Index Funds, Asset Prices and the Welfare of Investors

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Motivation

- Index funds hailed for "democratization of investment"– the stated purpose of Vanguard (Jack Bogle)
- Argument for index funds: middle-class investors benefit from access to market returns.

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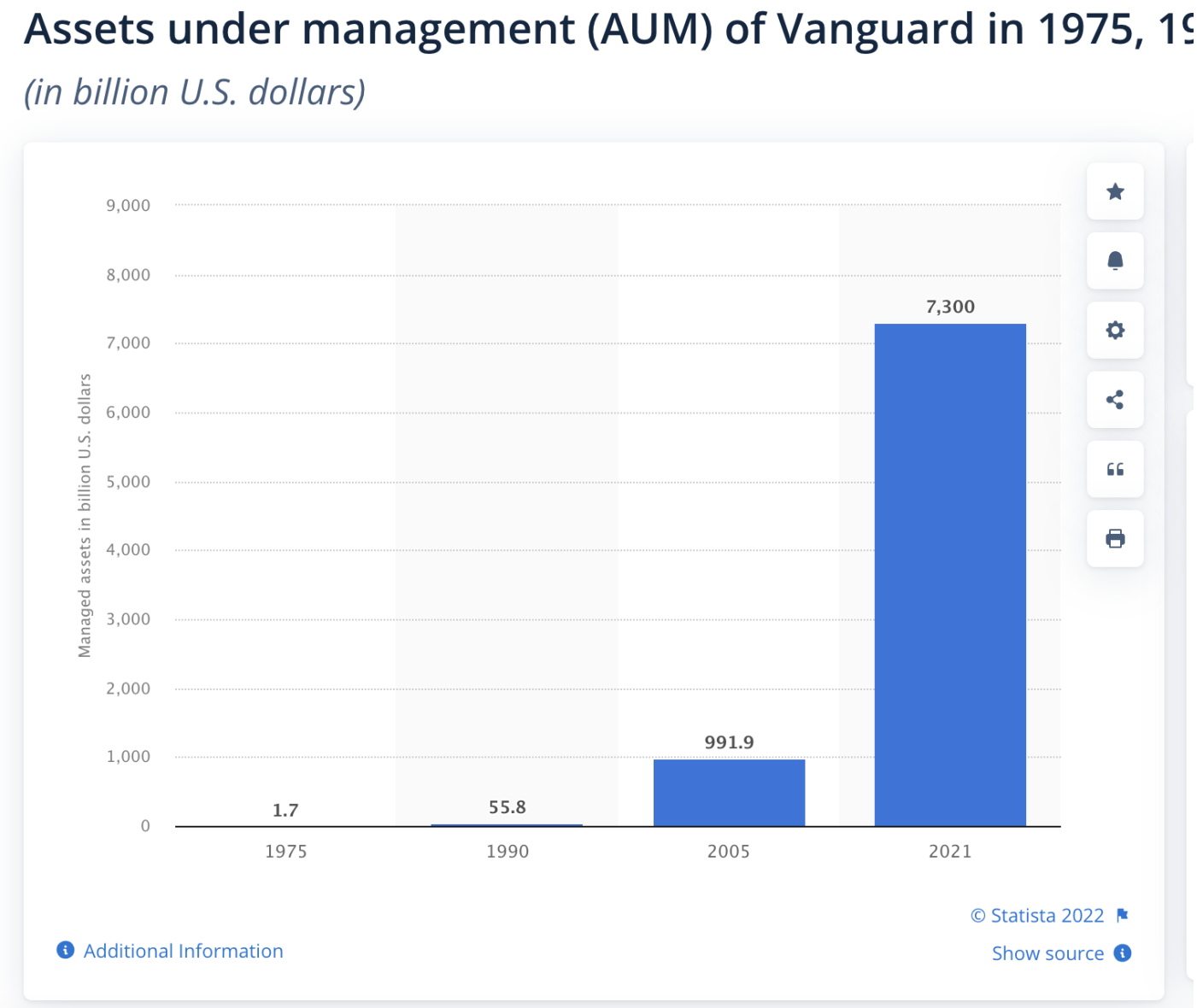
- Argument for index funds: middle-class investors benefit from access to market returns.
- Argument is correct for *marginal investor*.
- Correctness for the *mass of investors* assumes that index funds are small and don't affect prices.

Are Index Funds Small?



Are Index Funds Small?

- Big Three (Blackrock, Vanguard, State Street) own $\sim$ 25% of S&P 500
- Top 25 own $\sim$ 50% of US publicly traded firms

Research Questions

How do index funds affect

- stock market participation?
- asset prices?
- the welfare of investors?

What do we do?

- Build a simple model, in which heterogeneous investors choose portfolios of individual stocks, risk-free bonds, and an index fund, and prices are *endogenous*.
- Define notion of equilibrium.
- Prove existence of equilibrium.
- Simulate portfolio choices, asset prices, investor welfare as functions of the cost of indexing.

What do we find?

- *At the individual margin:* A small individual investor who learns about index funds benefits from shifting investments from bonds/individual stock to index funds

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- *At the individual margin:* A small individual investor who learns about index funds benefits from shifting investments from bonds/individual stock to index funds
- *In the aggregate:* Indexing increases demand for stock and hence equilibrium asset prices.
- *In equilibrium:* Indexing *decreases* the welfare of investors; cheaper indexing decreases welfare even more.

Model: Overview

- The model is static.
- The model represents two moments in time
  – consumption only at second date
- There is no trade (snapshot after trade).
- Representative Fund
- Many identical industries populated by small number of identical firms.
- Firms are subject to idiosyncratic shocks
- Market is subject to aggregate shock.
- Heterogeneous investors characterized by risk attitude and invested wealth.
- There is investment in stock (either directly or indirectly through the fund) and in bonds – but no other assets.
- There are no consumption/investment choices. (Choices already made)

Firms

- N identical firms in many small industries
  firms make positive profits
- Idiosyncratic shocks ϵ; mean 0 (cost shock?)
- Market-wide shock Δ; mean 0 (demand shock?)
- Firm behavior is summarized by random profit

$$\Pi = \pi + \epsilon + \Delta$$

- x_S shares of stock purchased *directly* at date 0 yield

$$x_S(\pi + \epsilon + \Delta)$$

  units of wealth at date 1

Index Fund

- Representative Fund
- Fund charges a fee $k \geq 0$ as fraction of AUM
  Fund does not maximize profit.
- Fund invests AUM uniformly across entire market
- Idiosyncratic risk completely washes out.
- x_F shares of stock purchased through the Fund at date 0 yield

$$x_F \frac{(\pi + \Delta)}{(1 + k)}$$

units of wealth at date 1

Bond

- Single riskless bond; interest rate $\rho \geq 0$
- x_B bonds purchased at date 0 yield

$$x(1+\rho)$$

units of wealth at date 1

Investors

- Non-atomic continuum of Investors $[0, T]$; $0 < T \leq \infty$
- Investor t characterized by
  - Choice set X^t
    - shares in a single firm (proxy for costly diversification)
    - shares in Fund
    - bonds
  - Invested wealth w^t
  - Bernoulli utility function u^t
    Investor maximizes $E[u^t]$
- Distribution ϕ, total mass M
- *Investors are heterogeneous*

Note

At equilibrium

- Market clearing for stock $\rightsquigarrow$ all shares held by investors, perfectly sorted
- Investor optimization $\rightsquigarrow$ all firms have same price p
- Investors can only buy stock in a single firm $\rightsquigarrow$ we view direct investment in stock as an asset with random return $\pi + \epsilon + \Delta$

Equilibrium Quantities

- Price for firms p
- Investor choices $x^t = (x_S^t, x_F^t, x_B^t)$

Equilibrium Conditions

- Investors maximize utility subject to budget constraint
- Market for stock clears:

$$\int_T x_S^t \, \phi(t) dt \; + \; \int_T x_F^t \, \phi(t) dt = N$$

Existence of Equilibrium

Theorem *Equilibrium Exists*

Proof Sketch

- Without loss: prices lie in a bounded interval $\left[\underline{p}, \overline{p}\right]$
- Fix candidate p. Define individual demand

$$d^t(p) = \left(x_S^t(p), x_F^t(p), x_B^t(p)\right)$$

- Aggregate demand

$$D(p) = \int_T x_S^t(p)\phi(t)\,dt + \int_T x_F^t(p)\phi(t)\,dt$$

- Show: $p \mapsto D(p)$ is uhc with compact convex values
- $D(\underline{p}) > N > D(\overline{p}) \Rightarrow$ there exists p^* with $D(p^*) = N$
- p^* determines an equilibrium

Is Equilibrium Unique?

$D(p)$ is strictly decreasing $\rightsquigarrow$

- *unique* p^* with $D(p^*) = N$ (unique equilibrium price)
- possible multiplicity of equilibrium choices

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Individual demand for stock need not be decreasing in price.

Aggregate demand for stock need not be decreasing in price.

Simulations: Questions

How do

- asset price
- investor choices
- investor welfare

Depend on

- distribution of wealth & risk aversion?
- absence/presence of Fund?
- fee k charged by Fund?

Simulations: Parameters, Guideline $\sim$ 1980

- Number of publicly traded US firms: $\sim 5,000$
- Market capitalization of all publicly traded US firms: $\sim$ \$1 Trillion
- Value of bond market: $\sim \$0.5 - 1.5$ Trillion
- Total invested wealth $W = \$2$ Trillion
- 100 Million investors

Note: We have made *very little* effort to make accurate calibrations to "real data".

Simulations: Firms

- Expected profit of each firm: $\pi = \$500$ Million
- Idiosyncratic risk: $\epsilon = \pm 0.5\pi$, equal probabilities
- Market risk: $\Delta = \pm 0.5\pi$, equal probabilities

Simulations: Investors

Investors maximize expected CRRA utility:

$$u^t(c) = \begin{cases} \frac{c^{1-t}-1}{1-t} & \text{if} \quad t \neq 1 \\ \log c & \text{if} \quad t = 1 \end{cases}$$

