UNIVERSITY OF CHICAGO
Booth School of Business

Bus 35120 – Portfolio Management Prof. Lubos Pastor

Assignment #9

Due: May 26 by 8:15am

Be as clear and brief as possible. The data for Part B of the assignment can be downloaded from WRDS. A program that can help you complete Part B can be downloaded from Canvas.

A.1. CASE STUDY: "The Hedge Fund Industry." Read the case and answer the following questions.

1. What are the main differences between hedge funds and more traditional money managers, such as mutual funds?
2. Which hedge fund firm performed the best in 2007? Why?

A.2. CASE STUDY: "AQR's DELTA Strategy." Read the case and answer the following questions.

1. What are the objectives of hedge fund replication?
2. How does AQR's approach differ from the competing approaches?
3. Why does AQR believe that its approach is superior?

Be prepared to discuss both cases in class.

B. DATA ANALYSIS. You work for Ford Motor Company. Your retirement portfolio is invested in a stock market index fund. You plan to retire in 20 years.

In an attempt to align the incentives of its employees with the incentives of its shareholders, Ford has created a new retirement plan called FLOP (Ford's Ludicrously Opulent Pension). Under this plan, Ford employees can switch 100% of their retirement funds into Ford's stock, which they can purchase from Ford at a discount as long as they agree to hold the Ford-stock-only portfolio until retirement. You need to decide whether to participate in the FLOP plan. Your objective is to maximize the 20-year Sharpe ratio of your retirement portfolio.[1]

[1]Hint: Compute the 20-year Sharpe ratio of portfolio P as $(E_P^{(20)} - R_f^{(20)})/\sigma_P^{(20)}$, where the 20-year expected return and standard deviation equal $E_P^{(20)} = 20E_P$ and $\sigma_P^{(20)} = \sqrt{20}\sigma_P$, respectively, and where E_P and σ_P are the mean and standard deviation of one-period log returns. The risk-free rate is $R_f^{(20)} = 20R_f$.

Download historical monthly simple returns on Ford's stock (ticker symbol "F") from WRDS. After logging in to WRDS[2], go to CRSP, Annual Update, Stock/Security Files, and download monthly holding period returns on F from April 1956 – December 2016. After deleting the first row (text labels) and the first column (PERMNO), save the file as "*ford.txt*". Monthly simple returns on the market and the riskless T-bill are in *ff_factors_192607_201612.txt*, which you already have from an earlier assignment. You can assume that log returns are i.i.d. over time. Estimate the means and variances of log returns by their sample estimates.

1. Would you participate in the FLOP plan if Ford offered no discount on its stock? Compare the 20-year Sharpe ratios of Ford and the market portfolio.
2. What is the minimum discount on the Ford stock that you would require in order to participate in the FLOP plan? Explain how you computed the discount.
3. How would your answer change if you had T years until retirement instead of 20? Plot the minimum required discount against T for $T = 1, \ldots, 40$. Explain.
4. The implicit assumption so far has been that your labor income is irrelevant for your decision. From now on, we relax this assumption. Your retirement portfolio grows not only through its own log returns (r_R) but also through your monthly contributions that are based on your labor income (r_L). Assume, for simplicity, that both sources of income are equally important, so that the log growth rate of your overall portfolio can be approximated by $r_P = \frac{1}{2}r_R + \frac{1}{2}r_L$. Your monthly contributions are such that $E(r_L) = 1\%$ per month and $\sigma(r_L) = 5\%$ per month.[3] The correlation between r_L and market returns r_M is $\rho_{L,M} = 0.02$ and the correlation between r_L and Ford returns r_F is $\rho_{L,F} = 0.3$. The correlation $\rho_{L,F}$ reflects the fact that your labor income from Ford tends to be higher when Ford is doing well (e.g., your bonus is higher or your options are worth more).
   (a) What is the minimum discount on the Ford stock that you would require in order to participate in the FLOP plan? Explain the difference between this discount and the discount computed in part 2.
   (b) How does your answer depend on $\rho_{L,F}$? Plot the minimum required discount against $\rho_{L,F}$ for $\rho_{L,F}$ between 0 and 1. Plot three lines, one for $T = 20$, one for $T = 10$, and one for $T = 5$ years.
5. Give an example of one profession in which the correlation between labor income and own-company stock return is high and one in which it is low.
6. What if anything have you learnt from this exercise?

[2] wrds.wharton.upenn.edu. I announced the username and password in class at the beginning of the quarter. If you have any difficulty in accessing WRDS, please contact Computing Services/HelpDesk.

[3] If r_L happens to be negative in some periods, it can be interpreted as a withdrawal from the retirement portfolio to cover your unexpected consumption needs. For example, if you company goes bankrupt and you lose your job, you might need to draw on your retirement account before you find a new job.

