Accounting for Factorless Income

Loukas Karabarbounis
University of Minnesota

Brent Neiman
University of Chicago

May 2018

Introduction

- Value added produced in an economy equals sum of:
  - Compensation to labor
  - Capital rental payments
  - Economic profits

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- Value added produced in an economy equals sum of:
  - 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

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- 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/Interpet 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)

How to Allocate/Interpet Factorless Income?

- Three (among other) Possibilities:
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- Variants of threse three strategies are common in literature:
  1. *Case* Π : Hall (1990), Rotemberg and Woodford (1995), Basu and Fernald (1997), Rognlie (2016), Barkai (2017), + others
  2. *Case* K : Hall (2001), McGrattan and Prescott (2005), Corrado, Hulten, and Sichel (2009), + others
  3. *Case* R : KLEMS, Gomme, Ravikumar, and Rupert (2011), Koh, Santaelalia-Llopis, and Zheng (2016), + others

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):

$$R_t^j = \xi_t^j \left[\left(\frac{\xi_{t-1}^j}{\xi_t^j} \right) (1 + r_t) - \left(1 - \delta_t^j \right) \right]$$

Data

- How do factor shares look before allocating factorless income?

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

Data

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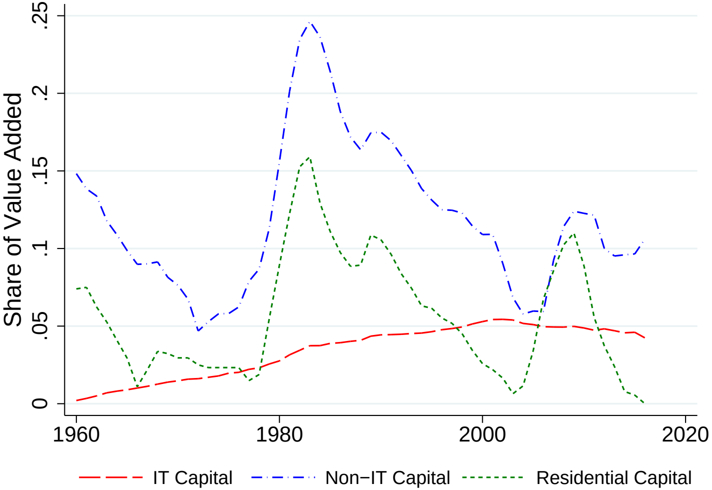

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Case Π

- $s_\Pi \uparrow$ 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 DeLoeker-Eeckhout (DLE, 2017)

Case Π

- But s_Π remains below average levels from 1960s/1970s

Case Π

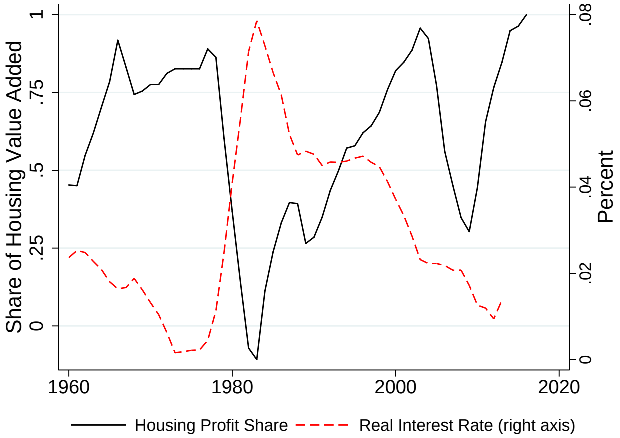
- $\text{Correl}(r, s_\Pi) = -0.91$: Little information beyond behavior of r

Case Π

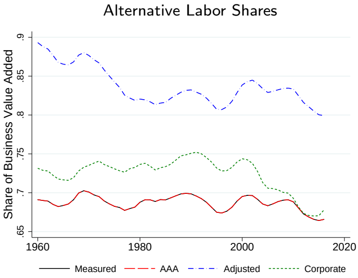
- Additional Implication: Not a markup shock on its own!
  - Stories must tightly link declining r and rising s_Π
  - Labor's share of business *costs* was 0.85 in 60s/70s, dropped to 0.70 in 1980 then rose back to 0.80 after 2000
  - Will formalize later, but major implications for technology

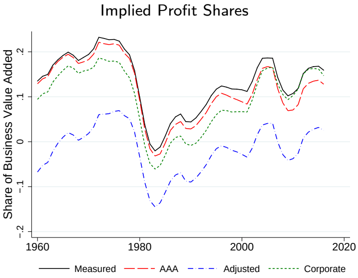
Case Π

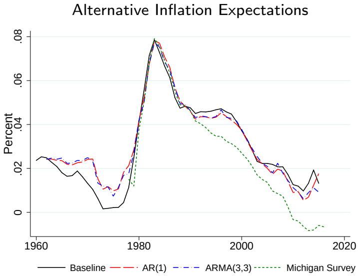
- Housing is a useful illustration, motivated by Vollrath (2017)
- Results look qualitatively the same as business sector!