Scaling: c in units of \$10,000

Distribution of wealth w_t

- exponential

$$w^t = \left(\frac{W}{1 - e^{-5}} \right) e^{-t}$$

Distribution of risk aversion t

- uniform on $[0, 5]$

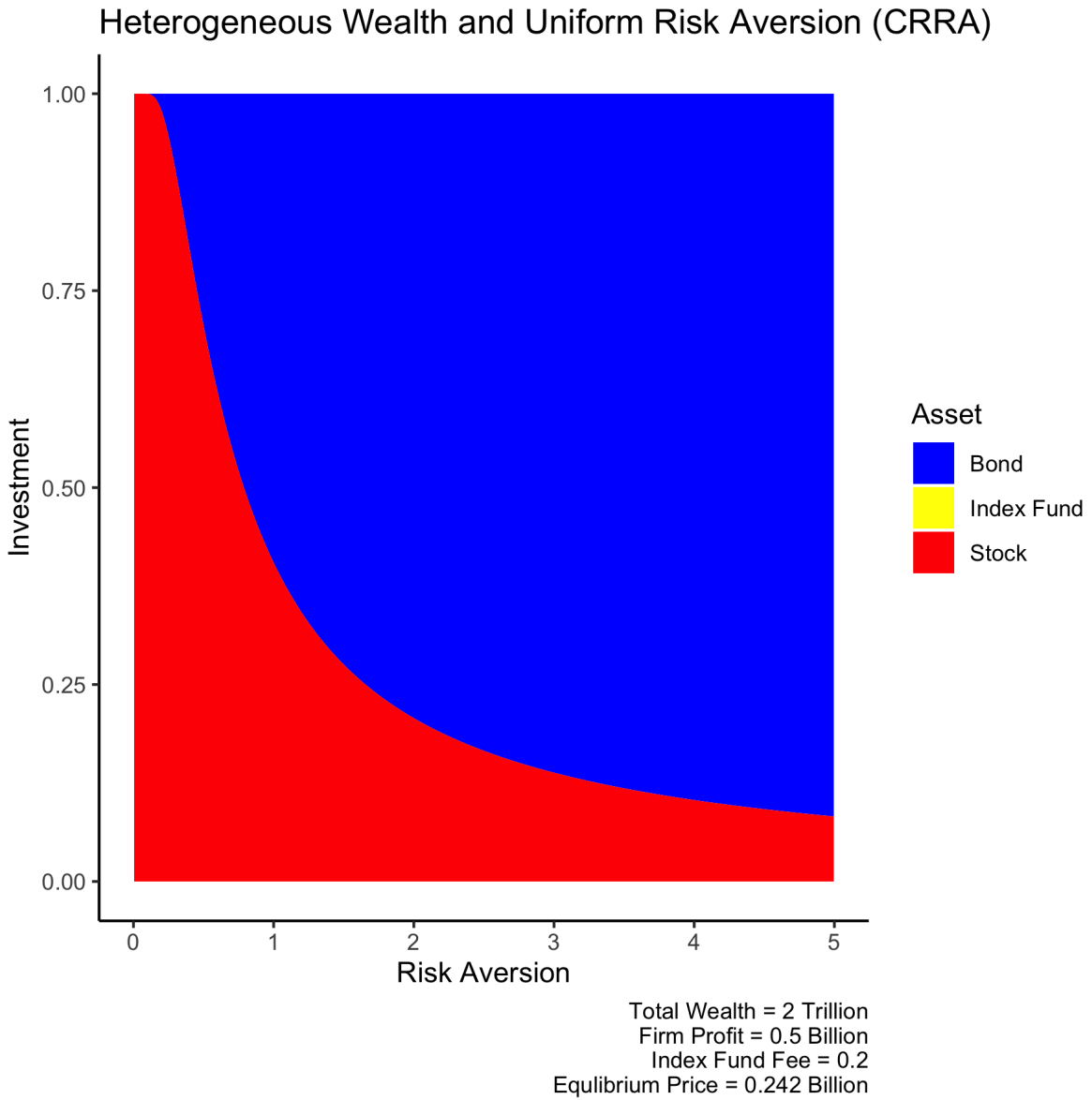
Comments

- Rich are less risk-averse
- Richest 20% have $\sim$ 65% of wealth
- Poor are more risk averse
- Poorest 20% have $\sim$ 2% of wealth

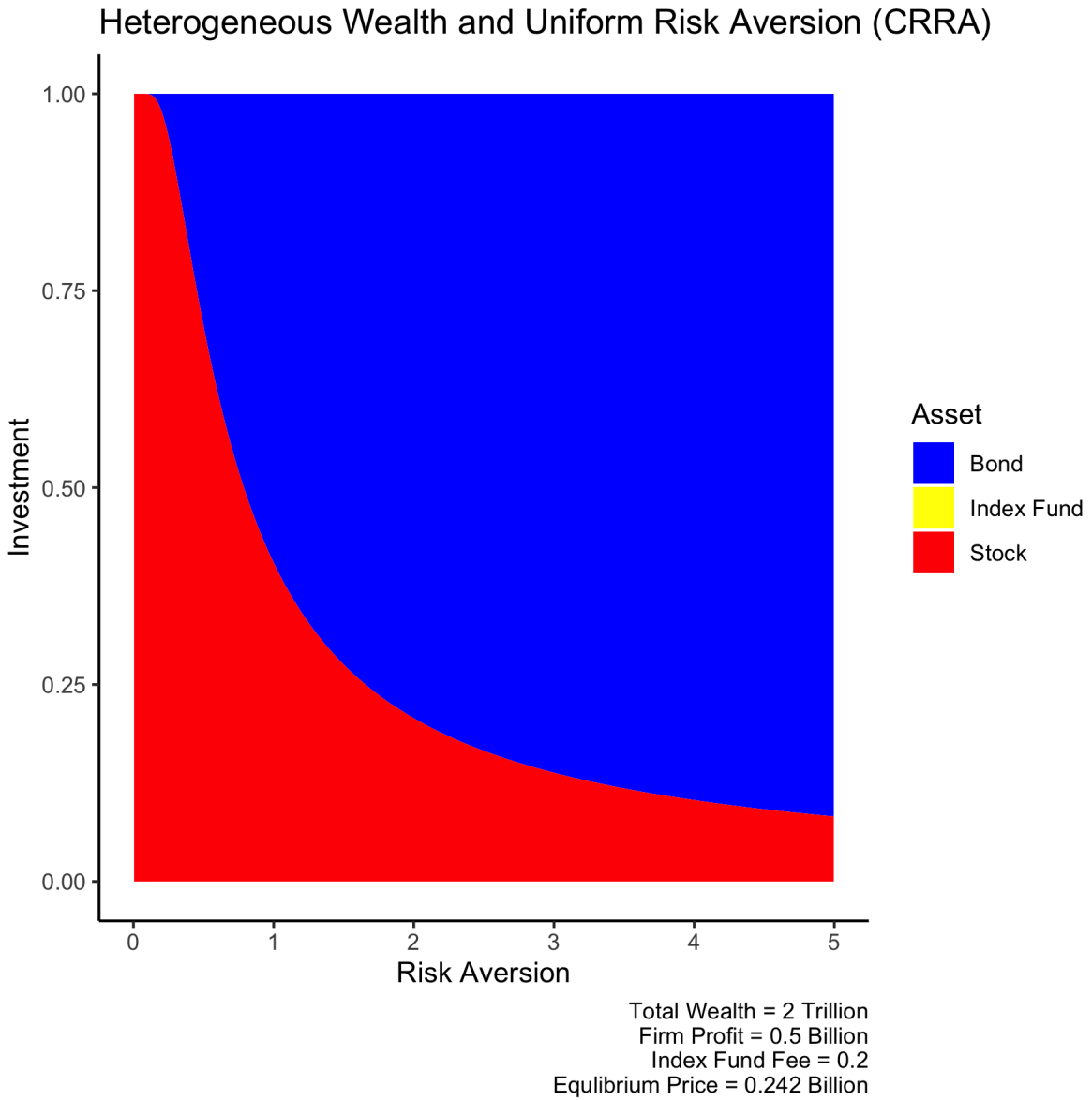
Remaining Parameters

- Interest rate
  $\rho = 0.5$
- Fund fee
  $k = \infty, 0.20, 0.10, 0.05, 0.02, 0.00$

CRRA Portfolio Choices $k = \infty$



CRRA Portfolio Choices $k = 0.20$



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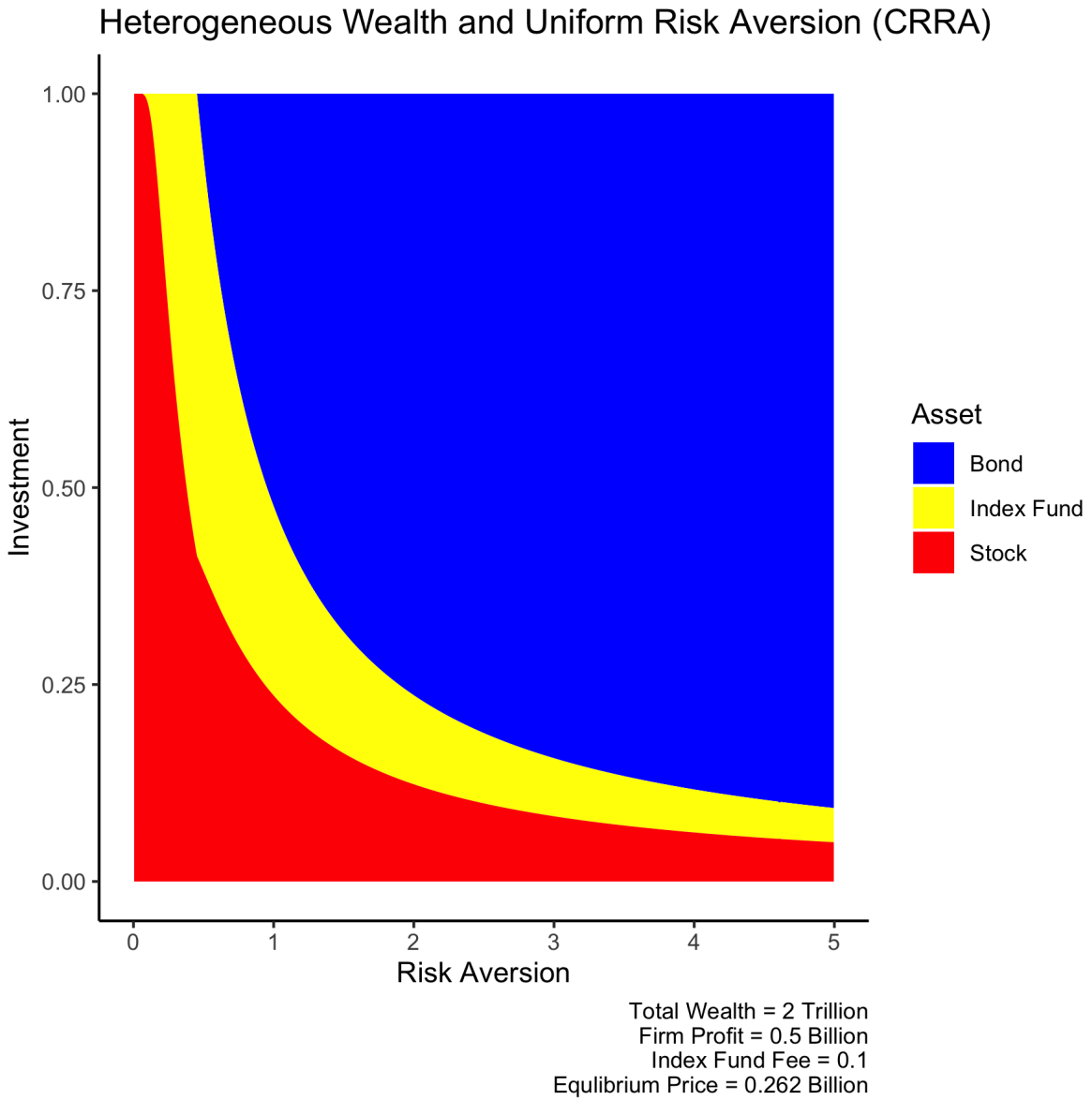
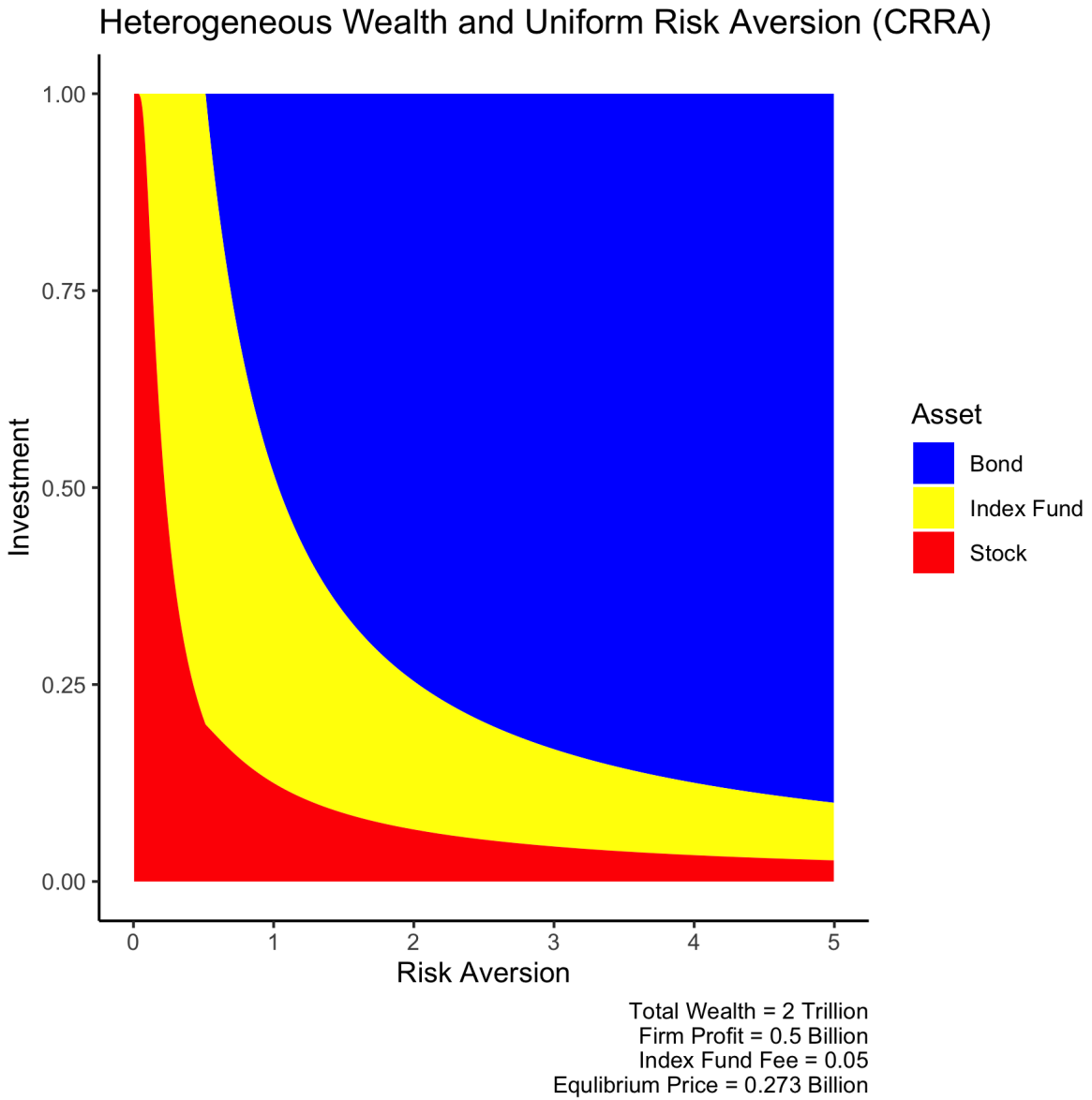


