```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import statsmodels.api as sm
```

EF5058 HW1

EID 58555905 LAM Chun Ming

Full File found here: https://github.com/Toby3220/EF-5058

Q1) For Equity Market Neutral (EqMktNtr), run the following regression: a multivariate regression on the market (MktRf), size (SMB), value (HML), profitability (RMW), and investment (CMA) factors

```python
#Importing Data

data = pd.read_csv("Performance.csv")

#format Date to Datetime
data["Date"] = pd.to_datetime(data["Date"],format="%Y-%m-%d")
data.set_index("Date",inplace=True)

data.columns
```

```
Index(['LnShEq', 'EqMktNtr', 'DedShBs', 'GlobalMac ', 'MngdFut ',
'EmgMkts',
       'EvntDrvn ', ' CnvrtArb ', 'FxIncArb ', 'HFIndex', 'LRF',
'MktRF',
       'SMB', 'HML', 'RMW', 'CMA', 'UMD', 'BondMkt', 'CreditS',
'PTFSBD',
       'PTFSFX', 'PTFSCOM', 'LiqPS', 'LiqSadka', 'AlphaQuest',
'Transtrend',
       'VFINX', 'VEXMX', 'NAESX', 'VVIAX', 'VBINX', 'VIMSX', 'VISGX',
'VISVX',
       'MTUM', 'TSMOM', 'TSMOMCM', 'TSMOMEQ', 'TSMOMFI', 'TSMOMFX'],
      dtype='object')
```

```python
# working data group
wdata = data.loc[:,["EqMktNtr","MktRF","SMB","HML","RMW","CMA"]]
wdata.dropna(0,inplace=True)

# creating X,y Datasets, inserting intercept
y = wdata.pop("EqMktNtr")
X = wdata
X["Intercept"] = 1
# Running OLS Regression
mod = sm.OLS(y,X)
```

```
res = mod.fit()
print(res.summary())
```

```
                            OLS Regression Results                            
==============================================================================
========
Dep. Variable:               EqMktNtr   R-squared:                       
0.111
Model:                            OLS   Adj. R-squared:                  
0.098
Method:                 Least Squares   F-statistic:                     
8.466
Date:                Mon, 24 Feb 2025   Prob (F-statistic):           
1.45e-07
Time:                        00:45:24   Log-Likelihood:                 
805.10
No. Observations:                 346   AIC:                            
-1598.
Df Residuals:                     340   BIC:                            
-1575.
Df Model:                           5                                         

Covariance Type:            nonrobust                                         

==============================================================================
========
                 coef    std err          t      P>|t|      [0.025      
0.975]
------------------------------------------------------------------------------
--------
MktRF          0.1159      0.033      3.557      0.000       0.052       
0.180
SMB           -0.0026      0.048     -0.055      0.957      -0.096       
0.091
HML            0.2060      0.055      3.757      0.000       0.098       
0.314
RMW           -0.0928      0.061     -1.527      0.128      -0.212       
0.027
CMA           -0.1831      0.081     -2.249      0.025      -0.343      
-0.023
Intercept      0.0031      0.001      2.305      0.022       0.000       
0.006
==============================================================================
========
Omnibus:                      655.665   Durbin-Watson:                   
1.995
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           
494805.454
Skew:                         -11.688   Prob(JB):                        
```

```
0.00
Kurtosis:                     186.781   Cond. No.
72.5
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
```

1.1 & 1.2) Interpret the significance of alphas and betas in the regression. Based on the sign of estimated betas, can we say something about the general characteristics of the underlying portfolios?

Firstly, R^2 score of the regression is low, this suggest that a large part of the varience is not explained by current factors

α (the intercept) is significant with a p value of 0.02% although the size of the alpha is modest but positive, at 0.31% per month (3.8% annual). However this might be unreliable as with the low R^2 score suggest missing factors, and regression intercept could change when they are included

$\beta_{MktRF} \wedge \beta_{HML}$ are the most signficant, with relatively low but positive exposures in both at 0.11 and 0.21 respectively. This means that there portfolio do have a slight preference towards "Value" stocks and do have very limtied market risk exposure. (exposure of 0.11 and 0.21 means that portfolio returns are expected to increase by 0.11% and 0.21% per 1% point increase in the Market Risk Premium and Value factor respectively)

The portfolio is slightly negatively exposed to the investment factor β_{CMA} (-0.18, P value at 2.5%) this suggests slight preference to capital intensive companies

Lastly portfolio exposure to β_{RWM} is only signifcant at 10+% level and sligthly negative (an occational tendency to favor low "profitability" companies), and has no exposure to β_{SMB} (both statistically insignificant and small magnitude of exposure)

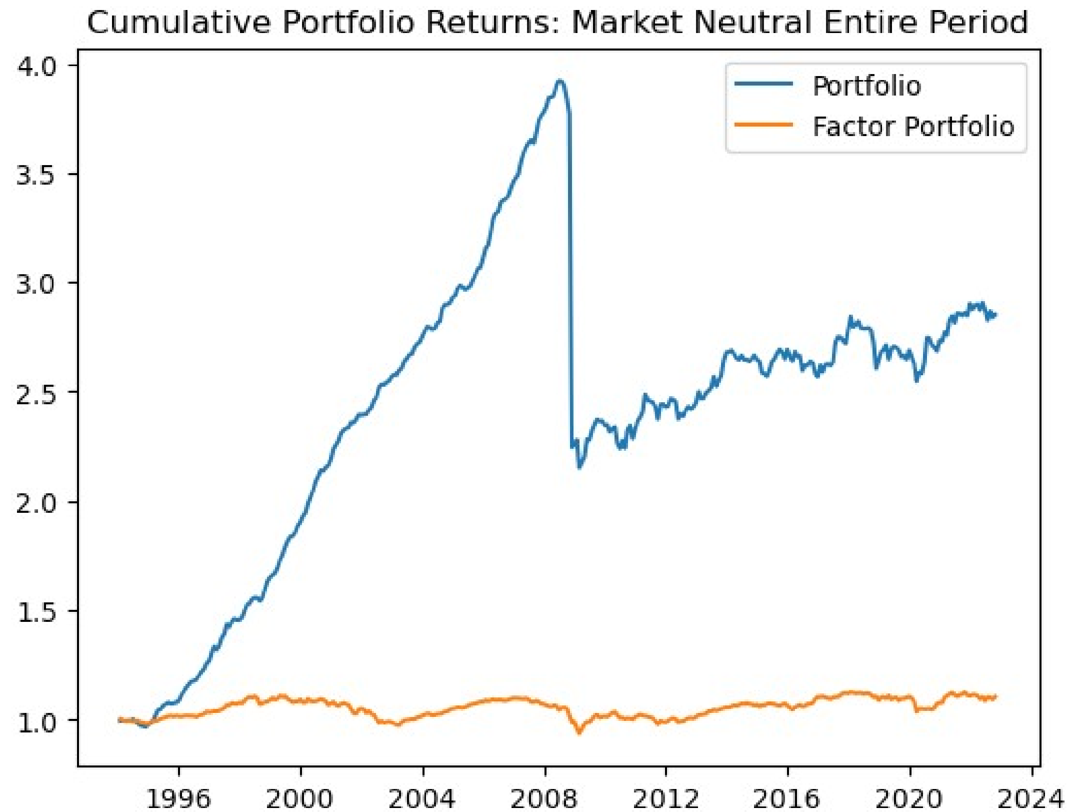
Note factor exposure analysis only shows statistical exposure/ preference, and does not nessicarly represent actual portfolio exposure/ preference.

1.3) What is EqMktNtr's monthly information ratio if we use the above five factors to calculate the benchmark?

```python
def visualise_rets(port_ret,bench_ret, type:int = 0, name:str = None):
    diff_ret = port_ret-bench_ret

    port = port_ret+1
    bench = bench_ret+1
    diff = diff_ret+1

    port_cumret = port.cumprod(0)
    bench_cumret = bench.cumprod(0)
```

```
    if type == 0:
        plt.plot(port_cumret)
        plt.plot(bench_cumret)
        plt.title("Cumulative Portfolio Returns: {} Entire
Period".format(name))
        plt.legend(["Portfolio","Factor Portfolio"])
        print("Information Ratio for the Entire Period:
{}".format(round(diff_ret.mean()/diff_ret.std(),4)))

    if type == 1:
        plt.plot(port_cumret.loc[:"2008-06-
01"]/port_cumret.loc[:"2008-06-01"][0])
        plt.plot(bench_cumret.loc[:"2008-06-
01"]/bench_cumret.loc[:"2008-06-01"][0])
        plt.title("Cumulative Portfolio Returns: {} Pre Financial
Crisis".format(name))
        plt.legend(["Portfolio","Factor Portfolio"])
        print("Information Ratio Pre Financial Crisis:
{}".format(round(diff_ret[:"2008-06-01"].mean()/diff_ret[:"2008-06-
01"].std(),4)))

    if type ==2:
        plt.plot(port_cumret.loc["2009-01-01":]/port_cumret.loc["2009-
01-01":][0])
        plt.plot(bench_cumret.loc["2009-01-
01":]/bench_cumret.loc["2009-01-01":][0])
        plt.title("Cumulative Portfolio Returns: {} Post
2009".format(name))
        plt.legend(["Portfolio","Factor Portfolio"])
        print("Information Ratio Post 2009:
{}".format(round(diff_ret["2009-01-01":].mean()/diff_ret["2009-01-
01":].std(),4)))

factor_params = res.params.copy()
factor_params["Intercept"] = 0
factor_params

bench_ret = pd.Series(mod.predict(factor_params,X),index=y.index)
port_ret = y

visualise_rets(port_ret,bench_ret,0,"Market Neutral")
```

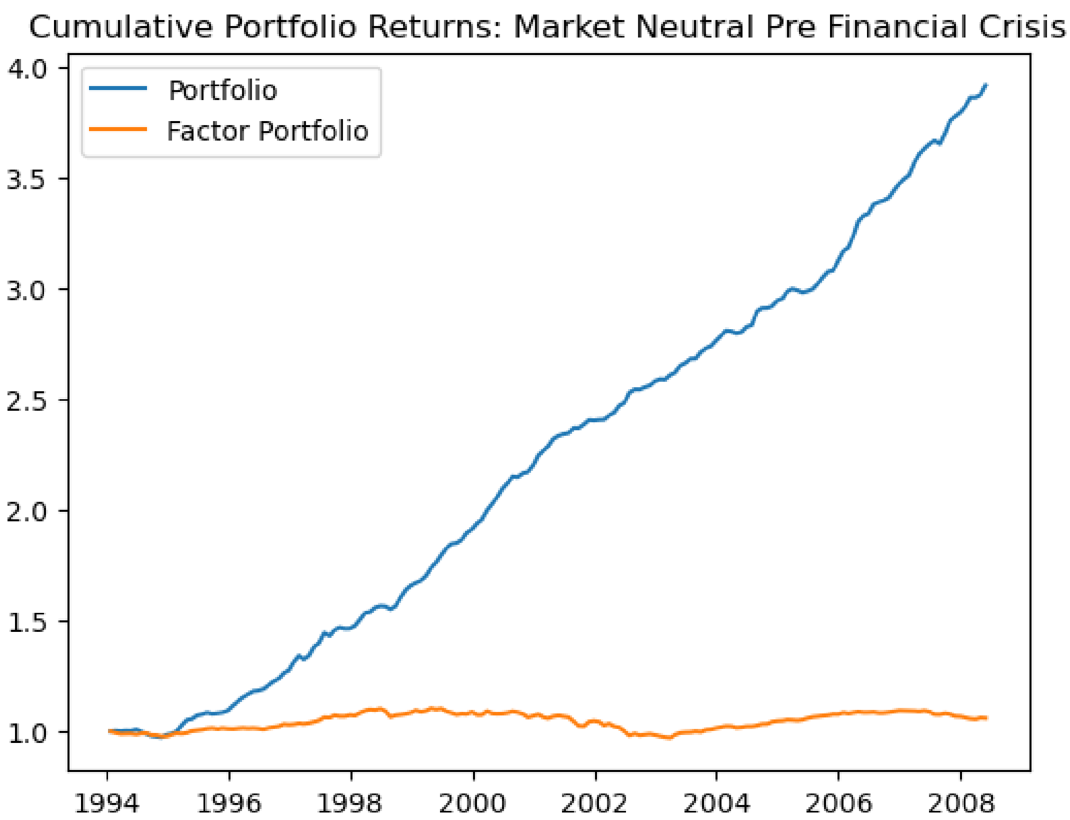
```
Information Ratio for the Entire Period: 0.1317
```



