Capital Misallocation and Secular Stagnation

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Federal Reserve Board
(joint with Andrea Caggese - Pompeu Fabra, CREI & BGSE)

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Secular stagnation hypothesis

- Low rates $\Rightarrow$ low growth in presence of ZLB (Summers (2013), Eggertsson and Mehrotra (2014), Bacchetta, Benhima, and Kalantzis (2016), Jones and Philippon (2016), Benigno and Fornaro (2017), Eggertsson, Mehrotra, and Robbins (2017))

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New mechanism

- Does not rely on a binding ZLB and sticky prices
- Is consistent with additional contemporaneous trends
  1. Significant decrease in corporate net borrowing
  2. Rise in the intangible capital share
  3. Increase in productivity dispersion in intangibles industries relative to tangibles industries

Motivation

Several trends:

1. **Secular stagnation (Summers (2015), Eichengreen (2015))**
   - **Decrease in real interest rates**
   - **Economic growth short of previous trends**

2. Rise in intangibles (Corrado and Hulten (2010))
   - Stronger importance of knowledge, human and organizational capital, and reduced reliance on physical capital

3. Decrease in corporate net borrowing (Armenter and Hnatkovska (2016), Quadrini (2016), Chen, Karabarbounis and Neiman (2016), Zetlin-Jones and Shourideh (2016))

4. Increase in productivity dispersion in intangibles industries relative to tangibles industries

Declining Real Interest Rate

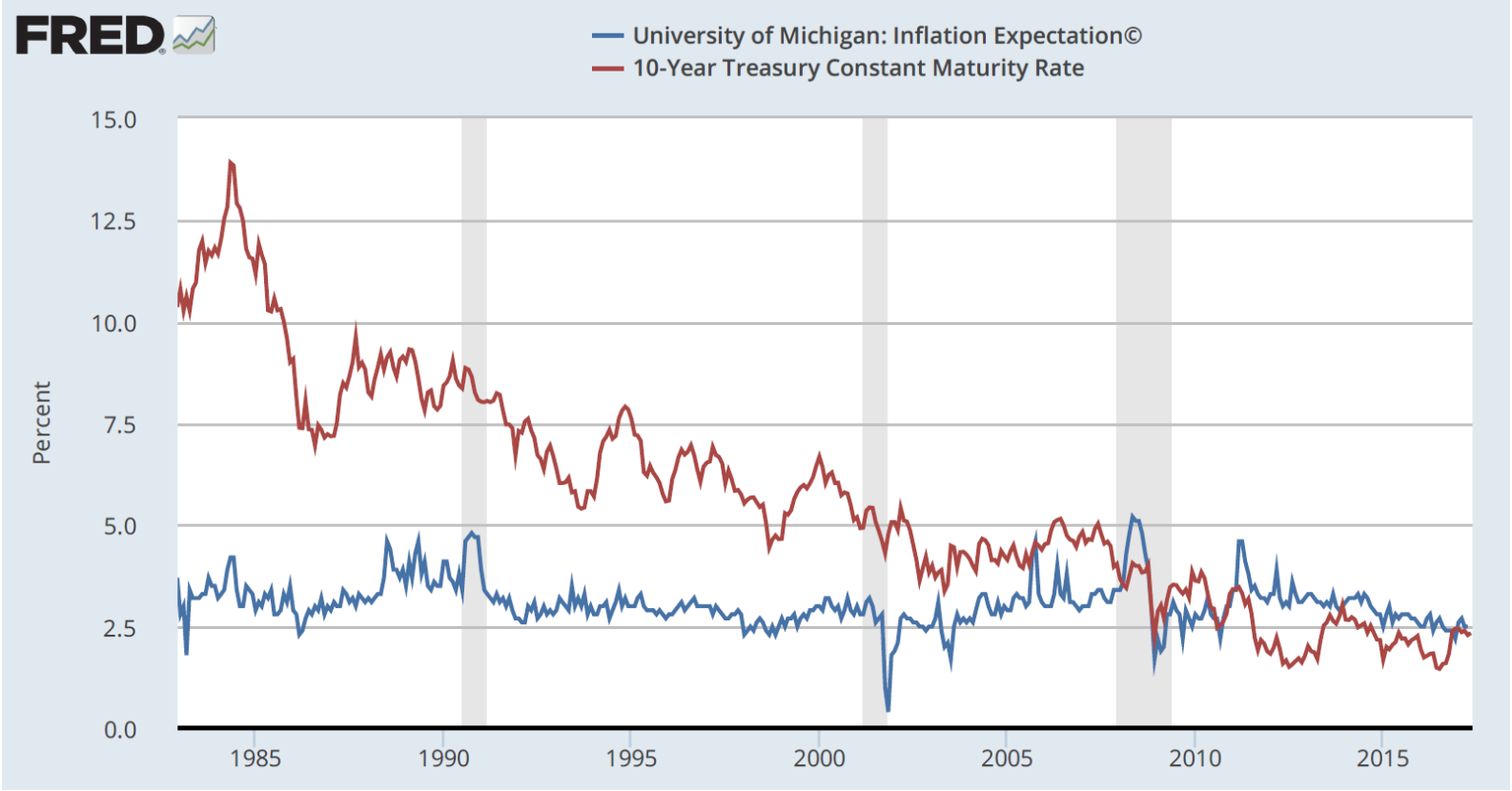

Figure: Long-term Nominal Interest Rates and 2-year ahead Inflation Expectations (*Source: Federal Reserve Bank of St. Louis*)

