The Energy and Health Industry:
A Hedging Strategy against Macroeconomic Factors?

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Agenda

1. Research Question
2. Executive Summary
3. Data Acquisition
4. Methodology
5. Summary of Findings

Research Question

Which macroeconomic factors affect the Health and Energy Industries?

Executive Summary

Strong predictors in both ETFs

- Initial Jobless Claims (d)
- Unemployment Rate (m)
- CPI (m)

Data Acquisition

2006 - 2020

- **Yahoo Finance** (*yfinance*)
  - VHT - response
  - VDE - response
  - S&P 500 - predictor

- **FRED** (*fredr*) - predictors
  - Crude Oil Prices (*d*)
  - International Trade Weighted Dollar (*d*)
  - 2-Year Bond Yield (*d*)
  - Initial Jobs Claim (*w*)
  - Chicago Fed NFCI (*w*)
  - M1 (*w*)
  - Fed Balance (*w*)
  - Treasury General Account (*w*)
  - CPI (*m*)
  - Unemployment Rate (*m*)

Methodology

1. Fixing Data
    a. Time series data - Stationary test
    b. Difference calculation
2. Cleaning Data
    a. **Fill** indicators for daily indices count
    b. **Merge** indicators for all frequencies → Daily
3. GARCH Model
    a. **Purpose :** Calculate volatility
    b. **Parameter:** Daily returns
4. Machine Learning Methods
    a. Linear Regression
    b. Elastic Net
    c. Trees
    d. Random Forest Regression
    e. Boosting

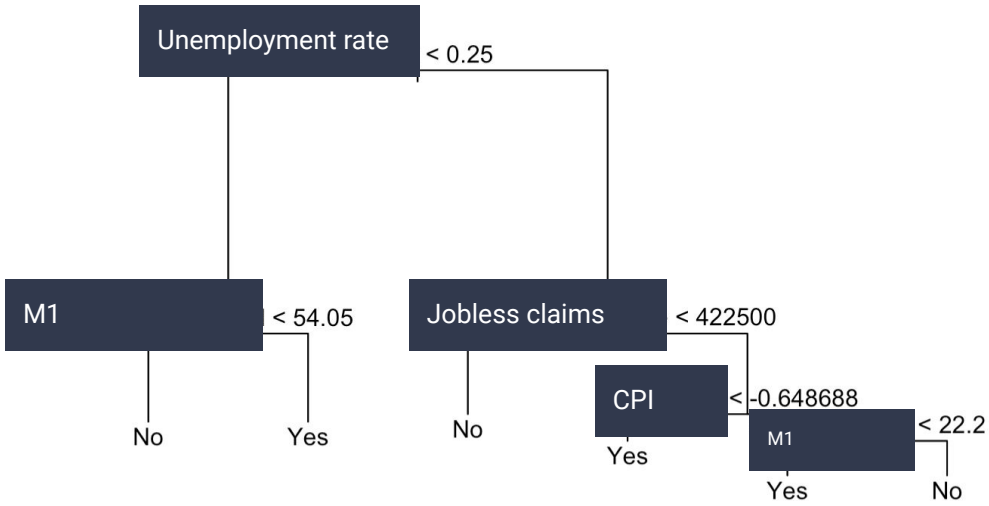
Classification Tree

VHT	Actual No	Actual Yes
Predict No	75.60%	12.63%
Predict Yes	13.85%	10.39%

VDE	Actual No	Actual Yes
Predict No	82.47%	3.14%
Predict Yes	7.67%	6.71%

1. Continuous variable into binary variable
2. Thresholds
3. Training and Testing Sample
4. Cross - validation (tuning tree size)
5. Pruning

VDE Pruned Tree



Random Forests

1. Pick the number of predictors to choose from
2. Training and Testing sample

VDE MSE: 0.00

VHT MSE: 0.00

Variable	VDE Increase in Node Purity	VHT Increase in Node Purity
Crude Oil Prices	0.0007127370	0.0002835635
Itrnl Trade Weighted Dollar	0.0007569161	0.0003725627
2- Year Bond Yield	0.0009719296	0.0003252290
Initial Jobless Claims	0.0134926626	0.0069649279
Chicago FED NFCI	0.0121885515	0.0046222098
M1	0.0085943266	0.0033604648
Fed Balance	0.0062397583	0.0045860008
Treasury General Account	0.0017153460	0.0007277648
Unemployment Rate	0.0214073200	0.0038090607
CPI	**0.0572383465**	**0.0204274831**
SP500	0.0011510405	0.0004831745

Boosting

1. Number of trees = 5000
2. Depth of trees = 3
3. Training and Testing sample

VDE MSE: 0.00

VHT MSE: 0.00

Variable	VDE Influence	VHT Influence
Crude Oil Prices	1.729492	1.442319
Itrnl Trade Weighted Dollar	2.146733	4.007173
2- Year Bond Yield	2.146733	1.668946
Initial Jobless Claims	8.581591	13.166991
Chicago FED NFCI	9.039287	10.460023
M1	7.779618	7.652743
Fed Balance	2.536950	5.613773
Treasury General Account	2.616731	2.611309
Unemployment Rate	9.101675	02.079824
CPI	**50.649656**	**47.391877**
SP500	3.684241	3.905022