Visualising the data shows that there is a fundamental difference between pre and post financial crisis portfolio performances, this suggest a need for separate analysis for each period

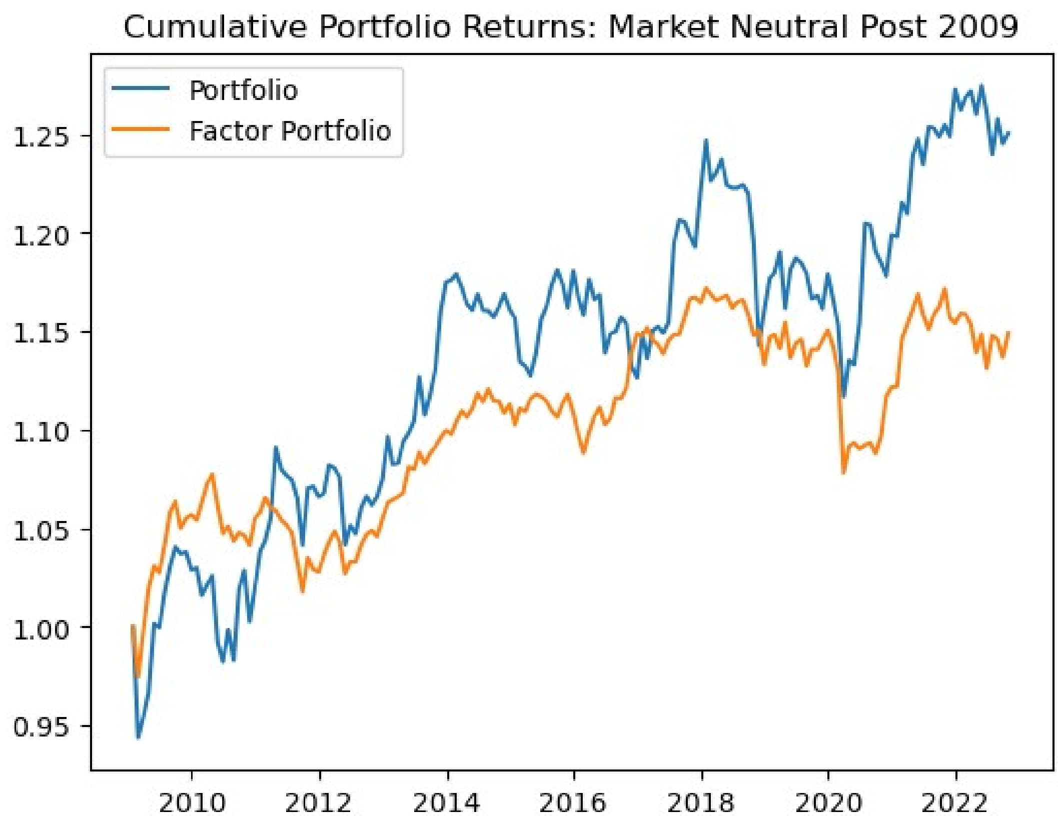
```
visualise_rets(port_ret,bench_ret,1,"Market Neutral")
```

```
Information Ratio Pre Financial Crisis: 0.8411
```




```
visualise_rets(port_ret,bench_ret,2,"Market Neutral")
```

```
Information Ratio Post 2009: 0.0593
```



Portfolio "alpha" has disspeared after financial crisis (assuming regressed factors over the entire period), and is reflected in the Information Ratio

2) For Equity Long/Short (LnShEq), run the following two regressions: (i) a univariate regression on the market factor; (ii) a multivariate regression on the market, size, value, and momentum (UMD) factor.

```
# Single Factor Regression

wdata2 = data.loc[:,["LnShEq","MktRF","SMB","HML","UMD"]]
wdata2.dropna(0,inplace=True)

y2 = wdata2.pop("LnShEq")
wdata2["Intercept"]=1
X2 = wdata2.loc[:,["MktRF","Intercept"]]

mod = sm.OLS(y2,X2)
res = mod.fit()
print(res.summary())
```

```
                            OLS Regression Results
======================================================================
========
Dep. Variable:                    LnShEq   R-squared:
```

```
0.563
Model:                            OLS   Adj. R-squared:
0.561
Method:                 Least Squares   F-statistic:
442.6
Date:                Mon, 24 Feb 2025   Prob (F-statistic):
9.43e-64
Time:                        00:45:24   Log-Likelihood:
920.26
No. Observations:                 346   AIC:
-1837.
Df Residuals:                     344   BIC:
-1829.
Df Model:                           1

Covariance Type:            nonrobust

==============================================================================
========
                 coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
--------
MktRF          0.4251      0.020     21.038      0.000       0.385
0.465
Intercept      0.0035      0.001      3.842      0.000       0.002
0.005
==============================================================================
========
Omnibus:                       91.243   Durbin-Watson:
1.692
Prob(Omnibus):                  0.000   Jarque-Bera (JB):
581.470
Skew:                           0.923   Prob(JB):
5.44e-127
Kurtosis:                       9.077   Cond. No.
22.1
==============================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.

# Full Regression

X2=wdata2
mod = sm.OLS(y2,X2)
res = mod.fit()
print(res.summary())
```

```
                            OLS Regression Results                            
==============================================================================
========
Dep. Variable:                 LnShEq   R-squared:                       
0.701
Model:                            OLS   Adj. R-squared:                  
0.697
Method:                 Least Squares   F-statistic:                     
199.8
Date:                Mon, 24 Feb 2025   Prob (F-statistic):           
4.94e-88
Time:                        00:45:24   Log-Likelihood:                 
986.01
No. Observations:                 346   AIC:                            
-1962.
Df Residuals:                     341   BIC:                            
-1943.
Df Model:                           4                                         

Covariance Type:            nonrobust                                         

==============================================================================
========
                 coef    std err          t      P>|t|      [0.025      
0.975]
------------------------------------------------------------------------------
--------
MktRF          0.4408      0.018     23.996      0.000       0.405       
0.477
SMB            0.1751      0.025      6.950      0.000       0.126       
0.225
HML           -0.0673      0.024     -2.836      0.005      -0.114      
-0.021
UMD            0.1469      0.017      8.628      0.000       0.113       
0.180
Intercept      0.0027      0.001      3.502      0.001       0.001       
0.004
==============================================================================
========
Omnibus:                       13.020   Durbin-Watson:                   
1.708
Prob(Omnibus):                  0.001   Jarque-Bera (JB):               
24.337
Skew:                           0.175   Prob(JB):                     
5.19e-06
Kurtosis:                       4.251   Cond. No.                         
34.9
==============================================================================
========
```

```
Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

2.1) Interpret the significance of the multivariate alpha and the alpha from the univariate market regression. Discuss the difference between these two alphas. Based on your own research of the availability of equity momentum-style products, do you think the equity long/short strategy should be rewarded for its exposure to UMD?

Alpha is reduced from 0.35% to 0.27% (4.3% to 3.3% annaul), but still signiicant for both. This is due to the introduction of other factors that explains a portion of the alpha, nad is common phenomemon.

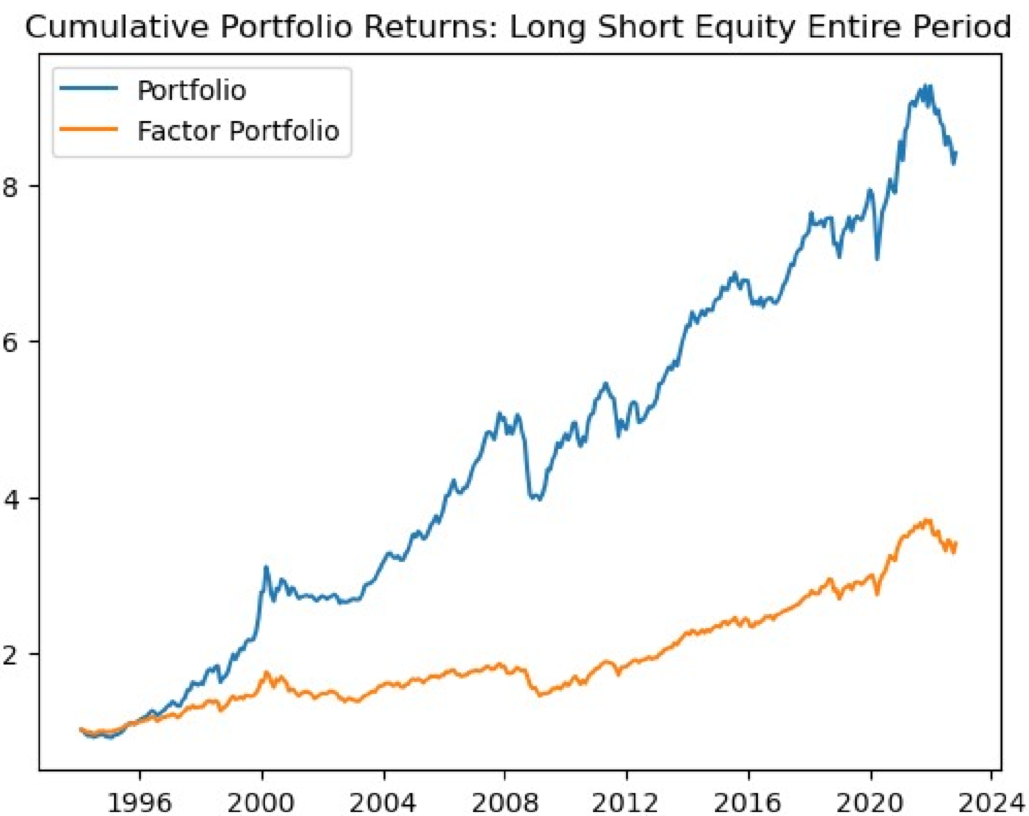
There is also significant Momentum factor exposure (statistical, and in magnitude) at 0.14. As Long Short Stratergies are typcally Long Biased, it can have significant Momentum Factor Exposures. This is different to Market Neutral where exposure to (Long) Momentum cancels out (Short) momentum in terms of factor exposure (this is reflected in the regression of our Market Neutral dataset UMD = 0.018; p val = 0.52 for Market Neutral)

Mometum style products is widly avaliable, so from a market effiecient and risk exposure framework, it should not be rewarded. **However** Whilst over the long term, markets are typically efficenct, in the short term/ locally markets are necessarily efficient. This can be due a range of reasons (market psychology/ emergent behvaiours, short & market limitations); Therefore participants can be rewarded due to market inefficencies.

Futhermore, Managers should be additionally rewarded if there is skillful explotation of momentum effects, i.e. market timing with skillful withdraw of exposure or "riding the fool". Unfortunately, this is not measurable under momentum factor exposure and instead would be a part of the alpha; however under this process, exposure of momentum factor should be **nessicary to attain the market timing alpha** (I.e. **Hypothesis**: a skillful market timing manager would have a alpha compared to a simple momentum portfolio with the same exposure, whislt the simple portfolio would not; However is it not possible for the manager to obtain the market timing alpha without momentum exposure)

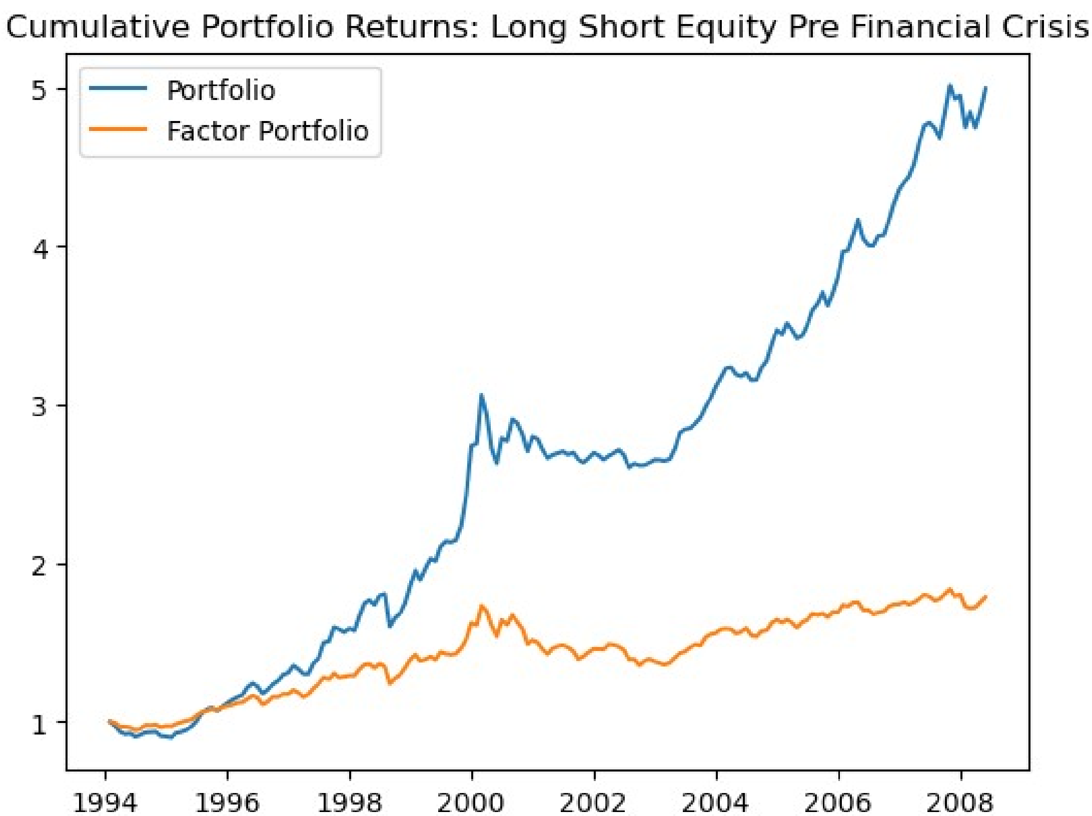
```python
factor_params = res.params.copy()
factor_params["Intercept"] = 0
factor_params

