an explanation why the market risk premium changes in the economic cycles. Unfortunately, once again, the measures are hard if not impossible to observe. Practitioners typically use spreads that they add or subtract from a general market risk premium they use. But this spread is typically rather subjective, as already the selection of the market portfolio is.

The CAPM is not made for dynamic economic environments with ups and downs. But the proposed adjustments make it usable. It is still the best and most used models in corporate finance. The main advantage of using a framework as proposed is that the valuations become comparable to each other. You can simply change the market risk premium and the risk free rate in your financial model and the valuation adapts automatically to the new economic state.

In biotech the whole thing complicates even more as the beta is most often difficult to estimate. Later this year we will give you more insight in how to estimate the beta for private and illiquid companies, which should complete the parameters that are needed for a thorough determination of the discount rate.