The Supply Theory of Asset Pricing

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A new class of Capital Asset Pricing Models arises from the first principle of real investment for individual firms

Three defining characteristics of neoclassical economics:

- Rational expectations
- Consumers maximize utility, and firms maximize market value
- Markets clear

A representative household maximizes:

$$U(C_t) + \rho E_t[U(C_{t+1})]$$

subject to:

$$\begin{aligned} C_t + \sum_i P_{it} S_{it+1} &= \sum_i (P_{it} + D_{it}) S_{it} \\ C_{t+1} &= \sum_i (P_{it+1} + D_{it+1}) S_{it+1} \end{aligned}$$

The first principle of consumption:

$$E_t[M_{t+1} r^S_{it+1}] = 1 \quad \Rightarrow \quad \overbrace{E_t[r^S_{it+1}] - r_{ft} = \beta^M_{it} \lambda_{Mt}}^{\textbf{The Consumption CAPM}}$$

An individual firm i maximizes:

$$P_{it} + D_{it} \equiv \max_{\{I_{it}\}} \left[\Pi_{it} K_{it} - I_{it} - \frac{a}{2} \left(\frac{I_{it}}{K_{it}} \right)^2 K_{it} + E_t \left[M_{t+1} \Pi_{it+1} K_{it+1} \right] \right]$$

The first principle of investment:

$$1 = E_t \left[M_{t+1} \frac{\Pi_{it+1}}{1 + a(I_{it}/K_{it})} \right]$$

$$\frac{P_{it+1} + D_{it+1}}{P_{it}} \equiv \underbrace{r^S_{it+1} = \frac{\Pi_{it+1}}{1 + a(I_{it}/K_{it})}}_{\textbf{The Investment CAPM}}$$

The consumption CAPM and the investment CAPM deliver the identical expected return in general equilibrium:

$$r_{ft} + \beta_{it}^{M} \lambda_{Mt} = E_t[r_{it+1}^{S}] = \frac{E_t[\Pi_{it+1}]}{1 + a(I_{it}/K_{it})}$$

- Consumption: Covariances are sufficient statistics of $E_t[r_{it+1}^{S}]$
- Investment: Characteristics are sufficient statistics of $E_t[r_{it+1}^{S}]$

The investment CAPM: The supply theory of asset pricing

Outline

Outline

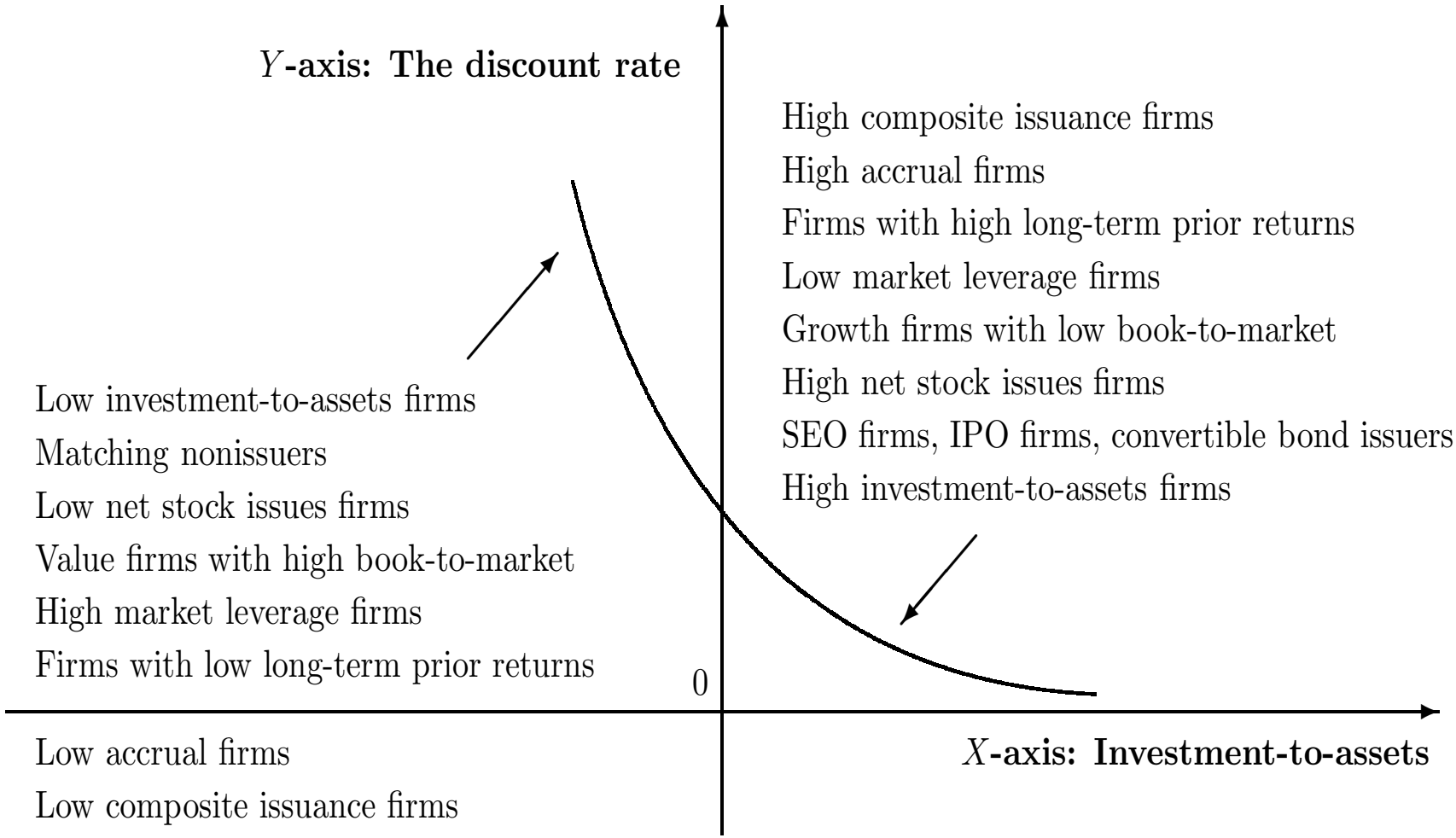
$$E[R_i - R_f] = \beta^i_{\text{MKT}}\, E[\text{MKT}] + \beta^i_{\text{Me}}\, E[R_{\text{Me}}] + \beta^i_{\text{I/A}}\, E[R_{\text{I/A}}] + \beta^i_{\text{Roe}}\, E[R_{\text{Roe}}]$$

- MKT, R_{Me}, $R_{\text{I/A}}$, and R_{Roe} are the market, size, investment, and profitability (return on equity, Roe) factors, respectively
- β^i_{MKT}, β^i_{Me}, $\beta^i_{\text{I/A}}$, and β^i_{Roe} are factor loadings

The q-factor model largely summarizes the cross section of average stock returns, capturing most (but not all) anomalies that plague the Fama-French 3-factor model and Carhart 4-factor model

The q-factor Model

Intuition behind the q-factor model



High Roe relative to low investment means high discount rates:

- Suppose the discount rates were low
- Combined with high Roe, low discount rates would imply high net present values of new projects and high investment
- High discount rates offset high Roe to induce low investment

Price and earnings momentum winners and less financially distressed firms have higher Roe and earn higher expected returns

The Fama-French 5-factor model:

$$E[R_{it} - R_{ft}] = b_i\, E[\mathrm{MKT}_t] + s_i\, E[\mathrm{SMB}_t] + h_i\, E[\mathrm{HML}_t] + r_i\, E[\mathrm{RMW}_t] + c_i\, E[\mathrm{CMA}_t]$$

- $\mathrm{MKT}_t, \mathrm{SMB}_t, \mathrm{HML}_t, \mathrm{RMW}_t$, and CMA_t are the market, size, value, profitability, and investment factors, respectively
- b_i, s_i, h_i, r_i, and c_i are factor loadings

Fama and French (2018) add UMD to form the six-factor model

The q-factor Model

The q-factor model predates the Fama-French 5-factor model by 3–6 years

Neoclassical factors	July 2007
An equilibrium three-factor model	January 2009
Production-based factors	April 2009
A better three-factor model that explains more anomalies	June 2009
An alternative three-factor model	April 2010, April 2011
Digesting anomalies: An investment approach	October 2012, August 2014
Fama and French (2013): A four-factor model for the size, value, and profitability patterns in stock returns	June 2013
Fama and French (2014): A five-factor asset pricing model	November 2013, September 2014

