Lecture Notes

Lin and Zhang (2012, J. of Monetary Economics): The Investment Manifesto

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Theme

The investment approach is no more and no less "causal" than the consumption approach in "explaining" anomalies

- Asset pricing is not all about the pricing kernel
- The investment approach is a new basis for asset pricing research

Theme

The investment approach questions the risk doctrine:

- If a characteristic-return relation is consistent with "rationality," the relation must be "explained" by a risk (factor) model

How?

- The risk doctrine ignores measurement errors in risk proxies
- The risk doctrine misinterprets risks as "determinants" of expected returns

Outline

Outline

The Risk Doctrine

Fama and French (1996, p. 57):

“[T]he empirical successes of [the three-factor model] suggest that it is an equilibrium pricing model, a three-factor version of Merton’s (1973) intertemporal CAPM (ICAPM) or Ross’s (1976) arbitrage pricing theory (APT). In this view, SMB and HML mimic combinations of two underlying risk factors or state variables of special hedging concern to investors.”

The Risk Doctrine

Daniel and Titman (1997, p. 4):

"Our results are disturbing in that, . . ., they suggest that traditional measures of risk do not determine expected returns. In equilibrium asset pricing models the covariance structure of returns determines expected returns. Yet we find that variables that reliably predict the future covariance structure do not predict future returns."

Outline

The Investment Approach

A two-period version of the Long and Plosser (1983, "Real business cycles") model as the organizing framework

$$\max_{\{C_0, C_1, S_{i1}\}} \quad U(C_0) + \rho E_0[U(C_1)]$$

$$\text{s.t.} \quad C_0 + \sum_i P_{i0} S_{i1} = \sum_i (P_{i0} + D_{i0}) S_{i0}$$

$$C_1 = \sum_i (P_{i1} + D_{i1}) S_{i1}$$

First-order condition:

$$E_0[M_1 r_{i1}^S] = 1 \quad \Leftrightarrow \quad E_0[r_{i1}^S] - r_f = \beta_i^M \lambda_M$$

The Investment Approach

Heterogeneous firms, indexed by i

$$P_{i0} + D_{i0} \equiv \max_{\{I_{i0}\}} \left[\Pi_{i0} K_{i0} - I_{i0} - \frac{a}{2} \left(\frac{I_{i0}}{K_{i0}} \right)^2 K_{i0} + E_0 \left[M_1 \Pi_{i1} K_{i1} \right] \right].$$

First-order condition:

$$1 + a \frac{I_{i0}}{K_{i0}} = E_0 \left[M_1 \Pi_{i1} \right] \quad \Rightarrow \quad 1 = E_0 \left[M_1 \frac{\Pi_{i1}}{1 + a \frac{I_{i0}}{K_{i0}}} \right]$$

$$\frac{P_{i1} + D_{i1}}{P_{i0}} \equiv r_{i1}^S = r_{i1}^I \equiv \frac{\Pi_{i1}}{1 + a \frac{I_{i0}}{K_{i0}}}$$

A microfoundation for the WACC approach to capital budgeting

The evidence that characteristics predicting returns is consistent with the investment approach, does not necessarily mean mispricing

The consumption approach and the investment approach deliver identical expected returns in general equilibrium:

$$r_f + \beta_i^M \lambda_M = E_0[r_{i1}^S] = \frac{E_0[\Pi_{i1}]}{1 + a\frac{I_{i0}}{K_{i0}}}$$

- Consumption: Covariances are sufficient statistics of $E_0[r_{i1}^S]$
- Investment: Characteristics are sufficient statistics of $E_0[r_{i1}^S]$

Outline

Char.-based factors $\neq$ Risk Factors

Why the Fama-French (1996) interpretation is too strong

Brock (1982) derives ICAPM/APT for stock returns by assuming a vector of F aggregate technological uncertainties:

$$\Pi_{it} \equiv \sum_{f=1}^{F} L_{it}^{f} \tilde{X}_{t}^{f} \quad \Rightarrow \quad r_{i1}^{S} = \sum_{f=1}^{F} \frac{L_{i1}^{f}}{1 + a\frac{I_{i0}}{K_{i0}}} \tilde{X}_{1}^{f}$$

Characteristics-based factor models as linear approximations to the investment return equation:

$$r_{i1}^{S} \equiv \frac{\Pi_{i1}}{1 + a\frac{I_{i0}}{K_{i0}}}$$

Outline

Measurement Errors

If equivalent, why do characteristics often dominate covariances in the CvC tests?