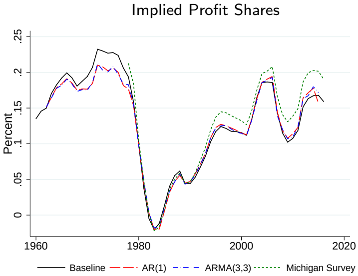


Case Π – Robustness



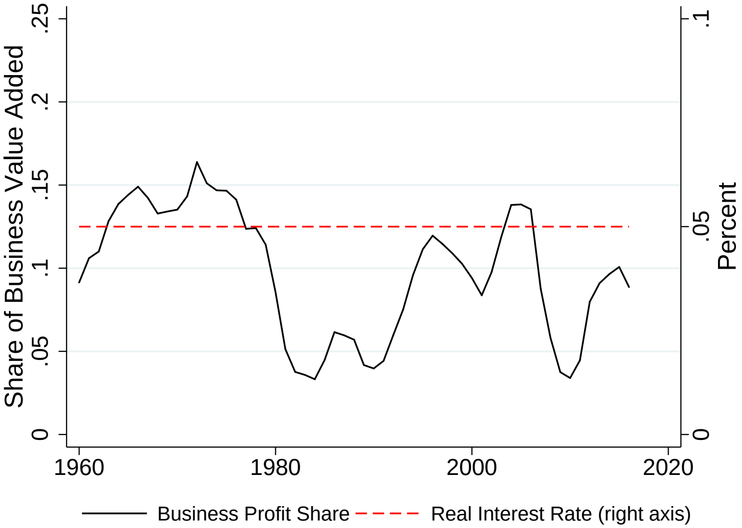






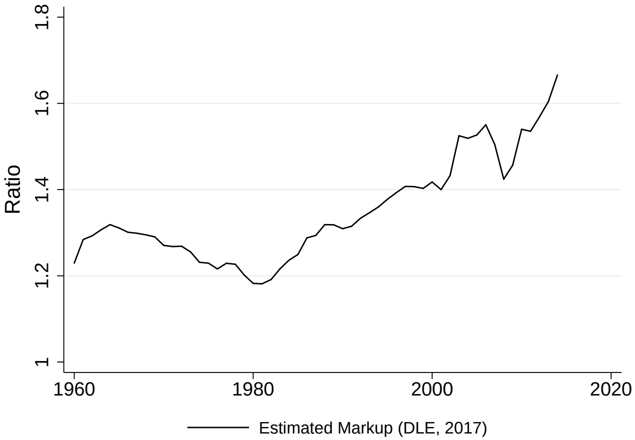
Case Π

- What about with (hypothetical) flat real interest rate?



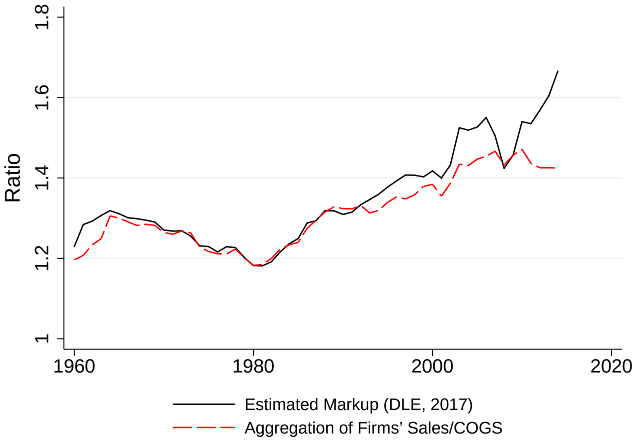
What About De Loecker and Eeckhout (2017)?

- *Case* Π not only evidence of rising profit share and markups
- DLE (2017) shows surge since 1980 using Compustat Data



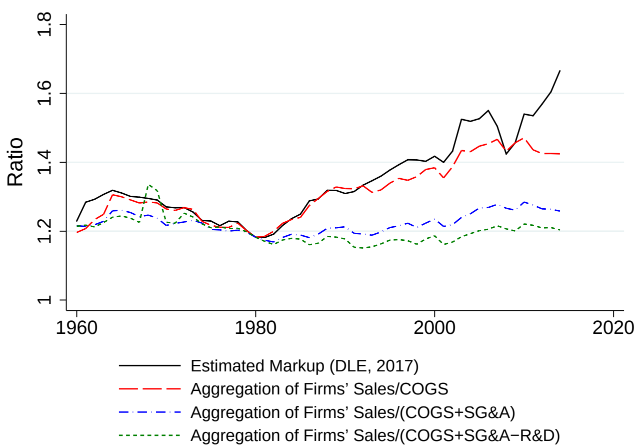
What About De Loecker and Eeckhout (2017)?