The q-factor Model

Hou et al. (2018, "Which factors?"): Factor spanning tests, 1/1967–12/2016

	$\overline{R}$	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{UMD}
R_{Me}	0.31	0.05	0.01	0.97	0.03	0.03	0.02	
	(2.43)	(1.58)	(0.72)	(64.99)	(1.63)	(0.98)	(0.72)	
		0.03	0.01	0.97	0.05	0.04	0.01	0.03
		(0.90)	(1.21)	(68.50)	(2.81)	(1.34)	(0.34)	(2.57)
$R_{\text{I/A}}$	0.41	0.12	0.01	0.04	0.03	0.06	0.82	
	(4.92)	(3.48)	(0.80)	(3.08)	(1.32)	(2.46)	(31.26)	
		0.11	0.01	0.05	0.04	0.06	0.81	0.01
		(3.15)	(0.97)	(3.06)	(1.79)	(2.21)	(33.12)	(0.77)
R_{Roe}	0.55	0.47	0.03	0.12	0.24	0.70	0.10	
	(5.25)	(5.91)	(1.18)	(2.98)	(3.72)	12.80	1.03	
		0.30	0.00	0.12	0.10	0.65	0.01	0.24
		(4.50)	0.03	(3.74)	(2.02)	(14.77)	(0.21)	(9.94)

The q-factor Model

Hou et al. (2018, "Which factors?"): Factor spanning tests, 1/1967–12/2016

	$\overline{R}$	α_q	β_{MKT}	β_{ME}	$\beta_{\text{I/A}}$	β_{ROE}
SMB	0.25	0.04	0.01	0.94	0.08	0.09
	(1.92)	(1.32)	(0.66)	(54.18)	(4.21)	(5.84)
HML	0.37	0.07	0.04	0.02	1.01	0.19
	(2.71)	(0.63)	(1.01)	(0.31)	(12.18)	(2.65)
RMW	0.26	0.01	0.03	0.12	0.03	0.54
	(2.53)	(0.11)	(1.21)	(1.70)	(0.35)	(8.53)
CMA	0.33	–0.00	0.04	0.04	0.96	0.10
	(3.51)	(0.13)	(3.74)	(1.90)	(34.93)	(3.48)
UMD	0.64	0.11	0.08	0.24	0.00	0.91
	(3.60)	(0.49)	(1.24)	(1.73)	(0.02)	(5.88)

The q-factors subsume RMW, CMA, and UMD in the Fama-French 6-factor model, which cannot subsume the q-factors

Outline

$E_t[M_{t+1} r^I_{it+1}] = 1$, in which r^I_{it+1} is the investment return:

$$r^I_{it+1} \equiv \frac{\overbrace{\left[\underbrace{(1-\tau_{t+1})\left[\kappa \frac{Y_{it+1}}{K_{it+1}} + \frac{a}{2}\left(\frac{I_{it+1}}{K_{it+1}}\right)^2\right]}_{\text{Marginal product plus economy of scale (net of taxes)}} + \tau_{t+1}\delta_{it+1} + \underbrace{(1-\delta_{it+1})\left[1 + (1-\tau_{t+1})a\left(\frac{I_{it+1}}{K_{it+1}}\right)\right]}_{\text{Expected continuation value}}\right]}^{\text{Marginal benefit of investment at time } t+1}}{\underbrace{1 + (1-\tau_t)a\left(\frac{I_{it}}{K_{it}}\right)}_{\text{Marginal cost of investment at time } t}}$$

After-tax corporate bond returns: $E_t\left[M_{t+1} r_{it+1}^{Ba}\right] = 1$, in which $r_{it+1}^{Ba} = (1 - \tau_{t+1}) r_{it+1}^{B} + \tau_{t+1}$

From the WACC approach to capital budgeting:

$$r_{it+1}^{I} = w_{it} r_{it+1}^{Ba} + (1 - w_{it}) r_{it+1}^{S} \Rightarrow r_{it+1}^{S} = r_{it+1}^{Iw} \equiv \frac{r_{it+1}^{I} - w_{it} r_{it+1}^{Ba}}{1 - w_{it}}$$

in which w_{it} is the market leverage

Expected stock returns = expected levered investment returns?

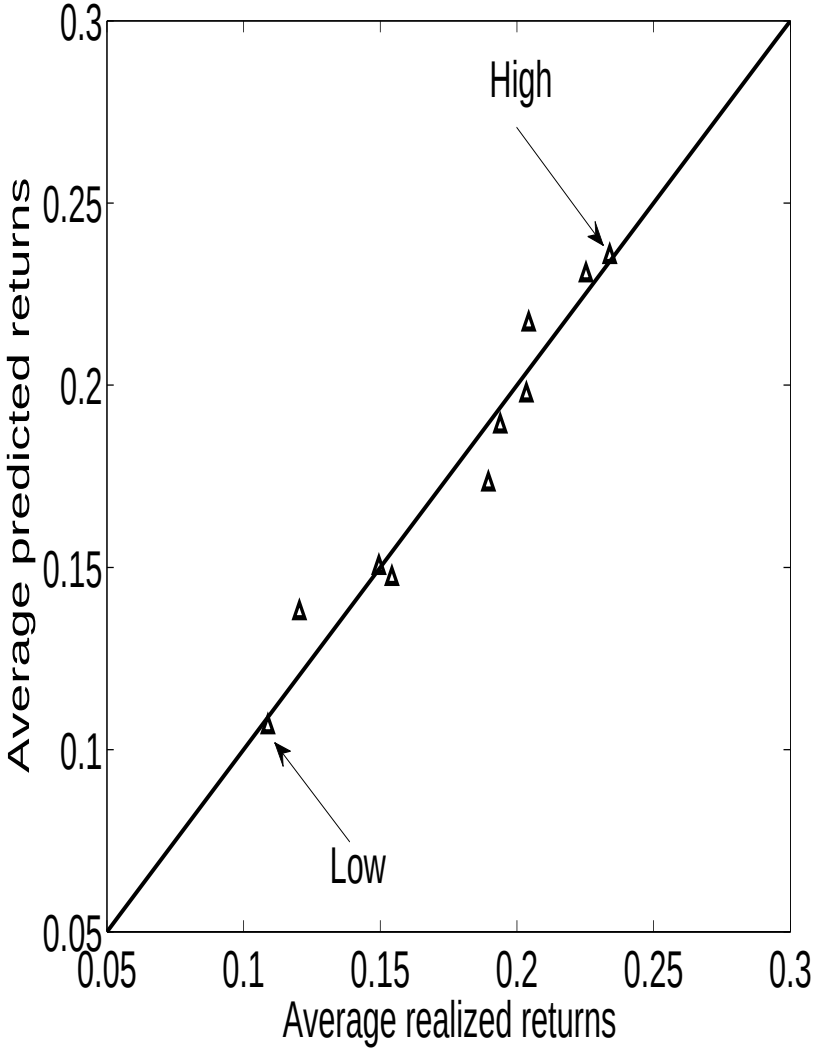
$$E\left[r^{S}_{it+1} - \underbrace{\frac{r^{I}_{it+1}(a,\kappa) - w_{it}\, r^{Ba}_{it+1}}{1 - w_{it}}}_{r^{lw}_{it+1}}\right] = 0,$$

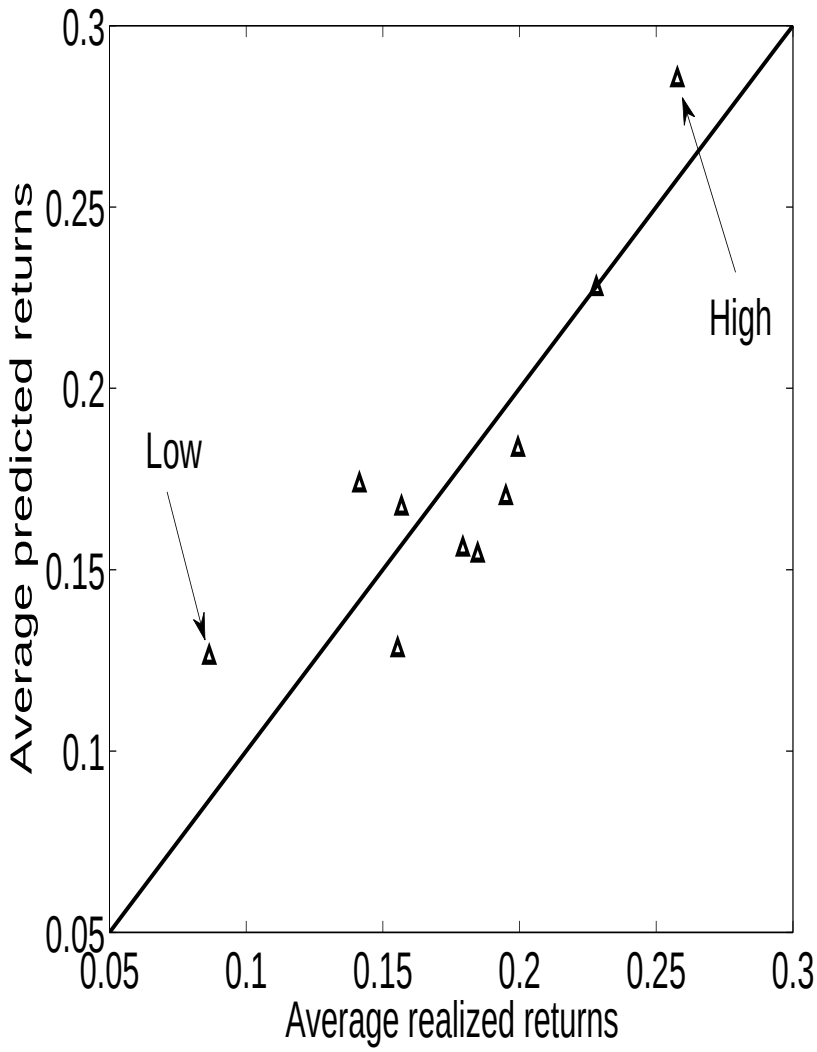
with the model error, α^{i}_{q}, as the sample average of the difference

