Tests of Asset Pricing Models

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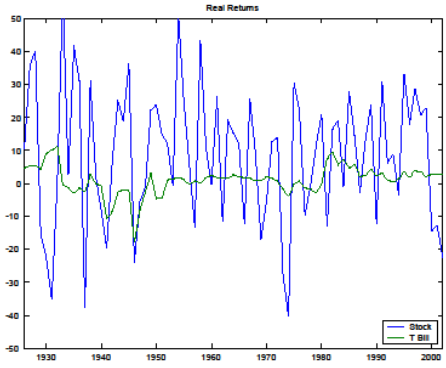
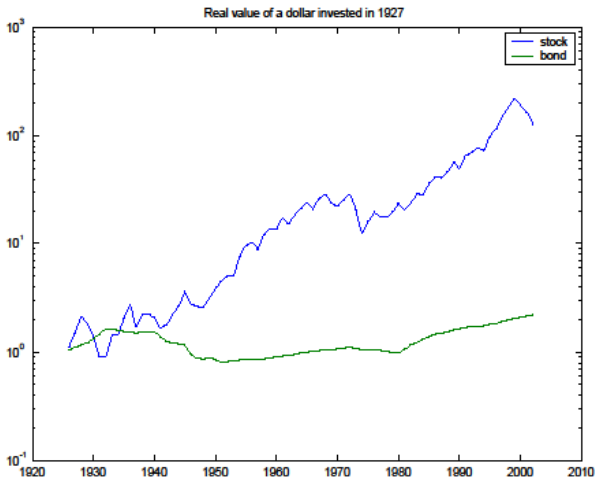
Facts:



Real stock and bond returns 1927-2002

	Bond	(Stock-Bond)
Mean annual % return	1.1	7.5
Standard Deviation	4.4	20.8



Empirical tests of CAPM

- CAPM implies market portfolio M is mean-variance efficient (MVE)
- M includes the universe of assets, which is not observable. Thus, we cannot test CAPM directly
- CAPM equation: $E_i = r_F + \beta_{iM} (E_M - r_F)$
  so β_{iM} is the only relevant measure of risk
- Beta should explain the cross-section of expected stock returns!

Three-step test approach

- (1) Estimate stock betas using T past stock returns up to t-1

  $r_{it}-r_{Ft}=\alpha_i+\beta_i(r_{Mt}-r_{Ft})+\varepsilon_{it}$, $t=1,\ldots\ldots,t-1$

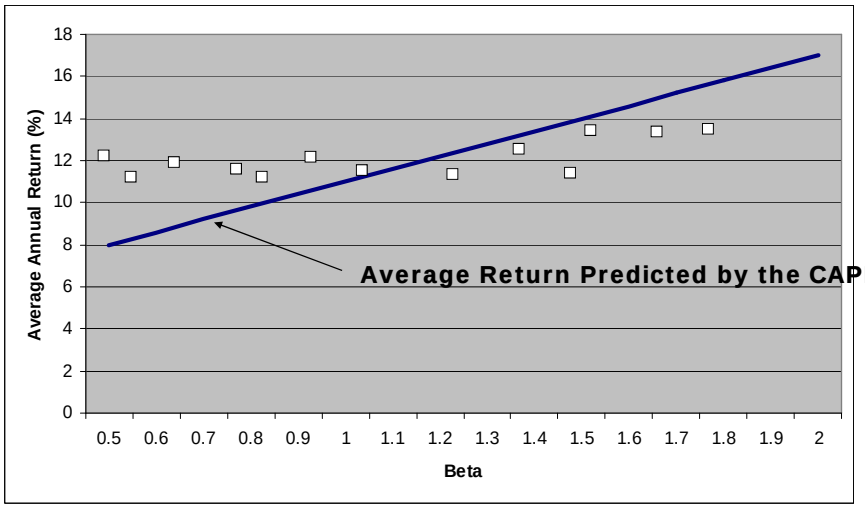
- (2) In month t, regress the month t stock return on the beta estimates

  $r_{it} = \gamma_0 + \gamma_1\beta^*_i + \varepsilon_i \qquad i=1,\ldots,N$

  where the "*" indicates "estimate". Repeat (1) and (2) monthly over entire period