Use the Zhang (2005) model to quantify the impact of measurement errors on the CvC tests

Even though the model admits a dynamic covariance structure, characteristics dominate covariances in the model's simulations

Production: $\Pi_{it} = X_t Z_{it} K_{it}^{\alpha} - f$

- Aggregate productivity, $x_t \equiv \log X_t$, assume:

$$x_{t+1} = \bar{x}(1 - \rho_x) + \rho_x x_t + \sigma_x \mu_{t+1}$$

- Firm-specific productivity, $z_{it} \equiv \log Z_{it}$ for firm i, assume:

$$z_{it+1} = \rho_z z_{it} + \sigma_z \nu_{it+1}$$

The pricing kernel:

$$M_{t+1} = \eta \exp\left[[\gamma_0 + \gamma_1(x_t - \bar{x})](x_t - x_{t+1})\right]$$

Capital accumulation: $K_{it+1} = I_{it} + (1-\delta)K_{it}$

Asymmetric adjustment costs:

$$\Phi(I_{it}, K_{it}) = \begin{cases} a^+ K_{it} + \frac{c^+}{2}\left(\frac{I_{it}}{K_{it}}\right)^2 K_{it} & \text{for} \quad I_{it} > 0 \\ 0 & \text{for} \quad I_{it} = 0 \\ a^- K_{it} + \frac{c^-}{2}\left(\frac{I_{it}}{K_{it}}\right)^2 K_{it} & \text{for} \quad I_{it} < 0 \end{cases}$$

in which $a^- > a^+ > 0$, and $c^- > c^+ > 0$

The cum-dividend market value of equity, $V(K_{it}, X_t, Z_{it})$:

$$\max_{\{I_{it}\}} \Pi_{it} - I_{it} - \Phi(I_{it}, K_{it}) + E_t\left[M_{t+1} V(K_{it+1}, X_{t+1}, Z_{it+1})\right]$$

Measurement Errors

Mean monthly percentage excess returns of the 25 portfolios formed on book-to-market and HML loadings in the data per the Daniel and Titman (1997) test design

	HML loadings					
	Low	2	3	4	High	All
Low	0.28	0.29	0.37	0.48	0.42	0.37
2	0.58	0.40	0.73	0.66	0.92	0.66
3	0.84	0.58	0.57	0.84	0.93	0.75
4	0.50	0.54	0.70	0.74	0.83	0.66
High	1.05	1.04	0.99	0.90	1.34	1.07
All	0.65	0.57	0.67	0.72	0.89	

Return spread: 0.70% from B/M versus 0.24% from HML loadings

Measurement Errors

Mean monthly percentage excess returns of the 25 portfolios formed on book-to-market and HML loadings in the model

	HML loadings					
	Low	2	3	4	High	All
Low	0.65	0.64	0.64	0.65	0.66	0.65
2	0.71	0.70	0.69	0.70	0.72	0.70
3	0.76	0.76	0.76	0.76	0.77	0.76
4	0.82	0.81	0.81	0.82	0.85	0.82
High	0.96	0.93	0.94	0.96	1.01	0.96
All	0.78	0.77	0.77	0.78	0.80	

