

Fairweather Pension Plan

In this case, you are to play the role of Leslie Rentleg, an independent investment consultant specializing in providing institutional investment clients, such as pension funds and endowment funds, with strategic advice regarding “core” portfolio allocations. (The portfolio “core” refers to the main component of professional investment portfolios the allocation of which is usually analyzed using Modern Portfolio Theory.) You should work in teams of 3 students each. (If necessary, a few 2-person teams will be permitted, but no 4-person teams.) Each team should prepare a PowerPoint presentation and a 2-page Word file executive summary covering all four of the “scenes” in the case. On the due-date of the case, teams will be selected randomly to present in class each of the scenes, using your PowerPoint presentation for that scene (a different team will be randomly selected for each scene). All teams should hand in to the TA printouts of their PowerPoint files (6 slides to the page), as well as a printout of their Word file executive summaries.*

Background:

It had taken Leslie almost an hour and a half to navigate the Audi A4 Quattro through yet another Boston snowstorm that was timed perfectly for the morning commute. He was beginning to wonder why he had bothered, when he received a call from Cate Polleys, Director of Real Estate Research for Fidelity Investment Management, just down the street. Cate was trying to land a new client, the pension fund of Fairweather Corporation, a major manufacturing firm in the packaging industry. Cate was hoping that Leslie’s expertise and experience could be helpful to her in convincing Fairweather that Fidelity was the right firm to provide strategic advice for the firm’s defined-benefit plan’s investment portfolio allocation decision.

Fairweather had recently had a major change in management. A closely held family firm, the original founder had recently stepped aside in favor of a professional management team, including a new CFO by the name of Clayton Patrick. Clayton had been surprised to learn that Fairweather’s pension plan was 100% in bonds. He believes that “a pension plan should be managed so as to maximize return within well-defined risk parameters,” and “anyone can buy bonds and sit on them”. Clayton contacted Cate, who convinced him that Fidelity should be one of a short list of investment management firms that Fairweather should consider hiring to assist with both planning and implementation of a more broad-based and profitable policy for the firm’s pension fund.

What Cate wanted from Leslie was an overview of the portfolio allocation implications of “Modern Portfolio Theory” (MPT). Cate knew that strategic investment decision making needed to consider other issues besides those treated in MPT, but she felt that this rigorous scientific model would be a good starting point and frame of reference for an objective discussion with Fairweather’s CFO. Also, Cate felt that one of Fidelity’s comparative advantages relative to their competition was their expertise in including a full range of investment asset classes in clients’ portfolios, going beyond just the traditional but narrow asset classes of stocks and bonds. (Surely her boss, Linda Valerie, didn’t really say: “*Portfolios of only stocks and bonds are sooo 20th*”

* At the discretion of the TA, electronic submission may be substituted for hardcopy. Check with the TA.

century,” - but the point was well taken.) Cate was proud of Fidelity’s ability to include real estate as a third major asset class in the portfolio, even for funds as small as Fairweather’s, by the use of various types of real estate securitization, both public and private, and even use of the new real estate equity derivatives. (For example, nowadays there were not just separate accounts and commingled funds for direct investment in private real estate, but “funds of funds”, private REITs, and a growing array of private equity vehicles, as well as the fascinating new possibility of index return swaps.)

Cate had already done some background research on Fairweather, which she summarized for Leslie. Fairweather is the eighth largest domestic packaging company, with annual revenues of \$500 million. Revenues have grown about 8.0% per year over the past seven years, with only one down year. The company employs about 7,000 people, compared with 6,500 seven years ago. The annual payroll is about \$300 million. Company profits last year were \$20 million, compared with \$12 million seven years ago. Pension assets are currently \$100 million, invested entirely in bonds. The average age of the pension eligible work force is 38 years. Leslie felt that this average age was slightly on the young side, suggesting a relatively long average holding period for Fairweather’s pension fund investments.

Leslie agreed to meet Cate next Monday to present her with a preliminary portfolio analysis. Leaving his donut and coffee half finished, he got right on the case...

