Universidad Rey Juan Carlos
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PhD Defense

Capital Theory, Capital Markets and Q

Olav A. Dirkmaat
olav@ufm.edu

Four sections

1. To show what capital theory **cannot** do

2. To show what capital theory **can** do

3. Reformulation of business cycle theory (yield curve and *Q*)

4. Applications of capital theory and "Q ratio" to various asset classes

olav@ufm.edu

Rough timeline of past debates

- Bohm-Bawerk & Wicksell ↔ John Bates Clark & Irving Fisher (side role Menger)
1900s
Austrians vs Neoclassicals: income distribution
-

- Hayek ↔ Knight ↔ Kaldor
1930s

Knight: "The total capital in a system means simply the aggregate present worth of all its capitalizable income items, however defined . . . The capitalization rate . . . measures the yield of new investment at the margin of growth. The choice of items to be capitalized is certainly not affected by their origin or past history. (Knight 1938: 79)"

Austrians vs Neoclassicals vs Neo-ricardians: business cycle (Great Depression)
-

- Joan Robinson & Piero Sraffa ↔ Paul Samuelson & Robert Solow
1960s
Neo-ricardians vs Neoclassicals: economic growth models
-

Not-so-notable mention #1: David Ricardo & Karl Marx

1. Marginal diminishing productivity on capital / rate of interest: the demise of capitalism?

2. Marginally less productive plots of **land** bring down rate of interest/profit, until no profit exists, wages are paid at subsistence level, and owners of marginally more productive plots of land earn greater surplus until they own a wide majority of wealth.

olav@ufm.edu

Notable mention #1: Frank Knight

1. Financial subjective definition of capital: distinction between land, labor and "capital" is wrong

2. But, deeply flawed neoclassical theory of interest: disappearance of interest?

# Notable mention #2:
Irving Fisher

1. Great on capital theory, disappointing on monetary theory

The Myth of the Single "Uniform" Rate of Interest

Three theories that explain the existence of the "term structure":

- **Expectation theory (Lutz, Keynes, Böhm-Bawerk)**
  Longer-term interest rates tend to equal the average of short-term rates expected over the duration of the longer-term debt.
  Assumption: "complete shiftability" > **Does not address demand side: why is there a market for longer maturities?**

- **Market segmentation hypothesis (Culbertson)**
  Every maturity is a separate market with no arbitrage between maturities. The intertemporal market is "segmented".

- **Preferred-habitat model (Modigliani-Sutch)**
  "[W]hile clienteles can substitute to maturities away from their "preferred habitat," such substitution is imperfect. > Who arbitrages: households or intermediaries?**

US Treasury Yield Curves
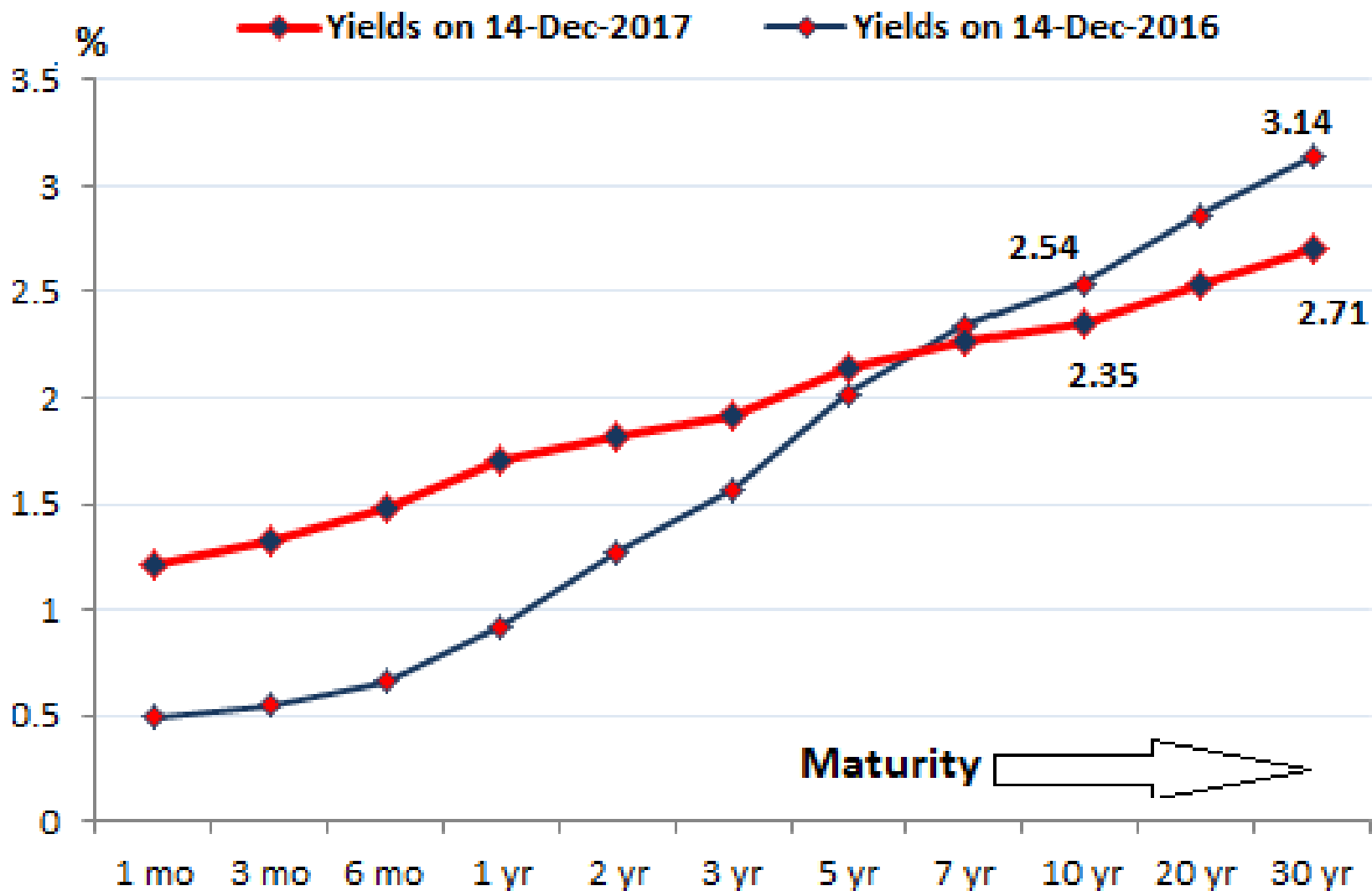
Source: US Treasury

WOLFSTREET.com

Böhm-Bawerk versus Menger

"The time will come when people will realize that Böhm-Bawerk's theory [of capital] is one of the greatest errors ever committed."

- *Carl Menger*, as quoted by Joseph Schumpeter in his book on the history of economic thought

Böhm-Bawerk versus Menger

1. Böhm-Bawerk defines capital as "a complex of heterogenous capital goods" excluding money, labor, permanent factors and (durable) consumer goods

2. Böhm-Bawerk: critique of marginal productivity theory of interest > time preferences > technical superiority of production with longer average period of production

3. Böhm-Bawerk: "subsistence fund" theory of capital, outlay of wages

4. Menger: *Principles of Economics*, but ... Menger protests: proposes alternative in 1888, a "financial" theory of capital as net worth and a result of "economic" calculation (profit and loss)

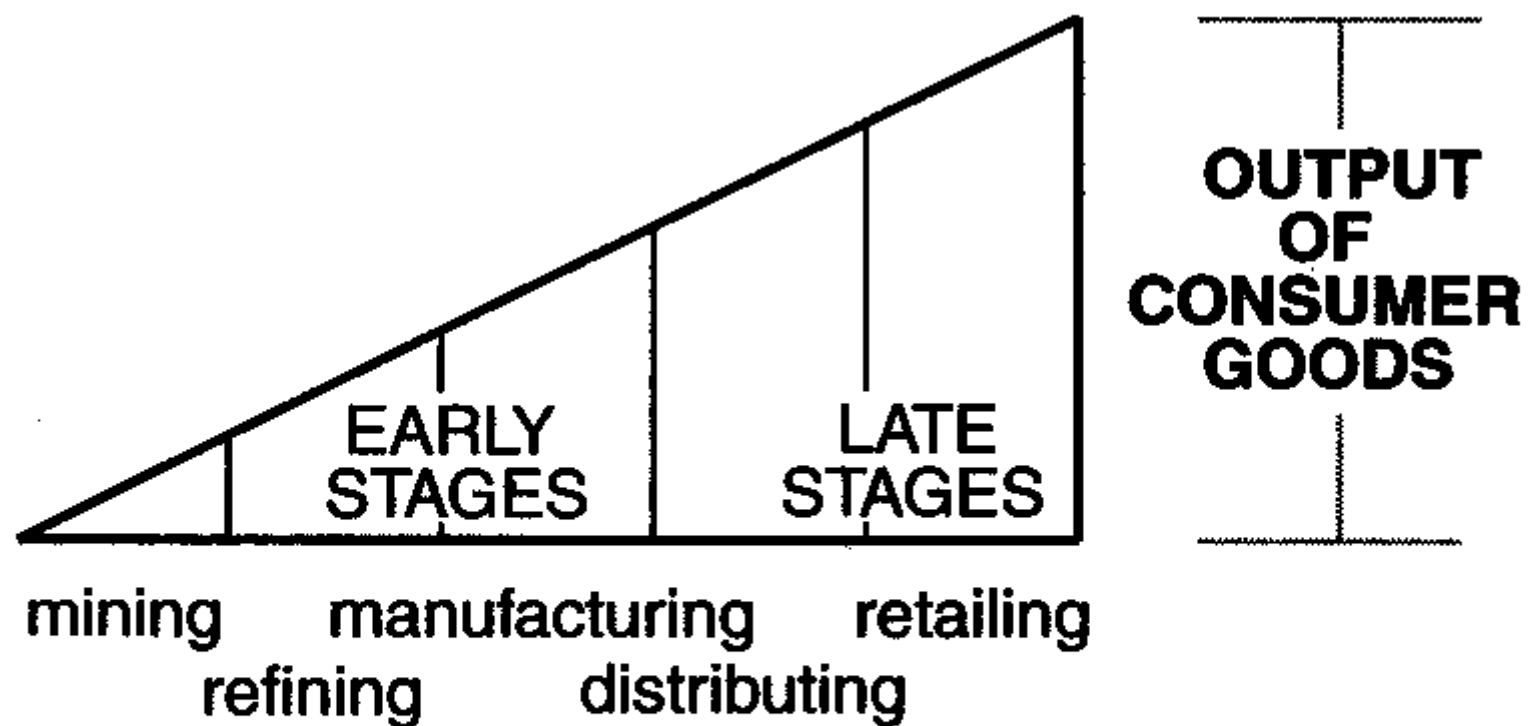5. Yet, Menger was wrong on entrepreneurship

olav@ufm.edu

Ludwig von Mises As Savior of Carl Menger's Theory of Capital

Olav A. Dirkmaat

School of Business, Universidad Francisco Marroquín

Abstract:

Ludwig von Mises revived the largely ignored subjectivist and financial capital theory first formulated by his intellectual forerunner Carl Menger (1888). While both outsiders and insiders assume that the theory of capital formulated by Böhm-Bawerk (and later by F.A. Hayek) is the only 'Austrian' theory of capital, Menger and later Mises presented an alternative theory. We will review Mises's contributions to capital theory (and how he saved Menger's theory) and how, after the publication of *Human Action*, he mostly forsook Menger's legacy, emphasizing the physical nature of capital and, as such, deflecting to the fallacious Böhm-Bawerkian capital theory. Moreover, the

OUTPUT
OF
CONSUMER
GOODS

EARLY
STAGES

LATE
STAGES

mining

refining

manufacturing

distributing

retailing

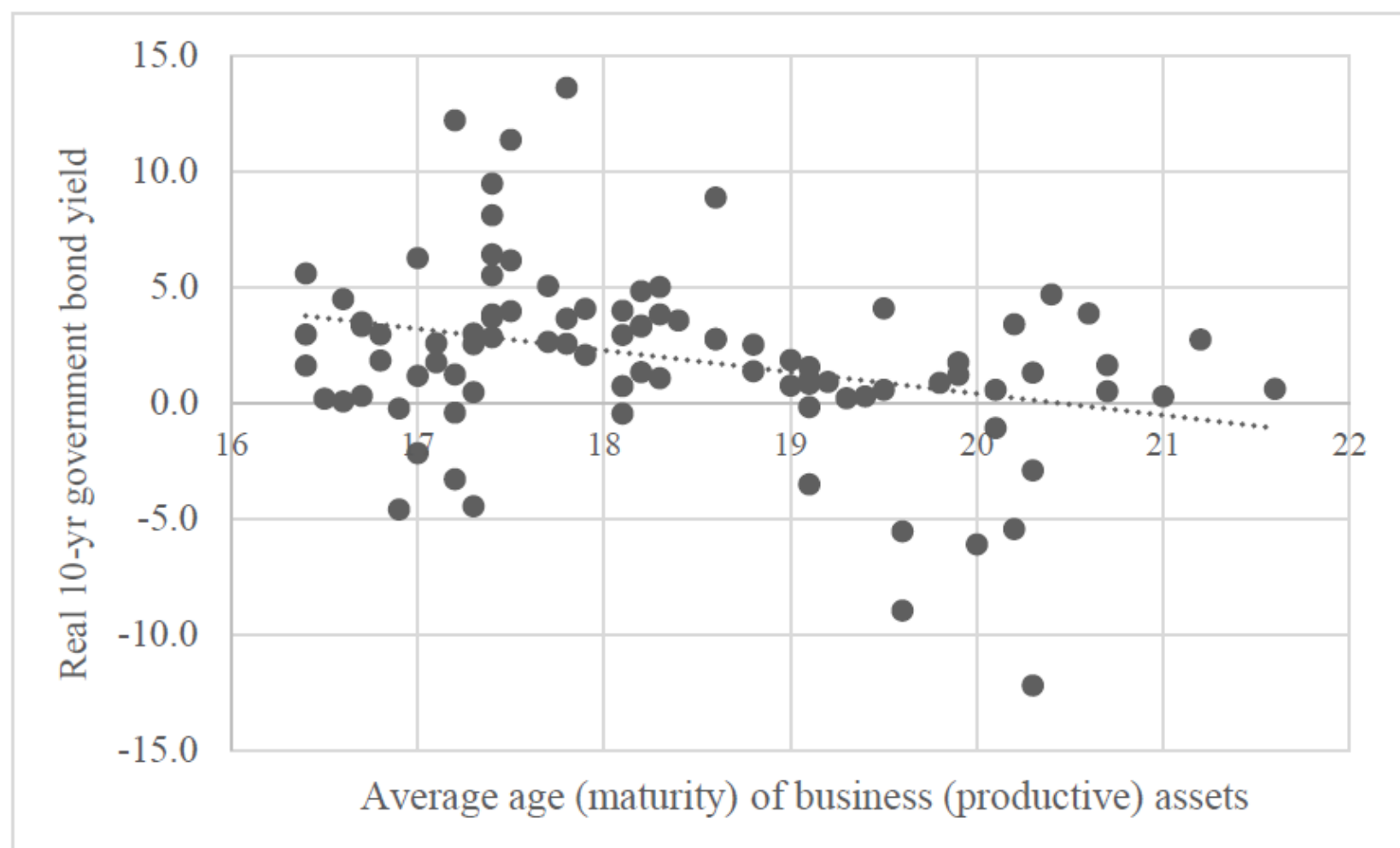**STAGES OF PRODUCTION**

PRODUCTION TIME

Figure 12: The average age (maturity) of fixed assets and consumer durable goods plotted against the 10-year bond rate adjusted for inflation.

What capital theory CANNOT (and should not) do

1. The "classical" triad of production: labor, land and capital

2. The "production function" and all its modern-day derivations (Solow/Swan)

3. The mistake of studying material production instead of economic value creation

4. To classify industries/activities, one way or another

olav@ufm.edu

Cambridge Controversies

- Devastating critique of Sraffa and Robinson on neoclassical capital theory that forms the basis of many other theories and applications, such as Solow's growth model.

  - Capital is considered "an input" besides labor (and technology) which leads to "an output" (production)
    -

  - However, capital goods cannot be added up (akin to adding up apples and pears)
    -

  - Neoclassicals argue that the "money value" of these goods must be added up, yet the money value of such goods is equal to the discounted future cash flows of said goods with the use of an interest rate. However, neoclassicals explain interest rates by equaling them to the marginal productivity of capital, which equals the "output" in a neoclassical production function. Therefore, they explain production output by referring indirectly to the very same production output: circular reasoning.
    -

Cambridge Controversies (2)

- Sraffa & Robinson: Capital switching and reswitching shows neoclassicals are wrong to define capital as "monetary value" of production goods
  - Best defense of "financial" definition of capital is the argument that capital reswitching is not very relevant – is it enough?

-

- The neoclassical problem of aggregating "capital" in its production function and Solow´s growth model
  - Growth theory is at the cornerstone of modern macroeconomic analysis. Solow´s growth theory is, however, an extrapolation of the flawed neoclassical production function.

Cambridge Controversies (3)

- Neo-classical growth theory:
  Three basic factors of production: land, labor and **capital (Cobb & Douglas)**

Definition of capital: sum of the value of capital goods

$$Q = A.f(K, L)$$

> Solow-Swan growth model
> > any increase in Q is an increase in economic growth or profits

Cambridge Controversies (4)

- **Problem:**
  "Sum of the value of capital goods" = net present value of future cash flows, i.e., future profits

$$\frac{\text{Net Cash Flows Year 1}}{(1 + \text{Discount Rate})^{\text{YEAR1}}} \; + \; \frac{\text{Net Cash Flows Year 2}}{(1 + \text{Discount Rate})^{\text{YEAR2}}} \; + \; \text{Etc.}$$

Neoclassical theory explains output (profits) with an input (K of capital) of which its value depends on profits? Circular argument!

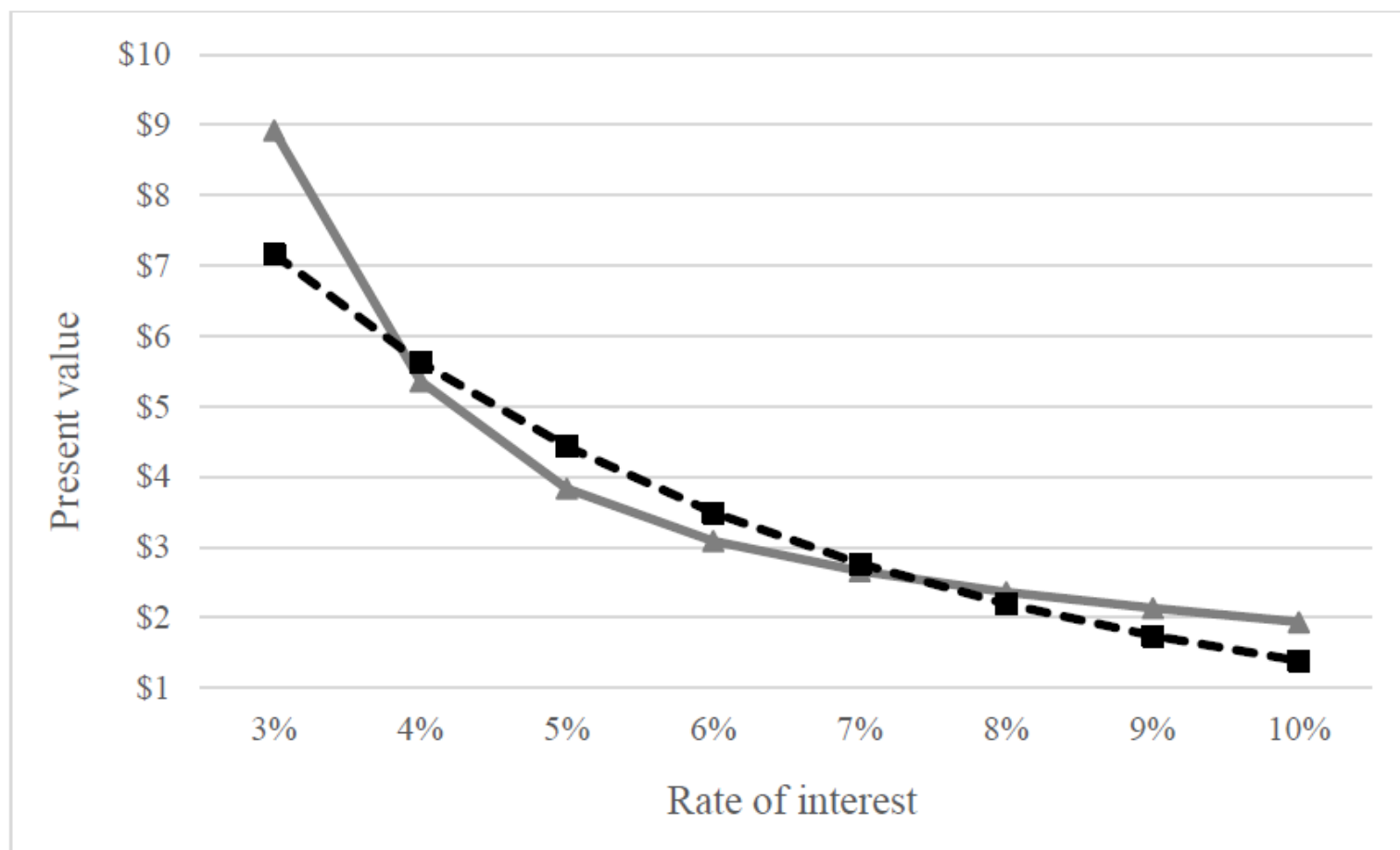Models are still being used despite this (unresolved) critique!

