Accounting for Factorless Income

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Introduction

- Value added produced in an economy equals sum of:
  - Compensation to labor
  - Capital rental payments
  - Economic profits
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• Or, \( s_L + s_K + s_\Pi = 1 \)
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  • Compensation to labor
  • Capital rental payments
  • Economic profits

• Or, $s_L + s_K + s_{\Pi} = 1$

• Separating these matters for understanding:
  • Production technology
  • Competition in product markets
  • Factor shares and inequality
  • Responsiveness to policies (monetary, tax, regulatory)
Introduction

• But, it’s hard to measure these components!
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- Economic profits?
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- Economic profits? Bad data on costs
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- Capital rental payments?
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- Capital rental payments? Firms own their capital
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• Wages and benefits?
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• Wages and benefits? Proprietors, mixed income, etc.
• But, it’s hard to measure these components!

• Economic profits? Bad data on costs

• Capital rental payments? Firms own their capital

• Wages and benefits? Proprietors, mixed income, etc.

• Relative ease in measuring labor compensation drove focus on labor share $s_L$, which was historically constant
Introduction

• $s_L$ has declined globally in recent decades, and most imputations of $s_K$ don’t offset it during this period

• Hence, significant residual has risen since 1980

• We call this residual “factorless income”, defined as:

\[
\text{Factorless Income} = Y - WL - RK,
\]

where:

• $Y$ is value added from national accounts
• $WL$ is compensation from national accounts
• $K$ is capital from the national accounts
• $R$ is calculated rental rate, following Hall-Jorgenson (1967)
How to Allocate/Interpret Factorless Income?

- Three (among other) Possibilities:
  1. Maybe it’s all profits (*Case Π*)
  2. Maybe we are “missing” investment (*Case K*)
  3. Maybe our imputation of rental rate isn’t good (*Case R*)

Variants of these three strategies are common in literature:

- *Case K*: Hall (2001), McGrattan and Prescott (2005), Corrado, Hulten, and Sichel (2009), + others
How to Allocate/Interpret Factorless Income?

• Three (among other) Possibilities:

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What We Do

• Explore these three interpretations of US factorless income and elaborate on their implications for tech, inequality, etc.

• We are skeptical of Case Π
  • $s_{Π}$ rises since ’80, but still below historical levels
  • Requires extremely volatile path of technology

• We are more open, but still skeptical of Case $K$
  • Recent scale of unmeasured capital plausible, less so in the 60s
  • Requires potentially different take on GDP (and labor share)

• We find Case $R$ most promising, but requires better explanation for why $r$ deviates from Treasuries
Agenda

• **Notation and Data**

• (Almost) Model-free Analysis
  • *Case Π*, with discussion of De Loecker and Eeckhout (2017)
  • *Case K*, and
  • *Case R*
  • TFP Comparison

• Model, Calibration, and Counterfactuals
Notation

• Business sector (i.e. corporate and non-corporate)
  • Value added: $P^Q Q$
  • Labor Compensation: $WL$

• Housing (i.e. residential sector)
  • Value added: $P^H H$
  • Labor Compensation: 0

• Private Economy
  • GDP (ex gov’t): $Y = P^Q Q + P^H H$
  • Profits: $\Pi = \Pi^Q + \Pi^H$
Data

- Data from US NIPA and FAT, exclude government, 1960-2016

- $RK = \sum_j R^j K^j$, where we have three capital types:
  
  - $j = I$: IT capital (used by business sector). Includes information processing equipment and software.
  
  - $j = N$: Non-IT capital (used by business sector). Includes non-residential structures, industrial, transportation, and other equipment, R&D, and entertainment and artistic originals.
  
  - $j = H$: Housing (consumed by households)

- Rental rate (derived from model below, taxes removed here):

  $$R^j_t = \xi_t \left[ \left( \frac{\xi^i_{t-1}}{\xi^i_t} \right) (1 + r_t) - (1 - \delta^j_t) \right]$$
Data

- How do factor shares look before allocating factorless income?

(Note: All plots throughout are 5-year moving averages.)
Data

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Case Π

- $s_\Pi \uparrow$ since 1980 led to $s_L \downarrow$ (Barkai ’17; Eggertsson et al. ’18)
- Referenced by view that monopoly power $\uparrow$ or call for antitrust
- Seemingly consistent with DeLoeeker-Eeckhout (DLE, 2017)
Case Π

- But $s_\Pi$ remains below average levels from 1960s/1970s
Case Π

- $\text{Correl}(r, s_\Pi) = -0.91$: Little information beyond behavior of $r$
Case Π

• Additional Implication: Not a markup shock on its own!