The model fits well across price and earnings momentum and B/M deciles, explains short-lived nature of momentum (Liu and Zhang 2014), but cannot explain value and momentum simultaneously

Structural Estimation

Estimation results in Liu, Whited, and Zhang (2009), SUE and B/M deciles





Structural Estimation

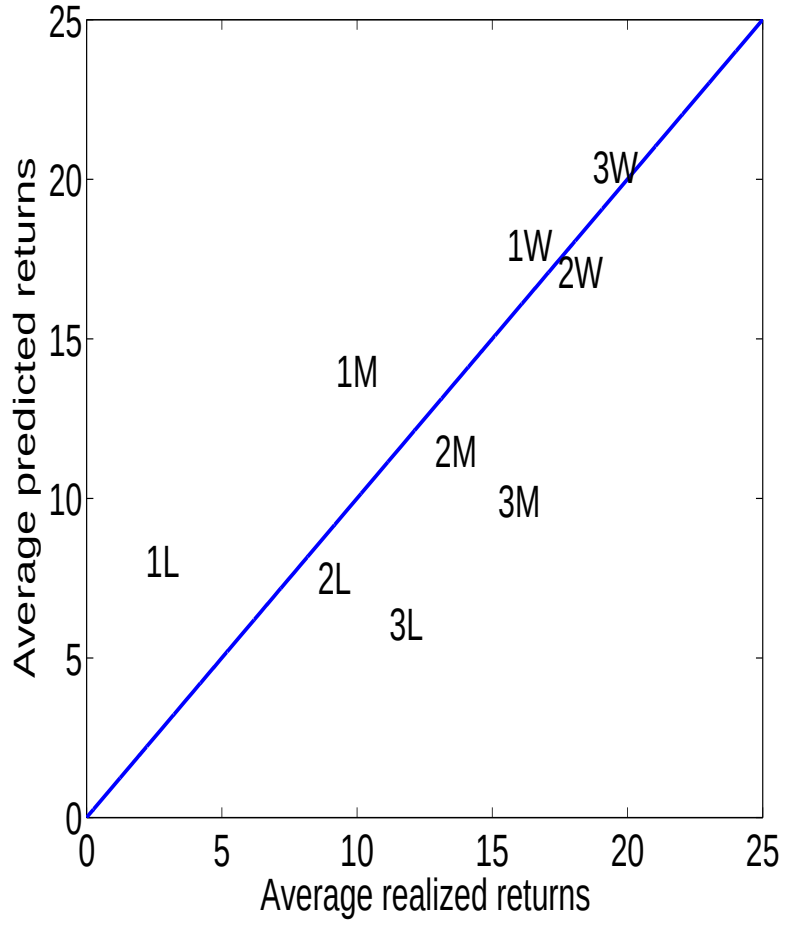
"This problem, that different parameters are needed to fit each anomaly, is a pervasive one in the q-theoretic asset pricing literature (Campbell 2017, p. 275)."

Liu, Whited, and Zhang (2009):

TABLE 2
PARAMETER ESTIMATES AND TESTS OF OVERIDENTIFICATION

	SUE	B/M	CI
	A. Matching Expected Returns		
a	7.7	22.3	1.0
	[1.7]	[25.5]	[.3]
α	.3	.5	.2
	[.0]	[.3]	[.0]
χ^2	4.4	6.0	6.5
d.f.	8	8	8
p	.8	.7	.6
m.a.e.	.7	2.3	1.5

Liu and Zhang (2014):



Operating profits: $\Pi(K_{it}, W_{it}, X_{it})$

- K_{it}: Physical capital; W_{it}: Working capital

$$\begin{aligned} K_{it+1} &= I_{it} + (1 - \delta_{it}) K_{it} \\ W_{it+1} &= \triangle W_{it} + W_{it} \end{aligned}$$

- X_{it}: A vector of exogenous shocks
- Constant returns to scale, Cobb-Douglas

Adjustment costs on physical (not working) capital:

$$\Phi(I_{it}, K_{it}) = \frac{a}{2} \left(\frac{I_{it}}{K_{it}} \right)^2 K_{it}$$

Optimal physical capital investment: $E_t[M_{t+1} r^K_{it+1}] = 1$, in which the physical capital investment return:

$$r^K_{it+1} = \frac{\begin{array}{c}(1-\tau_{t+1})\left[\gamma_K \frac{Y_{it+1}}{K_{it+1}} + \frac{a}{2}\left(\frac{I_{it+1}}{K_{it+1}}\right)^2\right] + \tau_{t+1}\delta_{it+1} \\ +(1-\delta_{it+1})\left[1 + (1-\tau_{t+1})a\left(\frac{I_{it+1}}{K_{it+1}}\right)\right]\end{array}}{1 + (1-\tau_t)a\left(\frac{I_{it}}{K_{it}}\right)}$$

Optimal working capital investment: $E_t[M_{t+1} r^W_{it+1}] = 1$, in which the working capital investment return:

$$r^W_{it+1} \equiv 1 + (1-\tau_{t+1})\gamma_W \frac{Y_{it+1}}{W_{it+1}}$$

The weighted average of the investment returns equals the weighted average of the cost of equity and after-tax cost of debt:

$$w_{it}^{K} r_{it+1}^{K} + (1 - w_{it}^{K}) r_{it+1}^{W} = w_{it}^{B} r_{it+1}^{Ba} + (1 - w_{it}^{B}) r_{it+1}^{S}$$

$w_{it}^{K} = q_{it} K_{it+1} / (q_{it} K_{it+1} + W_{it+1})$ and $w_{it}^{B} = B_{it+1} / (P_{it} + B_{it+1})$

$$r_{it+1}^{S} = \underbrace{\frac{w_{it}^{K} r_{it+1}^{K} + (1 - w_{it}^{K}) r_{it+1}^{W} - w_{it}^{B} r_{it+1}^{Ba}}{1 - w_{it}^{B}}}_{\textbf{The fundamental return, } r_{it+1}^{F}}$$

An extremely flexible theoretical framework

Portfolio-level fundamental returns are constructed from portfolio-level accounting variables aggregated from the firm level:

$$E\left[\begin{array}{c}\sum_{i=1}^{N_{pt}} w_{ipt} r^{S}_{ipt+1} - \\ r^{F}_{pt+1}\left(\gamma_K, a; Y_{pt+1}, K_{pt+1}, I_{pt+1}, \delta_{pt+1}, I_{pt}, K_{pt}, r^{Ba}_{pt+1}, w^{B}_{pt}\right)\end{array}\right] = 0$$

- N_{pt}: The number of firms in portfolio p at the start of t, w_{ipt}: Stock i's weight in portfolio p, r^{S}_{ipt+1}: The return of stock i in p over time t, r^{F}_{pt+1}: The fundamental return of p

Aggregating firm-level characteristics to the portfolio level:
$I_{pt+1} = \sum_{i=1}^{N_{pt}} I_{ipt+1}$, $w^{B}_{pt} = \sum_{i=1}^{N_{pt}} B_{ipt+1} / \sum_{i=1}^{N_{pt}} \left(P_{ipt} + B_{ipt+1}\right)$, etc

Construct firm-level fundamental returns from firm-level accounting variables, then aggregate to portfolio-level fundamental returns:

$$E\left[\begin{array}{c}\sum_{i=1}^{N_{pt}} w_{ipt} r^{S}_{ipt+1} - \sum_{i=1}^{N_{pt}} w_{ipt} \times \\ r^{F}_{ipt+1}\left(\gamma, a; Y_{ipt+1}, K_{ipt+1}, I_{ipt+1}, \delta_{ipt+1}, I_{ipt}, K_{ipt}, r^{Ba}_{ipt+1}, w^{B}_{ipt}\right)\end{array}\right] = 0$$

