Lecture 5: 'Anomalies'—or, how to beat the market

FE-312 Investments

NORTHWESTERN
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CAPM and beating the market

- In Lecture 3 we saw that tests of the CAPM that used the SP&500 (or a value-weighted portfolio of all stocks) were not very supportive
- This is bad news for the CAPM, or at least the version that we can test using the market portfolio
- However, it is good news for someone who is interested in beating the S&P 500.
- In this lecture, we will see several strategies that have historically beat the market
- In addition, we will examine the performance of professional money managers and examine the extent to which they add value

CAPM: Summary

- Consider the regression of portfolio p excess returns on the market:

$$R_{p,t} - r_f = \alpha_p + \beta_p \left(R_{m,t} - r_f \right) + \varepsilon_{p,t}$$

- If $\alpha_p \neq 0$ in the above regression, this means that if we combine this portfolio with the market we will get a higher Sharpe Ratio than if we invest in the market alone. (Another word for α is the 'Jensen' measure of performance.)

- If $\alpha > 0$ you will want to buy the portfolio; short if $\alpha < 0$
  - Beware of costs of shorting! We will revisit this issue later in class, but keep in mind that shorting can be rather expensive, especially if the stocks that you are shorting are relatively illiquid (e.g. small growth firms)

- How much will our Sharpe Ratio increase?

The Information Ratio

- One issue with the Jensen measure is that it does not adjust for how the risk of the portfolio changes.
  - If I add a substantial fraction of this fund to my portfolio (not just a small amount δ as in our CAPM derivation), then the portfolio's 'idiosyncratic risk' ε_p will increase the variance of my portfolio.

- This motivates the use of the *Information Ratio* (or Appraisal Ratio):

$$IR_j = \frac{\alpha_p}{\sigma(\varepsilon_p)}$$

- The Sharpe Ratio of optimal portfolio C that combines these two portfolios (market, or whatever you were doing before, plus portfolio p)

$$SR_C = \sqrt{SR_M^2 + IR_p^2}$$

Beating the market

Next, let's evaluate the extent to which popular investment strategies have beaten the market:

1. Small-stock investing
2. Value investing
3. Momentum
4. ...

The Small Firm Effect

- A number of researchers, starting with Keim (1981) and Banz (1981) claimed that investing in small firms helped 'beating the market'

  1. Small stocks (i.e. small cap stocks) outperformed large stocks (i.e. large cap stocks).

  2. Important: *firm size* defined as total market capitalization.

- Let's investigate the extent to which this is true ...

The Small Firm Effect

- Let's form portfolios of stocks based on their past market capitalizations

		# of Stocks			
Dec	MKCap(m$)	NYSE	AMEX	NASDAQ	Total
10	511,391	172	5	80	257
9	10,486	172	3	81	256
8	4,428	172	5	136	313
7	2,237	172	5	166	343
6	1,387	172	5	217	394
5	889	172	11	254	437
4	534	172	15	251	438
3	353	172	32	400	604
2	198	172	73	551	796
1	95	172	412	1,399	1,983

- Fortunately, we can download historical returns on these portfolios from Ken French's website

The Small Firm Effect: 1960–1980

```
use SizeSortedPortfolios.dta, clear
drop if month<0
drop if  (month)>251

 forval i = 1/10 {

 qui: gen eret‘i’=dec‘i’-rf

 qui: eststo r‘i’: reg  eret‘i’ mktrf

 predict eret‘i’_res,r
}
 gen rHmL=dec10-dec1

 qui: eststo r11: reg  rHmL mktrf
 predict rHmL_res,r

 tabstat eret? eret?? rHmL, stat(mean sd) format(%9.2f)
```

stats	eret1	eret2	eret3	eret4	eret5	eret6	eret7	eret8	eret9	eret10	rHmL
mean	0.93	0.71	0.78	0.70	0.65	0.53	0.52	0.47	0.38	0.21	-0.72
sd	6.86	6.42	6.29	5.98	5.65	5.43	5.31	5.01	4.55	4.10	4.97

- Small firms indeed have higher returns on average than large firms

The Small Firm Effect: 1960–1980

```
. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
------------------------------------------------------------------------------------------------------------------
mktrf          1.26      1.28      1.29      1.24      1.19      1.16      1.16      1.10      1.01      0.91     -0.35
             (21.96)   (29.01)   (33.19)   (34.82)   (38.92)   (45.16)   (55.09)   (62.02)   (71.37)   (71.54)   (-5.21)

_cons          0.53      0.29      0.36      0.31      0.27      0.16      0.14      0.12      0.05     -0.08     -0.61
              (2.07)    (1.51)    (2.13)    (1.95)    (2.01)    (1.40)    (1.54)    (1.52)    (0.85)   (-1.48)   (-2.04)
------------------------------------------------------------------------------------------------------------------
N              252       252       252       252       252       252       252       252       252       252       252
R-sq           0.659     0.771     0.815     0.829     0.858     0.891     0.924     0.939     0.953     0.953     0.098
------------------------------------------------------------------------------------------------------------------
t statistics in parentheses

. tabstat  eret*_res rHmL_res, stat(  sd) format(%9.2f)

   stats |  eret1_~s  eret2_~s  eret3_~s  eret4_~s  eret5_~s  eret6_~s  eret7_~s  eret8_~s  eret9_~s  eret10~s  rHmL_res
---------+--------------------------------------------------------------------------------------------------------
      sd |      4.01      3.07      2.70      2.47      2.13      1.79      1.46      1.24      0.99      0.89      4.72
------------------------------------------------------------------------------------------------------------------
```

- And the difference is not fully accounted by their market exposures
- Alphas are large (approximately 6% per year) and statistically significant
- Small-minus-Big portfolio has an IR of $0.61/4.72 \approx 0.13$
- Compare to (monthly) SR of market equal to 0.073. Looks like a good deal...

The Small Firm Effect: 1980-2016

```
drop if  (month)<251

.  tabstat eret? eret?? rHmL, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
---------+--------------------------------------------------------------------------------------------------------------
    mean |      0.62      0.69      0.78      0.69      0.77      0.75      0.77      0.74      0.71      0.57     -0.05
      sd |      5.89      6.19      5.81      5.62      5.53      5.10      5.02      4.99      4.58      4.27      4.53
--------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

--------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
--------------------------------------------------------------------------------------------------------------------
mktrf          1.02      1.16      1.15      1.13      1.14      1.08      1.08      1.08      1.01      0.94     -0.08
             (24.60)   (30.79)   (37.34)   (39.89)   (46.39)   (53.81)   (63.09)   (70.60)   (87.69)   (92.74)   (-1.55)

_cons          0.00     -0.01      0.09      0.01      0.09      0.10      0.12      0.09      0.10      0.00     -0.00
              (0.02)   (-0.08)   (0.62)    (0.10)    (0.79)    (1.13)    (1.53)    (1.31)    (2.01)    (0.07)   (-0.01)
--------------------------------------------------------------------------------------------------------------------
N               432       432       432       432       432       432       432       432       432       432       432
R-sq          0.585     0.688     0.764     0.787     0.833     0.871     0.903     0.921     0.947     0.952     0.006
--------------------------------------------------------------------------------------------------------------------
```

- No size effect post-1980.
- Data mining, or did the good deal disappear after it became known?

The Small Firm Effect: 1926-1960

```
drop if  (month)<0

.  tabstat eret? eret?? rHmL, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
---------+--------------------------------------------------------------------------------------------------------------
    mean |      0.62      0.69      0.78      0.69      0.77      0.75      0.77      0.74      0.71      0.57     -0.05
      sd |      5.89      6.19      5.81      5.62      5.53      5.10      5.02      4.99      4.58      4.27      4.53
----------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

----------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
----------------------------------------------------------------------------------------------------------------------
mktrf          1.65      1.52      1.42      1.32      1.28      1.27      1.18      1.13      1.10      0.93     -0.72
             (24.58)   (33.55)   (42.20)   (45.25)   (57.20)   (69.15)   (72.25)   (92.98)  (127.26)  (190.27)  (-10.19)

_cons          0.31      0.12      0.04      0.15      0.02      0.15      0.02      0.02     -0.03      0.02     -0.29
              (0.68)    (0.39)    (0.18)    (0.76)    (0.10)    (1.19)    (0.14)    (0.29)   (-0.47)    (0.62)   (-0.61)
----------------------------------------------------------------------------------------------------------------------
N               403       403       403       403       403       403       403       403       403       403       403
R-sq          0.601     0.737     0.816     0.836     0.891     0.923     0.929     0.956     0.976     0.989     0.206
----------------------------------------------------------------------------------------------------------------------
```

- No size effect pre-1960 either.
- Beware of data mining ...

The Value Effect

- Some researchers, starting with Graham and Dodd in the late 1930s, noticed that *value* stocks outperformed *growth* stocks.
  - **(Definition:** *A value stock is a stock with a low market price relative to the book value of assets.*
    Some people believe these stocks are undervalued by the market and thus should present good investment opportunities.
  - **Definition:** *A growth stock is a stock with a high market price relative to the book value of assets.*
    Some people believe that these stocks are "glamor" stocks that are overvalued by the market, and as such the expected returns form holding them will be poor.
- Other definitions of value are also possible, e.g. price-to-earnings. In general, most definitions have some measure of 'price' scaled by some measure of 'fundamentals'

The Value Effect: 1960-2016

```
use ValueSortedPortfolios, clear
drop if  (month)<0
 forval i = 1/10 {

 qui: gen eret‘i’=dec‘i’-rf

 qui: eststo r‘i’: reg  eret‘i’ mktrf

 predict eret‘i’_res,r
}

.  tabstat eret? eret?? rHmL rHmL_res, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL  rHmL_res
---------+--------------------------------------------------------------------------------------------------------------------
    mean |      0.40      0.53      0.57      0.53      0.55      0.68      0.61      0.70      0.84      0.89      0.49     -0.00
      sd |      5.07      4.62      4.57      4.61      4.42      4.33      4.55      4.62      4.92      6.04      4.62      4.61
--------------------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

--------------------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
--------------------------------------------------------------------------------------------------------------------------------
mktrf          1.07      1.00      0.99      0.98      0.91      0.88      0.92      0.92      0.98      1.13      0.06
             (66.50)   (84.91)   (82.15)   (68.58)   (57.67)   (52.58)   (50.36)   (47.24)   (47.62)   (38.14)    (1.52)

_cons         -0.14      0.03      0.07      0.04      0.09      0.23      0.14      0.23      0.35      0.31      0.46
             (-1.98)    (0.50)    (1.31)    (0.57)    (1.29)    (3.14)    (1.78)    (2.71)    (3.80)    (2.39)    (2.56)
--------------------------------------------------------------------------------------------------------------------------------
N              683       683       683       683       683       683       683       683       683       683       683
R-sq         0.867     0.914     0.908     0.874     0.830     0.802     0.788     0.766     0.769     0.681     0.003
--------------------------------------------------------------------------------------------------------------------------------
```

- Value stocks have higher average returns than growth stocks
- Similar CAPM betas implies value minus growth portfolio has large alpha
- The VmG portfolio has a sizeable IR ≈ 0.10

