# Investment Strategy

# The Science of Alternative Investments

*Science is a way of trying not to fool yourself. The first principle is that you must not fool yourself, and you are the easiest person to fool.*

*Richard Feynman, Physicist*

The word "science" means knowledge. Richard Feynman, a famous physicist, used science in his pursuit of knowledge about the world. He used science to avoid fooling himself when it came to his views about the world. It enabled him to be more objective when it came to analyzing data and coming to conclusions.

In the same way that science provided rigor to Richard Feynman's analyses, investors can use science to come to conclusions about alternative investments. In our September 2006 publication, *Alternative Investments: Managing Risks*, we outlined several types of alternative investments: private equity, private real estate, natural resources/real returns, and hedge funds/volatility. In spite of the number of types of alternative investments and the corresponding scope of study, these investments, to varying degrees, share some things in common with respect to their returns. These are:

- lockups and
- smoothing.

Most investors are concerned about return and risk, but lockups and smoothing can also play important roles in investors' returns. It may be that the investor's end experience of a manager's return stream is dominated by these two significant factors[1].

Lockups are periods of time when the investor's capital is committed to the fund and cannot be withdrawn. Lockups enable a manager to avoid simultaneous mass redemptions. Although there is an argument why this can be beneficial, the upshot of lockups is that investors surrender their options to remove capital from a nonperforming manager for a period of time. This can have the effect of capital destruction when an exit might have otherwise provided capital preservation.

Smoothing refers to the perceived notion that the returns of illiquid securities are smoother than the returns of liquid securities. When an investment's returns appear smoother, they also appear less risky. Given what we know about the cost of illiquidity from the crisis of 2008, we know that the apparent less risk is not complete or accurate (some sources of smoothing are more accepted than others, such as the use of broker dealer quotes, however, we are examining the effect, not the cause).

Here we attempt to quantify the costs of these effects. Novices will likely not be helped by what follows. Experienced practitioners will find our work too general. We make our apologies to both. Our purpose here is to put some numbers around our intuition about lockups and smoothing. The bare concept, however, remains unchanged and is summarized as follows.

- Lockups come at a cost to the investor because of alternative investments' illiquidity.

**Richard P. Feynman**

*(1918-1988) was a U.S. physicist and Nobel Prize winner. He assisted in the development of the atomic bomb, expanded the understanding of quantum electrodynamics, translated Mayan hieroglyphics, and cut to the heart of the Challenger disaster*

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[1] The exact numerical recipes for detecting and resolving smoothing and lockup features are open to interpretation. Here we want to establish the scale of the issues, that is, are these effects 1, 10, or even 100 basis points.

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- Smoothing can affect the asset allocation by making alternatives look less risky.

The descriptive part of the work ends here. Our quantitative analysis follows.

# Lockups[2]

Alternative investments provide alternative beta and alpha. Alternative beta reduces exposure to the overall market. Alpha is the uncorrelated return with respect to the benchmark. All other things being equal, these are positive attributes of alternative investments.

Fund managers usually charge some management fee of say 2% coupled with 20% of the profits (these figures do vary, but those are widely accepted averages). These alone are significant end-costs to the investor. What can sometimes be overlooked and is also significant is the cost of lockups.

Lockups deprive investors of the opportunity to disinvest from bad funds and reinvest in good ones. For many managers, lockups can be a number of years, ranging from one to more than five. What is the cost of these lockups? That is, what is the cost of being forced to stay with an underperforming manager from one year to the next?

Good, sick, or dead? Let's say that we can separate a manager's returns into three buckets: good; sick; or dead (Table 1).

- Good funds are those funds whose performance justifies the investor's continued ownership.
- Sick funds are those managers whose performance obligates the investor to divest and find a different fund.
- Dead funds are those funds that go out of business on their own.

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Table 1
**Portfolio Manager's Choice after a One-Year Lockup in A1**

| Return of A1 | Consequence | Action | Option |
|---|---|---|---|
| Dead:<br>    Returns below B | Fund shuts down | Reinvest money elsewhere | No |
| Sick:<br>    Returns between B and U | Fund is sick but continues operating | Disinvest from A1 and reinvest elsewhere | Yes |
| Good:<br>    Returns above U | Fund continues operating | No need to reinvest | No |

*Source: Emanuel Derman, <u>The Premium for Hedge Fund Lockups</u>*

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Good, sick, or dead classification involves looking at a manager's returns with respect to a distribution of his or her peers. Schematically, it involves partitioning a distribution into three regions (Chart 1, page 3).