- 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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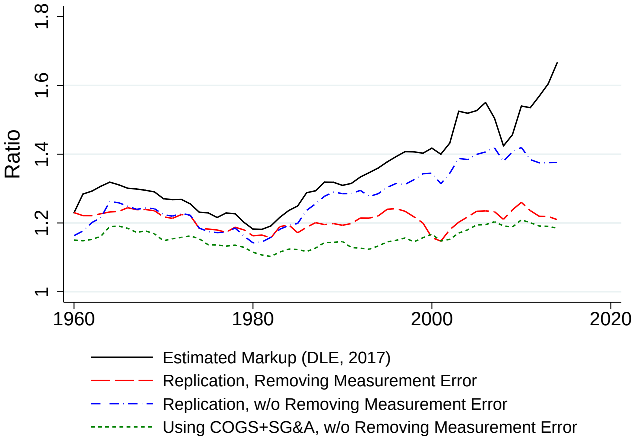
- Even if SG&A has more fixed costs than COGS, this **means that markups are less related to profits**, labor share, etc.

What About De Loecker and Eeckhout (2017)?

- Actual Markup Estimates? Our best efforts...



What About De Loecker and Eeckhout (2017)?

Country	Trend (per 10 years) $\frac{\text{Sales}}{\text{COGS}}$	Trend (per 10 years) $\frac{\text{Sales}}{\text{COGS+SG\&A}}$	Years Covered Start	Years Covered End	Firms Included Min	Firms Included Max
Brazil	-0.04	-0.00	1996	2016	128	284
China	-0.01	-0.02***	1993	2016	314	3683
France	-0.07*	-0.01	1999	2016	111	631
Germany	0.00	0.03***	1998	2016	119	668
India	0.12***	0.06**	1995	2016	630	2890
Italy	0.00	-0.06***	2005	2016	202	264
Japan	0.06***	0.03***	1987	2016	2128	3894
Korea	0.00	-0.03***	1987	2016	419	1682
Russia	-0.13	-0.01	2004	2016	127	245
Spain	0.27**	-0.03	2005	2016	102	128
Taiwan	-0.05**	-0.02	1997	2016	160	1789
United Kingdom	0.28***	0.07***	1988	2016	183	1489
United States	0.09***	0.02***	1981	2016	3136	8403
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 μ but not about Π

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Case K

- Idea is we "miss" certain investment expenditures
- Let ξ^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:

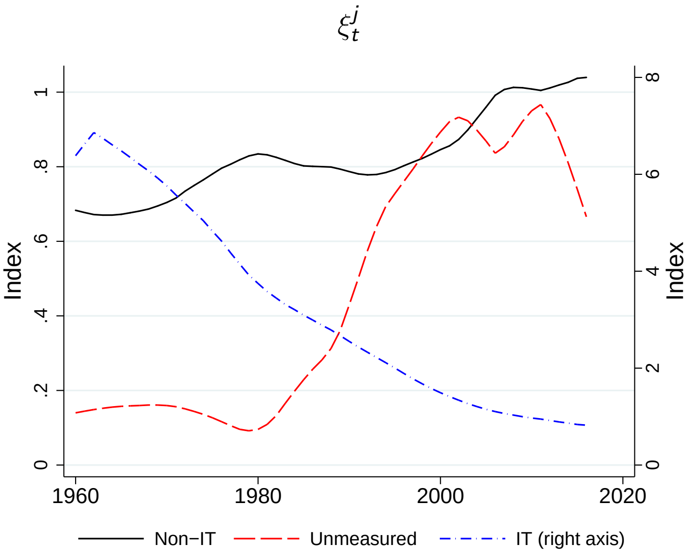
$$R^U K^U - \xi^U X^U = Y - WL - R^I K^I - R^N K^N - R^H K^H - \Pi^Q - \Pi^H$$

- We can solve for $\{\xi_t^U, X_t^U, R_t^U, K_t^U\}$ which satisfies:
  - Above equation
  - $R_{t+1}^U = R(\xi_t^U, \xi_{t+1}^U, \delta^U, r_t)$
  - $K_{t+1}^U = \left(1 - \delta_t^U\right) K_t^U + X_t^U$