• Stories must tightly link declining $r$ and rising $s_\Pi$

• Labor’s share of business costs was 0.85 in 60s/70s, dropped to 0.70 in 1980 then rose back to 0.80 after 2000

• Will formalize later, but major implications for technology
Case Π

- Housing is a useful illustration, motivated by Vollrath (2017)
- Results look qualitatively the same as business sector!
Case Π – Robustness

Alternative Labor Shares

Implied Profit Shares

Alternative Inflation Expectations

Implied Profit Shares
Case Π

- What about with (hypothetical) flat real interest rate?
What About De Loecker and Eeckhout (2017)?

- Case π not only evidence of rising profit share and markups
- DLE (2017) shows surge since 1980 using Compustat Data
What About De Loecker and Eeckhout (2017)?

- DLE (2017) shows surge since 1980 using Compustat Data
- “Driver” of this is surge is Sales/COGS
What About De Loecker and Eeckhout (2017)?

- But rise in Sales/COGS due to fall in COGS/(COGS+SG&A)!
  - First showed by Traina (2018)
  - Consistent with Gutierrez and Philippon (2017)
What About De Loecker and Eeckhout (2017)?

- COGS: “...all expenses directly allocated by the company to production, such as material labor, and overhead…”

- SG&A: “...all commercial expenses of operation (such as, expenses not directly related to product production) incurred in the regular course of business pertaining to the securing of operating income…”

- Compustat only includes items in COGS if company does not itself allocate to SG&A.

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- Even if SG&A has more fixed costs than COGS, this means that markups are less related to profits, labor share, etc.
What About De Loecker and Eeckhout (2017)?

- Actual Markup Estimates? Our best efforts...
What About De Loecker and Eeckhout (2017)?

<table>
<thead>
<tr>
<th>Country</th>
<th>Trend (per 10 years)</th>
<th>Years Covered</th>
<th>Firms Included</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sales COGS</td>
<td>Sales COGS+SG&amp;A</td>
<td>Start</td>
</tr>
<tr>
<td>Brazil</td>
<td>-0.04</td>
<td>-0.00</td>
<td>1996</td>
</tr>
<tr>
<td>China</td>
<td>-0.01</td>
<td>-0.02***</td>
<td>1993</td>
</tr>
<tr>
<td>France</td>
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<td>-0.01</td>
<td>1999</td>
</tr>
<tr>
<td>Germany</td>
<td>0.00</td>
<td>0.03***</td>
<td>1998</td>
</tr>
<tr>
<td>India</td>
<td>0.12***</td>
<td>0.06**</td>
<td>1995</td>
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<tr>
<td>Italy</td>
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<td>2005</td>
</tr>
<tr>
<td>Japan</td>
<td>0.06***</td>
<td>0.03***</td>
<td>1987</td>
</tr>
<tr>
<td>Korea</td>
<td>0.00</td>
<td>-0.03***</td>
<td>1987</td>
</tr>
<tr>
<td>Russia</td>
<td>-0.13</td>
<td>-0.01</td>
<td>2004</td>
</tr>
<tr>
<td>Spain</td>
<td>0.27**</td>
<td>-0.03</td>
<td>2005</td>
</tr>
<tr>
<td>Taiwan</td>
<td>-0.05**</td>
<td>-0.02</td>
<td>1997</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.28***</td>
<td>0.07***</td>
<td>1988</td>
</tr>
<tr>
<td>United States</td>
<td>0.09***</td>
<td>0.02***</td>
<td>1981</td>
</tr>
</tbody>
</table>

Simple Average 0.04 0.00
Case Π Summary

- We do not think all factorless income is economic profits
- Highlights mechanical role of $r$ and, therefore, huge decline in profits from the 60s/70s to 80s and reversion from 80s to now
- Major fluctuations in labor’s share of costs will require huge fluctuations (in both directions!) of factor-biased technology
- Other evidence extremely sensitive and, if picking up rising fixed costs, potentially informative about $\mu$ but not about $\Pi$
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Case $K$

- Idea is we “miss” certain investment expenditures

- Let $\xi^U$ denote the price of unmeasured investment

- Let $X^U$ denote the quantity of unmeasured investment

- Let $R^U$ denote the rental rate of unmeasured capital

- Let $K^U$ denote the stock of unmeasured capital
Case $K$

- “Revised” GDP $\tilde{Y}$ related to measured income $Y$ as:

$$\tilde{Y} = Y + \xi^U X^U = WL + R^I K^I + R^N K^N + R^H K^H + \Pi + R^U K^U$$

- We rearrange so RHS is all known or assumed:

$$R^U K^U - \xi^U X^U = Y - WL - R^I K^I - R^N K^N - R^H K^H - \Pi^Q - \Pi^H$$

- We can solve for $\{\xi^U_t, X^U_t, R^U_t, K^U_t\}$ which satisfies:
  - Above equation
  - $R^U_{t+1} = R(\xi^U_t, \xi^U_{t+1}, \delta^U_t, r_t)$
  - $K^U_{t+1} = (1 - \delta^U_t) K^U_t + X^U_t$
Case $K$

