

Long-Term Investment

Asset-Class Based Capital Budgeting with Duration

John Hopkins + U o Miami Presentation

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Mar 2015

Motivation

Most Important Topic in Corporate Finance?

What do we teach that students need to know?

Capital Budgeting

- ▶ Choosing good projects is the most value-important and ubiquitous question.
- ▶ Not 1-month projects, but multi-year projects.
- ▶ It's our bread and butter
 - ▶ Corporate Governance?? Capital Structure??

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Academic Interest

- ▶ Let's make sure we get “simple” capital budgeting right!
- ▶ Let's make sure it's something our students can apply.
(Theory is good and useful, but it is not a great applied cost-of-capital estimator.)
- ▶ Number of publications in top-5 Journals 2000-2013?

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Recap: IRR and NPV Logic

- ▶ Should you invest their money on behalf of your investors, or should you instead return it?
- ▶ Should you demand higher average returns for projects for which similar/equivalent projects are expected to deliver higher returns elsewhere?
- ▶ What if your calculations are wrong?

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What do we **really** teach about Equity Returns?

- ▶ Do you teach NPV?

⇒ Let's Survey.

- ▶ What do you use as the $E(R)$, esp. in your *Terminal Value*?

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What do we **really** teach about Equity Returns?

- ▶ Lots of caveats on CAPM/FFM in *Fama-French:1997* ...but we still use the models.
- ▶ Most academic capital-budgeting evidence is based on predictions of 1-mo ($\ll 1$ year) ahead stock returns.
 - ▶ CAPM fails even on 1-month ahead prediction.
 - ▶ Sadly, even FFM may or may not work. (Momentum and book-to-market may work—this is not the FFM!)
- ▶ Do any corporations really care about the cost of capital for 1-mo (or 1-yr) projects?
 - ▶ Interesting projects last 5-100 years. Most is Terminal Value.
- ▶ (Maybe) debt has a lower cost of capital than equity, but the WACC is fairly flat (or the same).

Surprising and Not Surprising

- ▶ Half of you won't believe **any** evidence, and not abandon the models because you believe they can be useful.
- ▶ Half will tell me that existing-models' uselessness was obvious.
- ▶ Most will think that other half already shares their views.

So here is what I will "sell" you:

- ▶ Some of what I will say will seem obviously true.
- ▶ Some of it you will know.
- ▶ Some of it will just be repackaged truth—but remember that the Church has to repeat the gospel many times, too—and it still often does not sink in.
- ▶ Some of it will be surprising.

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Four Key Points

1. Equity Premium

- ▶ Widespread (but not universal) misjudgment of historical geometric equity premium.

2. Factor Exposure Estimates (Beta):

- ▶ Universally too aggressive prescriptions

⇒ Lesser Importance of Equity Exp-Return Predictions

- ▶ Not, say, $(R_m - R_f) \times (\beta_B - \beta_A) = 6\% \times (1.5 - 0.5) = 6\%$,
- ▶ but more like $3\% \times (1.2 - 0.8) = 1.2$.

3. Recap of longer-horizon equilibrium model evidence

- ▶ Not even FFM works, and not even 1-month ahead.

⇒ "Fortunate" almost-irrelevance of Equity Return Predictions

4. Alternative Prescribable Capital-Budgeting Model

- ▶ We have specific better alternatives with solid empirical evidence.

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Equity Premium for Long-Term Projects

Equity Premium

- ▶ We want the forward-looking equity premium.
- ▶ Many of us justify an estimate based on backward-looking equity premium.
- ▶ ... but many of us have poor memory and/or use the wrong metric to begin with.

The relevant number wasn't 8%!

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Yields vs AvgReturns on Long-Term Bonds

Preparatory, Close-To-Tautology:

- ▶ Over the very long run, in a stationary equilibrium, long-term T-bonds had/have rates of return equal to their promised yields.
- ▶ Geometric, Above Risk-free