Declining Productivity Growth

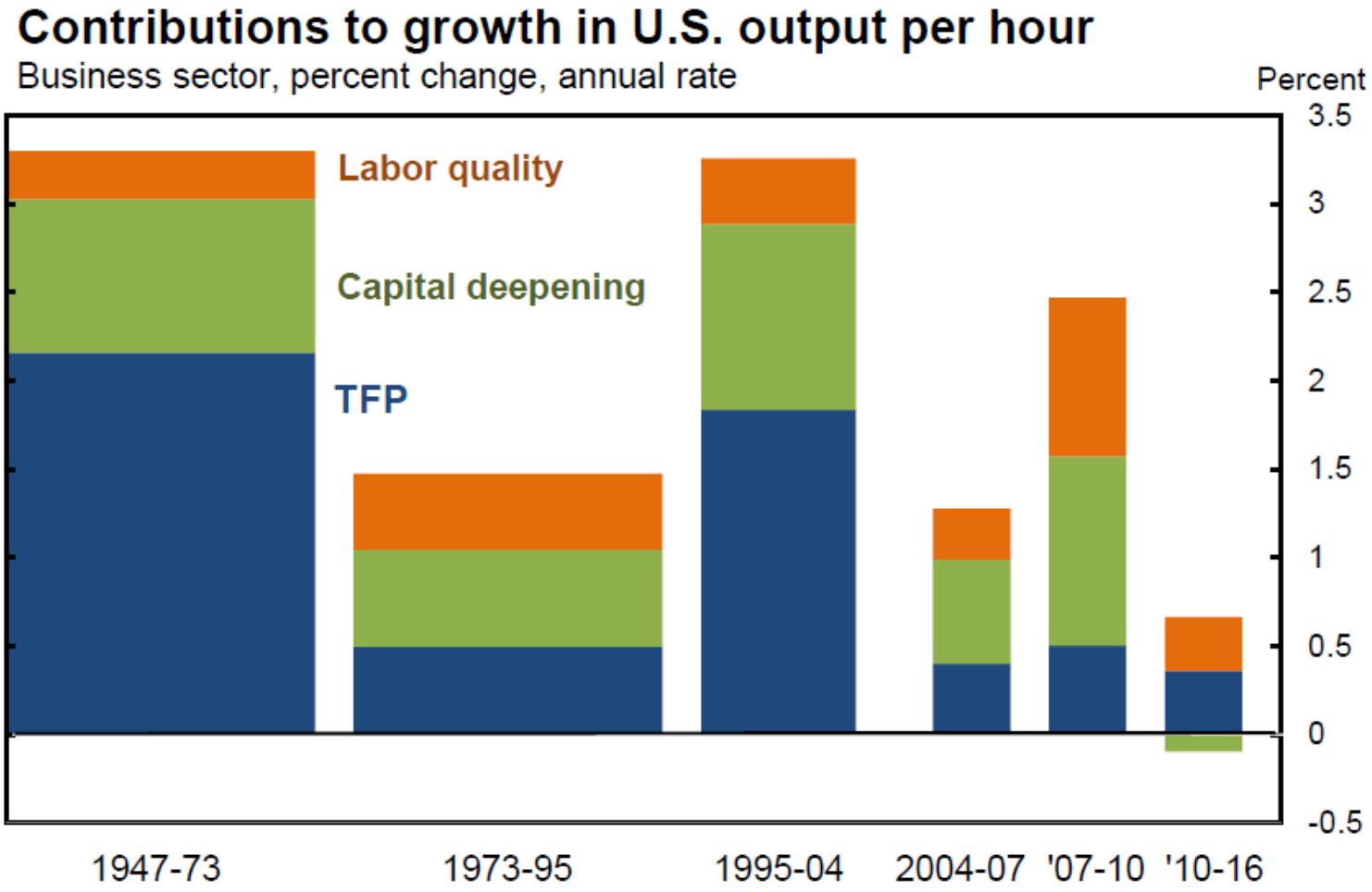

Figure: Weak Productivity Growth Since Early 2000s. (*Source: Fernald (2016)*).

Motivation and Questions

Several trends:

1. Secular stagnation (Summers (2015), Eichengreen (2015))
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Rise in intangibles

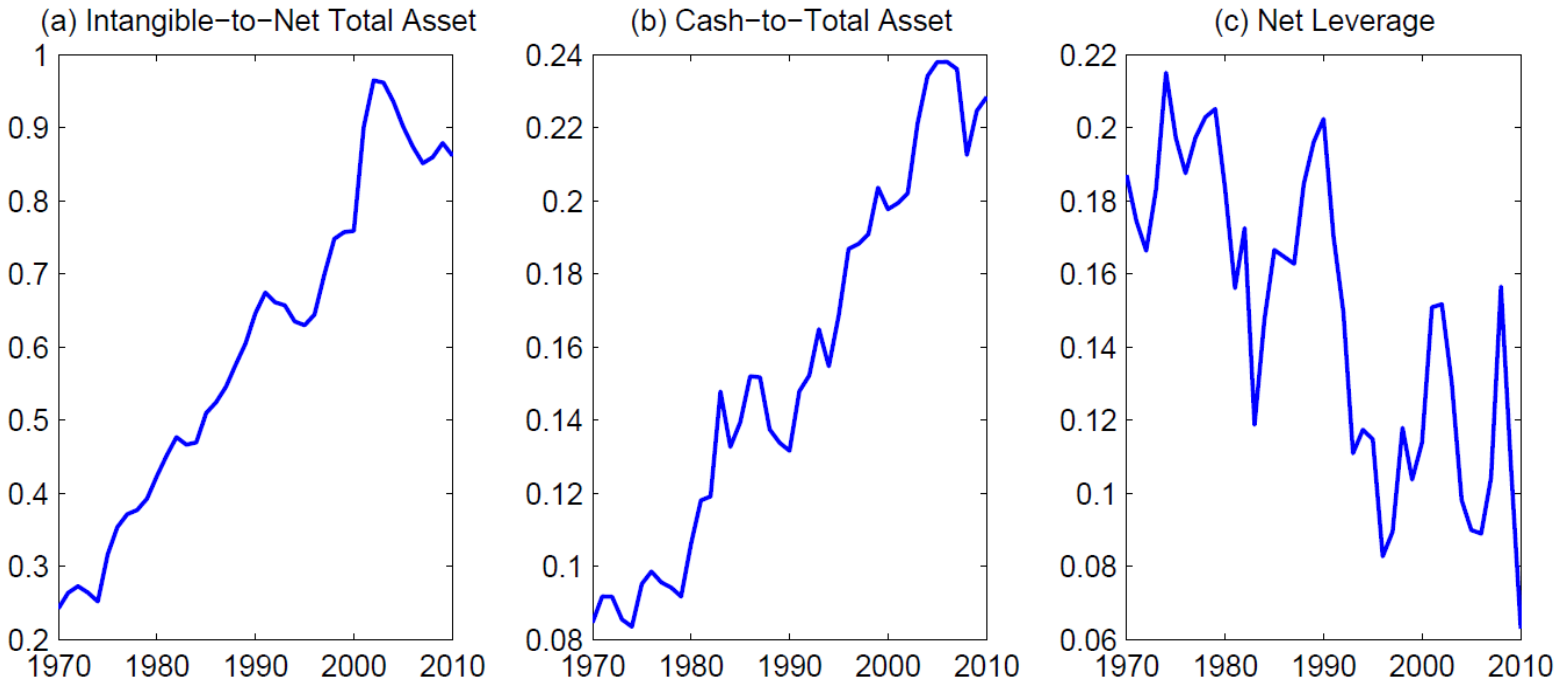

FIGURE: Rise in intangible intensity reduction in net leverage in U.S. non-financial listed firms (*Source: Falato, Kadyrzhanova and Sim (2014)*)