Figure 3: Fisher's (1907) discovery of reswitching, which eventually became front and center in future controversies on capital. Grey, straight line represents income stream 1; black, dashed line represents income stream 2.
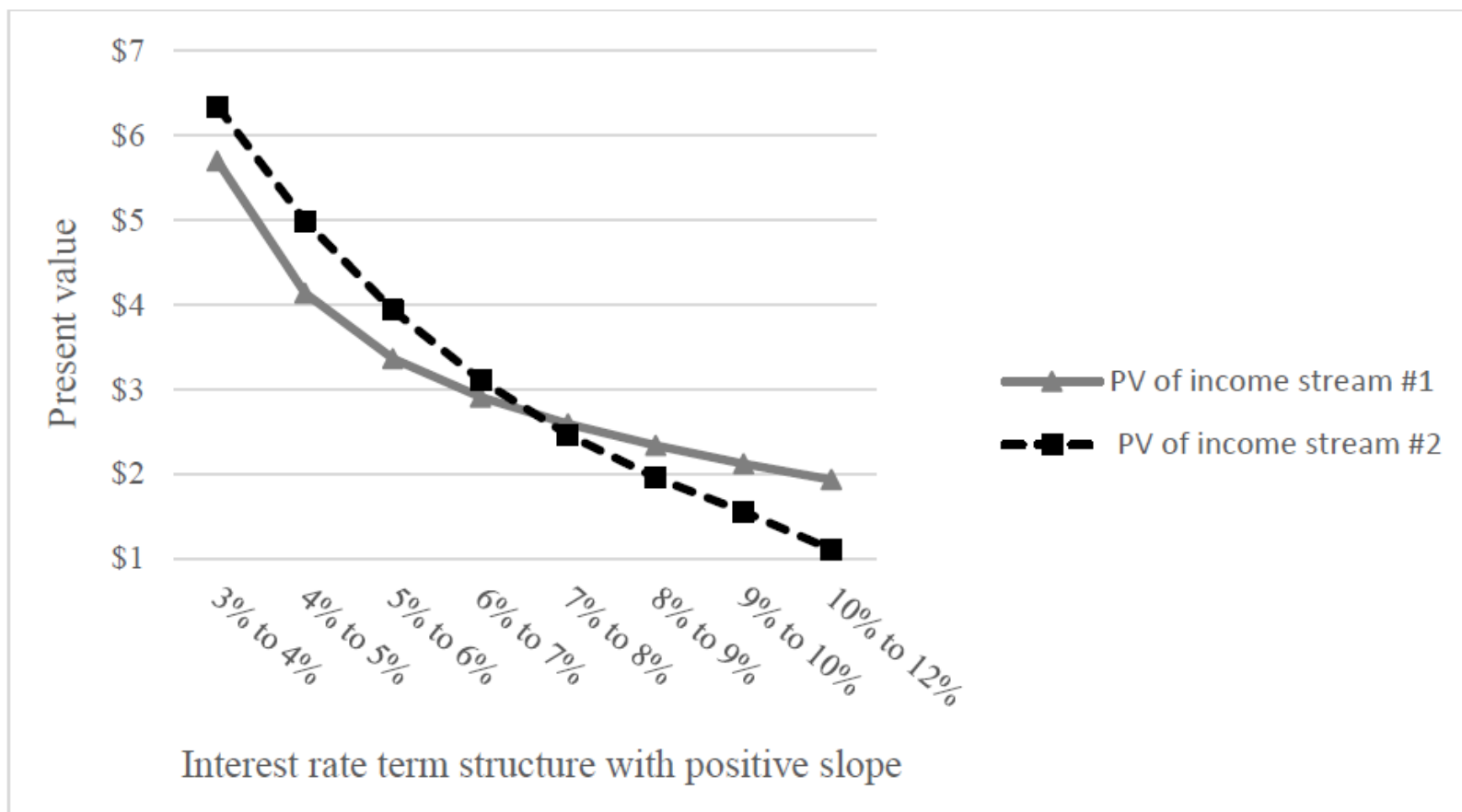
Figure 31: The same example as Fisher (1907), but this time with a yield curve spread applied to the cash flows (that is, the cash flows are discounted at different rates according to a positively sloped yield curve or term structure). After taking into account the term structure, no reswitching occurs.

Capital as Net Worth, NPV-criterion

- What matters is not the physical origin or characteristics of production goods, but rather how the entrepreneur views and acts upon them

- Capital = the present value of the future cash flows a production good, or a combination of production goods, are able to generate

ASSETS	"CAPITAL"

Capital as Net Worth, NPV-criterion (2)

- Menger (1888): capital = net worth = NPV of income-generating assets
- The NPV-criterion is a simple concept and consists of two important components:

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$$

where

CF_t = cash flow at time t

r = required rate of return for the investment (discount rate)

Net worth (NPV) criterion of what/whom?

Plan Structure (left) & *Control Structure* (right)

Operating assets	Securities
First-line assets (fixed capital)	Debt
Second-line assets (working capital)	Equity
Reserve assets (excess cash)	

Portfolio Structure (left)

Portfolio	-
Assets / Securities	

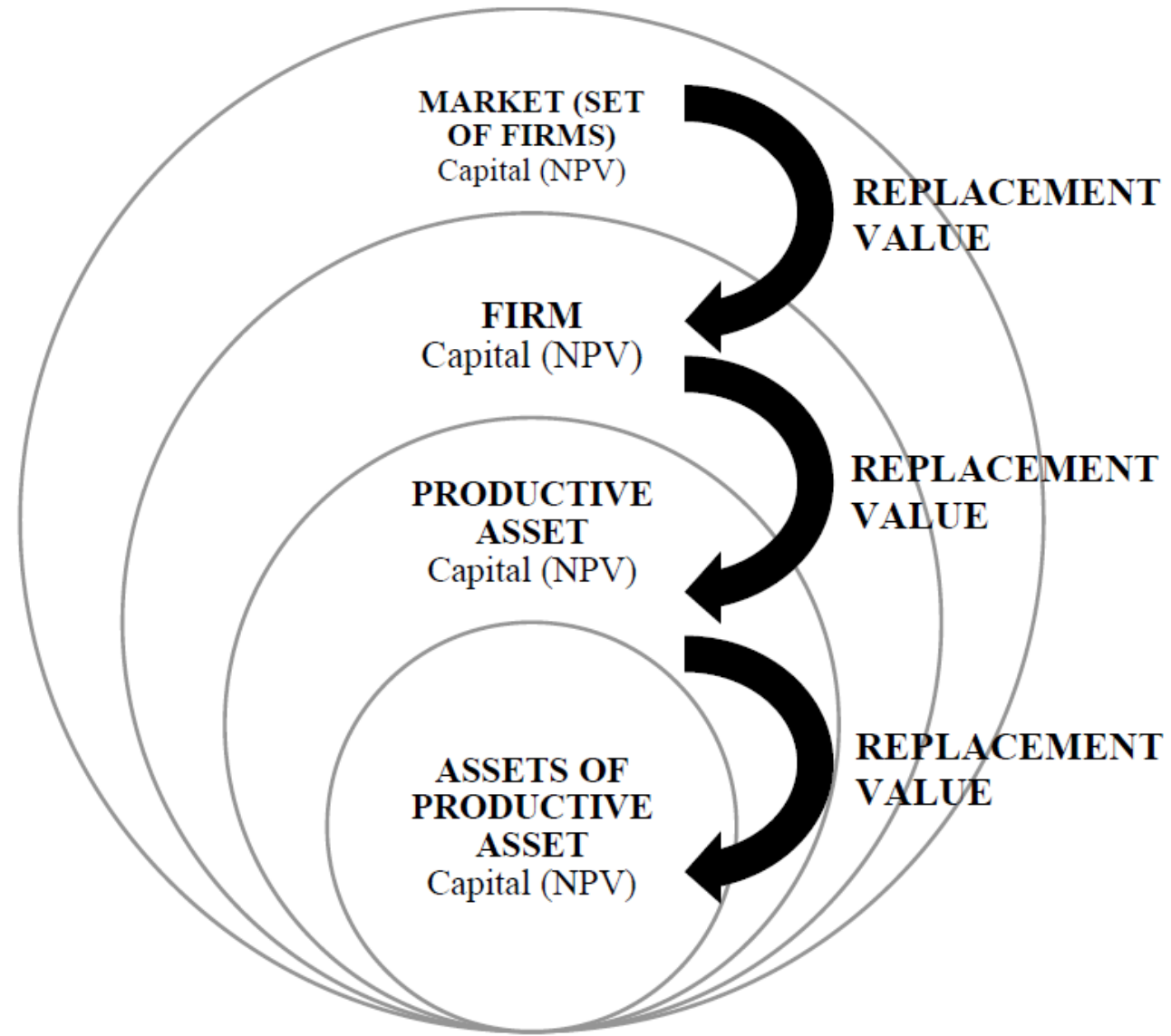Figure 17: Lachman's (1956) capital structure captured in two simplified balance sheets. We have preserved the original terms used by Lachmann.
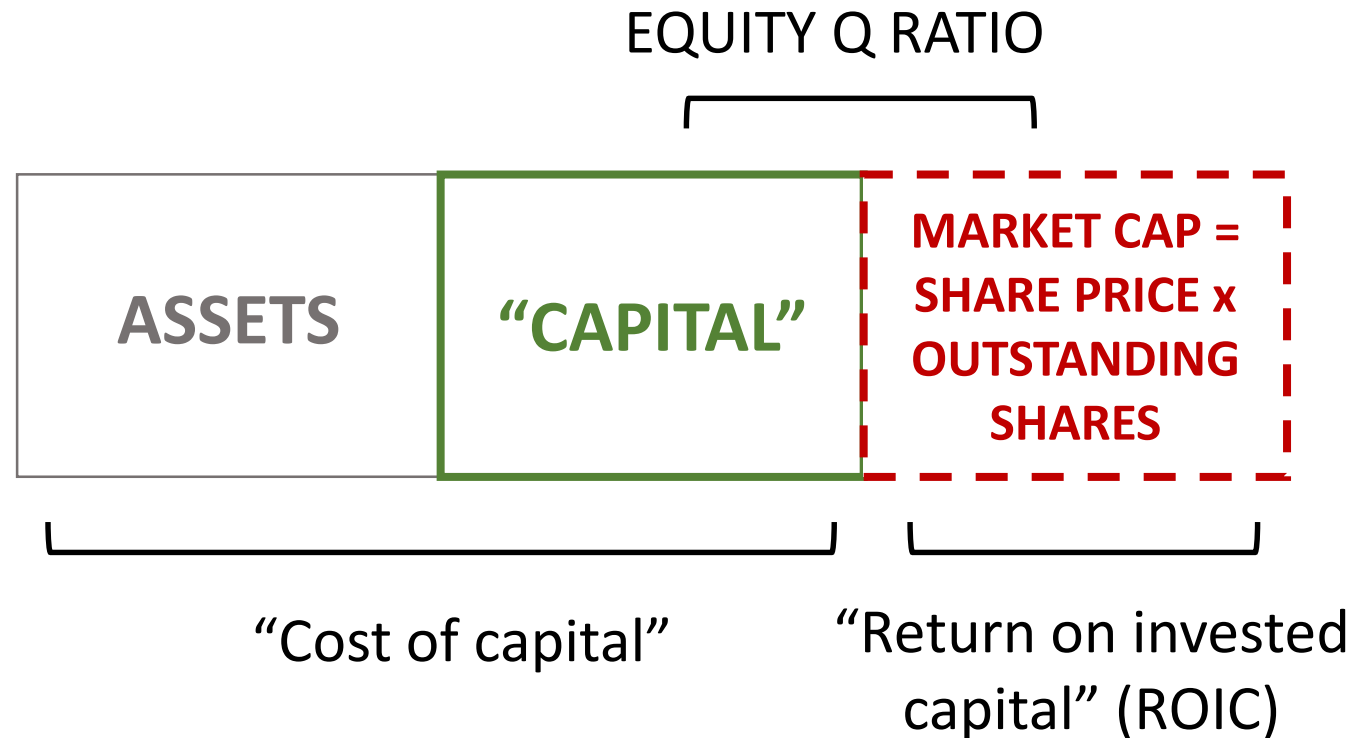
Figure 26: The different scales of capital: the dao of capital is the NPV approach.