Return spread: 0.31% from B/M versus 0.02% from HML loadings

Measurement Errors

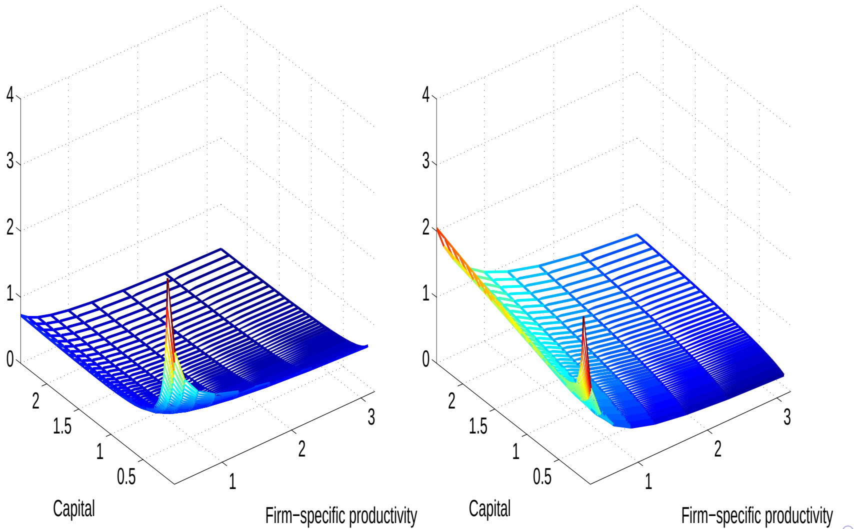
1. The true beta shows stronger predictive power for returns than the estimated beta; 2. Book-to-market retains strong predictive power even after the true beta is controlled for!

	The true beta					
	Low	2	3	4	High	All
Low	0.58	0.63	0.66	0.70	0.78	0.67
2	0.63	0.68	0.71	0.75	0.86	0.72
3	0.67	0.74	0.77	0.82	0.90	0.78
4	0.70	0.79	0.85	0.91	1.04	0.86
High	0.78	0.89	0.98	1.11	1.40	1.03
All	0.67	0.74	0.80	0.86	1.00	

Return spread: 0.36% from B/M versus 0.33% from the true beta

Measurement Errors

The true beta and book-to-market are tightly linked, with a cross-sectional correlation of 0.66 in simulations



Measurement Errors

Risk-adjusted B/M shows no predictive power for returns

	Risk-adjusted B/M, HML loadings						Risk-adjusted B/M, The true beta					
	Low	2	3	4	High	All	Low	2	3	4	High	All
Low	0.77	0.76	0.77	0.77	0.80	0.77	0.64	0.73	0.80	0.89	1.13	0.84
2	0.73	0.72	0.72	0.73	0.74	0.73	0.62	0.69	0.75	0.82	1.00	0.78
3	0.72	0.71	0.72	0.72	0.74	0.72	0.62	0.69	0.75	0.82	0.99	0.77
4	0.74	0.72	0.73	0.74	0.76	0.74	0.63	0.70	0.77	0.84	1.01	0.79
High	0.80	0.78	0.79	0.80	0.84	0.80	0.67	0.76	0.83	0.93	1.16	0.87
All	0.75	0.74	0.74	0.75	0.78		0.64	0.71	0.78	0.86	1.06	

Measurement Errors

Reversing the order of the Daniel-Titman multivariate sorts: first on covariances, then on B/M

	HML loadings, book-to-market						The true beta, book-to-market					
	Low	2	3	4	High	All	Low	2	3	4	High	All
Low	0.65	0.64	0.64	0.65	0.67	0.65	0.60	0.70	0.77	0.85	1.02	0.79
2	0.71	0.69	0.69	0.71	0.73	0.71	0.62	0.70	0.77	0.85	1.02	0.79
3	0.76	0.75	0.75	0.76	0.79	0.76	0.62	0.70	0.78	0.86	1.06	0.80
4	0.82	0.79	0.80	0.82	0.87	0.82	0.65	0.71	0.77	0.86	1.09	0.82
High	0.96	0.91	0.92	0.95	1.04	0.96	0.65	0.71	0.78	0.86	1.23	0.85
All	0.65	0.70	0.76	0.82	0.96		0.63	0.71	0.77	0.86	1.08	

Measurement Errors

Quantifying the measurement errors in the 36-month rolling betas as a proxy for the true beta

Rolling SDF betas						
	Low	2	3	4	High	All
Low	0.62	0.62	0.65	0.68	0.69	0.65
2	0.67	0.68	0.70	0.73	0.76	0.71
3	0.73	0.74	0.77	0.78	0.80	0.76
4	0.76	0.79	0.84	0.87	0.89	0.83
High	0.87	0.90	0.96	1.03	1.13	0.98
All	0.73	0.75	0.78	0.82	0.85	