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Net Financial Position of the US Corporate Sector

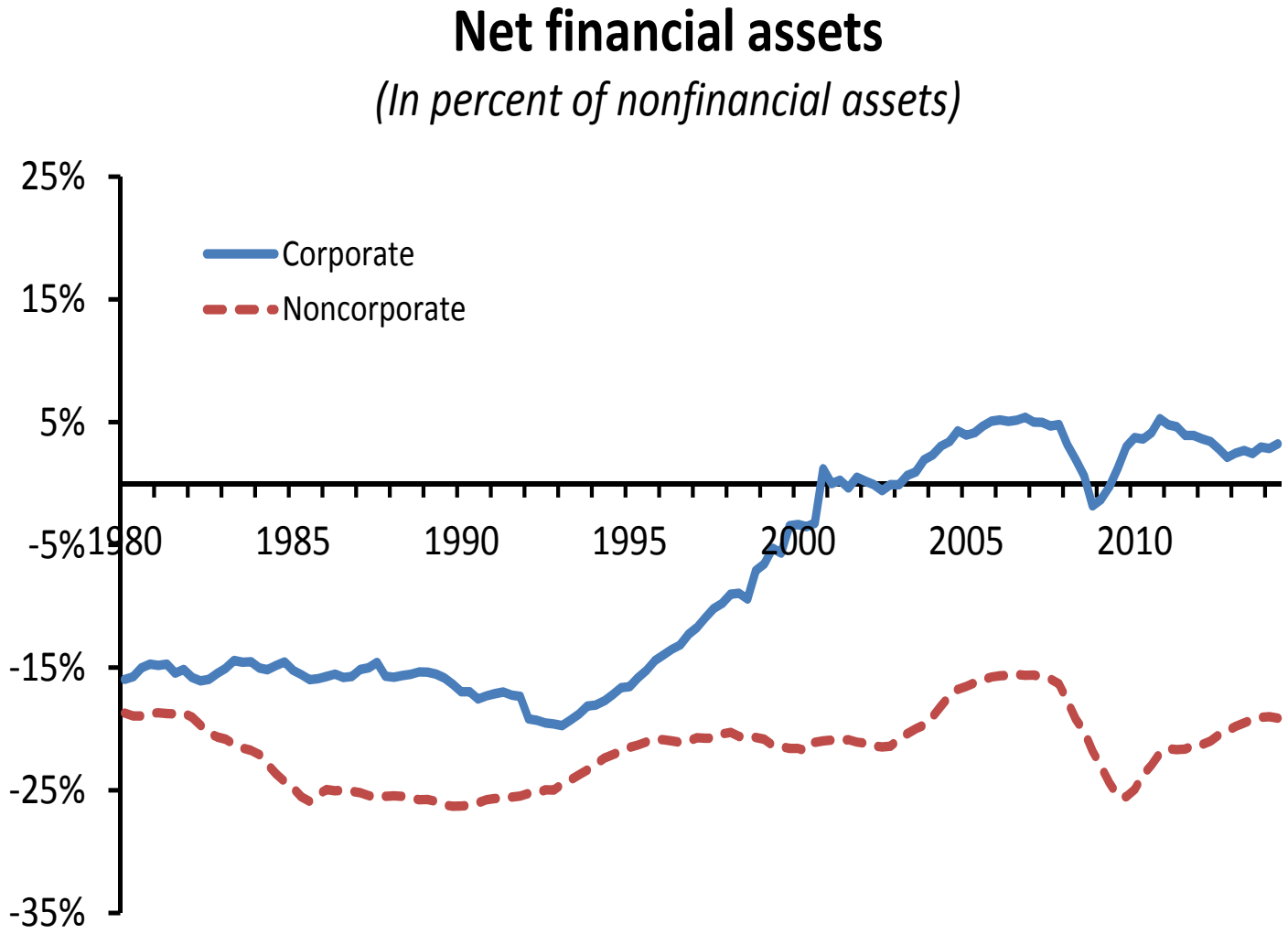

FIGURE: Net financial assets (assets minus liabilities) in the nonfinancial business sector as a percentage of nonfinancial assets. *Source: Quadrini (2014) and Flows of Funds Accounts.*

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Misallocation and Intangibles Intensity

