URI Presentation

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Purpose

- A method to determine whether an asset-pricing model can be rejected.
- ...and/or to determine whether a variable is priced in the context of such a model.

- Method is simpler and easier to use (than sorts)
- ...and provides more power in most cases, thus being more useful if
  - the signal is weak (few firms, low signal per firm)
  - there are few months
  - variables are in close competition
- Our application is conceptual, not a trading strategy...

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Background I

Two testing methods in use today:

- Fama-Macbeth (1973) XS Regressions, Time-averaged.
  - Independent variables are measured with noise $\rightarrow$ Bias.
  - Sensitive to repackaging.
  - Often not seen as time-series of portfolio returns.
  - Interest often not in intercept, but in coefficients on ex-ante identified "signals"
- Black-Jensen-Scholes (Fama-French 1993) TS Regression
  - Inputs: One sorted portfolio.
  - Obvious portfolio interpretation—This is the "alpha" everyone talks about.
- Our paper: Combine the two. Will be obvious soon.

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Background II

- Academic Goal #1:

  Can a Benchmark Model be rejected?

- The most common empirical benchmark models today
  - the Fama-French (FF) model: B/M, M.
  - the UMD-augmented Fama-French-Carhart (FFC) model.
- Features:
  - “Common Factor” (Exposures) AP models.
  - Constructed primarily to explain high returns of value stocks and momentum stocks.

Plan

1. Illustrate the method (CAPM).
2. Show how good this method in the context of a particular paper, whose power depends all on sorting out which of two hghly-correlated variables matters.

Model

- Work with excess returns (i.e., net of the prevailing risk-free rate), so the CAPM becomes

$$E(R_i) = 0 + E(R_m) \cdot \beta_i$$

- There are 6 stocks and their true behavior is

$$\begin{aligned}
R_{A,t} &= -0.05 + R_m \cdot \beta_{A,t} + \epsilon_{A,t} \\
R_{B,t} &= -0.02 + R_m \cdot \beta_{B,t} + \epsilon_{B,t} \\
R_{C,t} &= 0.00 + R_m \cdot \beta_{C,t} + \epsilon_{C,t} \\
R_{D,t} &= +0.01 + R_m \cdot \beta_{D,t} + \epsilon_{D,t} \\
R_{E,t} &= +0.02 + R_m \cdot \beta_{E,t} + \epsilon_{E,t} \\
R_{F,t} &= +0.04 + R_m \cdot \beta_{F,t} + \epsilon_{F,t}
\end{aligned}$$

  epsilons are iid. stocks are equal-sized.

- Say, you have the signals—*A* will underperform –0.05, *B* –0.02, etc.

Forming The Test Portfolio

- BJS and FF Method: Sort stocks into test portfolios based on strength of signal. Typically three, sometimes five portfolios. For test, omit the middle percentiles. (Often two-dimensional sorting.)
- Here, sort test portfolio on tertiales, omitting middle is

$$w = (-0.5, -0.5, 0, 0, 0.5, 0.5)$$

  - Zero Investment.
  - Equal weights into two extreme portfolios.
  - Return is $w'R$.

- What is a better test portfolio?
  - We want to give more weight to A than to B, more weight to F than to E, and some weight to D.

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Let's Change Portfolio Formation Method

- Why Sorts?
- Why not optimize an objective?
  - OK, non-parametric tests have their uses, too, but the usual approach would be a linear form. We run regression lines, not extremes.
  - Optimized portfolios are easier to use than sorts.
  - Optimized portfolios can control for more variables. Sorts limited to three.
  - Changing number of sort groups can change inferences.
  - Middle sort groups often dropped in final analysis.
  - Ignores variation in targeted variable within groups.
  - Not easy to include information about exposure accuracy.
  - Equal vs value weighting arbitrary?