Equity Q Ratio: price paid on stock market for combinations of NPV of income-generating assets
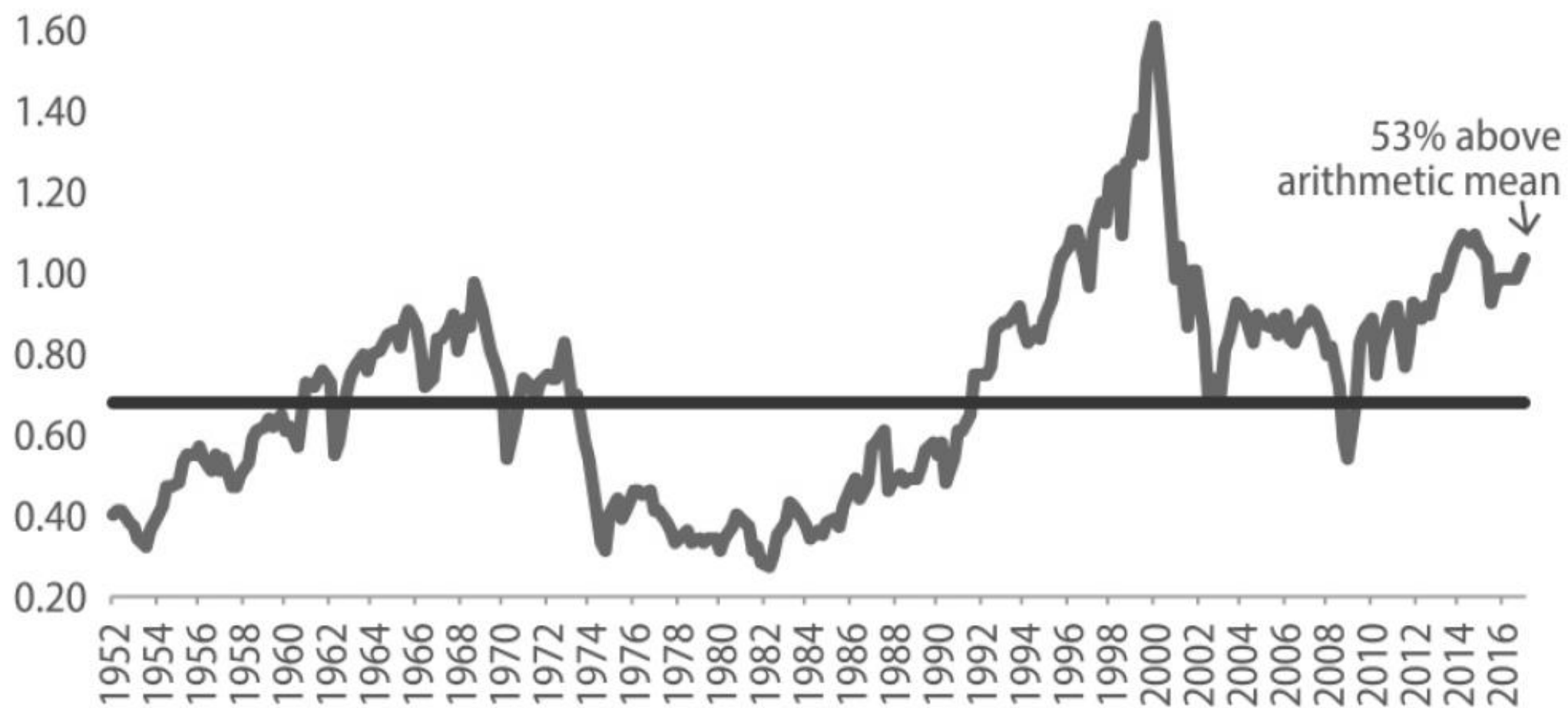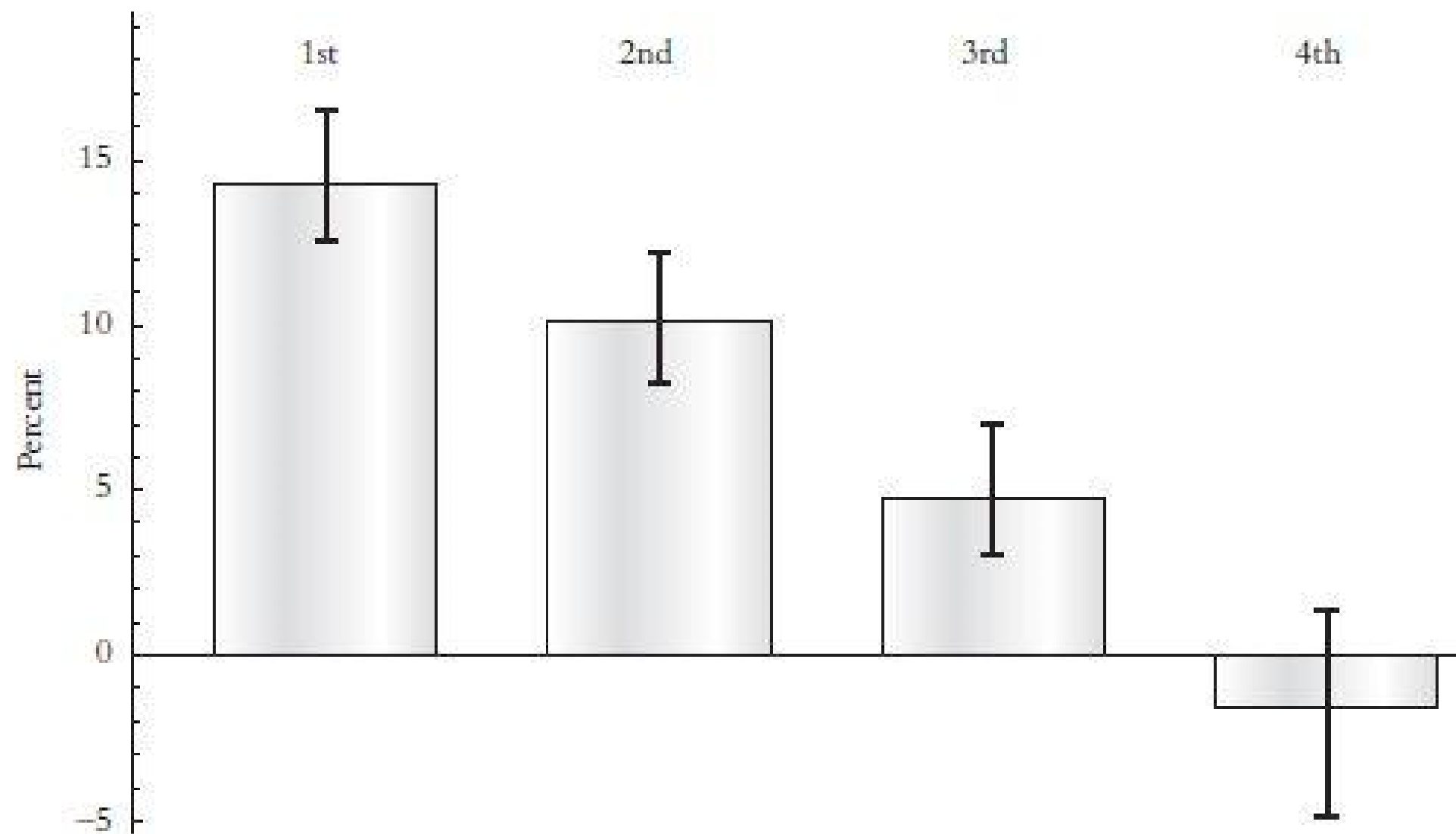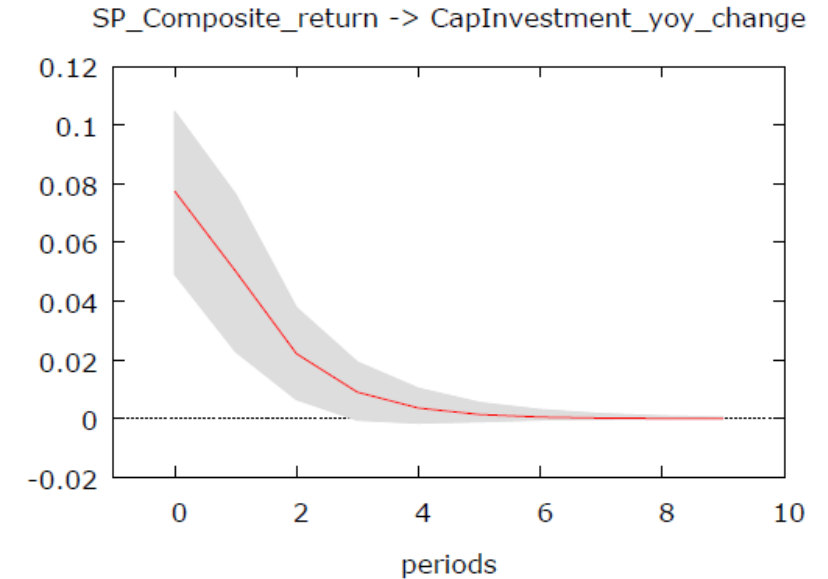
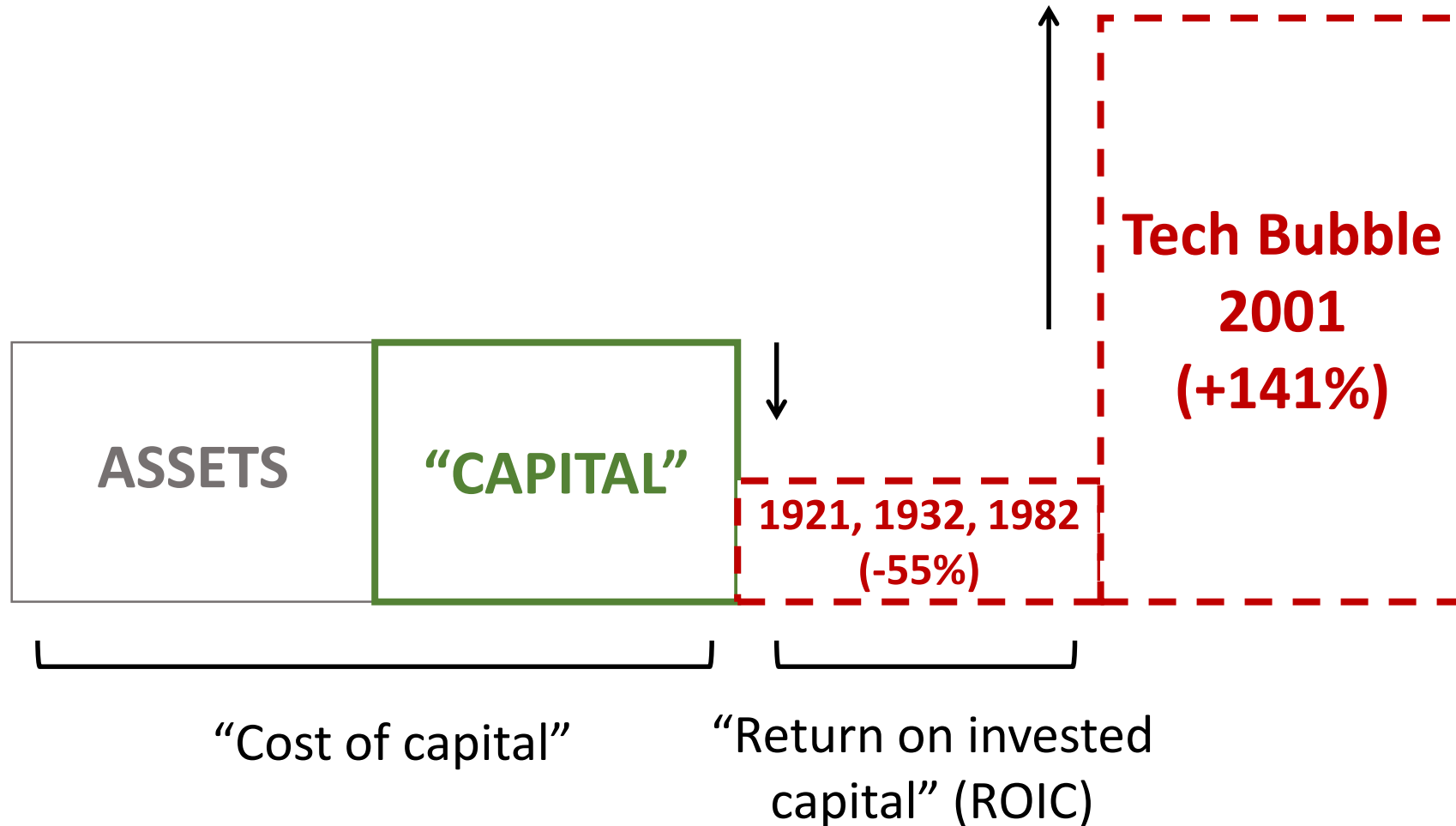*Figure 61: The historical equity q ratio in the U.S. from 1952 to 2016.*