- (3) If the CAPM holds: $\gamma_0=0$ and $\gamma_1=E_M-r_F$

Results from CAPM tests



Interpreting the previous graph

- Sort stocks on beta---and you will not get any cross-sectional variation in average return!
- A key implication of the CAPM is that you should get such a cross-sectional variation (provided the market proxy is mean-variance efficient)

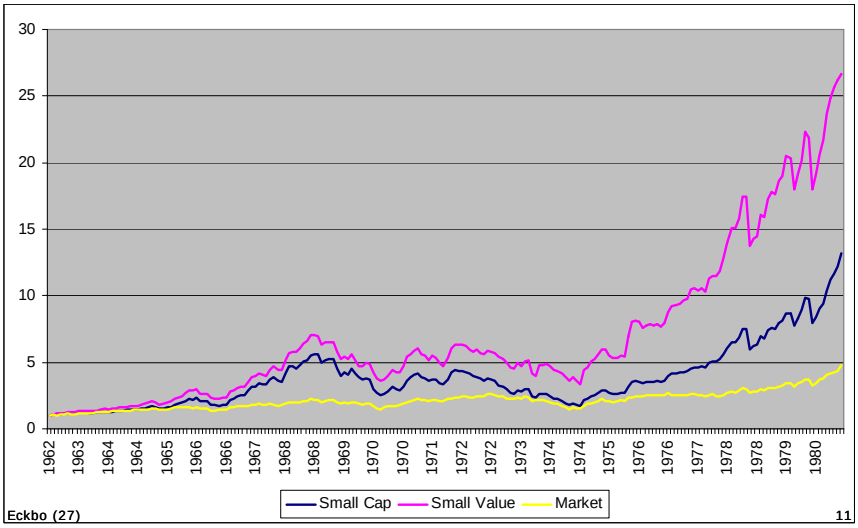
	Book-to-Market Equity (BE/ME) Quintiles									
Size	Low	2	3	4	High	Low	2	3	4	High
	Panel A: Summary Statistics									
	Means					Standard Deviations				
Small	0.31	0.70	0.82	0.95	1.08	7.67	6.74	6.14	5.85	6.14
2	0.48	0.71	0.91	0.93	1.09	7.13	6.25	5.71	5.23	5.94
3	0.44	0.68	0.75	0.86	1.05	6.52	5.53	5.11	4.79	5.48
4	0.51	0.39	0.64	0.80	1.04	5.86	5.28	4.97	4.81	5.67
Big	0.37	0.39	0.36	0.58	0.71	4.84	4.61	4.28	4.18	4.89

	Book-to-Market Equity (BE/ME) Quintiles									
Size	Low	2	3	4	High	Low	2	3	4	High
	Panel B: Regressions: $R_i - R_f = a_i + b_i(R_M - R_f) + s_iSMB + h_iHML + e_i$									
	a					t(a)				
Small	−0.45	−0.16	−0.05	0.04	0.02	−4.19	−2.04	−0.82	0.69	0.29
2	−0.07	−0.04	0.09	0.07	0.03	−0.80	−0.59	1.33	1.13	0.51
3	−0.08	0.04	−0.00	0.06	0.07	−1.07	0.47	−0.06	0.88	0.89
4	0.14	−0.19	−0.06	0.02	0.06	1.74	−2.43	−0.73	0.27	0.59
Big	0.20	−0.04	−0.10	−0.08	−0.14	3.14	−0.52	−1.23	−1.07	−1.17
	b					t(b)				
Small	1.03	1.01	0.94	0.89	0.94	39.10	50.89	59.93	58.47	57.71
2	1.10	1.04	0.99	0.97	1.08	52.94	61.14	58.17	62.97	65.58
3	1.10	1.02	0.98	0.97	1.07	57.08	55.49	53.11	55.96	52.37
4	1.07	1.07	1.05	1.03	1.18	54.77	54.48	51.79	45.76	46.27
Big	0.96	1.02	0.98	0.99	1.07	60.25	57.77	47.03	53.25	37.18

1980-1992: Development of CAPM anomalies

- "Size effect": Relatively small stocks (measured by log of equity value) have higher average returns than predicted by CAPM.
- "Value effect": Stocks with relatively low market-to-book ratio (M/B) also have higher average returns than predicted by CAPM.
- High expected returns should be revealed by low market values (high risk-adjusted discount factor).
- However, in 1992, Fama and French shows that the value and small firms do not have higher market betas! So what's the source of risk?

