Two Simple and Short Papers:

(1) Disaster Risk & The Eq Prem
(2) Long-Term Capital Budgeting

Texas Presentation

Ivo welch

Apr 2013

Disaster Risk and the 6% Hist Eq Prem

15-30 minutes:

- based on OOM index put options implied-volatility smile, disaster risk can/should account only for about 1-2% of the 6% geometric equity premium.
- ordinary sampling variation has been strangely neglected: one sd is 2% $\Rightarrow$ 3% is already ok.
- irony: if we ever observe such a disaster, we will no longer be able to reject risk-neutrality at the 5% level.
- I do not conclude disaster risk is not important. I am just pointing out its limits. 1-2% is a lot. It ain't 3-4%.

- equity premium *vol* is more of a puzzle for consumption models. strangely, many papers want to match this high equity premium of 6%, because consumption models also often claim low standard errors.

Long-Term Capital Budgeting

30-45 minutes:

- If you (want to) believe the CAPM or FFM are useful:
  - **Equity** factor loadings mean-revert tremendously.
  - Conventional beta-estimates (eg Vasicek) undershrink.
  - For 49 industries, 5-10-year project, take half again.
  - $\Rightarrow$ you will be left with tiny model E(R) variation.
- Model expected returns cannot predict future actual returns.
  - Not a CAPM/FFM “theory” test, but an “application” test.
  - Often negative association.
  - No surprise here—models barely predict one-month ahead. But think where you are recommending CAPM/FFM model use.
- But what are the alternatives?
  - Think imperfect markets: market segmentation, liquidity, lack of diversification, etc.
  - Don’t use CAPM as crutch for failure E(CF) adjustment.
  - ABC — assumes capital structure stability ?!

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Disaster Risk

Ivo Welch

Apr 2012

Data

- CRSP Value-Weighted Returns, 1926–2012. 30-day Treasury. Work in Excess Returns.
- Highly kurtotic. Use resampling (bootstrap) for inference, assuming no Peso problem.

	Mean	Sd	% Pos
Mean (not Draws)	0.0596	0.0211	0.998

Min	5th	25th	Med	75th	95th	Max
–0.0298	0.0253	0.0453	0.0594	0.0736	0.0945	0.1509

(remarkably, Gaussian Normal Inference = ok)

Peso Distribution

$$(1+x_{\text{true}})^{t+s} = \left\{\prod_t (1+x_{t\text{ realized}})\right\} \times \left\{\prod_s (1+x_{s\text{ dark}})\right\}$$

$$(1+x_{\text{true}})^{t+s} \approx 1.0594^{87} \times \prod_s (1+x_{s\text{ dark}}) \approx 151 \times D\,.$$

		True Annualized Equity Premium			
If True	0%	1%	3%	4%	5%
D Factor	0.006	0.016	0.087	0.202	0.465
≡ 1 Dark	–99.3%	–98.4%	–91.3%	–79.8%	–53.5%
≡ 2 Dark	–91.8%	–87.4%	–70.5%	–55.0%	–31.8%

Two Basic Thought Experiments

(Conceptually interesting, but not data.)

- How confident are you that the world is not risk-neutral, given what you have seen now?
- How confident will you be next month that the world is not risk-neutral, if you will see a disaster tomorrow?

Prob of Missing Disasters

- Each Dark Event: Prob = 0.000 (0/1000 Months):
  Prob Zero Dark Events in 87 Years: = 100% (max lik)
- Each Dark Event: Prob = 0.001 (1/1000 Months):
  Prob Zero Dark Events in 87 Years: = 37% (plausible)
- Each Dark Event: Prob = 0.002 (2/1000):
  Prob Zero Dark Events in 87 Years: = 13% (unlikely)
- Each Dark Event: Prob = 0.003 (3/1000):
  Prob Zero Dark Events in 87 Years: = 5% (implausible)

Posterior, Given None So Far

$$\text{ER}|\text{ true prob } > 0$$

- Illustration: Say you **know** M is –91%.
  - If p=1/1000, then one M is nice (3%/mo)
  - ...but same M with p=3/1000 is risk-neutral.
- think 0.001 and 0.003 are equally likely (prior), what is your posterior probability that it's the former?
  - $.37/(.37 + .05) \approx 88\%$.
  - You cannot be 95% confident that the world is not risk-neutral, given that you have not yet observed a single disaster.

Posterior, Given One Disaster

Say you just observed a –65% event.

1. Equity Premium: Historical = 4.8% (not 6.0%).
2. Now bootstrap: (one extra –65% prob in there).
   - Prob of Risk-Neutral: 95%.
3. Maybe add increased Peso prob of disaster from 0.001 to 0.0015.
   - Not able to reject risk-neutrality.

Options Data

Let's look at options data.

Put Costs

Put Implied Volatility Net of 18.5%	0.235 0.050	0.285 0.100	0.305 0.120	0.325 0.140
Monthly Cost Per $100	$0.017	$0.069	$0.104	$0.147
Annualized Return Cost	0.002	0.008	0.013	0.018

Put Implied Volatility Net of 18.5%	**0.335** **0.150**	0.345 0.160	0.365 0.180	0.385 0.200
Monthly Cost Per $100	**$0.172**	$0.198	$0.259	$0.328
Annualized Return Cost	**0.021**	0.024	0.032	0.040

Insurance converts, say, –50% into –15%. Not full insurance.