(Equity) Q Ratio

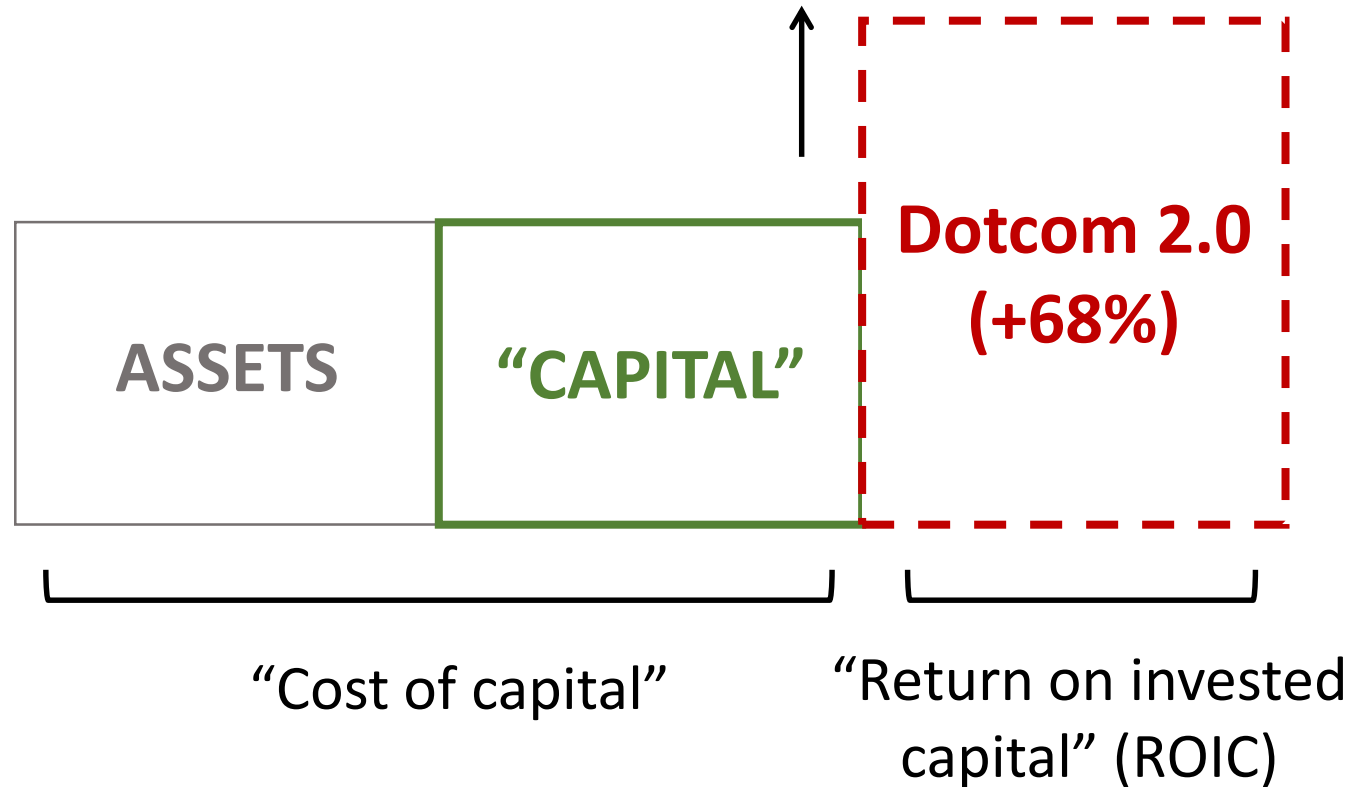SP_Composite_return -> CapInvestment_yoy_change

1. Why does it exist?
   Adjustments in financial assets vs adjustments in "real" assets

2. Change in long-term interest rate
   (but historically due to maturity mismatching)

olav@ufm.edu

Equity Q Ratio: historical extremes

Tech Bubble 2001 (+141%)

ASSETS **"CAPITAL"** **1921, 1932, 1982 (-55%)**

"Cost of capital"

"Return on invested capital" (ROIC)

Equity Q Ratio: today´s situation

ASSETS "CAPITAL" **Dotcom 2.0 (+68%)**

"Cost of capital" "Return on invested capital" (ROIC)

What capital theory CAN tell us

1. ROIC = WACC or, better put:
   CAPITALIZATION VALUE = REPLACEMENT VALUE

2. Arbitrage on all levels by <u>financial entrepreneurs</u> (who intermediate resources between savers/capitalists and entrepreneurs)