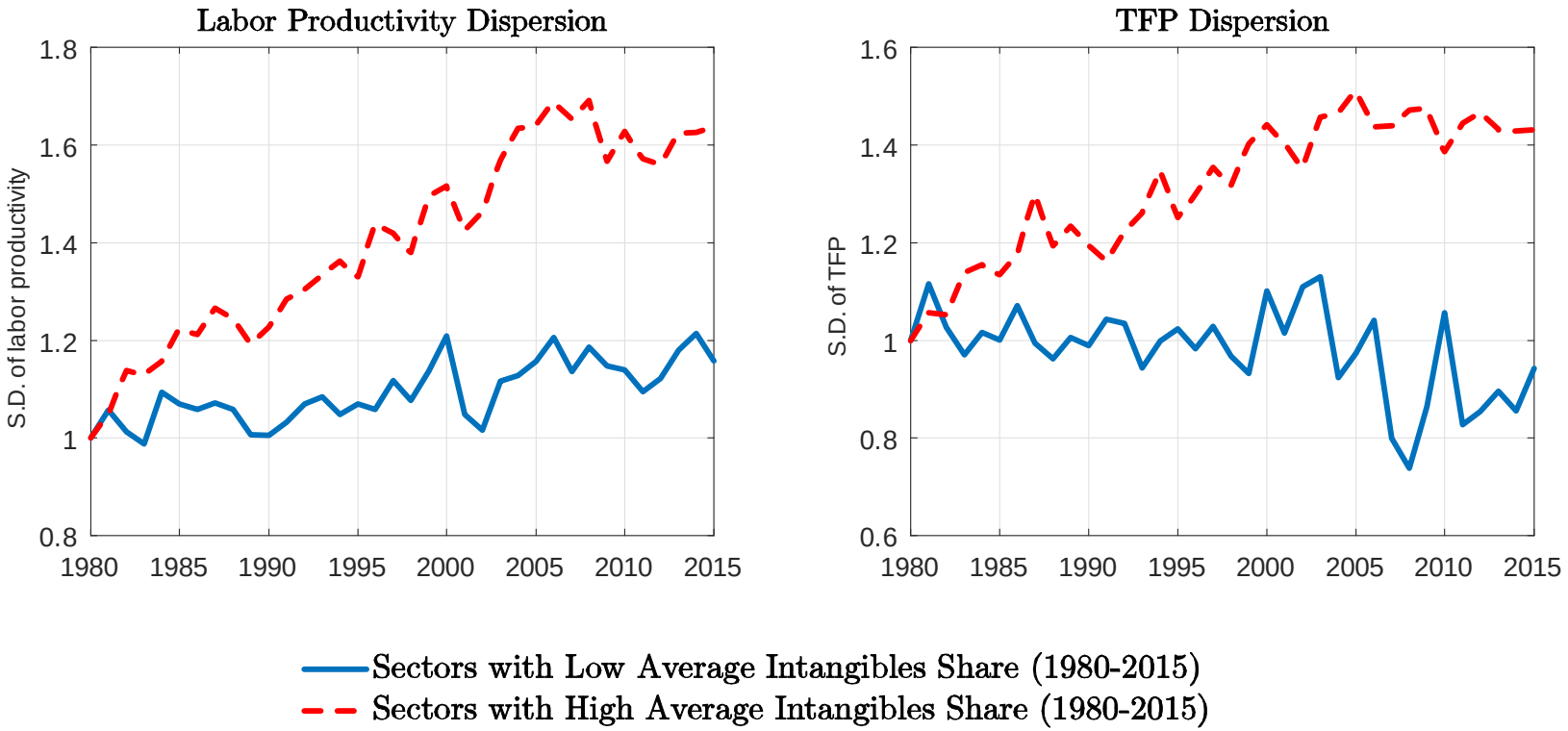

FIGURE: Mean labor productivity dispersion in low intangible vs high intangible industries (U.S. Compustat firms).

Main Insights

- Low interest rates can hurt capital reallocation, and as a result aggregate productivity and output, in economies that rely strongly on intangible technologies

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- Mechanism:
  - Intangible capital significantly less collateralizable than tangible capital: financed mostly with retained earnings
  - Low interest rates cause (i) high price of intangible assets, and (ii) slow accumulation of savings
  - Reduced ability of credit constrained expanding productive firms to purchase capital from exiting or unproductive firms: increased misallocation

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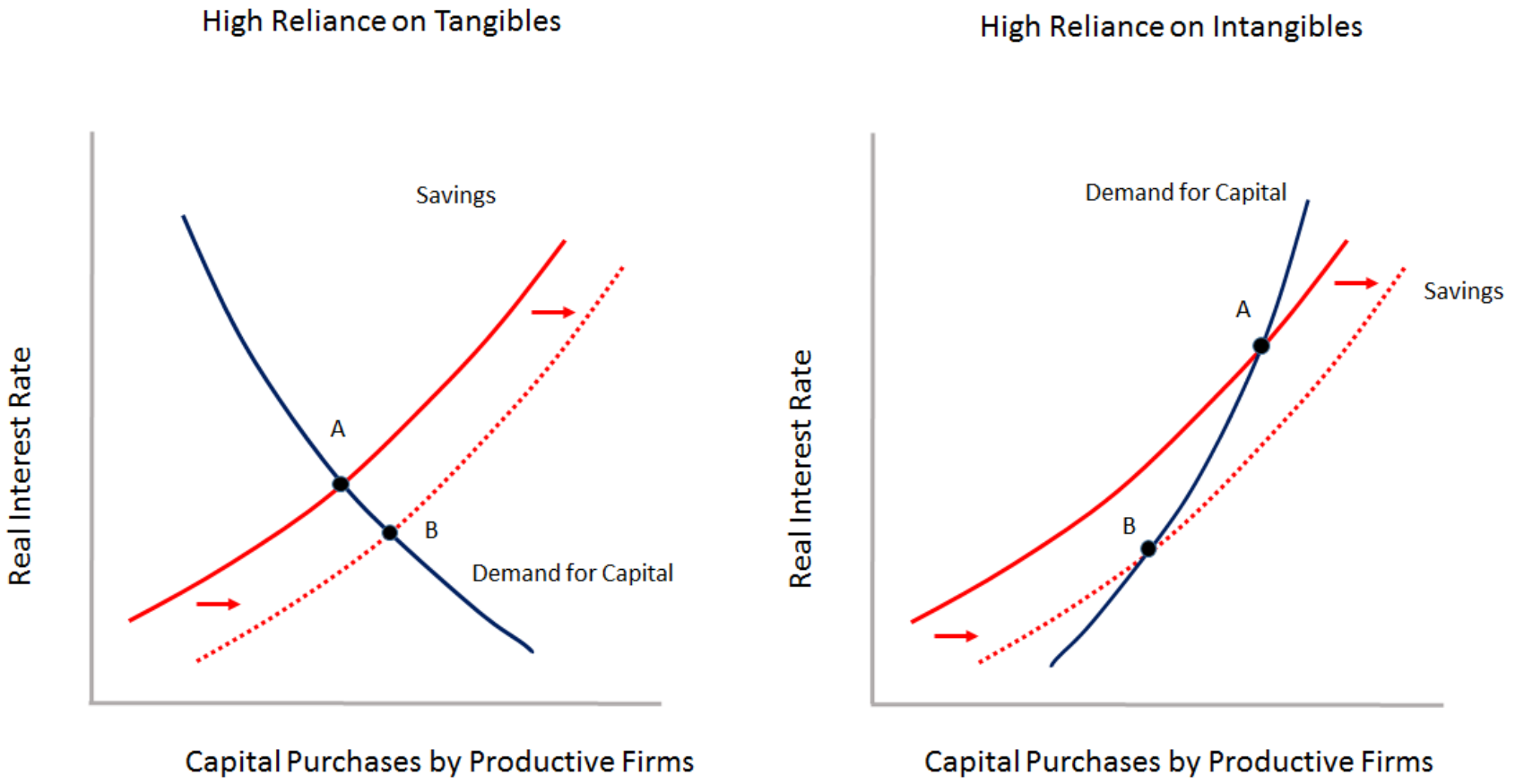
- Increase in share of intangible capital can itself be an important cause of decrease in interest rates (Dottling and Perotti (2014)), so it can hurt growth even in absence of other factors depressing rates

Graphical Intuition



- Demand for capital becomes upward sloping in interest rate with high intangibles reliance

Outline of Talk

1. **Model**
2. Simulations
    1. The Effect of a Rise in Households' Propensity to Save
    2. The Simultaneous Rise in Households' Propensity to Save and in Intangible Capital (1980-2015)

Model

- Infinite-horizon, discrete-time economy
- Agents
  - **Final good producers**
    - ⋆ use labor and tangible and intangible capital to produce consumption goods
    - ⋆ 2 types: *high-productivity* and *low-productivity*
  - **Capital producers**
  - **Households**
    - ⋆ provide labor and own firms
- No aggregate uncertainty: comparison of SS under different calibrations