Scene I: Preparation for Monday Meeting with Cate

Based on discussions with Cate considering the size and sophistication of Fairweather’s financial staff, Leslie decided to explore a relatively simple six asset class portfolio for Fairweather. The analysis would consider large stocks, small stocks, international stocks, long-term bonds, intermediate-term bonds, and REITs. Leslie decided to base the initial analysis on the historical returns that had actually been achieved by these six asset classes during the 1985-2006 period, analyzing the calendar year *annual*-frequency periodic *total* returns achieved.*

For the traditional asset classes of stocks and bonds, Leslie already had the historical investment performance data at hand in an *Excel*® file, using indices that are widely employed in the investments industry. Leslie would use the Ibbotson Associates “*Stocks, Bonds, Bills, & Inflation*” (S&BBI) historical total return indices to represent large stocks (S&P500) and small stocks. He would use the Lehman Brothers Government/Credit bond indexes for long-term and intermediate-term bond performance. (These indexes represent periodic total returns, or “holding period returns” – HPRs – the returns faced by portfolios regularly marked to market value, not the buy-and-hold-to-maturity return indicated by bond yields.) And Leslie would use the benchmark Morgan Stanley “EAFE” (Europe, Australia, Far East) Index for international stocks.†

* “Total” returns include both current income paid out as well as the change in the asset value each period. Annual frequency returns are accumulated within each year by compounding higher frequency returns such as quarterly or monthly, or by considering the year-over-year percentage change in a cumulative index level.

† The historical returns data for these five indexes is provided on the downloadable Excel file posted to the class MIT Server site. Note that the EAFE Index returns are based on US dollars, and so reflect the foreign exchange rate risk inherent in unhedged overseas investment. (The Excel file also contains worksheets for converting monthly or quarterly returns to annual.)

As Leslie's familiarity with REIT investment returns data was a bit rusty, he decided to first check out the NAREIT web site (www.nareit.org), to explore what sort of historical returns data were available on that site. One thing Leslie wanted to think about was whether to use the *NAREIT All REIT Index* or the *NAREIT Equity REIT Index* to represent the returns to the real estate asset class in his portfolio analysis. (Leslie knew that the main difference was the rather specialized breed of REITs that invest with very high leverage in mortgage assets and risky CMBS tranches, and he was pretty sure Cate wanted to present the REITs asset class with its "best foot forward".)

For his Monday meeting with Cate, Leslie wanted to generate a Markowitz (mean-variance) efficient frontier based on a choice set consisting of the six risky asset classes noted above.^{*†} After presenting a table that showed his expected return inputs (mean, volatility, correlations) for and among all the asset classes, he summarized the frontier in another table that specifically showed the efficient portfolio composition and risk and return statistics for five different risk/return points along the frontier, at target returns spanning the range of what was provided by the individual asset classes.[‡] For each target return, the table showed the share of the efficient portfolio in each of the six asset classes (if any), and the expected return and volatility (standard deviation of return) of the portfolio. Leslie also depicted the efficient frontier visually by generating a frontier "area chart" (portfolio composition), which he copy/pasted into a PowerPoint file for his presentation to Cate.

* Believe it or not, Leslie actually had an Excel workbook of templates that he had saved from the CD that came with the textbook he used in his days as a student at the MIT/CRE, that could be used for a portfolio optimization analysis with up to 14 assets or asset classes in the portfolio, based on the Excel *Solver*. The file repeatedly calls up the *Solver* utility automatically to fire off an entire "efficient frontier" of portfolios all at once. Leslie also still had his PowerPoint lecture notes covering Chapter 21 of the finance course text, which explained MPT and what the Excel files were actually doing (though of course Leslie had long since sold the actual textbook into the used book market to recoup a miniscule portion of his MIT tuition).

† Note that it is sometimes necessary to "reset" the Excel spreadsheet before running the Solver, by entering either zeros or all equal shares in the policy weights row. The point is to make the Solver start searching again for a new optimum. The Solver is a numerical algorithm that works by trial and error. It can sometimes "get stuck", and needs a sort of "kick" to get it moving. Also note that in the given Excel file with the automatically-solved frontier, you must repeatedly click on the "Optimize" button five times to map out the efficient frontier on five points, and if the macro does not work, you can manually run the Solver repetitively for each point you want on the frontier. Occasionally the Solver will give anomalous results at the extreme ends of the feasible return range (with target return equal to the minimum or maximum return among all the potential constituent assets – points at which the portfolio must consist 100% of the minimum or maximum return asset alone). Finally, note that the portfolio with target return equal to that of the minimum-return asset will not necessarily be the minimum-variance portfolio and therefore not necessarily on the efficient frontier (it will be below the "nose" of the leftward-bending curved frontier). However, you can ignore this fine point in this exercise.