Compounded value of $1 invested in 1963 held until 1981



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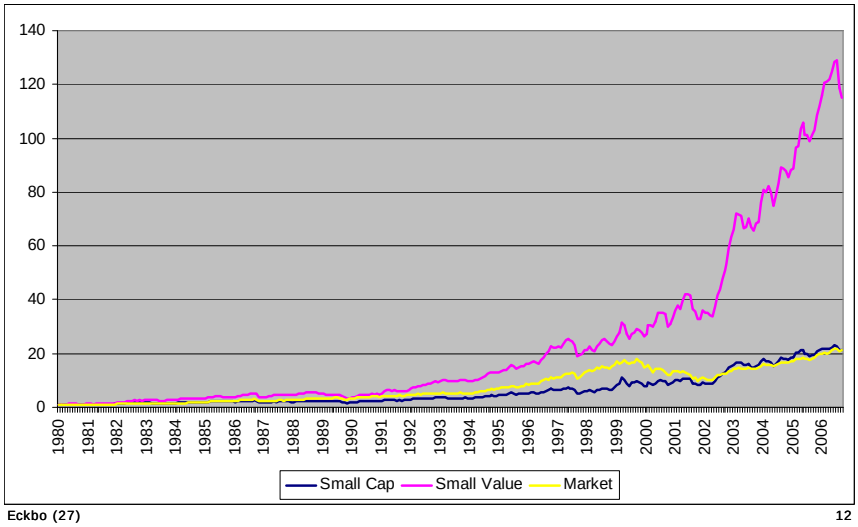
Compounded value of $1 invested in 1980 and held until 2007



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Fama-French 1993

- Develop an empirical three-factor model for expected stock returns
- The three "risk" factors are
  - M: the market portfolio (from CAPM)
  - SMB: the return on a portfolio long in small stocks and short in large stocks ("size" factor)
  - HML: the return on a portfolio long in high B/M stocks and short in low B/M stocks ("value" factor)

Fama/French Benchmark Portfolios

"Large" = 50% highest equity value stocks
"Small" = 50% lowest equity value stocks
"Value" = 1/3 highest B/M stocks
"Neutral = 1/3 middle B/M stocks
"growth" = 1/3 lowest B/M stocks

Small Value	Big Value
Small Neutral	Big Neutral
Small Growth	Bog Growth

FF factor construction

- SMB =
  1/3 (Small Value + Small Neutral + Small Growth) -
  1/3 (Big Value + Big Neutral + Big Growth).

- HML =
  1/2 (Small Value + Big Value) -
  1/2 (Small Growth + Big Growth).

	December 2010	Last 3 Months	Last 12 Months
Fama/French Benchmark Factors			
Rm-Rf	6.76	22.43	20.98
SMB	0.82	9.84	20.28
HML	4.70	-0.01	4.24
Fama/French Benchmark Portfolios			
Small Value	10.22	31.50	43.77
Small Neutral	8.03	30.77	36.38
Small Growth	6.93	32.22	41.88
Big Value	11.07	22.49	24.94
Big Neutral	6.69	20.69	17.92
Big Growth	4.97	21.79	18.34

Source: Ken French's web site at Tuck:

http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

	Book-to-Market Equity (BE/ME) Quintiles									
Size	Low	2	3	4	High	Low	2	3	4	High
	Panel B: Regressions: $R_i - R_f = a_i + b_i(R_M - R_f) + s_iSMB + h_iHML + e_i$									
	s					t(s)				
Small	1.47	1.27	1.18	1.17	1.23	39.01	44.48	52.26	53.82	52.65
2	1.01	0.97	0.88	0.73	0.90	34.10	39.94	36.19	32.92	38.17
3	0.75	0.63	0.59	0.47	0.64	27.09	24.13	22.37	18.97	22.01
4	0.36	0.30	0.29	0.22	0.41	12.87	10.64	10.17	6.82	11.26
Big	−0.16	−0.13	−0.25	−0.16	−0.03	−6.97	−5.12	−8.45	−6.21	−0.77
	h					t(h)				
Small	−0.27	0.10	0.25	0.37	0.63	−6.28	3.03	9.74	15.16	23.62
2	−0.49	0.00	0.26	0.46	0.69	−14.66	0.34	9.21	18.14	25.59
3	−0.39	0.03	0.32	0.49	0.68	−12.56	0.89	10.73	17.45	20.43
4	−0.44	0.03	0.31	0.54	0.72	−13.98	0.97	9.45	14.70	17.34
Big	−0.47	0.00	0.20	0.56	0.82	−18.23	0.18	6.04	18.71	17.57