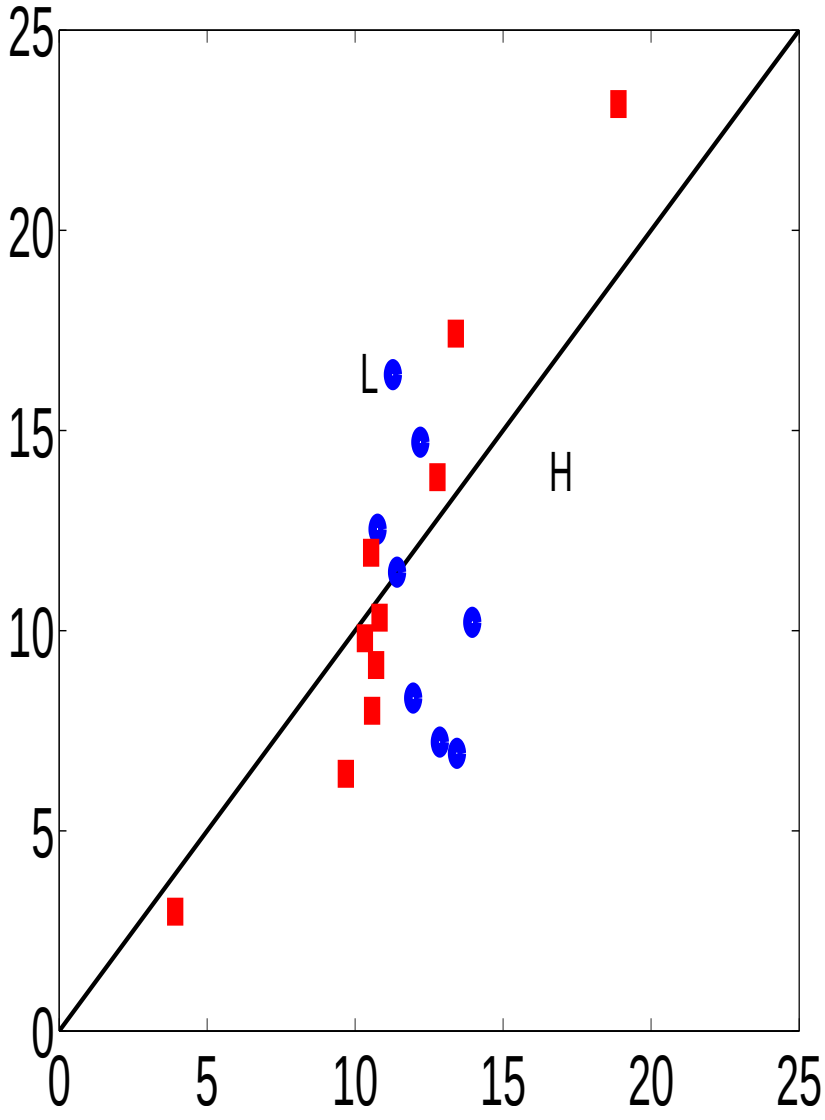
- r^{F}_{ipt+1}: Firm i's fundamental return, r^{F}_{pt+1} varies with w_{ipt}

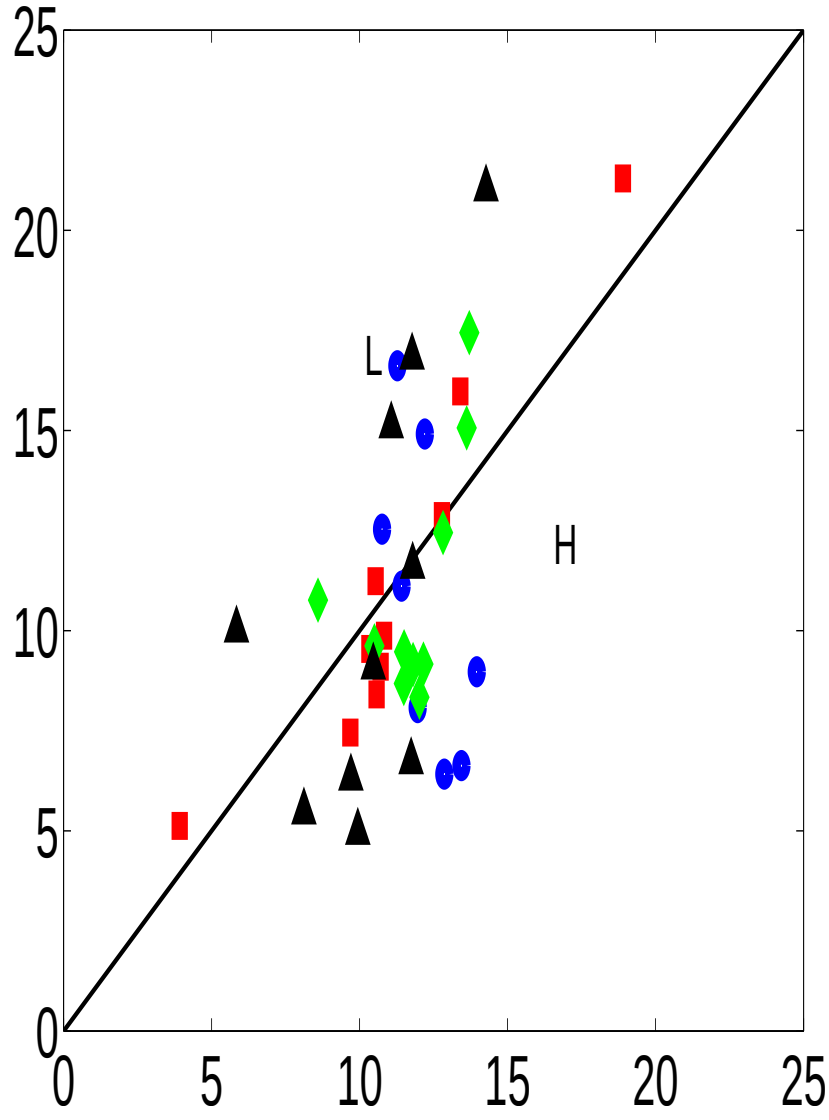
Why?

- Firms follow different investment policy rules
- Firm-level heterogeneity helps identify structural parameters

Structural Estimation

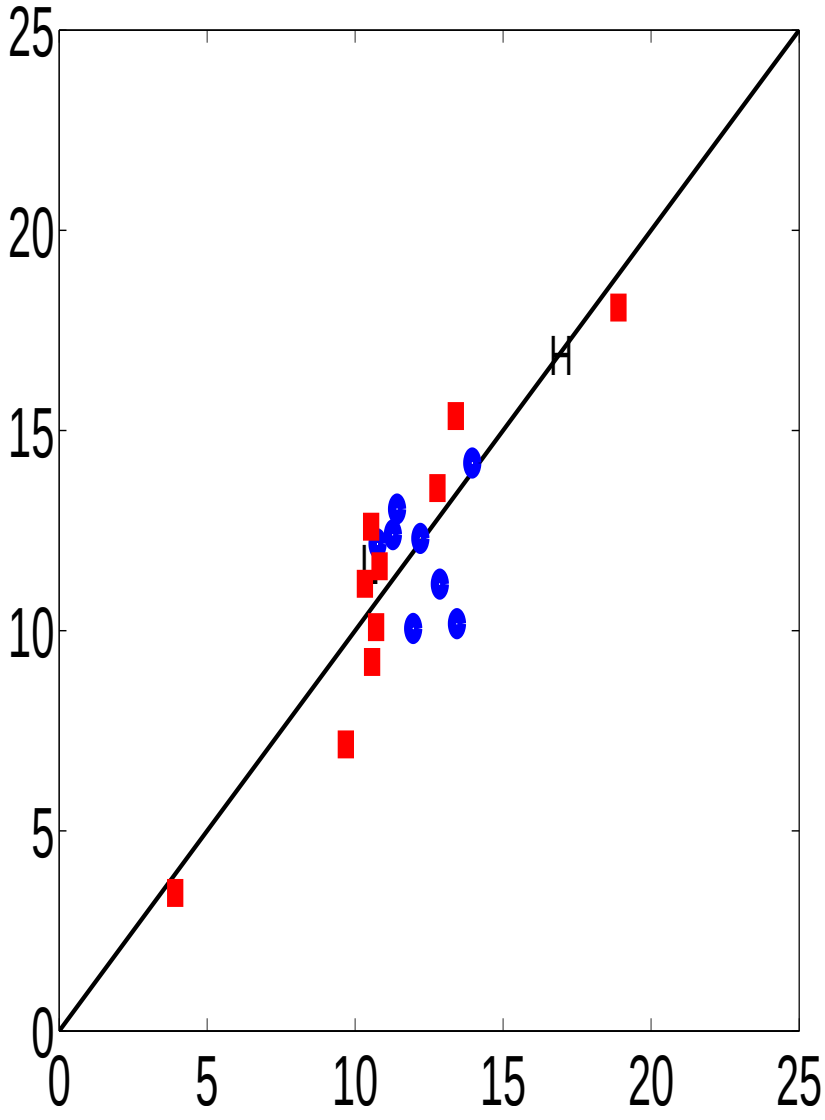
Average predicted versus realized stock returns, Bm-R^{11}, Bm-R^{11}-I/A-Roe, the physical capital model at the portfolio level