bench_ret = pd.Series(mod.predict(factor_params,X2),index=y.index)
port_ret = y2

visualise_rets(port_ret,bench_ret,0,"Long Short Equity")
```

```
Information Ratio for the Entire Period: 0.1943
```



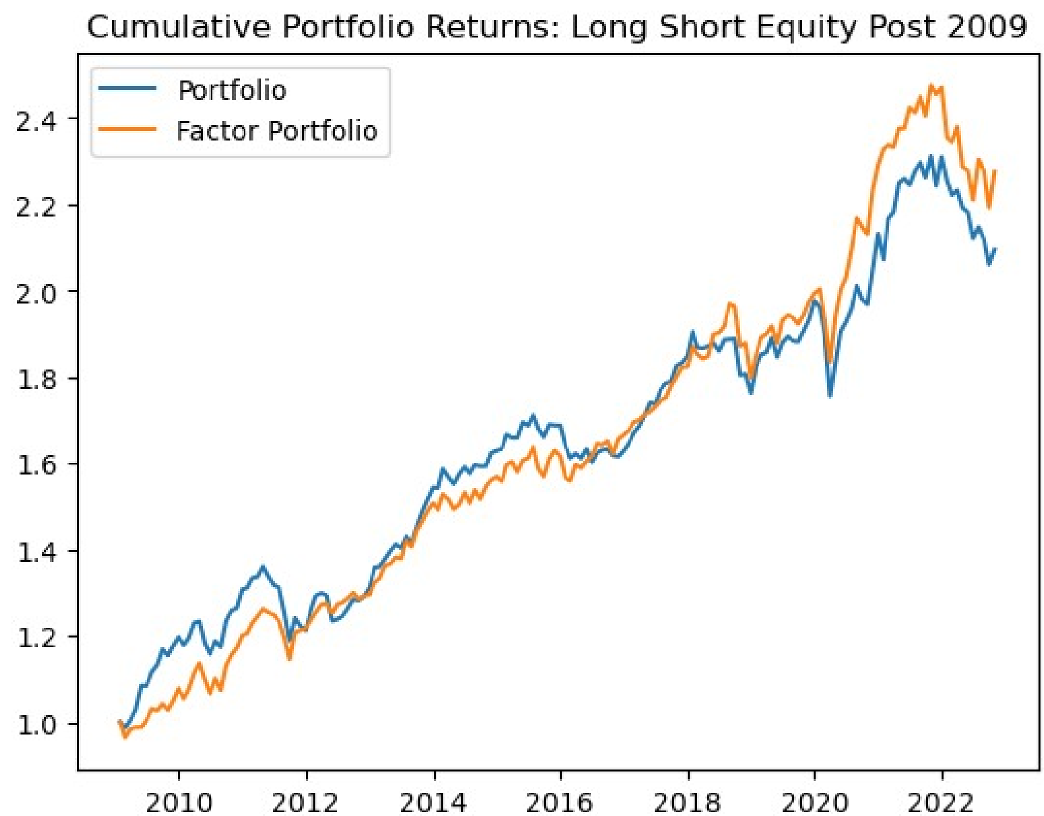

```
visualise_rets(port_ret,bench_ret,1,"Long Short Equity")
```

```
Information Ratio Pre Financial Crisis: 0.446
```




```
visualise_rets(port_ret,bench_ret,2,"Long Short Equity")
```

```
Information Ratio Post 2009: -0.0222
```



Portfolio "alpha" has disspeared after financial crisis (assuming regressed factors over the entire period), and is reflected in the Information Ratio

3) For Equity Market Neutral (EqMktNtr) and Dedicated Short Bias (DedShBs), report the results of regressing their excess returns on the current, one-month-lagged, two-month-lagged, and three-month-lagged market factor:

```
wdata3 = data.loc[:,["EqMktNtr","DedShBs","MktRF"]]
wdata3["Intercept"]=1

wdata3["MktRF_L1"] = wdata3["MktRF"].shift(1)
wdata3["MktRF_L2"] = wdata3["MktRF"].shift(2)
wdata3["MktRF_L3"] = wdata3["MktRF"].shift(3)


wdata3.dropna(0,inplace=True)

X31=wdata3.loc[:,
["Intercept","EqMktNtr","MktRF","MktRF_L1","MktRF_L2","MktRF_L3"]]
y31=X31.pop("EqMktNtr")

X32=wdata3.loc[:,
["Intercept","DedShBs","MktRF","MktRF_L1","MktRF_L2","MktRF_L3"]]
```

```
y32=X32.pop("DedShBs")

mod31 = sm.OLS(y31,X31)
res31 = mod31.fit()
print(res31.summary())

                            OLS Regression Results

==============================================================================
========
Dep. Variable:               EqMktNtr   R-squared:
0.138
Model:                            OLS   Adj. R-squared:
0.127
Method:                 Least Squares   F-statistic:
13.49
Date:                Mon, 24 Feb 2025   Prob (F-statistic):
3.29e-10
Time:                        00:48:27   Log-Likelihood:
801.98
No. Observations:                 343   AIC:
-1594.
Df Residuals:                     338   BIC:
-1575.
Df Model:                           4

Covariance Type:            nonrobust

==============================================================================
========
                 coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
--------
Intercept      0.0013      0.001      0.957      0.339      -0.001
0.004
MktRF          0.1509      0.028      5.355      0.000       0.095
0.206
MktRF_L1       0.1223      0.028      4.338      0.000       0.067
0.178
MktRF_L2       0.0632      0.028      2.228      0.027       0.007
0.119
MktRF_L3      -0.0184      0.028     -0.648      0.517      -0.074
0.037
==============================================================================
========
Omnibus:                      639.152   Durbin-Watson:
2.031
Prob(Omnibus):                  0.000   Jarque-Bera (JB):
442801.018
```

```
Skew:                         -11.279   Prob(JB):
0.00
Kurtosis:                     177.569   Cond. No.
23.7
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
```

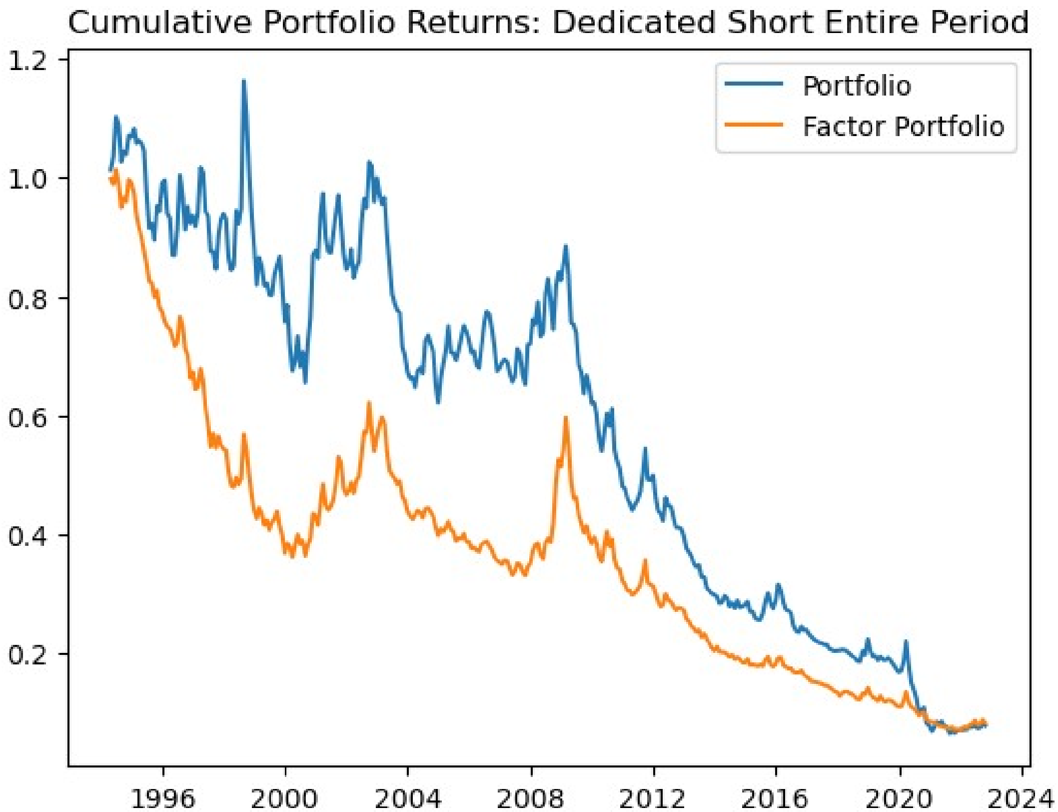
```
mod32 = sm.OLS(y32,X32)
res32 = mod32.fit()
print(res32.summary())
```

```
                            OLS Regression Results

======================================================================
========
Dep. Variable:                DedShBs   R-squared:
0.633
Model:                            OLS   Adj. R-squared:
0.629
Method:                 Least Squares   F-statistic:
145.7
Date:                Mon, 24 Feb 2025   Prob (F-statistic):
3.05e-72
Time:                        00:48:49   Log-Likelihood:
690.74
No. Observations:                 343   AIC:
-1371.
Df Residuals:                     338   BIC:
-1352.
Df Model:                           4

Covariance Type:            nonrobust

======================================================================
========
                 coef    std err          t      P>|t|      [0.025
0.975]
----------------------------------------------------------------------
--------
Intercept      0.0004      0.002      0.202      0.840      -0.003
0.004
MktRF         -0.9333      0.039    -23.953      0.000      -1.010
-0.857
MktRF_L1      -0.0581      0.039     -1.491      0.137      -0.135
0.019
MktRF_L2       0.0313      0.039      0.797      0.426      -0.046
```