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Portfolio Objective

Find w_i:

$$\min_{w_i} \sum_i w_i^2 \cdot \widehat{\mathcal{V}ar(a_i)}$$

subject to the constraints that

$$\begin{aligned} \sum_i w_i &= 0 && \text{Zero investment} \\ \sum_i w_i \cdot S_i &= 1 && \text{Exposure to Signal} \end{aligned}$$

Fama (1976), Chapter 9, Section 1C shows construction

The Better Test Portfolio

Define

$$\mathbf{X} = \begin{pmatrix} 1 & S_A \\ 1 & S_B \\ 1 & S_C \\ 1 & S_D \\ 1 & S_E \\ 1 & S_F \end{pmatrix} = \begin{pmatrix} 1 & -0.05 \\ 1 & -0.02 \\ 1 & 0.00 \\ 1 & 0.01 \\ 1 & 0.02 \\ 1 & 0.04 \end{pmatrix}$$

- Compute $(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'$, which is a 2 by N matrix.

$$\mathbf{W} = \begin{pmatrix} 0.167 & 0.167 & 0.167 & 0.167 & 0.167 & 0.167 \\ -10 & -4 & 0 & 2 & 4 & 8 \end{pmatrix}$$

The Better Test Portfolio

$$\mathbf{W} = \begin{pmatrix} 0.167 & 0.167 & 0.167 & 0.167 & 0.167 & 0.167 \\ -10 & -4 & 0 & 2 & 4 & 8 \end{pmatrix}$$

- The first row are the investment weights in a portfolio that costs \$1 and has no exposure to the signal.

$$\mathbf{W}(\mathbf{X}[,1]) = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}(\mathbf{X}[,1]) = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}\vec{1} = (1,0)$$

- The second row are the investment weights in a portfolio that costs \$0 and has unit exposure to the signal, i.e.,

$$\mathbf{W}(\mathbf{X}[,2]) = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}(\mathbf{X}[,2]) = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}\vec{S} = (0,1)$$

- These two test portfolios are the minimum-variance portfolios with these attributes under certain (reasonable linear) model assumptions.

Calculation

- An easy way to calculate the rate of return on this test portfolio is to run a Fama-Macbeth cross-sectional regression.
- Note: in FM, the rate of return is one-period ahead. (The portfolio is formed 1 period ago.)
- The gamma (γ_S) is the test pfio's rate of return.
- Fama-Macbeth's test statistic is for the model

$$\gamma_S = \overline{\gamma} + \epsilon_t$$

  which is tested by computing the mean of the coefficients (γ_S).
- Our test statistic is for a BJS model

$$\gamma_S = \overline{\gamma} + \beta \cdot R_{M,t} + \epsilon_t$$

  AP model gets its "second chance" to explain gammas.
- If you like FM, you should like our method.

Scaling Zero-Investment Portfolios

- Note that a zero-investment portfolio can be scaled arbitrarily. That is

$$w_1 = (-10, -4, 0, 2, 4, 8)$$

and

$$w_2 = (-0.5, -0.2, 0, 0.1, 0.2, 0.4)$$

will give you the same inference (but not magnitude!) on alpha in your model later on.

- If you want to compare alpha's magnitude to typical sort portfolios' magnitudes, then you should normalize investment weights to be sum-long is 1 and sum-short is 1. (This is a scaled version of the FM γ_1.)

Gain in Power

- Model is (net of risk-free) APT or CAPM

$$R_i = R_m + \epsilon_{i,t}$$

- Define average epsilon for stock i its perfect signal, p_i. Some stocks will have done better, others worse.
- Define your signal accuracy:

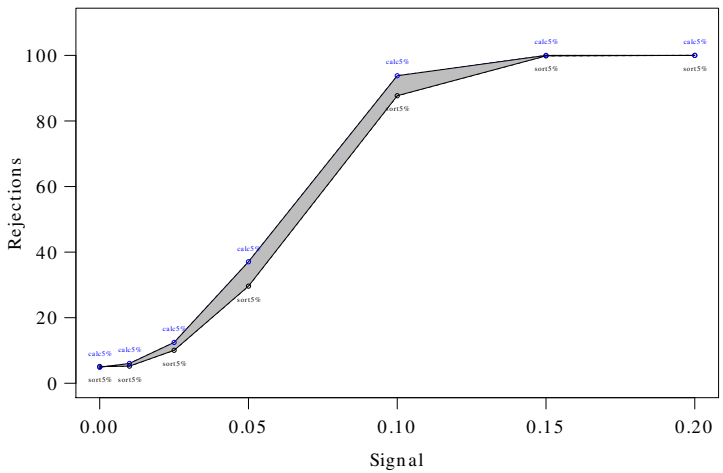
$$a \cdot S_i + (1 - a) \cdot \nu$$

  where S_i is normalized and ν is pure noise.
- If such a signal exists, then the model is false.
- Can you reject the model?
- Tertiale sorting vs. Calculated portfolios.

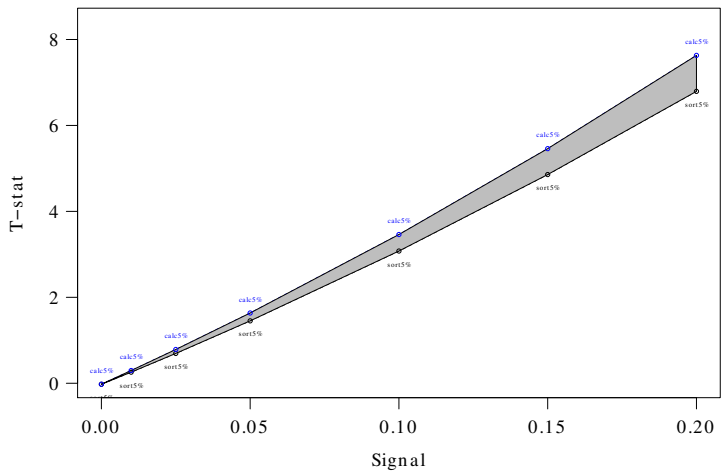
Gain in Power

- (1000 firms. 80 years. different accuracy levels.)
-

Rejection Level



T-statistic



- Typical Gain in T-stats: 14%.
- Approximately the same gain as 25% more months.

Return To Task

1. Illustrate the method (CAPM).
2. Show how good this method in the context of a particular paper, whose power depends all on sorting out which of two hghly-correlated variables matters.

Daniel-Titman (1997) Challenge

- Fama-French (1993) argued that firm's own book-to-market ratio could predict future stock returns only because it proxied for each firm's exposure to an "HML" factor.
- Put differently, they argue that value firms are different from growth firms, and when one value firm goes up, so will others. They earn higher rates of returns on average because of their "common component."

- So what predicts returns better? Firms' exposure (beta) to the HML factor, or firms' own book-to-market ratio?

Daniel-Titman (1997) Challenge

- An important challenge to the FF model came from Daniel-Titman (1997).
  - Main Focus: HML and book-to-market.
  - Argues that own book-to-market could predict stock returns because it is a (behavioral) characteristic and not because it is an exposure to a common factor.
  - Brattle Prize. Many Reprints.
  - Sparked Followup by Davis-Fama-French.

Daniel-Titman (1997)

- $\hat{h}$ is each firm's exposure to HML.
- Naive test: Stick both HML exposure ($\hat{h}$) and Log(BE/ME) into a Fama-Macbeth regression.

No: Measurement error in exposures biases Fama-Macbeth test against the AP model. Gammas would indicate no power on h and a lot of power on Log(BE/ME).

- Construct an "**incongruence**" zero-investment portfolio.
  - Long in stocks with high $\hat{h}$ and low log(BE/ME).
  - Short in stocks with low $\hat{h}$ and high log(BE/ME).

Portfolio construction details are "gruesome."

- Double independent sorts with trouble filling corner portfolios, followed by another sort. Value-weighting within and equal-weighting across portfolios.

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Effect of Measurement Error in Exposure Calculations

- Test portfolios will be weaker.
- AP Model is not more likely to be rejected. It has the *ex-post* factors in them, too. In fact, it is less likely to be rejected.
- In FM, the AP model was more likely to be rejected if exposures are poorly estimated.