Given Put Costs, What Is Worst Disaster?

$$151 \times (1+\mathbf{M})^T$$

$$\geq$$

$$\left(\prod_t \{1 + \max[-0.15, x_{m,t}] - P\} \right) \times [1 - 0.15 - P]^T$$

- S is riskier than S+P. If P is too cheap, S+P would outperform S with high disaster return(s).
- Min-bound for risk-neutral market. If market were risk-averse, max disaster would be less painful.

- I will just show historical data. 1985- has same mean as 1926-. Ignore sampling variation.
- Ignore correlation of ex-post returns with put-costs. Dynamic strategy (get out of S whenever market put cost is too high) has almost no net disaster insurance cost.
- Implied-vol cost can be non-linear in moneyness. Can be different at different times.
- None is a problem. It's in the paper.

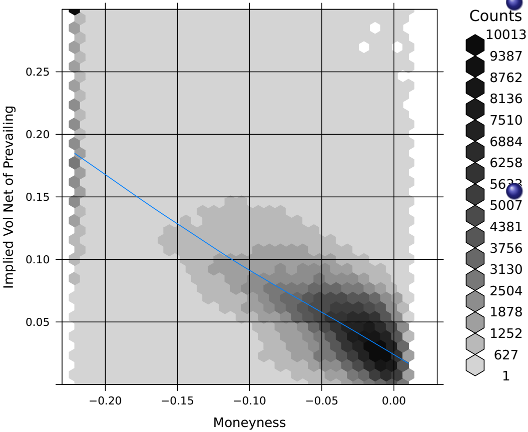
Put-Implied Vol Cost and Equity Premium

Solve above inequality to find worst disaster:

IVol – 18.5%	0.12	0.14	**0.15**	0.16	0.18	0.25
T=1, $M \geq$	–0.42	–0.63	**–0.72**	–0.79	–0.89	–0.99
EqPrem$\geq$	0.053	0.047	**0.044**	0.041	0.033	–0.000
T=2 $M \geq$	–0.30	–0.44	**–0.51**	–0.57	–0.69	–0.93
EqPrem$\geq$	0.051	0.045	**0.042**	0.039	0.031	–0.002

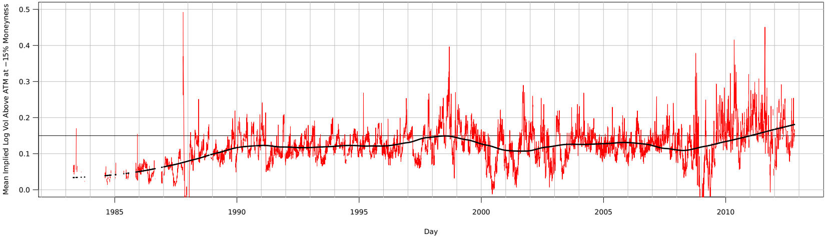
- Anything worse, and the S+P position would have had both lower risk and higher mean than naked S.
- Now I need to show you that IVOL of 15% is reasonable for –15% put.

Vol Smile



- I am conservative with ivol-cost of 15%. But, with enough adverse variations in specification, I can sometimes get to 15%.
- I also tried absolute (not net of 18.5%) option cost. Inference is the same.

Time Series



- Based on one price per day.
- Get out of market when implied-vol cost is too high, instead of buying S+P. after all, if IVOL(P) > 25%, you are pretty sure that the E(R) of S+P should be less than 0.
- This does **not** give you a time-series of exp eq prem point forecast, but only a time-series of a min bound on eq prem forecast.

Conclusion

- A 1-2% disaster premium is reasonable. Smile suggests it's not 0. 1-2% is nothing to sneeze at.
- ...but a $> 2\%$ premium is not only not justified by the put-pricing data, it would also have some nasty model consequences, principally the potential to make it difficult to reject risk-neutrality.
- we need to pay more attention to ordinary standard errors. 3% equity premium? Not rejectable by the data.
- Paper is *very* new. Available at:

  `http://temp.ivo-welch.info/eqprem-disaster-0.pdf`

Asset-Class Based Capital Budgeting

Yaron Levi and Ivo Welch

Apr 2012

What is the most important Corporate Finance topic for students and managers?

Capital Budgeting

- Project Choice is most value-important and ubiquitous.
- Bread and Butter
  - Corporate Governance? Capital Structure?
- Let's make sure we teach this one right!

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IRR and NPV Logic

- Should managers invest the money on behalf of their investors, or instead return it?
- Managers and investors should demand higher returns for projects for which similar/equivalent projects are expected to deliver higher returns elsewhere.
- What if the models' claims about other opportunities are wrong, perhaps not because of the model itself but because they are not usefully implementable?

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So what do we know about E(R)?

- Equity Returns:
  - Lots of caveats on CAPM/FFM in Fama-French:1997 ...but we still use the models.
  - Virtually all evidence is based on predictions of 1-mo (<1 year) ahead stock returns.
    - CAPM fails even on 1-month ahead prediction.
    - FFM may or may not work.
    - (Momentum and book-to-market work on 1-mo, but not LT.)
  - Which corporations care about cb 1-mo or 1-yr projects?
    - Interesting projects last 5 years to 100 years
- We believe debt is cheaper than equity.