The Value Effect: 1926-1960

```
drop if  (month)>0

.  tabstat eret? eret?? rHmL rHmL_res, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL  rHmL_res
---------+--------------------------------------------------------------------------------------------------------------------
    mean |      0.85      0.90      0.86      0.87      1.00      0.98      0.90      1.26      1.41      1.36      0.51      0.00
      sd |      6.69      6.34      6.61      7.69      7.40      8.15      8.77      9.29     10.91     12.96      8.64      7.08
--------------------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

--------------------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
--------------------------------------------------------------------------------------------------------------------------------
mktrf          0.97      0.91      0.96      1.10      1.07      1.15      1.24      1.31      1.50      1.71      0.74
             (79.65)   (67.93)   (79.74)   (69.49)   (72.09)   (56.94)   (57.66)   (56.58)   (47.35)   (37.56)   (14.01)

_cons          0.00      0.10      0.02     -0.10      0.06     -0.03     -0.18      0.12      0.10     -0.13     -0.14
             (0.02)    (1.12)    (0.19)   (-0.96)    (0.62)   (-0.24)   (-1.26)    (0.74)    (0.46)   (-0.44)   (-0.38)
--------------------------------------------------------------------------------------------------------------------------------
N              403       403       403       403       403       403       403       403       403       403       403
R-sq         0.941     0.920     0.941     0.923     0.928     0.890     0.892     0.889     0.848     0.779     0.329
--------------------------------------------------------------------------------------------------------------------------------
```

- Value stocks have higher average returns than growth stocks pre 1960's
- But they also have much higher CAPM betas!
- No value effect in 1926-1960 sample

The Value Effect: 1926-2016

```
. tabstat eret? eret?? rHmL rHmL_res, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL  rHmL_res
---------+--------------------------------------------------------------------------------------------------------------------
    mean |      0.58      0.68      0.68      0.66      0.72      0.80      0.72      0.91      1.06      1.07      0.49     -0.00
      sd |      5.72      5.32      5.41      5.94      5.72      6.03      6.45      6.74      7.71      9.23      6.41      5.93
--------------------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

--------------------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
--------------------------------------------------------------------------------------------------------------------------------
mktrf          1.01      0.95      0.97      1.05      1.00      1.03      1.10      1.14      1.28      1.46      0.45
             (99.76)  (107.92)  (116.28)   (99.35)   (92.25)   (77.54)   (75.98)   (72.38)   (64.98)   (53.43)   (13.50)

_cons         -0.08      0.06      0.05     -0.02      0.07      0.12      0.01      0.17      0.23      0.12      0.20
             (-1.49)    (1.27)    (1.13)   (-0.37)    (1.15)    (1.70)    (0.08)    (1.98)    (2.13)    (0.78)    (1.09)
--------------------------------------------------------------------------------------------------------------------------------
N             1085      1085      1085      1085      1085      1085      1085      1085      1085      1085      1085
R-sq         0.902     0.915     0.926     0.901     0.887     0.847     0.842     0.829     0.796     0.725     0.144
--------------------------------------------------------------------------------------------------------------------------------
```

- No value effect in the 1926-2016 sample
- What is going on?

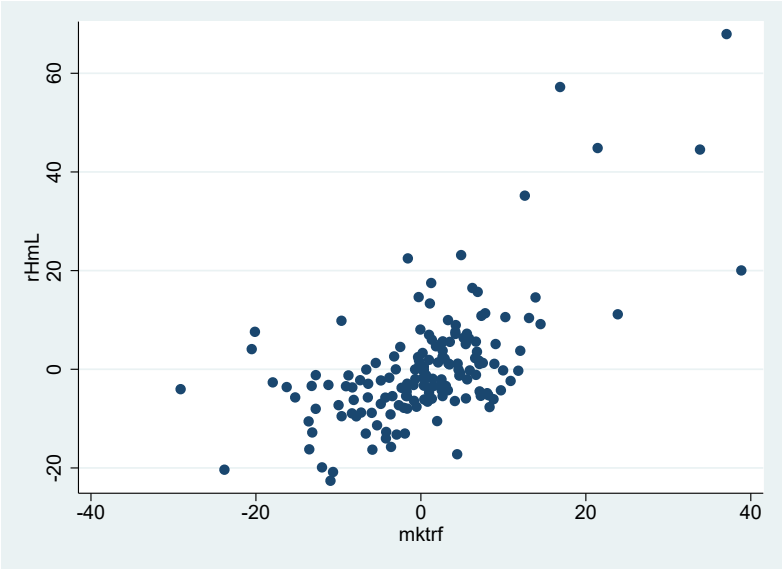
The Value Effect: 1940-2016

```
use ValueSortedPortfolios, clear
drop if  (month)<-240

.  tabstat eret? eret?? rHmL rHmL_res, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL  rHmL_res
---------+--------------------------------------------------------------------------------------------------------------------
    mean |      0.56      0.65      0.63      0.67      0.76      0.81      0.74      0.91      1.03      1.08      0.52      0.00
      sd |      4.83      4.49      4.40      4.44      4.33      4.29      4.54      4.68      5.01      6.27      4.73      4.69
--------------------------------------------------------------------------------------------------------------------------------
.
. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

--------------------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
--------------------------------------------------------------------------------------------------------------------------------
mktrf          1.05      1.00      0.98      0.97      0.93      0.91      0.95      0.96      1.02      1.20      0.15
             (79.42)   (100.08)   (96.87)   (82.93)   (69.69)   (64.82)   (61.36)   (56.90)   (55.26)   (43.76)    (4.16)

_cons         -0.13     -0.00     -0.01      0.04      0.15      0.22      0.12      0.29      0.36      0.29      0.42
             (-2.26)   (-0.06)   (-0.28)    (0.73)    (2.66)    (3.58)    (1.80)    (3.90)    (4.50)    (2.45)    (2.69)
--------------------------------------------------------------------------------------------------------------------------------
N              923       923       923       923       923       923       923       923       923       923       923
R-sq         0.873     0.916     0.911     0.882     0.841     0.820     0.803     0.779     0.768     0.675     0.018
--------------------------------------------------------------------------------------------------------------------------------
```

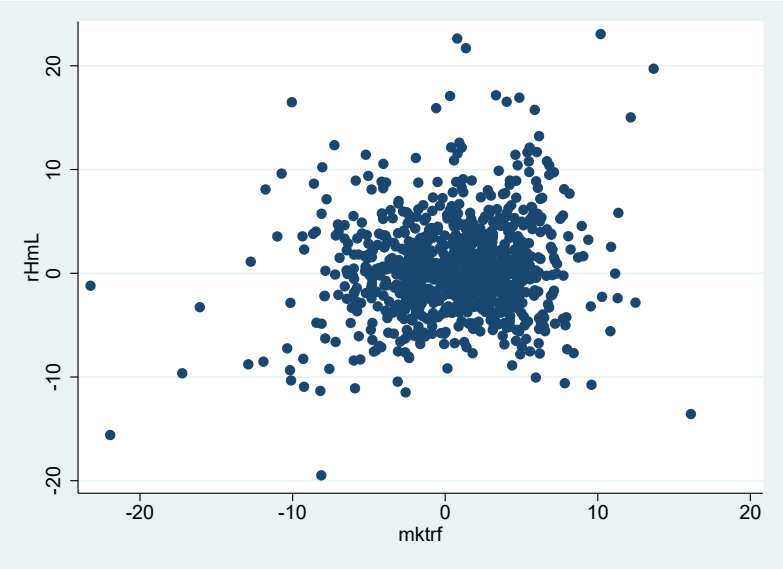
- The 1930's seem to be special.
- The plot thickens...

The Value Effect

1926–1940



1940–2016



- Notice the difference in scale between the left and right panel
- VmG seems to have a high beta only in the 1930's...

The Value Effect—Is it there?

Depends on your view of the world regarding the 1930's.

- In general, it is not a good idea to throw data away. The 1930's are not a random decade, it was the time of the Great Depression. It is possible that value firms are particularly risky during these large disasters, in which case if you omit the 1930's you will mis-measure their market risk.
- At the same time, there are some important caveats:
  - In the 1930's there were much fewer firms in the portfolio (43 vs 400+ towards the end of the sample)
  - The quality of the data (especially accounting data, i.e. book values) is much worse prior to the formation of the SEC in 1936. It is possible that B/M during this period measures mostly $1/M$, i.e. mostly captures a *size* effect as opposed to a *value* effect.

    Consistent with this view, the correlation between the VmG and SmB portfolios are 81% in the 1926-1940 period, vs 50% in the 1940-2016 sample.
- Bottom Line: you will often have to make a judgement call...

Disentangling Value vs Size effects

- One way to disentangle the two effects is by forming *double-sorted* portfolios
- There are multiple ways of doing this.
  - The way Fama and French do it is to create two independent sorts (ME and BE/ME) and then form each portfolio as the intersection
  - Another way to do it is to keep the number of firms constant in each portfolio: first sort on size, and then within ME quintiles sort on BE/ME
- Conditioning on firm size yields some interesting results ...

Value and Size Effects: 1926-2016

```
use SizeBMSortedPortflios, clear
 forval j = 1/5 {
forval i = 1/5 {

 qui: gen eret‘j’_‘i’ =me‘j’bm‘i’-rf

 qui: eststo r‘j’‘i’: reg  eret‘j’_‘i’ mktrf

 }
  qui: gen eret‘j’_HML =me‘j’bm5 - me‘j’bm1

 qui: eststo r‘j’_HML: reg  eret‘j’_HML mktrf
}
```

```
. esttab r?_HML, r2 compress b(2) t(2) nostar
```

	(1)	(2)	(3)	(4)	(5)
	eret1_HML	eret2_HML	eret3_HML	eret4_HML	eret5_HML
mktrf	-0.25	0.11	0.13	0.33	0.36
	(-5.96)	(4.04)	(4.86)	(11.07)	(11.18)
_cons	0.96	0.56	0.37	0.11	0.12
	(4.24)	(3.72)	(2.52)	(0.68)	(0.68)
N	1085	1085	1085	1085	1085
R-sq	0.032	0.015	0.021	0.102	0.103

- Controlling for firm size brings back the ‘anomaly’
- That said, the value premium exists mostly on smaller stocks (below the 60-th percentile)

Value and Size Effects: 1926-2016

```
. esttab r1?  , r2 compress b(2) t(2) nostar

------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)
            eret1_1   eret1_2   eret1_3   eret1_4   eret1_5
------------------------------------------------------------
mktrf          1.63      1.41      1.37      1.27      1.38
            (33.55)   (39.28)   (46.64)   (46.29)   (43.18)

_cons         -0.50     -0.23      0.10      0.36      0.47
            (-1.90)   (-1.16)    (0.63)    (2.40)    (2.69)
------------------------------------------------------------
N             1085      1085      1085      1085      1085
R-sq         0.510     0.588     0.668     0.664     0.633
------------------------------------------------------------

. esttab r2?  , r2 compress b(2) t(2) nostar
------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)
            eret2_1   eret2_2   eret2_3   eret2_4   eret2_5
------------------------------------------------------------
mktrf          1.27      1.23      1.20      1.21      1.38
            (52.82)   (59.81)   (62.21)   (59.46)   (52.83)

_cons         -0.20      0.13      0.21      0.29      0.36
            (-1.57)    (1.15)    (2.02)    (2.63)    (2.54)
------------------------------------------------------------
N             1085      1085      1085      1085      1085
R-sq         0.720     0.768     0.781     0.766     0.720
------------------------------------------------------------
```

- Keep in mind that half of the value premium involves shorting small growth stocks.
- Bottom Line: conditioning on firm size allows for more flexible strategies

Related patterns

- Value and size effects are only the tip of the iceberg.
- The literature has documented a number of other patterns:
  - Firms with high earnings-to-price ratios out-perform firms with low E/P ratios
    (Rosenberg, Reid, and Lanstein, 1985)
  - Firms with high investment rates under-perform firms with low investment rates
    (Titman, Wei and Xie, 2003)
  - Firms that issue new shares under-perform that do not.
    (Loughran and Ritter, 1995)
  - Firms that repurchase their shares over-perform that do not.
    (Ikenberry, Lakonishok and Vermaelen, 1995)
  - Firms with high idiosyncratic volatility under-perform firms with low idiosyncratic volatility
    (Ang, Hodrick, Xing, and Zhang, 2009)
- Are these separate phenomena?