```
0.108
MktRF_L3       0.0702      0.039      1.785      0.075      -0.007
0.148
======================================================================
========
Omnibus:                       53.041   Durbin-Watson:
1.765
Prob(Omnibus):                  0.000   Jarque-Bera (JB):
344.073
Skew:                          -0.394   Prob(JB):
1.93e-75
Kurtosis:                       7.843   Cond. No.
23.7
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
```

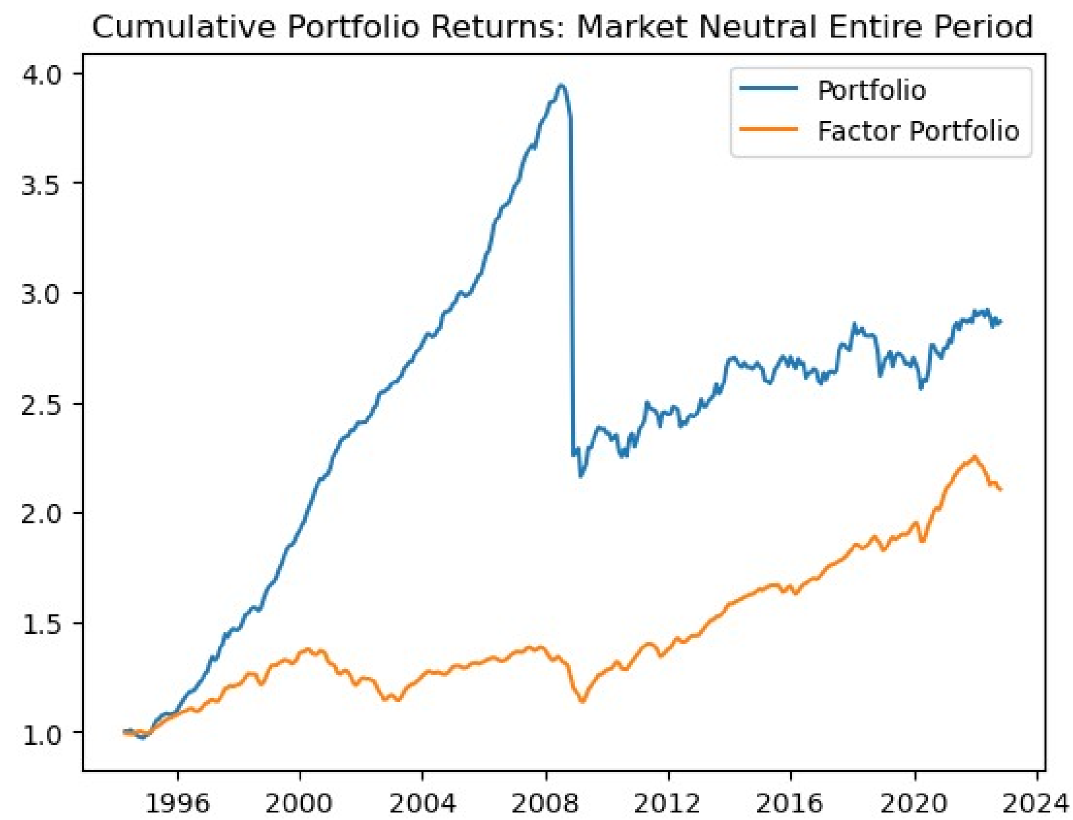
```
factor_params = res32.params.copy()
factor_params["Intercept"] = 0
factor_params


bench_ret =
pd.Series(mod32.predict(factor_params,X32),index=y32.index)
port_ret = y32


visualise_rets(port_ret,bench_ret,0,"Dedicated Short")
```

```
Information Ratio for the Entire Period: 0.0115
```




```
factor_params = res31.params.copy()
factor_params["Intercept"] = 0
factor_params

bench_ret =
pd.Series(mod31.predict(factor_params,X31),index=y31.index)
port_ret = y31

visualise_rets(port_ret,bench_ret,0,"Market Neutral")
```

```
Information Ratio for the Entire Period: 0.0543
```



3.1) Discuss the significance of the factor loadings. Can you say something about the liquidity of the underlying portfolios of these two strategies?

For Market Neutral; $\beta_{MktRF}, \beta_{MktRFL1} \wedge \beta_{MktRFL2}$ Factors are significant at the 5% level , whilst for the Dedicated Short Bias only β_{MktRF} is significant at the 5% level. This indicates that the Market Neutral Stratergy are more illiquid as it demonstrate a delayed marking to market, smoothing the resutls to make results appear better when updating portfolio values

The the risks and limitation of a dedicated short stratergy means, that they can be more liquid, than a market neutral stratergy. This is because there can be high barrier (borrowing avalibilty, borrowing costs and transaction fees) and liquidty risks (trading induced price movement, short sqeeze risks) for illiquid names; whist market neutral stratergy can take long positions in more illiquid names. Furthermore, it is also fundamentally harder to take long term short positions which should lead to quickly realised gains and losses/ & higher turn overs.

Appendix: Disapearing Alphas Post Financial Crisis

most alphas Disappeared post 2009... Why? talent drain/ culture shift in big banks? (not clear if this is data from credit suisse internal desks or industry wide) industry overcrowding? new wave quants eating everyone's lunch?

```
wdata = data.loc[:,["MktRF","SMB","HML","RMW","CMA","UMD"]]
wdata["MktRF_L1"] = wdata["MktRF"].shift(1)
wdata["MktRF_L2"] = wdata["MktRF"].shift(2)
```

```python
wdata["MktRF_L3"] = wdata["MktRF"].shift(3)
wdata["Intercept"] = 1

X_EMN = wdata.copy()
X_EMN["EqMktNtr"] = data.loc[:,"EqMktNtr"]
X_EMN.dropna(inplace=True)
y_EMN = X_EMN.pop("EqMktNtr")

X_DSB = wdata.copy()
X_DSB["DedShBs"] = data.loc[:,"DedShBs"]
X_DSB.dropna(inplace=True)
y_DSB = X_DSB.pop("DedShBs")

X_ELS = wdata.copy()
X_ELS["LnShEq"] = data.loc[:,"LnShEq"]
X_ELS.dropna(inplace=True)
y_ELS = X_ELS.pop("LnShEq")

X_ELS = wdata.copy()
X_ELS["LnShEq"] = data.loc[:,"LnShEq"]
X_ELS.dropna(inplace=True)
y_ELS = X_ELS.pop("LnShEq")

X_GMC = wdata.copy()
X_GMC["GlobalMac "] = data.loc[:,"GlobalMac "]
X_GMC.dropna(inplace=True)
y_GMC = X_GMC.pop("GlobalMac ")

X_EME = wdata.copy()
X_EME["EmgMkts"] = data.loc[:,"EmgMkts"]
X_EME.dropna(inplace=True)
y_EME = X_EME.pop("EmgMkts")


def fit_period(y,X,type: int = 0, name: str=None):
    d1 = "2008-06-01"
    d2 = "2009-01-01"

    if type == 0:
        mod = sm.OLS(y,X)
        y_ret = y

    if type == 1:
        mod = sm.OLS(y[:d1],X.loc[:d1,:])
        y_ret = y[:d1]


    if type ==2:
        mod = sm.OLS(y[d2:],X.loc[d2:,:])
        y_ret = y[d2:]
```

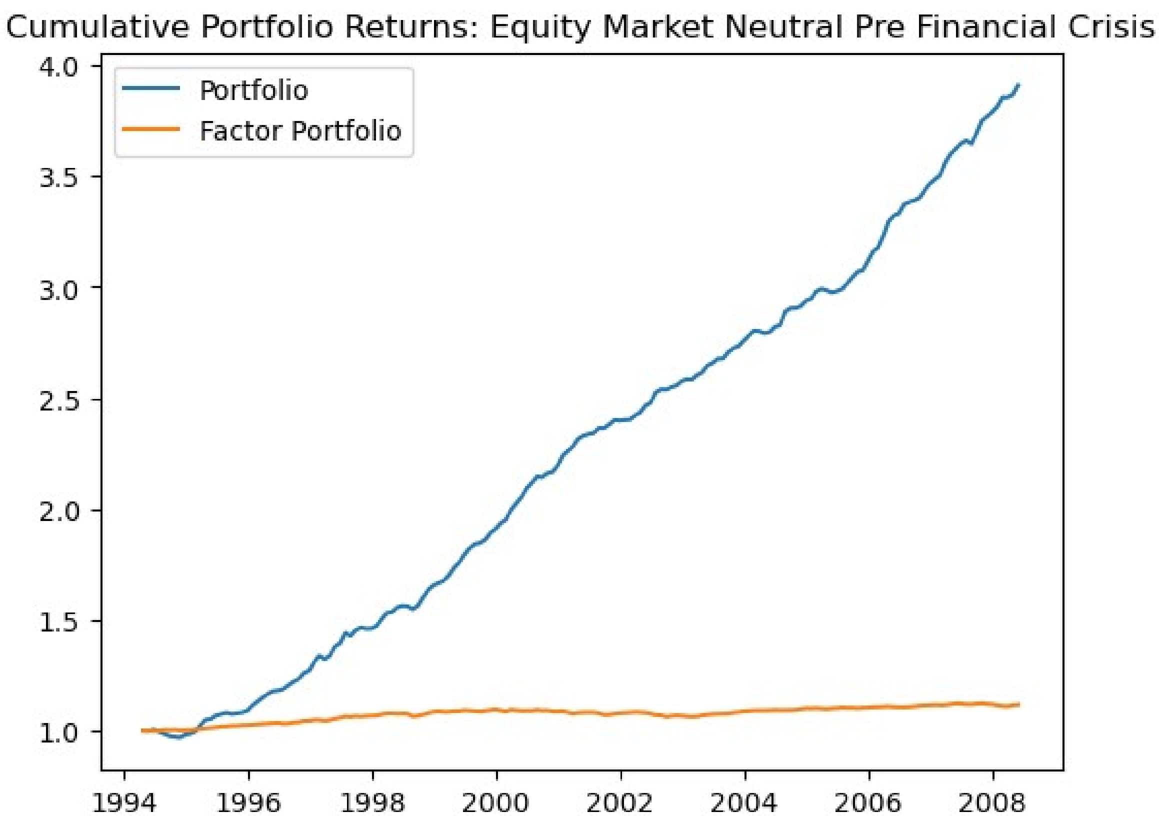
```
    res = mod.fit()
    print(res.summary())

    params = res.params.copy()
    params["Intercept"] = 0
    bench_ret = pd.Series(mod.predict(params,X),index=y.index)

    params = res.params.copy()

params.loc[["MktRF_L1","MktRF_L2","MktRF_L3"]]=res.pvalues.loc[["MktRF
_L1","MktRF_L2","MktRF_L3"]]
    return y_ret, bench_ret, params
```

Equity Market Neutral