CRRA Portfolio Choices $k = 0.05$



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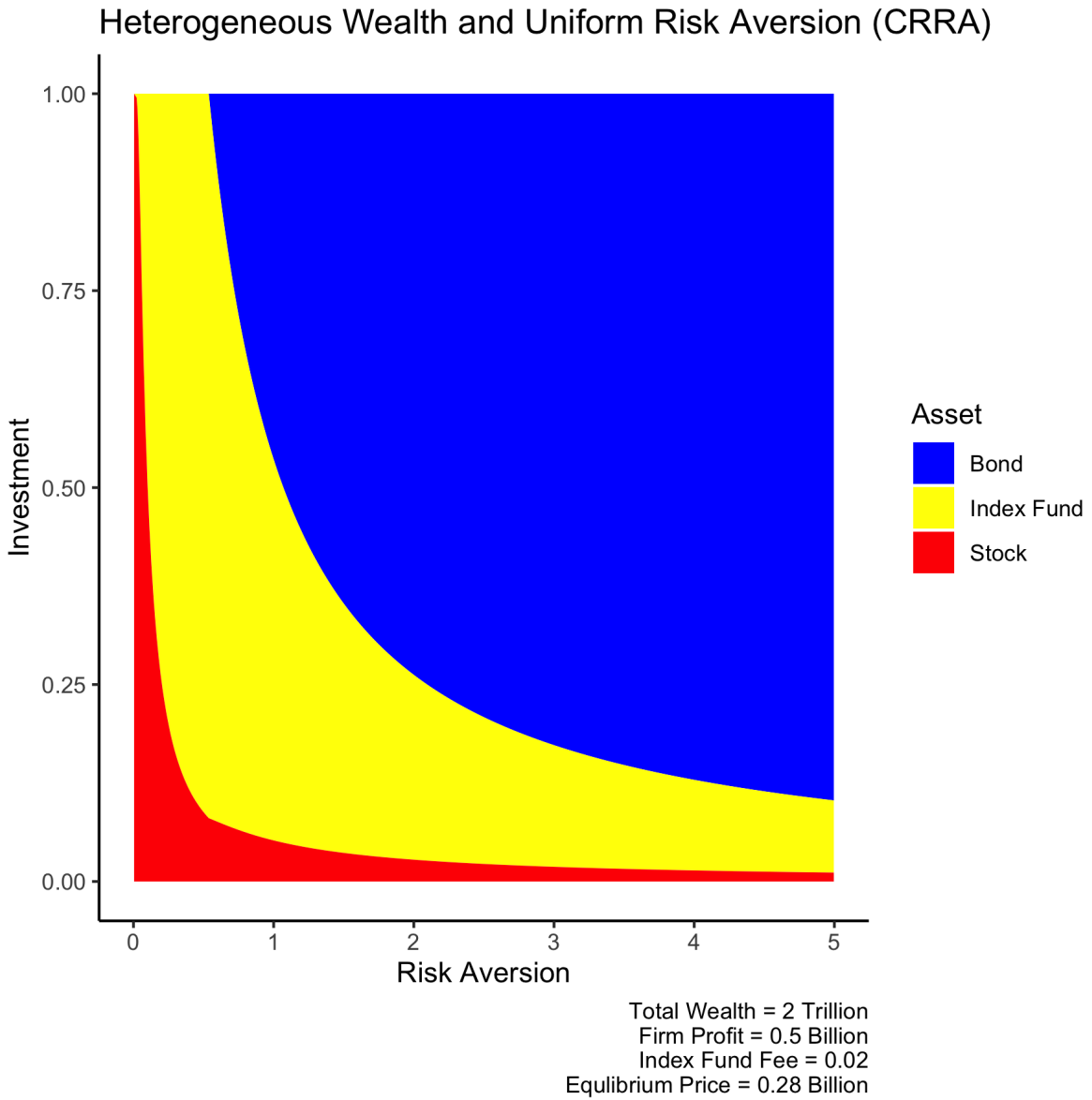

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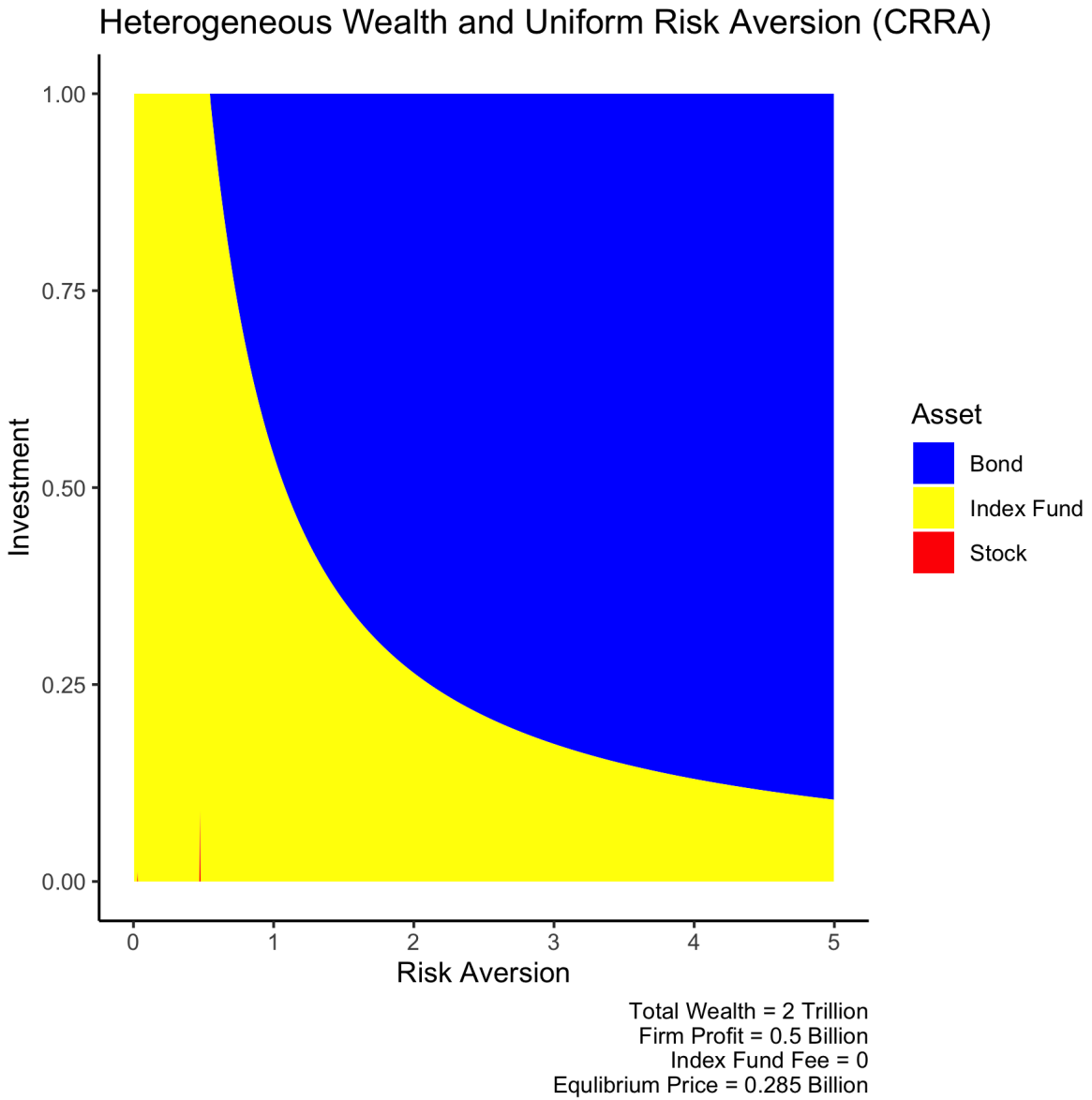
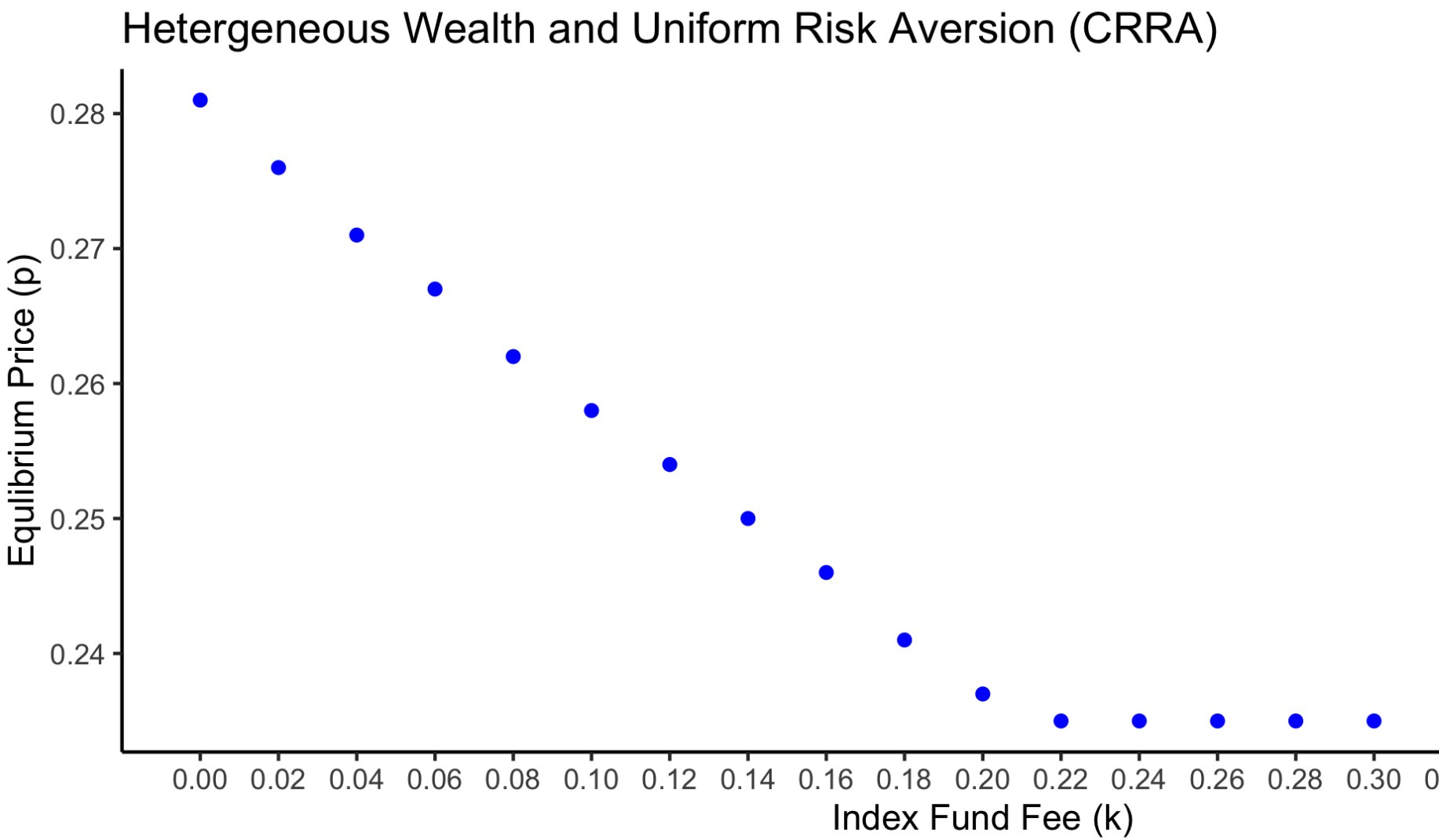
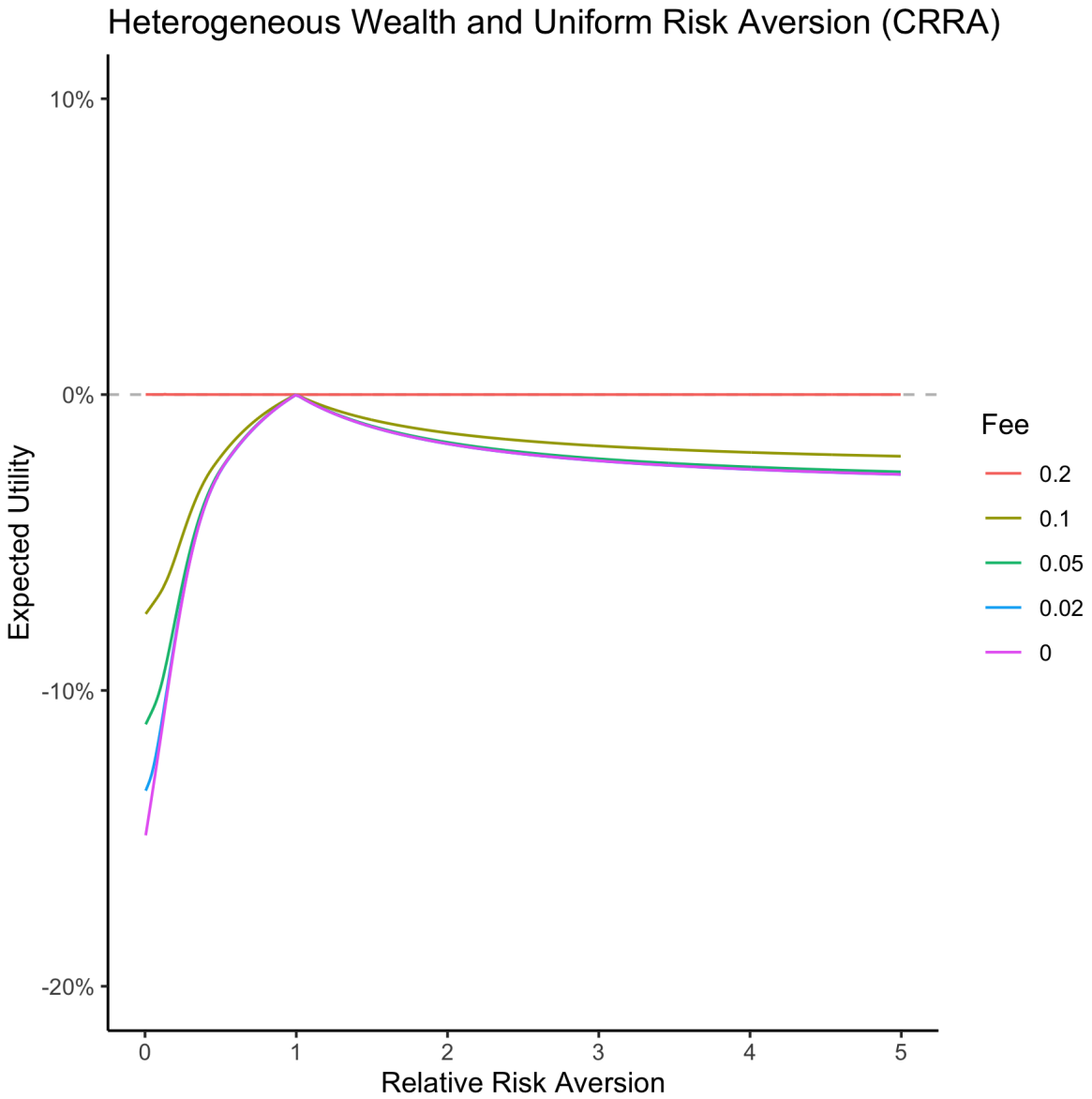