Sorting on E/P: 1951-2016

```
. use EPSortedPortfolios.dta, clear

.  tabstat eret? eret?? rHmL, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
---------+--------------------------------------------------------------------------------------------------------------
    mean |      0.52      0.48      0.59      0.59      0.64      0.77      0.81      0.87      0.95      1.03      0.50
      sd |      5.45      4.56      4.36      4.23      4.31      4.28      4.25      4.47      4.73      5.17      4.07
------------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

------------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
------------------------------------------------------------------------------------------------------------------------
mktrf          1.16      1.00      0.94      0.91      0.93      0.90      0.89      0.91      0.96      1.04     -0.12
             (63.15)   (79.97)   (69.05)   (66.88)   (68.79)   (57.51)   (57.80)   (50.98)   (48.64)   (47.92)   (-3.60)

_cons         -0.18     -0.12      0.03      0.04      0.08      0.23      0.27      0.32      0.38      0.40      0.57
             (-2.21)   (-2.21)   (0.45)    (0.71)    (1.31)    (3.39)    (4.11)    (4.14)    (4.43)    (4.23)    (3.94)
------------------------------------------------------------------------------------------------------------------------
N               785       785       785       785       785       785       785       785       785       785       785
R-sq          0.836     0.891     0.859     0.851     0.858     0.809     0.810     0.769     0.751     0.746     0.016
------------------------------------------------------------------------------------------------------------------------
t statistics in parentheses
```

- Sorting on E/P produces similar results to sorting on B/M
- Notice that market betas are higher for high P/E firms

Sorting on INV: 1963-2016

```
. use INVSortedPortfolios.dta, clear

.  tabstat eret? eret?? rHmL, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
---------+--------------------------------------------------------------------------------------------------------------
    mean |      0.78      0.77      0.62      0.59      0.57      0.54      0.59      0.50      0.56      0.30     -0.47
      sd |      5.34      4.74      4.30      4.06      4.16      4.31      4.39      4.74      5.40      6.08      3.22
------------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

------------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
------------------------------------------------------------------------------------------------------------------------
mktrf          1.10      0.98      0.88      0.85      0.88      0.92      0.94      1.02      1.15      1.29      0.19
             (55.87)   (57.24)   (55.24)   (65.50)   (67.15)   (74.61)   (75.87)   (81.66)   (68.94)   (68.85)    (6.84)

_cons          0.22      0.27      0.17      0.16      0.12      0.07      0.11     -0.02     -0.02     -0.35     -0.57
             (2.50)    (3.55)    (2.45)    (2.71)    (2.06)    (1.30)    (1.97)   (-0.30)   (-0.29)   (-4.21)   (-4.61)
------------------------------------------------------------------------------------------------------------------------
N              641       641       641       641       641       641       641       641       641       641       641
R-sq         0.830     0.837     0.827     0.870     0.876     0.897     0.900     0.913     0.881     0.881     0.068
------------------------------------------------------------------------------------------------------------------------
t statistics in parentheses
```

- Sorting on INV produces similar results to sorting on M/B or P/E
- Notice that market betas are higher for high INV firms

Sorting on ID VOL: 1963-2016

```
. use RVARSortedPortfolios.dta, clear

.  tabstat eret? eret?? rHmL, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
---------+--------------------------------------------------------------------------------------------------------------
    mean |      0.53      0.57      0.54      0.61      0.64      0.82      0.61      0.82      0.56     -0.07     -0.61
      sd |      3.57      4.10      4.44      4.80      5.04      5.51      5.96      6.62      7.43      8.56      7.16
------------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

------------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
------------------------------------------------------------------------------------------------------------------------
mktrf          0.71      0.87      0.94      1.02      1.08      1.18      1.27      1.38      1.51      1.60      0.89
             (47.17)   (67.12)   (69.69)   (68.78)   (72.95)   (76.21)   (70.75)   (61.02)   (52.76)   (37.34)   (16.70)

_cons          0.17      0.13      0.06      0.09      0.09      0.22     -0.03      0.11     -0.21     -0.89     -1.06
             (2.60)    (2.26)    (0.97)    (1.34)    (1.41)    (3.18)   (-0.39)    (1.14)   (-1.64)   (-4.64)   (-4.46)
------------------------------------------------------------------------------------------------------------------------
N              641       641       641       641       641       641       641       641       641       641       641
R-sq         0.777     0.876     0.884     0.881     0.893     0.901     0.887     0.854     0.813     0.686     0.304
------------------------------------------------------------------------------------------------------------------------
t statistics in parentheses
```

- Sorting on ID VOL produces similar results to sorting on INV, M/B or P/E
- Notice that market betas are higher for high ID VOL firms

My view

- All these 'anomalies' are really the same!
- What seems to be happening is that 'growth' firms, that is, firms that:
  - Grow fast
  - Have high market valuations (relative to book value of assets or earnings)
  - Have high idiosyncratic risk
  - Have high market betas
- underperform 'value' firms, that is, 'cash cow' firms that
  - Have low market valuations
  - Have low market betas and low idiosyncratic risk
  - Have few investment opportunities
- See my research if you're interested in a rational explanation...

Short-Term Momentum

- Consider the following, seemingly naive, strategy:
- At the end of every month, you rebalance your portfolio and buy stocks that did well in the past year (winners), shorting stocks that did poorly during the same period (losers)
- In a 1993 *Journal of Finance* article, Jagadeesh and Titman show that this strategy seems to work well.
- Caveat: the momentum effect seems short-lived in the data, lasting for only a few months, so you should rebalance often

Short-term Momentum: 1926-2016

```
use MomentumSortedPortfolios.dta, clear

.  tabstat eret? eret?? rHmL rHmL_res, stat(mean sd) format(%9.2f)

   stats |     eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL  rHmL_res
---------+--------------------------------------------------------------------------------------------------------------------
    mean |      0.04      0.42      0.47      0.60      0.60      0.66      0.74      0.84      0.92      1.23      1.19      0.00
      sd |      9.81      8.07      7.00      6.37      5.96      5.81      5.51      5.35      5.64      6.49      7.83      7.28
--------------------------------------------------------------------------------------------------------------------------------

. esttab r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11, r2 compress b(2) t(2) nostar

--------------------------------------------------------------------------------------------------------------------------------
                (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)
              eret1     eret2     eret3     eret4     eret5     eret6     eret7     eret8     eret9    eret10      rHmL
--------------------------------------------------------------------------------------------------------------------------------
mktrf          1.56      1.33      1.18      1.09      1.04      1.03      0.97      0.93      0.96      1.02     -0.53
             (54.23)   (62.95)   (69.72)   (79.76)   (88.17)  (105.06)   (97.46)   (90.15)   (77.84)   (52.70)  (-12.97)

_cons         -0.97     -0.44     -0.29     -0.11     -0.07     -0.01      0.11      0.23      0.30      0.56      1.53
             (-6.22)   (-3.84)   (-3.14)   (-1.46)   (-1.07)   (-0.19)    (2.01)    (4.17)    (4.40)    (5.34)    (6.85)
--------------------------------------------------------------------------------------------------------------------------------
N             1079      1079      1079      1079      1079      1079      1079      1079      1079      1079      1079
R-sq         0.732     0.786     0.819     0.855     0.878     0.911     0.898     0.883     0.849     0.721     0.135
--------------------------------------------------------------------------------------------------------------------------------
t statistics in parentheses
```

- Winners-minus-Losers portfolio has positive average returns
- More importantly, it has a negative correlation with the market!
- Information Ratio is huge (0.21) implying that we can increase our Sharpe Ratio from 0.12 (market) to 0.24 (market + WmL)

Short-term Momentum: Returns by Decade

```
gen decade = floor((36+month)/120)

forval i = 1/9 {
 qui: eststo rd‘i’: reg  rHmL mktrf if decade==‘i’-4
}

 esttab rd*, r2 compress b(2) t(2) nostar mtitles("1926-36" "1936-46" "1946-56" "1956-66" "1966-76" "1976-86" "1986-96" "1996-2006" "2006-16"
```

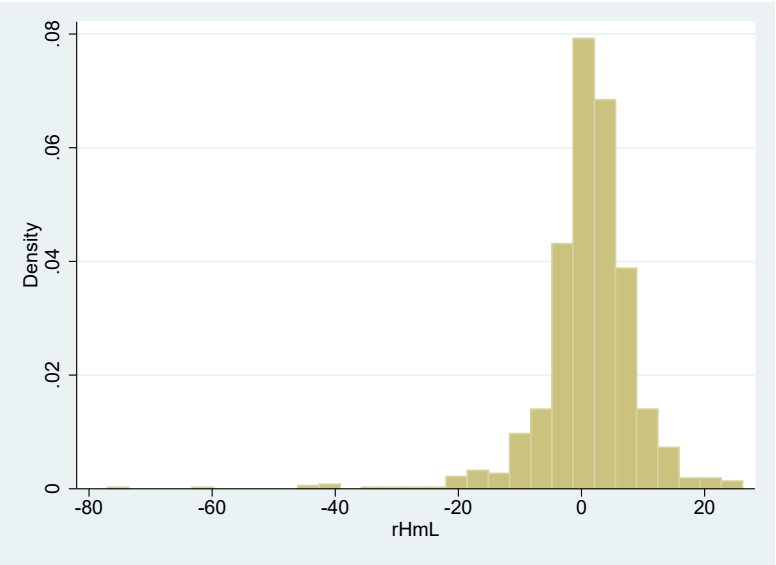
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	1926-36	1936-46	1946-56	1956-66	1966-76	1976-86	1986-96	1996-2006	2006-16
mktrf	-0.95	-0.48	0.10	-0.16	-0.39	0.29	0.02	-0.43	-0.81
	(-9.72)	(-4.25)	(0.94)	(-1.35)	(-3.57)	(2.58)	(0.18)	(-2.39)	(-4.67)
_cons	2.12	0.73	1.09	1.44	1.69	1.43	1.54	1.28	0.99
	(2.20)	(1.04)	(2.85)	(3.62)	(3.18)	(2.90)	(3.86)	(1.55)	(1.25)
N	120	120	120	120	120	120	120	120	119
R-sq	0.445	0.133	0.007	0.015	0.097	0.053	0.000	0.046	0.157

- Result seems there in almost every decade
- Though it seems somewhat weaker post–1996
- Research published in 1993 . . .

