Labor Share Decline and the Capitalization of Intellectual Property Products

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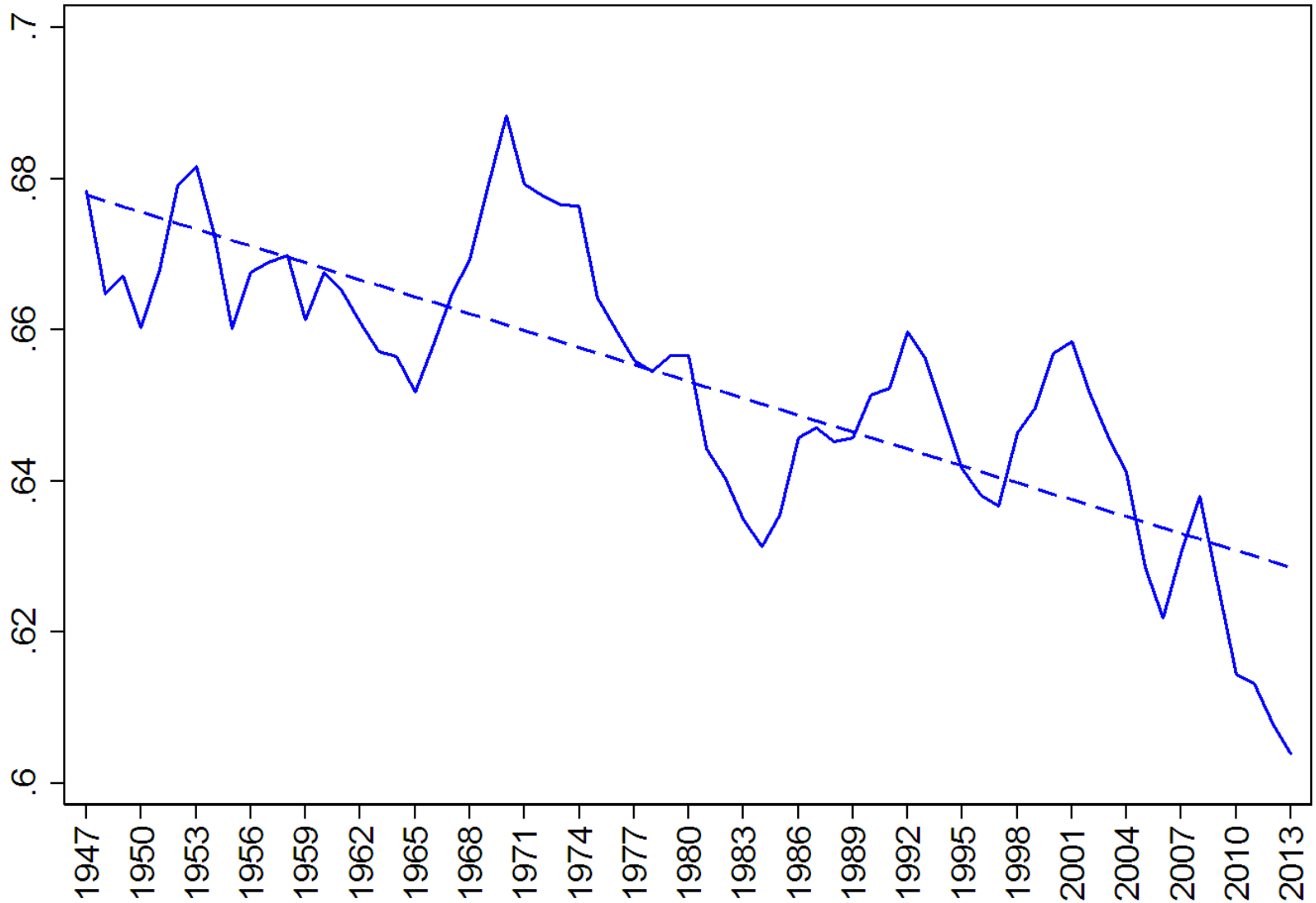
US Labor Share (LS), BEA 1947-2013