Case K

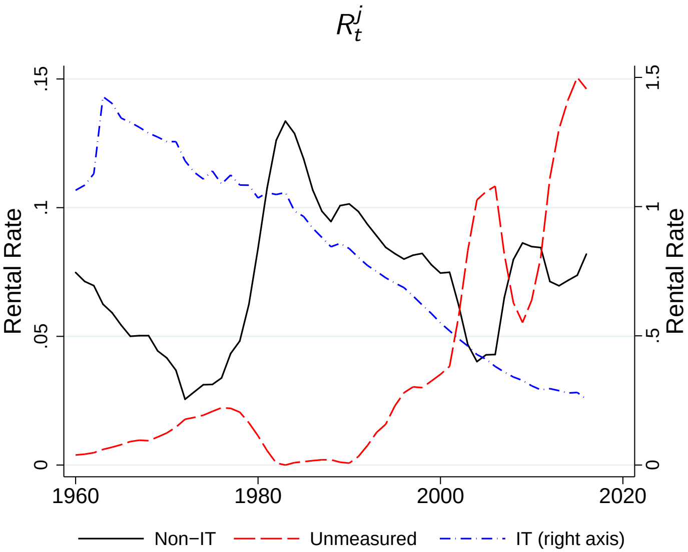
- Leave Π_t^H as in Case Π, choose $\Pi^Q = 0.06$, and $\delta^U = 0.05$
- Many different paths of $\{\xi_t^U, X_t^U, R_t^U, K_t^U\}_{(t \in 1960,2016)}$
- We choose one such path, with small $\xi_t^U X_t^U$ and $\text{Vol}(\frac{\xi_{t+1}^U}{\xi_t^U})$
- (We could do strictly better with variation in s_Π^Q or δ^U)

Case K



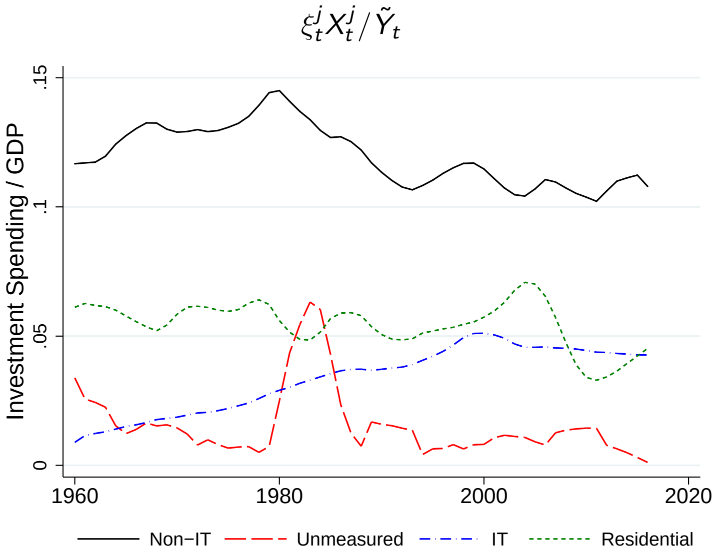
ξ_t^j
Index
1
.8
.6
.4
.2
0
8
6
4
2
0
Index
1960
1980
2000
2020
Non−IT
Unmeasured
IT (right axis)

Case K



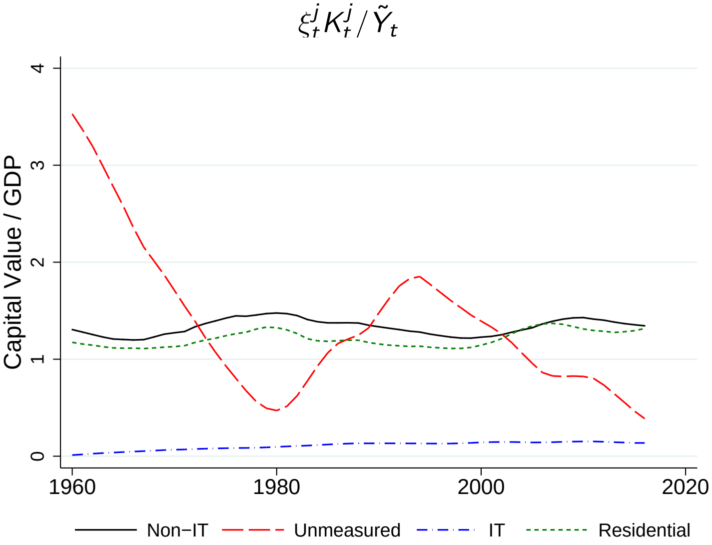
R_t^j
Rental Rate
0
.05
.1
.15
1960
1980
2000
2020
Rental Rate
0
.5
1
1.5
Non−IT
Unmeasured
IT (right axis)