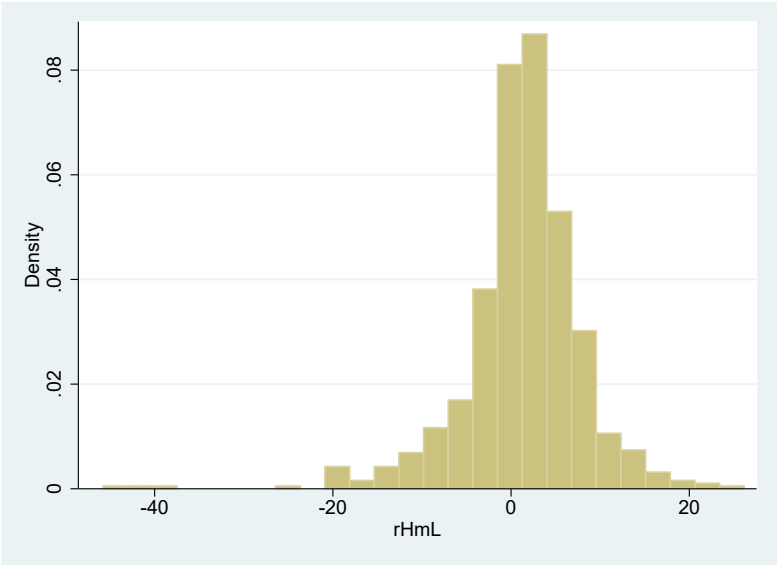
Momentum can generate some frightful losses

```
. hist rHmL

. hist rHmL if month>0
```

1926–2016



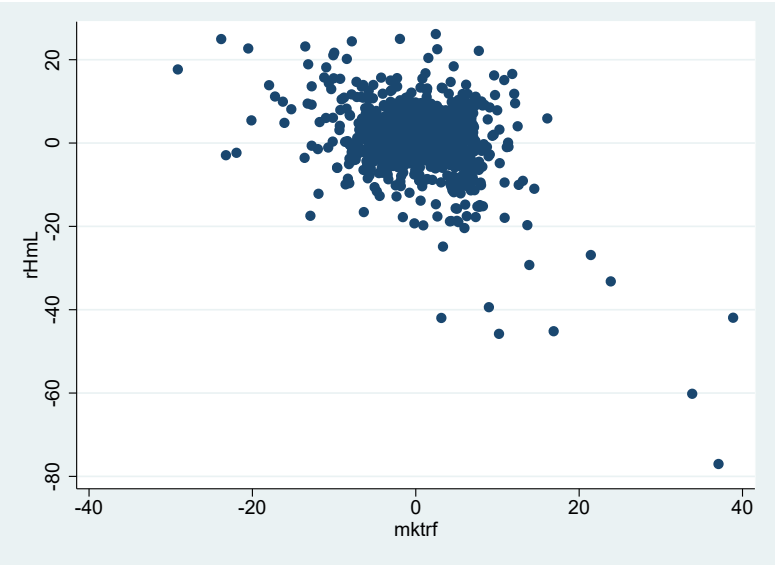
1960–2016



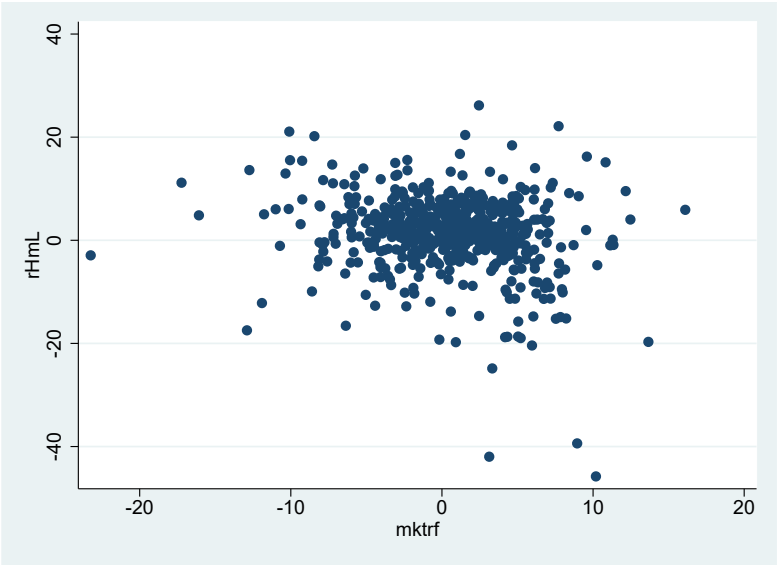
...especially when the market is recovering

```
. scatter rHmL mktrf

. scatter rHmL mktrf  if month>0
```

1926–2016



1960–2016



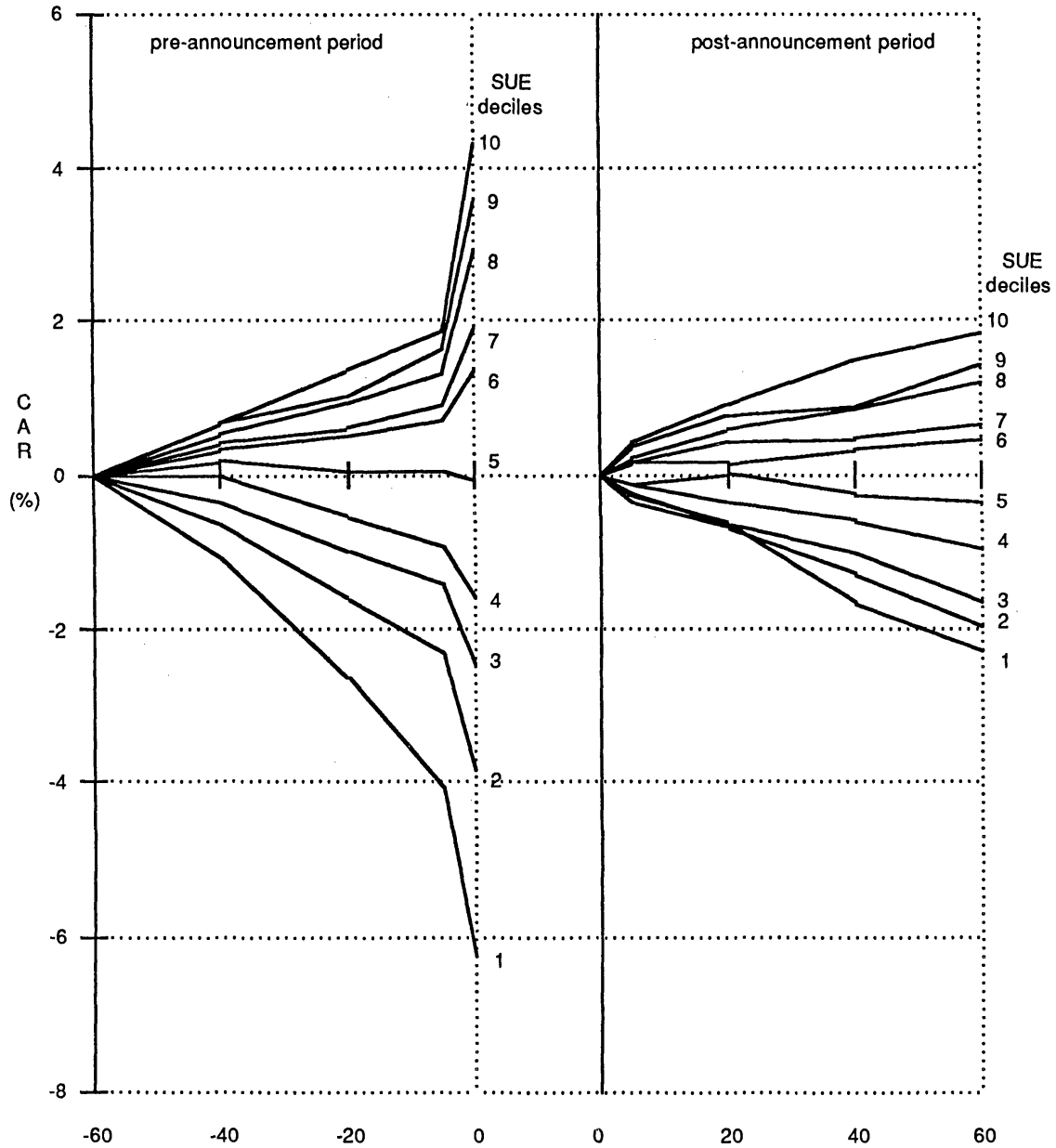
Short-Term Momentum

- To complicate matters further, momentum also exists among different asset classes, not just individual stocks.
- It also exists among:
  - Commodities
  - Currencies
  - Sovereign bonds
  - Industry indices
- Short-term under-reaction?
  - Momentum is consistent with prices not fully incorporating info immediately
  - When there's good news, get a return now, more return later
  - Second example: post earnings announcement drift

Post-Earnings Announcement Drift

- Bernard and Thomas in the 1989 article in *Journal of Accounting Research* found evidence that stock prices were predictable based on *past* earnings announcements.
  1. They found that firms that had better than expected earnings had higher returns over the next few months.
  2. Firms that had worse than expected earnings in the past had lower returns going forward.
- They interpret this as evidence of market inefficiency due to investor *under-reaction* to earnings announcements.
- They formed portfolios of stocks based on past earnings surprises and tracked their performance.

Post-Earnings Announcement Drift



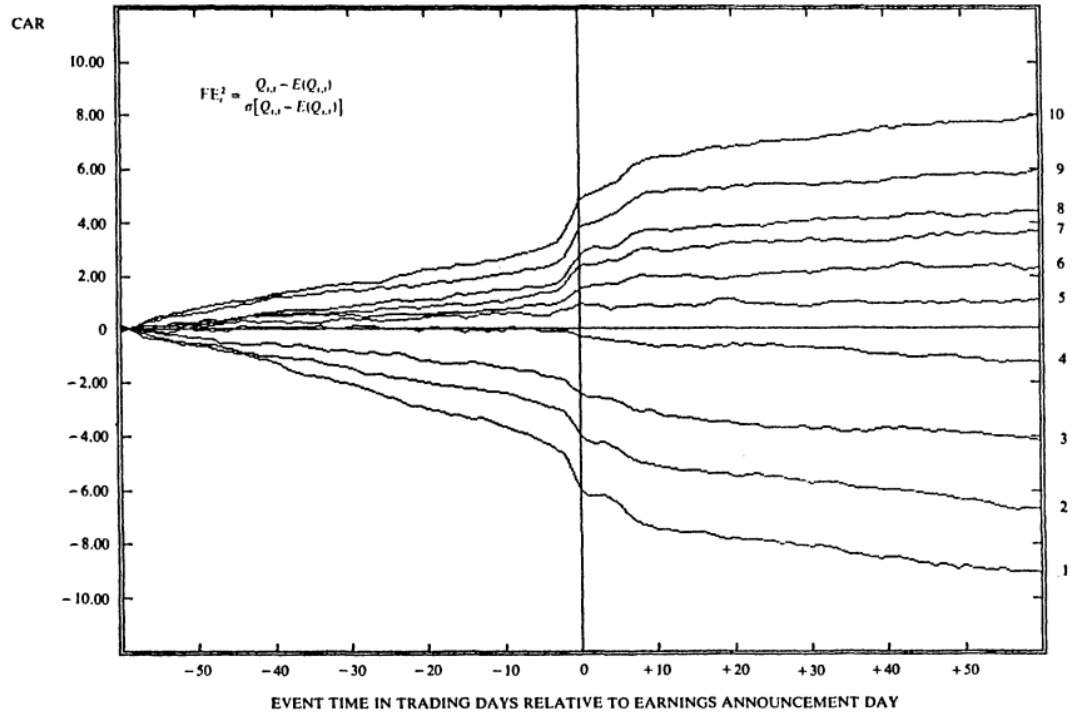


FIG. 1.—Cumulative abnormal returns for FOS earnings-based model (*EBM*) tests. Earnings announcements are assigned to deciles based on standing of standardized unexpected earnings (*SUE*) relative to prior-quarter *SUE* distribution. Portfolio 10 includes firms with the highest *SUE* ranking. Based on data from 1974–81. Cumulative abnormal returns are the sums over 120 trading days surrounding the earnings announcement, of the difference between daily returns and returns for NYSE firms in the same size decile. *SUE* represents forecast error from a first-order autoregressive earnings expectations model (in seasonal differences) scaled by its estimation-period standard deviation. (Reprinted, by permission of the publisher, from G. Foster, C. Olsen, and T. Shevlin, "Earnings Releases, Anomolies, and the Behavior of Security Returns," *The Accounting Review* [October 1984]: 589.)