High-Productivity Firms

- Produce consumption goods according to

$$y_t^p = z_t(\mu)\, n_t^{(1-\alpha)} \left[\min\left(\frac{k_{T,t}}{1-\mu}, \frac{k_{I,t}}{\mu} \right) \right]^{\alpha},$$

where $\mu = \frac{k_{I,t}}{k_{I,t}+k_{T,t}}$ captures optimal intangible capital ratio

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- Maximize PV dividends paid out to shareholders:

$$d_t = y_t^p - w_t n_t + (1+r_t)a_{f,t} - a_{f,t+1} - \sum_{j=T,I} q_{j,t}\left(k_{j,t+1} - (1-\delta)k_{j,t}\right)$$

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- Financial constraints
  - Unable to issue equity: $d_t \geq 0$.
  - Can issue one-period riskless debt, subject to:

$$a_{f,t+1} \geq -\frac{\theta^T q_{T,t+1}(1-\delta)\, k_{T,t+1} + \theta^I q_{I,t+1}(1-\delta)\, k_{I,t+1}}{1+r_{t+1}}$$

  - $\theta^T > \theta^I$

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- A firm enters a period with predetermined capital, and **produces**
- **Exit shock**: technology becomes useless with probability ψ each period
  - Firm liquidates all its capital, and pays out as dividends all of its savings, and exits
  - Replaced with new firm with no capital and small amount of wealth W_0

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- If firm survives, **investment shock**: only fraction η of firms can purchase capital (Kiyotaki and Moore (2012))

High-Productivity Firms: Value Function

- Investing firm value function

$$V_t^+(k_{I,t}, a_{f,t}) = \max_{a_{f,t+1}, k_{I,t+1}} d_t + \frac{1-\psi}{1+r_{t+1}} \eta V_{t+1}^+(k_{I,t+1}, a_{f,t+1}) + \frac{1-\psi}{1+r_{t+1}} (1-\eta) V_{t+1}^-(k_{I,t+1}, a_{f,t+1}) + \frac{\psi d_{t+1}^{exit}}{1+r_{t+1}}$$

- Non-investing firm value function

$$V_t^-(k_{I,t}, a_{f,t}) = \max_{a_{f,t+1}} d_t + \frac{1-\psi}{1+r_{t+1}} \eta V_{t+1}^+(k_{I,t+1}, a_{f,t+1}) + \frac{1-\psi}{1+r_{t+1}} (1-\eta) V_{t+1}^-(k_{I,t+1}, a_{f,t+1}) + \frac{\psi d_{t+1}^{exit}}{1+r_{t+1}}$$

High-Productivity Firms: Constrained Investment Choice

- Claim (check later) - in equilibrium marginal return of capital always higher than marginal cost:

$$\frac{\partial y^{p}_{t+1}}{\partial k_{I,t+1}} > \left(q_{T,t} \frac{1-\mu}{\mu} + q_{I,t} \right) - \frac{(1-\delta)\left(q_{T,t+1} \frac{1-\mu}{\mu} + q_{I,t+1} \right)}{1 + r_{t+1}}$$

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- Therefore, firms invest as much as possible, subject to a binding borrowing constraint:

$$\begin{aligned} k_{I,t+1} &= \frac{y^p_t - w_t n_t + (1+r_t) a_{f,t} + (1-\delta)\left(q_{T,t} \frac{1-\mu}{\mu} + q_{I,t} \right) k_{I,t}}{\left(q_{T,t} - \frac{(1-\delta)\theta^T q_{T,t+1}}{1+r_{t+1}} \right) \frac{1-\mu}{\mu} + q_{I,t} - (1-\delta)\theta^I \frac{q_{I,t+1}}{1+r_{t+1}}} \\ &= \frac{\text{Available wealth}}{\text{Downpayment}} \end{aligned}$$

High-Productivity Firms: Borrowing/Savings

- Firms always retain all earnings $(d_t = 0)$

- Investing firms borrow as much as possible:

$$a^+_{f,t+1} = -\left((1-\delta)\,\theta^T \frac{q_{T,t+1}}{1+r_{t+1}} \frac{1-\mu}{\mu} + (1-\delta)\,\theta^I \frac{q_{I,t+1}}{1+r_{t+1}} \right) k_{I,t+1} < 0$$

- And non-investing firms save as much as possible:

$$a^-_{f,t+1} = y^p_t + (1+r_t)a_{f,t} - w_t n_t$$

Rest of the Economy

- **Unproductive sector** of final good producers
  - financially unconstrained, absorb all capital not demanded by productive
  - marginal buyers, capital priced by them

- **Capital-producers**
  - representative financially unconstrained firm
  - produce tangible and intangible capital

- **Household sector**
  - Life-cycle with two types of households, young and old (measures H^y and H^o, $H^y + H^o = 1$)
  - Young households: work and receive dividends
  - Old households: cannot work, receive dividends, die with probability ϱ (Blanchard (1985) and Yaari (1965) framework))

Steady State

- Total amount of steady state intangible capital K_I held by the productive firms:

$$K_I = \frac{\eta(1-\psi)\left(\alpha z_t \left(\frac{K_I}{\mu}\right)^{\alpha} + (1+r)A_f\right) + \eta\psi W_0}{(Q-Q_\theta)\left[\delta + \psi(1-\delta)\right] - Q_\theta \eta(1-\delta)(1-\psi)},$$

where

$$\text{price of capital:} \qquad Q = q_T \frac{1-\mu}{\mu} + q_I$$

$$\text{collateral value of capital:} \qquad Q_\theta = q_T \frac{(1-\delta)\,\theta^T}{1+r} \frac{1-\mu}{\mu} + q_I \frac{(1-\delta)\,\theta^I}{1+r}$$

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Calibration

Parameter	Symbol	Value
Capital share	α	0.4
Low-productivity firms, TFP tangible technology	$z_t^{u,T}$	10
Low-productivity firms, TFP tangible technology	$z_t^{u,I}$	10
Years households remain young	N	40
High-productivity firms, TFP	z	25
Collateral value of tangible capital	θ^T	1
Collateral value of intangible capital	θ^I	0.35
Probability of an investment opportunity	η	0.13
Additional productivity of intangible capital	κ	0.1
Adjustment cost convexity	φ	9
Exit probability of high-productivity firms	ψ	0.13
Endowment of new firms	W_0	5
Depreciation of capital	δ	0.15
Share of dividends to young households	γ	40%

Rise in Intangibles and Increase in Household Net Savings (U.S. 1970s-present)