The Decline of US Labor Share

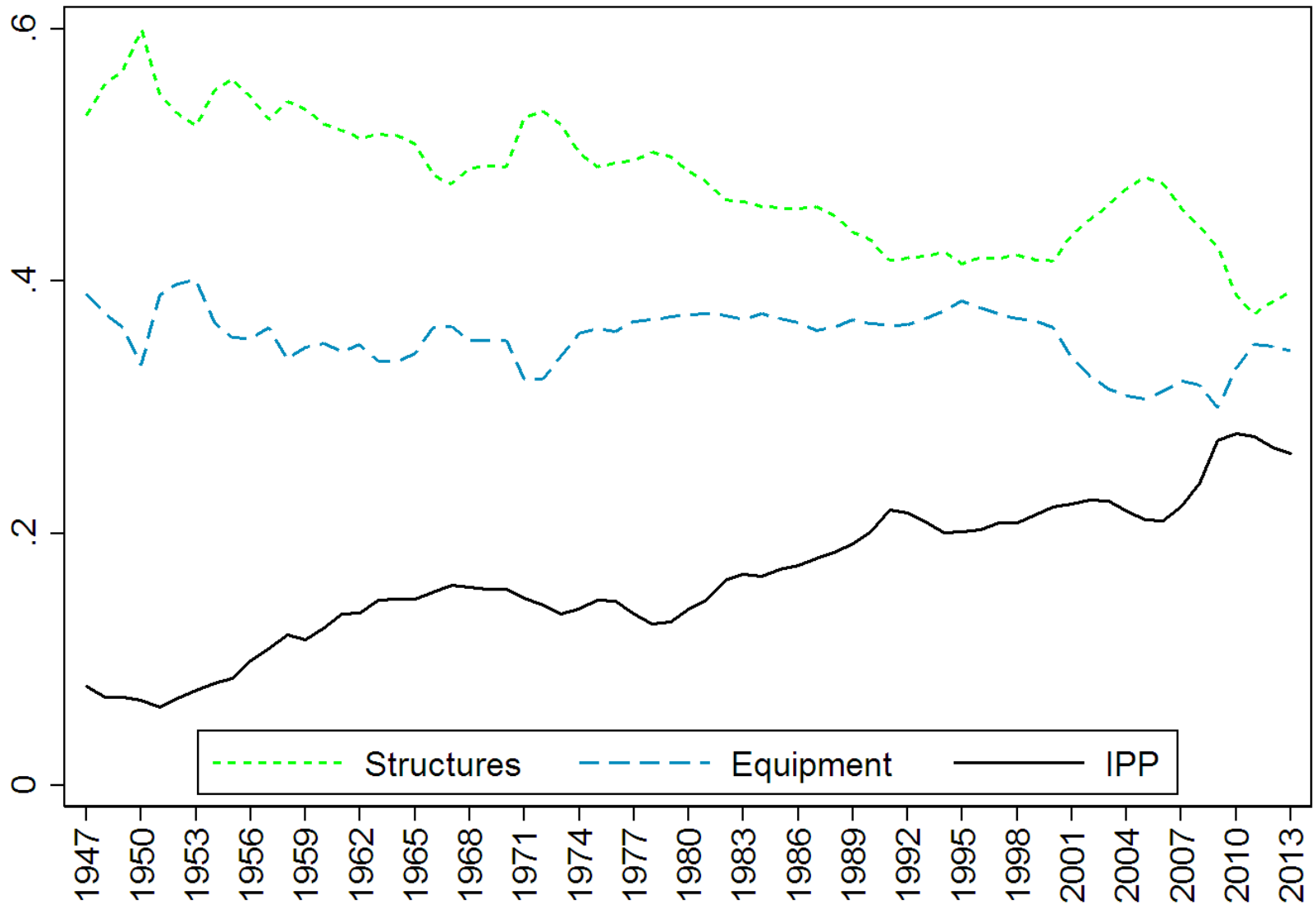
- One of the great fantasies of contemporary macroeconomics is finally gone: The LS declines.
- Our main finding: **The decline of the US LS is entirely explained by Intellectual Property Products (IPP) capital**, which includes software, R&D, and artistic originals.

  Recent discussion: Elsby, Hobijn, & Sahin '13, Karabarbounis & Neiman '14, Piketty & Zucman '13, and Piketty '14.