Equilibrium Prices for CRRA Investors



Equilibrium Welfare of CRRA Investors



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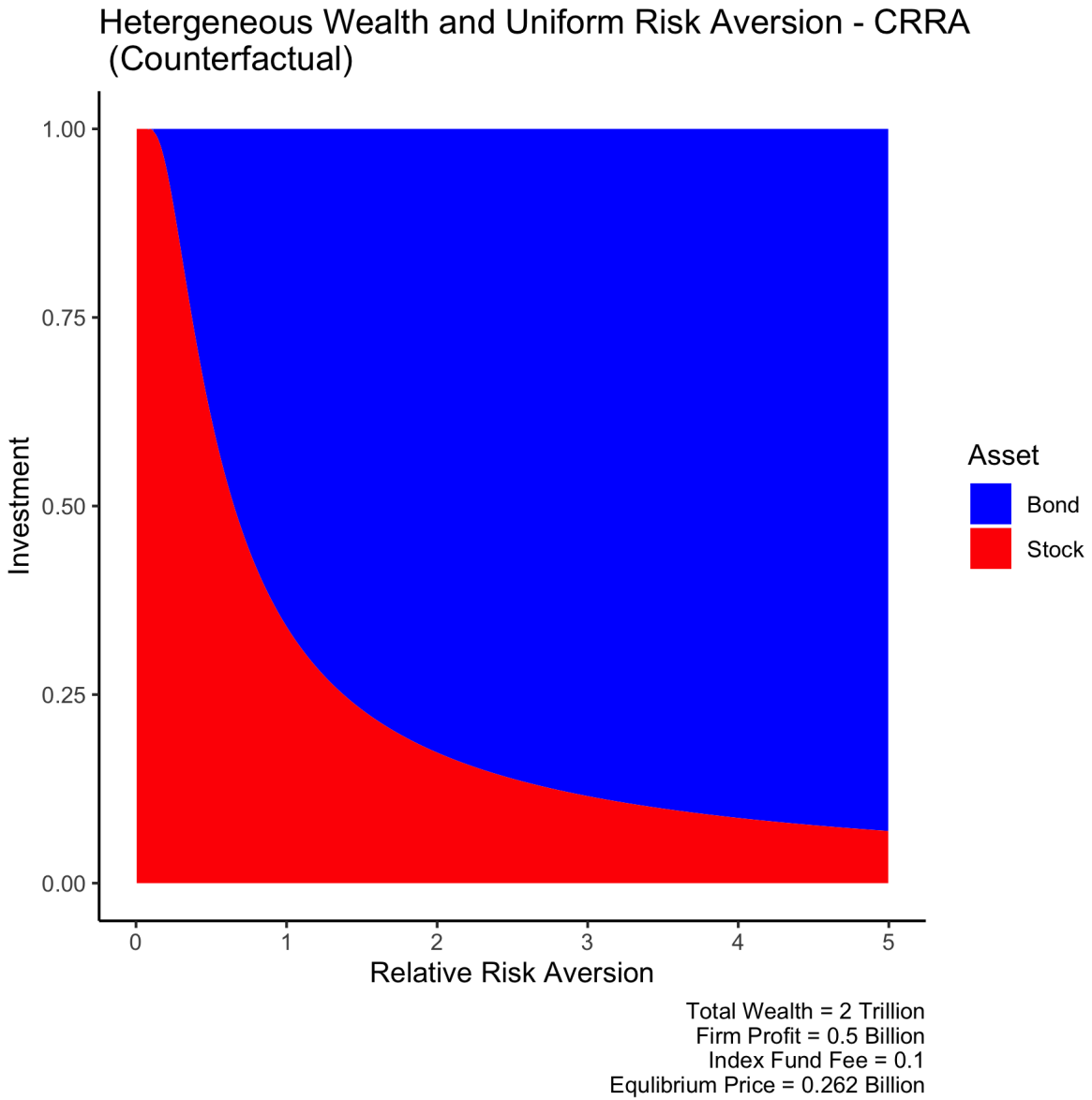

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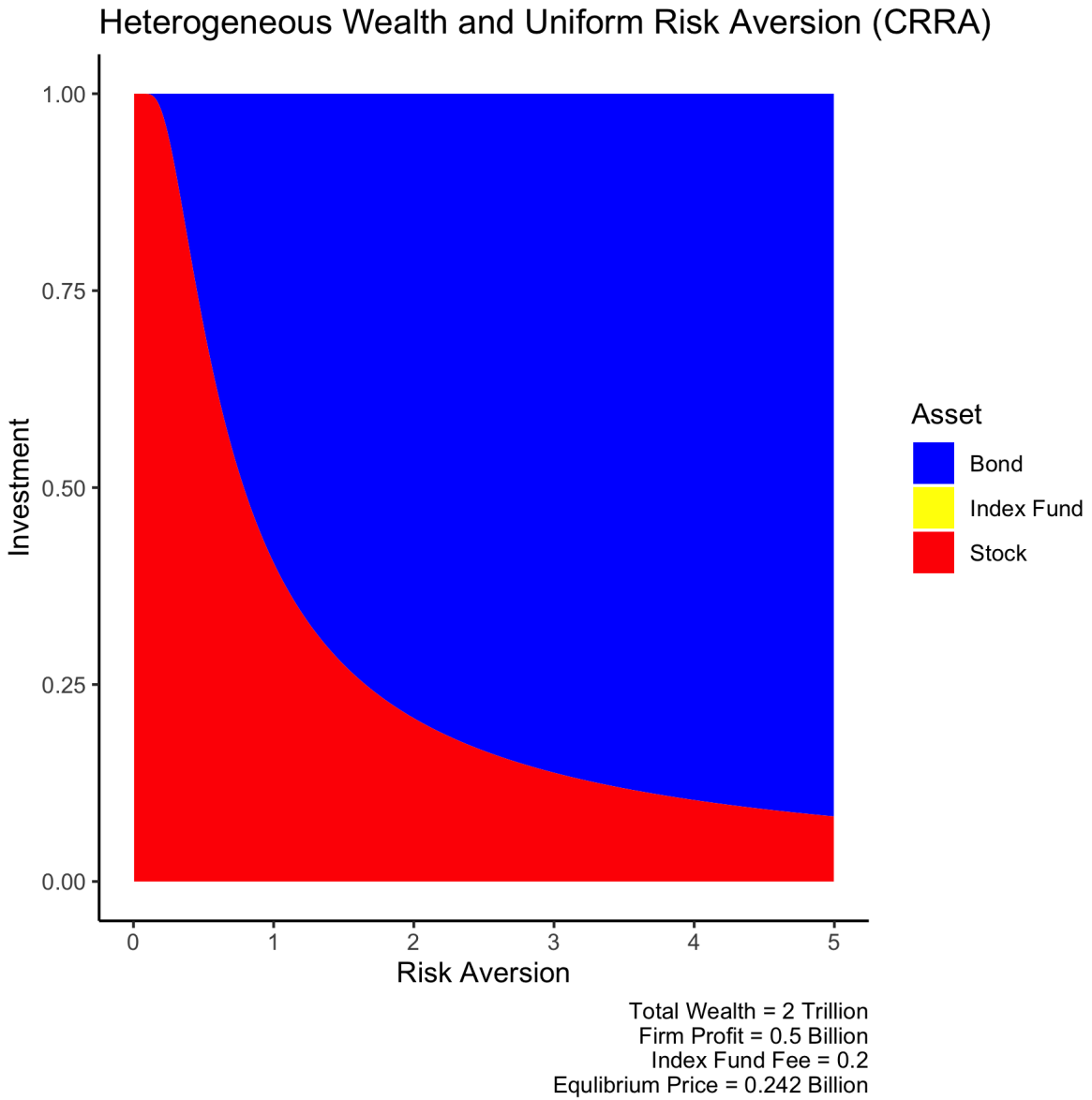