Case K



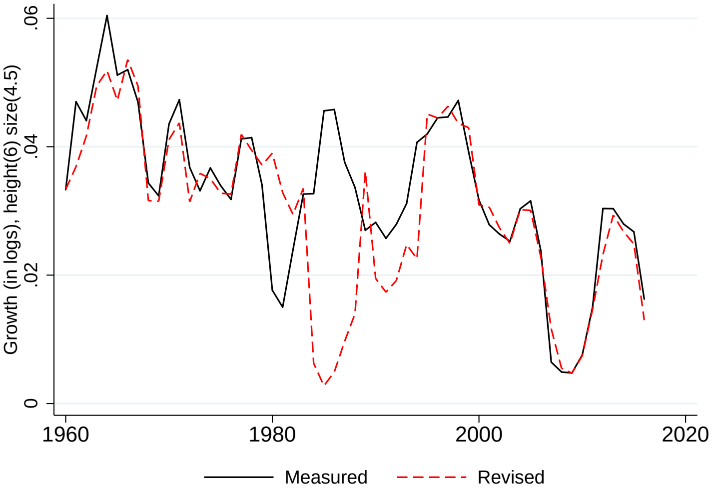
$\xi_t^j X_t^j / \tilde{Y}_t$
Investment Spending / GDP
0
.05
.1
.15
1960
1980
2000
2020
Non−IT
Unmeasured
IT
Residential

Case K


$\xi_t^j K_t^j / \tilde{Y}_t$
Capital Value / GDP
0
1
2
3
4
1960
1980
2000
2020
Non−IT
Unmeasured
IT
Residential

Case K

$$\ln\left(\tilde{Y}_{t+1}/\tilde{Y}_t\right) \text{ and } \ln\left(Y_{t+1}/Y_t\right)$$



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.)

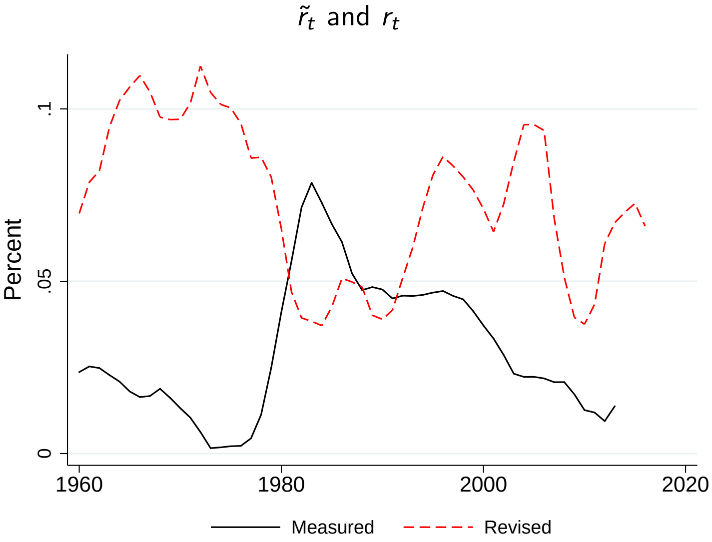
- Solve for revised opportunity cost of capital $\tilde{r}$ such that:

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

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

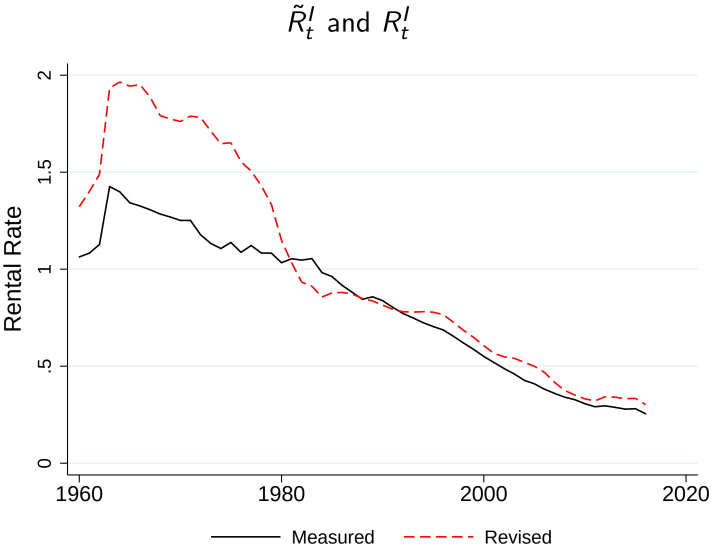
- Assumption made in KLEMS, Gomme, Ravikumar, and Rupert (2011), and Koh, Santaelalia-Llopis, and Zheng (2016)

