Declining Labor and Capital Shares

Job Market Paper 2017

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UC3M Macro Reading Group

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Motivation

- Previous work on the **decline of the LS** highlights it as an **efficient outcome**:
  

- **Perfect competition:**

  \[
  Y = rK + wL \quad \Rightarrow \quad 1 = \frac{rK}{Y} \uparrow + \frac{wL}{Y} \downarrow
  \]

- **Imperfect competition:**

  \[
  Y = rK + wL + \pi \quad \Rightarrow \quad 1 = \frac{rK}{Y} \uparrow\downarrow? + \frac{wL}{Y} \downarrow + \frac{\pi}{Y} \uparrow\downarrow?
  \]
Motivation

- Previous work on the decline of the LS highlights it as an efficient outcome:

- Perfect competition:
  \[ Y = rK + wL \Rightarrow 1 = \frac{rK}{Y} \uparrow + \frac{wL}{Y} \downarrow \]

- Imperfect competition:
  \[ Y = rK + wL + \pi \Rightarrow 1 = \frac{rK}{Y} \downarrow + \frac{wL}{Y} \downarrow + \frac{\pi}{Y} \uparrow \]

This paper...

Documents a joint decline of the Capital Share (KS) and the Labor Share (LS) while profits increase. How? Decline in competition.
Contribution

- Construct series of capital costs \( (rK) \) and the KS.
  - From 1980 find a decline of both KS (30%) and LS (10%) which is jointly offset by an increase in share of profits.

- Build on Karabarbounis and Neiman (2014) to provide a theoretical framework consistent with previous findings.

- Model results:
  - Successful match of empirically measured declines in KS and LS when calibrated to an increase in the markup from 2.5% (1984) to 21% (2014) and decline in real interest rate from 8.5% to 1.25%.
  - Gains of increasing competition to its 1984 level: 10% increase in output, 24% increase in wages, 19% increase in investment.
Data: The capital share

- Compute series of capital costs following Hall and Jorgenson (1967)

  Capital costs = \frac{\text{Required rate of return}}{\text{Value of the capital stock}}

- Required rate of return of capital type $s$:

  \[
  R_s = i^D - E[\pi_s] + \delta_s \tag{1}
  \]

  \[
  R_s = \left( \frac{D}{D + E} i^D + \frac{E}{D + E} i^E \right) - E[\pi_s] + \delta_s \tag{2}
  \]

  \[
  R_s = \left[ \left( \frac{D}{D + E} i^D (1 - \tau) + \frac{E}{D + E} i^E \right) - E[\pi_s] + \delta_s \right] \frac{1 - z_s \tau}{1 - \tau} \tag{3}
  \]

  where $i^D$ is the cost of debt borrowing in financial markets, $D$ is market value of debt, $i^E$ is the equity cost of capital, $E$ is market value of equity, $\tau$ is the corporate income tax rate and $z_s$ is the net present value of depreciation allowances of capital of type $s$. 
Data: The capital share

- Capital costs for capital of type $s$

$$E_s = R_s P_s^K K_s$$

- Aggregate capital costs

$$E = \sum_s R_s P_s^K K_s = \sum_s \left( \sum_j P_s^K K_j \right) R_s \times \sum_s \left( \sum_{P^K K} \right)$$