- Leave $\Pi^H_t$ as in Case $\Pi$, choose $\Pi^Q = 0.06$, and $\delta^U = 0.05$

- Many different paths of $\{\xi_t^U, X_t^U, R_t^U, K_t^U\}_{t \in 1960, 2016}$

- We choose one such path, with small $\xi_t^U X_t^U$ and $\text{Vol}(\frac{\xi_t^U + 1}{\xi_t^U})$

- (We could do strictly better with variation in $s^Q_\Pi$ or $\delta^U$)
Case $K$

\[ \xi_j \]

\[ \xi_t \]

Index

0 .2 .4 .6 .8 1

1960 1980 2000 2020

Non−IT Unmeasured IT (right axis)
Case K

$R_t^j$

Rental Rate

1960 1980 2000 2020

Non−IT Unmeasured IT (right axis)
Case K

\[ \frac{\xi_j X_j}{\tilde{Y}_t} \]

Investment Spending / GDP

Non-IT
Unmeasured
IT
Residential
Case $K$

\[ \frac{\xi_t K_t^j}{\tilde{Y}_t} \]

The diagram illustrates the trend of capital value to GDP from 1960 to 2020, categorized into Non-IT, Unmeasured, IT, and Residential sectors.
Case $K$

$\ln \left( \frac{\tilde{Y}_{t+1}}{\tilde{Y}_t} \right)$ and $\ln \left( \frac{Y_{t+1}}{Y_t} \right)$
Case $K$ Summary

- One case of factorless income arising from unmeasured capital
- Recent scale similar to Hall (2001) or Eisfeldt & Papanikolaou (2013), though scale before 1970 implausibly large.
- Scale nowhere near Corrado, Hulten, and Sichel (2009) – must envision unmeasured capital more broadly than “IT”
- Note that tradeoff between scale early vs. late reflects decision to minimize $\xi U X^U$
- Requires re-evaluation of factor share dynamics since “revised” GDP differs in some years
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Case $R$

- Idea is lots of factors omitted from our rental-rate calculation (risk premium, adjustment costs, etc.)

- Solve for revised opportunity cost of capital $\tilde{r}$ such that:

$$P^Q Q - WN - \tilde{R}^I K^I - \tilde{R}^N K^N - \Pi^Q = 0,$$

where $\tilde{R}^j = R(\tilde{r}, \cdot)$ and where $\Pi^Q = 0.06$ as in Case $K$.

Case $R$

$\tilde{r}_t$ and $r_t$

Percent

1960 1980 2000 2020

Measured Revised
Case $R$

$\tilde{R}_t'$ and $R_t'$

![Graph showing rental rates over time.](image)
Case $R$

$\tilde{R}_t^N$ and $R_t^N$

Rental Rate

1960 1980 2000 2020

Measured Revised

- $\tilde{R}_t^N$
- $R_t^N$

- Measured
- Revised
Case R

$\tilde{R}_t^H$ and $R_t^H$

Rental Rate

1960 1980 2000 2020

Measured Revised

Graph showing the time series of $\tilde{R}_t^H$ and $R_t^H$ from 1960 to 2020.
Case $R$ Summary

- Shifting $r$ to account for factorless income results in more stable paths for interest and rental rates.

- Similar logic drives conclusion in Caballero, Farhi, and Gourinchas (2017) that risk premium has risen since 1980.

- We find this most promising of our cases, though it clearly requires elaboration on where gap between $\tilde{r}$ and $r$ comes from.
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Naive vs. Modified TFP

- Standard “Naive” Solow Residual uses factor shares of revenues:

\[ d \ln \text{TFP}_{\text{Naive}} = d \ln Q - s_L^Q \times d \ln L - \left(1 - s_L^Q\right) \sum_{j \in \{I, N\}} \frac{s_{Kj}^Q}{s_K} \times d \ln K^j \]

- “Modified” Solow Residual uses factor shares of costs and better approximates technology:

\[ d \ln \text{TFP}_{\text{Modified}} = d \ln Q - \frac{s_L^Q}{1 - s_{\Pi}^Q} \times d \ln L - \sum_{j \in \{I, N, U\}} \frac{s_{Kj}^Q}{1 - s_{\Pi}^Q} \times d \ln K^j \]

- “Modified” calculation differs across our three cases
Naive vs. Modified TFP

- Two series most closely correspond for case $R$
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Model