```
# Pre FC
y_ret_d1, EMN_bench_ret_d1, EMN_params_d1 =
fit_period(y_EMN,X_EMN,1,"Equity Market Neutral")

visualise_rets(y_EMN,EMN_bench_ret_d1,1,"Equity Market Neutral")
```

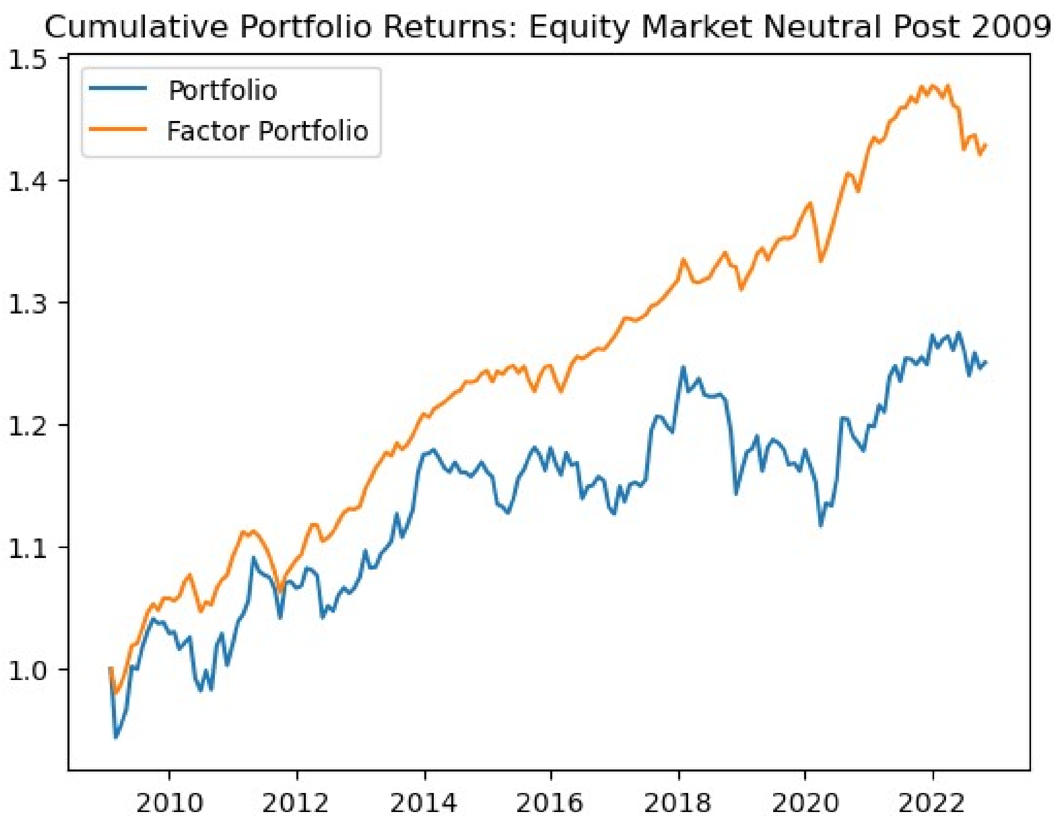
```
                            OLS Regression Results

======================================================================
========
Dep. Variable:               EqMktNtr   R-squared:
0.131
Model:                            OLS   Adj. R-squared:
0.082
Method:                 Least Squares   F-statistic:
2.670
Date:                Mon, 24 Feb 2025   Prob (F-statistic):
0.00650
Time:                        00:45:26   Log-Likelihood:
591.56
No. Observations:                 170   AIC:
-1163.
Df Residuals:                     160   BIC:
-1132.
Df Model:                           9

Covariance Type:            nonrobust

======================================================================
========
                 coef    std err          t      P>|t|      [0.025
0.975]
----------------------------------------------------------------------
--------
```

```
MktRF            0.0772      0.019      4.030      0.000       0.039
0.115
SMB              0.0067      0.021      0.320      0.749      -0.035
0.048
HML             -0.0109      0.034     -0.321      0.749      -0.078
0.056
RMW              0.0420      0.030      1.385      0.168      -0.018
0.102
CMA              0.0022      0.038      0.057      0.954      -0.073
0.077
UMD             -0.0035      0.013     -0.264      0.792      -0.029
0.022
MktRF_L1         0.0117      0.015      0.792      0.430      -0.018
0.041
MktRF_L2         0.0023      0.015      0.155      0.877      -0.027
0.031
MktRF_L3         0.0016      0.014      0.112      0.911      -0.027
0.030
Intercept        0.0074      0.001     11.291      0.000       0.006
0.009
======================================================================
========
Omnibus:                        0.863   Durbin-Watson:
1.371
Prob(Omnibus):                  0.649   Jarque-Bera (JB):
0.526
Skew:                           0.088   Prob(JB):
0.769
Kurtosis:                       3.208   Cond. No.
84.7
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Pre Financial Crisis: 0.9947
```




```
# Post 2009
y_ret_d1, EMN_bench_ret_d2, EMN_params_d2 =
fit_period(y_EMN,X_EMN,2,"Equity Market Neutral")

visualise_rets(y_EMN,EMN_bench_ret_d2,2,"Equity Market Neutral")

                            OLS Regression Results

======================================================================
========
Dep. Variable:                EqMktNtr   R-squared:
0.260
Model:                             OLS   Adj. R-squared:
0.218
Method:                  Least Squares   F-statistic:
6.097
Date:                 Mon, 24 Feb 2025   Prob (F-statistic):
2.51e-07
Time:                         00:45:26   Log-Likelihood:
493.42
No. Observations:                  166   AIC:
-966.8
Df Residuals:                      156   BIC:
-935.7
```

```
Df Model:                           9

Covariance Type:            nonrobust

======================================================================
========
                 coef    std err          t      P>|t|      [0.025
0.975]
----------------------------------------------------------------------
--------
MktRF          0.1661      0.025      6.540      0.000       0.116
0.216
SMB           -0.0849      0.046     -1.847      0.067      -0.176
0.006
HML            0.0171      0.045      0.383      0.702      -0.071
0.105
RMW           -0.0930      0.057     -1.631      0.105      -0.206
0.020
CMA            0.0531      0.069      0.775      0.440      -0.082
0.188
UMD            0.0097      0.026      0.369      0.712      -0.042
0.062
MktRF_L1       0.0535      0.022      2.420      0.017       0.010
0.097
MktRF_L2       0.0177      0.023      0.780      0.437      -0.027
0.062
MktRF_L3      -0.0281      0.022     -1.257      0.211      -0.072
0.016
Intercept     -0.0006      0.001     -0.516      0.607      -0.003
0.002
======================================================================
========
Omnibus:                        3.480   Durbin-Watson:
2.350
Prob(Omnibus):                  0.175   Jarque-Bera (JB):
3.653
Skew:                          -0.135   Prob(JB):
0.161
Kurtosis:                       3.675   Cond. No.
77.3
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Post 2009: -0.0477
```




```
#MktRF_L1, L2, L3 shows p values instead
EMN_Params = EMN_params_d1.to_frame("PFC")
EMN_Params["Post09"] = EMN_params_d2
EMN_Params.round(4)
```

	PFC	Post09
MktRF	0.0772	0.1661
SMB	0.0067	-0.0849
HML	-0.0109	0.0171
RMW	0.0420	-0.0930
CMA	0.0022	0.0531
UMD	-0.0035	0.0097
MktRF_L1	0.4298	0.0167
MktRF_L2	0.8773	0.4366
MktRF_L3	0.9111	0.2107
Intercept	0.0074	-0.0006

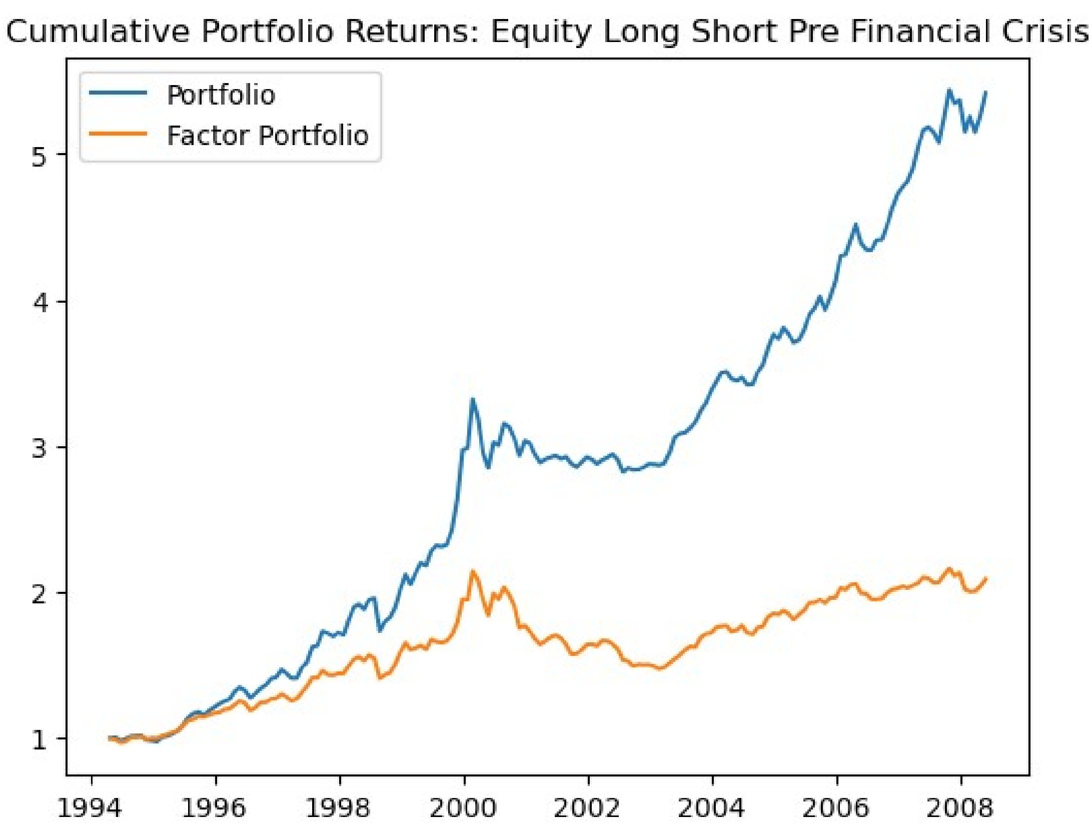
There's a differnt style and reduced liqudity Post 2009; No alpha

Equity Long Short

```
# Pre FC
y_ret_d1, ELS_bench_ret_d1, ELS_params_d1 =
fit_period(y_ELS,X_ELS,1,"Equity Long Short")
```

```
visualise_rets(y_ELS,ELS_bench_ret_d1,1,"Equity Long Short")

                            OLS Regression Results                            
==============================================================================
Dep. Variable:                 LnShEq   R-squared:                       0.812
Model:                            OLS   Adj. R-squared:                  0.801
Method:                 Least Squares   F-statistic:                     76.55
Date:                Mon, 24 Feb 2025   Prob (F-statistic):           2.20e-53
Time:                        00:45:26   Log-Likelihood:                 507.78
No. Observations:                 170   AIC:                            -995.6
Df Residuals:                     160   BIC:                            -964.2
Df Model:                           9                                         
Covariance Type:            nonrobust                                         
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
MktRF          0.4384      0.031     13.990      0.000       0.377       0.500
SMB            0.2027      0.035      5.870      0.000       0.135       0.271
HML           -0.0087      0.056     -0.157      0.876      -0.118       0.101
RMW           -0.0617      0.050     -1.242      0.216      -0.160       0.036
CMA           -0.1322      0.062     -2.118      0.036      -0.255      -0.009
UMD            0.2160      0.021     10.073      0.000       0.174       0.258
MktRF_L1       0.0775      0.024      3.199      0.002       0.030       0.125
MktRF_L2       0.0377      0.024      1.556      0.122      -0.010       0.085
MktRF_L3       0.0089      0.024      0.380      0.704      -0.038       0.055
Intercept      0.0056      0.001      5.239      0.000       0.004
```

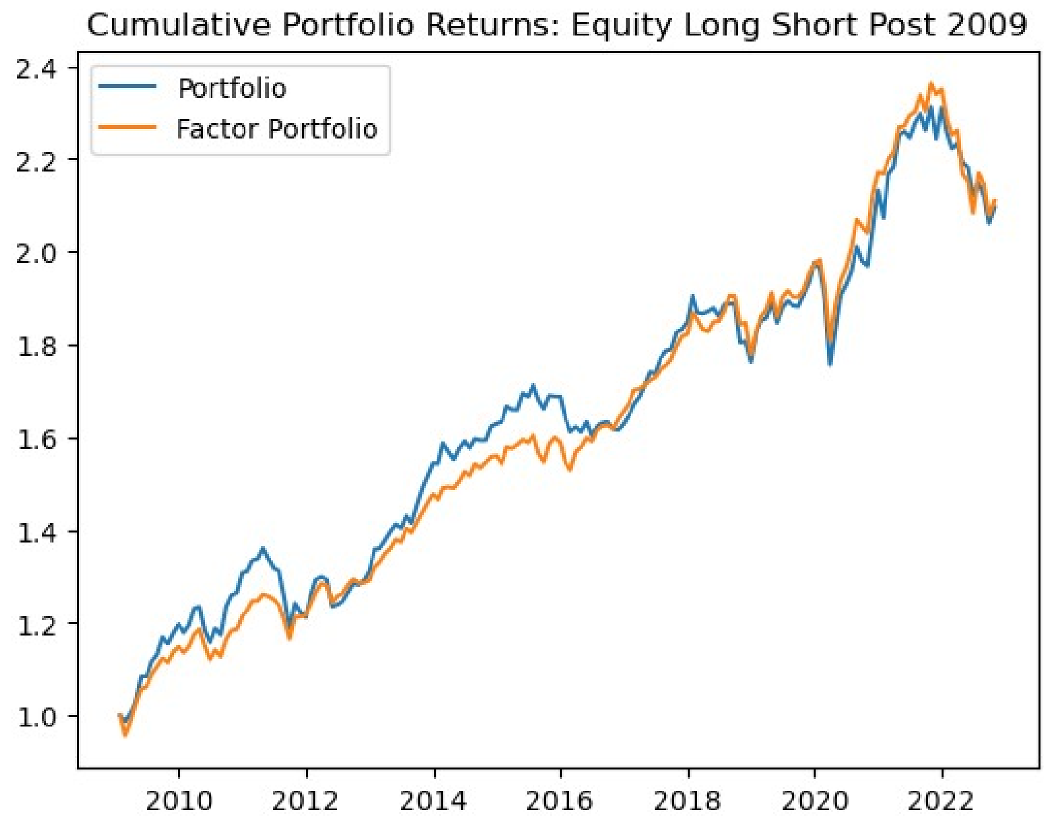
```
0.008
==============================================================================
========
Omnibus:                          0.320   Durbin-Watson:
1.840
Prob(Omnibus):                    0.852   Jarque-Bera (JB):
0.435
Skew:                             0.093   Prob(JB):
0.805
Kurtosis:                         2.836   Cond. No.
84.7
==============================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Pre Financial Crisis: 0.4615
```