Fama-French factors

	Mkt-RF	SMB	HML	Rf
1926-1962	0.84%	0.22%	0.36%	0.11%
1963-1981	0.24%	0.47%	0.49%	0.51%
1982-2007	0.67%	0.08%	0.43%	0.43%

- For the period 1963-1992, the (ex ante) mean-variance efficient portfolio of M, SMB and HML has a Sharpe Ratio of 0.745
- This means that you can construct a portfolio with the same variance as M, but with an expected excess return of 11.9% a year, i.e., an extra 6.6% a year, just by using these three portfolios
- Note that this portfolio would not track M
- Thus, M is most likely not MVE

Why SMB?

- Take two firms with identical expected future cash flow, but where firm 1 is less risky than firm 2
- Firm 2 will have the highest discount rate and therefore the smallest current equity value
- *Thus, size most likely proxies for risk, even if the CAPM is true!*
- If so, regressions with both beta and size as factors suffers from multicollinearity, which may cause beta to be insignificant

- Is HML a "relative distress premium" ?
  - Low B/M typical for firms that have persistently strong earnings
  - Variation through time in industries' loadings on HML appears to correctly reflect periods of industry strengths and distress
  - Why is financial distress a hedging concern to investors? Perhaps due to loss of specialized human capital when firm goes bankrupt

Additional empirical anomalies

- Fama-French three-factor model not successful in pricing large portfolios of
  - small growth stocks,
  - momentum stocks
  - relatively illiquid stocks
  - industry-sorted stocks

Momentum stocks

- Jegadeesh and Titman (1993): Firms with high returns in the prior year tend to have high returns in the next few months – and vice versa
- This predictability represents the single greatest anomaly in the literature on expected stock returns
- Momentum is observed also internationally
- Note: After a period with high returns, the stock may be riskier. If so, the expected return should be higher thereafter

Liquidity factor: LMH

- Eckbo and Norli (2005) launches a liquidity factor based on stock turnover
  - Sort stocks on monthly stock turnover (stocks traded divided by total stocks outstanding)
  - LMH: A portfolio long in the 50% stocks with low liquidity and short in the 50% with high liquidity
  - The average monthly return on LMH from 1973-2003 is 0.175%
    - This exceeds the SMB factor of Fama-French.

Eckbo and Norli (2005)

Risk factor	Monthly average return 1973-2002 (US data)
Excess return on market portfolio	0.400
SMB (size)	0.164
HML (value)	0.491
UMD (momentum)	0.986
LMH (liquidity)	0.175

Other possible liquidity measures

- Proportional bid-ask spread
  - $100(P_A-P_B)/(.5P_A+.5P_B)$
- Price impact of trade
  - Reflects transient price effects of trade
  - For a given trade size, the greater the price impact, the less liquid the stock
  - Liquidity measure is ψ_2 in following regression:

$$r_{i,t}-r_{m,t}=\psi_0+\psi_1 r_{i,t-1}+\psi_2[\text{sign}(r_{it}-r_{mt})(vol_{it})]+u_{it}$$

r_m = return on CRSP value-weighted market portfolio

vol = trading volume measured in millions of dollars

Missing Human Capital

- Jagannathan and Wang (1996) simply expands M to include "human capital" proxied by wage rates. When allowing for time-varying betas, this model performs as well as the Fama-French three-factor model
- Shows that the portfolios of Fama-French may proxy for more fundamental risks that are basically consistent with a CAPM-type of model

Long-term reversals and Contrarian strategies

- Firms with low three- and five-year returns tend to have high returns in subsequent years - and vice versa
- Low B/M, E/P, CF/P, D/P, and strong prior sales growth tend to imply low future returns – and vice versa
- All these patterns seem to be manifestations of the same value versus growth phenomenon
- Much of the spread between the returns of value and growth firms shows up around earnings announcements (overreaction or risk?)