

Long-Term Investment  
Asset-Class Based Capital Budgeting  
Claremont McKenna College

Yaron Levi and Ivo Welch

Oct 2014

# 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??

# 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??

# 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??

# 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??

# 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?

0

# 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?

0



## 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?

## 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?

## 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*?

⇒ Let's Survey.

## 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*?

⇒ Let's Survey.

# 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.

## 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.

## 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.



# Four Key Points

## 1. Equity Premium

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

## 2. Exposure Estimates

- ▶ Universal incorrect prescriptions of long-term exposure estimates

## ⇒ Almost-Irrelevance of Equity Exp-Return Predictions

- ▶ Not  $6\% \times (1.5 - 0.5)$ , but  $2\% \times (1.1 - 0.9)$ .

## 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.

# Four Key Points

## 1. Equity Premium

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

## 2. Exposure Estimates

- ▶ Universal incorrect prescriptions of long-term exposure estimates

## ⇒ Almost-Irrelevance of Equity Exp-Return Predictions

- ▶ Not  $6\% \times (1.5 - 0.5)$ , but  $2\% \times (1.1 - 0.9)$ .

## 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.

# Four Key Points

## 1. Equity Premium

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

## 2. Exposure Estimates

- ▶ Universal incorrect prescriptions of long-term exposure estimates

⇒ Almost-Irrelevance of Equity Exp-Return Predictions

- ▶ Not  $6\% \times (1.5 - 0.5)$ , but  $2\% \times (1.1 - 0.9)$ .

## 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.

# Four Key Points

## 1. Equity Premium

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

## 2. Exposure Estimates

- ▶ Universal incorrect prescriptions of long-term exposure estimates

## ⇒ Almost-Irrelevance of Equity Exp-Return Predictions

- ▶ Not  $6\% \times (1.5 - 0.5)$ , but  $2\% \times (1.1 - 0.9)$ .

## 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.

# Four Key Points

## 1. Equity Premium

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

## 2. Exposure Estimates

- ▶ Universal incorrect prescriptions of long-term exposure estimates

## ⇒ Almost-Irrelevance of Equity Exp-Return Predictions

- ▶ Not  $6\% \times (1.5 - 0.5)$ , but  $2\% \times (1.1 - 0.9)$ .

## 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.

# Four Key Points

## 1. Equity Premium

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

## 2. Exposure Estimates

- ▶ Universal incorrect prescriptions of long-term exposure estimates

## ⇒ Almost-Irrelevance of Equity Exp-Return Predictions

- ▶ Not  $6\% \times (1.5 - 0.5)$ , but  $2\% \times (1.1 - 0.9)$ .

## 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.

# 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%!*



# 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%!***

# Yields vs AvgReturns on Long-Term Bonds

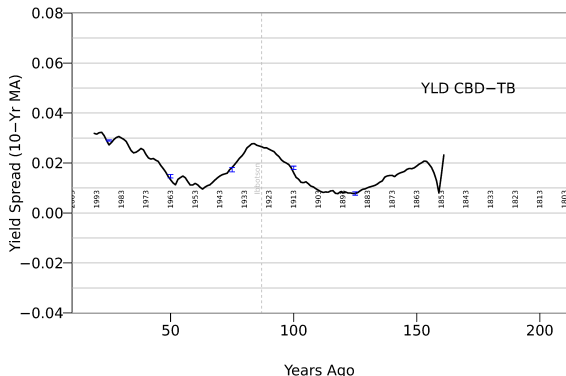
## Preparatory, Close-To-Tautology:

- ▶ Over the very long run, in a stationary equilibrium, long-term bonds had/have rates of return equal to their 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

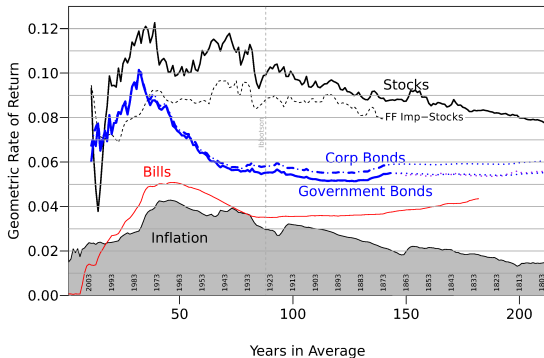
**Preparatory**, Bonds Pay More Than Bills:



- ▶ 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 Performance, X To 2013

**Preparatory:** In 2013, looking back X Years...



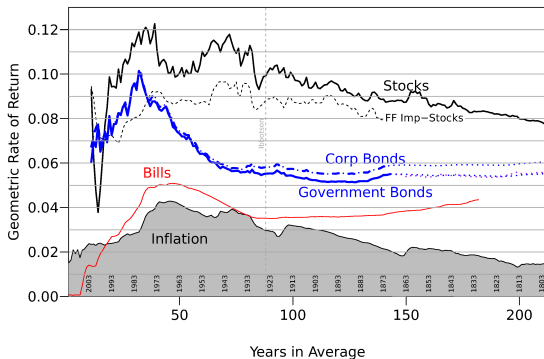
Long-Horizon Equity Premium Spread (Now=12/2013):

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

# Geometric Performance, X To 2013

**Preparatory:** In 2013, looking back X Years...

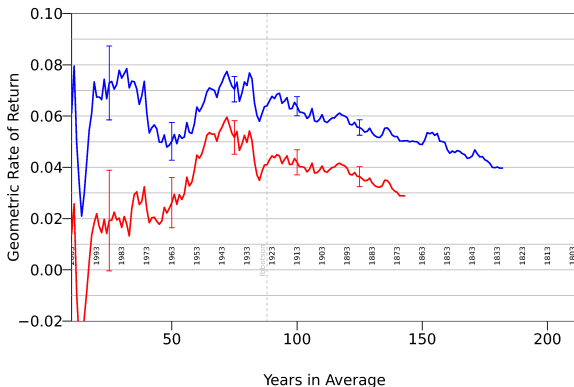


Long-Horizon Equity Premium Spread (Now=12/2013):

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 2008/2012! ▶

# 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.

# Omit Log Plot

More stuff at

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

# Historical Inference

## Equity Premium

- ▶ Principal Data Change: Not lower stock returns nowadays, but higher long-term bond yields nowadays.
- ▶ 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%.



# 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.

# 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.

# Long-Term Exposure Estimates

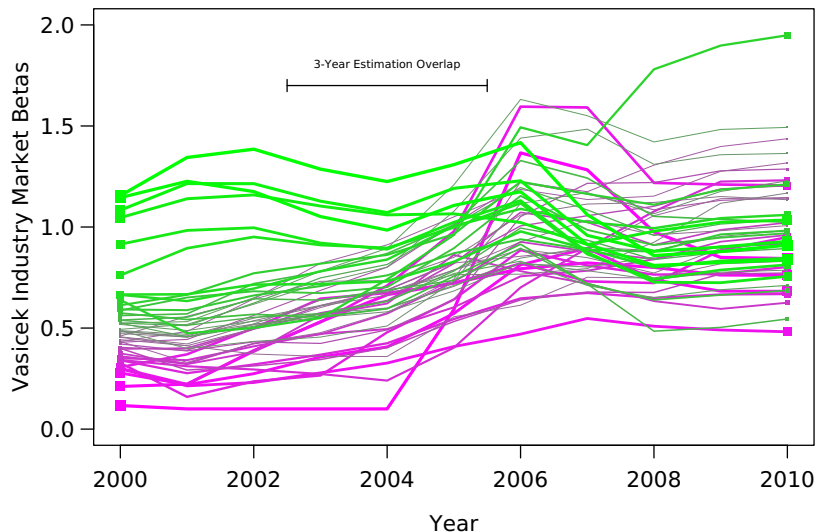
# Needed Long-Run Exposure Adjustments

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. Needed in long-term applications.)