3. Large deviations between price and (replacement) value can persist for years, but will regress to the mean

4. Lower (long-term) interest rates increase duration and vice versa

5. We do not "get" richer by increasing "capital"; capital is a tool of economic calculation, with lower market returns capital is actually worth less than with higher market returns, but returns are a result of discoordination not coordination

6. Capital is a result of growth (increased coordination), not a cause. Economics is about COORDINATION, not PRODUCTION per se
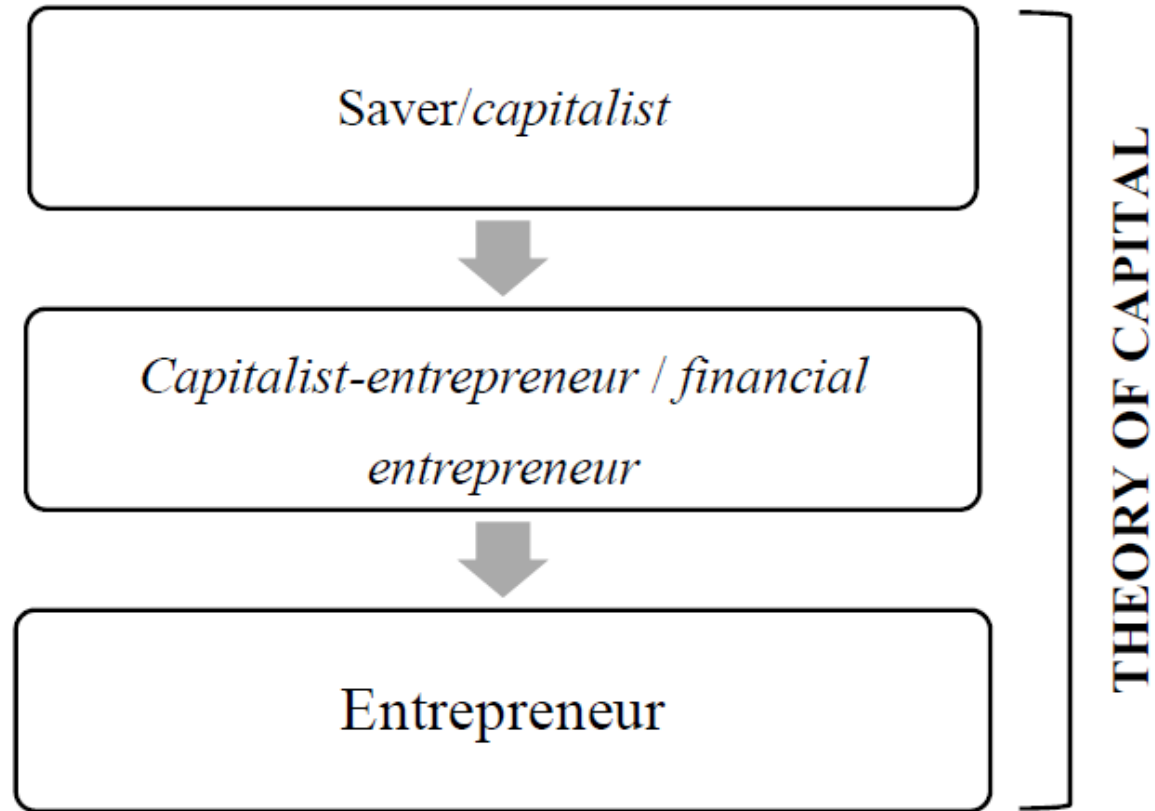
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Figure 58: A diagram representing a broader theory of the entrepreneur that includes financial intermediaries as financial entrepreneurs.

Expansion

S1. Savers/capitalists decide to hold liquid, short-term debt (instead of holding a greater part in illiquid, long-term investments).

S2. Banks begin arbitraging the yield curve by expanding the maturities of their loans and investments, financed by liquid, short-term debt (mostly demand deposits).

Boom

S3. Long-term interest rates fall and the yield curve spread begins to narrow

S4. Financial asset prices rise; q ratios go up.

S5. At lower long-term interest rates, businesses begin (on the margin) to invest in projects with longer *durations* that are more illiquid.

S6. Long-term (capital or fixed) investment increases and pushes up (marginally) the prices of productive assets (including commodities), the *average* or aggregate rate of profit (across the economy) peaks.
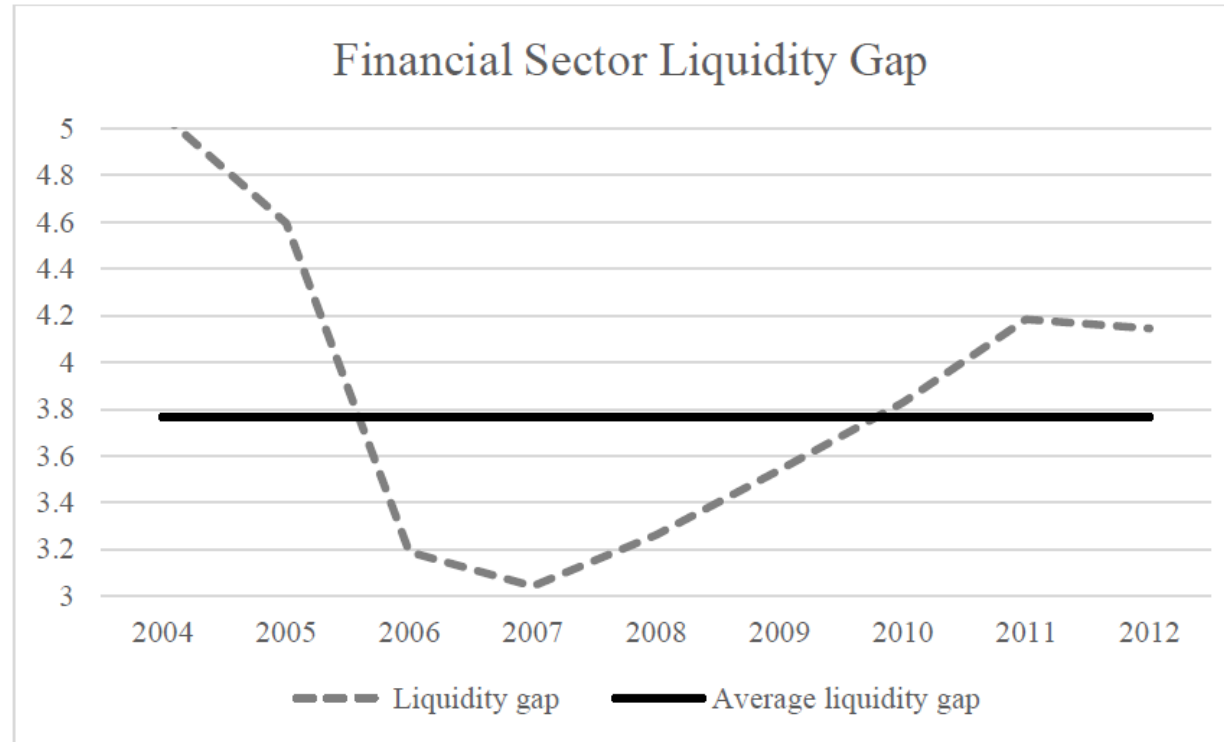
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Figure 92: The liquidity gap of the five major U.S. banks from 2004 to 2016. The (arithmetic) mean liquidity gap equals 3.77. As can be observed, banks engaged in extreme maturity mismatching in 2004 and 2005, but began reducing the liquidity gap in 2006 and 2007 (right before the 2008 financial crisis.
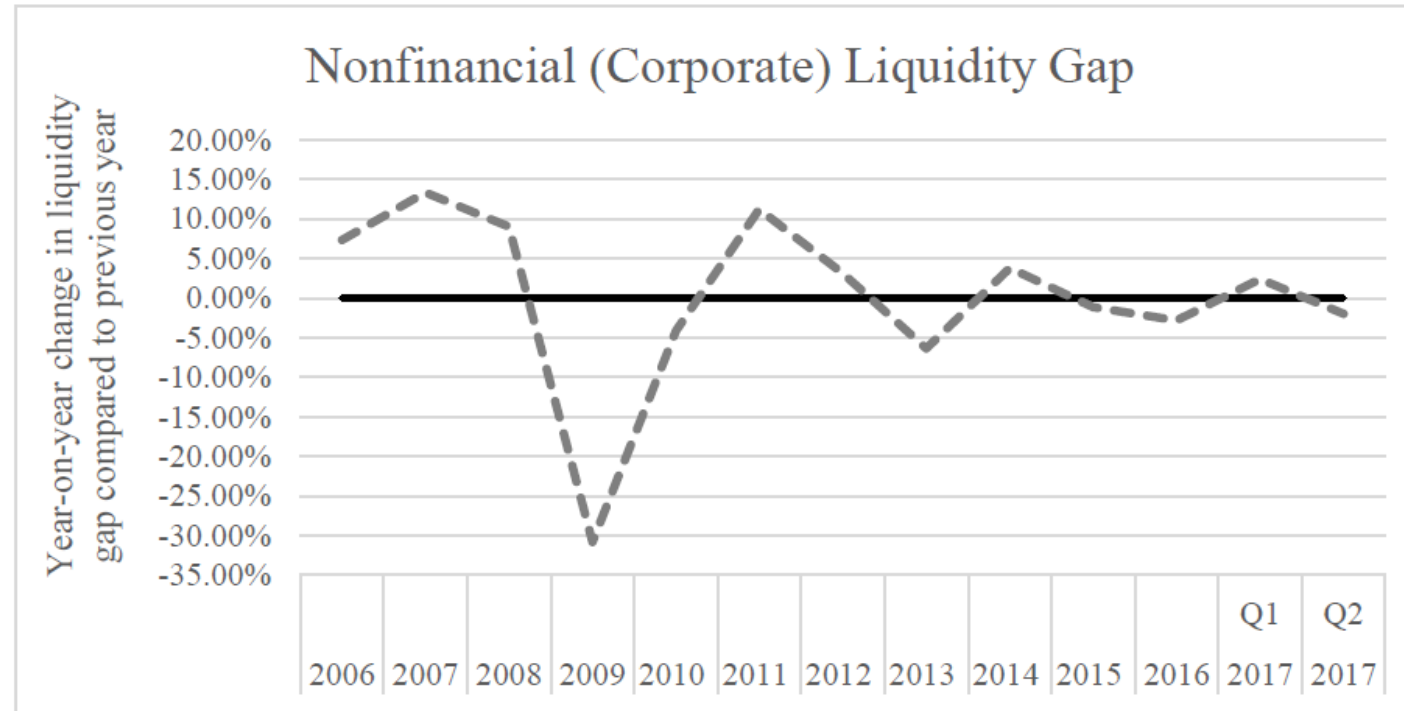
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Figure 93: Nonfinancial (corporate) businesses also increased their degree of maturity mismatching. Data is from the Federal Reserve, Release Z.1, specifically: liquid assets (broad measure), total short-term liabilities, liquid assets as a percentage of short-term liabilities, short-term debt as a percentage of total debt).