(Need not be risk-aversion. Liquidity, sentiment, asset-class segmentation, industry segmentation, etc., could induce the same differential as risk aversion and differential systematic risk exposure.)

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What can LW:2014 do to help?

- Half the referees won't believe **any** evidence, and not abandon the models because they believe they can be useful:

  (1) Let's show them a few more coffin nails:
  - (1a) If the models held, how should you use them?
  - (1b) Show evidence how badly they fail long-term.

- The other half will tell us this was obvious—and then go back and teach only the CAPM/FFM for CB.
  - (2) What could they teach instead?

Fama-French:1997 takeaways: first group remember that applications should use industries instead of firms. second subgroup remember that small variations in assumptions come up with completely different estimates.

Quick Summary of Presentation Figs

Test reasonable model use, not model per se:

- Only 49 Industries. (Indiv. firms = worse. no IPOs, survival)
- 1962–2010. (21,683 stocks / 2.1m firm-months)
- Vasicek betas, daily data, 5 year windows. FFM=MV.
- 30-50 year prevailing premia estimates.
- Use models to calculate expected rates of return.
- How do model X="expected rates of return" *predict* future Y=E(r) or future actual Y=r? Ideally, $\hat{\gamma}_1 = 1$. Useful model if $\hat{\gamma}_1 > 0$.
- Xsect Q: Always out-of-sample, Fama-Macbeth like.
- All standard errors are from **placebo**: randomize returns across firms/industries on same date. Keeps irregular data matrix intact. We do not randomize factor premia—if we destroyed them, NULL would look even better.

Sort of best-case scenario

Presentation omits MANY robustness checks. Robustly zero.

Let's Rock

(Easier to show than to explain. Equities Only! Not Unlevered!)

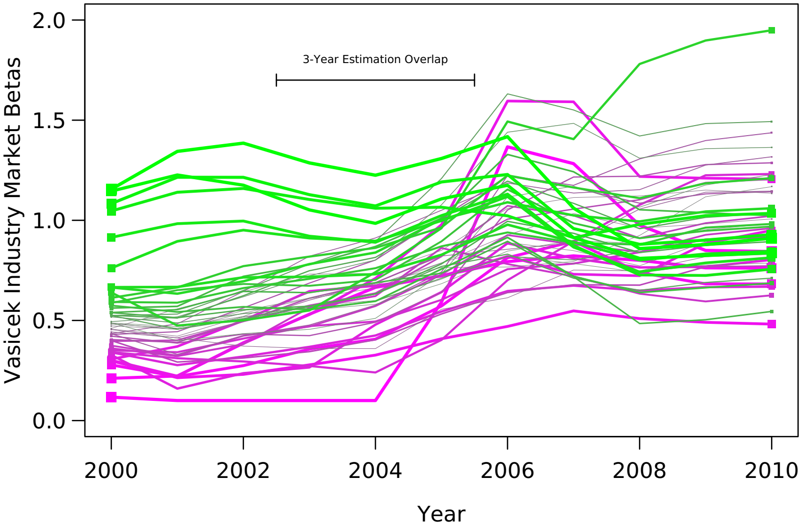
Point #1a:

Even if you are a believer, your models' estimates/loadings do not have much long-term stability. (Stability is necessary, but not sufficient. stability is *not* a tough model criterion.)

Will show that today's beta estimates cannot be used for cash flows in 5-10 years.

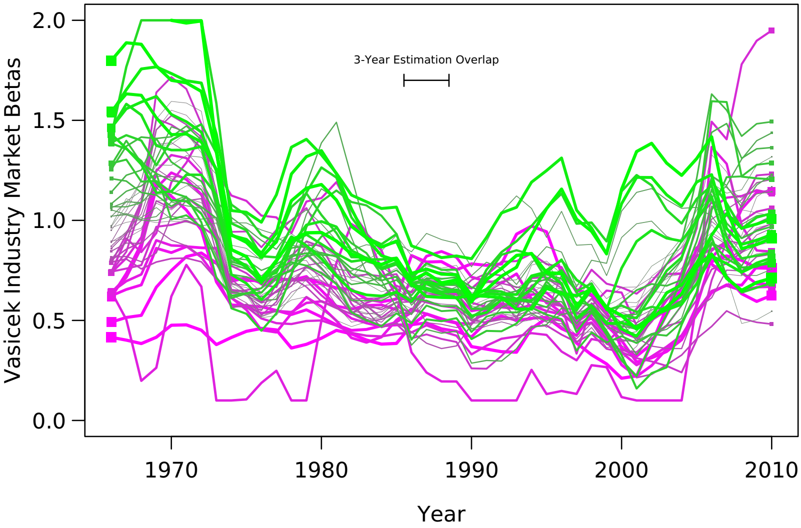
- This is *after* Bayesian Vasicek exposure shrinking.
- Estimated= 5% E(R) difference in cc today
  $\Longrightarrow$ optimally use= 2% E(R) diff for 5-year's CFs (Car)
  $\Longrightarrow$ optimally use= 1% E(R) diff for 20-year's CFs (Building)
  $\Longrightarrow$ optimally use= 0% E(R) diff for 50-year's CFs (Land)
- Good use of your investigation time? (Gaming?)