```
# Pre FC
y_ret_d1, ELS_bench_ret_d2, ELS_params_d2 =
fit_period(y_ELS,X_ELS,2,"Equity Long Short")

visualise_rets(y_ELS,ELS_bench_ret_d2,2,"Equity Long Short")
```

```
                            OLS Regression Results                            
                                                                              
======================================================================
========
Dep. Variable:                 LnShEq   R-squared:                       
0.756
Model:                            OLS   Adj. R-squared:                  
0.742
Method:                 Least Squares   F-statistic:                     
53.80
Date:                Mon, 24 Feb 2025   Prob (F-statistic):           
2.25e-43
Time:                        00:45:26   Log-Likelihood:                 
526.81
No. Observations:                 166   AIC:                            
-1034.
Df Residuals:                     156   BIC:                            
-1002.
Df Model:                           9                                         

Covariance Type:            nonrobust                                         

======================================================================
========
                 coef    std err          t      P>|t|      [0.025      
0.975]
----------------------------------------------------------------------
--------
MktRF          0.3843      0.021     18.502      0.000       0.343       
0.425
SMB           -0.0360      0.038     -0.958      0.340      -0.110       
0.038
HML            0.0560      0.037      1.533      0.127      -0.016       
0.128
RMW           -0.0546      0.047     -1.171      0.243      -0.147       
0.037
CMA           -0.1633      0.056     -2.915      0.004      -0.274      
-0.053
UMD            0.0144      0.022      0.669      0.505      -0.028       
0.057
MktRF_L1       0.0501      0.018      2.771      0.006       0.014       
0.086
MktRF_L2       0.0169      0.019      0.914      0.362      -0.020       
0.053
MktRF_L3      -0.0142      0.018     -0.776      0.439      -0.050       
0.022
Intercept      0.0002      0.001      0.218      0.828      -0.002       
0.002
======================================================================
========
```

```
Omnibus:                              7.016   Durbin-Watson:
2.049
Prob(Omnibus):                        0.030   Jarque-Bera (JB):
8.642
Skew:                                 0.284   Prob(JB):
0.0133
Kurtosis:                             3.963   Cond. No.
77.3
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Post 2009: 0.0201
```




```
# MktRF_L1, L2, L3 shows pvalues instead
ELS_Params = ELS_params_d1.to_frame("PFC")
ELS_Params["Post09"] = ELS_params_d2
ELS_Params.round(4)
```

	PFC	Post09
MktRF	0.4384	0.3843
SMB	0.2027	-0.0360

```
HML        -0.0087  0.0560
RMW        -0.0617 -0.0546
CMA        -0.1322 -0.1633
UMD         0.2160  0.0144
MktRF_L1    0.0017  0.0063
MktRF_L2    0.1217  0.3623
MktRF_L3    0.7044  0.4387
Intercept   0.0056  0.0002
```

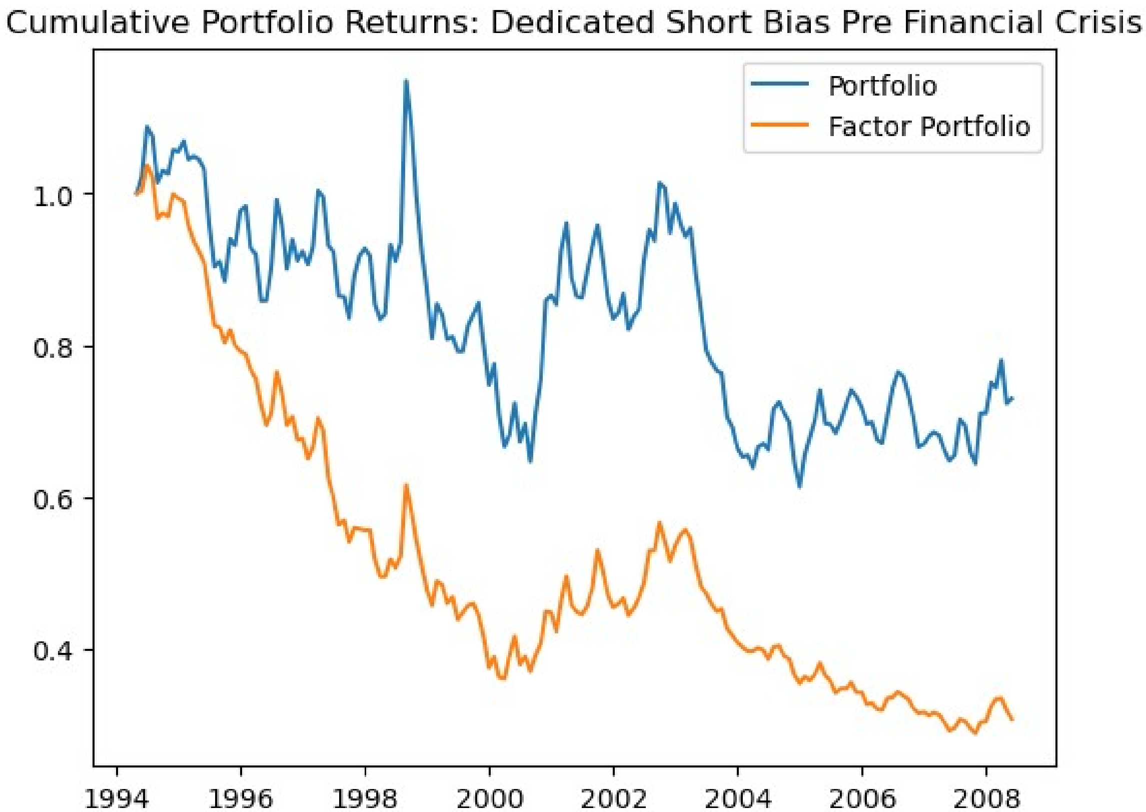
There's a change in style; again next to No alpha

Short Bias

```
# Pre FC
y_ret_d1, DSB_bench_ret_d1, DSB_params_d1 =
fit_period(y_DSB,X_DSB,1,"Dedicated Short Bias")

visualise_rets(y_DSB,DSB_bench_ret_d1,1,"Dedicated Short Bias")
```

```
                            OLS Regression Results

======================================================================
========
Dep. Variable:                DedShBs   R-squared:
0.767
Model:                            OLS   Adj. R-squared:
0.754
Method:                 Least Squares   F-statistic:
58.65
Date:                Mon, 24 Feb 2025   Prob (F-statistic):
3.72e-46
Time:                        00:45:27   Log-Likelihood:
397.60
No. Observations:                 170   AIC:
-775.2
Df Residuals:                     160   BIC:
-743.9
Df Model:                           9

Covariance Type:            nonrobust

======================================================================
========
                 coef    std err          t      P>|t|      [0.025
0.975]
----------------------------------------------------------------------
--------
MktRF         -0.9155      0.060    -15.280      0.000      -1.034
-0.797
SMB           -0.3809      0.066     -5.770      0.000      -0.511
```

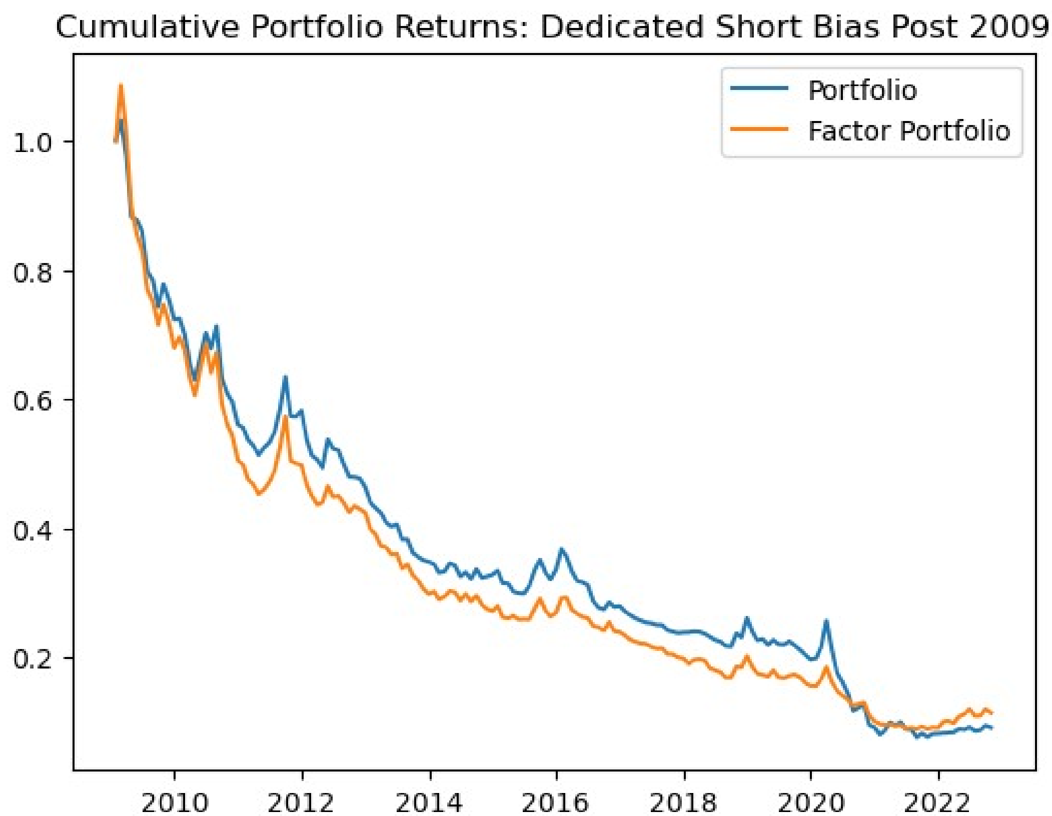
```
-0.251
HML              0.1643      0.106      1.548      0.124      -0.045
0.374
RMW             -0.2014      0.095     -2.122      0.035      -0.389
-0.014
CMA              0.1425      0.119      1.195      0.234      -0.093
0.378
UMD             -0.0275      0.041     -0.671      0.503      -0.108
0.053
MktRF_L1        -0.0512      0.046     -1.107      0.270      -0.143
0.040
MktRF_L2         0.0639      0.046      1.380      0.169      -0.028
0.155
MktRF_L3        -0.0230      0.045     -0.510      0.611      -0.112
0.066
Intercept        0.0054      0.002      2.609      0.010       0.001
0.009
======================================================================
========
Omnibus:                        4.130   Durbin-Watson:
1.810
Prob(Omnibus):                  0.127   Jarque-Bera (JB):
3.940
Skew:                          -0.246   Prob(JB):
0.139
Kurtosis:                       3.561   Cond. No.
84.7
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Pre Financial Crisis: 0.2299
```