C. EXAM-LIKE QUESTIONS.

1. You are a trustee of the Quantie Corporation's defined benefit pension plan. The entire pension fund is currently invested in an S&P 500 index portfolio. The plan is currently overfunded, and the portfolio's current value (at the beginning of the year) is \$4.6 billion. The plan would be underfunded if the portfolio's value were to drop below \$4.0 billion by year end. Quantie's management will tolerate no more than 1-in-6 chance that the pension plan will become underfunded by year end. Under the risk/return parameters for the S&P that the management has been using up to this point (12% expected return and 20% volatility, both annual), Quantie's analysts have concluded that the current portfolio would be within this risk limitation. Recently, however, the analysts have developed concerns that the coming year will be unusually volatile, and they now believe that the appropriate assumption for the S&P's return volatility is 32%, not 20% (retaining the 12% expected return assumption). You have been asked to evaluate the fund's current investment position in light of the new volatility assumption. Quantie views two alternative actions as feasible: 1. transfer capital from the index portfolio to one-year T-bills, which are currently yielding 4%; 2. add additional capital to the index portfolio and thereby maintain an all-equity position.
   (a) If Quantie takes no action under the higher-volatility assumption, does the probability of being underfunded at year end exceed the 1-in-6 limitation?
   (b) If action 2 is taken, what dollar amount must be added to the index portfolio in order to reduce the risk of underfunding to the acceptable 1-in-6 level?[4]
   (c) If action 1 is taken, what dollar amount must be transferred out of the index portfolio and into the T-bills?
   (d) Separate from the shortfall concern, would you recommend for Quantie to shift some capital out of the S&P and into long-term bonds? Would such a shift be likely to increase or decrease shareholder value? Why?
2. Is the future pension problem likely to be more severe in the United States or in continental Europe? Explain your answer in less than 50 words.
3. State three differences between the pension systems in the U.S. and UK.
4. "A decrease in interest rates across all maturities typically contributes to the underfunding of defined benefit pension plans." True or false? Explain briefly.
5. (not graded) Read the following article from The Economist. Who is right, Mr. Ralfe or Mr. Daykin? Do you agree with the article's conclusion?

[4] You might find Matlab's *norminv.m* function useful.

Booting Out Equities
The Economist
February 14, 2002

Was Boots right to switch its entire pension fund to bonds?

IN LATE 2001, Boots, a British retail chain that sells prescription drugs, cosmetics and other personal-care products, astonished the world of pension investment by announcing that it had shifted its entire pension fund into high-quality bonds. The decision confounded the investment orthodoxy in favour of equities that had prevailed for the past 40 years. It also, as it happened, turned out to be well-timed because it avoided the worst of last year's bear market in equities and crystallised a pension-fund surplus.

If Boots had simply switched the bulk of its fund into bonds, and kept quiet about it, no one would have paid much attention. After all, Boots' main defined-benefit pension plan is different from that of many British companies in that new employees qualify to join it only after five years at work. Until then, they are offered a less generous defined-contribution plan. Given the rapid turnover of staff in its shops, this means that the company's DB plan is not unlike a "closed" mature fund, which has no new entrants and more and more members either already retired or approaching pensionable age. No one would quarrel with the idea that as a scheme matures, it should match the pensions it is paying out with income from bonds.

But John Ralfe, Boots' head of corporate finance, is arguing that all company pension funds should invest solely in bonds as a matter of economic principle. He maintains that the distinction between a company's pension fund and the company itself is notional, because the company backs the fund. A company whose fund holds equities to meet its pension liabilities is therefore, in effect, borrowing money to invest in stocks. A company with an equity-based pension fund, he says, is like a company running an investment trust on the side.

Many would take issue with this view. For one thing, if the company and the pension fund really were economically indivisible, there would be no point in setting up a separate fund. The point of the fund is that it represents the interests of its members, both working and drawing pensions, although it needs to take the company's interests into account too. And senior figures in the actuarial profession disagree with Mr Ralfe's argument that members' interests are better served by investing only in bonds. "From the corporate treasurer's perspective, it may make sense to hold only bonds, but regulators take a different view: that the fund should be diversified," says Chris Daykin, the British government's actuary.

Putting a pension fund's entire portfolio into bonds may make it easier to deal with short-term volatility, but pension funds operate on a much longer investment horizon. DB plans are offering a starting benefit that is linked to wages and salaries, so they must ensure that their assets match this accruing pension liability. "The pension rights that workers in DB plans are building up are linked to wages, so you need to match them with a real claim on the economy," says Mr Daykin.

Cults of any kind are suspect, and a new cult of the bond would be no better than the old cult of the equity. Equities should remain a mainstay of pension funds' holdings because both have long time horizons. If you are planning 40 years ahead, short-term volatility becomes less of a worry. ♠