- Business sector: \( L, K^L, K^N, K^U \rightarrow C, X^I, X^N, X^U, X^H \)
- Housing sector: \( K^H \rightarrow H \)
- Representative workers work and consume \((C, H)\) using wages
- Representative capitalists lease capital, invest, consume \((C, H)\) using rental income
- Perfect foresight and exogenous real interest rate path
- Purpose of model is to understand how shocks and their impact differ across our three cases
Model

- $C_t, X_j^t, H_t$ are CES aggregates of intermediate varieties

- Intermediates produced with CES technology:
  \[
  Q_t = \left( \alpha \left( A^K_t K^Q_t \right)^{\frac{\sigma-1}{\sigma}} + (1 - \alpha) \left( A^L_t L_t \right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}
  \]

- Labor rented at wage $W_t$

- Capital bundle:
  \[
  K_t^Q = \left( \sum_{j \neq H} \left( \nu^j_t \right)^{\frac{1}{\theta}} \left( K_t^j \right)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}
  \]
  rented at rate:
  \[
  R_t^Q = \left( \sum_{j \neq H} \nu^j_t \left( R_t^j \right)^{1-\theta} \right)^{\frac{1}{1-\theta}}
  \]
Model

- Relative prices from productivity in final good production
- Markups from elasticity of substitution in those processes
- Workers and capitalists are Cobb-Douglas in $C_t$ and $H_t$
- Capitalists’ FOC yields formula for $R^j_t$ used above
Quantification

- Exogenous processes taken straight from data:
  \[ \{\tau_s, L_t, \delta^j_t, \xi^j_t, \mu^Q_t, \mu^H_t\} \]

- Extracted processes to match rest of data:
  \[ \{\beta_t, A^L_t, A^K_t, \nu^j_t, A^H_t\} \]

- Equilibrium requires sequence of prices and quantities:
  Prices: \[ \{W_t, R^j_t, P^H_t\} \]
  Quantities: \[ \{H^L_t, H^K_t, H_t, C^L_t, C^K_t, Q_t, K^j_t, X^j_t, D_t\} \]

- Reaches BGP with values equal to factual at end of data

- Match data during 1960-2016 under each of the three cases
$\sigma = 1.25 \quad A^L_t = (1 - \alpha)^\frac{1}{1-\sigma} \left( S_{Q,L,t}^{Q} \right)^{\frac{1}{\sigma-1}} \left( \mu_{Q,t}^{Q} \right)^{\frac{\sigma}{\sigma-1}} W_t$
Blank
Extracted Capital-Augmenting Technology

\[ \sigma = 1.25, \quad A^K_t / R^Q_t = \alpha^{\frac{\sigma}{1-\sigma}} \left( s^K_{Q,t} \mu^Q_t \right)^{\frac{1}{\sigma-1}} \mu^Q_t \]
\[ \sigma = 0.75 \quad A^K_t / R^Q_t = \alpha^{\frac{\sigma}{1-\sigma}} \left( s_{K,t}^Q \mu_t^Q \right)^{\frac{1}{\sigma-1}} \mu_t^Q \]
Counterfactuals: Examples of How the Cases Matter

Changes (1986-1990 vs. 2011-2015) in $s_L^Q$

<table>
<thead>
<tr>
<th></th>
<th>Elasticity $\sigma = 1.25$</th>
<th>Elasticity $\sigma = 0.75$</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Case Π</td>
<td>Case K</td>
</tr>
<tr>
<td>Baseline</td>
<td>-0.030</td>
<td>-0.029</td>
</tr>
<tr>
<td>$\mu^Q$</td>
<td>-0.071</td>
<td>0.000</td>
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<tr>
<td>$\xi^I$</td>
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</tr>
<tr>
<td>($A^K, \nu^I$)</td>
<td>0.041</td>
<td>-0.056</td>
</tr>
<tr>
<td>$\xi^N$</td>
<td>-0.002</td>
<td>-0.002</td>
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<tr>
<td>($A^K, \nu^N$)</td>
<td>0.075</td>
<td>0.009</td>
</tr>
<tr>
<td>$\tau^k$</td>
<td>0.000</td>
<td>-0.012</td>
</tr>
</tbody>
</table>
Counterfactuals: Examples of When Cases Don’t

Changes (1986-1990 vs. 2011-2015) in $\ln \left( \frac{C_K}{C_L} \right)$

- $\sigma = 1.25$
- $\sigma = 0.75$

- Same for implications on GDP growth (see paper)
Conclusions

- Skeptical of Case Π:
  - Two (negatively correlated) shocks, not one
  - Requires longer view than just early-1980s onward

- A bit less skeptical of Case K: Our version requires too much $K^U$ early-on, but other versions might do better

- Most optimistic about Case R: But what is source of wedge?

- For many questions – including cause of $s_L$ decline, but also much more! – interpretation of factorless income matters

- Hope to see explorations of factorless income around the world