UNIVERSITY OF CHICAGO
Booth School of Business

Bus 35120 – Portfolio Management Prof. Lubos Pastor

Assignment #7

Due: May 12 by 8:15am

Be as clear and brief as possible. The data for Part B of the assignment can be downloaded from Canvas, along with a sample program that can help you complete Part B.

A. CASE STUDY.

There is no case study this week so we can spend more time discussing research in class.

B. DATA ANALYSIS.

The purpose of this assignment is to study the long-term performance of leveraged exchange-traded funds (leveraged ETFs, or "LETFs").

LETFs, first introduced in 2006, are ETFs that use financial derivatives and debt to amplify the daily returns of an underlying index. LETFs feature leverage ratios such as -1x, 2x, -2x, 3x, and -3x. For example, if the underlying index has a daily return of 1%, a 2x LETF will return approximately 2% for the day, while a -2x LETF will return -2%. LETFs are rebalanced daily to maintain the desired leverage.

Download the Jan 3, 2006–Dec 30, 2016 daily returns from WRDS[1] for the following LETF ticker symbols: SPY, SH, SSO, SDS, IYF, SEF, UYG, SKF, IYR, REK, URE, SRS, IWM, RWM, UWM, and TWM. After logging in to WRDS, select CRSP, Annual Update, Stock/Security Files, Daily Stock File, and download the holding period returns for the 16 ticker symbols. Rearrange the data (e.g., in Excel) so that column 1 contains the dates (20060103 through 20161230) and columns 2 through 17 contain the returns on the 16 LETFs, in the order listed above. Make sure the LETF returns are properly aligned with the dates in the first column. Many returns will be missing since most LETFs were introduced well after January 2006; replace all missing returns by "-99". After eliminating any text from the file, save it as "LETF.txt".

The LETFs correspond to four different indexes: the S&P 500 index, the Dow Jones U.S. Financial index (DJUSFN), the Dow Jones U.S. Real Estate index (DJUSRE), and the Russell 2000 index. The leverage ratios are as follows:

[1] 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.

- S&P500: 1x SPY / -1x SH / 2x SSO / -2x SDS
- Dow Jones U.S. Financial index: 1x IYF / -1x SEF / 2x UYG / -2x SKF
- Dow Jones U.S. Real Estate index: 1x IYR / -1x REK / 2x URE / -2x SRS
- Russell 2000: 1x IWM / -1x RWM / 2x UWM / -2x TWM

In addition, download the daily returns for the S&P 500 index over the same time period. Still under CRSP, go to Index / S&P 500 Indexes / Index File on S&P 500, and download the daily value-weighted returns including distributions from Jan 3, 2006 to Dec 30, 2016. After eliminating any text from the file, save it as "SP500.txt."

1. **Index vs. 1x ETF.** Plot the cumulative return series of the S&P 500 index and SPY. How does the 1x ETF track the performance of the underlying index?
2. **Buying and holding LETFs.**
   (a) Compare the strategy of investing in a 2x LETF to a double-levered investment in the corresponding unlevered ETF. For each of the four indexes, produce a chart showing cumulative returns from the two strategies. Does either strategy perform better? Why?
   (b) For all four indexes, compare the strategy of going long (i.e., buying) a 1x unlevered ETF with the strategy of going short (i.e., selling) the -1x LETF on the same index. For each of the four indexes, plot the two cumulative return series in the same chart. Do the two strategies deliver the same performance? Why? Does the answer change if you do the same for 2x versus -2x LETFs?
   (c) Analyze LETF performance during the financial crisis. Specifically, for three of the LETFs benchmarked to Russell 2000, namely IWM, UWM, and TWM, plot their cumulative returns for the 3-year period between May 31, 2007 and May 31, 2010. Do you find anything interesting? Explain.
3. **A paired LETF strategy.** For all four indexes, consider the buy-and-hold strategy that buys both a 2x and -2x LETF on the same index. On day 1, split the initial $1 investment equally between the 2x and -2x LETFs, and hold on to your LETF portfolio without any subsequent rebalancing.
   (a) Plot the cumulative returns of this strategy for each of the four indexes. Does this strategy perform well or poorly over the full sample period? Why?
   (b) Given this evidence, can you propose an attractive investment strategy based on LETF pairs? What is the most likely impediment in the implementation of that investment strategy?
4. **The main lesson.** What if anything have you learned from this exercise?

C. EXAM-LIKE QUESTIONS.

1. "In efficient markets, the price is always right, so there is no point in trying to gather information to beat the market." Comment.

2. What is the stratified sampling approach to passive management?
3. What investors generally prefer ETFs to passive mutual funds, and vice versa?
4. Do "smart beta" products tend to have higher or lower trading costs compared to more standard market cap-weighted index products?
5. **(not graded)** Read the following excerpt from a 2009 article in the Financial Times. Explain why the author is confused about market efficiency.

Wanted: new model for markets

By John Authers

Financial Times, September 29, 2009

Don Putnam, designer of investment products since the 1970s, points to the most fundamental of lessons learnt from last year's global financial implosion: markets are "defined by their participants as much as they are by their mechanics" and it is people's motivations that ultimately count.

. . . To some, that conclusion may seem self-evident. But to accept it sweeps away assumptions that for half a century formed the foundations of the financial industry. The reigning theory, often referred to in shorthand as "efficient markets", is deeply embedded in the way that markets operate. The regulations for pension funds and banks both ultimately hinge on these assumptions. So does much law on securities fraud.

It is central to business schools' curriculum and is part of the Chartered Financial Analyst qualification that acts as a gateway to the investment profession. Fund managers run their businesses by comparing their performance against benchmark indices, another idea from efficient markets. The products based on derivatives that grew notorious for their role in the market crash all stemmed directly from efficient markets theory.

If the theory needs to be abandoned, the effect on investing will be profound. More important still is what will come to replace it. Efficient markets borrowed from mathematics but that is now widely regarded as an oversimplified and often downright misleading theory that fostered the cavalier confidence leading to the crash.

. . . In spite of the weight that was put on the theory, it has long been known to have problems. First, market returns do not follow a "bell curve". Instead, extreme events happen far more often than a "normal" distribution would imply. Benoit Mandelbrot, the mathematician who invented fractal geometry, proved this more than 40 years ago, when efficient markets theory was in its infancy, and has continued to criticise the established theory ever since.

If stocks really followed a bell curve, he observed, then a swing of more than 7 per cent in a day for the Dow Jones industrial average should happen once every 300,000 years. In fact there were 48 such days during the 20th century. "Truly, a calamitous era that insists on flaunting all predictions. Or, perhaps, our assumptions are wrong," he concluded.

Another obvious weakness in efficient markets is the assumption that investors always make their decisions rationally. Virtually everyone knows this is not true. Indeed, over the past two decades a new discipline of behavioural economics had started to substitute findings from psychology for the assumption of rationality. But last year's events inflicted fresh damage in the critical area of asset allocation - how to divide up an investment portfolio among broad asset classes such as stocks, bonds and commodities.

. . . But it relies on these correlations being static. Investing using this formula - and borrowing money to do so - can be a recipe for disaster if the correlations change. And that is what happened last year. According to Jeremy Siegel of the University of Pennsylvania's Wharton School, whose book Stocks for the Long Run was influential in persuading asset allocators to put a big weighting towards equities, says: "The most serious attack on efficient markets is the change in correlation of asset classes under extreme conditions." . . .