‡ Use points defined by target returns equally spaced between the mean returns of the minimum and maximum return asset classes. With only 6 asset classes in the analysis, "extra" asset class slot(s) in the template (up to 14) must be filled in with "dummy data" such that the extra asset class(es) would not appear in the optimal portfolio. This can be done by giving them artificially very bad return performance (very low negative mean, high volatility, and perfect positive correlation with the other asset classes). The given Excel file initially has such data filled in, but you will need to override or replace some of that depending on how many asset classes you have. Also, when you copy/paste historical return data into the "DATA & STATS" worksheet, take care that you don't leave any excess old data not written over or erased at the bottom.

Scene I: Monday Meeting with Cate

Leslie's Monday meeting with Cate went pretty well. However, Cate had a couple of constructive suggestions to improve the analysis. First, she noted that REITs are very similar to "small cap value stocks", that is, relatively small-capitalization stocks that tend to have high dividend yields and/or high book/market value ratios, stocks that by those measures might be considered to be traditionally "under-valued" in the stock market (and thereby to provide high returns). As there are numerous mutual funds and benchmark indexes that specialize in, and track, the small-cap value stock sector, Cate felt it would make sense to also include an index of the performance of this investment "style" in the portfolio analysis, as small-cap value stocks might act as a potential substitute for REITs in the portfolio.

Cate therefore suggested that instead of using one small-cap stock index in the analysis, Leslie should replace the Ibbotson Small Stock index with two more specialized small stock indexes: the Russell 2000 Value Stock Index, and its alter-ego, the Russell 2000 Growth Stock Index. ("Growth stocks" are just the opposite of "value stocks", stocks with low dividend yields and high price appreciation orientation, often including low book/market value ratios and high price/earnings ratios.)

Cate's other suggestion was potentially even more important. She pointed out that there are really two rather different types of real estate investment vehicles: the publicly-traded REITs that Leslie had considered, but also private investment directly in the underlying property assets, which Leslie had ignored. Cate pointed out that private direct real estate investment was possible even for smaller pension funds nowadays, using private "securitization" vehicles such as co-mingled real estate funds (CREFs), or one of the newer "fund of funds" that allows even smaller denominated investments in diversified portfolios of property by pooling CREF units and issuing smaller-denominated interests in the pool. In fact, recent developments in the investment industry effectively enable highly diversified "synthetic" investment in direct private real estate with greater liquidity and at relatively low transaction costs via derivatives, such as "index return swaps", which pay off periodically based on indexes of real estate investment returns.*

Cate suggested that the National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index (NPI) would be a good benchmark to use to represent the historical periodic investment performance of the direct private real estate asset class.

Cate also suggested that, since each of the other two broad asset classes in the portfolio (stocks and bonds) was represented by at least two "sub-classes" (stocks now by four: large cap, both value and growth small cap, and international, while bonds would be represented by both long-term and intermediate-term indexes), it was a bit "unfair" to represent the real estate asset class by only one index. Such an arbitrary asymmetry of "granularity" in the portfolio asset class choice set could bias the result against the asset class that was less well represented by sub-indices. Considering that the underlying real estate assets in the economy make up roughly as much market value as each of the other two broad classes (stocks as a whole and bonds as whole), it seemed only reasonable to represent real estate by at least two sub-classes of investment vehicles.

* For more information about this possibility, see the Geltner & Pollakowski (2006) white paper about the new RCA-based index developed at MIT. The paper is downloadable from the MIT/CRE web site at: <http://web.mit.edu/cre/research/credl/rca.html>. Derivatives will be covered in the 11.434 "Advanced Topics" course taught in the second half of the spring semester.

Well, of course, Leslie could have kicked himself for not recognizing Cate's point earlier by himself. Now he was afraid he had made a bad impression. Leslie realized that the private property market is not perfectly correlated with the REIT market, because Leslie knew that REITs often trade at time-varying premia and discounts to their "net asset values" (NAV). In effect, the stock market (where REIT equity trades) and the private property market (where the underlying properties trade directly) do not always agree about the value of real estate, and this "disagreement" varies over time. (Also, firm level effects such as management actions, agency concerns, capital structure, property development and trading, and other REIT activities, may influence REIT firm equity value and stock returns in ways that may differ from those of the underlying "bricks and mortar".) Thus, including private direct real estate in the portfolio asset class choice set should improve on the efficient frontier possibilities, allowing greater diversification. Leslie was determined to impress Cate better the next time around. They arranged to meet the following Wednesday after Leslie had incorporated the private direct real estate asset class into the analysis.