Value and momentum everywhere

- We saw value and momentum strategies in US equities
- Asness, Moskowitz, and Pedersen (2013) show that the same ideas work in other rmarkets
- Not a riskless arbitrage!
  - Value strategies are correlated across markets
  - Same for momentum

Value and momentum everywhere

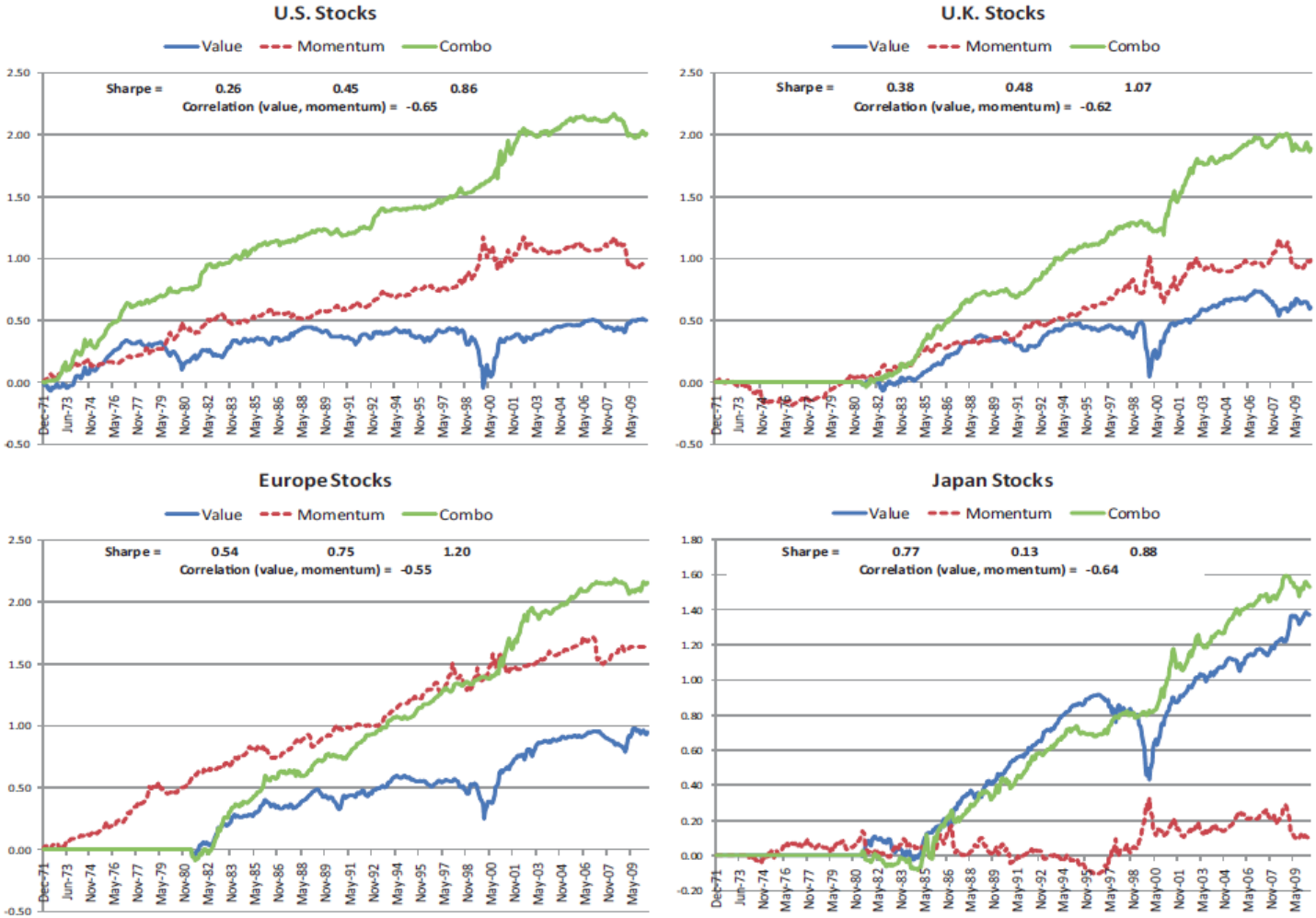
	Sharpe ratio			CAPM alpha			
	Value	Momentum	50/50 combo	Value	Momentum	50/50 combo	Correlation
US stocks (1972–2011)	0.26	0.45	0.86	5.8	8.7	7.2	-0.65
UK stocks (1972–2011)	0.38	0.48	1.07	4.4	8	7.2	-0.62
European Stocks (1974–2011)	0.54	0.75	1.2	4	10.7	7.1	-0.55
Japan stocks (1974–2011)	0.77	0.13	0.88	10.7	2.2	6.1	-0.64
Country indexes (1978–2011)	0.6	0.63	1	5.3	7.1	10	-0.37
Currencies (1979–2011)	0.44	0.32	0.69	4.1	3.5	5.7	-0.43
Fixed income (1982–2011)	0.07	0.17	0.2	1.4	0.1	0.7	-0.35
Commodities (1972–2011)	0.31	0.71	0.77	8.2	10.5	17.1	-0.46
Global other (1972–2011)	0.55	0.62	1.14	3.9	4.1	6.8	-0.49
Global all (1972–2011)	0.72	0.74	1.59	4.8	5	6.9	-0.6

Value and momentum everywhere

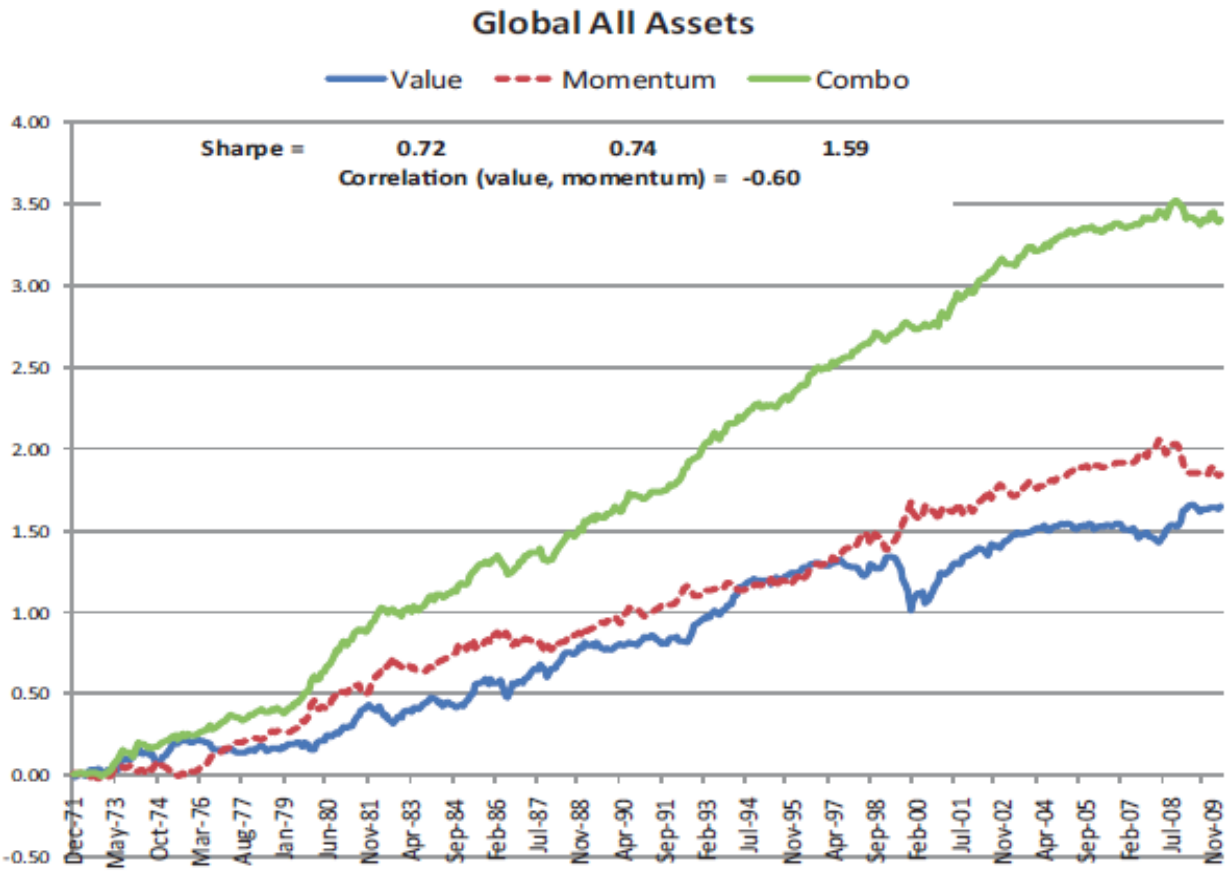
Panel A: Correlation of Average Return Series

	Stock Value	Nonstock Value	Stock Momentum	Nonstock Momentum
Stock value	0.68*	0.15*	−0.53*	−0.26*
Nonstock value		0.07	−0.16*	−0.13*
Stock momentum			0.65*	0.37*
Nonstock momentum				0.21*

Cumulative returns to value and momentum



Cumulative returns to value and momentum



Value and Momentum

- At the moment, the value and momentum effect are one of the *most studied* anomalies in Finance.

- On the surface, value and momentum appear to challenge the 'efficient market' hypothesis. This has led behavioral finance advocates to declare victory. They propose several behavioral explanations:

  1. under-reaction: bad news travels slowly.

  2. over-reaction: positive feedback.

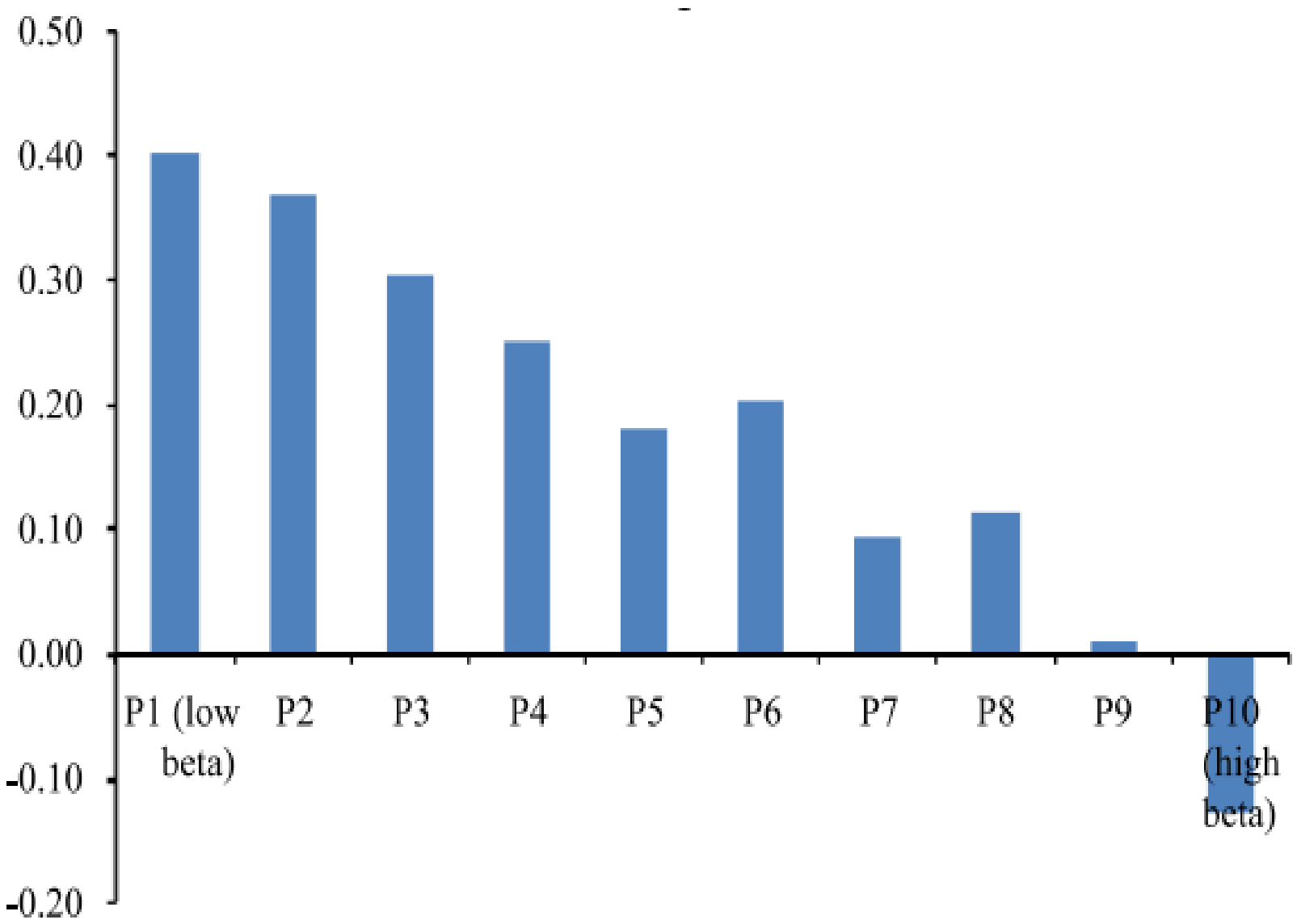
  3. disposition effect: investors are reluctant to sell loser stocks.