- If a fund manager's return falls to the right of U, then an investor does nothing, thereby staying with a successful manager.

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[2] Our approach borrows from a white paper by Emanuel Derman of Prisma Capital Partners and Columbia University. The title of the work is *The Premium for Hedge Fund Lockups*.

- If the return of the manager falls between B and U, then the investor pulls the capital even though the manager might continue on.
- In the area to the left of B, the fund is driven out of existence by mass redemption and the investor's capital is withdrawn automatically.

The value of B is 20% and of U is 10%. These values will influence the end cost of the lockup.

Another input is the volatility of the fund returns, which we conservatively keep below 20%. These are all inputs in the model that incorporates jump diffusion to account for fat tails and asymmetries. Further details are not important, but it suffices to say that we made assumptions that will keep costs lower as opposed to higher to be as fair as possible. The results are included in Table 2.

Chart 1
**The Distribution of One-Year Hedge Fund Returns**



*Source: PNC*

The conclusion is that lockups cost money. They cost even more money when investors can distinguish between good versus very good funds. They cost more money when the disparities between top and bottom performers become more pronounced. They cost more money for smaller survival rates. They cost more money for investments with inherently more volatility. We are trying to be conservative, so we will forgo exploration of these extremes and focus on the results we have here.
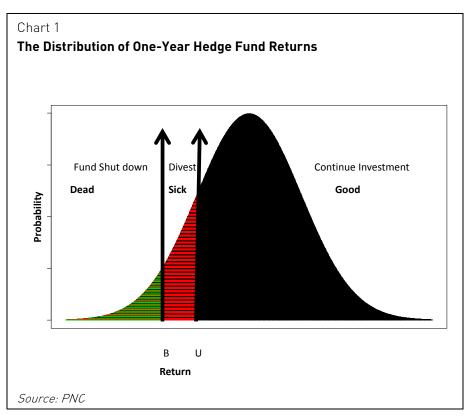
Table 2
**Excess Return of Longer Lockups over One-Year Lockups**
Jump diffusion model of hedge fund evolution

| Lockup (years) | Excess Annual Return |
|---|---|
| 2 | 0.9% |
| 3 | 1.3 |
| 4 | 1.6 |
| 5 | 1.9 |
| 7 | 2.2 |
| 10 | 3.0 |

*Source: Emanuel Derman, The Premium for Hedge Fund Lockups*

# Smoothing[3]

Another question to ask is: What is the cost of autocorrelation in managers' historical returns? Serial correlation, sometimes referred to as smoothing, introduces an artificial reduction in volatility. (We use smoothing and illiquidity interchangeably, although, in the technical sense, they are not exact substitutes.) Smoothing need not be intentional, and it is an unavoidable attribute of some types of alternative investments, most notably private equity. Serial correlation, or the k-th order autocorrelation of $\{R_t\}$, is represented by the formula:

$$\rho_k = \text{Cov}[R_t, R_{t-k}]/\text{Var}[R_t].$$

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[3] Our approach for detecting smoothing follows Andrew Lo's work on the subject, which emphasizes the Box-Ljung statistic. Papers regarding his work on hedge funds can be found on his website, http://web.mit.edu/alo/www/.

For instance, it is well known that the returns of residential real estate are more highly autocorrelated than the returns of the S&P 500®. This is not limited to real estate; any security for which values are obtained via a third party, such as a broker dealer, can be subject to this effect. Sometimes this is the result of a linear extrapolation, which must be made in the absence of any better information because the security may not trade heavily on any exchange. Returns that are marked-to-market suffer this effect to a much lesser degree. One can detect smoothing through Box-Ljung statistics and correct for it via AR(1) procedures.

## Smoothing Detection

Detecting smoothed returns and the serial correlation that accompanies them can be involved. In the same way that we wrote the equation for $\rho_k$, the degree of autocorrelation theoretically may vary from 1 to infinity; in practice, 3, 6, and 12 are the usual numbers.

