Measuring and Managing Alternative Assets Risk

Alternative assets present a variety of challenges to risk managers. Indeed, it is difficult to evaluate the risks of these complex instruments, particularly for assets that are illiquid and opaque. But there is hope. Dr. Susan Woodward provides a risk metrics-friendly blueprint for effective alternative assets measurement.

Evaluating alternative assets can often be frustrating work for risk managers. The available risk metrics for these instruments are far from satisfactory. Because many alternative assets lack up-to-date market values, traditional risk measurement approaches are misleading. Managers charged with estimating risks for these complex products need new methods to measure risk and return.

This article will identify and analyze the key risk-related questions surrounding alternative assets, including: (1) What are the different types of alternative assets and how are they typically valued? (2) Why do the standard methods for evaluating portfolios of traded assets fail when applied to alternative assets? and (3) What new methods give reliable risk metrics for alternative assets?

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The standard analysis of alternative assets — a regression of reported portfolio quarterly returns on quarterly returns for a market index such as the Wilshire5000 — gives results that do not inspire confidence. Compared to how the markets felt over the last cycle, the regression betas are too low, the correlations are too low and even standard deviations of return are too low. As a result, the alphas are too high. Nobody believes them.

So what do managers do instead of using these estimates for risk management and performance analysis of alternative assets? Most use some standard index plus a margin as the benchmark for performance: something like the S&P500 + 5, or the Russell2000 + 3, implicitly guessing at what the "true" standard deviation and correlation looks like.

But you don't have to punt like this. With a clearer understanding of the portfolio returns — e.g., how they are computed and what they represent — you can apply an alternative approach to estimating risk that will get all of your metrics right, even for your illiquid, difficult-to-value, opaque venture and buyout funds.

Here's the basic idea: The assets held in an alternative portfolio — whether it is venture, buyouts, oil and gas, distressed debt or real estate — simply do not trade very often. Consequently, when reported valuations do change, they are not just related to the most recent market returns but also to past market returns back to the date of the previous valuation event. So the portfolio manager's problem is to measure the full relation of portfolio returns to market returns, despite the smoothing resulting from the general partner's reporting convention.

The procedure is surprisingly easy: to capture the full relation between portfolio returns and market returns, you need to include on the right-hand side of the regression not just the current return on the market but also lagging returns, with lags going back far enough to capture the most distant valuation events.

How portfolio values are reported differs by type of fund, and the reporting method offers guidance on what to expect in terms of the number and structure of lagging coefficients. For venture funds, general partners nearly always report each company at the share value for its most recent round of funding. For example, for a company with three rounds of funding, they take their shares in the A, B and C rounds, add them, and multiply by the price for the C round and report that value. It is a real market value.

But since venture-funded companies do a round of funding only once a year or less, the value of that company stays the same on the quarterly report for a year or two, until the next fund raising occurs. In a portfolio of 30 or 40 companies, the fund is likely to have several companies change value each quarter and will thus display change in the value of the portfolio. But the value changes are related to public market changes, not just for the most recent quarter but for past quarters as well.

In our experience, venture fund returns are related to stock market returns going back six to eight quarters. The weights decline in successive quarters. Other alternative

assets — such as buyouts, distressed debt, oil and gas and real estate — see even fewer transactions than venture funds do. Between valuation events, their general partners estimate quarterly value through an appraisal process.

Studies of real estate[1] valuations have found that the views of appraisers are not just influenced by the most current comparables, but by comparables extending over a period of a year or so. There is also noise in the appraisal process coming from individual appraisers, but this noise is uncorrelated across appraisers and will net out (diversify) in a large portfolio.

In actual application, we find that buyout fund returns reported by the general partner are related to stock market returns over the past year — so that, on average, they are less stale than the valuations of venture funds, even though reported venture valuations are real prices and buyout valuations are appraisals.

Analyzing Funds

Hedge funds generally hold traded securities or derivatives with traded underlying securities and report returns on a monthly basis. But hedge fund returns, too, are related to both present and past market returns. This is partly because of imperfect marking-to-market for the securities that are not traded (also an appraisal process), but in many cases the reporting reflects the choice of an amortization accounting method adopted to get the desired tax treatment for a portfolio. The stale pricing in hedge funds also causes the returns to be related to returns not just for the current month for the market but to three lagging months as well.[2]

Why is this important? The return reporting conventions for alternative assets all "smooth" the returns. In the case of hedge funds, this is deliberate. But in the case of other funds holding illiquid assets, this "smoothing" occurs because price is hard to find.

The difficulty of determining price forces venture funds to simply report the price they have for each company until they have a new one.

Buyout and other types of funds see even fewer transactions, so they estimate value through an appraisal process, which itself inherently smooths values. Smoothing does not change the mean of the return series (all assets have to reach their ending values eventually). But it does lower the variance and also lowers the correlation and covariance with other assets if measured in the usual way.

Despite the smoothed returns for alternative assets, you can obtain the same measures of risk for your alternative assets that asset managers use for all of their traded assets. The parameters risk managers want, all straight from the capital asset pricing model (CAPM), are beta, sigma, rho and alpha.