Measurement Errors

Conditional betas do not alleviate the measurement error issue (aggregate dividend-to-price as the single instrument in a linear beta specification)

Conditional SDF betas						
	Low	2	3	4	High	All
Low	0.63	0.64	0.66	0.67	0.69	0.66
2	0.68	0.70	0.71	0.72	0.75	0.71
3	0.74	0.76	0.77	0.78	0.80	0.77
4	0.78	0.81	0.84	0.86	0.89	0.84
High	0.89	0.93	0.98	1.03	1.10	0.98
All	0.74	0.77	0.79	0.81	0.85	

Outline

Reply to Critics

Critics: The investment approach does not "explain" anomalies

1. A rational "explanation" for anomalies should account for why there seems to be a common factor related to a given anomaly variable, suggesting that extreme portfolios have different exposures to unknown sources of systematic risk

2. Predictability means time-varying risk premiums in a "rational" model; because the investment approach does not model risks, it has nothing to say about predictability

3. A rational "explanation" for anomalies should account for why extreme portfolios have similar market (and consumption) betas, suggesting that the (consumption) CAPM fails to "explain" the average returns across the extreme portfolios

As noted, Fama-French style common factors are not risk factors per ICAPM or APT

Time series and cross-sectional regressions are largely equivalent ways of reporting correlations

Factor loadings (risks) are no more primitive than characteristics, and vice versa, in "explaining" expected returns

To the extent that characteristics are more precisely measured, characteristics should be more useful in predicting returns

Reply to Critics

Time-varying discount rates ≈ time-varying risk premiums

The interest rate is not very predictable. So stock market predictability largely means time-varying risk premiums

The interest rate is constant across firms! So the cross-section of expected returns is the cross-section of risk premiums

Reply to Critics

The failure of the CAPM: A valid and important critique

	Low	2	3	4	5	6	7	8	9	High	H−L
	January 1965–December 2010										
Mean	0.33	0.44	0.48	0.48	0.46	0.55	0.60	0.65	0.74	0.88	0.55
Std	5.3	4.9	4.8	4.9	4.6	4.6	4.5	4.7	4.9	6.0	4.8
α	−0.13	0.01	0.06	0.06	0.08	0.16	0.23	0.27	0.35	0.43	0.56
t_α	−1.2	0.1	1.0	0.5	0.7	1.6	2.0	2.1	3.2	2.9	2.4
β	1.07	1.01	0.98	0.99	0.91	0.93	0.87	0.88	0.93	1.06	0.00
t_β	33.4	35.0	25.7	24.8	24.4	26.5	19.6	15.3	17.4	12.6	−0.03

Reply to Critics

Don't ignore sampling variations!
The CAPM "explains" the value premium in the long sample!

	Low	2	3	4	5	6	7	8	9	High	H−L
	January 1927–December 2010 (including the Great Depression)										
Mean	0.55	0.65	0.64	0.63	0.71	0.74	0.75	0.91	0.97	1.08	0.53
Std	5.8	5.5	5.4	6.1	5.7	6.2	6.7	7.0	7.6	9.5	6.7
α	−0.07	0.05	0.05	−0.03	0.10	0.08	0.05	0.19	0.20	0.18	0.25
t_α	−1.0	0.9	1.1	−0.4	1.3	0.9	0.6	1.8	1.9	1.1	1.2
β	1.00	0.98	0.94	1.06	0.98	1.07	1.12	1.16	1.24	1.45	0.45
t_β	37.5	35.1	29.1	18.9	21.1	15.0	12.3	10.6	14.1	11.9	3.1

Adding a second shock to fail the CAPM (interesting in itself) would be inconsistent with the long sample evidence