	Yld	Ret
2000-2013	3.6	4.8
1970-2013	3	4
1926-2013	2.5	2.5
1870-2013	1.9	2.2

Yield Term Spread

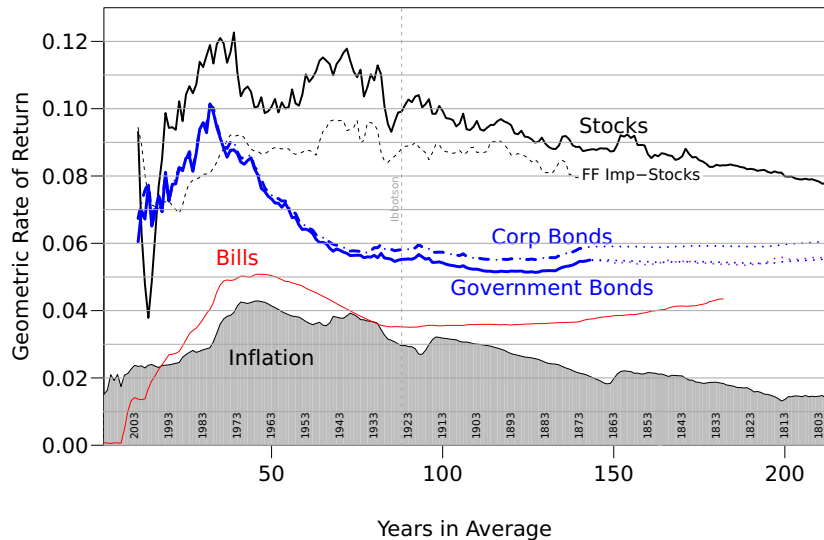
Preparatory, Bonds Tended to Pay More Than Bills:

- ▶ Bonds tended to yield 2% (0% to 3%) more than bills.
- ▶ Obvious: bonds had higher average yields and higher avg returns.
- ▶ Bonds have higher yields in 2014.
- ▶ The obvious: maybe not the 2014-bonds, but in the long-run, the bond yield spread will also be the bond return spread.

Geometric Equity Premium

- ▶ 2% difference between long-term and short-term equity premium.
- ▶ Whatever your choice of equity premium is, it should be about 2% lower for long-term projects than for short-term projects.
- ▶ You can't believe in an 8% equity premium with respect to long-term bonds and an 8% equity premium with respect to short-term bills.

Geometric Performance, X To 2013



Historical Inference

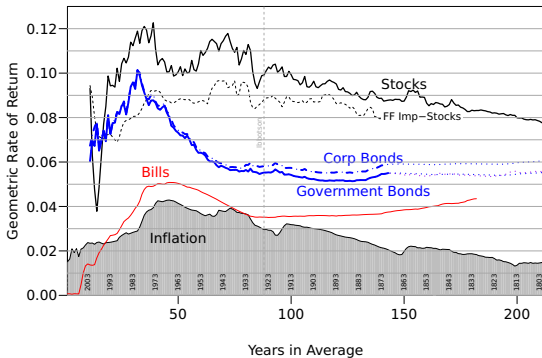
Equity Premium

- ▶ Principal Data Change: Not lower stock returns nowadays, but higher long-term bond yields (drifting closer to stocks and farther from T-bills) over the decades.
- ▶ Oft-quoted 6-8% are arithmetic returns from 1926 to 1970 vis-a-vis Treasury bills. R u kidding?
- ▶ If based on historical performance, the exp. equity premium relative to LT bonds should be 3% or less. (This is 5% above short-term.)

Me: < 2%.

Geometric Performance, X To 2013

In 2013, looking back X Years...



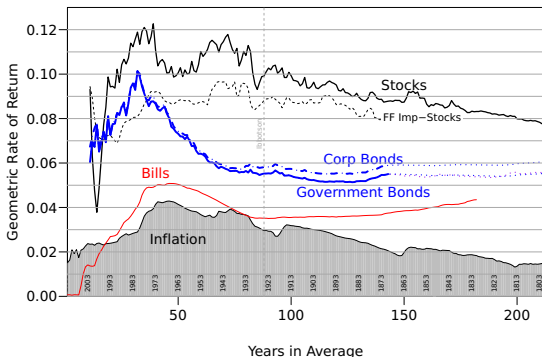
Long-Horizon Equity Premium Spread (Now=12/2013):

2000-now \approx 0%	1950-now \approx 5%
1990-now \approx 1.5%	1926-now \approx 4%
1980-now \approx 2%	1872-now \approx 3%
1970-now \approx 2%	1803-now \approx 2%

(2009 = 26% - (-15%); 2013 = +32% - (-7%)) LT Eq Prem was lower in 2009 & 2013

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(2009 = 26% - (-15%); 2013 = +32% - (-7%) !) LT Eq Prem was lower in 2008/2012! ▶

Omit Log Plot

More stuff at

<http://www.ivo-welch.info/professional/goyal-welch/>

Non-Historical Inference

It used to be that implied cost of capital (ICCs) were lower than the historical cost of capital.