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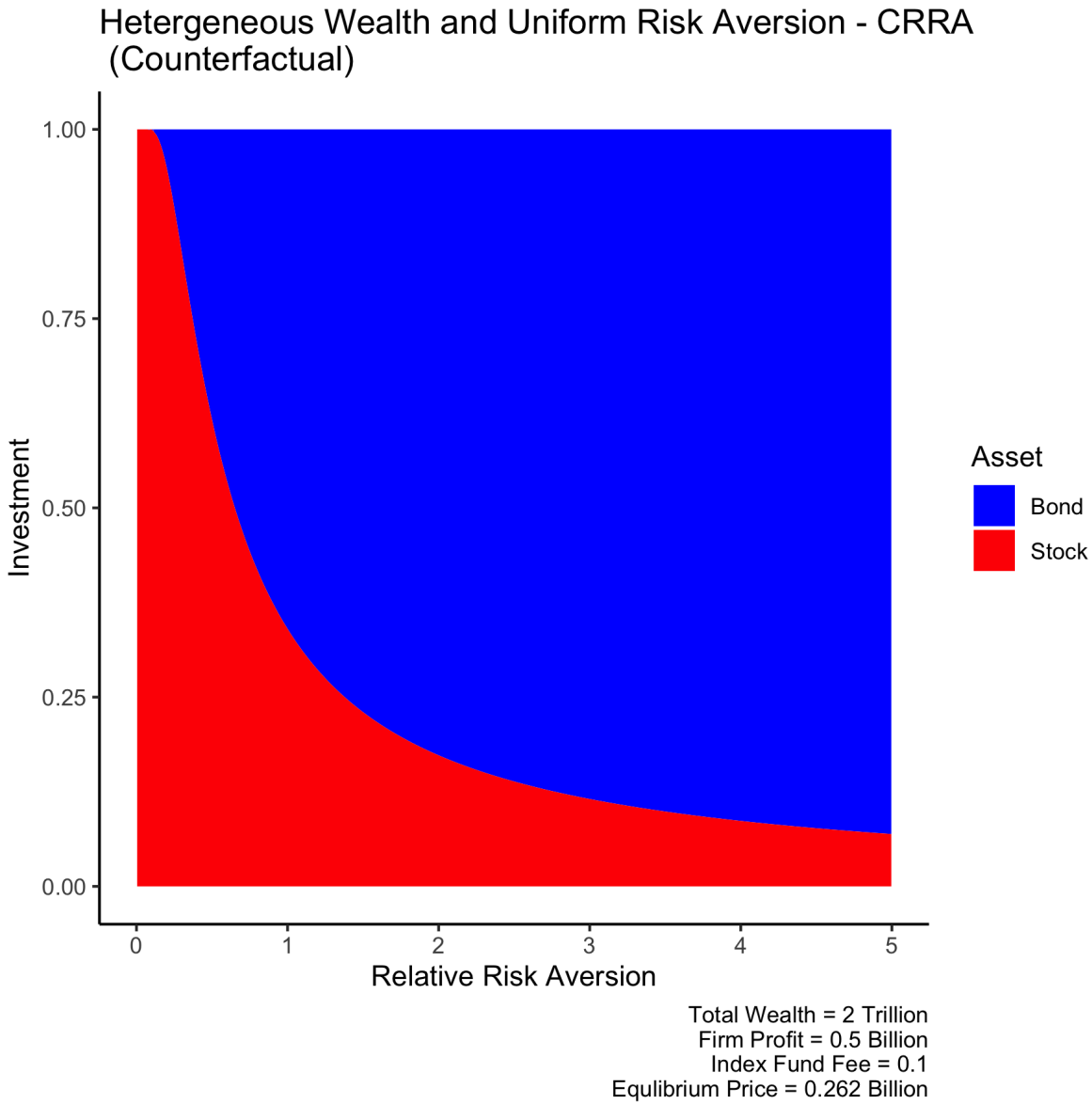

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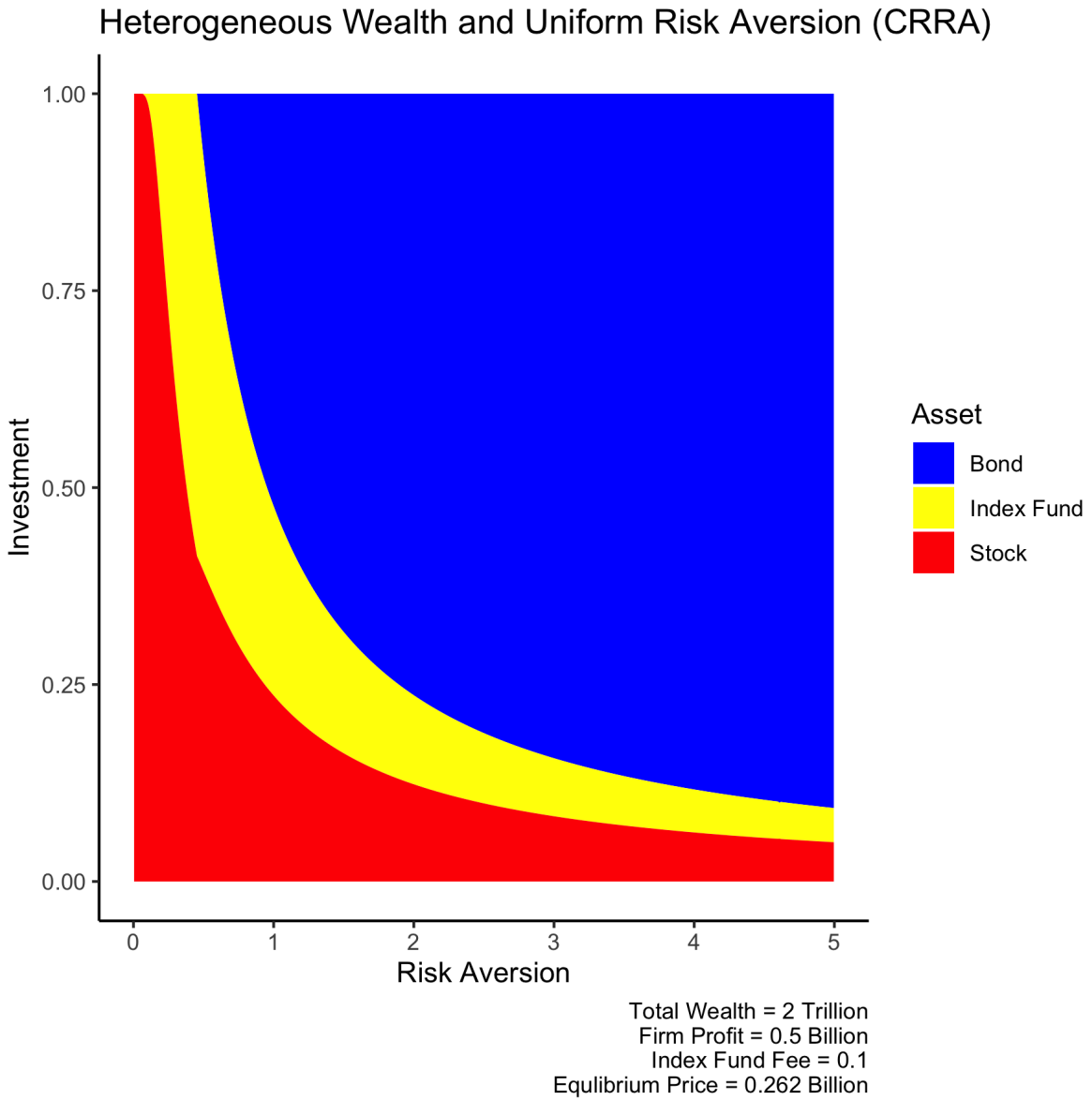

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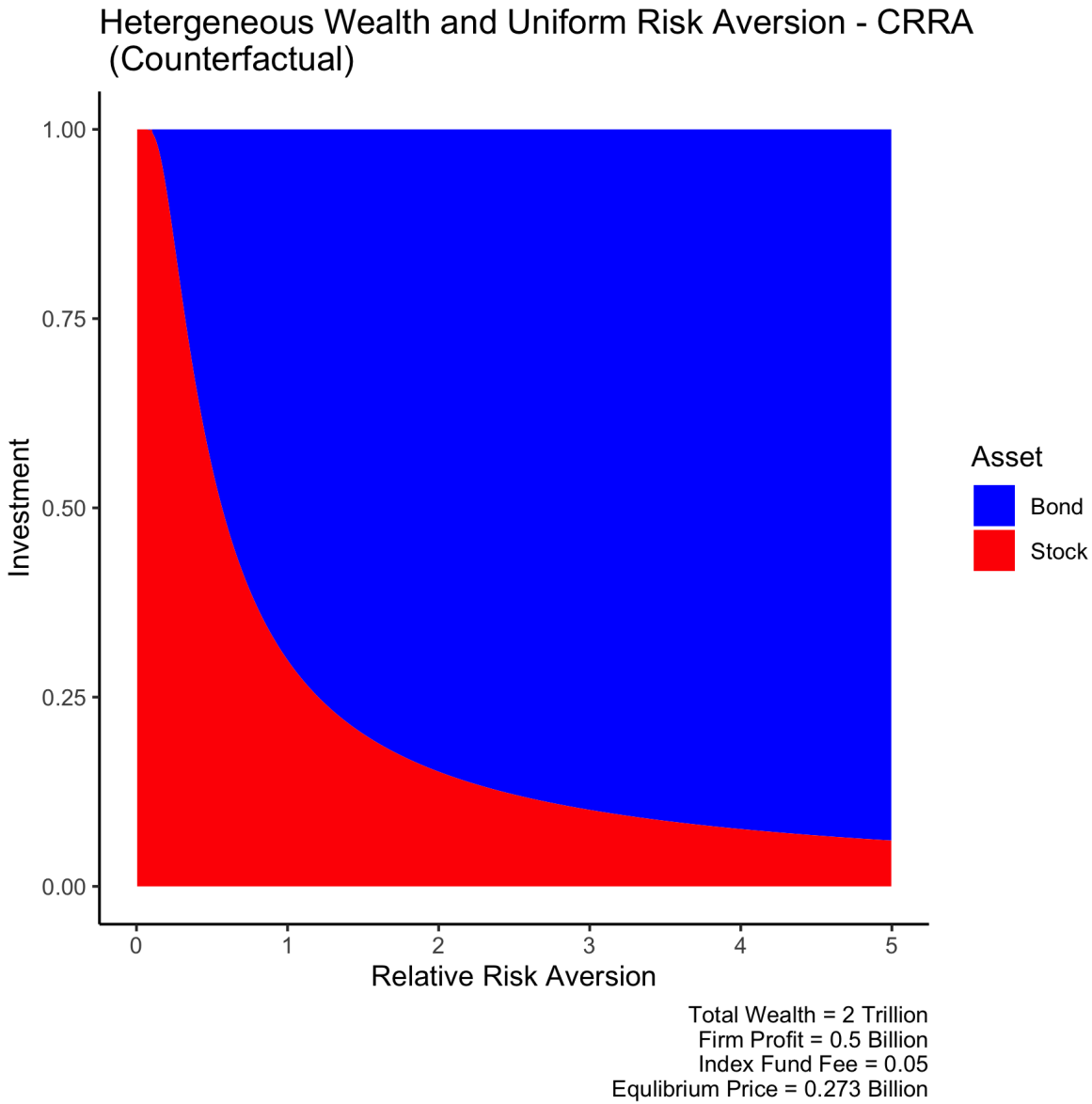