```
# Pre FC
y_ret_d2, DSB_bench_ret_d2, DSB_params_d2 =
fit_period(y_DSB,X_DSB,2,"Dedicated Short Bias")

visualise_rets(y_DSB,DSB_bench_ret_d2,2,"Dedicated Short Bias")
```

```
                            OLS Regression Results

==============================================================================
========
Dep. Variable:                DedShBs   R-squared:
0.699
Model:                            OLS   Adj. R-squared:
0.682
Method:                 Least Squares   F-statistic:
40.30
Date:                Mon, 24 Feb 2025   Prob (F-statistic):
2.30e-36
Time:                        00:45:27   Log-Likelihood:
339.95
No. Observations:                 166   AIC:
-659.9
Df Residuals:                     156   BIC:
-628.8
```

```
Df Model:                           9

Covariance Type:            nonrobust

==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
MktRF         -0.9468      0.064    -14.789      0.000      -1.073      -0.820
SMB           -0.4497      0.116     -3.882      0.000      -0.679      -0.221
HML            0.3658      0.113      3.247      0.001       0.143       0.588
RMW            0.2498      0.144      1.738      0.084      -0.034       0.534
CMA           -0.2403      0.173     -1.391      0.166      -0.581       0.101
UMD           -0.0004      0.066     -0.006      0.995      -0.131       0.131
MktRF_L1      -0.0896      0.056     -1.608      0.110      -0.200       0.020
MktRF_L2      -0.0029      0.057     -0.050      0.960      -0.116       0.110
MktRF_L3       0.0307      0.056      0.545      0.587      -0.081       0.142
Intercept     -0.0008      0.003     -0.284      0.777      -0.007       0.005
==============================================================================
Omnibus:                       30.780   Durbin-Watson:                   2.035
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              152.633
Skew:                          -0.484   Prob(JB):                     7.18e-34
Kurtosis:                       7.597   Cond. No.                         77.3
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
Information Ratio Post 2009: -0.0263
```




```
# MktRF_L1, L2, L3 shows pvalues instead
DSB_Params = DSB_params_d1.to_frame("PFC")
DSB_Params["Post09"] = DSB_params_d2
DSB_Params.round(4)
```

	PFC	Post09
MktRF	-0.9155	-0.9468
SMB	-0.3809	-0.4497
HML	0.1643	0.3658
RMW	-0.2014	0.2498
CMA	0.1425	-0.2403
UMD	-0.0275	-0.0004
MktRF_L1	0.2701	0.1099
MktRF_L2	0.1694	0.9599
MktRF_L3	0.6105	0.5866
Intercept	0.0054	-0.0008

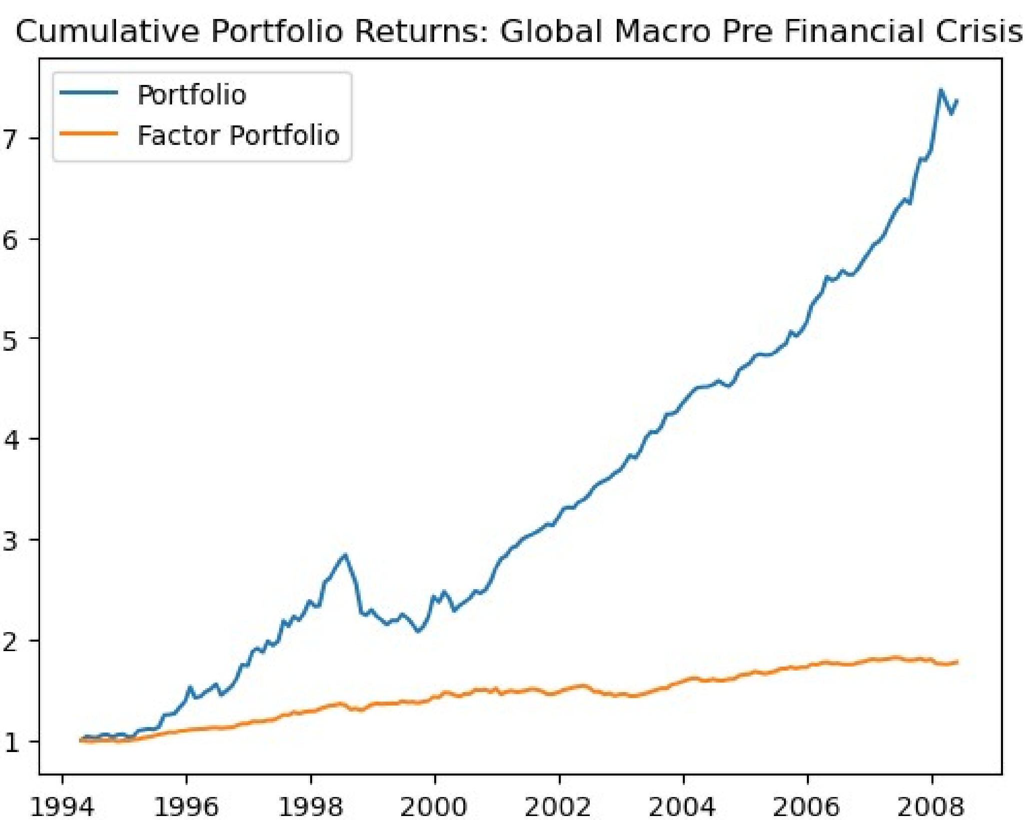
style mostly the same, Momentum just disappeared, Again there's no alpha

Global Macro

```
# Pre FC
y_ret_d1, GMC_bench_ret_d1, GMC_params_d1 =
fit_period(y_GMC,X_GMC,1,"Global Macro")
```

```
visualise_rets(y_GMC,GMC_bench_ret_d1,1,"Global Macro")

                            OLS Regression Results                            
==============================================================================
Dep. Variable:              GlobalMac   R-squared:                       
0.140
Model:                            OLS   Adj. R-squared:                  
0.092
Method:                 Least Squares   F-statistic:                     
2.891
Date:                Mon, 24 Feb 2025   Prob (F-statistic):            
0.00341
Time:                        00:45:27   Log-Likelihood:                 
371.14
No. Observations:                 170   AIC:                            
-722.3
Df Residuals:                     160   BIC:                            
-690.9
Df Model:                           9                                         

Covariance Type:            nonrobust                                         

==============================================================================
                 coef    std err          t      P>|t|      [0.025      
0.975]
------------------------------------------------------------------------------
MktRF          0.2332      0.070      3.331      0.001       0.095       
0.371
SMB            0.0664      0.077      0.860      0.391      -0.086       
0.219
HML            0.1509      0.124      1.217      0.225      -0.094       
0.396
RMW           -0.0069      0.111     -0.062      0.950      -0.226       
0.212
CMA            0.0177      0.139      0.127      0.899      -0.258       
0.293
UMD            0.1147      0.048      2.394      0.018       0.020       
0.209
MktRF_L1      -0.0132      0.054     -0.244      0.808      -0.120       
0.094
MktRF_L2       0.1122      0.054      2.075      0.040       0.005       
0.219
MktRF_L3      -0.0144      0.053     -0.273      0.785      -0.118       
0.089
Intercept      0.0087      0.002      3.605      0.000       0.004
```

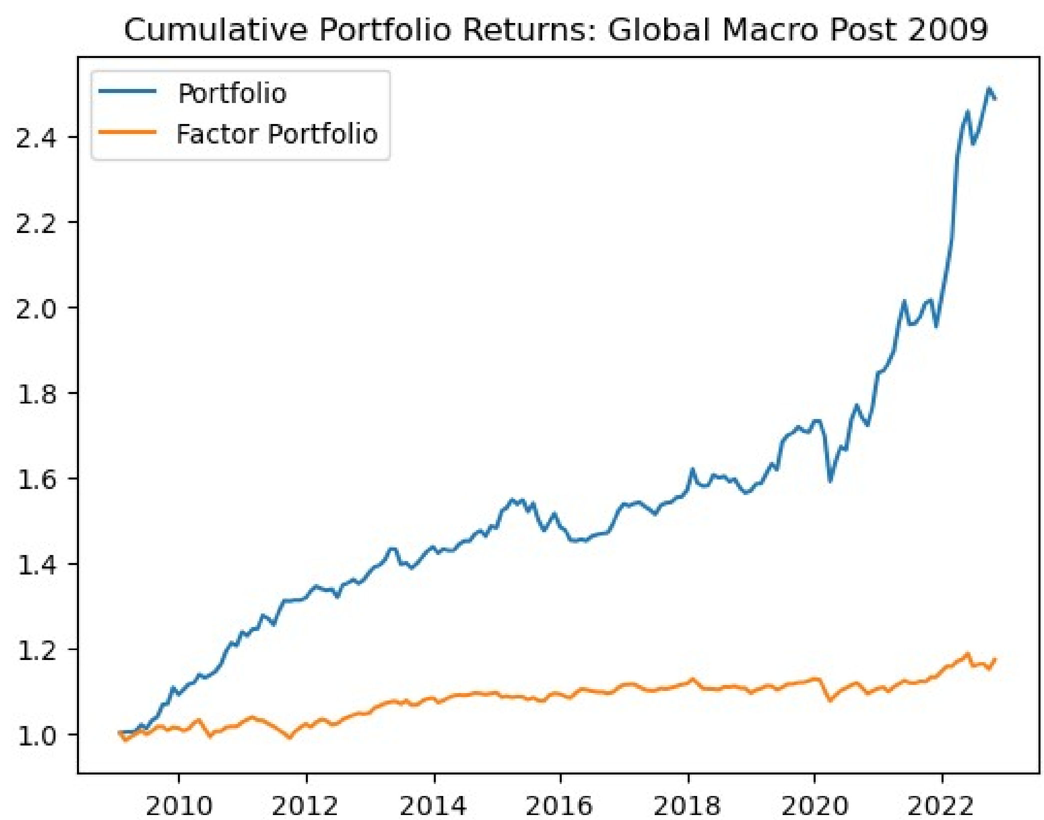
```
0.013
==============================================================================
========
Omnibus:                       15.121   Durbin-Watson:
1.952
Prob(Omnibus):                  0.001   Jarque-Bera (JB):
48.230
Skew:                           0.086   Prob(JB):
3.36e-11
Kurtosis:                       5.604   Cond. No.
84.7
==============================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Pre Financial Crisis: 0.3175
```




```python
# Pre FC
y_ret_d2, GMC_bench_ret_d2, GMC_params_d2 =
fit_period(y_GMC,X_GMC,2,"Global Macro")

visualise_rets(y_GMC,GMC_bench_ret_d2,2,"Global Macro")
```

```
                            OLS Regression Results                            
==============================================================================
Dep. Variable:              GlobalMac   R-squared:                       0.216
Model:                            OLS   Adj. R-squared:                  0.170
Method:                 Least Squares   F-statistic:                     4.764
Date:                Mon, 24 Feb 2025   Prob (F-statistic):           1.30e-05
Time:                        00:45:28   Log-Likelihood:                 466.12
No. Observations:                 166   AIC:                            -912.2
Df Residuals:                     156   BIC:                            -881.1
Df Model:                           9                                         
Covariance Type:            nonrobust                                         
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
MktRF          0.1589      0.030      5.306      0.000       0.100       0.218
SMB           -0.1115      0.054     -2.057      0.041      -0.218      -0.004
HML            0.0949      0.053      1.800      0.074      -0.009       0.199
RMW           -0.0304      0.067     -0.452      0.652      -0.163       0.102
CMA            0.1102      0.081      1.365      0.174      -0.049       0.270
UMD            0.0481      0.031      1.551      0.123      -0.013       0.109
MktRF_L1       0.0186      0.026      0.715      0.476      -0.033       0.070
MktRF_L2      -0.0282      0.027     -1.056      0.293      -0.081       0.025
MktRF_L3      -0.0612      0.026     -2.322      0.022      -0.113      -0.009
Intercept      0.0049      0.001      3.583      0.000       0.002       0.008
==============================================================================
```