No longer. Li, Ng, and Swaminathan, JFE2013 extended: Implied Cost of Capital, Based on Analyst Estimates, Oct 2014:

- ▶ Relative to Bonds: **6.5%**
- ▶ Relative to Bills: 9.7%

I cannot reconcile them. Choose:

- ▶ $\approx 3\%$ (historical)
- ▶ or $\approx 6\%$ (ICC).
- ▶ I choose $< 3\%$.
- ▶ If you choose 6%, you need to worry more about beta than I.

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Long-Term Exposure Estimates

Factor Exposure (Beta) Estimates

- ▶ What is the last paper on the subject that you read?

(Must be really unimportant, easy, or obvious!?)

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How should you estimate beta?

- ▶ Shrink? Vasicek.
- ▶ 1-year, 3-year, 5-year, 10-year history?
- ▶ Is 1-year-ahead beta different from 5-year-ahead beta?
- ▶ Daily or Monthly Data?
- ▶ Industry or Own Betas?
- ▶ Growth-Related? Instrumented?
- ▶ Large firms vs. small firms?
- ▶ After 2000 vs. before?
- ▶ Does it matter if asset is a pfio rather than firms?
- ▶ Is it different in the UK? Germany? China?
- ▶ How bad is the time-decay? Can we predict 1-year beta in 5-years?

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Methods

Rows are same dep var, so R^2 and autoccoef are comparable.

Dep=1 year	Independent Variable, 1 Year				Independent Variable, 3 Years				sd(y) N
	Daily		Monthly		Daily		Monthly		
	OLS	VCK	OLS	VCK	OLS	VCK	OLS	VCK	
pooled	firms	monthly	OLS	VS					
pooled	firms	daily	OLS	VS					
pooled	firms	daily	OLS	VS					
pooled	big 1000	daily	OLS	VS					
pooled	2000s	daily	OLS	VS					
FM	firms	daily	OLS	VS					
pooled	industries	daily	OLS	VCK					

(not a Regression, but RMSE of direct use (prediction) with each beta estimate)

RMSE	Firms	daily	OLS	VS

Answers

Dep=1 year				Indep Var, 1 Year				Indep Var, 3 Years				sd(y)	N
				Daily		Monthly		Daily		Monthly			
				OLS	VCK	OLS	VCK	OLS	VCK	OLS	VCK		
pooled	firms	monthly	OLS	10.7	11.4	5.1	6.8	11.1	11.2	9.4	11.0	1.2	197,068
			VS	16.2	18.0	7.0	10.9	17.0	17.6	13.0	17.0		
pooled	firms	daily	OLS	46.1	50.0	11.9	17.0	48.3	49.4	21.0	26.2	0.6	199,783
			VS	50.7	56.2	12.9	19.3	53.3	55.1	22.8	29.6		
pooled	firms	daily	OLS	43.2	47.5	10.9	15.9	NA				0.6	280,181
			VS	48.2	54.5	12.0	18.5	NA					
pooled	big 1000	daily	OLS	57.3	57.7	20.2	21.3	56.0	56.1	34.1	31.0	0.6	64,129
			VS	57.5	58.6	20.4	22.1	56.7	57.0	34.6	35.1		
pooled	2000s	daily	OLS	56.6	58.5	16.3	22.7	54.2	54.6	23.2	29.7	0.6	64,505
			VS	59.0	61.6	16.9	24.5	56.8	57.5	24.4	31.9		
FM	firms	daily	OLS	44.9	47.6	14.0	17.1	46.2	47.1	21.7	24.9	0.6	199,783
			VS	48.4	52.5	14.8	18.9	50.3	52.0	23.1	27.5		
pooled	industries	daily	OLS	64.7	64.4	26.7	27.0	58.6	58.7	37.8	35.9	0.3	3,827
			VS	64.2	64.7	26.5	27.9	58.0	58.4	37.7	36.8		