- My view: none of these explanations quite account for the fact that investing in value or momentum is so risky! Put differently, if investors are so stupid, why isn't everyone else making a killing?

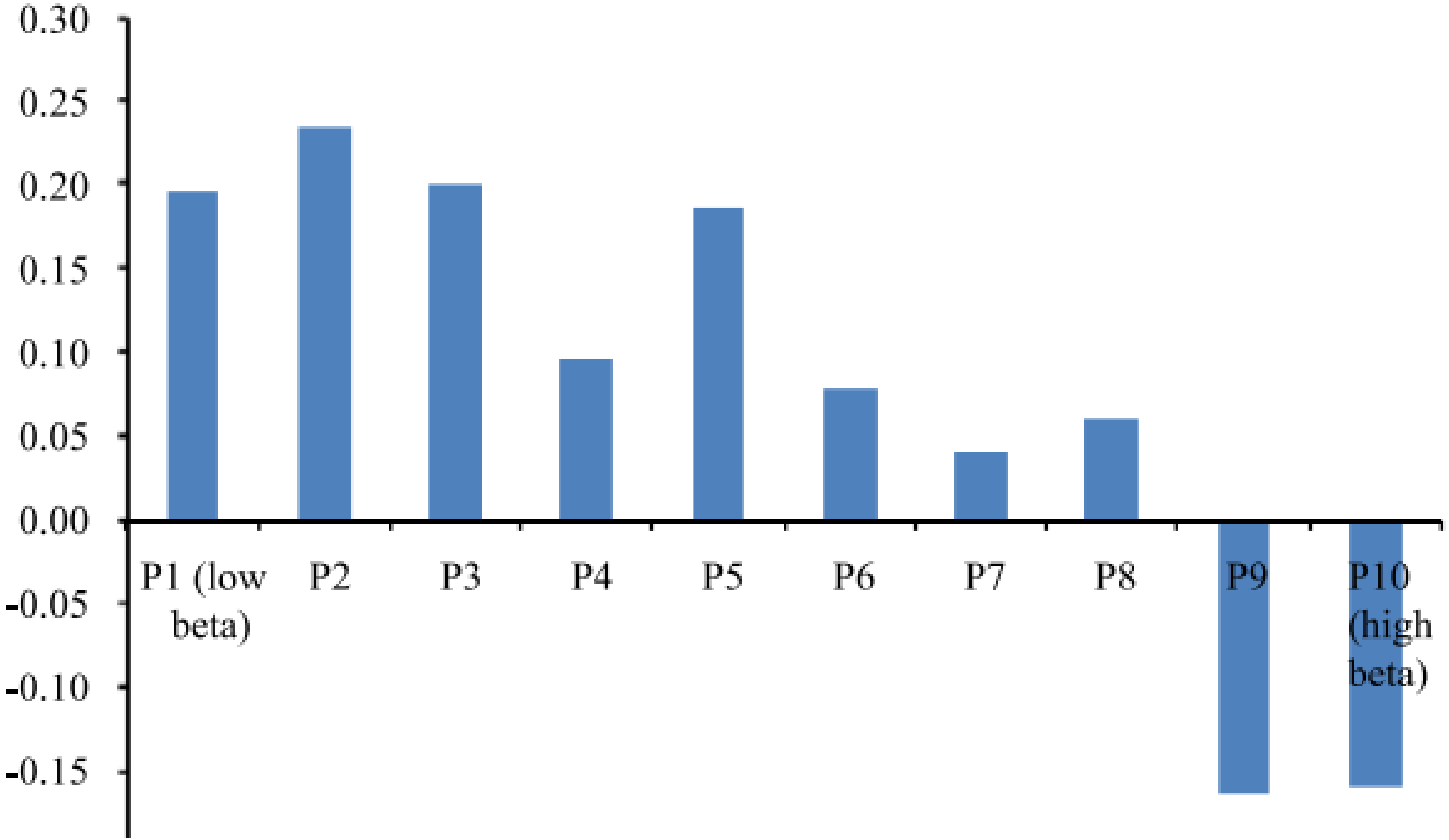
Betting against beta

- Recall our tests of the CAPM
- Frazzini and Pedersen extend this idea: try betting against beta in many markets, i.e., bonds, commodities, currencies, etc
  - Using a CAPM for each market (i.e. replacing r_m with the overall return for that particular market)
- Beta arbitrage seems to work in many markets
  - I.e. short commodities that move a lot with aggregate commodity market; go long commodities that are neutral
  - Equities in different countries; Treasury bonds; corporate bonds; commodities; sovereign debt; currencies
  - In each market, use the value-weighted portfolio to estimate beta (e.g. in commodities measure beta relative to a commodity market portfolio)

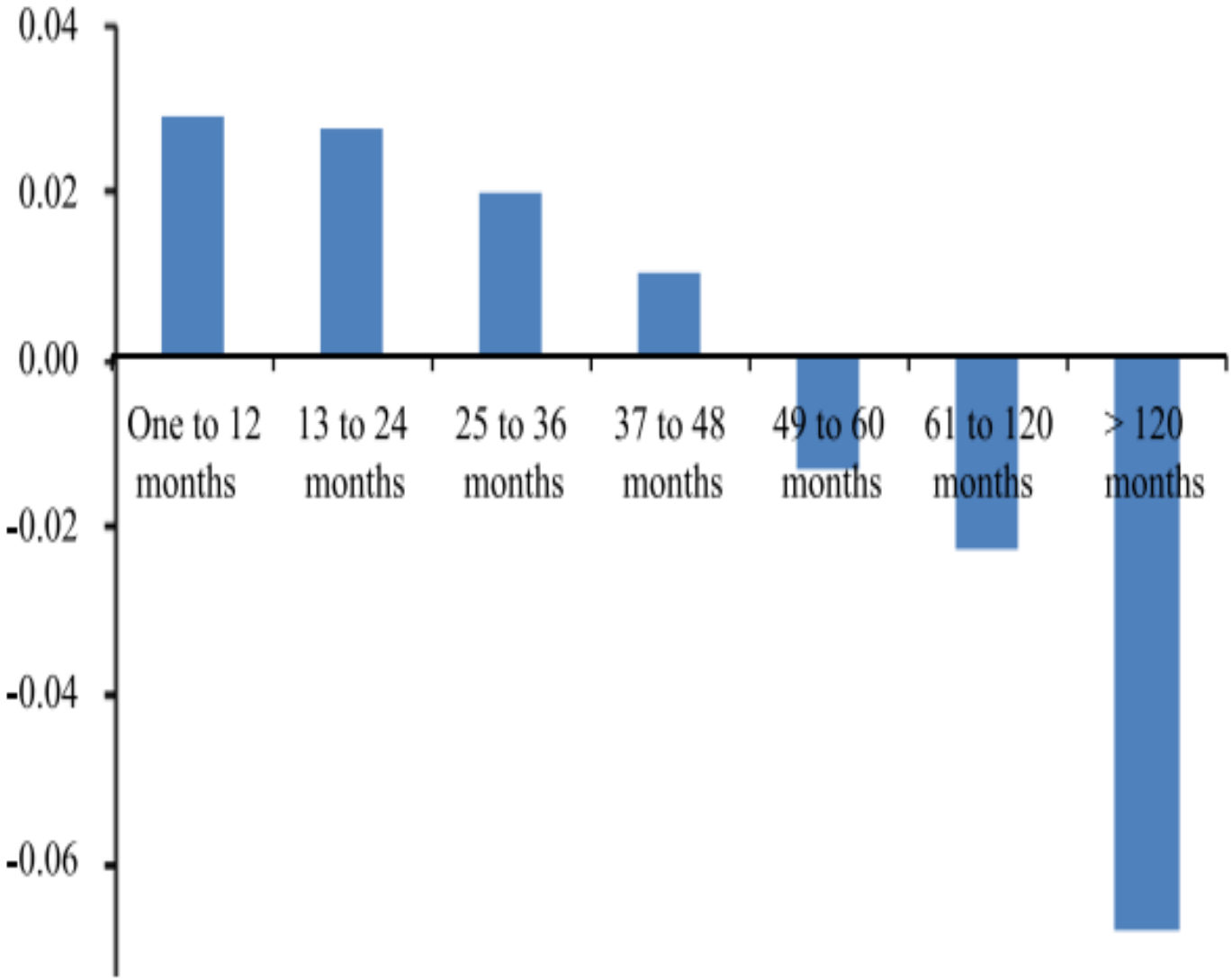
Betting against beta: US Equities



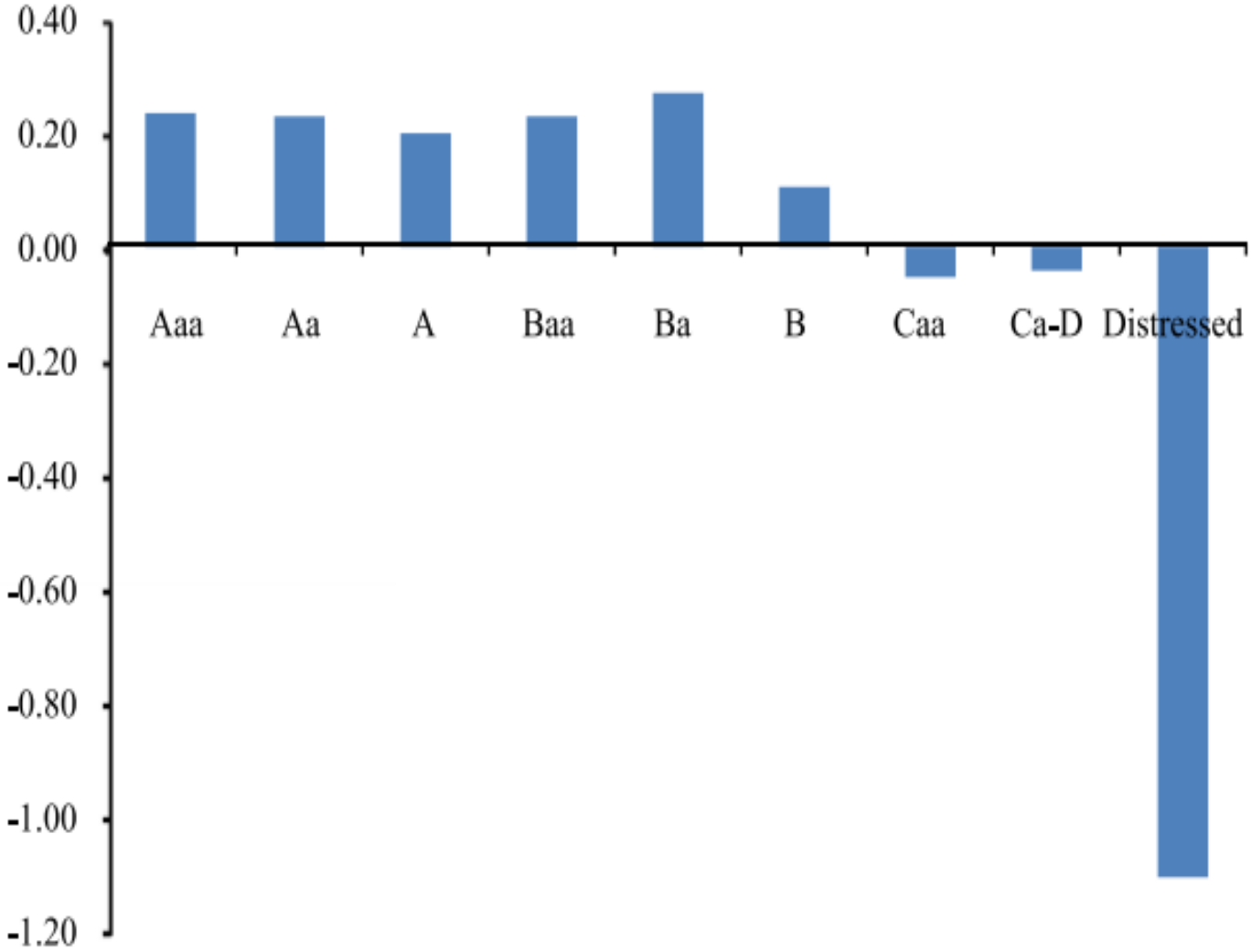
Betting against beta: International Equities