- Capital share

$$S^K = \frac{E}{PYY}$$
Data: Results

(a) Cost of Capital

(b) Expected Inflation

(c) Depreciation Rate

(d) Required Rate of Return
Data: Results

Figure: Capital Share
## Data: Results

**Table:** Time Trends of Labor, Capital and Profits, 1984 - 2014. BEA Data.

<table>
<thead>
<tr>
<th>Required Rate of Return</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decline in Labor Share</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Decline in Required Rate of Return</td>
<td>39%</td>
<td>34%</td>
<td>31%</td>
</tr>
<tr>
<td>Decline in Capital Share</td>
<td>30%</td>
<td>25%</td>
<td>20%</td>
</tr>
<tr>
<td>Increase in Profit Share</td>
<td>13.5pp</td>
<td>13.1pp</td>
<td>12.2pp</td>
</tr>
<tr>
<td>Increase in Profits per Employee</td>
<td>$14.4 (thousand)</td>
<td>$13.9 (thousand)</td>
<td>$13.0 (thousand)</td>
</tr>
<tr>
<td>Increase in Break-even Capital-to-Output</td>
<td>492pp</td>
<td>235pp</td>
<td>232pp</td>
</tr>
<tr>
<td>Value of Increase in Break-Even Capital</td>
<td>$42.5 (trillion)</td>
<td>$20.3 (trillion)</td>
<td>$20.0 (trillion)</td>
</tr>
</tbody>
</table>

(1) \[ R_s = i^D - \mathbb{E} [\pi_s] + \delta_s \]

(2) \[ R_s = \left( \frac{D}{D+E} i^D + \frac{E}{D+E} i^E \right) - \mathbb{E} [\pi_s] + \delta_s \]

(3) \[ R_s = \left[ \left( \frac{D}{D+E} i^D (1 - \tau) + \frac{E}{D+E} i^E \right) - \mathbb{E} [\pi_s] + \delta_s \right] \frac{1 - z_s \tau}{1 - \tau} \]
Table: Time Trends of Labor, Capital and Profits, 1984 - 2014. Robustness different databases.

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<td>31 - 39%</td>
<td>34 - 38%</td>
<td>35 - 40%</td>
</tr>
<tr>
<td>Decline in Capital Share</td>
<td>20% - 30%</td>
<td>32% - 36%</td>
<td>35% - 40%</td>
</tr>
<tr>
<td>Increase in Profit Share</td>
<td>12.2pp - 13.5pp</td>
<td>15.8pp - 17.6pp</td>
<td>18.3pp - 20.2pp</td>
</tr>
<tr>
<td>Increase in Profits per Employee</td>
<td>$13.0 - $14.4</td>
<td>$16.7 - $18.6</td>
<td>$19.4 - $21.4</td>
</tr>
<tr>
<td></td>
<td>(thousand)</td>
<td>(thousand)</td>
<td>(thousand)</td>
</tr>
</tbody>
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(1) BEA Fixed Asset Tables
(2) Integrated Macroeconomic Accounts for the Unites States, real state valued at market prices.
(3) Integrated Macroeconomic Accounts for the Unites States, real state valued at market prices and inventories are included.
Model: Final goods (Corporate Sector)

- Based on Karabarbounis and Neiman (2014).
- Corporate sector (final goods producer) made up of a unit measure of firms, each producing a differentiated intermediate $y_i$.
- Final good produced in perfect competition with production function

\[
Y_t = \left( \int_0^1 \frac{y_{i,t}^{-1}}{y_{i,t}^\varepsilon} \, di \right)^{\frac{\varepsilon_t}{\varepsilon_t-1}}
\]

- Cost minimization yields conditional factor demand for intermediate $i$

\[
D_t(p_{i,t}) = Y_t \left( \frac{p_{i,t}}{\lambda_t} \right)^{-\varepsilon_t}
\]

where

\[
\lambda_t = \left( \int_0^1 p_{i,t}^{1-\varepsilon_t} \, di \right)^{\frac{1}{1-\varepsilon_t}} = P_t^Y
\]
Firm \( i \) produces \( y_{i,t} \) using CRS production function \( y_{i,t} = f_t(k_{i,t}, \ell_{i,t}) \).

**Timing:**
- At \( t - 1 \) issue one-period nominal bond to buy \( k_{i,t} \) at price \( P_{t-1}^K \). At \( t \) produce, repay face value of debt and sell undepreciated capital at \( P_t^K \).