(not a Regression, but RMSE of direct use (prediction) with each beta estimate

RMSE	Firms	daily	OLS	0.50	0.45	1.14	0.74	0.46	0.45	0.80	0.63
			VS	0.45	0.38	1.12	0.69	0.40	0.38	0.77	0.57

Universal Beta Estimation Advice

- ▶ Use Daily Frequency
 - ▶ Use Approx 1-2 Years of Data
 - ▶ Shrink with Vasicek, not OLS.
 - ▶ and, as I will soon show you, shrink again
-
- ▶ Omitted
 - ▶ Do not use industry (exposure) information. (Even additionally, on the margin, it's of no use. By itself = 5% instead of 50%.)
 - ▶ Do not use growth/value industry (exposure) information.
 - ▶ Similar prescription, we think, for XML and SMB exposures.
 - ▶ Dimson-Marsh does little

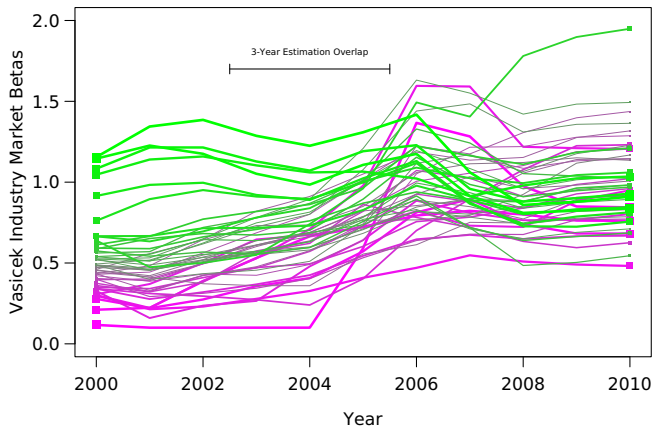
Two Problems Not In Vasicek

- ▶ Vasicek is just the random-effects panel data method, applicable for any X variable.
- ▶ Two Omitted Problems:
 1. You do not know the true X (beta). You have to work with estimated betas, like X with measurement errors.
 2. The true beta is itself wandering around.
 - ▶ Autocoeff of 1-year beta in 1/5/10 yrs: 0.73/0.52/0.39 .
 - ▶ Some cool figures below.
- ▶ So, start with Vasicek beta, but shrink again.

[derive, given stderr of beta estimate. in paper, write first shrink magnitude of OLS, too.]

Beta Stability of Equity (Not Assets)

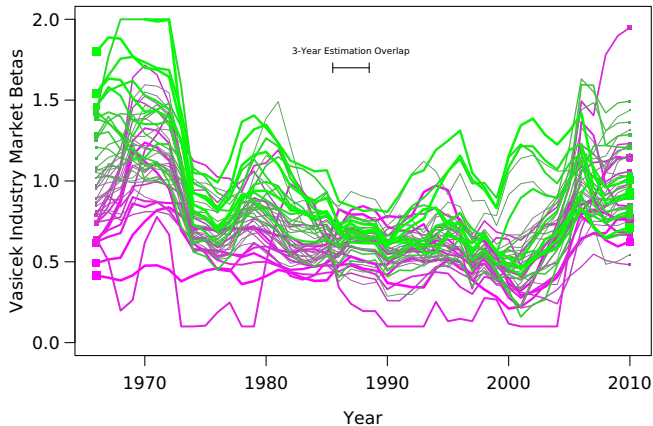
49 Industries Now



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

Beta Stability of Equity (Not Assets)

49 Industries Now



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

Pragmatic Patch: What to do?

- ▶ The best individual-firm forecast of 1-mo ahead = $0.67 \times$ estimated VS beta—too much unreliability over 1-mo.
- ▶ Best forecast of 1-yr ahead = $0.73 \times$ estimated VS beta
- ▶ Best forecast of 5-yr ahead = $0.69 \times$ estimated VS beta
- ▶ Best forecast of 10-yr ahead = $0.62 \times$ estimated VS beta