olav@ufm.edu

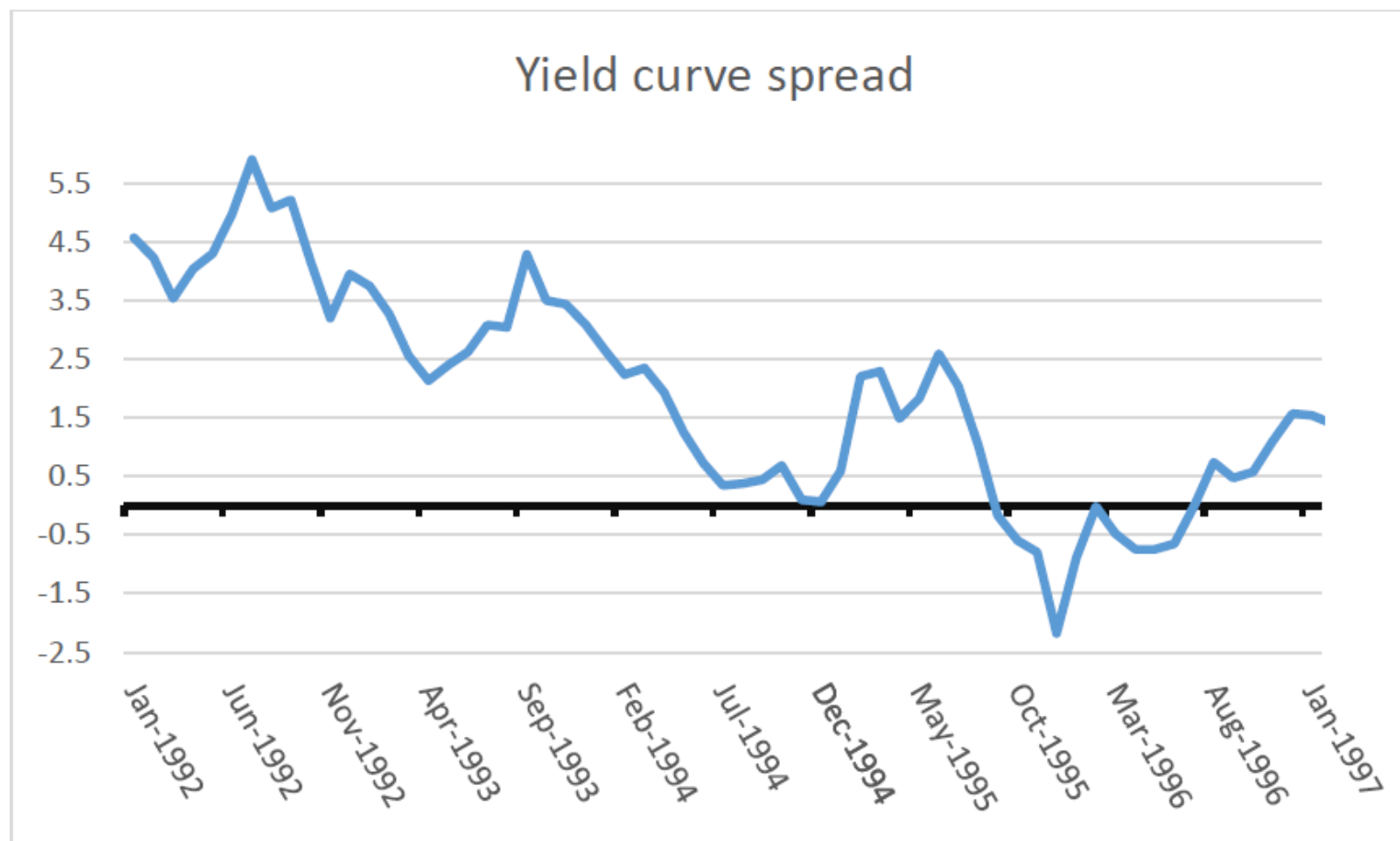*Figure 90: A proxy of the yield curve spread in Korea from 1992 to 1998 prior to the Asian contagion crisis.*
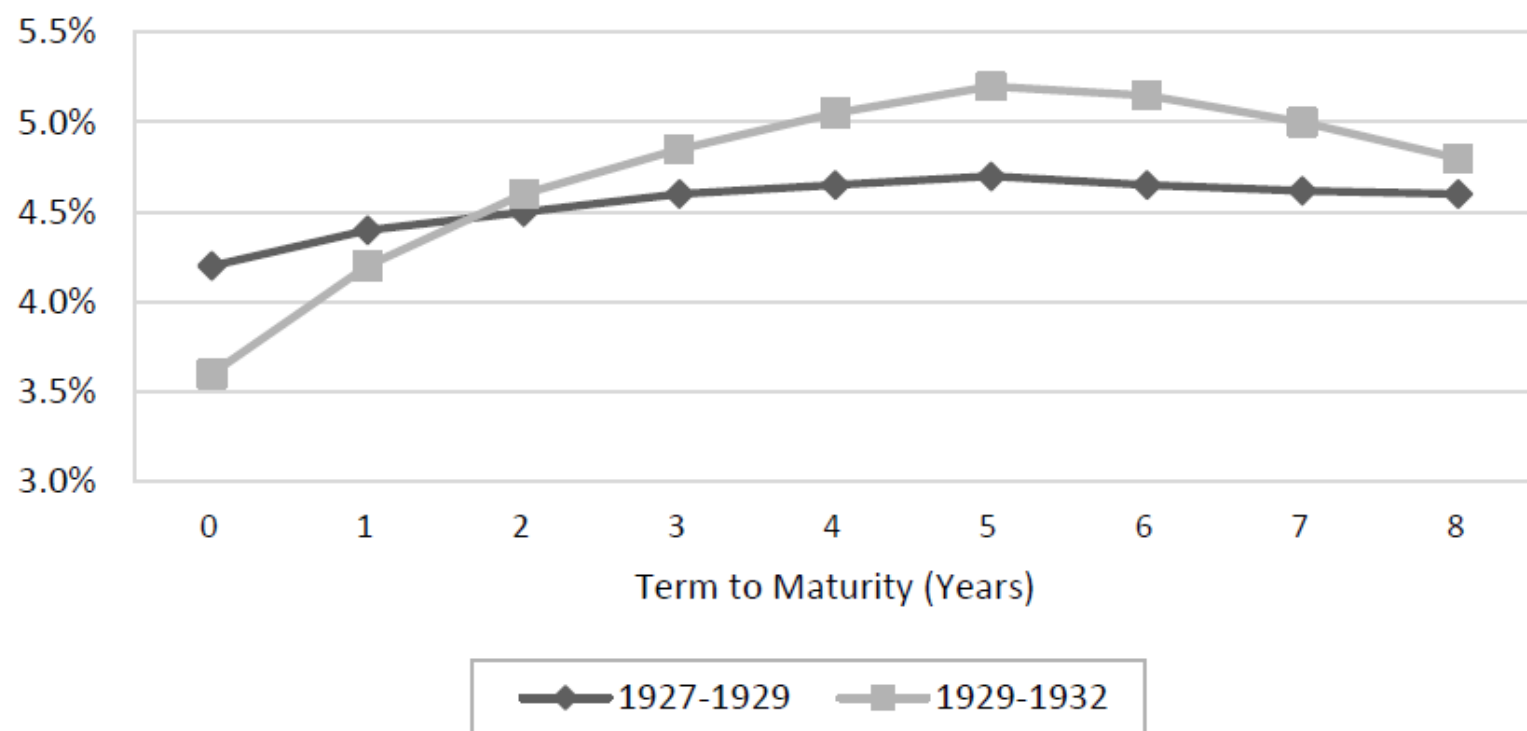
olav@ufm.edu

Figure 84: Average term structure of interest rates of 1927-29 and 1929-32, data from Baum & Thies (1989)

olav@ufm.edu

Qué es la curva de yield o de rendimientos, la poderosa señal que podría anticipar la próxima recesión económica

Cecilia Barría
BBC News Mundo

🕒 29 junio 2018

Toward a new capital theory

1. Completely financial and entrepreneurial: **capital is equal to financial net worth**, that is, the net present value (NPV) of a sum of economic goods

2. Balance sheet approach: businesses and households have assets (savings), households own businesses (Kirzner)

3. Every asset has some "underlying asset"; there is constant arbitrage between the prices of assets (market value) and the prices of underlying assets (replacement value) at different levels

4. To analyze whether a capital structure is sustainable or not, one must review deviations between different levels

olav@ufm.edu

Coordination of consumption / capital

- When time preferences of consumers (i.e., the maturity of their expected future consumption) are aligned with the maturities of producers (i.e., the maturity of their expected future production), an economy is *structurally* liquid. When both sets of maturities are misaligned, an economy is *structurally* illiquid. This is perhaps best expressed by Howden & Bagus (2010): "There is a term structure of savings and a subsequent term structure of investing that align, optimally, with consumers' plans." (p. 65)

  Any productive asset[156] finds its corollary in a financial asset[157]. And part of a society's financial asset base consists of financial assets with monetary characteristics (checkable, transferable or any equivalent). **Thus, any *capital* held, is held through some type of financial asset**.

This implies that capital per definition *cannot* be an input, as is the case in the conventional neoclassical production function ($y = K, L$). Rather, it is an intellectual conception of the goods that *are* inputs. If society invests in more durable consumer goods (consumer goods with longer effective durations), it is in effect *accumulating* capital. Indeed, capital is more an outcome of *output* (of value, not physical goods) than a *direct cause* of output.