**Given demand for intermediate \( i \), profits of Firm \( i \) are given by**

\[
\pi_{i,t} = \max_{k_{i,t}, \ell_{i,t}} p_{i,t} y_{i,t} - (1 + i_t) P_{t-1}^K k_{i,t} - w_t \ell_{i,t} + (1 - \delta_t) P_t^K k_{i,t}
\]

\[
= \max_{k_{i,t}, \ell_{i,t}} p_{i,t} y_{i,t} + R_t P_{t-1}^K k_{i,t} - w_t \ell_{i,t}
\]

where

\[
R_t = i_t - (1 - \delta_t) \frac{P_t^K - P_{t-1}^K}{P_{t-1}^K} + \delta_t
\]

**Let \( \mu_t = \frac{\epsilon_t}{\epsilon_t - 1} \), then the FOC of the profit maximization problem are**

\[
p_{i,t} \frac{\partial f_t}{\partial k_{i,t}} = \mu_t R_t P_{t-1}^K \quad \text{and} \quad p_{i,t} \frac{\partial f_t}{\partial \ell_{i,t}} = \mu_t w_t\]
Model: Households

- Infinitely lived representative HH with preferences
  \[
  \sum_t \beta^t U(C_t, L_t)
  \]

- Savings technology in a nominal bond: invest 1 dollar in period \( t \), obtain \( 1 + i_{t+1} \) in period \( t + 1 \).

- Let \( \Pi_t \) be the time \( t \) profits of the corporate sector and \( a_0 \) be the initial nominal wealth. The lifetime budget constraint is given by
  \[
  \sum_t \left[ \prod_{s \leq t} (1 + i_s)^{-1} \right] P_t^Y C_t = a_0 + \sum_t \left[ \prod_{s \leq t} (1 + i_s)^{-1} \right] (w_t L_t + \Pi_t)
  \]

- Assume all agents have access to a technology that transforms capital into output at a ratio of 1 : \( \kappa_t \). Arbitrage implies
  \[
  P_t^K \kappa_t = P_t^Y \cdot 1
  \]

- Aggregate resource constraint of the economy is given by
  \[
  P_t^Y Y_t = P_t^Y C_t + P_t^K [K_{t+1} - (1 - \delta)K_t]
  \]
Model: Equilibrium

**Equilibrium**

An equilibrium is a vector of prices \((i^*_t, w^*_t)_{i \in \mathbb{N}}\) that satisfy the aggregate resource constraint and clears the labor market, the capital market and the market for consumption goods.

**Implications (already in KN)**

Since all firms face the same factor costs and produce using the same technology, in equilibrium they produce the same quantity of output \(y_{i,t} = Y_t\) and sell this output at the same per-unit price \(p_{i,t} = P^Y_t\).
Proposition 1

*When markups are fixed, any decline in the labor share must be offset by an equal increase in the capital share.*

- **The proposition holds in equilibrium**, not only in steady state.
- **Implications:**
  - **TFP.** Consider homogeneous of constant degree
    \[
    f_t(k, \ell) = A_t f(k, \ell)
    \]
    then changes in \( A_t \) do not affect combined shares of capital and labor.
  - **Biased technical change.** Consider
    \[
    f_t(k, \ell) = \left( \alpha_K (A_{K,t} k)^{\frac{\sigma-1}{\sigma}} + (1 - \alpha_K) (A_{L,t} \ell)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}
    \]
    then biased technical change does not affect combined shares of capital and labor.
  - **Relative prices.** Decline in price of capital (or labor) does not affect combined shares of capital and labor.
Model: Calibration

Functional form specifications:

\[ y_{i,t} = \left( \alpha_K (A_K, t k_{i,t}) \frac{\sigma - 1}{\sigma} + (1 - \alpha_K)(A_L, t \ell_{i,t}) \frac{\sigma - 1}{\sigma} \right) \frac{\sigma}{\sigma - 1} \]

\[ U(C_t, L_t) = \log C_t - \gamma \frac{\theta}{1 + \theta} L_t^{\frac{1+\theta}{\theta}} \]

Calibration

- \( \kappa_t = 1, \forall t \) and \( \delta \) matched to average depreciation,
- \( \sigma \in \{0.4, 0.5, 0.6, 0.7\} \),
- \( \alpha_K, A_K \) and \( A_L \) chosen to match the LS and \( K/Y \) in 1984, and to equate the level of output across different elasticities of substitution,
- \( \beta \) chosen to match real interest rate,
- \( \theta \) (governs Frisch elasticity of labor supply) is set at 0.5,
- \( \gamma \) normalized to equate SS labor supply across different specifications.
First exercise is **backward looking**. Feed calibration into the model and check consistency with the reality.