1. Increase in firms' reliance on intangible capital

- Follow Corrado and Hulten (2010a), Falato et al (2013), Döttling and Perotti (2015):
  - from $\mu = 0.2$, 1970s ratio of intangible to tangible of 20%
  - to $\mu = 0.6$ 2010's ratio of intangible to tangible 60%
  - Shortcut for endogenous process of adoption of more productive technologies

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2. Household sector increase in net savings

- Captures demand side factors such as demographic forces, higher inequality, and higher saving by emerging market governments, over last three decades (Rachel and Smith, 2015)
- Increase in longevity and decrease in rate of time preference
- Achieve transition from 6% to 0% real interest rate

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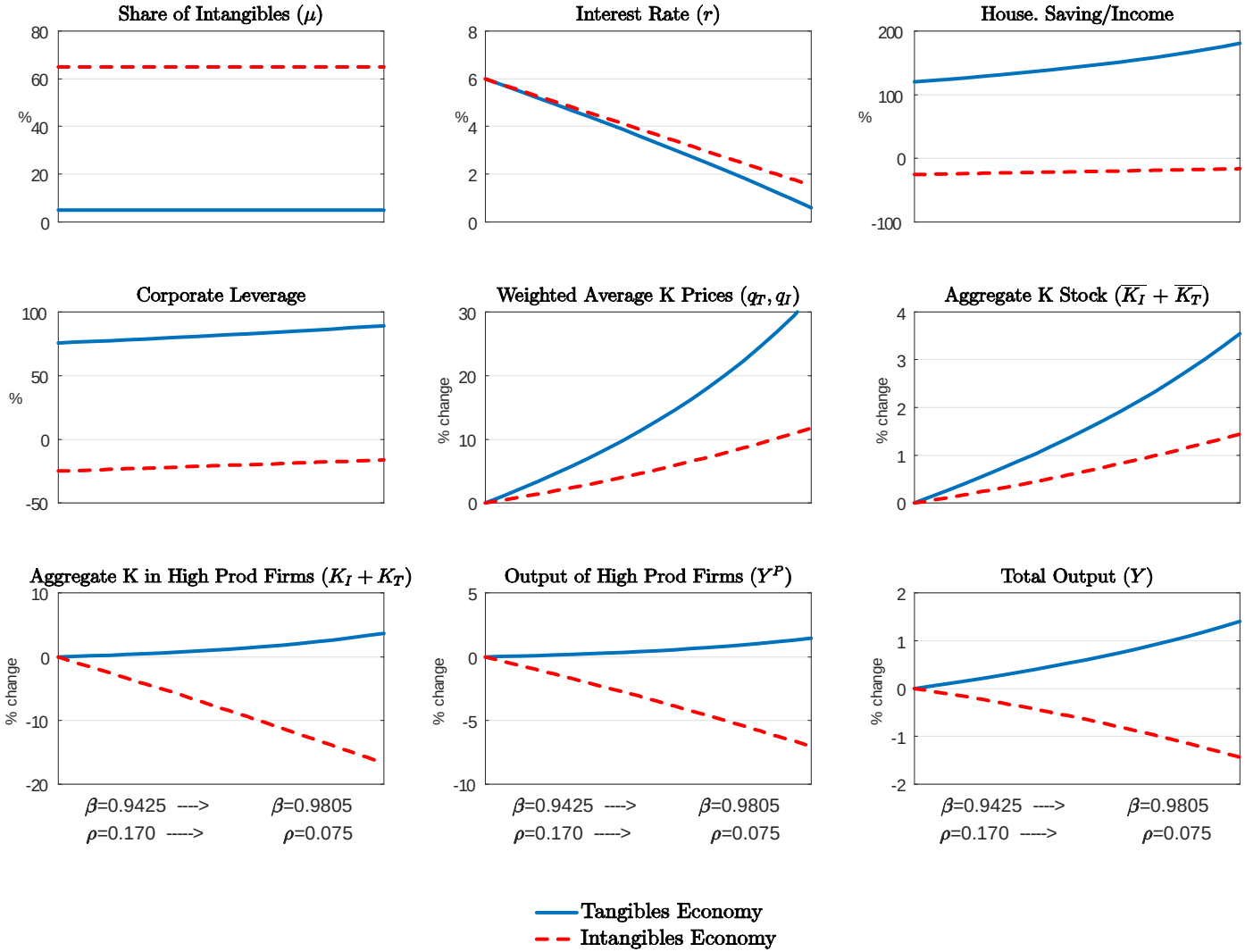
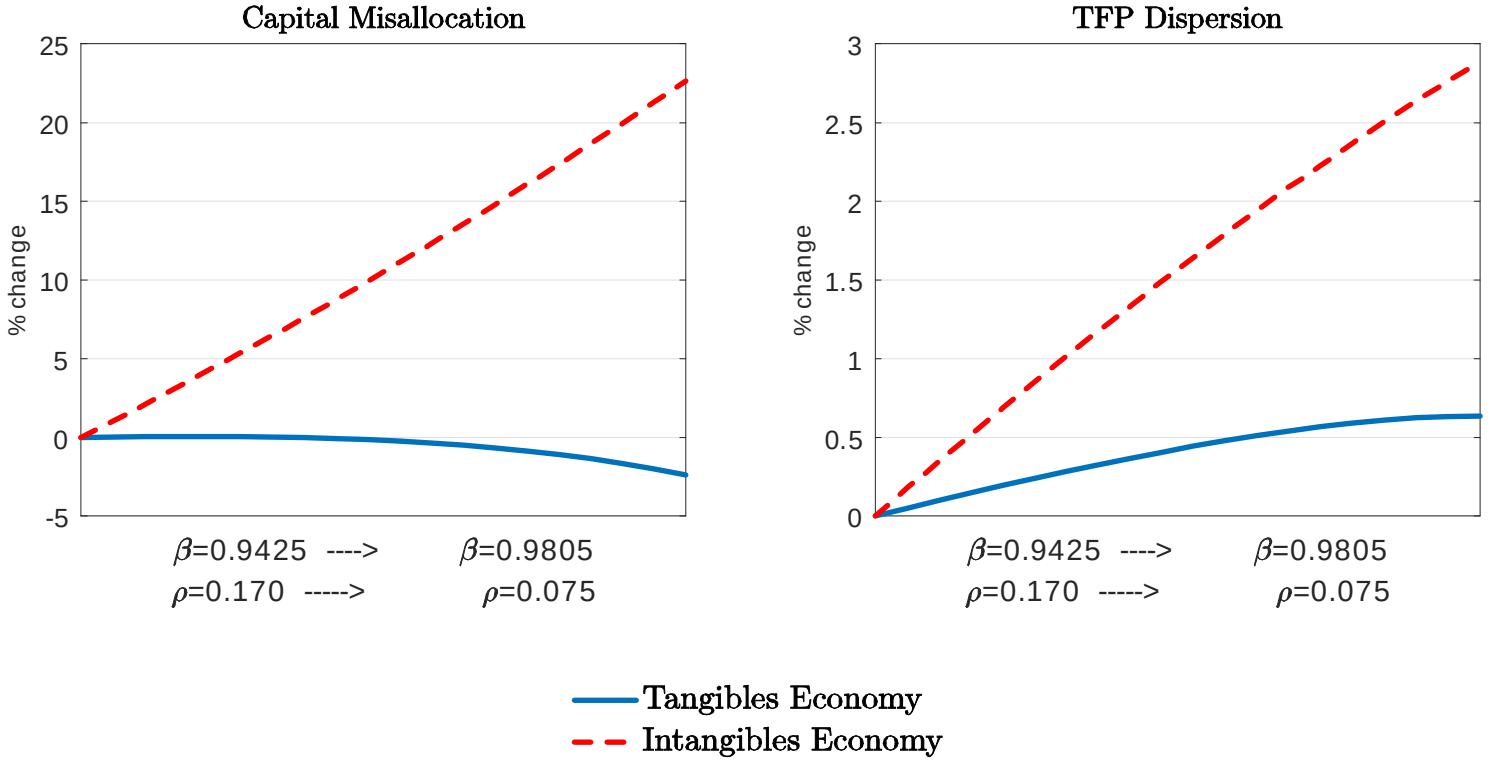
Increase in Household Savings