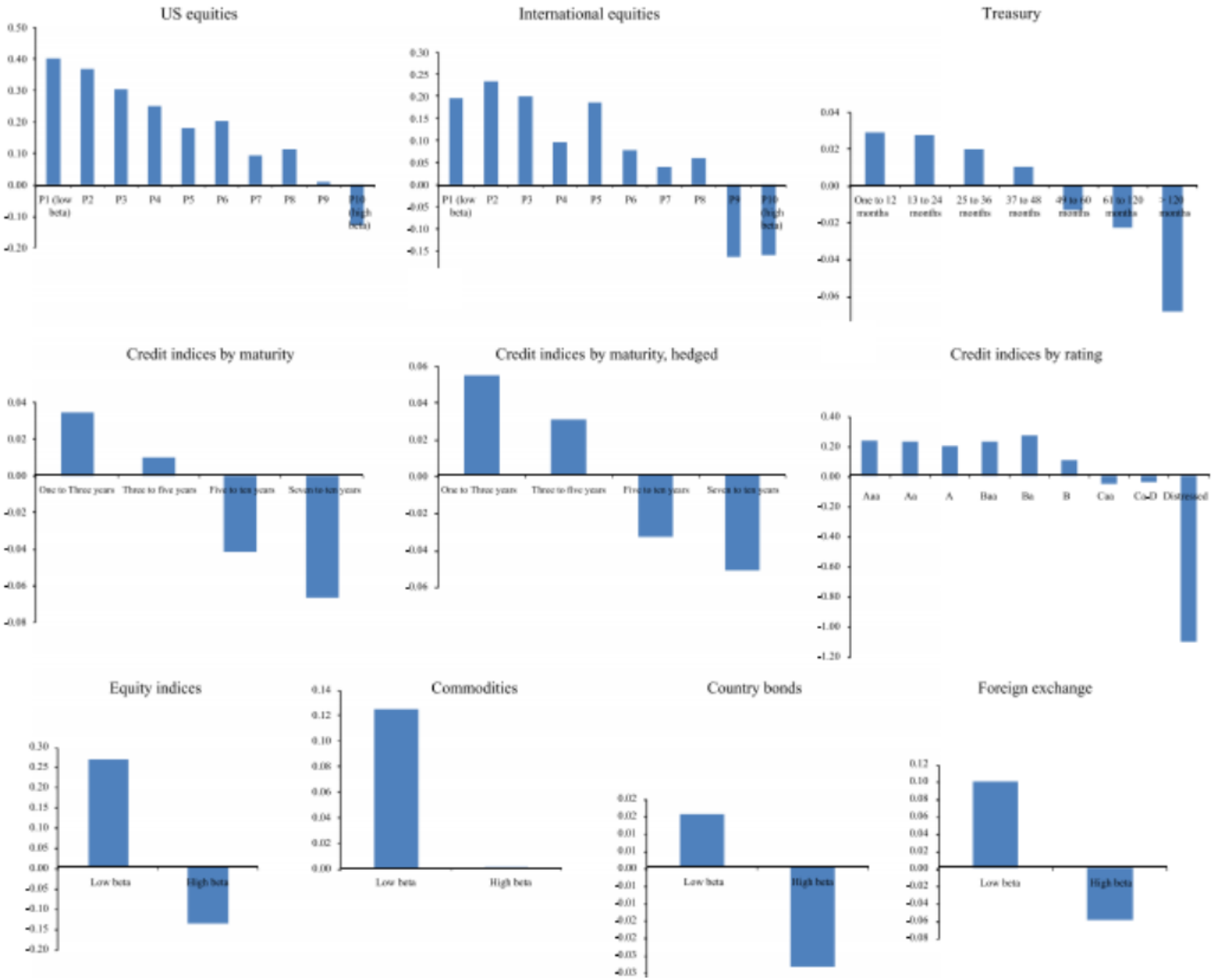
Betting against beta: Treasuries



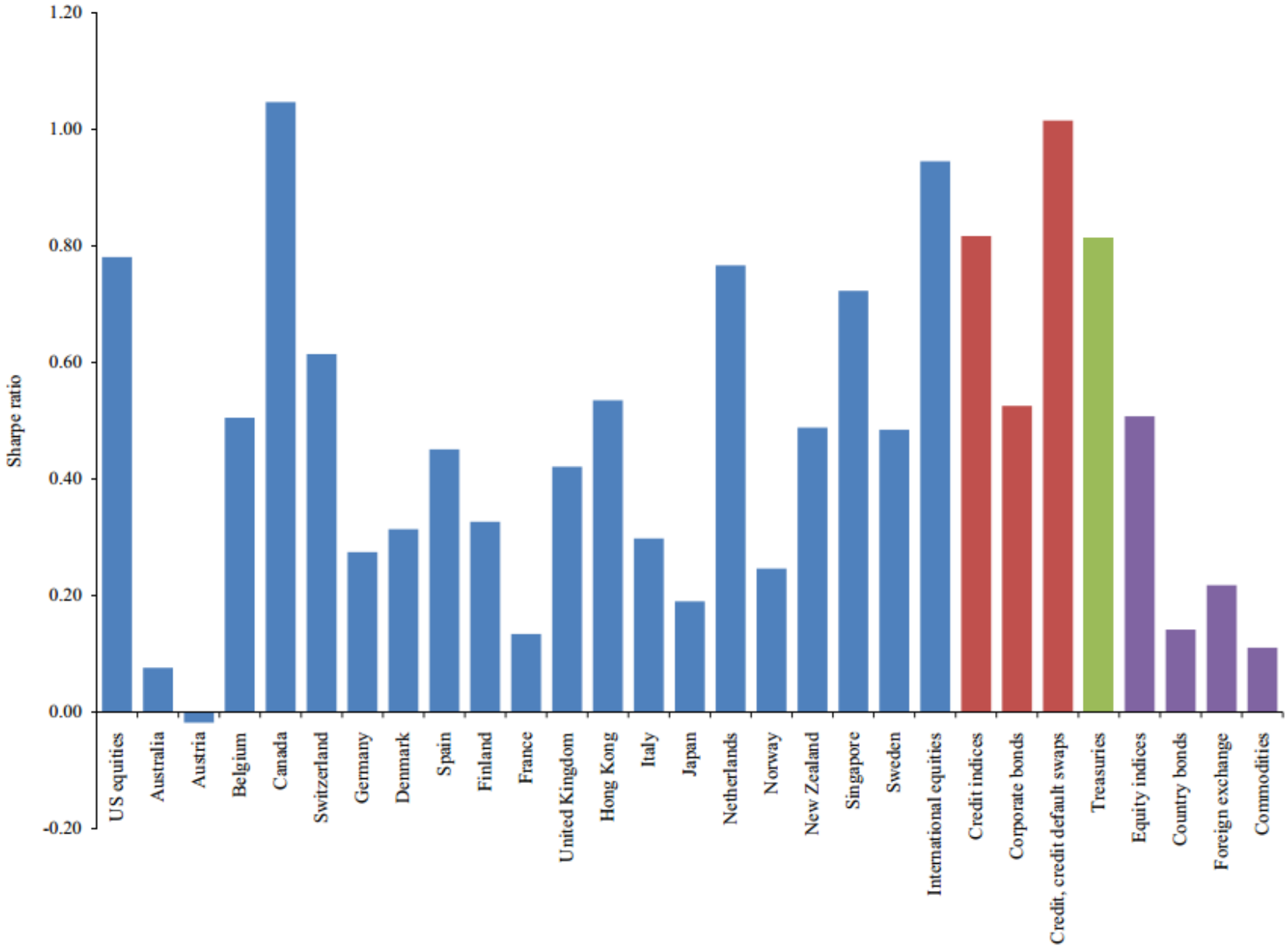
Betting against beta: Credit



Betting against beta: All markets



Betting against beta: All markets

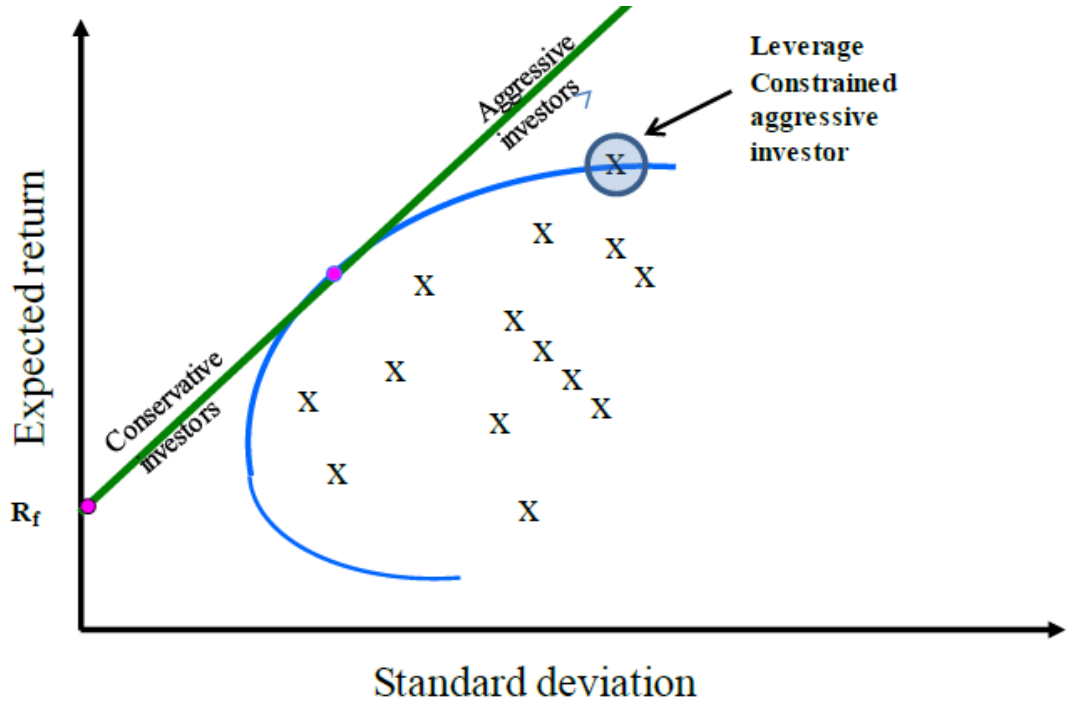


Betting against beta

- Betting against beta seems to generate large Sharpe ratios in many (though not all) markets
- Example: in US equities, eliminate market risk, earn a Sharpe ratio of 0.80
- Same for Treasuries
- Warning: this is still relatively new: risks aren't well understood.
- Might not work out of sample ...