Linear Regression

Linear Model for VDE using all predictors

```
Call:
lm(formula = coredata.volvde. ~ . - date, data = final_merged_vde)

Residuals:
      Min        1Q    Median        3Q       Max
-0.020525 -0.003429 -0.001141  0.001588  0.042104

Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)               1.131e-02  1.650e-04  68.561  < 2e-16 ***
detr_crude_oil_prices     3.774e-05  6.823e-05   0.553  0.58023
detr_intl_dol            -1.260e-04  2.888e-04  -0.436  0.66266
detr_yield               -2.504e-03  2.195e-03  -1.141  0.25394
intl_job_claims_value     7.889e-09  3.667e-10  21.512  < 2e-16 ***
chifed_nfci_detrended     3.542e-02  2.522e-03  14.043  < 2e-16 ***
m.1_detrended             1.993e-07  1.367e-07   1.458  0.14490
fed_bal_detrended        -7.644e-09  2.880e-09  -2.654  0.00799 **
treas_gen_acct_detrended -2.341e-09  2.515e-09  -0.931  0.35202
ur_detr                  -9.349e-04  1.599e-04  -5.847 5.43e-09 ***
cpi_detr                 -6.490e-03  2.809e-04 -23.103  < 2e-16 ***
adjusted_detr             7.764e-07  4.462e-06   0.174  0.86189
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.005715 on 3742 degrees of freedom
Multiple R-squared:  0.3483,    Adjusted R-squared:  0.3464
F-statistic: 181.8 on 11 and 3742 DF,  p-value: < 2.2e-16
```

Linear Regression

Linear Model for VHT using all predictors

```
Call:
lm(formula = coredata.volvht. ~ . - date, data = final_merged_vht)

Residuals:
      Min        1Q    Median        3Q       Max
-0.006764 -0.002065 -0.000762  0.001092  0.033914

Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)               8.017e-03  9.982e-05  80.311  < 2e-16 ***
detr_crude_oil_prices     1.048e-06  4.129e-05   0.025    0.980
detr_intl_dol             2.213e-05  1.748e-04   0.127    0.899
detr_yield               -7.183e-04  1.328e-03  -0.541    0.589
intl_job_claims_value     2.495e-09  2.219e-10  11.244  < 2e-16 ***
chifed_nfci_detrended     2.730e-02  1.526e-03  17.892  < 2e-16 ***
m.1_detrended             6.161e-08  8.273e-08   0.745    0.456
fed_bal_detrended         7.816e-09  1.743e-09   4.485 7.51e-06 ***
treas_gen_acct_detrended -1.441e-09  1.522e-09  -0.947    0.344
ur_detr                  -1.562e-04  9.676e-05  -1.614    0.107
cpi_detr                 -3.578e-03  1.700e-04 -21.045  < 2e-16 ***
adjusted_detr             2.551e-06  2.700e-06   0.945    0.345
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.003458 on 3742 degrees of freedom
Multiple R-squared:  0.3265,    Adjusted R-squared:  0.3245
F-statistic: 164.9 on 11 and 3742 DF,  p-value: < 2.2e-16
```

AIC VALUES OF EACH MODEL

Model selection based on AICc:

	K	AICc	Delta_AICc	AICcWt	Cum.Wt	LL
adjusted	6	-28111.24	0.00	0.75	0.75	14061.63
whole	13	-28109.01	2.22	0.25	1.00	14067.56
weekly	6	-27593.33	517.91	0.00	1.00	13802.68
monthly	5	-27451.99	659.25	0.00	1.00	13731.00
daily	5	-26529.43	1581.80	0.00	1.00	13269.73

VDE

	K	AICc	Delta_AICc	AICcWt	Cum.Wt	LL
adjusted_vht	6	-31887.10	0.00	0.97	0.97	15949.56
whole_vht	13	-31880.43	6.67	0.03	1.00	15953.27
weekly_vht	6	-31463.34	423.76	0.00	1.00	15737.68
monthly_vht	5	-31256.91	630.19	0.00	1.00	15633.46
daily_vht	5	-30431.87	1455.23	0.00	1.00	15220.94

VHT

Lasso Regression

Tuning Lambda by Cross-Validation

Vanguard Energy

(Intercept)	5.925841e-03
detr_crude_oil_prices	.
detr_intl_dol	.
detr_yield	.
chifed_nfci_detrended	4.296401e-02
intl_job_claims_value	2.239954e-08
m.1_detrended	8.883712e-06
fed_bal_detrended	2.945184e-10
treas_gen_acct_detrended	.
ur_detr	1.576440e-02
cpi_detr	-6.091692e-03
adjusted_detr	7.509376e-06

