Capital Misallocation and Secular Stagnation

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Can low real interest rates be contractionary?
Question

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Secular stagnation hypothesis

Can low real interest rates be contractionary?

Secular stagnation hypothesis


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
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


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

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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)*)
Motivation and Questions

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Net Financial Position of the US Corporate Sector

Net financial assets
(In percent of nonfinancial assets)

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

 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.

- 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.
Demand for capital becomes upward sloping in interest rate with high intangibles reliance.
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)
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.
High-Productivity Firms

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- Maximize PV dividends paid out to shareholders:

\[ d_t = y_t^p - w_t n_t + (1 + r_t) a_{f, t} - a_{f, t+1} - \sum_{j = T, L} q_{j, t} \left( k_{j, t+1} - (1 - \delta) k_{j, t} \right) \]
High-Productivity Firms

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

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

  - \( \theta^T > \theta^l \)
High-Productivity Firms

Given Leontief structure, optimal capital ratio is

\[ k_{T,t} = \frac{1 - \mu}{\mu} k_{I,t} \]
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**Firm dynamics and timing:**

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**Firm dynamics and timing:**

- A firm enters a period with predetermined capital, and *produces*
- **Exit shock:** technology becomes useless with probability \( \psi \) 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 \( W_0 \)
HIGH-PRODUCTIVITY FIRMS

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- If firm survives, investment shock: only fraction \( \eta \) of firms can purchase capital (Kiyotaki and Moore (2012))
HIGH-PRODUCTIVITY FIRMS: VALUE FUNCTION

Investing firm value function

\[ V_t^+(k_{I,t}, a_{f,t}) = \max_{a_{f,t+1}, k_{I,t+1}} \left( d_t + \frac{1 - \psi}{1 + r_{t+1}} \eta V_{t+1}^+(k_{I,t+1}, a_{f,t+1}) \right) \]

\[ + \frac{1 - \psi}{1 + r_{t+1}} (1 - \eta) V_{t+1}^-(k_{I,t+1}, a_{f,t+1}) + \frac{\psi d^{exit}_{t+1}}{1 + r_{t+1}} \]

Non-investing firm value function

\[ V_t^-(k_{I,t}, a_{f,t}) = \max_{a_{f,t+1}} \left( d_t + \frac{1 - \psi}{1 + r_{t+1}} \eta V_{t+1}^+(k_{I,t+1}, a_{f,t+1}) \right) \]

\[ + \frac{1 - \psi}{1 + r_{t+1}} (1 - \eta) V_{t+1}^-(k_{I,t+1}, a_{f,t+1}) + \frac{\psi d^{exit}_{t+1}}{1 + r_{t+1}} \]
High-Productivity Firms: Constrained Investment Choice

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

\[
\frac{\partial y^p_{t+1}}{\partial k_I,t+1} > \left( qT,t \frac{1-\mu}{\mu} + qI,t \right) - \frac{(1-\delta) \left( qT,t+1 \frac{1-\mu}{\mu} + qI,t+1 \right)}{1 + r_{t+1}}
\]
HIGH-PRODUCTIVITY FIRMS: CONSTRAINED INVESTMENT CHOICE

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\]

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

\[
k_{I,t+1} = \frac{y^p_t - w_t n_t + (1+r_t) a_{f,t} + (1-\delta) \left( q_T,t \frac{1-\mu}{\mu} + q_{I,t} \right) k_{I,t}}{\left( q_T,t - \frac{(1-\delta) \theta^T q_T,t+1}{1+r_{t+1}} \right) \frac{1-\mu}{\mu} + q_{I,t} - (1-\delta) \theta^I q_{I,t+1} \frac{1}{1+r_{t+1}}} = \frac{\text{Available wealth}}{\text{Downpayment}}
\]
Firms always retain all earnings \( d_t = 0 \)

Investing firms borrow as much as possible:

\[
a_{f,t+1}^+ = - \left( (1 - \delta) \theta^T \frac{q_T,t+1}{1 + r_{t+1}} \frac{1 - \mu}{\mu} + (1 - \delta) \theta^l \frac{q_l,t+1}{1 + r_{t+1}} \right) k_{l,t+1} < 0
\]

And non-investing firms save as much as possible:

\[
a_{f,t+1}^- = y_t^p + (1 + r_t) a_{f,t} - w_t n_t
\]
**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 $\varphi$
    (Blanchard (1985) and Yaari (1965) framework)
Total amount of steady state intangible capital $K_I$ held by the productive firms:

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

where

price of capital: \[ Q = q_T \frac{1 - \mu}{\mu} + q_I \]

collateral value of capital: \[ Q_\theta = q_T \frac{(1 - \delta) \theta^T}{1 + r} \frac{1 - \mu}{\mu} + q_I \frac{(1 - \delta) \theta^I}{1 + r} \]
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)
## Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital share</td>
<td>$\alpha$</td>
<td>0.4</td>
</tr>
<tr>
<td>Low-productivity firms, TFP tangible technology</td>
<td>$z^u_T$</td>
<td>10</td>
</tr>
<tr>
<td>Low-productivity firms, TFP tangible technology</td>
<td>$z^u_l$</td>
<td>10</td>
</tr>
<tr>
<td>Years households remain young</td>
<td>$N$</td>
<td>40</td>
</tr>
<tr>
<td>High-productivity firms, TFP</td>
<td>$z$</td>
<td>25</td>
</tr>
<tr>
<td>Collateral value of tangible capital</td>
<td>$\theta^T$</td>
<td>1</td>
</tr>
<tr>
<td>Collateral value of intangible capital</td>
<td>$\theta^I$</td>
<td>0.35</td>
</tr>
<tr>
<td>Probability of an investment opportunity</td>
<td>$\eta$</td>
<td>0.13</td>
</tr>
<tr>
<td>Additional productivity of intangible capital</td>
<td>$\kappa$</td>
<td>0.1</td>
</tr>
<tr>
<td>Adjustment cost convexity</td>
<td>$\varphi$</td>
<td>9</td>
</tr>
<tr>
<td>Exit probability of high-productivity firms</td>
<td>$\psi$</td>
<td>0.13</td>
</tr>
<tr>
<td>Endowment of new firms</td>
<td>$W_0$</td>
<td>5</td>
</tr>
<tr>
<td>Depreciation of capital</td>
<td>$\delta$</td>
<td>0.15</td>
</tr>
<tr>
<td>Share of dividends to young households</td>
<td>$\gamma$</td>
<td>40%</td>
</tr>
</tbody>
</table>
Rise in Intangibles and Increase in Household Net Savings (U.S. 1970s-present)

1. Increase in firms’ reliance on intangible capital


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

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     - Shortcut for endogenous process of adoption of more productive technologies

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
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)
Households’ propensity to save gradually increases: comparison of effects in a tangibles economy (μ = 0.05) and an intangibles economy (μ = 0.65)
Households’ propensity to save gradually increases: comparison of capital misallocation and TFP dispersion in a tangibles economy ($\mu = 0.05$) and an intangibles economy ($\mu = 0.65$)
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)
Rise in Household Savings and in Intangibles

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