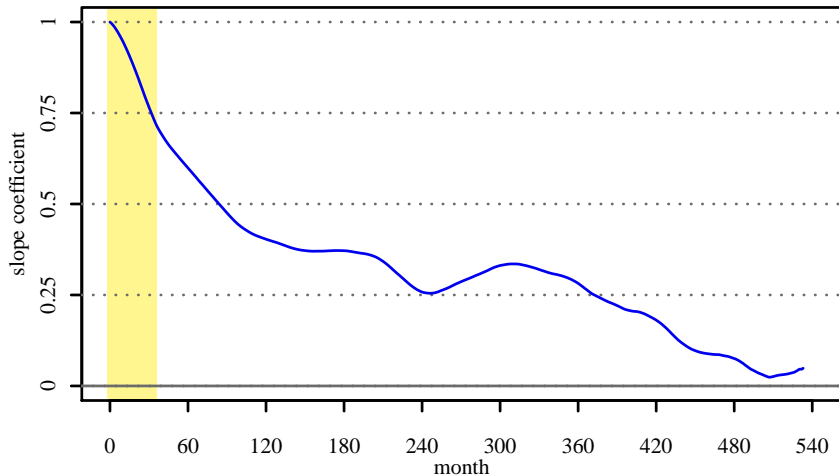
Advice:

- ▶ You should shrink via VCK and then shrink again...a lot.
[add intercept]
- ▶ Instead of $\beta_A = 0$ and $\beta_B = 2$, you need 0.33 and 1.67 .
- ▶ Instead of $\Delta ER = 3\% \times 2 = 6\%$, you need $3\% \times 1.3 \approx 4\%$.
- ▶ ...even if you believe everything else about CAPM and Vasicek shrinkage.

Model Prediction (Not EqP or Beta)

X-Sectional Correlation of Industry ER over Time

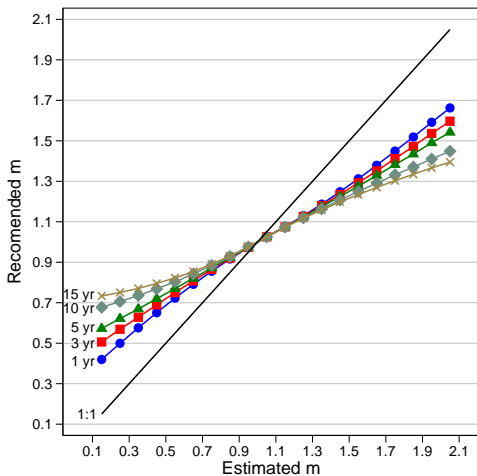
Regress ER on Lagged ER in **49 industries**.



Warning: final data points are based on very few regressions.

How should you double-shrink Beta?

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



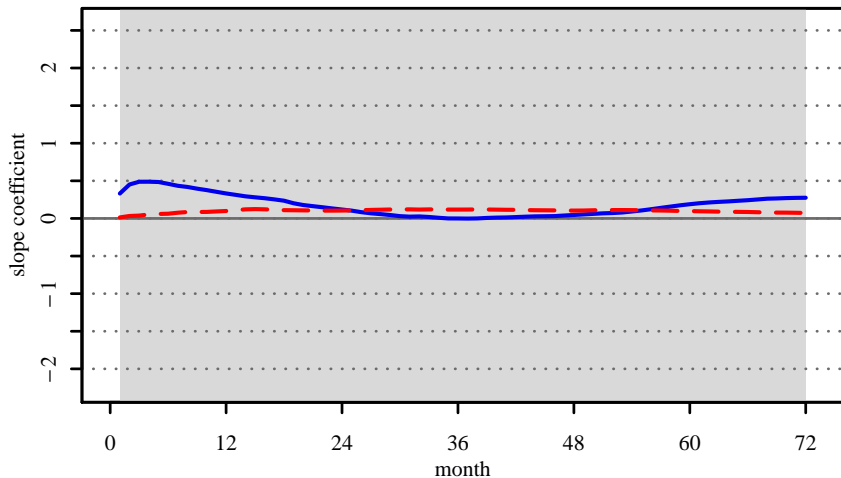
X-axis is already the Vasicek shrunk beta!