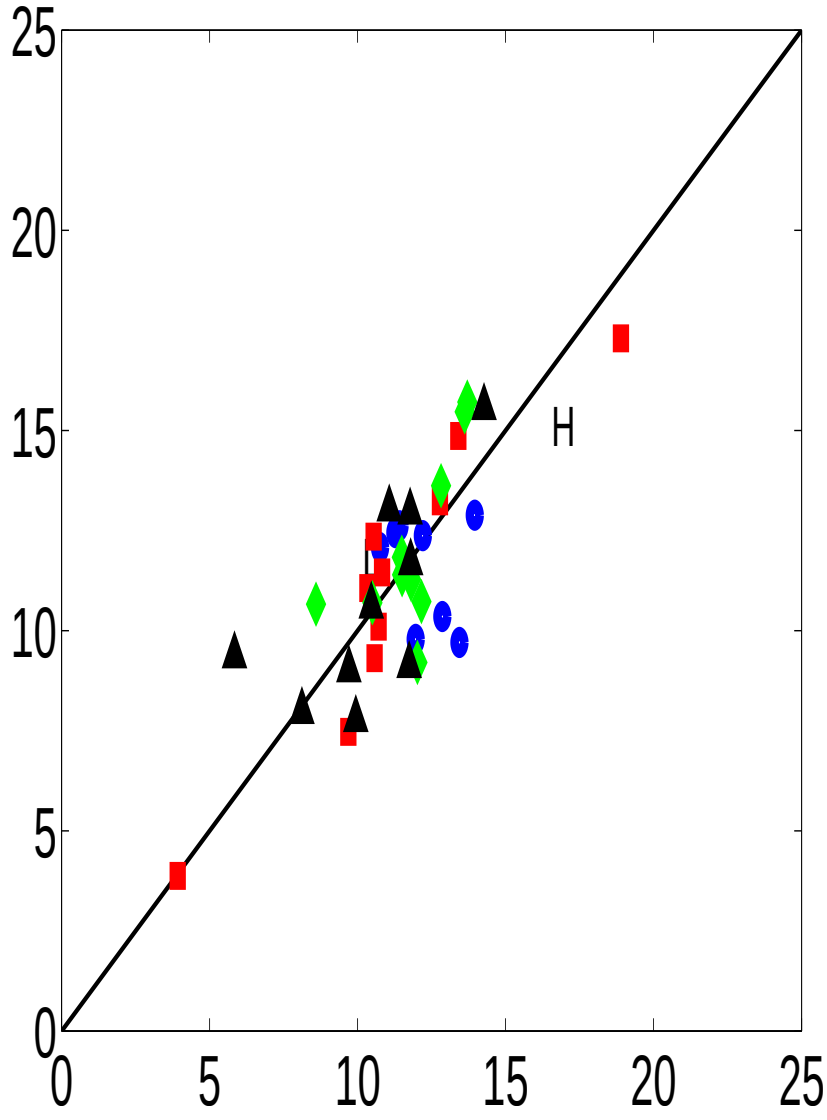




Structural Estimation

Average predicted versus realized stock returns, Bm-R^{11}, Bm-R^{11}-I/A-Roe, the 2-capital model at the firm level

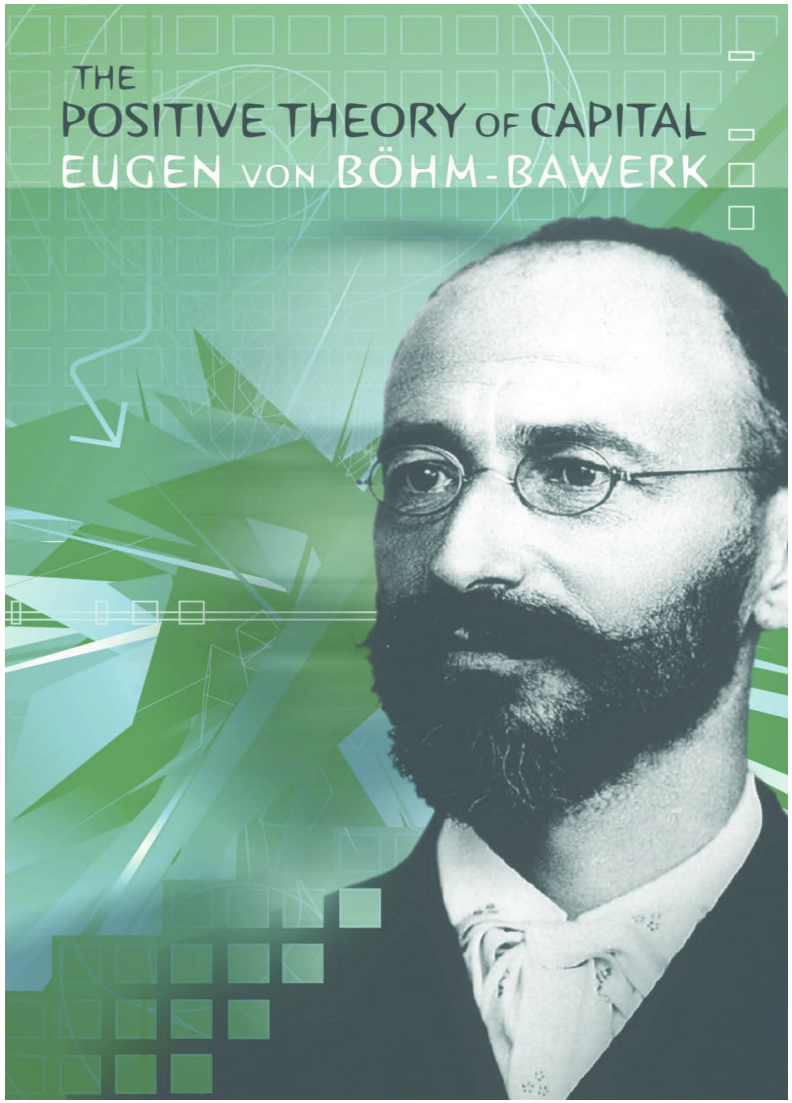




Outline

History

A historical perspective: Böhm-Bawert (1891, The positive theory of capital)



1st generation Austrian School economists, with Carl Menger and Friedrich von Wieser

Why the interest rate > 0?

- The falling marginal utility of income over time
- Consumers tend to underestimate future needs
- "Roundabout" production: Production per worker rises with the production length

"It is an elementary fact of experience that methods of production which take time are more productive. That is to say, given the same quantity of productive instruments, the lengthier the productive method employed the greater the quantity of products that can be obtained (p. 260, my emphasis)."

A positive interest rate offsets benefits from a long production period, giving rise to a negative interest rate-investment relation

History

Fisher (1930, The Theory of Interest)

THE THEORY
OF INTEREST

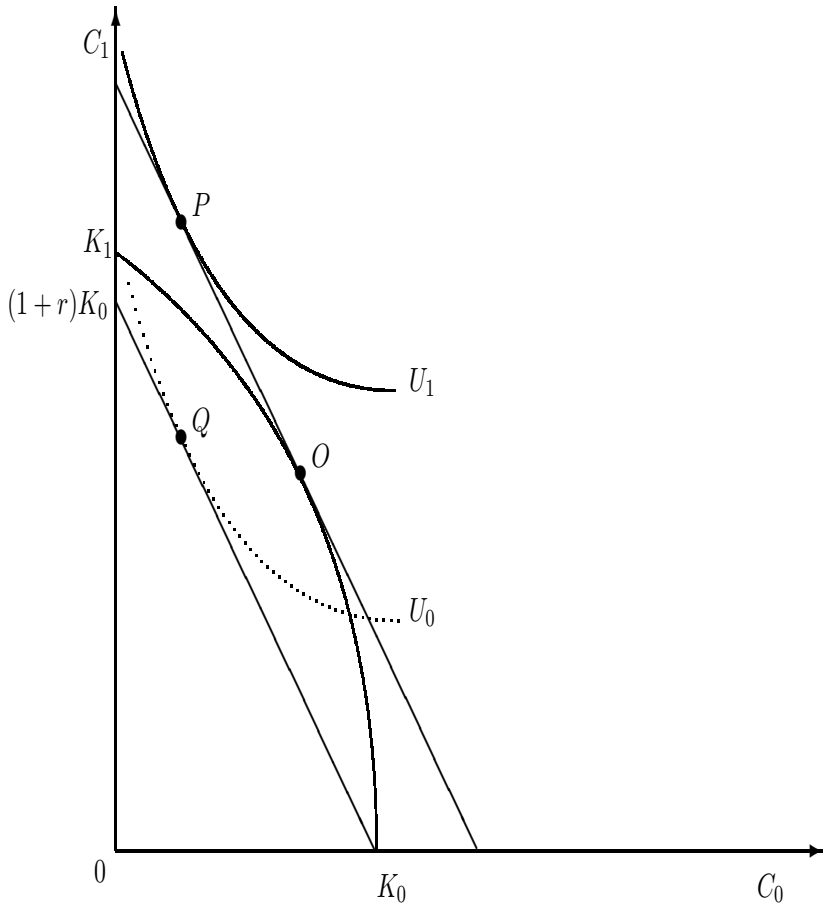
AS DETERMINED BY IMPATIENCE TO SPEND INCOME
AND OPPORTUNITY TO INVEST IT

BY

IRVING FISHER

[1930]

AUGUSTUS M. KELLEY • PUBLISHERS
CLIFTON 1974



The first general equilibrium model with both intertemporal consumption and production

Fisher Separation Theorem: Maximizing the present value of free cash flows as the objective of the firm

Without any dependence on shareholder preferences

History

Jack Hirshleifer's (1958, 1965, 1966, 1970) seminal work

Revives and extends Fisher's (1930) general equilibrium analysis to uncertainty

A pioneer in applying the Arrow-Debreu state-preference approach in finance, including capital budgeting and capital structure

"The logic of the production-based model is exactly analogous [to that of the consumption-based model]. It ties asset returns to marginal rates of transformation, which are inferred from data on investment (and potentially, output and other production variables) through a production function. It is derived from the producer's first order conditions for optimal intertemporal investment demand. Its testable content is a restriction on the joint stochastic process of investment (and/or other production variables) and asset returns. This restriction can also be interpreted in two ways. If we fix the return process, it is a version of the q theory of investment. If we fix the investment process, it is a production-based asset pricing model. For example, the production-based asset pricing model can make statements like 'expected returns are high because (a function of) investment growth is high' (p. 210, original emphasis)."