Case R



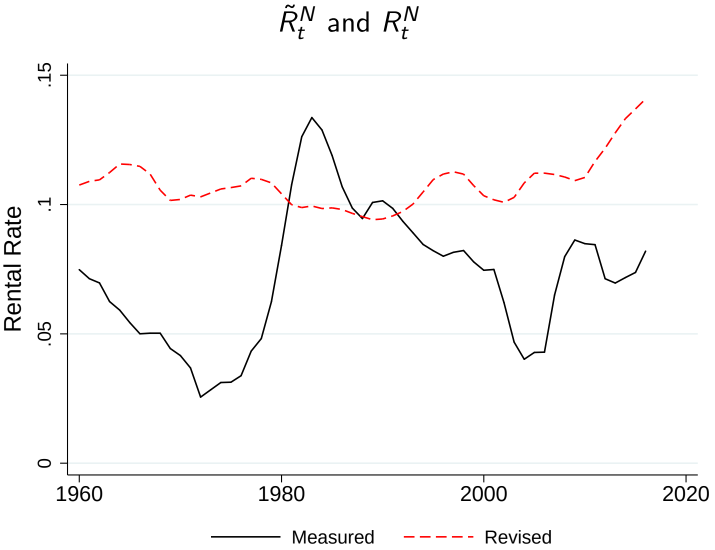
$\tilde{r}_t$ and r_t
Percent
0
.05
.1
1960
1980
2000
2020
Measured
Revised

Case R

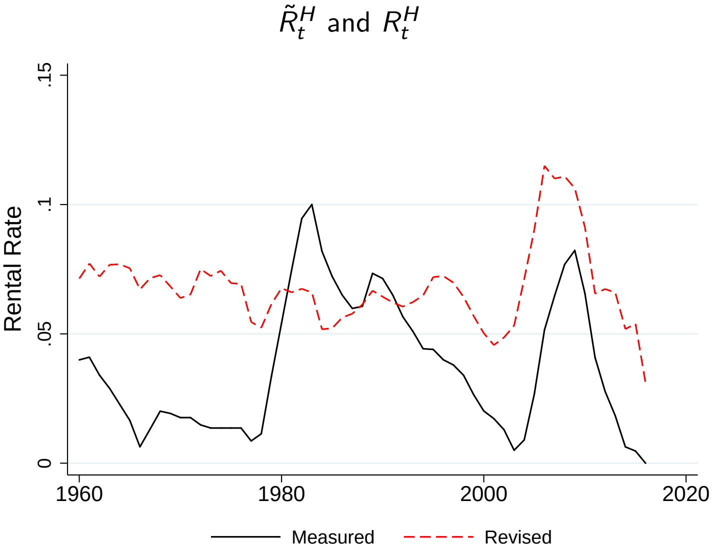


$\tilde{R}_t^I$ and R_t^I
Rental Rate
0
.5
1
1.5
2
1960
1980
2000
2020
Measured
Revised

Case R


$\tilde{R}_t^N$ and R_t^N
Rental Rate
0
.05
.1
.15
1960
1980
2000
2020
Measured
Revised

Case R



$\tilde{R}_t^H$ and R_t^H
Rental Rate
0
.05
.1
.15
1960
1980
2000
2020
Measured
Revised

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:

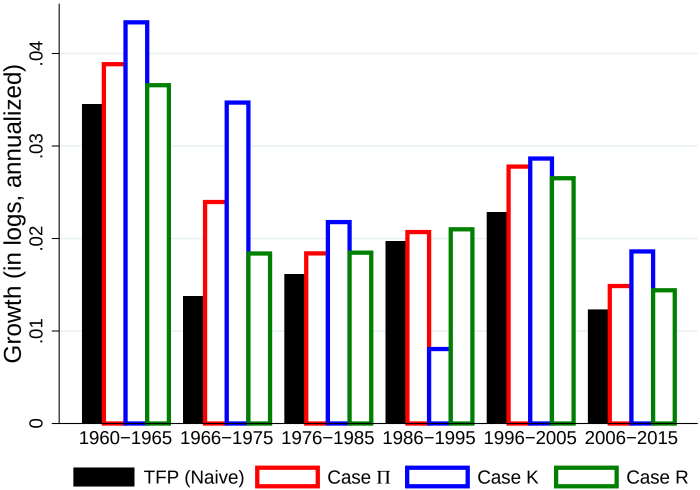
$$d \ln \mathrm{TFP}_{\mathrm{Naive}} = d \ln Q - s_L^Q \times d \ln L - \left(1 - s_L^Q\right) \sum_{j \in \{I,N\}} \frac{s_{K^j}^Q}{s_K^Q} \times d \ln K^j$$

