

Homework #4

Due on Monday, October 28, at 6:00pm.

ProShares Hedge Replication ETF [UV6939].

The case is only seven pages, though it contains many exhibits. No need to study/review the exhibits beyond what is useful in addressing the homework questions. But they are interesting if you are inclined.

1 The ProShares ETF Product

- **This section is not graded, and you do not need to submit your answers.**
- But you are expected to consider these issues and be ready to discuss them.
- This section requires no empirical analysis; answer solely based on the material given in the case.

1. ProShares and ETFs

- (a) ProShares made much of its name originally through levered, or “geared” ETFs. Explain the trouble with these ETFs, and why ProShares was looking for new product lines.
- (b) Describe what is meant by “alternative ETFs”. Describe the two types of investments referenced by this term.

2. Hedge Funds.

- (a) Using just the information in the case, what are two measures by which hedge funds are an attractive investment?
- (b) What are the main benefits of investing in hedge funds via an ETF instead of directly?

3. The Benchmarks

- (a) How well does the Merrill Lynch Factor Model (MLFM) track the HFRI?
- (b) In which factor does the MLFM have the largest loading? (See a slide in Exhibit 1.)
- (c) What are the main concerns you have for how the MLFM attempts to replicate the HFRI?

4. The HDG Product

- (a) What does ProShares ETF, HDG, attempt to track? Is the tracking error small?
- (b) HDG is, by construction, delivering beta for investors. Isn't the point of hedge funds to generate alpha? Then why would HDG be valuable?
- (c) The fees of a typical hedge-fund are 2% on total assets plus 20% of excess returns if positive. HDG's expense ratio is roughly 1% on total assets. What would their respective net Sharpe Ratios be, assuming both have a gross excess returns of 10% and volatility of 20%?

2 Analyzing the Data

Use the data found on Canvas, in ‘**hedge_fund_replication.xlsx**’. It has several tabs, with data through Sep 2019.

1. For every asset in the “HEDGE-REP” tab, report the following summary statistics:

- (a) mean
- (b) volatility
- (c) Sharpe ratio
- (d) Market Beta, (based on SPY).

Annualize the mean, volatility, and SR. (Multiply the mean by 12, and the vol and SR by $\sqrt{12}$.)

2. Relative Performance

- (a) How do they perform since the case in 2013?
- (b) Does HDG outperform its competitor, QAI?
- (c) How do they compare to the S&P 500? (“SPY”)

3. Report the correlation matrix for these assets based on the full sample of data, 2011-2019.

- (a) How well does the Merrill Lynch Factor Model track the HFRI?
- (b) How much precision is lost by using the ML Exchange Series (ML-ES) instead?
- (c) How well does HDG correlate to the HFRI? And to the ML-ES?
- (d) How does the competitor, QAI, compare to the ML series and HDG?

4. Replicate HFRI with the six factors listed on the “MERRILL-FACS” tab. Include a constant, and run the unrestricted regression,¹

$$r_t^{\text{hfri}} = \alpha^{\text{merr}} + \mathbf{x}_t^{\text{merr}} \boldsymbol{\beta}^{\text{merr}} + \epsilon_t^{\text{merr}} \quad (1)$$

$$\hat{r}_t^{\text{hfri} \rightarrow \text{merr}} \equiv \hat{\alpha}^{\text{merr}} + \mathbf{x}_t^{\text{merr}} \hat{\boldsymbol{\beta}}^{\text{merr}} \quad (2)$$

Note that the second equation is just our notation for the fitted replication.²

- (a) Report the intercept and betas.
 - (b) Are the betas realistic position sizes, or do they require huge long-short positions?
 - (c) Report the r-squared.
 - (d) Report the volatility of ϵ^{merr} , (the tracking error.)
5. Replicate HFRI with the factors listed on the “MULTI-ASSET” tab. Include a constant, and run the unrestricted regression to get the fitted values:

$$r_t^{\text{hfri}} = \alpha^{\text{alt}} + \mathbf{x}_t^{\text{alt}} \boldsymbol{\beta}^{\text{alt}} + \epsilon_t^{\text{alt}} \quad (3)$$

$$\hat{r}_t^{\text{hfri} \rightarrow \text{alt}} \equiv \hat{\alpha}^{\text{alt}} + \mathbf{x}_t^{\text{alt}} \hat{\boldsymbol{\beta}}^{\text{alt}} \quad (4)$$

¹ML restricts their regression to ensure the position sizes stay within certain bounds. We leave it unrestricted.

²This is just the fitted value of your regression, which in classic regression notation would be \hat{y} , and based on your regression fit for y .

- (a) Report the intercept and betas.
 - (b) Are the betas realistic position sizes, or do they require huge long-short positions?
 - (c) Report the r-squared.
 - (d) Report the volatility of ϵ^{alt} , (the tracking error.)
6. Comparison.
- (a) Which replication is better?
 - (b) Does either replication do a better job tracking HFRI than HDG?

7. Let's take a serious look at the out-of-sample performance.

For monthly values of t from January 2015 through September 2019, do the following:

- Use data up to $t - 1$ to estimate the regression equation, (1). This gives time- t estimates of the regression parameters, $\hat{\alpha}_t^{\text{merr}}$ and $\hat{\beta}_t^{\text{merr}}$
- Use the estimated regression parameters, along with the time- t regressor values, $\mathbf{x}_t^{\text{merr}}$, to calculate the time- t replication value³ that is, with respect to the regression estimate, built “out-of-sample” (OOS).

$$\hat{r}_t^{\text{hfri} \rightarrow \text{merr}: \text{OOS}} \equiv \hat{\alpha}_t^{\text{merr}} + (\mathbf{x}_t^{\text{merr}})' \hat{\beta}_t^{\text{merr}}$$

How well does $\hat{r}_t^{\text{hfri} \rightarrow \text{merr}: \text{OOS}}$ perform, particularly with respect to the target, \hat{r}_t^{hfri} ?

3 Model Selection

This section is not graded, and you do not need to submit your answers.

1. We estimated the replications using an intercept.
 - (a) Would it make more sense to run the regressions without an intercept?
 - (b) Do you think Merrill and ProShares fit their replicators with an intercept or not?
2. Suppose you built a replication and then observed its performance through the end of 2020.
 - (a) Conceptually, which replication above, (merr, alt,) do you think would do better out-of-sample? Why?
 - (b) Overall, do you have much concern about the out-of-sample performance in these regressions? What feature of the data bears on this question?
3. Re-do the out-of-sample problem to analyze the replication model in (3). That is, construct and analyze $\hat{r}_t^{\text{hfri} \rightarrow \text{alt}: \text{OOS}}$.

³This is just a single number!