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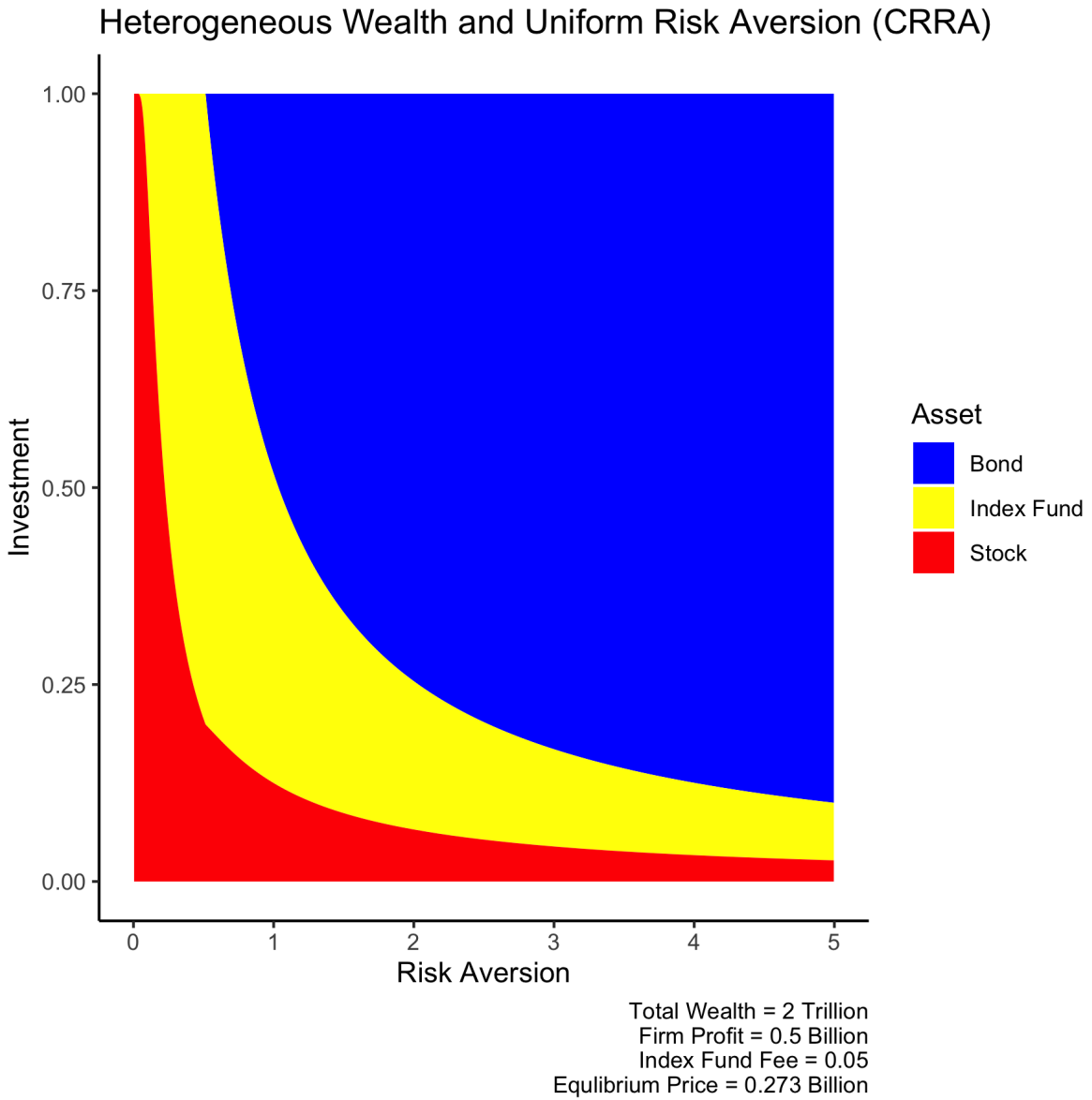

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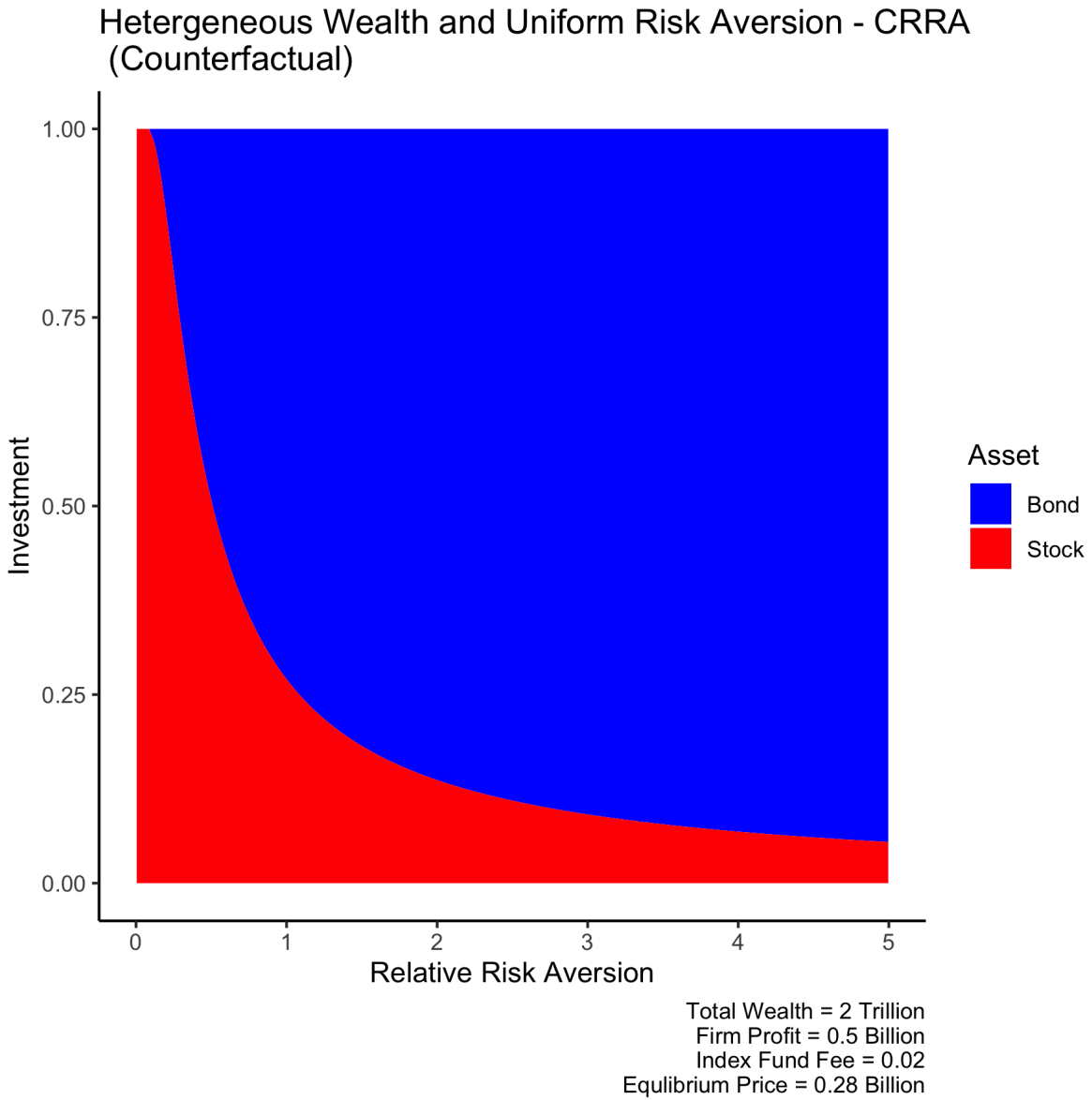

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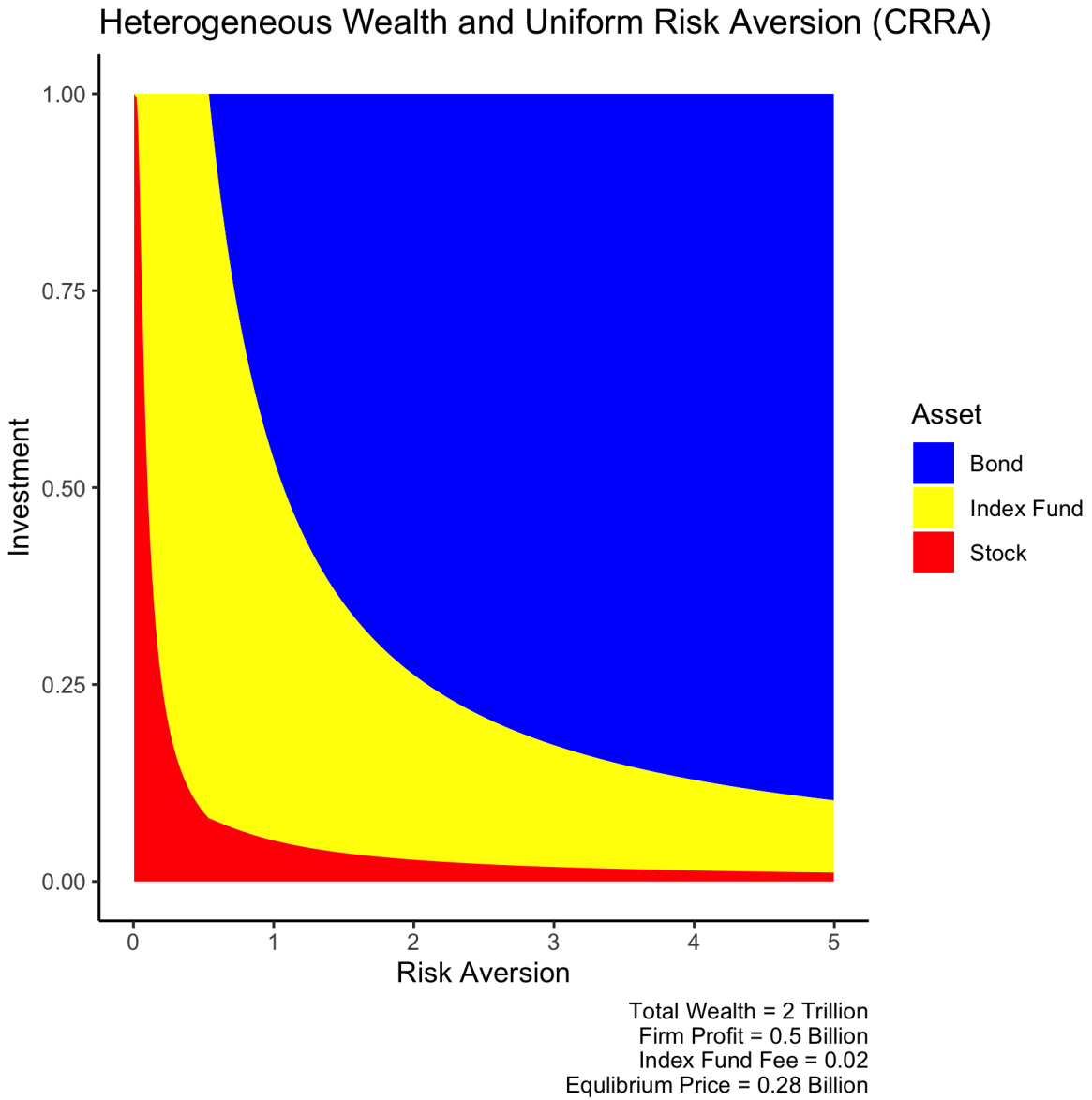