Scene II: Preparation for Wednesday Meeting with Cate

As with the NAREIT data previously, Leslie's first step was to go to the NCREIF web site (www.ncreif.org), and familiarize himself with the nature of the private real estate investment returns data.* He saw how it was possible to use NCREIF's query screens to generate "custom indices" consisting of particular types of properties in particular geographic locations, and how the returns indices could be generated based on either value-weighting or equal-weighting of the constituent property returns (the former being the "official" NCREIF method), and with income and appreciation return components computed based either on NOI or cash flow, the former subtracting capital expenditures from the appreciation component instead of from the income component (which is the official NCREIF method).†

To prepare for his Wednesday meeting with Cate, Leslie produced tabular and area chart representations of the efficient frontier and target return portfolios exactly as he had before (including also a table of the input assumptions), only now with eight asset classes including private real estate as represented by the NCREIF Index. Leslie summarized the general characteristics of the efficient frontier with a brief discussion (in *executive summary* format, both in his PowerPoint presentation and in a hardcopy Word file he prepared for Cate). In this summary Leslie made particular mention of the nature and role of the real estate asset classes in the efficient frontier.

* Get the username and password for accessing the NCREIF web site from the TA or Professor Geltner. You will want to download the total return history using the "custom data query" feature of the web site. When you get into the Member Data Access area of the NCREIF web site, go to the NCREIF Property Index (NPI) Data Products area and then to the NPI Custom Query Screen to add a query to download the returns data history that you want. For our present purposes, the official (default) All properties NPI calendar year total returns will suffice.

† While you should use the "official" NPI definitions in the present exercise, keep in mind that an equal-weighted index is arguably superior from a statistical perspective if the index is viewed as a "sample" representing a larger population. The NCREIF property population is less than \$300 billion worth out of perhaps ten times that much value in commercial property in the U.S. that is similar in size and quality to the "institutional" properties held by NCREIF members. While the NCREIF population may indeed represent a "universe" of all of the pension fund investment managers who are members of NCREIF, it is not the complete commercial property "universe" in the U.S. It should also be noted that the cash flow based definition of return components, rather than the "official" NOI-based definition, provides a break-out between income and appreciation return components that is more comparable to that in stock market indexes (although this does not matter in the present context as the *total* return is unaffected).

Scene II: Wednesday Meeting with Cate

The Wednesday meeting went better than Monday's. Indeed, reflection on the real estate role in the efficient frontier led Cate and Leslie to brainstorm a bit about what was going on, and whether they ought to explore the analysis further. They were both troubled by the difference between the results implied by the MPT analysis based on the historical performance data, and the typical makeup of real world pension portfolios, which they knew had on average less than 5% in real estate, with most small funds like Fairweather having no real estate allocation at all.

They were not really satisfied with the data Leslie was using in the inputs of his optimization. Perhaps the NCREIF Index was presenting a biased picture of real estate risk and return, more favorable than real estate really presents, they wondered. It is well known that the NPI is based on appraised values of the constituent properties, and this can make the index artificially "smooth" and "lagged" in time, causing both the volatility of the real estate index and its correlations with the other asset classes to be biased on the low side. This could skew the optimal portfolio excessively toward private real estate.

To address this problem, Cate and Leslie hit on the idea of using one of the new transactions prices based real estate indexes rather than an appraisal-based one to represent the private real estate asset class. After some research, Leslie decided to use the transactions based index ("TBI") developed at MIT, which is based on the NCREIF population of properties, but calibrated off of actual transaction prices rather than appraised values. The TBI is available on the MIT/CRE web site, and Leslie suggested that it would be a good measure of the periodic total returns of the direct private real estate institutional investment asset class. Particularly given that derivatives based on transactions-prices-based indexes similar to the TBI are or would soon be available for trading and formation of synthetic investment, it seemed that a transaction price based index such as the TBI would present periodic investment returns in a manner comparable to securities-based indexes such as the NAREIT Index and the stock and bond-based indexes, thereby enabling the type of "apples-to-apples" comparison across asset classes necessary for a more rigorous portfolio analysis.