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

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

- "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: $L, K^I, K^N, K^U \rightarrow C, X^I, X^N, X^U, X^H$
- Housing sector: $K^H \rightarrow H$
- Representative workers work and consume (C, H) using wages
- Represntative 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_t^j, H_t are CES aggregates of intermediate varieties
- Intermediates produced with CES technology:

$$Q_t = \left(\alpha \left(A_t^K K_t^Q \right)^{\frac{\sigma-1}{\sigma}} + (1-\alpha) \left(A_t^L L_t \right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

- Labor rented at wage W_t
- Capital bundle:

$$K_t^Q = \left(\sum_{j \neq H} \left(\nu_t^j \right)^{\frac{1}{\theta}} \left(K_t^j \right)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}$$

rented at rate:

$$R_t^Q = \left(\sum_{j \neq H} \nu_t^j \left(R_t^j \right)^{1-\theta} \right)^{\frac{1}{1-\theta}}$$

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_t^j used above

Quantification

- Exogenous processes taken straight from data:

$$\{\tau s, L_t, \delta_t^j, \xi_t^j, \mu_t^Q, \mu_t^H\}$$

- Extracted processes to match rest of data:

$$\{\beta_t, A_t^L, A_t^K, \nu_t^j, A_t^H\}$$

- Equilibrium requires sequence of prices and quantities:

$$\text{Prices:} \quad \{W_t, R_t^j, P_t^H\}$$

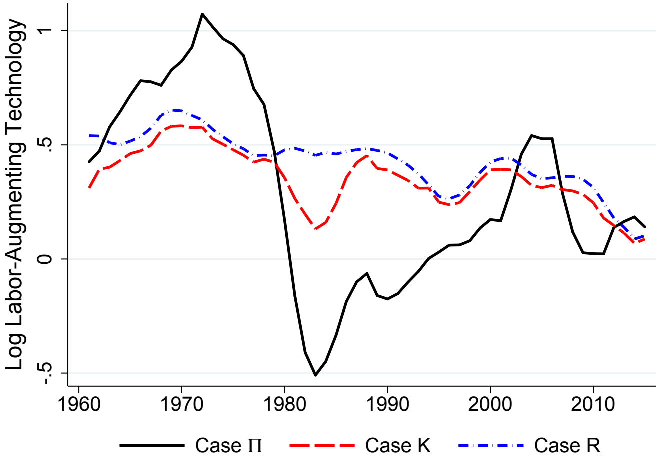
$$\text{Quantities:} \quad \{H_t^L, H_t^K, H_t, C_t^L, C_t^K, Q_t, K_t^j, X_t^j, D_t\}$$

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

- Match data during 1960-2016 under each of the three cases

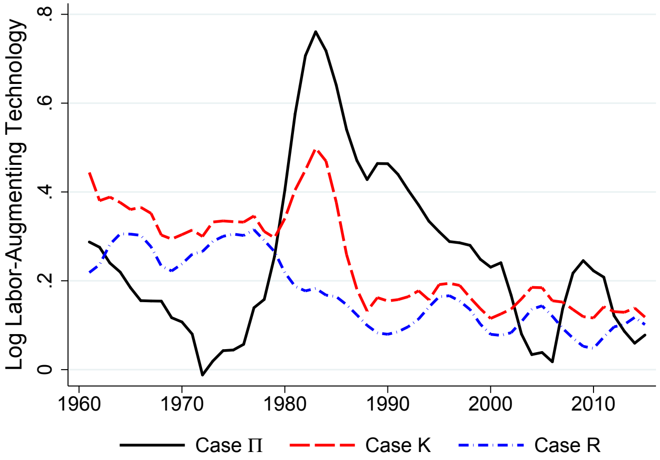
Extracted Labor-Augmenting Technology

$$\sigma = 1.25 \qquad A_t^L = (1-\alpha)^{\frac{\sigma}{1-\sigma}} \left(s_{L,t}^Q\right)^{\frac{1}{\sigma-1}} \left(\mu_t^Q\right)^{\frac{\sigma}{\sigma-1}} W_t$$