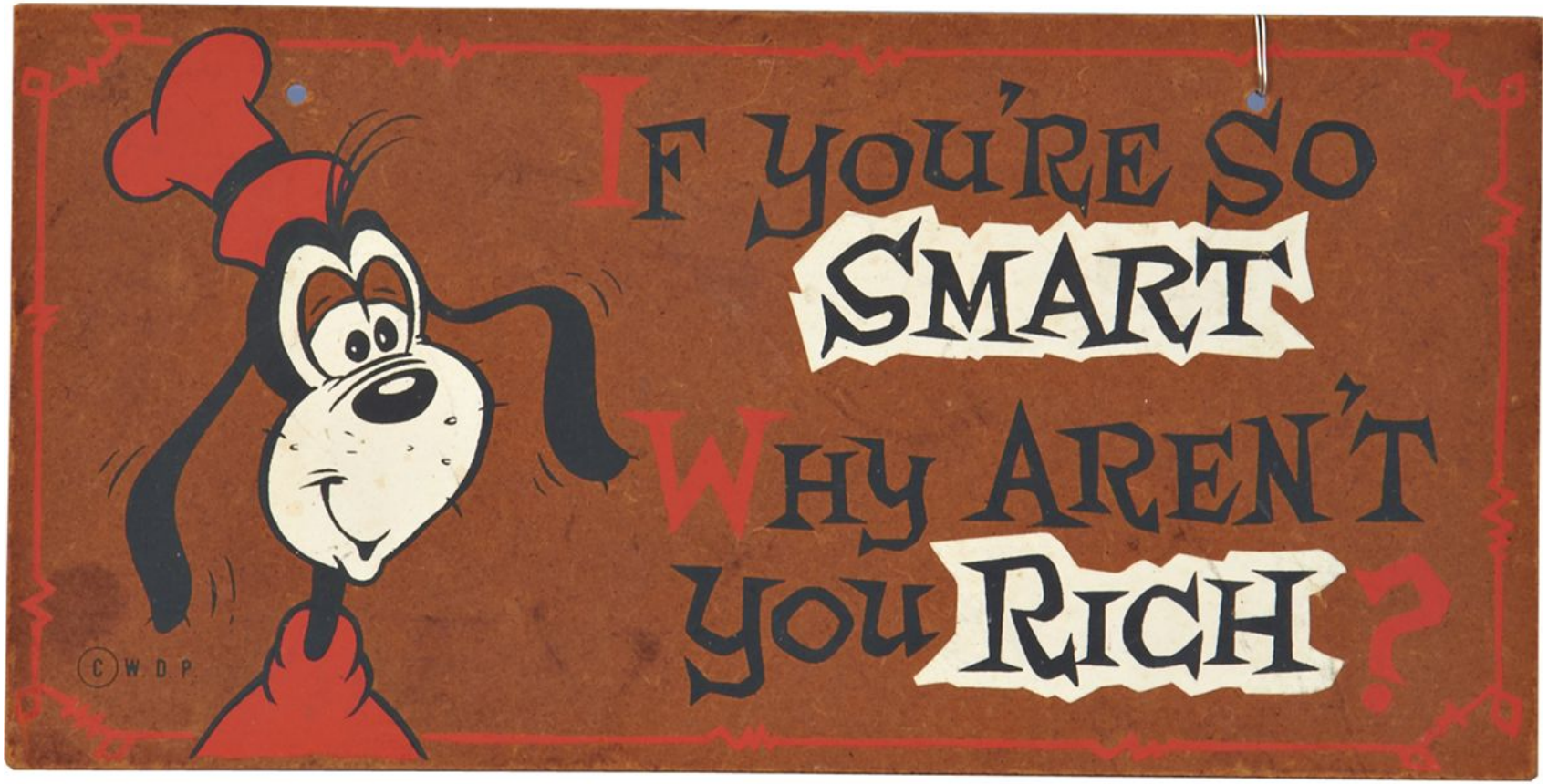
Explanation? Leverage Constraints Story

- Frazzini and Pedersen (2014) argue that many investors are unable to lever (borrow money) but would like to lever . . .
- . . . hence, they tilt their portfolios towards stocks with "built in" leverage like high beta stocks.
- Investors bid up the price of high beta stocks leading to a flat SML



Explanation? Leverage Constraints Story

- Sounds plausible. Many institutions may face this constraint.
- But not all. Why is everyone else leaving money on the table?
- Evidence stronger for stocks. But high beta stocks tend also to be growth stocks ...
- Frazzini and Petersen are currently employed by AQR


IF YOU'RE SO
SMART
WHY AREN'T
YOU RICH?
© W D P

AQR Equity Market Neutral Fund

9/30/2016

Performance as of 9/30/2016

			Annualized Total Return			
	QTD	YTD	1 Yr	3 Yr	5 Yr	Since Inception (10/07/2014)
Class I Shares: QMNIX	1.39%	1.66%	3.97%	N/A	N/A	12.64%
Class N Shares: QMNNX	1.31%	1.31%	3.64%	N/A	N/A	12.33%
Class R6 Shares: QMNRX	1.48%	1.65%	4.07%	N/A	N/A	12.71%
Merrill Lynch 3 Month T-Bill Index	0.10%	0.24%	0.27%	N/A	N/A	0.15%

As of the latest prospectus, the gross expense ratio for the for the Fund's Class I, Class N and Class R6 shares are 2.22%, 2.46% and 3.10%, respectively. Past performance does not guarantee future results. Investment returns and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance may be lower or higher than the performance data quoted. Call 1-866-290-2688 or visit www.aqrfunds.com for current month-end performance. The Merrill Lynch 3-Month Treasury Bill Index consists of U.S. Treasury Bills maturing in 90 days. Indexes are unmanaged and one cannot invest directly in an index.

About the Fund

Investment Objective:

Seeks positive absolute returns.

Reasons to Invest:

The Fund seeks to earn a positive total return over a full market cycle regardless of market conditions or general market direction.

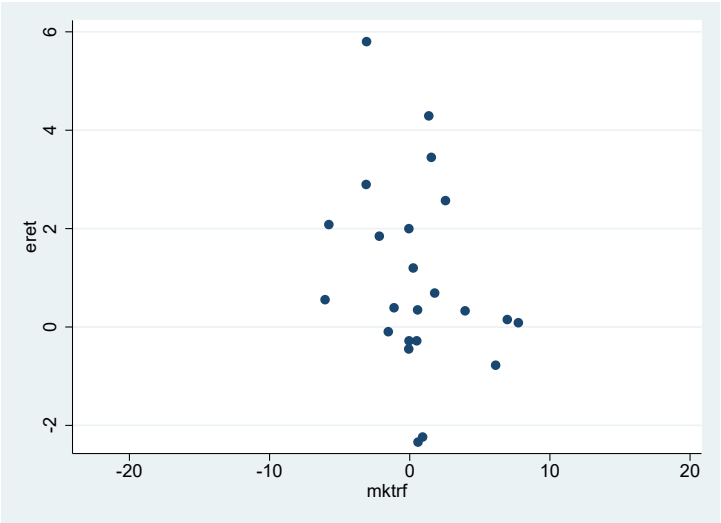
Key Advantages:

Breadth of Investment Themes

The Fund uses a set of value, momentum and quality indicators to generate an investment portfolio based on AQR's proprietary global security selection and asset allocation models.

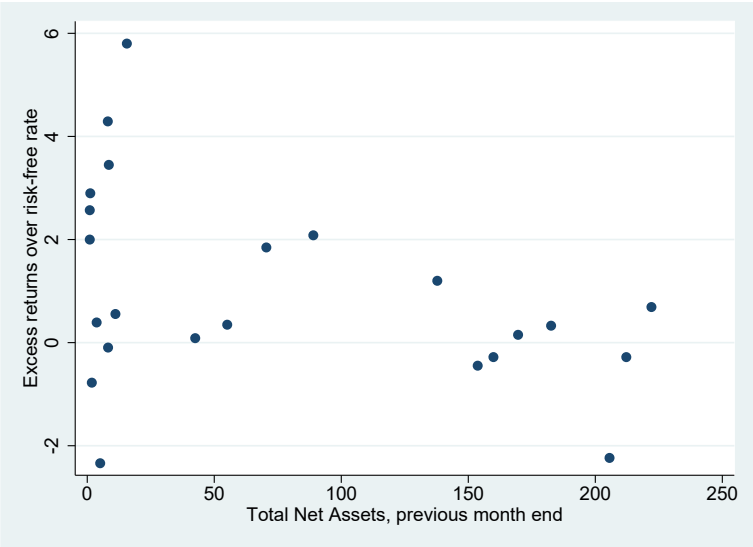
AQR equity-neutral fund seems indeed market-neutral

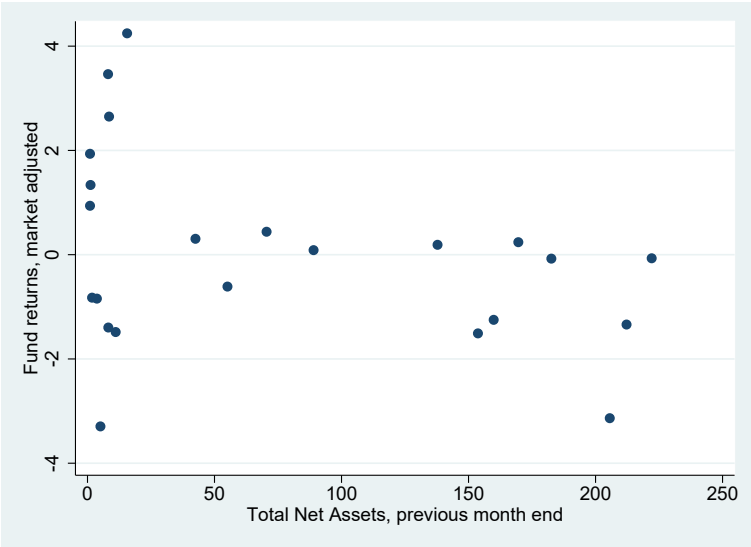
```
. keep if crsp_fundno== 062498 % CRSP id for QMNIX fund shares

. reg eret mktrf

      Source |       SS           df       MS      Number of obs   =        23
-------------+----------------------------------   F(1, 21)        =      1.99
       Model |  7.19441352         1  7.19441352   Prob > F        =    0.1734
    Residual |  76.0919333        21  3.62342539   R-squared       =    0.0864
-------------+----------------------------------   Adj R-squared   =    0.0429
       Total |  83.2863468        22  3.78574304   Root MSE        =    1.9035

------------------------------------------------------------------------------
        eret |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       mktrf |  -.1636762   .1161576    -1.41   0.173    -.4052392    .0778867
       _cons |   1.050821   .4013923     2.62   0.016     .2160805    1.885562
------------------------------------------------------------------------------
```



...with a few caveats

- Sample is quite short:
  - fund has only existed since 2014, so we only have 23 observations...
- Most of the high returns seem to have occurred while the fund was small...





- Decreasing returns to scale?

Summary

- Beating the market seems easy (on paper)
- Is this what professional asset managers do?
- If so, why pay management fees?
  - Growing market of ETF's that exploit anomalies cheaply (e.g. easy to find small and value funds; momentum is harder)
- Next week: how much value do money managers add?