While there may be accepted values, it is also well known that multiple degrees of autocorrelation may exist at the same time. This presents an issue because many tests assume that the degree of serial correlation is known beforehand. A nonrigorous approach to this is to assume that all $k \leq 6$. To that end, we may use a figure called the Box-Ljung statistic. Ljung and Box (1978) proposed the following statistic to measure the overall significance of the first k autocorrelation statistics:

$$Q = T(T+2) \sum_{j=1}^{k} \hat{\rho}_j^2/(T-j).$$

This is asymptotically $\chi_k^2$ under the null hypothesis of no autocorrelation. By forming the sum of the squared correlations, the statistic Q reflects the absolute magnitudes of the $\hat{\rho}_j$ irrespective of their signs, hence funds with larger positive autocorrelation coefficients will exhibit large Q-statistics.

Let us look at hedge funds/volatility, public[4] real estate, private equity, and natural resources/real returns through the results of the Box-Ljung test (Table 3). In this examination we are concerned with high X-squared and low p-value. A low p-value indicates that the effect is significant and indicates a high autocorrelation, which is associated with high illiquidity.

Table 3
**Results of the Box-Ljung Tests for Alternative Categories**

| Vehicle | X-Squared | p |
|---|---|---|
| Hedge Funds/Volatility | 10.15 | 0.1182 |
| Public Real Estate | 19.06 | 0.0041 |
| Private Equity | 27.01 | 0.0001 |
| Natural Resources/Real Return | 4.35 | 0.6290 |

*Source: PNC*

- Quite naturally, private equity is the most highly illiquid.
- This is followed by public real estate.
- The most liquid vehicle, according to this metric, is natural resources/real return. Natural resources/real return are daily traded instruments, and there is no reason to expect stale pricing under normal circumstances.
- In between private equity and natural resources/real returns is hedge funds/volatility. Hedge funds/volatility are still well within the liquid regime, but some hedge funds in this index might include some portion of illiquid investments, which push them more toward being

[4] Our list of alternatives formally includes private real estate, but we shall deal with that category later.

like private equity. However, the vast majority of managers deal with exchange-traded instruments and this effect is muted.

## Smoothing Correction

There is absolutely no universally accepted way to correct for smoothing in returns. What follows is a recipe for a straightforward case, a time series that is purely autocorrelated of order 1. So, we look at AR(1) series. To remind the reader, an AR(1) series is generated by the following process:

$$y_t = c + \Phi y_{t-1} + \varepsilon_t$$

where the current period's value of $\{y_t\}$ is explained by a previous one, a constant c, and an error process $\{\varepsilon_t\}$. To recover the original $\{\varepsilon_t\}$, one performs the regression. Keeping in mind a well-known result that the expected value for the AR(1) series is $E[y_t] = c/(1 - \Phi)$, we make a new series, $x_t = \frac{y_t - y_{t-1}}{1 - \phi}$, which preserves the expected return but recovers the original (or suspected) volatility. The results are in Table 4.

| Table 4 |||
|---|---|---|
| **Volatilities Before and After the Unsmoothing Process** |||
| | Volatility ||
| Vehicle | Smoothed | Unsmoothed |
| Public Real Estate | 31.1 | 33.5 |
| Private Equity | 31.5 | 54.4 |
| *Source: PNC* |||

As we expected, the volatilities increased after we performed the unsmoothing process. The increase in volatility for private equity seems larger than that for public real estate. One could make the judgment that smoothing is always greater for private equity, but that is not always the case. (Again, we emphasize that this unsmoothing procedure is not rigorous. Different answers will be calculated by different practitioners.) The point we make here is that volatility is always dampened with smoothing and one should always attempt to correct for it.