Leslie and Cate made plans to meet the following Friday (under some time pressure, as the scheduled presentation to Clayton Patrick at Fairweather was fast approaching).

Scene III: Preparation for Friday Meeting with Cate

Leslie developed a new 8-class portfolio optimization analysis, this time representing the private real estate asset class by the TBI annual total returns from 1985 through 2006. He appended the results as additional tabular and area graph slides in his previous PowerPoint presentation file for Cate. To clarify the potential effect that optimal diversification can have, Leslie also put together another chart, based on optimal *ex post* diversification. This second chart was a line graph depicting the cumulative total returns for each of the eight asset classes (what \$1 invested at the end of 1984 would have grown to in each subsequent year, with reinvestment), with also included in the chart as a ninth line the "*ex post* optimal" mixed-asset portfolio treating T-bills as the riskless asset, with a target return equal to the maximum achieved by any of the individual eight asset classes.

To construct this line graph, Leslie used the "Riskless Asset" worksheet in his Excel workbook to identify the Sharpe Ratio Maximizing portfolio, using as the "riskfree rate" the average annual T-bill total return during 1985-2006 (from the Ibbotson SBBI data). He then used the WACC

formula to construct the *ex post* optimal portfolio's returns from the Sharpe-maximizing risky asset weights and the leverage necessary to meet the target return (i.e., the optimal portfolio's return each period would be $v \cdot r_M + (1-v) \cdot r_f$, where v is the weight on the risky portfolio necessary to achieve the specified target return (maximum across the asset classes), r_M is the return on the Sharpe-maximizing risky asset portfolio (a particular weighted average of the individual risky asset classes), and r_f is the return (each year) to T-bills achieved during 1985-2006.

Interlude: Tuesday Meeting with Fairweather

Cate was well satisfied with their preparations for their meeting the following Tuesday with Fairweather. The meeting on Tuesday also went well until Fairweather's CFO, Clayton Patrick, stood up, cleared his throat, and in a very authoritative manner declared that he had "two major problems" with the analysis.

First, he said, he "could not believe that it could be optimal to allocate such a large fraction of the fund's portfolio to real estate." How could all of the other pension funds "be so wrong?", he asked. Surely, he said, the historical data must be biased. "After all, the 1985-2006 period is just one sample of time". Patrick suggested that the recent years had been "uncharacteristically favorable for real estate, and uncharacteristically unfavorable for the stock market." Patrick wanted to see the analysis re-run based on statistics from the 1985-1999 period, truncating the data from 2000 on.

Leslie protested that such a time sample would be "wasting good data", and that by leaving out the bursting of the "dot.com bubble" it would bias the analysis *in favor* of the stock market. Leslie pointed out that the resulting truncated historical period would be unusually dominated by the worst fall in the history of the commercial real estate market since the Great Depression (the 1991-92 period). He said that by beginning the history in 1985 the data was actually leaving out the period in which real estate did the best in comparison to the stock market (the 1970s). But Patrick would hear none of it, and cut Leslie off simply by saying that the 1985-99 period would still include the 1987 stock market crash.

Then Patrick launched into his second problem, claiming that the analysis Cate and Leslie had presented: "*has not really solved anything for Fairweather, because how can we know which point along the frontier we should target?*" In response, Cate covered nicely for the two of them, pointing out that this was a question that could ultimately be decided only by Fairweather, based on their risk tolerance and objectives for the pension portfolio. They agreed, however, that Leslie would prepare some additional relevant analysis and some thoughtful discussion prior to a second meeting scheduled for the following Thursday.

Scene IV & Conclusion: Preparation for Thursday Meeting with Fairweather

Leslie spent the intervening two days re-doing the portfolio analysis based on the truncated historical period requested by Patrick, and collecting his thoughts regarding the risk posture Fairweather might consider for the pension portfolio. He organized these latter thoughts into two perspectives: (i) In the context of the classical MPT model, where along the efficient frontier should Fairweather position itself? (ii) What are the implications of bringing in a slightly different (but also "classic") model, in which the existence of a riskless asset is postulated? Although Leslie did not believe the analysis was now being fair to the real estate asset class, he noted that the resulting optimal portfolios looked much more like the traditional and still widely prevailing pension fund allocations, and he collected his presentation in two succinct PowerPoint

slides and another brief Word file Executive Summary, similar to his previous presentations (only without the extra line graph this time).