Model Empirical Validity

Model Evidence

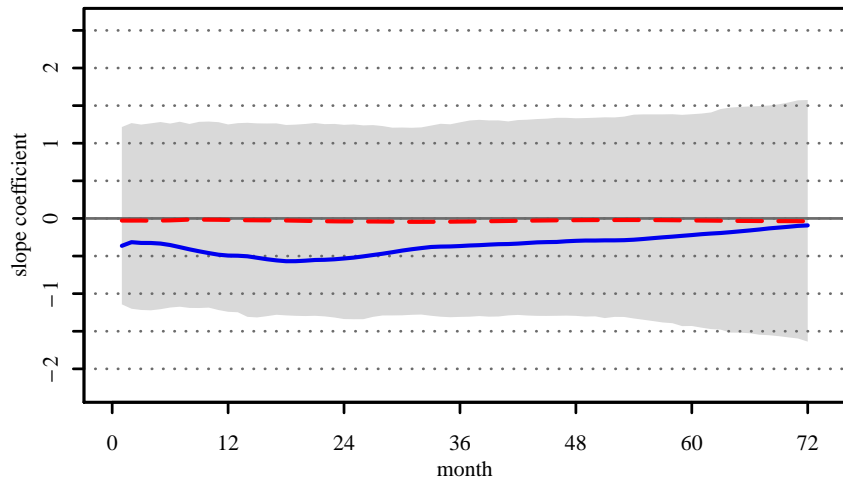
- ▶ Predict future average returns with current model expected rates of return.
- ▶ At each moment in time,
 - ▶ Use lagged 50-year average rate of return as factor premium.
 - ▶ Estimate naive market-beta (Vasicek, but not double shrunk).
 - ▶ Calculate an $E(R_i)$ according to the (CAPM or FFM) model.
 - ▶ Regress R_i over compound x years on $E(R_i)$.
 - ▶ Repeat next month (Fama-Macbeth like)
- ▶ Ideally, your coefficient is 1.
- ▶ A useless model has a coefficient of 0.
- ▶ Use 49 Industries
- ▶ As placebo, randomly switch firm IDs. Plot 95% range in gray.

CAPM Evidence



Model is too noisy to be useful.

FFM Evidence



Model is less noisy, but counterproductive.

Model Evidence

- ▶ As noted in many earlier papers esp Fama-French, the equilibrium models are very imprecise. Their standard errors are very large. The CAPM is less precise than the FFM model.
- ▶ There is not even a hint that the models were useful. Their mean coefficient estimates were often negative.
- ▶ If you are using the models, you better have strong priors that they work.
- ▶ ... even though even the most sophisticated hedge funds are having trouble to predict just 1-month horizon average rates of return. How are you going to do 20 years on close-to-iid returns?
- ▶ And, if you do, make sure to use up-to-date equity premia, and appropriately shrunk.

CAPM and FFM Model Evidence

- ▶ Lousy.
- ▶ Nothing works, not even 1-month.
- ▶ 120 months prediction?? Go To a Hedge Fund!
- ▶ Not in the sense: *could the model be true?*
- ▶ In the sense: *could the model be useful?*
- ▶ No reliable avgret relation to risk, vol, or leverage.

Eric Falkenstein Video

Financial Genius



What Works?

Alternatives:

Now What?

It takes a model to beat a model.

What should we teach? Would can we teach?

Fact 1

- ▶ With **Taxes**, Corporate Debt Has A Lower Cost of Capital Than Corporate Equity.

⇒ Debt-Financed Projects are Cheaper

within reasonable limits, of course. I have seen evidence that endogenous market-betas can reject a little less severely. But in themselves, to believe this, you really need to have a lot of faith that this is at work, because there is little evidence that this is the reason why leverage increasing firms do not suffer *appropriately* (rather than just some) increasing higher betas.

Fact 2

Long-Term Projects Must Offer Higher Exp Rate of Return than Short-Term Projects.

- ▶ Make sure to teach students the difference between promised payoffs and expected payoffs.
- ▶ Use my book if they are wobbly here.

Rely on Facts

- ▶ Asset-Class Differential CoC
- ▶ Term-Spread Differential CoC

Specific ABCD Advice

ABCD = Asset-Class Based Capital Budgeting With Duration

- ▶ Don't worry about CAPM equity beta. Assume it is 1.
- ▶ Use a reasonable term-spread to match your project CFs.
- ▶ Use a modest equity-premium.
- ▶ Use your (intended) project financing leverage.
- ▶ Use the debt-tax shield in CC.
- ▶ Worry about expected cash flows and optionalities. Cost of NFL. Reasonable distress costs. Market imperfections (your liquidity). Executive gaming.

Your errors won't be (much/any) worse than if you use CAPM or FFM capital budgeting.