Beta Stability



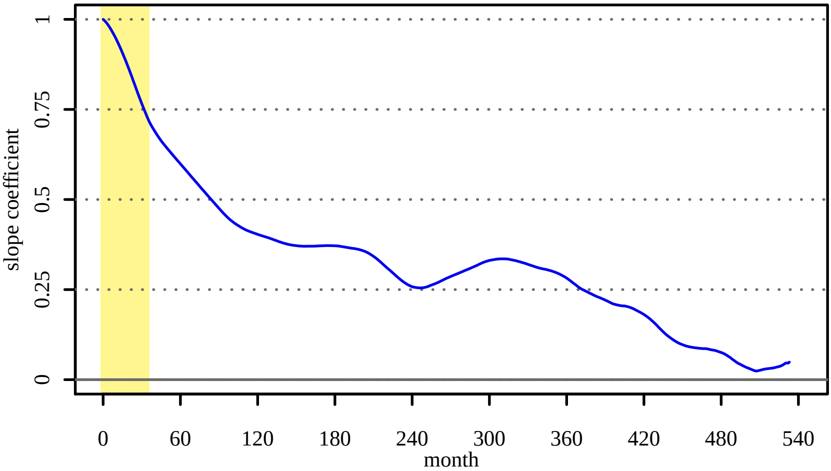
(10-year autocoef for 49 industries is about 0.4.)

Beta Stability



(50-year autocoef for 49 industries is about 0.)
(FFM loadings are similarly or more unstable.)

X-Sectional Correlation



Final points are based on very few regressions.

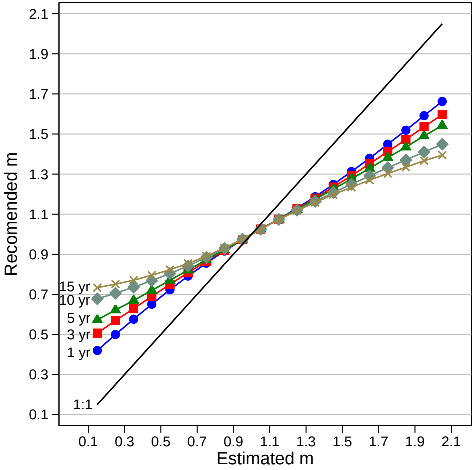
Optimal Weight on Vasicek

- Assume CAPM is true. Simulate World (know true ER).
  - Match beta reversion: $m_t \approx 0.01 \times 1 + 0.99 \times m_{t-1} + e$
  - Match E(M), sd(M), sd(e). sd[E(R)].
  - No LR industry own means. just long-run but temp moves.
- Estimate Vasicek beta and cost of capital.
- Find best θ weighted Vasicek beta / E(r) and "1.1" that minimizes MSE difference to true E(r).

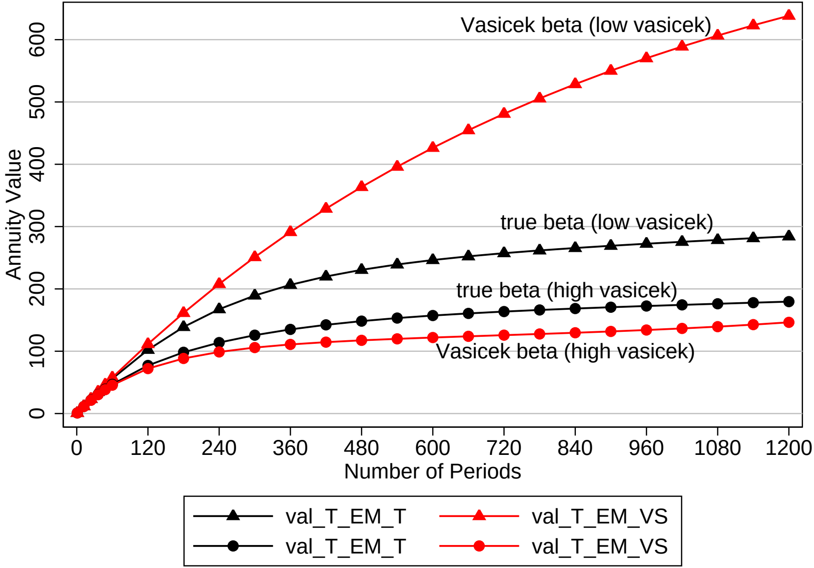
  Double shrinkage:
  - Shrinkage / Vasicek says put some weight on 1.1, some weight on your own beta.
  - With autocorr of beta, we need to shrink more.

How should you double-shrink Beta?