Beta is both the regression coefficient of asset returns on market returns (Equation 1, below) and also, in the theory of the CAPM, the factor that captures the systematic risk of an asset – i.e., the part of its risk that is rewarded by higher return. Beta, both in the theory of the CAPM and as an ordinary least squares (OLS) estimator, is given by the following:

$$\beta_p = \rho_{p,m}\frac{\sigma_p}{\sigma_m} = \frac{\mathrm{Cov}(R_m, R_p)}{\mathrm{Var}(R_m)}$$

Sigma is the standard deviation. A measure of variability or total risk, denoted σ, it is the square root of the average squared deviations from the mean, applied (above) to both returns on a portfolio and returns on a market index.

Rho, which measures the relatedness of two variables, is the correlation of returns on a portfolio with returns on a market index, denoted ρ. It is equal to the square root of the ratio of explained variance to total variance in the regression estimate, taking the same sign as beta.

Alpha is the intercept term in the equation above. It estimates the amount of return that the portfolio is earning above the return the market requires given its systematic risk. If the market is efficient, alpha will be zero for all assets.

It is a simple proof that if you undermeasure your beta (such as, by leaving out some important variable), then, because the line of regression must pass through the means of both variables, your alpha will be overmeasured. Beta will be too low, sigma too low, correlation too low and alpha too high. You will overstate the performance of the portfolio (alpha too high) and understate its risk (beta too low).

In contrast, if you do your regressions with the correct set of lags, you will measure beta and alpha correctly, and with a few computations you can also recover the true standard deviation of return and correlation with the benchmark.

Practical Advice

Armed with this new risk tool, what can you do to manage alternative assets? For starters, you can measure the risk of each category of your portfolio (venture, buyouts, real estate, oil and gas, etc.), so that you know how much risk you are taking. Measurement of risk should be performed regularly, because betas and sigmas change over time for alternative assets — just as they do for traded stocks.

You should also become familiar with the correctly measured risk metrics for each class of alternative assets, as well as their sub-classes. If your risk metrics are different from the asset class average, this can help you understand why. For example, a venture fund that was heavy in biotech and light in information technology would likely have a beta and sigma lower than average for venture and be less diversified in venture capital than is generally possible.

Lastly, you must remember that when portfolio risk is

higher than anticipated or desired, it may be easier to reduce risk by backing off on exposure to public markets than to go through the costly process of selling alternative assets, whose transaction costs can be quite high. Correctly measured, the correlation between public markets and alternative assets is higher than generally appreciated.

Naïve vs. Standard Approach

Here's the difference in the specification for measuring risk done the naïve (standard) way versus the aforementioned new approach that fully captures correlation and risk:

Naïve (standard) Approach (Eq. 2):

$$R_{p,t} = \alpha + \beta R_{m,t} + \epsilon_t$$

Approach for Alternative Assets (Eq. 3):

$$R_{p,t} = \alpha + \beta_0 R_{m,t} + \beta_1 R_{m,t-1} + \cdots + \beta_n R_{m,t-n} + \eta_t$$

In Equation 3, the sum of the coefficients is the true beta for the portfolio. Because the returns on the public market index are not serially correlated, the coefficient on the first market return in Equation 2 will generally be close to the coefficient on the single market return in Equation 2. The additional lagging returns capture what is missing from the first equation and cause it to underestimate risk and correlation.

These regressions not only untangle the serial correlation in fund returns, they also exploit the covariance with returns on other assets to recover the standard deviation of true returns (the one your risk manager wants) from the smoothed returns. So you must first define the staleness profile as the fraction of beta that comes from each of the lags, estimated by the regression in Equation 3 above, via (Eq. 4):

$$w_i = \frac{\beta_i}{\sum_j \beta_j}$$

The standard deviation of true returns from Geltner is (Eq. 5):

$$\sigma_{\text{true}} = \sigma_{\text{smoothed}} \sqrt{\frac{1}{\sum_i w_i^2}}$$

where σ_{smoothed} is simply the standard deviation of the returns as they are reported by the general partner, and σ_{true} is the standard deviation of the true returns — sometimes called "latent," because they cannot be observed directly — that have been smoothed by the general partner's reporting convention.

The above calculation of the standard deviation incorporates the coefficients of the regression, but its connection to covariance with the market and the CAPM is even more clear when we express the standard deviation in terms of systematic and idiosyncratic risk (Eq. 6):

$$\sigma^2_{\text{true}} = \left(\sum_i \beta_i\right)^2 \sigma^2_{\text{m}} + \frac{\sigma^2_\eta}{\sum_i w_i^2} = \beta^2_{\text{true}} \sigma^2_{\text{m}} + \frac{\sigma^2_\eta}{\sum_i w_i^2}$$

where σ_{m^2} is the variance on the market index you are using. This implies (Eq. 7):

$$\sigma_{\text{true}} \geq \beta_{\text{true}} \sigma_{\text{m}}$$

i.e., the standard deviation of the true returns must be at least as large as your estimated true beta times the standard deviation of returns on whatever market index you are using. We use Equation 6 in preference to Equation 5 to calculate standard deviation because, by explicitly using the sum of the coefficients on the contemporaneous and lagged market variables as beta, it relies on the absence of serial correlation in quarterly public market returns — a property in which we have high confidence.