- Note that this highlights the EIV problem with the rates of returns on the factors. Then again, the question is whether this AP model *IS* the right AP model.

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Daniel-Titman Test

- Regress time series of returns of the incongruence portfolio on benchmark model (FF).
- If alpha is zero, then the benchmark model can explain the return influence of the characteristic.

$$\Rightarrow \text{“book-to-market” is a factor exposure.}$$

- If alpha is negative, then the benchmark model cannot explain the return influence of the characteristic.

$$\Rightarrow \text{“book-to-market” is a characteristic.}$$

Daniel-Titman Evidence and Conclusion

7/1973–12/1993, 246 mo:

			⇓ Alpha	⇓ T-stat	b	s	h	u
DT	[157%]	**–0.30%***	**(–3.16)**	1%,	4%,	**49%***,	
		–0.24%*	**(–2.37)**	1%,	3%,	**48%***,	–6%

$\Rightarrow$ Book-To-Market is a Characteristic.

Davis-Fama-French Evidence and Conclusion

7/1929–6/1997, 816 mo (instead of 7/1973–12/1993, 246 mo):

			⇓	⇓				
		$\hat{h}$	Alpha	T-stat	b	s	h	u
DFF	[155%]		–0.04%	(–0.65)	**–5%***,	**9%***,	**40%***,	
			–0.08%	(–1.18)	**–5%***,	**9%***,	**42%***,	4%

$\Rightarrow$ DT period was unusual.

$\Rightarrow$ Book-To-Market is a Factor Exposure.

Daniel-Titman-Wei Response

- Not enough variation (incongruence) before 1973.
- You should believe DT and not DFF

State of the Art

- Why Kent and Sheridan will find our paper “not interesting”:

(Tongue in Cheek, of course.)

Extend sample only forward. 7/1973 **–12/2008** , 426 mo:

⇓ ⇓

	$\hat{h}$	Alpha	T-stat	b	s	h	u
	[182%]	–0.01%	(–0.09)	–1%,	3%,	**53%***,	
		–0.07%	(–0.77)	-0%,	3%,	**54%***,	7%

⇒ DFF were correct. DT period was unusual.
⇒ Book-To-Market is clearly a Factor Exposure.
⇒ Daniel-Titman (1997) is, plainly, obsolete.

⇓ ⇓

	$\hat{h}$	Alpha	T-stat	b	s	h	u
Overall	[165%]	0.04%	(+0.71)	**–6%***,	**7%***,	**44%***,	
		–0.03%	(–0.49)	**–5%***,	**7%***,	**47%***,	**7%***

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- Why Sorts?
- Let's optimize an objective.
  - OK, non-parametric tests have their uses, too, but the gold standard is a linear form.
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OLS Objective

- If $\mathcal{V}ar(a_i) = c$, these are Fama-Macbeth equivalent pfios. This was shown by Fama (1976), Chapter 9, Section 1C.
- In each month, create **X** matrix with lagged information in columns for N firms (rows):
  - constant
  - Log(ME)
  - Log(BE/ME)
  - $\hat{h}$ Exposure

  The fourth row in $\mathbf{W} = (\mathbf{X'X})^{-1}\mathbf{X'}$ is a portfolio that has
  - Zero Investment Weights ($\sum w_i = 0$)
  - Zero Investment-weighted Market-Cap ($\sum w_i \cdot \log(\text{ME}_i) = 0$)
  - Zero Investment-weighted Book-To-Market Characteristic. ($\sum w_i \cdot \log(\text{BE}_i/\text{ME}_i) = 0$)
  - Positive loading on (ex-ante) HML Exposure.

Optimized Portfolios

- Are parsimonious and simple.
- Use same information as the sorts.
- Use all firms.
- Do not require ex-ante N-group choice.
- Put more weight on firms with more x inside portfolios, too.
- Can control for more dimensions.
- Can use WLS machinery for value-weighting or heteroskedasticity or ...