```
Omnibus:                       32.222   Durbin-Watson:
1.743
Prob(Omnibus):                  0.000   Jarque-Bera (JB):
89.386
Skew:                           0.758   Prob(JB):
3.89e-20
Kurtosis:                       6.260   Cond. No.
77.3
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Post 2009: 0.3316
```




```
# MktRF_L1, L2, L3 shows pvalues instead
GMC_Params = GMC_params_d1.to_frame("PFC")
GMC_Params["Post09"] = GMC_params_d2
GMC_Params.round(4)
```

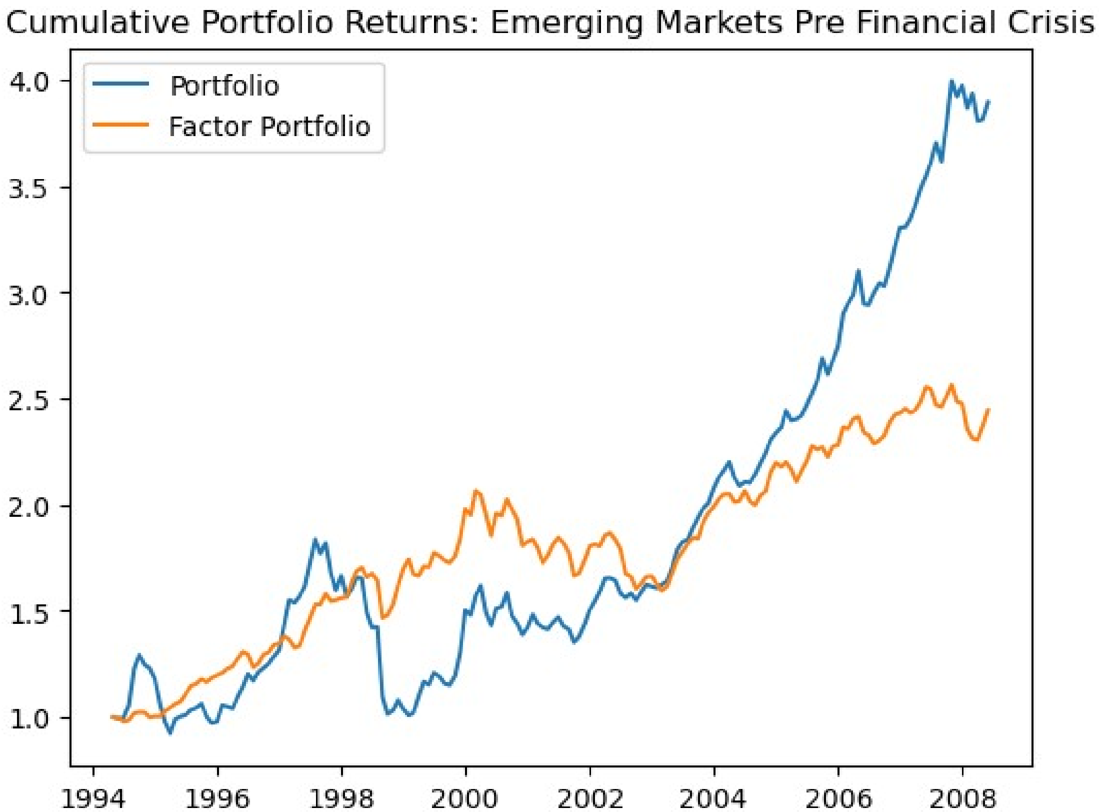
	PFC	Post09
MktRF	0.2332	0.1589
SMB	0.0664	-0.1115

```
HML         0.1509  0.0949
RMW        -0.0069 -0.0304
CMA         0.0177  0.1102
UMD         0.1147  0.0481
MktRF_L1    0.8078  0.4758
MktRF_L2    0.0395  0.2925
MktRF_L3    0.7849  0.0215
Intercept   0.0087  0.0049
```

Emerging markets

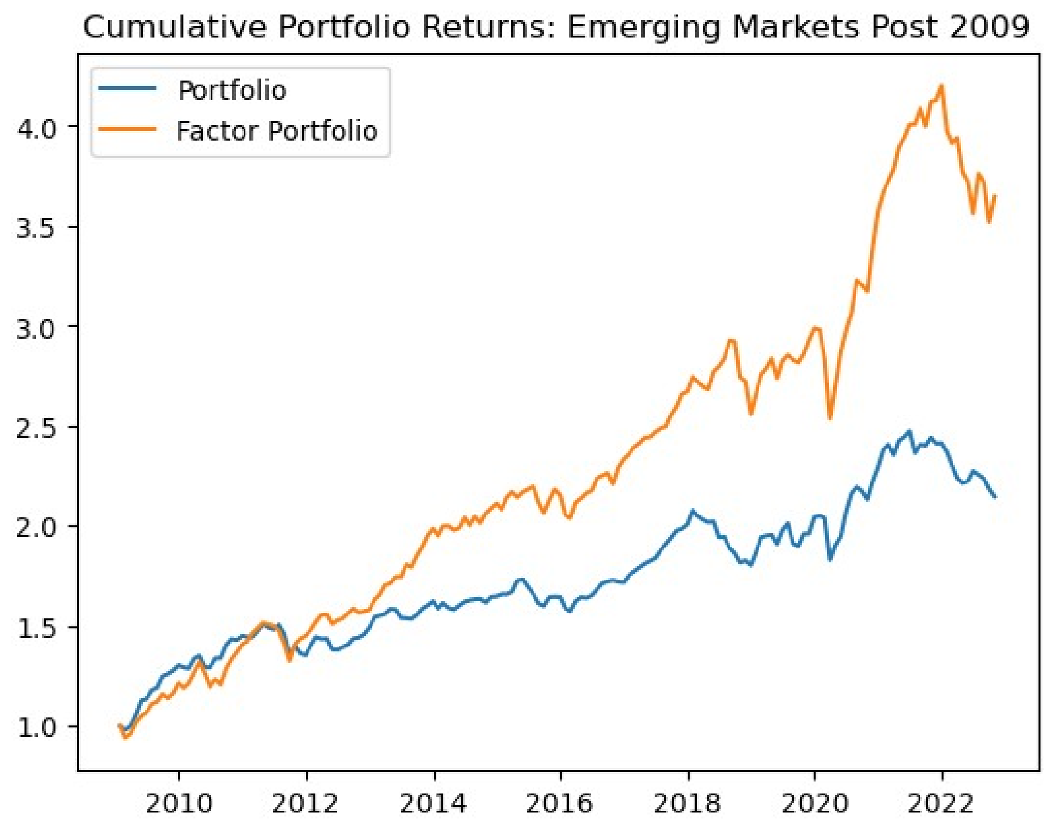
```
# Pre FC
y_ret_d1, EME_bench_ret_d1, EME_params_d1 =
fit_period(y_EME,X_EME,1,"Emerging Markets")

visualise_rets(y_EME,EME_bench_ret_d1,1,"Emerging Markets")

                            OLS Regression Results                            

======================================================================
========
Dep. Variable:                EmgMkts   R-squared:                    
0.365
Model:                            OLS   Adj. R-squared:               
0.330
Method:                 Least Squares   F-statistic:                  
10.24
Date:                Mon, 24 Feb 2025   Prob (F-statistic):           
2.17e-12
Time:                        00:45:28   Log-Likelihood:               
328.92
No. Observations:                 170   AIC:                          
-637.8
Df Residuals:                     160   BIC:                          
-606.5
Df Model:                           9                                 

Covariance Type:            nonrobust                                 

======================================================================
========
                 coef    std err          t      P>|t|      [0.025    
0.975]
----------------------------------------------------------------------
--------
MktRF          0.5815      0.090      6.479      0.000       0.404    
0.759
SMB            0.2898      0.099      2.930      0.004       0.094    
0.485
HML           -0.0229      0.159     -0.144      0.886      -0.337    
```

```
0.291
RMW              0.1252      0.142      0.881      0.380      -0.156
0.406
CMA             -0.0382      0.179     -0.214      0.831      -0.391
0.315
UMD              0.1041      0.061      1.695      0.092      -0.017
0.225
MktRF_L1         0.1327      0.069      1.914      0.057      -0.004
0.270
MktRF_L2         0.0171      0.069      0.247      0.805      -0.120
0.154
MktRF_L3        -0.0507      0.067     -0.753      0.453      -0.184
0.082
Intercept        0.0029      0.003      0.941      0.348      -0.003
0.009
======================================================================
========
Omnibus:                       17.500   Durbin-Watson:
1.279
Prob(Omnibus):                  0.000   Jarque-Bera (JB):
37.915
Skew:                          -0.431   Prob(JB):
5.85e-09
Kurtosis:                       5.147   Cond. No.
84.7
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Pre Financial Crisis: 0.0829
```




```
# Pre FC
y_ret_d1, EME_bench_ret_d2, EME_params_d2 =
fit_period(y_EME,X_EME,2,"Emerging Markets")

visualise_rets(y_EME,EME_bench_ret_d1,2,"Emerging Markets")

                            OLS Regression Results
==============================================================================
Dep. Variable:                EmgMkts   R-squared:
0.496
Model:                            OLS   Adj. R-squared:
0.467
Method:                 Least Squares   F-statistic:
17.09
Date:                Mon, 24 Feb 2025   Prob (F-statistic):
2.06e-19
Time:                        00:45:28   Log-Likelihood:
442.12
No. Observations:                 166   AIC:
-864.2
Df Residuals:                     156   BIC:
-833.1
```

```
Df Model:                           9

Covariance Type:            nonrobust

======================================================================
========
                 coef    std err          t      P>|t|      [0.025
0.975]
----------------------------------------------------------------------
--------
MktRF          0.3094      0.035      8.943      0.000       0.241
0.378
SMB            0.0354      0.063      0.565      0.573      -0.088
0.159
HML            0.0218      0.061      0.358      0.721      -0.098
0.142
RMW           -0.0866      0.078     -1.115      0.267      -0.240
0.067
CMA           -0.1327      0.093     -1.422      0.157      -0.317
0.052
UMD           -0.0532      0.036     -1.483      0.140      -0.124
0.018
MktRF_L1       0.1064      0.030      3.535      0.001       0.047
0.166
MktRF_L2       0.0313      0.031      1.015      0.312      -0.030
0.092
MktRF_L3      -0.0216      0.030     -0.711      0.478      -0.082
0.039
Intercept      0.0005      0.002      0.295      0.768      -0.003
0.004
======================================================================
========
Omnibus:                        4.614   Durbin-Watson:
1.974
Prob(Omnibus):                  0.100   Jarque-Bera (JB):
4.324
Skew:                          -0.294   Prob(JB):
0.115
Kurtosis:                       3.530   Cond. No.
77.3
======================================================================
========

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is
correctly specified.
Information Ratio Post 2009: -0.1392
```




```python
# MktRF_L1, L2, L3 shows pvalues instead
EME_Params = EME_params_d1.to_frame("PFC")
EME_Params["Post09"] = EME_params_d2
EME_Params.round(4)
```

	PFC	Post09
MktRF	0.5815	0.3094
SMB	0.2898	0.0354
HML	-0.0229	0.0218
RMW	0.1252	-0.0866
CMA	-0.0382	-0.1327
UMD	0.1041	-0.0532
MktRF_L1	0.0575	0.0005
MktRF_L2	0.8052	0.3118
MktRF_L3	0.4526	0.4784
Intercept	0.0029	0.0005