What Vasicek tells you, vs what you should be using:



Annuities Value Effects



Point #1b:

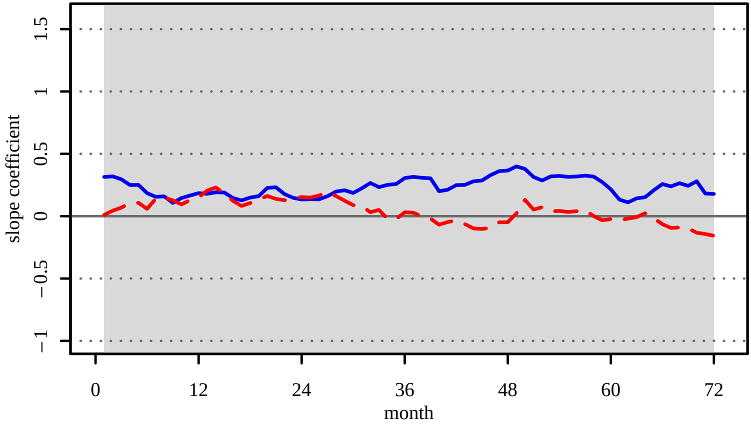
- Preceding was internal model validity. It did not look at actual "other project" opportunity costs—actual rates of return delivered.
- So, did the models have any predictive ex-ante power for what other projects with similar model riskiness actually delivered ex-post?
- Q: You know the 1-mo evidence. What do you think the 10-yr evidence is?

Predict future actual returns with your model returns (not with model ingredient factors).

$$r_i = \gamma_0 + \gamma_1 \times E(R_i) + \text{noise}$$

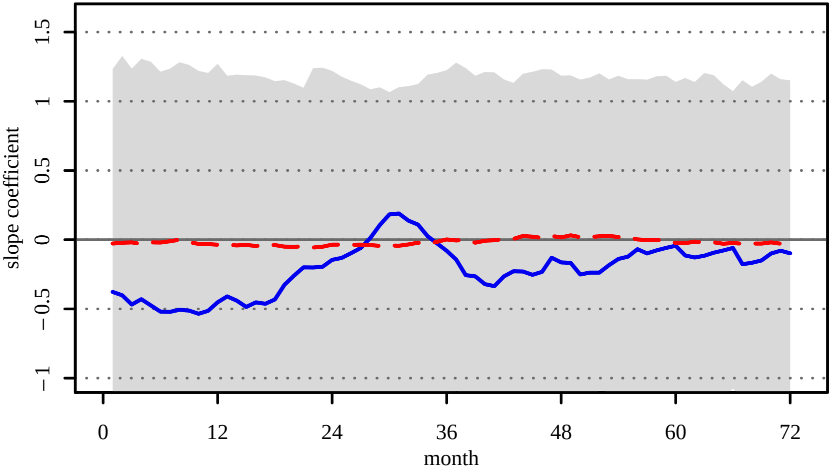
Aggregate over time. Doesn't matter much.

CAPM – Marginal Returns

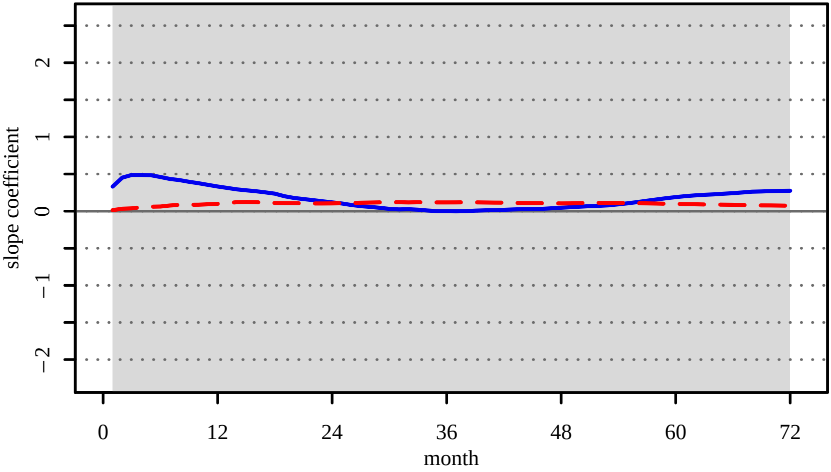


IAW: Stop and Explain Graph.

FFM – Marginal Returns



CAPM – Compound Returns



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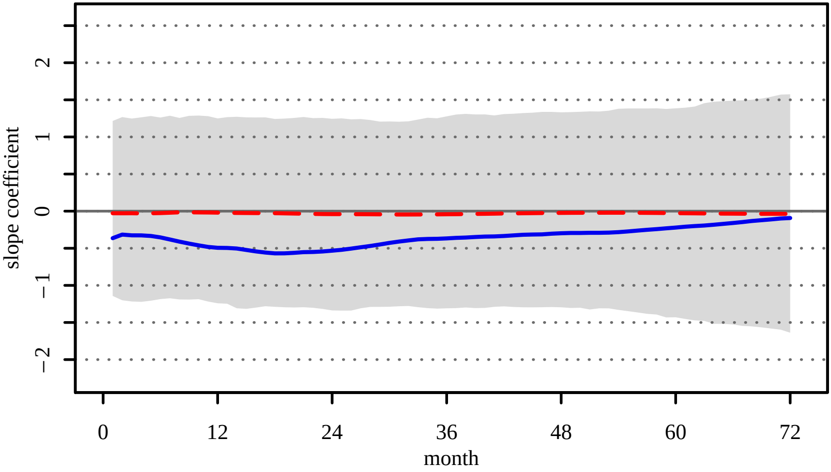


Conclusions?!