BEA Revisions and IPP Capital since 1999

- Before the 1999 BEA revision, IPP items were treated as expenditures in intermediate non-durable goods.
- We focus on the two recent BEA revisions that have capitalized IPP:
  - The 1999 BEA revision capitalized software.
  - The 2013 BEA revision additionally capitalized R&D and artistic originals.
- These revisions represent an **important improvement in the measurement of aggregate investment, capital, and income.**

Structures, Equipment and IPP Investment Shares, BEA 1947-2013



CONSTRUCTION OF LS

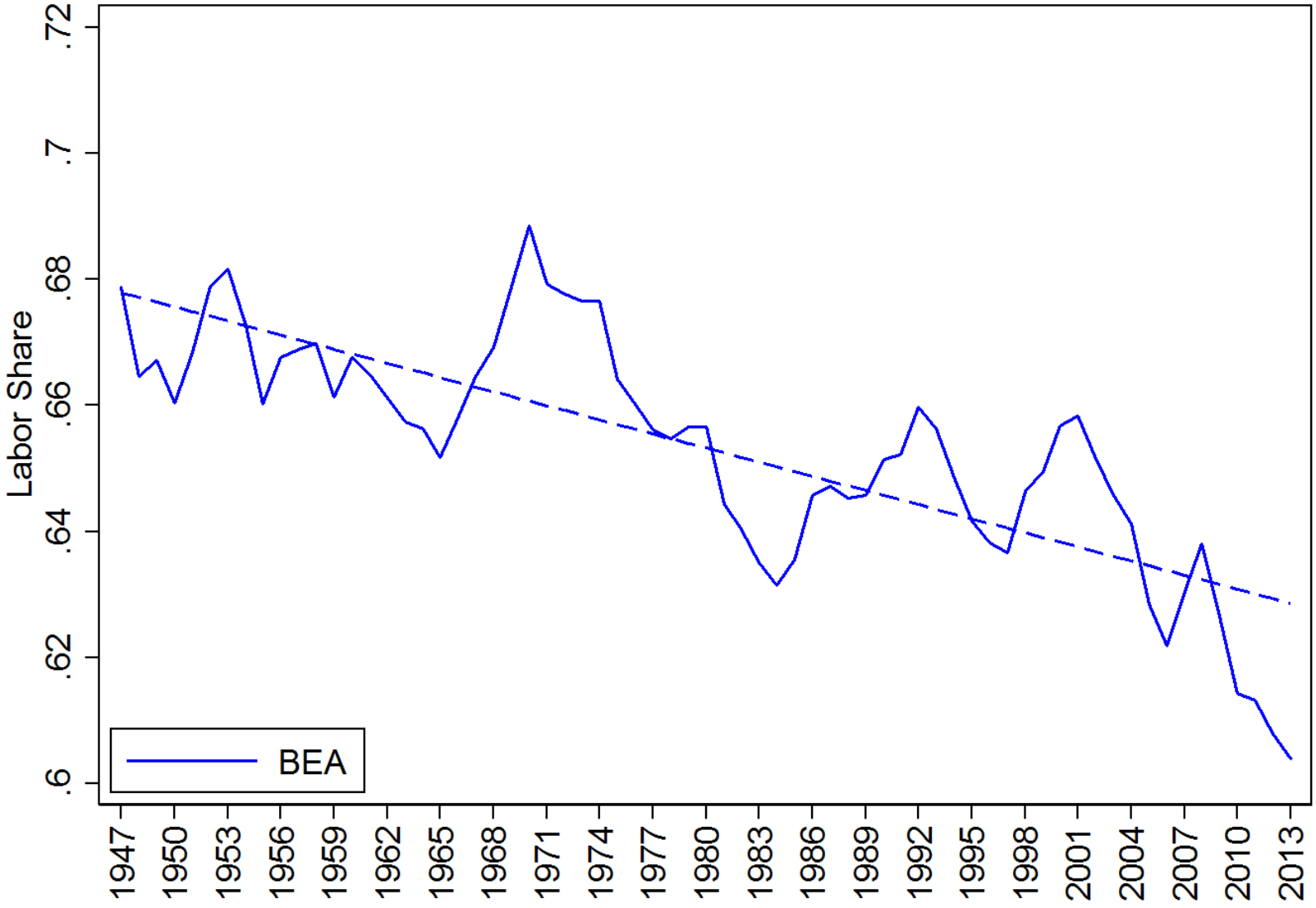
We apply a standard definition to national income data (BEA):
(e.g., Cooley and Prescott 1995, Krueger 1999, Gomme and Rupert 2007)

- Unambiguous Capital Income (UCI) = Rental Income + Corporate Profits + Net Interest + Current Surplus Government Enterprises
- Unambiguous Labor Income (ULI) = Compensation of Employees
- Unambiguous Income (UI) = UCI + DEP + ULI