Vanguard Health Care

(Intercept)	2.261224e-03
detr_crude_oil_prices	.
detr_intl_dol	.
detr_yield	.
chifed_nfci_detrended	2.990439e-02
intl_job_claims_value	1.574285e-08
m.1_detrended	1.543382e-05
fed_bal_detrended	1.265942e-08
treas_gen_acct_detrended	.
ur_detr	6.993130e-03
cpi_detr	-3.189315e-03
adjusted_detr	1.067258e-06

Statistics

ETF	MSE	In Sample R^2	AIC	Optimal Lambda
VHT	1.097067e-05	0.5556351	14.02059	0.0001221047
VDE	3.07041e-05	0.5380359	14.05763	0.0001221047

Tuning Lambda by AIC

Vanguard Energy

(Intercept)	0.01463029
detr_crude_oil_prices	0.00000000
detr_intl_dol	.
detr_yield	.
chifed_nfci_detrended	.
intl_job_claims_value	.
m.1_detrended	.
fed_bal_detrended	.
treas_gen_acct_detrended	.
ur_detr	.
cpi_detr	.
adjusted_detr	.

Vanguard Health Care

(Intercept)	0.008645089
detr_crude_oil_prices	0.000000000
detr_intl_dol	.
detr_yield	.
chifed_nfci_detrended	.
intl_job_claims_value	.
m.1_detrended	.
fed_bal_detrended	.
treas_gen_acct_detrended	.
ur_detr	.
cpi_detr	.
adjusted_detr	.

Ridge Regression

Lambda Tuning by AIC Criteria:

VDE

(Intercept)	5.389500e-03
detr_crude_oil_prices	-1.658657e-06
detr_intl_dol	1.318736e-04
detr_yield	-2.229633e-03
chifed_nfci_detrended	4.553154e-02
intl_job_claims_value	2.351666e-08
m.1_detrended	1.246455e-05
fed_bal_detrended	9.755285e-10
treas_gen_acct_detrended	2.202616e-09
ur_detr	1.629563e-02
cpi_detr	-6.146519e-03
adjusted_detr	2.057465e-05

VHT

(Intercept)	1.796526e-03
detr_crude_oil_prices	-2.949427e-05
detr_intl_dol	-7.900282e-05
detr_yield	-2.737297e-04
chifed_nfci_detrended	3.231313e-02
intl_job_claims_value	1.675129e-08
m.1_detrended	1.879654e-05
fed_bal_detrended	1.375404e-08
treas_gen_acct_detrended	1.814854e-09
ur_detr	7.444095e-03
cpi_detr	-3.271181e-03
adjusted_detr	1.050730e-05

Lambda Tuning by Cross Validation:

(Intercept)	5.741436e-03
detr_crude_oil_prices	-9.474560e-06
detr_intl_dol	1.310978e-04
detr_yield	-2.037072e-03
chifed_nfci_detrended	4.226466e-02
intl_job_claims_value	2.252168e-08
m.1_detrended	1.410936e-05
fed_bal_detrended	3.601176e-09
treas_gen_acct_detrended	1.908549e-09
ur_detr	1.563695e-02
cpi_detr	-5.947963e-03
adjusted_detr	1.825861e-05

(Intercept)	2.114481e-03
detr_crude_oil_prices	-3.190046e-05
detr_intl_dol	-6.481427e-05
detr_yield	-2.598439e-04
chifed_nfci_detrended	3.030211e-02
intl_job_claims_value	1.592126e-08
m.1_detrended	1.943932e-05
fed_bal_detrended	1.461273e-08
treas_gen_acct_detrended	1.702155e-09
ur_detr	7.223037e-03
cpi_detr	-3.199567e-03
adjusted_detr	9.431666e-06

Elastic Net

VDE

(Intercept)	5.716040e-03
detr_crude_oil_prices	.
detr_intl_dol	.
detr_yield	.
intl_job_claims_value	2.282824e-08
chifed_nfci_detrended	4.395946e-02
m.1_detrended	9.961779e-06
fed_bal_detrended	3.653384e-10
treas_gen_acct_detrended	.
ur_detr	1.598484e-02
cpi_detr	-6.100981e-03
adjusted_detr	1.022523e-05

VHT

(Intercept)	1.971269e-03
detr_crude_oil_prices	.
detr_intl_dol	.
detr_yield	.
intl_job_claims_value	1.637848e-08
chifed_nfci_detrended	3.141095e-02
m.1_detrended	1.743816e-05
fed_bal_detrended	1.340534e-08
treas_gen_acct_detrended	2.864692e-10
ur_detr	7.264614e-03
cpi_detr	-3.246510e-03
adjusted_detr	6.476946e-06

Summary of Findings

1. Machine Learning Methods
    a. Classification Tree
    b. Random Forest
    c. Boosting
    d. Linear Regression
    e. Ridge Regression
    f. Elastic Net Regression