Models had no actual-return forecasting power over long-horizons, either. Not a close call.

As benchmark providers for what expected returns projects should have provided, both models have utterly failed usefulness test in the past. Not a close call.

...yet you are assuming that this is what your projects have to meet!?

Not a model test, but a test of our ability to properly use models. Thus, no EIV. What we measure is the quantity we want.

Are your priors that the models give you a good number, or that the models give you lousy numbers??

Now What?

It takes a model to beat a model.

What should we teach?

Asset-Based Capital Budgeting

- We are interested in asset betas, not equity betas: $E(R_A) = w_E \times E(R_E) + w_D \times E(R_D)$.
- For whatever reason (imperfect markets?), all equities seem to offer similar long-term average returns.
- If your $E(R_D) < E(R_E)$, **and** you can predict own future D/E, then you can predict future **asset** cost-of-capital.
- Leverage ratios are often predictable and/or stable.
- It's a standard CorpFin (not AssPrc) approach. Assign one cost of capital to equity. Assign one cost of capital to debt. (Debt capacity can be useful.) Take wght avg.

Asset-Based Capital Budgeting

For long-term standard corporate projects:

- Assume $\beta \approx 1$.
- Use (tax-adj) cost of debt capital, often promised $\approx$ expected
- Assess your planned/intended project debt-ratio.
- (Possibly worry about cost of capital of NFL.)

$$\Rightarrow \; E(R_A) = \hat{w}_E \times (6-8\%) + (1-\hat{w}_E) \times E(R_D) \times (1-\tau)$$

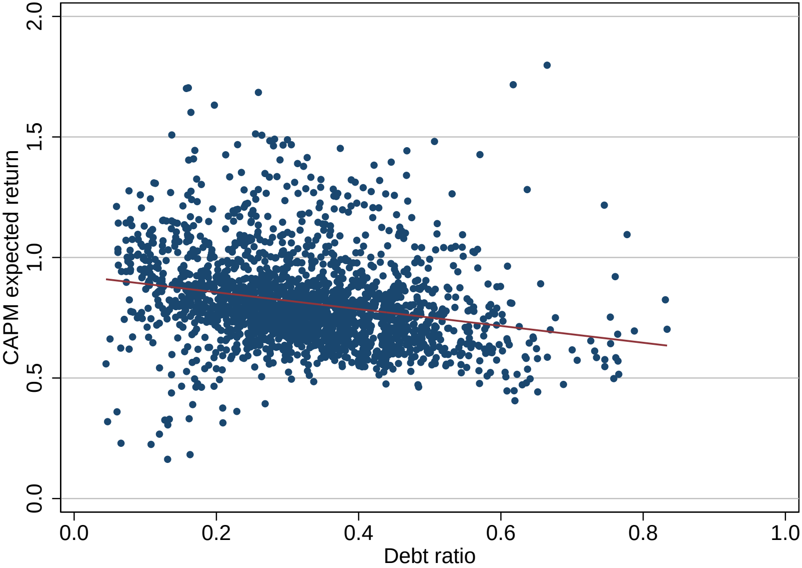
Spend your time worrying about E(CF) instead.

Mistakes?

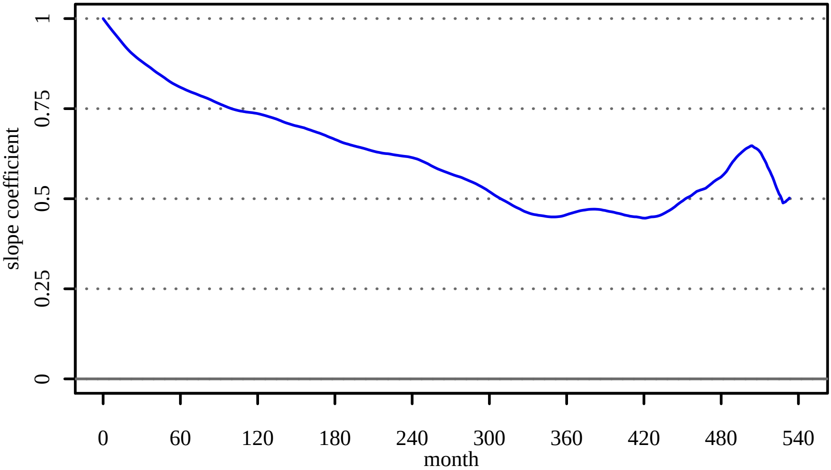
How bad are ABC errors relative to true CAPM/FFM?

- Don't use this model for (short-term) bond pricing or for 99% levered companies. Use this model for normal firms/projects.
- Leverage ameliorates further asset-beta errors. Errors in $E(R_E)$ typically map into lower $E(R_A)$ errors. High leverage, high $E(R_E)$ errors are mult. by $1-w_D$.
  - High-leverage same-asset-beta firms should have had high w_E, $E(R_E)$, and $E(R_D)$.
  - Empirical Evidence:
    high LR = high $E(R_E)$? see next pg.
    high LR = high $E(R_D)$? maybe. see Altman etc.