CONSTRUCTION OF LS

- Ambiguous Income (AI) = Proprietors' Income + Taxes on Production − Subsidies + Business Current Transfers Payments + Statistical Discrepancy
- Ambiguous Capital Income (ACI) = $\frac{\text{UCI}+\text{DEP}}{\text{UI}} \times$ AI.
- Capital Income: $Y_K =$ UCI + DEP + ACI
- Labor Share $= 1 -$ Capital Share $= 1 - \frac{Y_K}{Y}$

LS Net of IPP Depreciation



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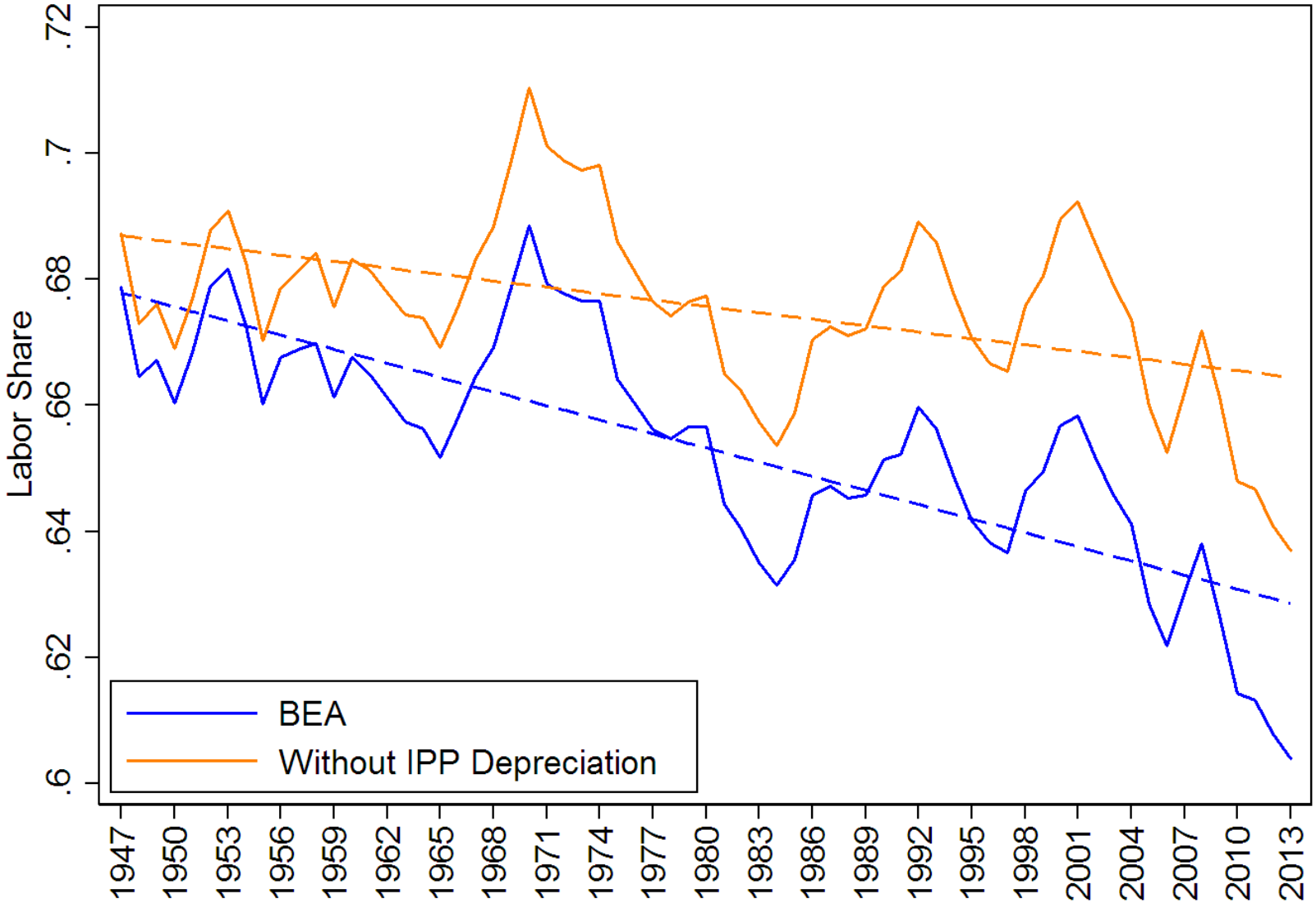
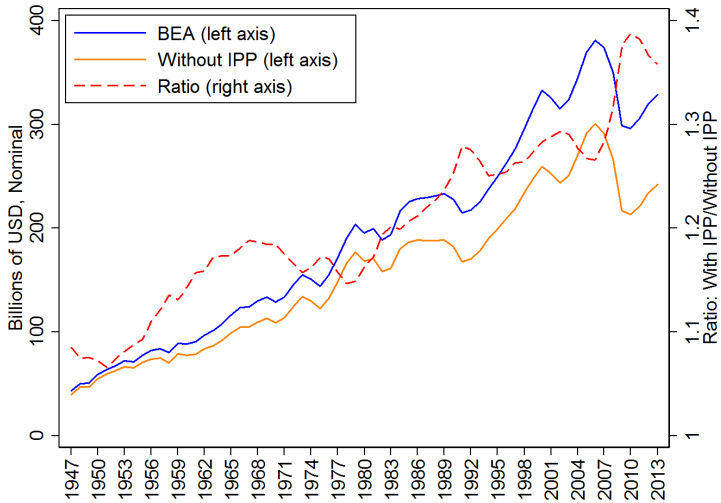