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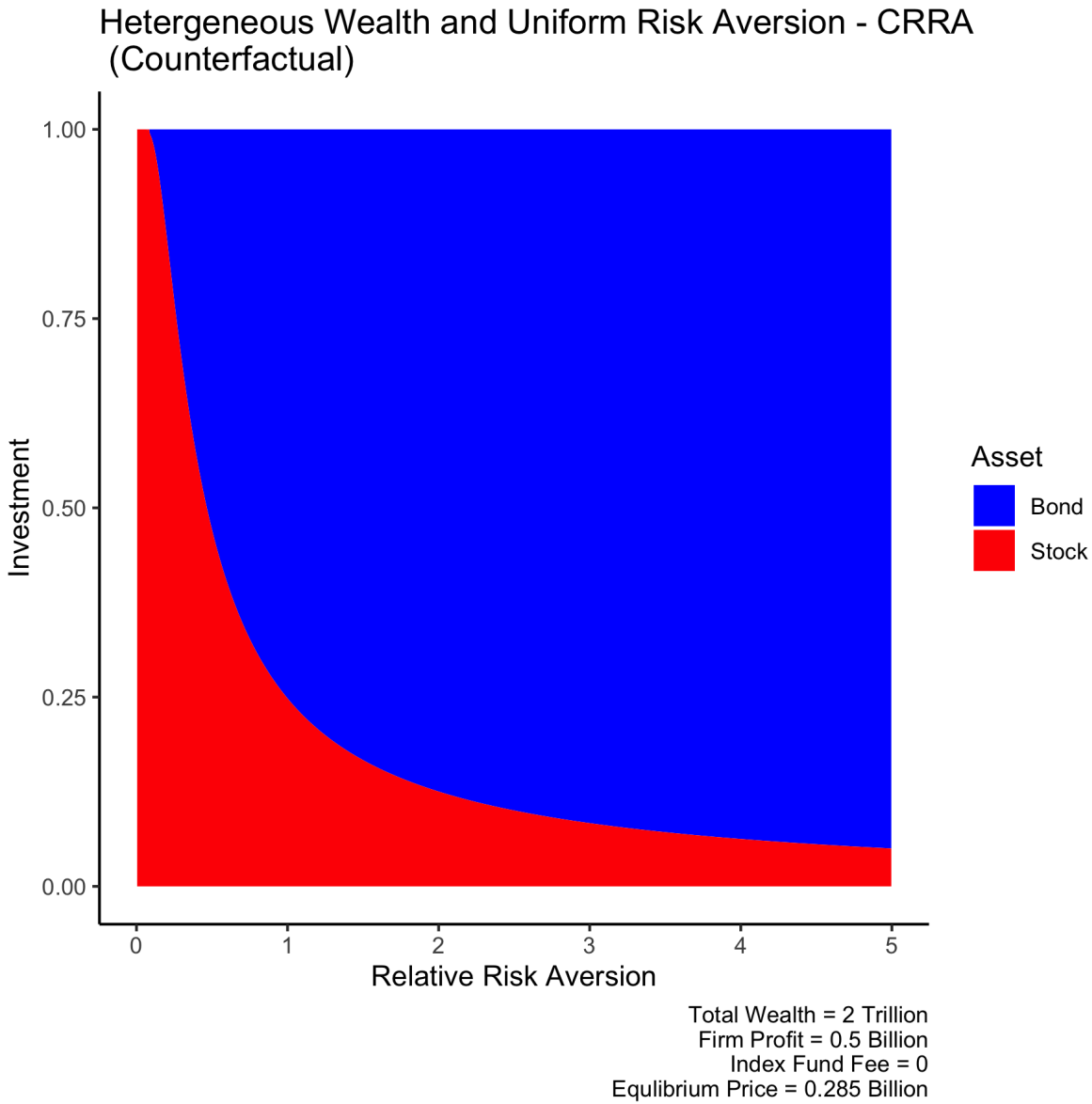

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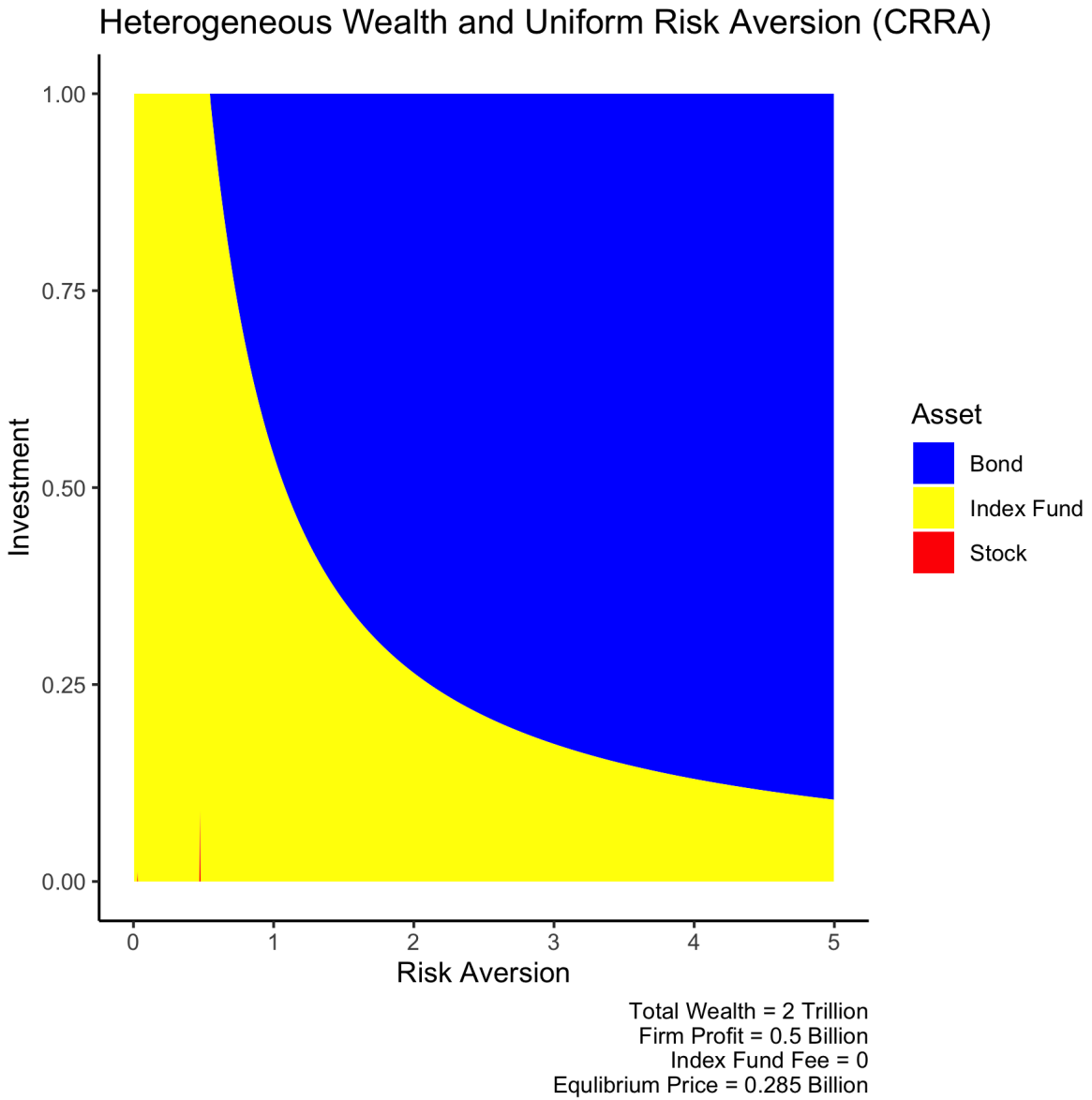
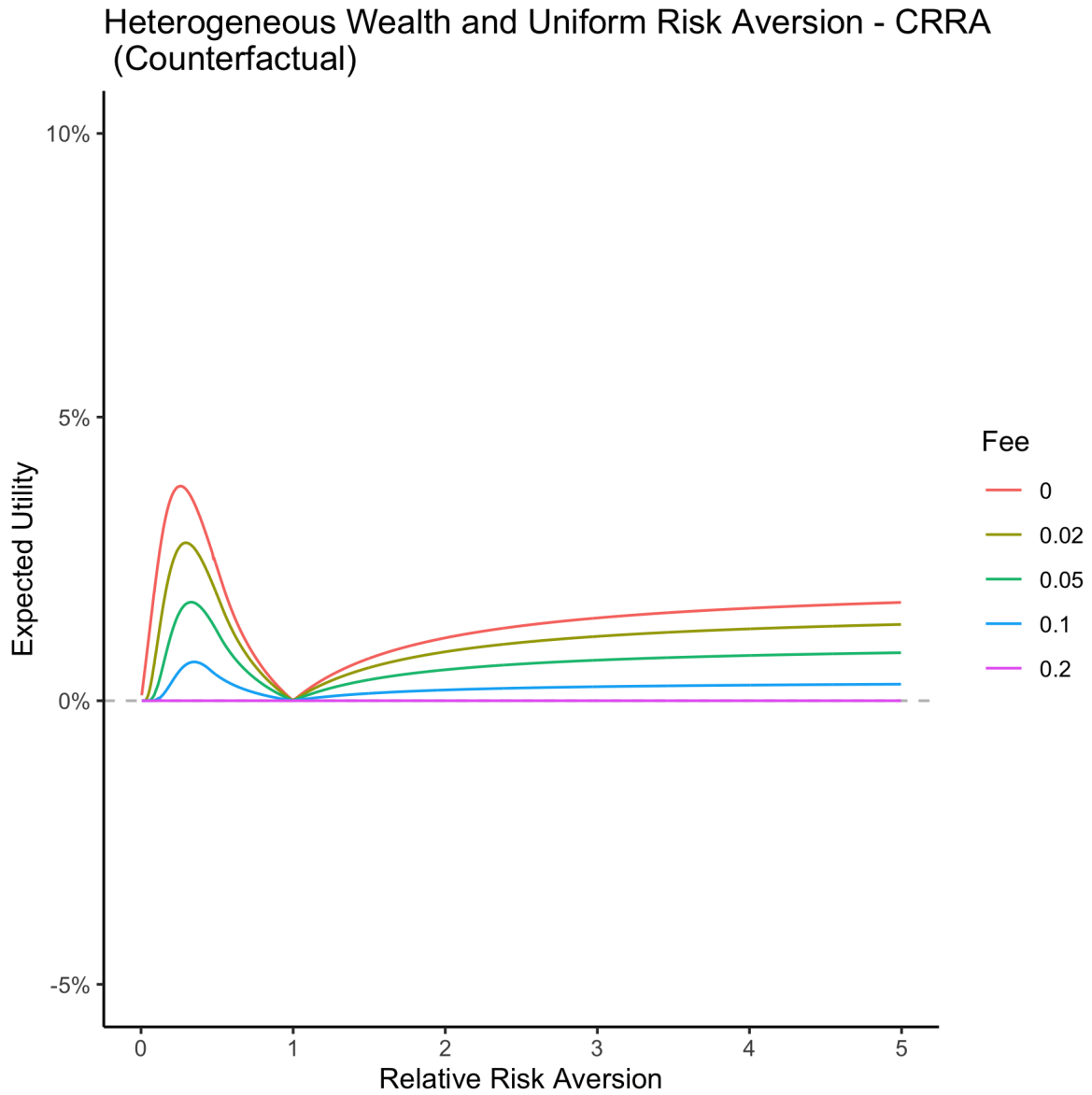