# Asset Allocation Procedure

We have discovered that hedge fund lockups are actually costs to the investors and that smoothed returns can lead an investor to believe in a fund's low volatility. To that end, we want to see how the asset allocation is affected once these ideas are incorporated. Asset allocation involves the consideration of risks and expected returns. The risks will be adjusted by the unsmoothing process and the returns will be adjusted by the by the premium for hedge fund lockups.

| Table 5 |||
|---|---|---|
| **PNC Alternative Investments Classification** |||
| | **No Lockup** | **Lockup** |
| **No Smoothing** | Natural Resources/ Real Return | Hedge Funds/ Volatility |
| **Smoothing** | Public Real Estate | Private Equity |
| *Source: PNC* |||

Returns: $r => r' -$ fund lock-up costs

Standard Deviation: $\sigma_{smoothed} -> \sigma_{unsmoothed}$

We do not change natural resources/real return.

We unsmooth public real estate.

We subtract the lockup premium for hedge funds/volatility.

We unsmooth and subtract the lockup premium for private equity[5].

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[5] Later, we treat private real estate as private equity because there are both smoothing and lockups.

Table 6
**Comparison of Arithmetic and Robust Averages for Alternative Investments**

| Vehicle | Average Return | Robust Average Return |
|---|---|---|
| Hedge Funds/Volatility | 5.6% | 7.7% |
| Public Real Estate | -4.2 | 11.0 |
| Private Equity | -3.6 | 10.5 |
| Natural Resources/Real Return | 10.0 | 13.9 |

*Source: PNC*

Table 7
**Comparison of Volatility and Robust Volatility for Alternative Investments**

| Vehicle | Robust Volatility | Volatility |
|---|---|---|
| Hedge Funds/Volatility | 7.4% | 7.4% |
| Public Real Estate | 33.5 | 21.2 |
| Private Equity | 54.5 | 29.7 |
| Natural Resources/Real Return | 12.7 | 11.0 |

*Source: PNC*

You may note that the expected returns for public real estate and private equity have been less remarkable in recent history. To compensate for the distortions caused by using a simple arithmetic average, we use robust statistics. Robust statistics will de-emphasize the large, negative outliers caused over the past two years. This will turn the expected values of private equity and real estate both positive, which puts all the investments on an equal footing with reasonable positive values (Table 6). We can perform a similar computation for volatility (Table 7).

Robust averages are useful for de-emphasizing outliers and giving a more typical value when accounting for extreme events. If we had left the returns of private equity and real estate as negative values, then our optimizer would have allocated 0% to them, which, intuitively, we know should not be the case. There are other methods for forecasting returns, but this is the one we have chosen for this exercise.

## Asset Allocation Results

The new asset allocation for alternatives is presented in Table 8. The new allocations reflect an evolution of risk appetite from Preservation to Aggressive. On the more conservative side of the spectrum, we optimized on minimum variance. On the more aggressive side of the spectrum we optimized on maximum ratio of return-to-CVaR between hedge fund/volatility and natural resources/real return.

Table 8
**Baseline Asset Allocation with Alternative Assets**

| | Preservation | Conservative | Moderate | Balanced | Growth | Aggressive |
|---|---|---|---|---|---|---|
| **Strategic Allocation** | | | | | | |
| Stocks | 15.0% | 30.0% | 40.0% | 50.0% | 60.0% | 70.0% |
| Bonds | 30.0 | 60.0 | 45.0 | 30.0 | 15.0 | |
| Cash | 55.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Alternative | | 10.0 | 15.0 | 20.0 | 25.0 | 30.0 |
| *Total* | *100.0%* | *100.0%* | *100.0%* | *100.0%* | *100.0%* | *100.0%* |
| **Alternative Assets** | | | | | | |
| Hedge Funds | | 2.5 | 7.5 | 8.0 | 14.0 | 17.0 |
| Private Equity | | 0.0 | 0.0 | 2.0 | 3.0 | 4.0 |
| Private Real Estate | | 0.0 | 0.0 | 2.0 | 3.0 | 4.0 |
| Natural Resources/Real Return | | 7.5 | 7.5 | 8.0 | 5.0 | 5.0 |
| *Total Alternative Assets* | *0.0%* | *10.0%* | *15.0%* | *20.0%* | *25.0%* | *30.0%* |

*Source: PNC*

### Preservation and Conservative

Preservation has nothing allocated to alternatives in keeping with the theme of capital preservation. Though alternatives provide alternative beta, this access to different risks comes at a cost of illiquidity in the form of lockups or structural risk associated with the nature of alternatives.