Leverage Ratios and Model Equity Expected Rates



Leverage Ratios and Future Leverage Ratios



(but debt may well be your decision variable, so you don't need this)

Is Corporate Debt Really Cheaper?

We think so, but even this is **not** 100% clear.

Ibbotson (2010), Table 2.1, geometric:

- Large Company Stocks: 9.8% (sd=20%)
- LT Corp bonds: 5.9% (10%)

Is the (pre-tax) corporate cost of bonds really lower? 4% difference is not statistically significant. But after-tax cost of (short-term) bonds does seem meaningfully lower.

Fortunately, like w_D, this can be a firm-specific CFO judgment call. (From the inside, in an imperfect market, quoted yields may even be your expected cost of debt.)

Natural Consequences

Optimal behavior is similar to some imperfect-market corporate theories, but ABC is more pragmatic and less specialized.

- Value debt-financed projects (like buildings) more highly than equity-financed projects (like R&D).
- Don't put equity money into cash. The presumed reduction in equity betas which reduces the cost of capital is *not* there. Holding cash is not worth it.
- Take projects until the marginal cost of debt is equal to the marginal cost of equity and the marginal return on projects.
- Conjecture—firm may incur sudden sharp increase in the cost of debt and equity when "overlevered."

Academic Advantages

- Most Important: (Academic) Integrity.
- Truth in Advertising.
- Not priors=faith-based capital budgeting.
- Lots of tough problems become much easier.
  - E.g., real options turn from real hard into real simple problems.
  - E.g., tax shelters are simple now. APV and WACC yield the same results.
  - E.g., behavioral finance may be easier to understand.
- Less distraction with unimportant details.

- No claims to short-term AP. ABC is not all the answers.

Managerial Advantages

- Focus more on time and less on risk adjustments.
- Focus more on expected cash flows—which is where the focus should be!
- Focus more on failure probabilities (cash flows).
  - Higher expected rates of return for high-failure projects based on an asset-pricing model is the wrong crutch.
  - Maybe helped by a volatility-based E(R) model?
- Easier (=cheaper) to use same cost of equity capital for all projects.
- Less gaming.

Appendix

(1) Model for #1A: Dynamic-Beta CAPM

$$m^{true}_{i,t} \overset{iid}{\sim} N(\mu_m, \sigma_m) \qquad t = -35 \qquad m^{true}_{i,t} = \mu_{dm} + \rho_{dm} m^{true}_{i,t-1} + \varepsilon_{dm} t = -34, \cdots, 180 \quad (1)$$

$$\varepsilon_{dm} \overset{iid}{\sim} N(0, \sigma^2_{dm}) \qquad M_t \overset{iid}{\sim} N(\mu_M, \sigma^2_M) t = -599, \cdots, 0 \quad (2)$$

$$MP \sim N(\mu_M, \sigma^2_{MP}) \quad (3)$$

$$r_{i,t} = r_f + m^{true}_{i,t} M_t + \varepsilon_{i,t} \qquad t = -35, \cdots, 0 \qquad \varepsilon_i \overset{iid}{\sim} N(0, \sigma^2_E) \quad (4)$$

$$E(r_{i,t})^{true} = r_f + m^{true}_{i,t} \mu_M \qquad t = 0, 1, \cdots, 180 \quad (5)$$

Manager estimates her loading over 36 periods.

$$r_{i,t} - rf = \alpha_i + m^{est}_i M_t \qquad -35 \leqslant t \leqslant 0 \quad (6)$$

Manager chooses her cost of capital by weighting her own estimated cost of capital and the cross sectional mean,

$$COND = E(r_i)^{est} = r_f + m^{est}_i MP \quad (7)$$

$$UNCO = r_f + \mu_m MP \quad (8)$$

We find the optimal weight by simulating the model and solving

$$min_{w_t} E\left[\left(w_t UNCO + (1 - w_t) COND - E(r_{i,t})^{true}\right)^2\right] \qquad t = 0, \cdots, 180 \quad (9)$$

Note that the dynamics of $\mathrm{m_{i,t}}$ in equation 1 can be represented as

$$\mathrm{m^{true}_{i,t}} = \theta \mathrm{K} + (1 - \theta)\mathrm{m^{true}_{i,t-1}} + \varepsilon_{\mathrm{dm}} \quad (10)$$

with $\theta = 1 - \rho_{\mathrm{dm}}$, $\mathrm{K} = \frac{\mu_{\mathrm{dm}}}{1 - \rho_{\mathrm{dm}}}$.

Estimation

Direct estimation We set $\mu_m, \sigma_m, \sigma_E, \mu_M, \sigma_M$ and r_f equal to the corresponding population moments. See table pop dynamics.

Calibration We set μ_{dm}, ρ_{dm} and σ_{dm} to fit the population moments in tables 49 ind. The calibration process for the 49 industries simulations is as follows:

- We construct a panel, size 49 industries and 108 periods ($t = -35, \cdots, 72$), of true market loadings. We draw $t = -35$ loadings for the 49 industries from a normal distribution with mean μ_m and std σ_m (see table **??**). True loadings evolve over the additional 107 periods according to equation 1.
- We draw a ts of factor (M) realizations from a normal distribution with mean μ_M and variance σ_M. (See table **??**.)
- We construct a panel of realized returns using the ts of factor realizations, the panel of true loadings and σ_E from table **??**.
- We construct a panel ***estimated*** loadings using the realized returns and the factor realizations.
- We construct find expected returns using the estimated loadings and market premium drawn from a normal distribution with mean μ_M and variance σ_{MP}.
- We repeat this process 1000 times and present the means of the collected moments in table tables **??**.