- In the data, the markup increase from 2.5% in 1984 to 21% in 2014. Therefore, in the model, set \( \mu_{1984} = 1 + 0.025 \) and \( \mu_{2014} = 1 + 0.21 \), which implies \( \varepsilon_{1984} = \frac{1.025}{1.025 - 1} = 41 \) and \( \varepsilon_{2014} = \frac{1.21}{1.21 - 1} \approx 5.76 \).

- To match observed change in the real interest rate, set \( \beta_{1984} = 1.085^{-1} \) (real interest rate of 8.5%) and \( \beta_{2014} = 1.0125^{-1} \) (real interest rate of 1.25%).

Second exercise is **forward looking**. Staring in 2014 steady state, reduce markups to its 1984 level while keeping interest rates constant.
## Model: Results

<table>
<thead>
<tr>
<th></th>
<th>$\sigma = 0.4$</th>
<th>$\sigma = 0.5$</th>
<th>$\sigma = 0.6$</th>
<th>$\sigma = 0.7$</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Backward Looking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor Share</td>
<td>-9.5</td>
<td>-10.4</td>
<td>-11.3</td>
<td>-12.2</td>
<td>-10.3</td>
</tr>
<tr>
<td>Capital Share</td>
<td>-30.6</td>
<td>-28.2</td>
<td>-25.8</td>
<td>-23.3</td>
<td>-30.0</td>
</tr>
<tr>
<td>Investment-to-output</td>
<td>14.2</td>
<td>18.1</td>
<td>22.1</td>
<td>26.2</td>
<td>7.0</td>
</tr>
<tr>
<td><strong>Forward Looking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output gap</td>
<td>-8.3</td>
<td>-8.8</td>
<td>-9.4</td>
<td>-10.0</td>
<td></td>
</tr>
<tr>
<td>Wage gap</td>
<td>-18.9</td>
<td>-19.1</td>
<td>-19.3</td>
<td>-19.5</td>
<td></td>
</tr>
<tr>
<td>Investment gap</td>
<td>-14.1</td>
<td>-16.0</td>
<td>-17.9</td>
<td>-19.8</td>
<td></td>
</tr>
</tbody>
</table>
Summary

- Documents a joint decline of both KS (30%) and LS (30%) from early 1980's which is offset by an increase in the share of profits.

- Builds on Karabarbounis and Neiman (2014) to match the empirically measured declines in KS and LS with a decline in competition. Successful match when calibrated to an increase in the markup from 2.5% (1984) to 21% (2014) and decline in real interest rate from 8.5% to 1.25%.

- Counterfactual exercise. Gains of increasing competition to its 1984 level: 10% increase in output, 24% increase in wages, 19% increase in investment as

- (Not in the slides) Provides empirical evidence of increase in concentration and decline of the labor share, in line with Autor et al. (2017).
Consider a firm that uses an office and 100 laptops. The firm’s cost of capital in financial markets is 6% per year. Gross value added = $500,000.

- **Office.** Assume sale value = $880,000, expected inflation = 4% and depreciation = 3%, then
  - Required rate of return = 5%,
  - Capital cost = $44,000 ( = 0.05 × $880,000).

- **Laptops.** Assume sale value = $70,000, expected inflation = -10% and depreciation = 25%, then
  - Required rate of return = 41%,
  - Capital cost = $28,700 ( = 0.41 × $70,000).

Aggregate capital cost = $72,700 and value of capital stock = $950,000.

Aggregate required rate of return ≈ 8% ( = $72,700 ÷ $950,000 × 100).

**Capital share** ≈ 15% ( = $72,700 ÷ $500,000 × 100).