Conservative takes the view that a modest allocation to alternatives in the form of a minimum variance portfolio makes sense. The optimization for a minimum variance portfolio is made between hedge funds/volatility and natural resources/real return. Minimum variance portfolios take into account only risk and do not seek to maximize any expected return. To that end, there is more allocated to real return versus hedge funds[6]. There is nothing allocated to private equity or private real estate.

### Moderate and Balanced

The relative weighting of hedge funds/volatility to natural resources/real return is kept at 1:1 in Moderate. This is in keeping with moving away from the minimum variance portfolio's overweighting toward natural resources/real return.

The introduction of private equity and private real estate is made in the Balanced portfolio. They are in the same proportion to one another because of their identical attributes of lockups and smoothing. One could make a tactical call of one asset class over another, but tactical calls on illiquid investments are harder to make and implement, and we will not do so here.

### Growth and Aggressive

In Growth and Aggressive, the relative weightings of hedge funds/volatility to natural resources/real return are evolving toward 1:3 in favor of hedge funds/volatility. This is the ratio for a maximum return to risk portfolio. Before, we were concerned with minimizing the variance irrespective of the return. Now we are maximizing the return with respect to risk. The ratio of private equity to private real estate remains 1:1. Their absolute value in terms of total weight in the portfolio has increased from 6% to 8% for the pair.

## Private Equity and Private Real Estate

Private equity and private real estate were challenging alternatives to include in a portfolio from a purely financial engineering point of view. Putting all the investments on the same footing with respect to expected return, variance, smoothing, and lockups, we find that the allocation to private equity and private real estate drops considerably. The compounding effect of the yearly costs for the illiquidity premium is too substantial even for modest market returns. For a 15%-per-year return for the market, one would have to triple one's money in private equity just to account for a 10-year lockup! This is an extreme example, but it speaks to the nature of the lockup and its costs. It adds up very quickly with compounding.

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[6] Natural resources include commodity indexes. Given the recent bubble, we know that the idea that tilting a portfolio toward natural resources for risk reduction makes less sense. However, it is a legacy issue that natural resources and real returns are combined. For the conservative portfolio, it would make more sense to make an allocation to TIPS over pure commodity indexes.

Having said these things, we acknowledge that there is a place for private equity in the investment portfolios of many of PNC's investors. PNC's Investment Advisor Research team conducts the due diligence to place investments with higher decile managers because of the disparity between top and bottom performers in private equity and private real estate. Money with a bottom decile performing manager with a long lockup can very easily become a nonperforming investment in a portfolio.

## Public Real Estate, Private Real Estate, and REITs

Due to the lack of data for private real estate, we have used public real estate data as a proxy for private real estate. Both categories suffer from smoothing. It is not hard to imagine that private real estate has more smoothing due to its private aspect. Because private real estate has both illiquidity and smoothing, we assign it the same weight as private equity.

In PNC's baseline asset allocation framework, real estate investment trusts (REITs) are grouped with U.S. equities because of their equity like behavior. We have no explicit baseline allocation to REITs (an implicit allocation exists in the equity subheadings). One could weigh the prospect of investing in REITs versus investing in private real estate, and, for all the arguments made in this paper, come to the conclusion that REITs are favored over private real estate. However, in the PNC approach, the baseline portfolio balancing is done internally with respect to the overall group heading, for example U.S. equities, international equities, U.S. fixed income. For that reason, the weighting for REITs is considered with respect to large-cap, small-cap, and mid-cap equities. It is not a call of private real estate versus REITs but a call on REITs versus other equities. This is merely a result of the PNC methodology and should not be interpreted beyond that.

## Parting Thoughts

We have attempted to outline the costs of illiquidity and smoothing. Many people account for this from their experience or judgment. Hopefully, the steps for the framework outlined here are in concert with investors' intuition. The analysis was included to determine the weightings inside a portfolio of alternative assets and to give more clarity about what was decided and why. The numbers merely added a sense of scale to the issue. Lockups cost about as much as management fees. Smoothing understates the volatility by a half or more. These are detractors from performance and they ought to be considered before an asset allocation framework is put in place. Also, investors are more formally made aware of beliefs that were almost certainly already contained within their respective investing mantra from before.