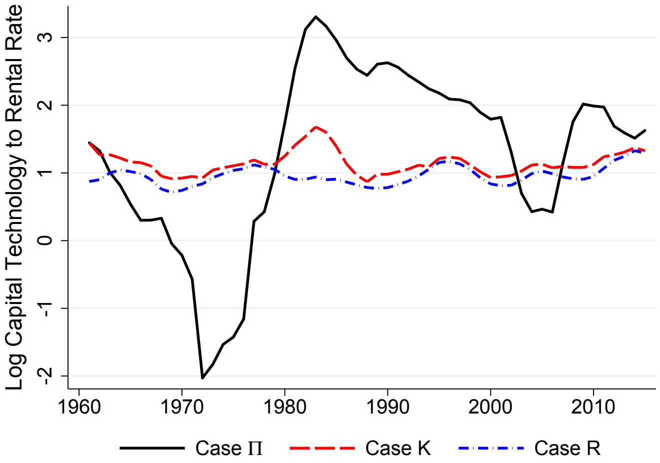
Extracted Labor-Augmenting Technology

$$\sigma = 0.75 \qquad A_t^L = (1-\alpha)^{\frac{\sigma}{1-\sigma}} \left(s_{L,t}^Q\right)^{\frac{1}{\sigma-1}} \left(\mu_t^Q\right)^{\frac{\sigma}{\sigma-1}} W_t$$



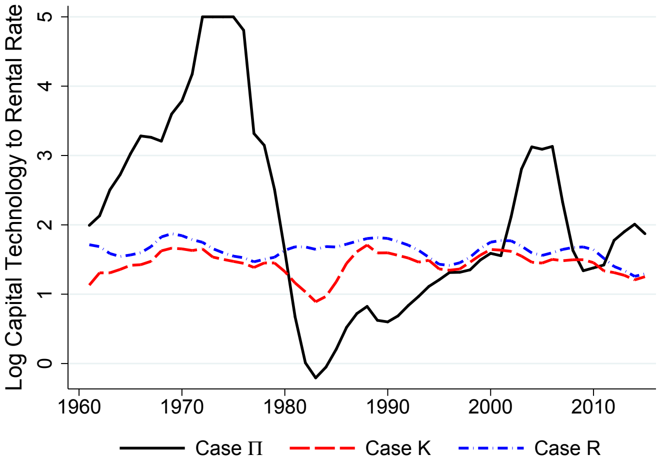
Extracted Capital-Augmenting Technology

$$\sigma = 1.25 \qquad A_t^K / R_t^Q = \alpha^{\frac{\sigma}{1-\sigma}} \left(s_{K,t}^Q \mu_t^Q \right)^{\frac{1}{\sigma - 1}} \mu_t^Q$$



Extracted Capital-Augmenting Technology

$$\sigma = 0.75 \qquad A_t^K / R_t^Q = \alpha^{\frac{\sigma}{1-\sigma}} \left(s_{K,t}^Q \mu_t^Q \right)^{\frac{1}{\sigma-1}} \mu_t^Q$$



Counterfactuals: Examples of How the Cases Matter

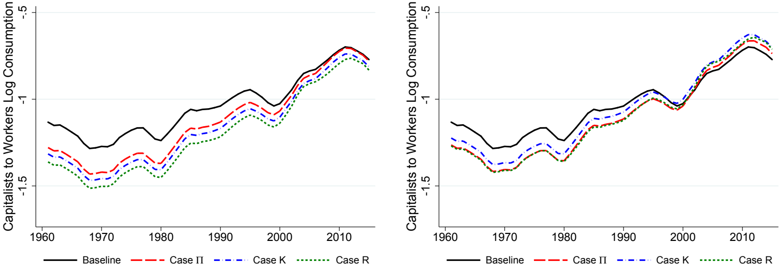
Changes (1986-1990 vs. 2011-2015) in s_L^Q

	Elasticity $\sigma = 1.25$			Elasticity $\sigma = 0.75$		
	Case Π	*Case* K	*Case* R	*Case* Π	*Case* K	*Case* R
Baseline	**-0.030**	**-0.029**	**-0.030**	**-0.030**	**-0.029**	**-0.030**
μ^Q	-0.071	0.000	0.000	-0.083	0.000	0.000
ξ^I	-0.016	-0.016	-0.021	0.019	0.018	0.024
(A^K, ν^I)	0.041	-0.056	-0.048	0.063	0.025	-0.003
ξ^N	-0.002	-0.002	0.009	0.002	0.002	-0.008
(A^K, ν^N)	0.075	0.009	-0.035	0.023	-0.094	-0.024
τ^k	0.000	-0.012	0.002	0.000	0.011	-0.001

Counterfactuals: Examples of When Cases Don't

Changes (1986-1990 vs. 2011-2015) in $\ln(C_K/C_L)$

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



- 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