Dynamic model parametrization, CAPM, direct estimation

model parameter	sample	value	source
μ_M		0.458	XMKT 600 month ending at 2010/12
σ_M		4.525	XMKT 600 month ending at 2010/12
σ_{MP}		0.185	standard error of μ_M
rf		0.049	rf 36 month ending at 2010/12
σ_E	49 industries	4.797	average of error term std in loading estimation r
μ_m	49 industries	1.115	mean XMKT loading
σ_m	49 industries	0.309	std XMKT loading
σ_E	all CRSP	13.030	average of error term std in loading estimation r
μ_m	all CRSP	1.097	mean XMKT loading
σ_m	all CRSP	0.779	std XMKT loading

Dynamic model parametrization, matched moments, 49 industries

statistic	49 industries sample value	s.e.	calibration results* $t=0$	$t=36$	$t=72$
μ_m	1.115	0.009	1.113	1.113	1.111
σ_m	0.309	0.004	0.343	0.340	0.340
$corr(m_t, m_{t+1})$	0.987	0.001	0.992		
$corr(m_t, m_{t+36})$	0.560	0.008	0.577		
$corr(m_t, m_{t+72})$	0.444	0.009	0.423		
$std(E(ret)^{est})$	0.188	0.003	0.158	0.158	0.156

* Chosen calibrated parameters are $\mu_{\mathrm{dm}} = 0.01, \rho_{\mathrm{dm}} = 0.991, \sigma_{\mathrm{dm}} = 0.04$.
Population moments are ts averages of the monthly data 1966/07 to 2010/12.
Population market loadings were estimated using 36 historical month
Population expected returns were constructed using constant risk free rate (0.049) and 600 months running average of XMKT.

CRSP, betas below 0.5 at t=0 , moments in population vs simulations

statistic	All CRSP sample			calibration results*		
	t=0	t=36	t=72	t=0	t=36	t=72
μ_m	0.173	0.657	0.680	0.006	0.585	0.754
$s.e.(\mu_m)$	0.005	0.008	0.008	0.003	0.004	0.003
σ_m	0.325	0.623	0.620	0.409	0.678	0.670
$s.e.(\sigma_m)$	0.007	0.008	0.008	0.002	0.005	0.004
$std(E(ret)^{est})$	0.222	0.403	0.387	0.196	0.306	0.296
$s.e.(std(E(ret)^{est}))$	0.005	0.006	0.005	0.008	0.012	0.014
$corr(m_t, m_{t+1})$	0.924			0.965		
$corr(m_t, m_{t+36})$	-0.003			0.288		
$corr(m_t, m_{t+72})$	0.021			0.192		

CRSP, betas above 1.5 at t=0 , moments in population vs simulations

statistic	All CRSP sample			calibration results*		
	t=0	t=36	t=72	t=0	t=36	t=72
μ_m	2.112	1.477	1.357	2.045	1.537	1.389
$s.e.(\mu_m)$	0.010	0.012	0.012	0.003	0.003	0.002
σ_m	0.591	0.789	0.793	0.440	0.680	0.673
$s.e.(\sigma_m)$	0.009	0.012	0.012	0.002	0.005	0.004
$std(E(ret)^{est})$	0.387	0.510	0.498	0.211	0.307	0.298
$s.e.(std(E(ret)^{est}))$	0.006	0.007	0.007	0.008	0.012	0.014
$corr(m_t, m_{t+1})$	0.950			0.969		
$corr(m_t, m_{t+36})$	0.152			0.306		
$corr(m_t, m_{t+72})$	0.122			0.206		

(2) List of Omitted Variations

- Firms rather than Industries. We do not have project data. Firms with IPOs. (Problem: Survival.)
- Variations in factor premia assessments. Full-sample ex-post. 50-year. 30-year.
- No-adjustment beta. Blume-adjustment. ML adjustment. Dimson beta. Conditional Vasicek beta (size, leverage, book-market).
- Beta = 5 years, daily. 5-years monthly (worse). excess vs. raw regressions.
- Equal-weighted vs. value-weighted factor portfolios
- Industry portfolios, equal-weighted vs value-weighted. 49 vs. more.
- Forecast compound returns with and without volatility adjustment. (1/2 sigma-squared)
- Forecast discount factors.
- Model expected return calculation:

$$E_t[r_i] = r_{f,t} + \hat{\beta}_{i,M} \cdot \overline{XMK_t} \ ,$$

$$E_t[r_i] = r_{f,t} + \hat{\beta}_{i,M} \cdot \overline{XMK_t} + \hat{\beta}_{i,S} \cdot \overline{SMB_t} + \hat{\beta}_{i,H} \cdot \overline{HML_t} \ .$$

- Placebo-adjustment for overlap. Non-overlap. Omitted Model Factors.
- Worry about worry—placebo seems most robust.
- HML model, instead of FFM model.