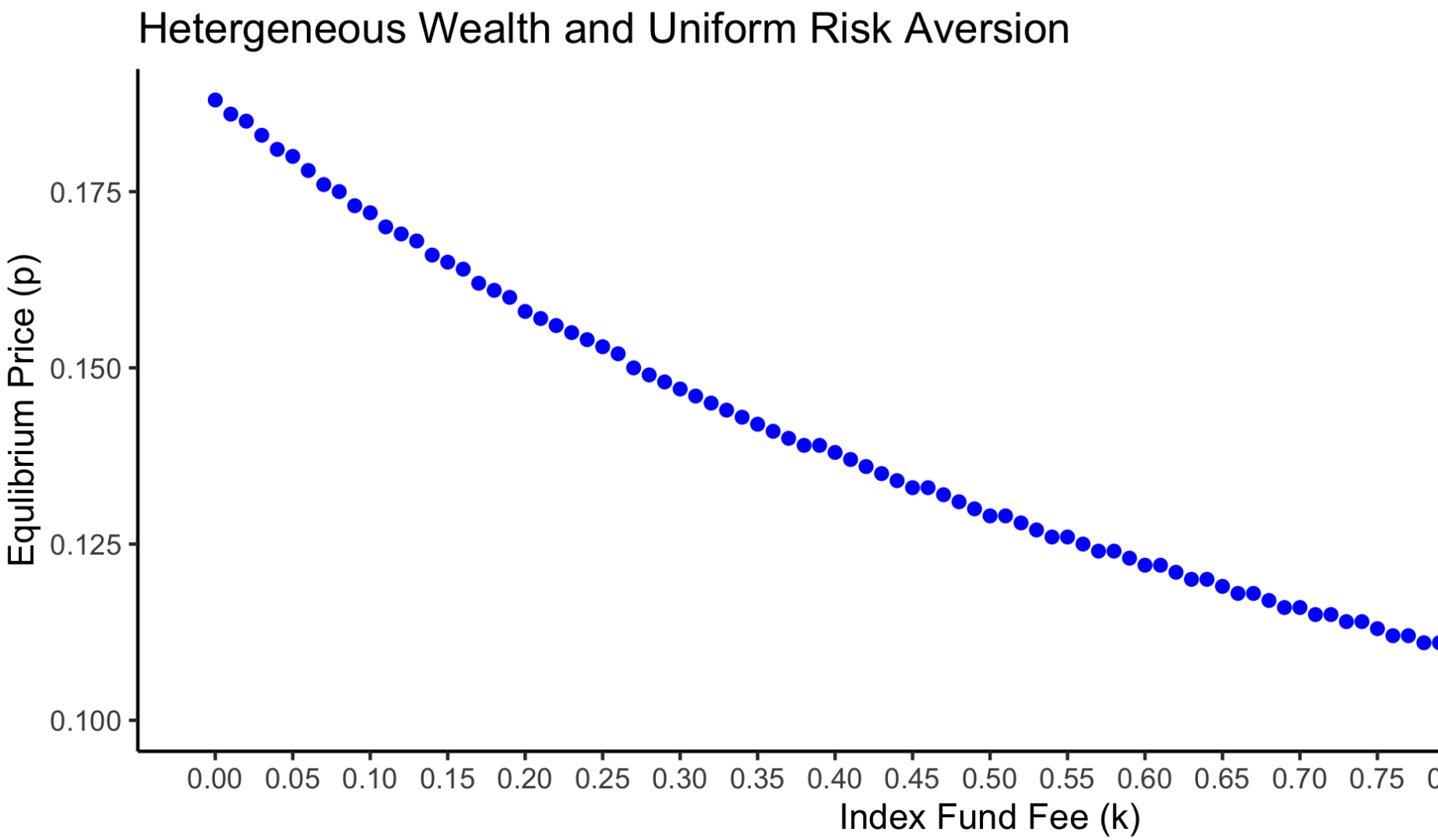
Welfare of the Marginal CRRA Investor



Simulation Parameters?

- CARA utility
- Homogeneous wealth
- Indivisible choices

Equilibrium Prices for CARA Investors



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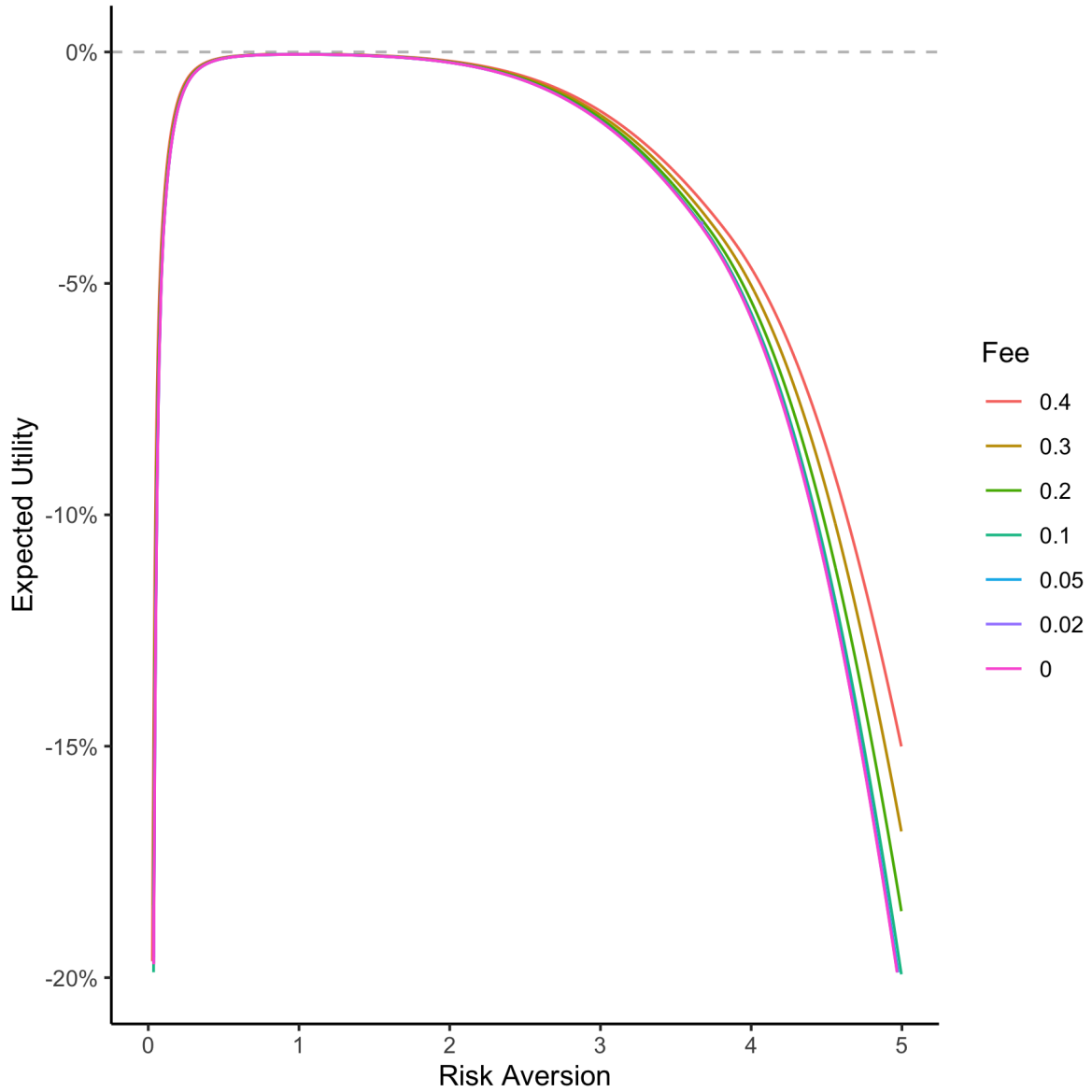
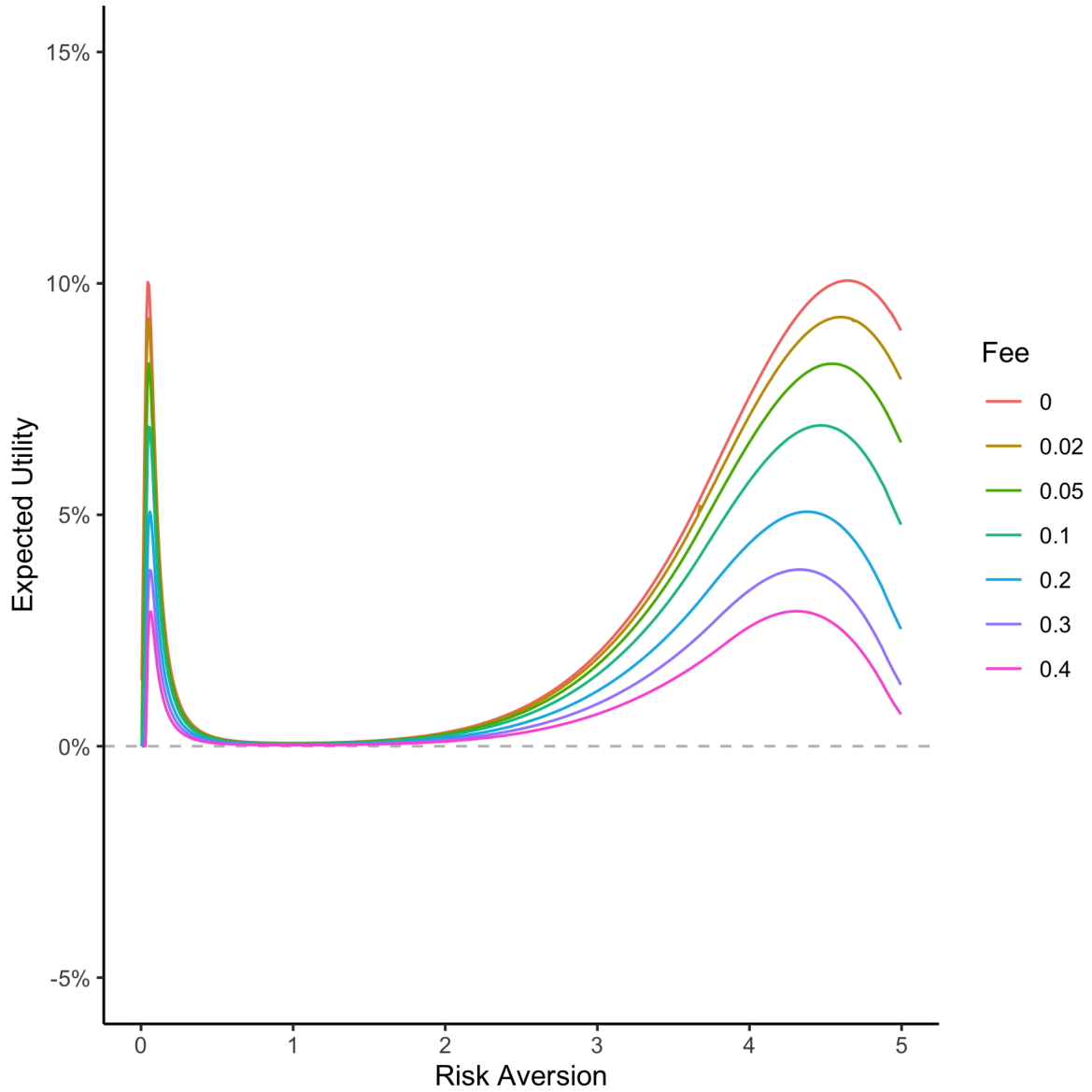


Welfare of the Marginal CARA Investor



First Summary Conclusions

- Index Funds benefit the marginal investor
- Index Funds harm investors as a whole

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- Index Funds harm investors as a whole
- Tragedy of the Commons

Caution: Many simplifying assumptions. *It's a model.*

Cost of Capital?

- Firm cost includes cost of capital
- Higher share price $\rightsquigarrow$ lower cost of capital
- Lower cost of capital $\rightsquigarrow$ lower cost of production
- Lower cost of production $\rightsquigarrow$
  - Higher output
  - Lower price
  - Higher profit

This benefits investors *and* consumers

Oversight

- Firm cost depends on quality of management
- Fund votes shares $\rightsquigarrow$ improved quality of management
- Improved quality of management$\rightsquigarrow$ lower cost of production
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Common Ownership

What is the objective of the Firm?

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$\rightsquigarrow$ Decreased competition $\rightsquigarrow$

- Benefit for investors
- Harm for consumers

Second Summary Conclusions

- Index Funds $\rightsquigarrow$ *many* economic forces
- Different forces lead in *different* directions
  - for investors
  - for consumers
  - net effects of these forces is unclear

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Empirical evidence?