In hindsight, thanks to Arrow-Debreu, asset pricing theory is just the standard price theory extended to uncertainty and over time

- Fisher (1930) did the extension over time; Debreu (1959), Arrow (1964), and J. Hirshleifer (1970) to uncertainty

Asset pricing theorists, led by Markowitz (1952), started with investors' problem under uncertainty, and never looked back

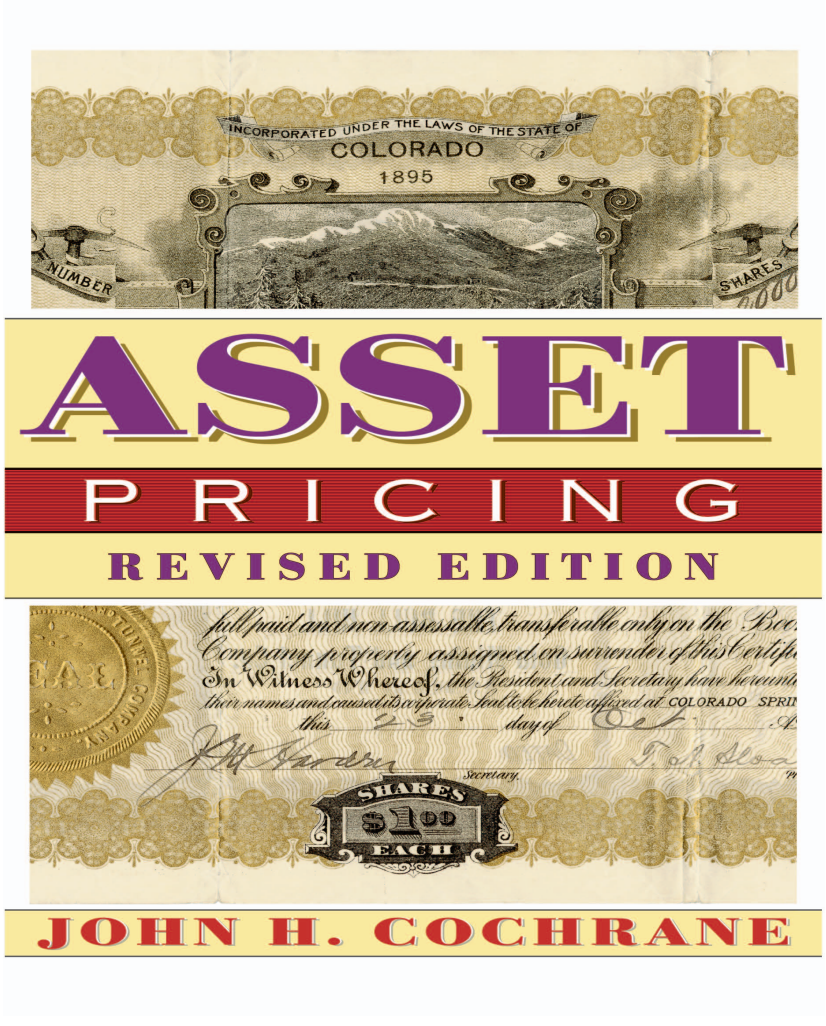
- Markowitz (1952); Roy (1952)
- Treynor (1962); Sharpe (1964); Lintner (1965); Mossin (1966)
- Merton (1973); Long (1974)

Empirical work reinforced the investors-centered CAPM, by favoring the mean variance approach over the state-preference approach

- Fama and Miller (1972); Fama (1976)

History

Böhm-Bawert, Fisher, and Hirshleifer all disappeared from modern asset pricing



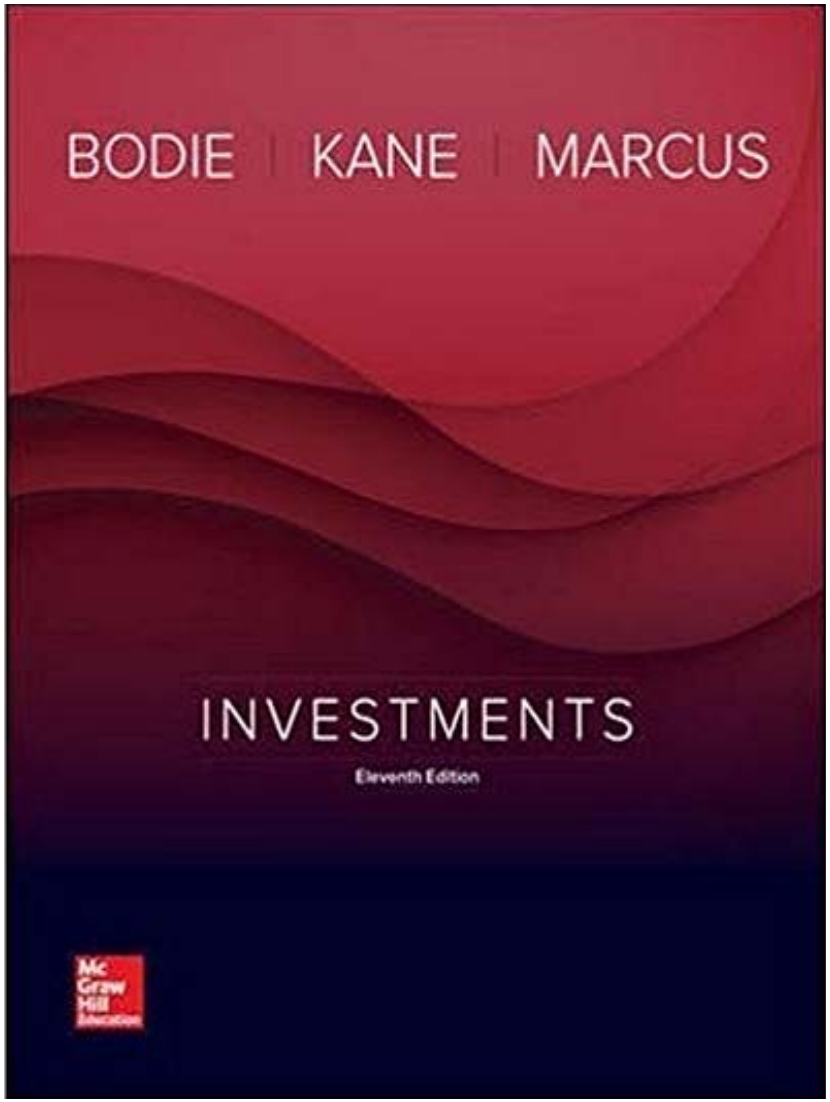
Rubinstein (1976); Lucas (1978); Breeden (1979)

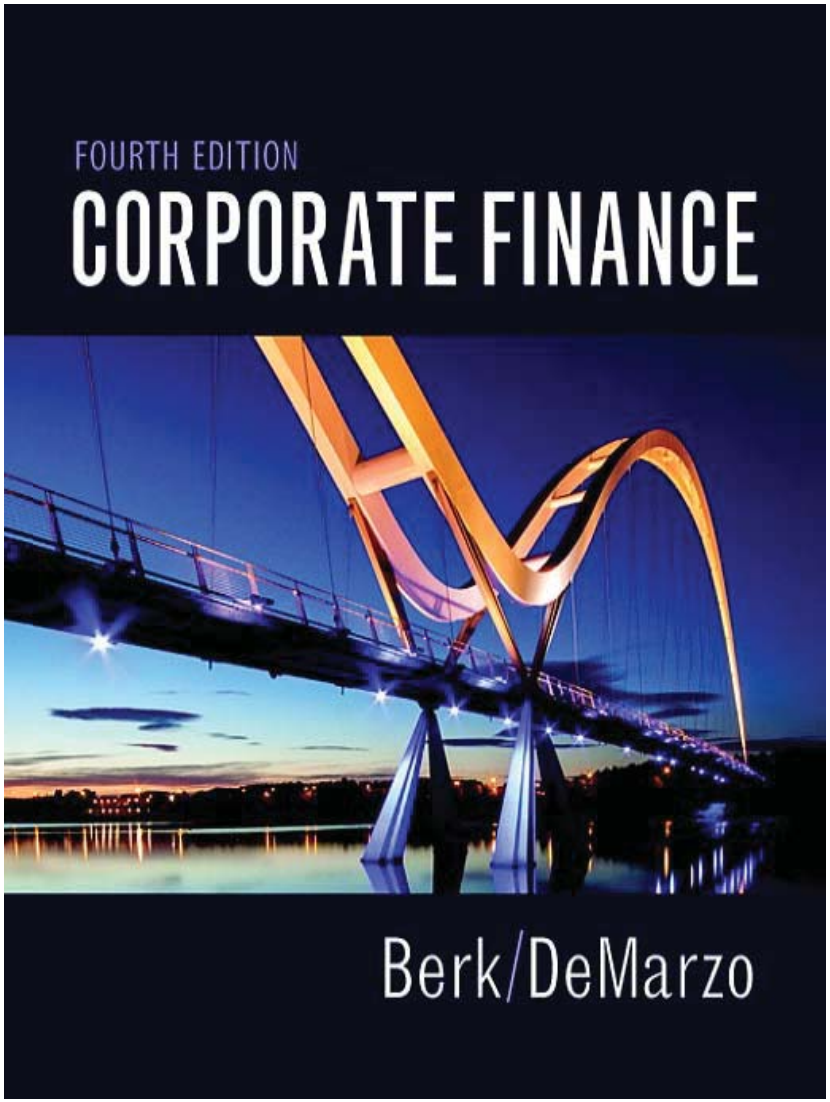
Hansen and Singleton (1982); Breeden, Gibbons, and Litzenberger (1989)