Omitted: Input Exposures from Daily Stock Returns are Better.

Remainder of Our Paper

- Why Ken and Gene will find our paper “not interesting.”

(Tongue in Cheek, of course.)

- We will show that book-to-market in their benchmark model is a characteristic, not a factor...in all sample periods.

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Back to Where Fama-French Won't Like Us

Optimized Portfolios:

			⇓	⇓				
	$\hat{h}$	Alpha	T-stat	b	s	h	u	
Overall	[105%]	–0.12%	(–1.85)	–3%,	**–7%***,	**56%***,		
Overall	[105%]	**–0.25%***	**(–3.26)**	0%,	**–6%***,	**61%***,	**12%***	
DFF	[101%]	**–0.15%***	**(–2.28)**	-0%,	–3%,	**48%***,		
DFF	[101%]	**–0.25%***	**(–3.64)**	1%,	–2%,	**53%***,	**10%***	
DT	[108%]	**–0.38%***	**(–3.58)**	1%,	–1%,	**68%***,		
DT	[108%]	**–0.43%***	**(–3.92)**	1%,	0%,	**69%***,	6%	

Even Better...

Instead of holding net $\log(BE_i/ME_i)$ at zero and pushing $\hat{h}_i$ positive, let's push (standardized) $\hat{h}_i$ minus $\log(BE_i/ME_i)$

		⇓ $\hat{h}$	⇓ Alpha	T-stat	b	s	h	u
Overall	[84%]	**–0.16%***	**(–2.74)**	–2%,	1%,	**27%***,	
Overall	[83%]	**–0.29%***	**(–4.51)**	1%,	2%,	**30%***,	**12%***
DFF	[82%]	**–0.19%***	**(–3.06)**	0%,	1%,	**21%***,	
DFF	[81%]	**–0.32%***	**(–4.70)**	2%,	3%,	**25%***,	**12%***
DT	[91%]	**–0.48%***	**(–4.68)**	2%,	7%,	**43%***,	
DT	[91%]	**–0.54%***	**(–5.08)**	2%,	**8%***,	**44%***,	**6%***

Stable

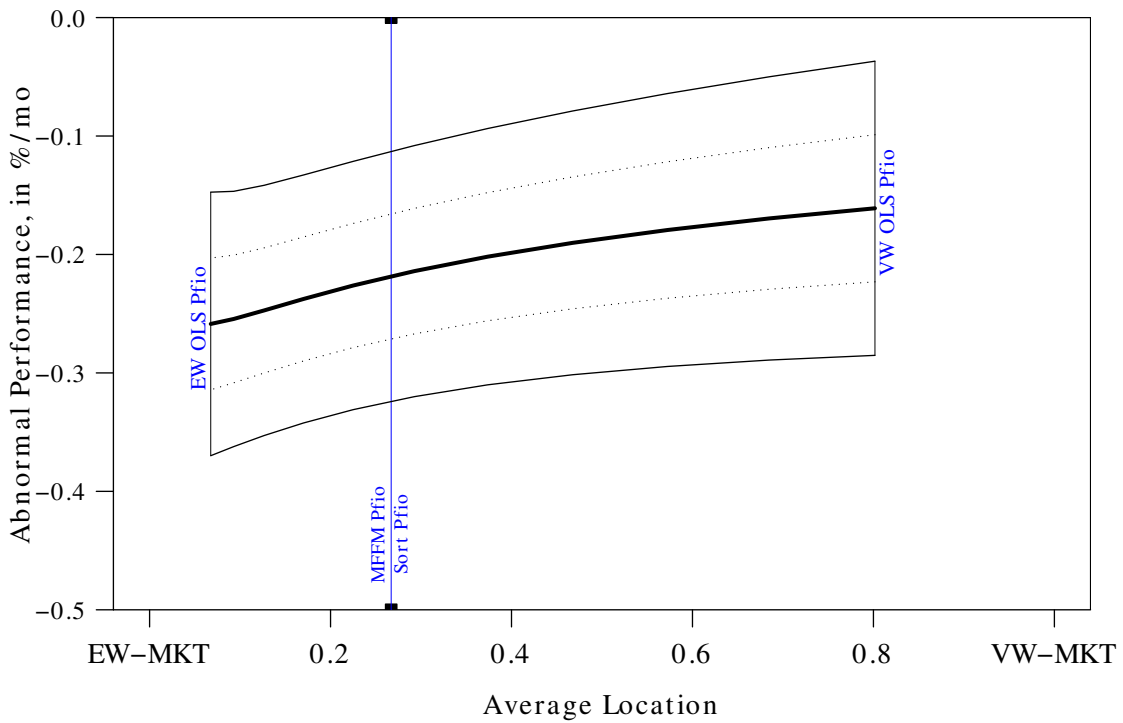
		⇓	⇓				
	$\hat{h}$	Alpha	T-stat	b	s	h	u
-6/1963	[74%]	**–0.21%***	**(–2.14)**	**6%***,	1%,	**10%***,	
-6/1963	[73%]	**–0.34%***	**(–3.29)**	**9%***,	3%,	**14%***,	**13%***
7/1963-	[92%]	**–0.22%***	**(–3.26)**	0%,	**7%***,	**47%***,	
7/1963-	[91%]	**–0.33%***	**(–4.36)**	2%,	**7%***,	**49%***,	**10%***
1/1994-	[97%]	–0.17%	(–1.34)	–1%,	**11%***,	**54%***,	
1/1994-	[97%]	**–0.29%***	**(–2.00)**	4%,	**9%***,	**57%***,	**11%***