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

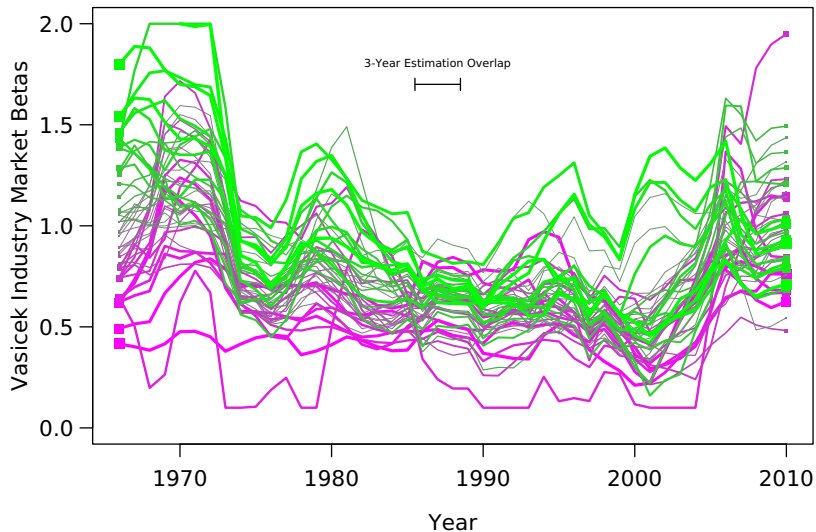
- ▶ This is *after* Bayesian Vasicek exposure shrinking.
- ▶ CAPM estimates, say, 5% E(R) difference in cc today
  - ⇒ optimally use= 2% E(R) diff for 5-year's CFs (Car)
  - ⇒ optimally use= 1% E(R) diff for 20-year's CFs (Building)
  - ⇒ optimally use= 0% E(R) diff for 50-year's CFs (Land)
- ▶ Is this a good use of your research money? (Gaming?)

# Beta Stability of Equity (Not Assets)



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

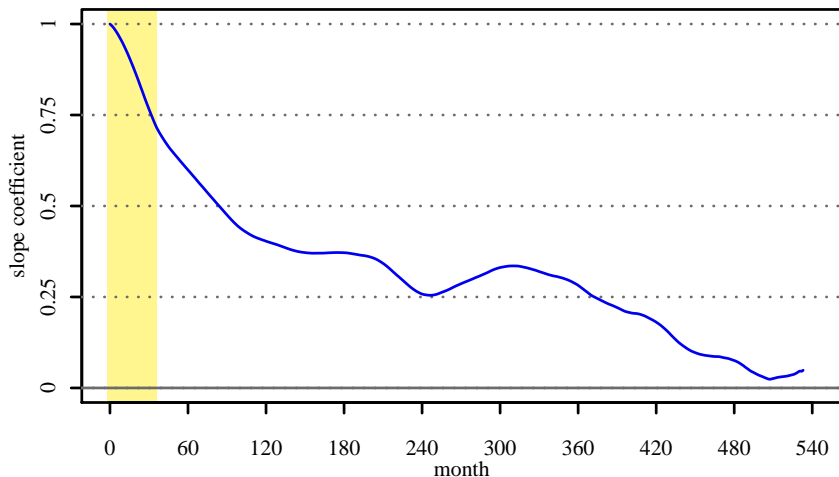
# Beta Stability of Equity (Not Assets)



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

# X-Sectional Correlation of Industry ER over Time

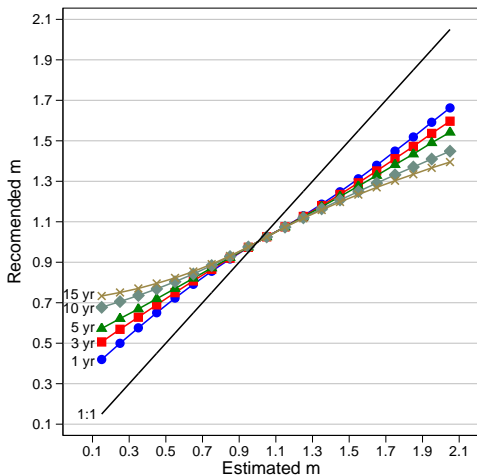
Regress ER on Lagged ER in 49 industries.



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

# CAPM and FFM Model Evidence

- ▶ Omitted.
- ▶ Lousy.
- ▶ Nothing works, not even 1-month.
- ▶ 120 months?? 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.

# CAPM and FFM Model Evidence

- ▶ Omitted.
- ▶ Lousy.
- ▶ Nothing works, not even 1-month.
- ▶ 120 months?? 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.

# 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 ABC Advice

- ▶ 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 bad.