For calculating the correlation between true returns and the market,[3] we make use of the following equation from Geltner (Eq. 8):

$$\rho_{\text{true}} = \rho_{\text{smoothed}} \frac{w_0}{\sqrt{\sum_i w_i^2}}$$

where ρ_{smoothed} is the square root of the r-square from a simple regression of portfolio returns on market returns with no lagged variables, and the weights are calculated from Equation 4 using the estimated coefficients from Equation 3. Note that ρ_{true} is not the square root of r-square of the regression using lags, but instead the correlation between the unobserved true returns with benchmark returns.

We can also express the correlation in terms of explained variance over total variance, as (Eq. 9):

$$\rho^2_{\text{true}} = \frac{\beta^2_{\text{true}} \sigma^2_{\text{m}}}{\beta^2_{\text{true}} \sigma^2_{\text{m}} + \frac{\sigma^2_\eta}{\sum_i w_i^2}}$$

again, connecting directly to the spirit of the CAPM. We use Equation 9 in preference to Equation 8 again because of our confidence in the absence of serial correlation in public market returns.

Lags and Regressions

How many lags should you use? Let two things guide you. First, you must identify how the general partner reports values. For venture capital, many of the company values

reported are from deals that occurred a year or two ago. Thus, expect that you will need six to eight lagging values of the market to capture the full relationship between venture capital and the public markets.

To get a good idea about how many lags are useful, the second step you should take is to analyze the regressions themselves. The size of the coefficients generally declines with the length of the lag, and at the point where the coefficients are either economically or statistically zero, there are enough lagging values. If you used this approach for an ordinary traded stock portfolio, you would see your true beta on the contemporaneous return, and the coefficients on the lagging values of the index would be economically and statistically zero.

One problem you may encounter for most alternative assets is that the residuals from the estimation of Equation 3 and Equation 2 will be serially correlated, showing a Durbin-Watson statistic far outside the range in which you can regard the residuals as free of autocorrelation. The OLS estimates are unbiased despite the autocorrelated residual. But they are not minimum variance, and they can be improved upon by correcting the residuals for autocorrelation. The corrected estimates are not only unbiased, they are asymptotically efficient. In our experience, the first-order autocorrelation correction does change the betas somewhat (+/- 10-15%), but the direction is not predictable, as expected, because OLS is unbiased even with autocorrelation errors.

Possible Solutions

We have investigated some of the standard software packages for portfolio optimization and analysis, but have not found one that offers the option of running regressions with lagged values of a benchmark. These programs were mainly written for analyzing traded securities, where autocorrelation is simply not much of a problem. So, if the standard software packages offer no help, what can you do?

Well, one option is to define new benchmarks in Excel that are the same as your basic benchmarks but lagged (create one for each lag you want, so for venture capital you would create six new series). After you load these, use them as additional right-hand-side variables. Then you can obtain the basic OLS betas, which will be quite informative — much better than not using lags at all.

Another option is to buy a statistical package like eViews, written for the time series user, which makes the incorporation of lags and auto-correlation corrections easy. eViews is easy to use once you become familiar with this powerful package, but it presumes some knowledge of statistics. The main message here is that you don't have to guess anymore on alternative assets risk; you can measure it directly.

Additional Factors

Though we have covered a lot of ground in this article, there are other practical issues to consider when measuring alternative assets risk. For example, it is logical to ask whether the betas for these assets are stable over time. The answer is that they are no more stable than the betas for given stocks or industries.

Generally, the betas for both venture and buyout funds were lower before 1995 than they were after. Keep in mind that with the growing importance of information technology and biotechnology, what venture funds delivered after 1995 was much more closely related to the overall economy than it was before.

There are also good economic reasons to expect that the staleness profiles of valuations will change over time. For example, when values were rising during the Internet boom, venture-funded companies were doing rounds of funding closer together than they were when valuations were on the way down. Thus, returns should be related to the market over a shorter period of time, and the lag structure should be shorter for the upward-moving period.

Looking toward the future, one key question is whether investors will want to hold fewer alternative assets when they have improved measures of risk and alpha. This depends on whether they undershot or overshot on the adjustments they used in place of actual measurements. We won't know until we see their choices. But when alternative asset managers come knocking, seeking to raise money, investors should demand to see risk and performance measures that are done with lagging values of the market and autoregressive corrections before they invest. ■

FOOTNOTES:

1. David M. Geltner, "Smoothing In Appraisal-Based Returns," *Journal of Real Estate Finance and Economics*, September 1991.

2. Clifford Asness, Robert Krail and John Liew, "Do Hedge Funds Hedge?" *Journal of Portfolio Management*, Fall 2001, and Mila Getmansky, Andrew Lo and Igor Makarov, "An Econometric Model of Serial Correlation and Illiquidity in Hedge Fund Returns," *Journal of Financial Economics*, 2005.

3. David M. Geltner, "Smoothing In Appraisal-Based Returns," *Journal of Real Estate Finance and Economics*, September 1991.

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