Robust

- Holds when we value-weight portfolio (WLS) according to marketcap ($\mathbf{W}(e) = (\mathbf{X}' \Omega^{e/2} \mathbf{X})^{-1} \mathbf{X}' \Omega^{e/2}$).
- Holds when we control for more factors ex-ante (including momentum).
- Holds when we allow for heteroskedasticity.
- Holds outside Januaries.

Robust—Multi-Control

- Philosophically, same or better than sorting ex-ante to hold marketcap fixed.
- Improves when we control for more factors ex-ante (including momentum).



Switch

- Optimized Portfolios Now on FF Factors, not on Incongruency Pfios.

- Inputs into Matrix **X** (**W**):
  - log(ME),
  - log(BE/ME),
  - Market-Beta,
  - Own Momentum.
- Report on log(ME), log(BE/ME), **VWMKT**, Momentum.
- "Balanced Portfolios" (i.e., multi-controlled)

Replace Fama-French Factors Themselves?

HML	Mean	Sd	Sharpe	Corr
Original-FF	0.43%	3.61%	11.9%	100%
EW,Balanced	0.46%	2.95%	15.5%	79%
Volat-adj,Balanced	0.52%	3.13%	16.5%	77%
MFFM,Balanced	0.36%	2.62%	13.6%	85%

SMB	Mean	Sd	Sharpe	Corr
Original-FF	0.26%	3.36%	7.8%	100%
EW,Balanced	0.40%	4.38%	9.0%	82%
Volat-adj,Balanced	0.44%	4.59%	9.6%	80%
MFFM,Balanced	0.27%	3.65%	7.4%	90%

PS: **UMD** is the same (15.7% vs. 16.4%, 15.5%, and 16.4%)

Incongruence Test on Alternative Benchmark Models

Book-To-Market, Marketcap, VWMKT, Momentum Optimized Factor Replacement Models:

- Volatility Adjusted can price its own incongruence portfolio.
- EW can price its own incongruence portfolio much better than original FF.
- MFFM cannot. (Marketcap must play a role in factor quality!)

Incongruence Test on Optimized-Factor Benchmark Models

(Overall Sample.)