Moreover, this implies that, although strictly true, the law of diminishing marginal returns make little sense in capital theory. It is true that whenever equilibrium exists and no further
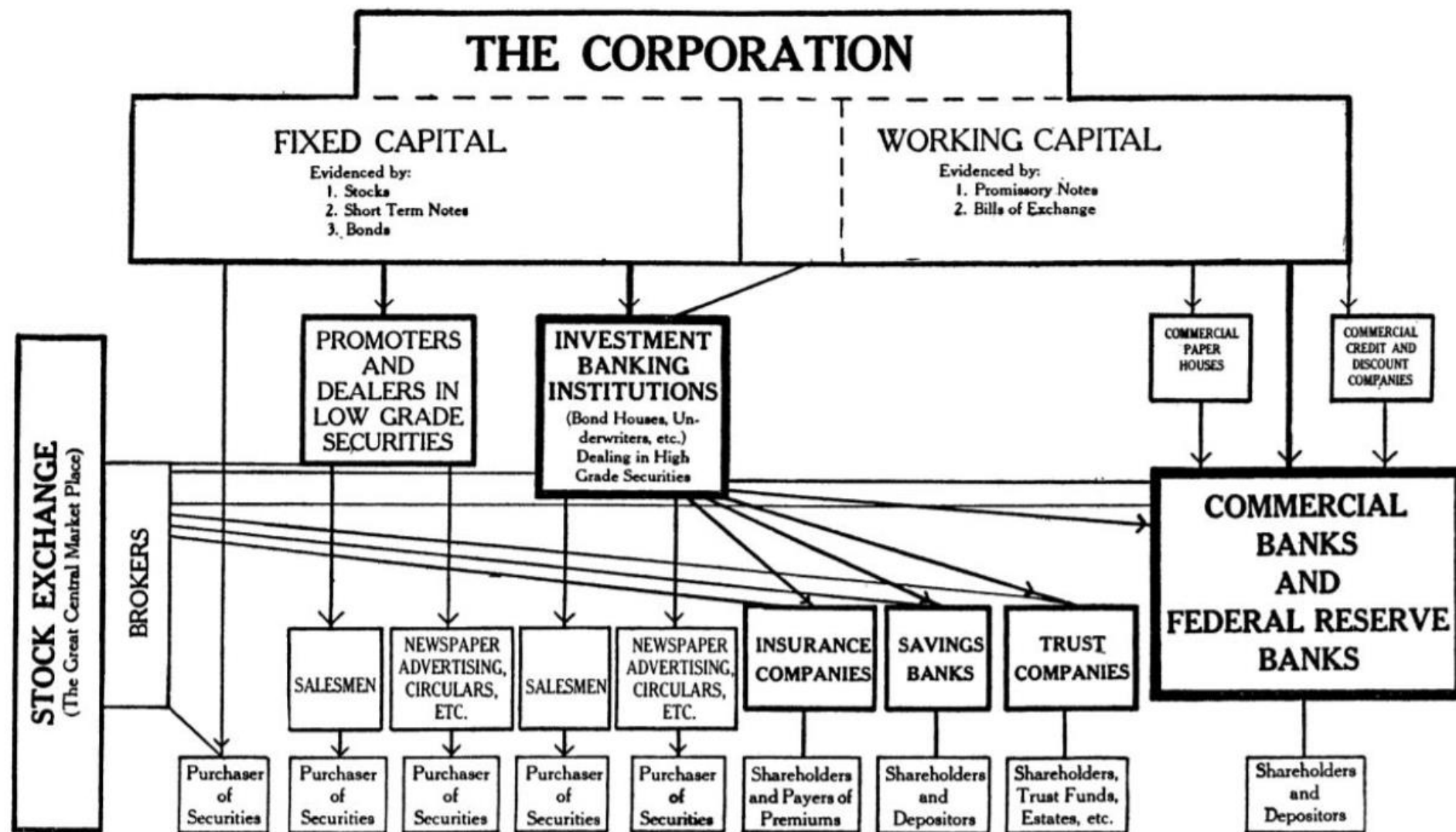
Figure 4: Moulton's (1921) visualization of the intimate relationship between (fixed and circulating) capital and capital markets[42].

Not only is capital expressed and estimated in money terms, it lies at the opposite side of financial assets. **Any productive asset[156] finds its corollary in a financial asset[157]**. And part of a society's financial asset base consists of financial assets with monetary characteristics (checkable, transferable or any equivalent).

Thus, any *capital* held, is held through some type of financial asset. If an individual owns capital (that is, in this case, legal title to underlying assets and thus part of its *net worth*), he either owns equity or debt instruments[158] in some underlying asset(s). Put differently, part of a society's investment depends on the amount of bank money households and businesses hold (the other part depends on the amount of other non-bank financial assets that households and businesses hold[159]).
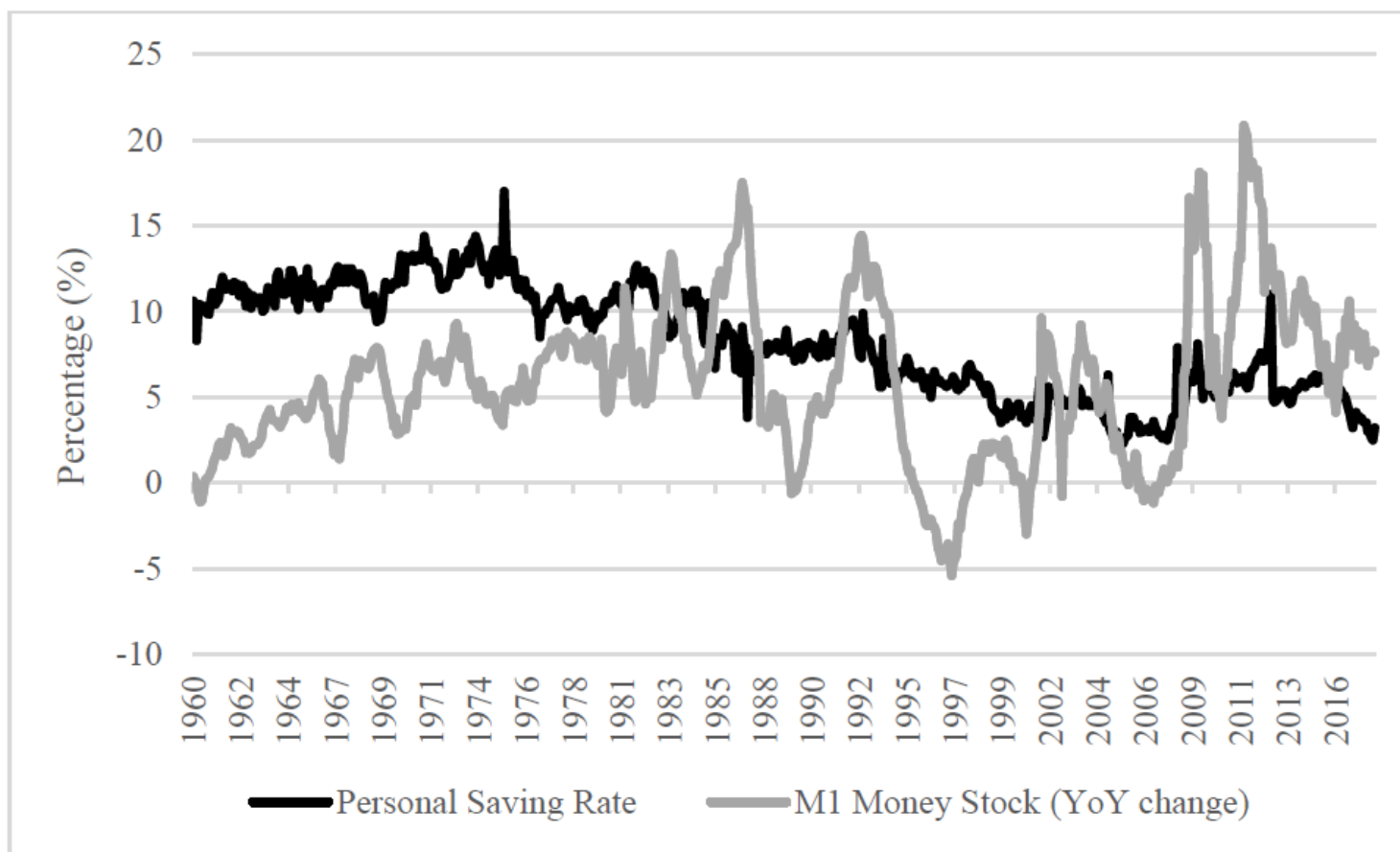
Figure 57: The personal saving rate (black curve) versus year-on-year change in M1 money stock (grey curve).

First, we ran a one-way ANOVA model with the forex q quartiles (1 to 4, low to high) as independent variable and the (change in the) exchange rate as dependent variable. Our ANOVA p-value (0.0277) is lower than the 95% confidence level, therefore we conclude with 95% confidence that the means of various q's are *significantly* different.

	Sum of squares	df	Mean square
Treatment	0.692493	3	0.230831
Residual	18.8965	253	0.0746897
Total	19.589	256	0.0765195

$F(3, 253) = 0.230831 / 0.0746897 = 3.09053$ [p-value 0.0277]

Level	n	mean	std. dev
q = 1	89	0.120727	0.23190
q = 2	42	0.125788	0.22244
q = 3	62	0.207342	0.30838
q = 4	64	0.239476	0.31709

Grand mean = 0.172021

Figure 76: Our one-way ANOVA model output, which at a 95% confidence level shows that the average mean return among the q quartiles is different.

Our first step, was to run a one-way ANOVA model with the housing q quartiles (1 to 4, low to high) as independent variable and the average 5-year annual return on housing as dependent variable. Our ANOVA p-value (0.00001) is lower than the 99% confidence level. We therefore conclude with 99% confidence that the mean returns on housing at the various q's are *significantly* different.

```
                        Sum of squares      df       Mean square

Treatment                     0.290417       3         0.0968057
Residual                       4.68096     686        0.00682356
Total                          4.97138     689        0.00721536


F(3, 686) = 0.0968057 / 0.00682356 = 14.187 [p-value
0.00001]


Level           n        mean      std. dev

1             143   0.0815098      0.098166
2             171   0.0477377      0.079394
3             129   0.0526648      0.072090
4             247   0.0253143      0.080035


Grand mean = 0.0476311
```

Figure 70: *Our one-way ANOVA model output, which at a 99% confidence level shows that the average mean return among the q quartiles is different.*

Thank you

olav@ufm.edu