Cochrane (2005): "*All* asset pricing models amount to alternative ways of connecting the stochastic discount factor to data (p. 7, original emphasis)."

History

MBA curriculum largely reflects the academic literature





"Since movements from equilibrium to equilibrium through time involve both price and quantity adjustment, a complete analysis would require a description of both the rate of return and change in asset value dynamics. To do so would require a specification of firm behavior in determining the supply of shares, which in turn would require knowledge of the real asset structure (i.e., technology; whether capital is 'putty' or 'clay'; etc.). (Merton 1973, p. 871, my emphasis)."

"Since the present paper examines only investor behavior to derive the demands for assets and the relative yield requirements in equilibrium, only the rate of return dynamics will be examined explicitly (Merton 1973, p. 871)."

"[It] is not necessary to explicitly examine firms' production decisions and the supply of asset shares, provided that the assumptions made are consistent with optimal behavior of firms in a general equilibrium model. To be consistent with general equilibrium, prices must be recognized to be endogenously determined through the equilibrium of supply and demand (Breeden 1979, p. 269)."

Lucas (1978) never bothered to justify with words

Basically, the general equilibrium problem is too messy, let's solve the tractable consumption-based partial equilibrium problem first

History

Inspired by Cochrane (1991), I recognize in Zhang (2005) that the neoclassical q-theory of investment allows a different reduction of the general equilibrium problem

NBER WORKING PAPER SERIES

ANOMALIES

Lu Zhang

Working Paper 11322
http://www.nber.org/papers/w11322

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2005

I was intrigued by anomalies but disturbed by behavioral finance

The investment CAPM expresses expected returns in terms of corporate policies without any dependence on shareholder preferences

Neatly complementary to the consumption CAPM's reduction of general equilibrium

Alas, the paper was never published

The first principle of consumption and the first principle of investment are two key optimality conditions in equilibrium theory

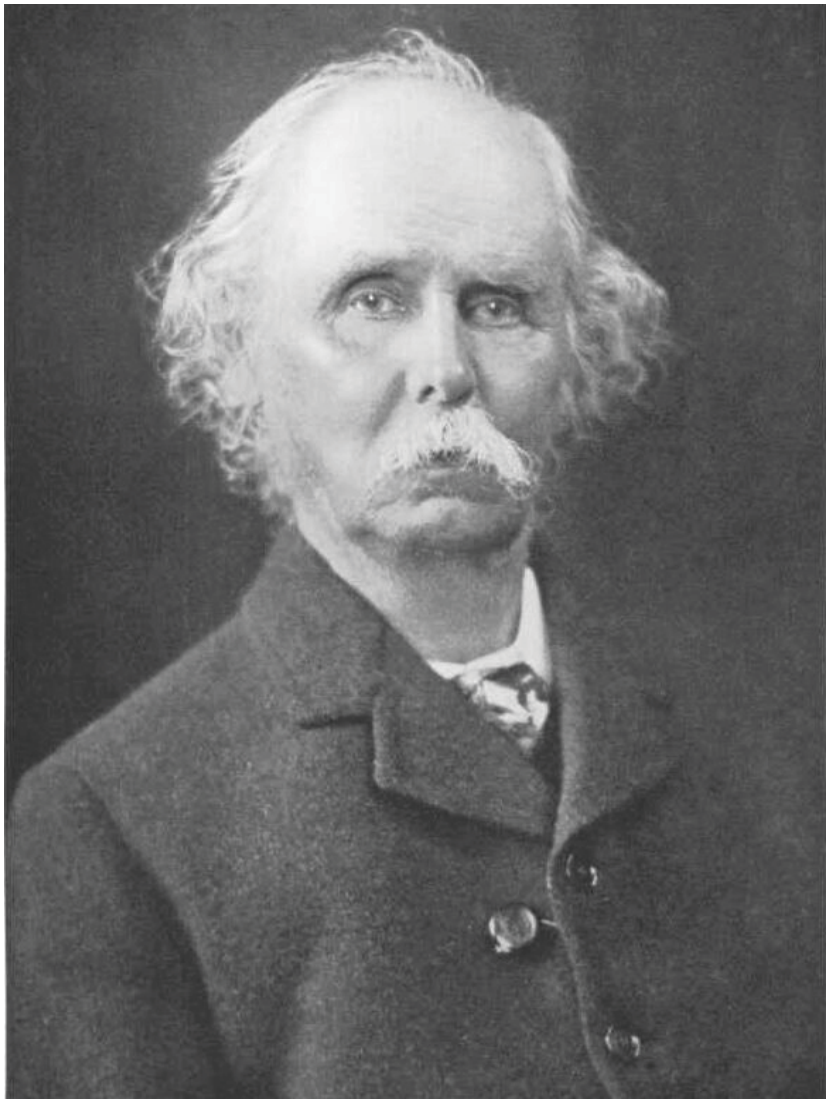
- The investment CAPM as "causal" as the consumption CAPM

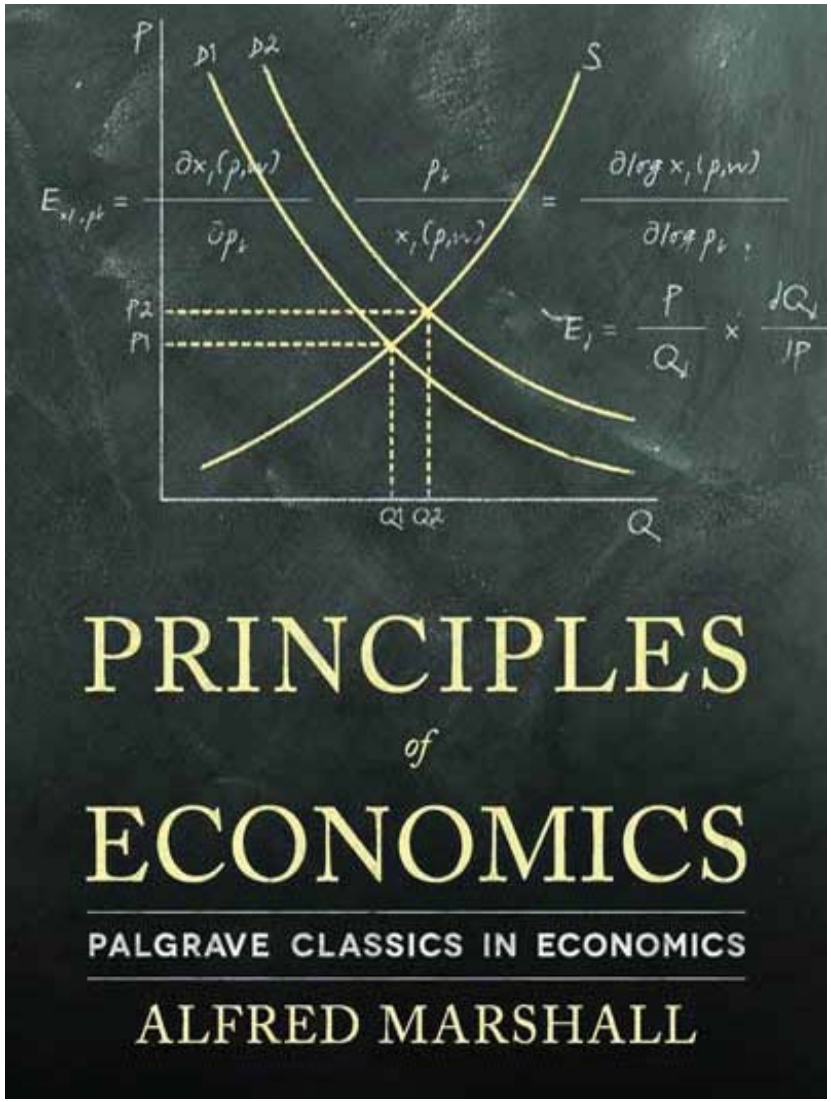
Consumption risks, expected returns, and firm characteristics are all endogenously determined by a system of simultaneous equations, with no causality running in any direction:

- The "risk doctrine" that risks determine expected returns is a relic and an illusion from the CAPM

History

Marshall's "scissors:" Marshall (1890, Principles of Economics)





Ricardo and Mill: Costs of production determine value, but Jevons, Menger, and Walras: Marginal utility determines value

- The water versus diamond example

"We might as reasonably dispute whether it is the upper or under blade of a pair of scissors that cuts a piece of paper, as whether value is governed by utility or costs of production. It is true that when one blade is held still, and the cutting is affected by moving the other, we may say with careless brevity that the cutting is done by the second; but the statement is not strictly accurate, and is to be excused only so long as it claims to be merely a popular and not a strictly scientific account of what happens (Marshall 1890 [1961, 9th edition, p. 348], my emphasis)."