	$\hat{h}$	Alpha ⇓	T-stat ⇓	b	s	h	u
Overall	[84‹	**–0.16%***	**(–2.74)**	–2%	1%	**27%**	
...	[83‹	**–0.29%***	**(–4.51)**	1%	2%	**30%**	**12%**
...EW	[81%]	–0.05%	(–0.78)	**–6%***,	**16%***,	–1%,	
...	[80%]	**–0.16%***	**(–2.30)**	–5%,	**18%***,	5%,	**10%***
...Volat-adj	[66%]	0.01%	(+0.19)	**–7%***,	**10%***,	2%,	
...	[65%]	–0.08%	(–1.33)	**–7%***,	**12%***,	7%,	**9%***
...MFFM	[87%]	–0.13%	(–1.79)	–3%,	**14%***,	–1%,	
...	[85%]	**–0.30%***	**(–3.69)**	–1%,	**16%***,	9%,	**19%***

Related Work

Rest of presentation is a random collection of work in progress and questions to you (also viewable as potential ideas).

Market-Beta

Related paper analyzes the role of beta

- “Purge spikes” = forward-looking.
  “Spikes” = backward-looking.
- Appears that beta itself has a “characteristic” component to it, too, which is backward-looking and which has a negative infuence on future stock returns.
- Beta’s forward-looking aspect (“exposure”) is appropriately positively priced.
- There is a strong “attention component” interaction with market-beta. This can potentially be exploited for a trading strategy.

Related Work

- Does momentum accuracy matter?
- Can we reduce the noise in momentum as a predictor of future stock returns.
- Yes! Momentum is forward-looking. It can be improved by purging it from noise. (Dominates Grinblatt-Moskowitz uncertainty+momentum approach.)

Questions You Can Answer For Me

- How do you exploit large scale?
  - Intelligent Market-making?
  - Cross-market participation?
  - Storage + Spot/Futures?
  - Publicity?
  - Control? (AMD-ATI = $6B. NVDA=$9.5B.)
  - How can you steal clients of GSAM, Fidelity, Blackrock, AQR?
  - Who has performed poorly?
  - What can you do differently? ("out of the box")
  - How sellable is integrity? (PS: Even if integrity is not in demand by clients, I would not work for a firm that acts inappropriately, even if legal.)
- How do you deal with manipulable performance ratios?
  - Consider xr of $+10\%, +11\%, +11\%, \ldots, +200\%$. If you throw away 190%, your Sharpe ratio goes up. Does our competition manage their Sharpe ratios? Is arithmetic return performance with different volatilities badly misleading?
- What is the optimal way to hedge portfolios?
  - Can you measure exposures better? in crashes?
  - What should you hedge, what should you load up on?

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More Questions For You

- “Value” seems to be like writing liquidity or options—it makes money a lot of the time but then blows up.
  - Would it make sense to purchase OOM insurance? How?
- Other Academic Papers?
  - Refined Momentum and Value?
  - Net Issuing
  - Index Drops and Fallen Angels
  - Trust Funds?
  - What about media coverage, attention, and neglect?
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Questions Too easy?

- Can known exchange rate (and commodity) movements predict earnings of heavily international firms?
- What do you know about what other funds and investors are doing? Does it matter *who* has been buying/selling? Can you avoid correlated collapses? (And should you, if it costs us performance in up markets?)
- Are there strategies that used to be in vogue, were tried, collapsed, and that are now underserved? (Minimum-variance portfolio?)
- What assets are distressed right now (and won't die if you go into a prolonged recession)?
    - Can you look out of the box and create a real+financial leg strategy? (E.g., hedged Florida Real Estate.)
- How do you use qualitative assessments with quant data?

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Conclusion

Our main paper

- was not about finding novel high-alpha strategies. (Sorry.)
- shows Daniel-Titman is obsolete
  (incongruence sort pfios can be priced)
- advocates optimized pfios instead of sort pfios.
- shows that optimized pfios are better **test** pfios.
- shows optimized incongruence portfolios cannot be priced by the Fama-French model.
- shows optimized **factor** portfolios can be better, too.
- shows some optimized factor benchmark models can price their own incongruence portfolios.

`http://ssrn.com/abstract=1327004`: Optimized vs. Sort-Based Portfolios