Households' propensity to save gradually increases: comparison of effects in a tangibles economy ($\mu = 0.05$) and an intangibles economy ($\mu = 0.65$)

Increase in Household Savings



Households' propensity to save gradually increases: comparison of capital misallocation and TFP dispersion in a tangibles economy ($\mu = 0.05$) and an intangibles economy ($\mu = 0.65$)

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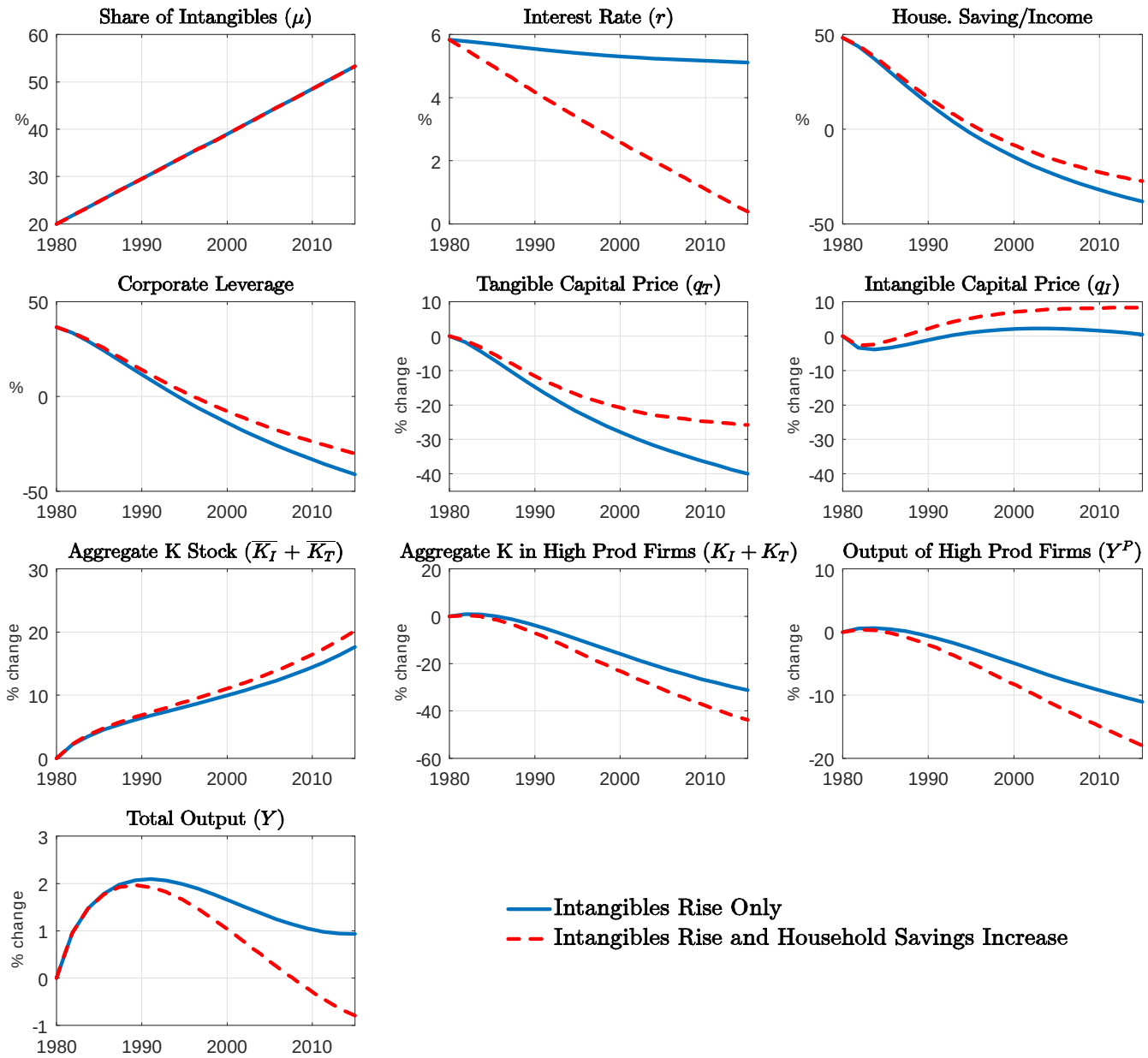
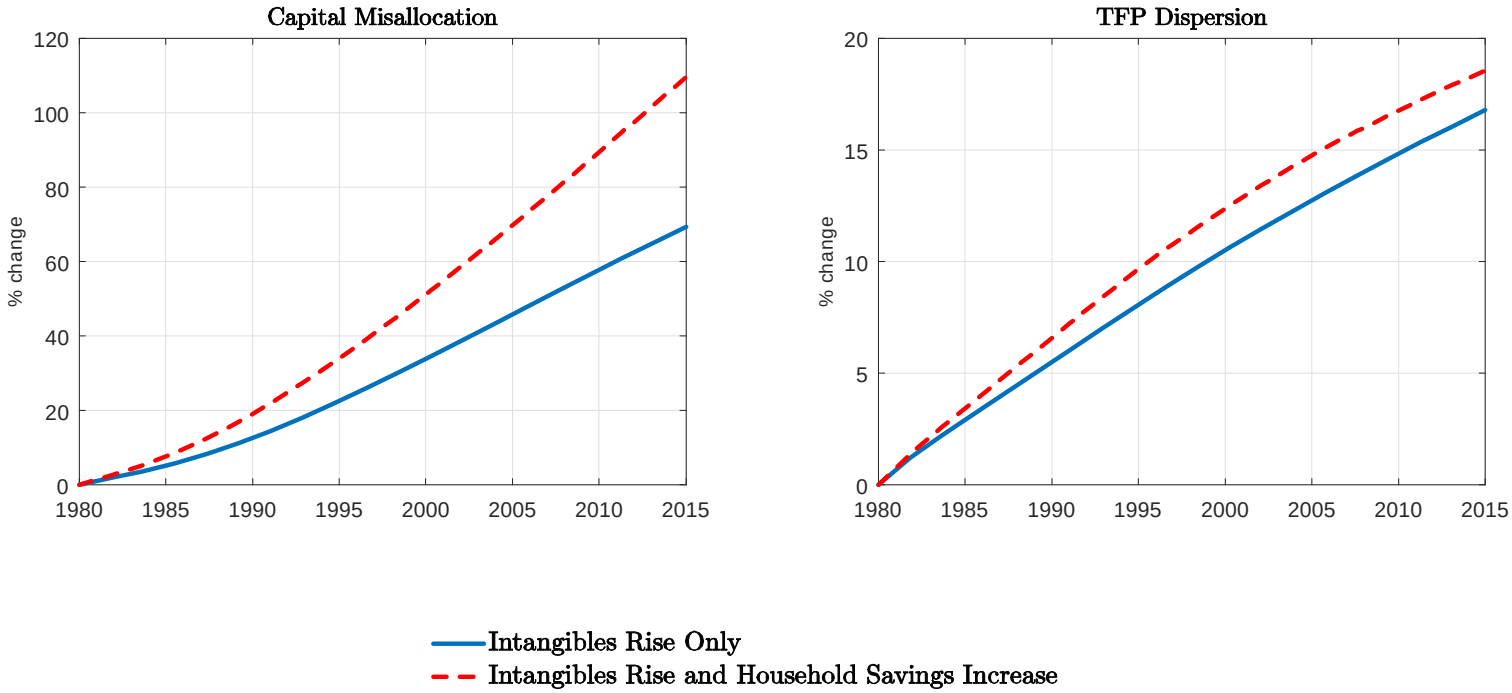
Rise in Household Savings and in Intangibles