If the investment CAPM and the consumption CAPM are complementary, why does the former perform better than the latter in the data?

What explains the empirical difficulties, if not outright failure, of the consumption CAPM in explaining anomalies?

Most consumption CAPM studies assume a representative investor

The Sonnenschein-Mantel-Debreu theorem in general equilibrium theory: The aggregate excess demand function is not restricted by the standard rationality assumption on individual demands

Individual maximization does not imply collective rationality, and collective maximization does not imply individual rationality

The representative's response to a parameter change might not be the same as the aggregate response of individuals

It is possible for the representative to exhibit preference orderings that are opposite to all the individuals'.

The aggregate behavior of rational individuals might exhibit complicated dynamics, and imposing these dynamics on one individual can lead to unnatural characteristics of the individual

Is it possible to assign rational preferences to "the representative voter" in the U.S. presidential election that picked Trump in 2016 right after Obama?

Insisting on assigning would yield highly irrational preferences

Analogously, assigning irrational preferences on the representative investor is not particularly illuminating

"[It] is clear that the 'representative' agent deserves a decent burial, as an approach to economic analysis that is not only primitive, but fundamentally erroneous (Kirman 1992, p. 119, my emphasis)."

"I have come to believe that [representative agent models] are of limited value, and that what we have learned from them is more methodological than substantive. Representative agents have two failings: they know too much, and they live too long... We are likely to learn more about aggregate consumption by looking at microeconomic behavior, and by thinking seriously about aggregation from the bottom up (Deaton 1992, p. ix, my emphasis)."

The failure of the consumption CAPM might have nothing to say about individual rationality

The consumption CAPM studies with heterogeneous consumers face severe data limitations (Ludvigson 2013)

- The intermediary asset pricing literature is a step in the right direction, but the empirical performance is too early to tell

The investment CAPM, derived for individual firms, is immune to the aggregation critique

The investment CAPM offers an unequivocal defense of EMH

"Research in experimental psychology suggests that, in violation of Bayes' rule, most people tend to 'overreact' to unexpected and dramatic news events. This study of market efficiency investigates whether such behavior affects stock prices. The empirical evidence, based on CRSP monthly return data, is consistent with the overreaction hypothesis. Substantial weak form market inefficiencies are discovered (De Bondt and Thaler 1985, p. 793)."

"Evidence presented here is consistent with a failure of stock prices to reflect fully the implications of current earnings for future earnings... Even more surprisingly, the signs and magnitudes of the three-day reactions are related to the autocorrelation structure of earnings, as if stock prices fail to reflect the extent to which each firm's earnings series differs from a seasonal random walk (Bernard and Thomas 1990, p. 305)."

"While [the IPO underperformance] does not rule out bad luck being the cause of the underperformance, it is consistent with a scenario of firms going public when investors are irrationally over optimistic about the future potential of certain industries which, following Shiller (1990), I will refer to as the 'fad' explanation (Ritter 1991, p. 4)."

"[It] is possible that the market underreacts to information about their short-term prospects of firms but overreacts to information about their long-term prospects. This is plausible given that the nature of the information available about a firm's short-term prospects, such as earnings forecasts, is different from the nature of the more ambiguous information that is used by investors to assess a firm's longer-term prospects (Jegadeesh and Titman 1993, p. 90)."

"Investor expectations of future growth appear to have been excessively tied to past growth despite the fact that future growth rates are highly mean reverting. In particular, investors were systematically disappointed (Lakonishok, Shleifer, and Vishny 1994, p. 1575)."

"The results indicate that earnings performance attributable to the accrual component of earnings exhibits lower persistence than earnings performance attributable to the cash flow component of earnings. The results also indicate that stock prices act as if investors "fixate" on earnings, failing to distinguish fully between the different properties of the accrual and cash flow components of earnings. Consequently, firms with relatively high (low) levels of accruals experience negative (positive) future abnormal stock returns that are concentrated around future earnings announcements (Sloan 1996, p. 290)."

"If investors fail to appreciate managements' incentives to oversell their firms in these situations, stock returns subsequent to an increase in investment expenditures are likely to be negative. This effect is likely to be especially important for managers who are empire builders, and invest for their own benefits rather than the benefits of the firm's shareholders (Titman, Wei, and Xie 2004, p. 678)."

"While the behavior of the aggregate stock market is not easy to understand from the rational point of view, promising rational models have nonetheless been developed and can be tested against behavioral alternatives. Empirical studies of the behavior of individual stocks have unearthed a set of facts which is altogether more frustrating for the rational paradigm. Many of these facts are about the cross-section of average returns: they document that one group of stocks earn higher average returns than another. These facts have come to be known as 'anomalies' because they cannot be explained by the simplest and most intuitive model of risk and return in the financial economist's toolkit, the Capital Asset Pricing Model, or CAPM (Barberis and Thaler 2003, p. 1087)."

The argument for inefficient markets based on the failure of the CAPM represents, to paraphrase Shiller (1984), "one of the most remarkable errors in the history of economic thought."

Why "remarkable"?

How can economists forget about supply altogether?

Why are investors more psychologically biased than managers?

Why would individuals exhibit biases at home making portfolio selections, but switch them off readily at work making real investment decisions?

More plausible: Aggregation renders the consumption CAPM not testable, but the investment CAPM is immune to this problem

Chui, Titman, and Wei (2010): Momentum stronger in developed than emerging markets

Developed markets

	WML	t		WML	t
Australia	1.08	4.76	Japan	−0.04	−0.18
Austria	0.63	2.70	Netherlands	0.83	4.40
Belgium	0.89	5.50	New Zealand	1.58	5.01
Canada	1.35	6.29	Norway	1.05	3.77
Denmark	0.96	4.29	Singapore	0.14	0.47
Finland	0.98	2.62	Spain	0.63	2.24
France	0.94	4.68	Sweden	0.71	2.27
Germany	0.99	4.41	Switzerland	0.82	4.39
Hong Kong	0.77	3.18	United Kingdom	1.13	7.08
Ireland	0.88	3.06	United States	0.79	3.44
Italy	0.90	4.47			
Average	0.86				

Chui, Titman, and Wei (2010): Momentum stronger in developed than emerging markets

Emerging markets

	WML	t		WML	t
Argentina	0.08	0.12	Mexico	0.69	2.00
Bangladesh	1.68	2.75	Pakistan	0.46	1.05
Brazil	0.46	0.96	Philippines	0.37	0.68
Chile	0.99	3.60	Poland	1.76	3.33
China	0.26	0.92	Portugal	0.31	0.93
Greece	0.59	1.49	South Africa	0.94	3.29
India	1.14	2.91	Taiwan	−0.20	−0.48
Indonesia	0.14	0.30	Thailand	0.48	1.10
Israel	0.32	1.19	Turkey	−0.41	−0.96
Korea	−0.34	−0.81	Malaysia	0.10	0.26
Average	0.49				

U.S. investors more biased than Chinese investors? U.S. markets with higher limits to arbitrage than Chinese markets?

Behavioral finance relies on dysfunctional, inefficient markets for biases and limits to arbitrage to work, contradicting the evidence

The investment CAPM relies on well functioning, efficient markets for its mechanisms to work, consistent with the evidence

The consumption CAPM anomalies are the investment CAPM regularities

"[The] really pressing problems, e.g., a cure for cancer and the design of a lasting peace, are often not puzzles at all, largely because they may not have any solution. Consider the jigsaw puzzle whose pieces are selected at random from each of two different puzzle boxes. Since that problem is likely to defy (though it might not) even the most ingenious of men, it cannot serve as a test of skill. In solution in any usual sense, it is not a puzzle at all. Though intrinsic value is no criterion for a puzzle, the assured existence of a solution is (Kuhn 1962, p. 36–37, my emphasis)."

Asset prices are equilibrated by both supply and demand

The consumption CAPM and behavioral finance, both of which are demand-based, cannot possibly be the whole story

Asset pricing anomalies doom the consumption CAPM, but behavioral finance is not the answer

The investment CAPM as a new asset pricing paradigm