Reply to Critics

Properties of the B/M deciles in the Zhang (2005) model

	Low	2	3	4	5	6	7	8	9	High	H−L
Mean	0.62	0.66	0.69	0.70	0.77	0.76	0.81	0.86	0.92	1.12	0.50
Std	5.9	6.3	6.5	6.6	7.1	7.0	7.4	7.8	8.2	9.5	3.9
α	−0.02	−0.01	−0.01	−0.01	0.00	0.00	0.01	0.02	0.04	0.10	0.11
t_α	−0.8	−0.6	−0.5	−0.4	0.0	−0.1	0.5	0.6	1.0	1.5	1.4
α, 2.5	−0.09	−0.08	−0.06	−0.06	−0.03	−0.03	−0.03	−0.03	−0.03	−0.04	−0.05
α, 97.5	0.02	0.02	0.02	0.02	0.04	0.03	0.07	0.12	0.21	0.50	0.59
β	0.86	0.91	0.95	0.96	1.03	1.02	1.07	1.13	1.17	1.36	0.50
t_β	123.2	164.4	219.8	162.5	123.9	227.4	127.3	112.2	76.9	42.0	12.4
β, 2.5	0.83	0.87	0.93	0.93	1.00	1.00	1.05	1.07	1.10	1.18	0.27
β, 97.5	0.91	0.94	0.96	0.99	1.07	1.06	1.12	1.18	1.29	1.52	0.68

The model fails in that the zero beta in the 1965–2010 sample does not lie within the 95% confidence interval, $[0.27, 0.68]$

Reply to Critics

Critics: The consumption approach is more "causal" than the investment approach in "explaining" expected returns

False.

Three alternative technological underpinnings for $E[Mr^S] = 1$:

- The endowment economy: Lucas (1978)
- The linear technologies economy: CIR (1985)
- The adjustment costs economy

Reply to Critics

Covariances, characteristics, and expected returns: Causality?

Covariances determine expected returns in the Lucas economy:

- $E[Mr^S] = 1 \;\Leftrightarrow\; E[r^S] - r_f = -r_f \mathrm{Cov}(M, r^S)$
- $D \;\Rightarrow\; M \;\Rightarrow\; \mathrm{Cov}(M, r^S) \;\Rightarrow\; E[r^S]$

Characteristics determine expected returns in the CIR economy:

- $r_i^S = \Pi_i$, which is stochastic productivity
- $\Pi_i \;\Rightarrow\; r_i^S \;\Rightarrow\; E[r_i^S] \;\Rightarrow\; \mathrm{Cov}(M, r^S)$

No causality in the adjustment costs economy:

- $E_0[M_1 r_{i1}^S] = 1$ and $r_{i1}^S = \Pi_{i1}/[1 + a(I_{i0}/K_{i0}])$
- Simultaneous determination in general equilibrium

The investment approach does not "explain" anomalies

Neither does the consumption approach (or its behavioral variant)

- Risks (pricing errors) are as endogenous as expected returns
- Characteristics are not even modeled
- Even if $E[Mr^S] = 1$ holds for some anomaly portfolios, still have to explain why characteristics are connected with r^S

Investment first-order condition as fundamental (primitive) as consumption first-order condition in general equilibrium

The investment approach is no more and no less "causal" than the consumption approach in "explaining" anomalies

Reply to Critics

Critics: The investment approach has nothing to say about investor "rationality" or "irrationality"

False.

In the anomalies literature, the characteristics-return relations are often interpreted as mispricing

The investment approach says these relations can be consistent with optimal producer behavior

As such, the relations per se do not prove consumer irrationality

The failure of the covariances-based models can be due to measurement errors

Reply to Critics

Critics: The Liu-Whited-Zhang (2009) investment return test is a weak consistency test, not an asset pricing model

False.

The investment approach predicts $r_{i1}^S = r_{i1}^I$, but Liu, Whited, and Zhang test $E[r_{i1}^S] = E[r_{i1}^I]$

The investment return is derived from investment first-order condition, which should qualify as a "model"

Testing the means captures the essence of the economic question, i.e., why anomaly portfolios earn different returns on average

The ex-post nature of $r_{i1}^S = r_{i1}^I$ helps explain the pattern of earnings announcement returns

The investment approach is no more and no less “causal” than the consumption approach in “explaining” anomalies