Households' propensity to save and share of intangible capital both gradually increase

Rise in Household Savings and in Intangibles



Households' propensity to save and share of intangible capital both gradually increase - comparison of capital misallocation and TFP dispersion when both trends occur and when only increase in share of intangible capital occurs

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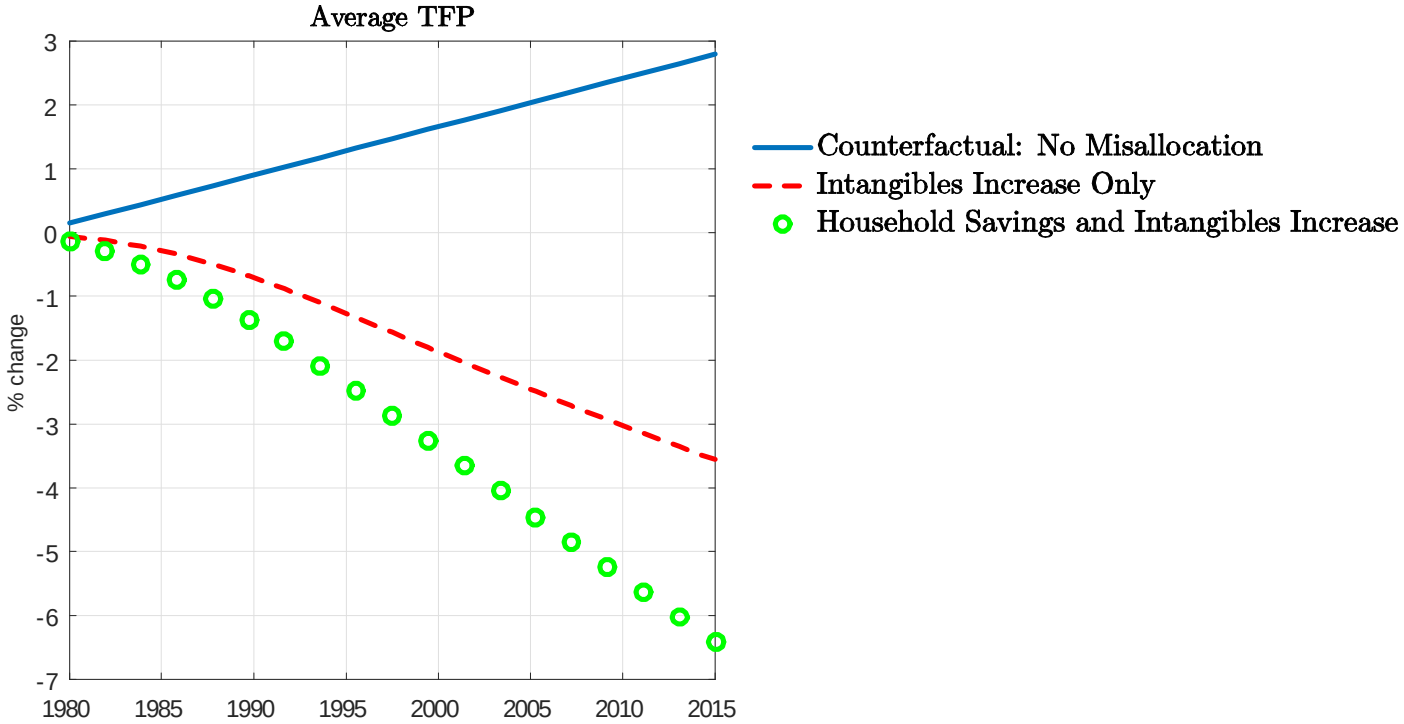

Households' propensity to save and share of intangible capital both gradually increase - comparison of effects on TFP when both trends occur, when only increase in share of intangible occurs, and in counterfactual partial equilibrium scenario

Conclusion

- Changes in firms' financing behavior brought about by technological evolution might help explain the subpar growth associated with secular stagnation
- These changes interact with low interest rates behind secular stagnation to amplify negative effects
- Insights could be extended to develop interesting policy implications: negative externality in households' and firms' saving decisions might introduce a role for a fiscal policy that discourages such saving