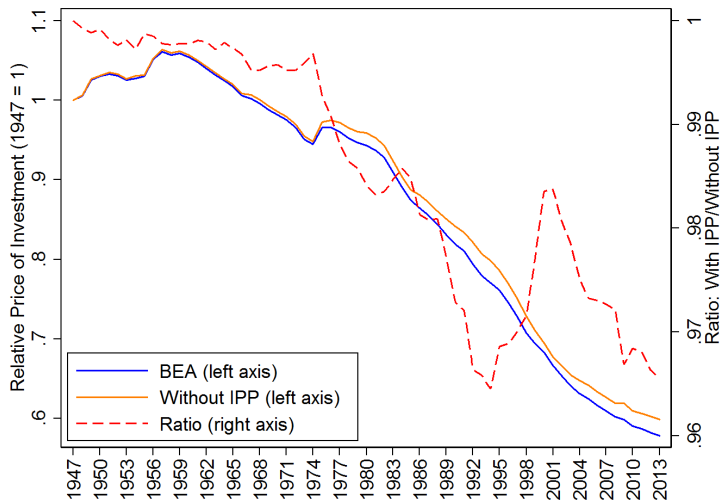
... But IPP is Not Only Depreciation

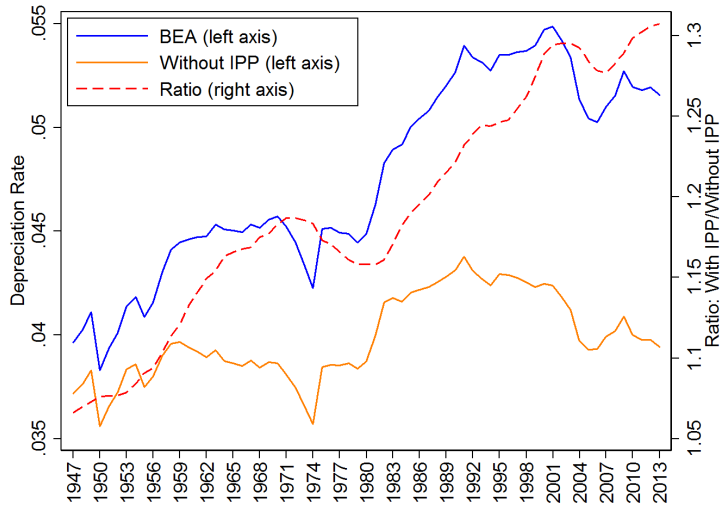
The full effects of IPP on LS are captured in an investment model through three channels:

1. Aggregate Investment
2. Price of Investment
3. Depreciation Rate

Effects of IPP on Agg. Investment, Its Price, and Depreciation Rate







A One-Sector Investment Model as Accounting Device

- Assume one sector and one good economy. CRS production:

$$y_t = f(k_t^x, l_t; \Omega_t)$$

- Aggregate investment:

$$x_t = v_t i_t \tag{1}$$

where v_t is the (inverse of) the relative price of investment.

- Capital accumulation:

$$k_{t+1}^x = x_t + (1 - \delta_t) k_t^x \tag{2}$$

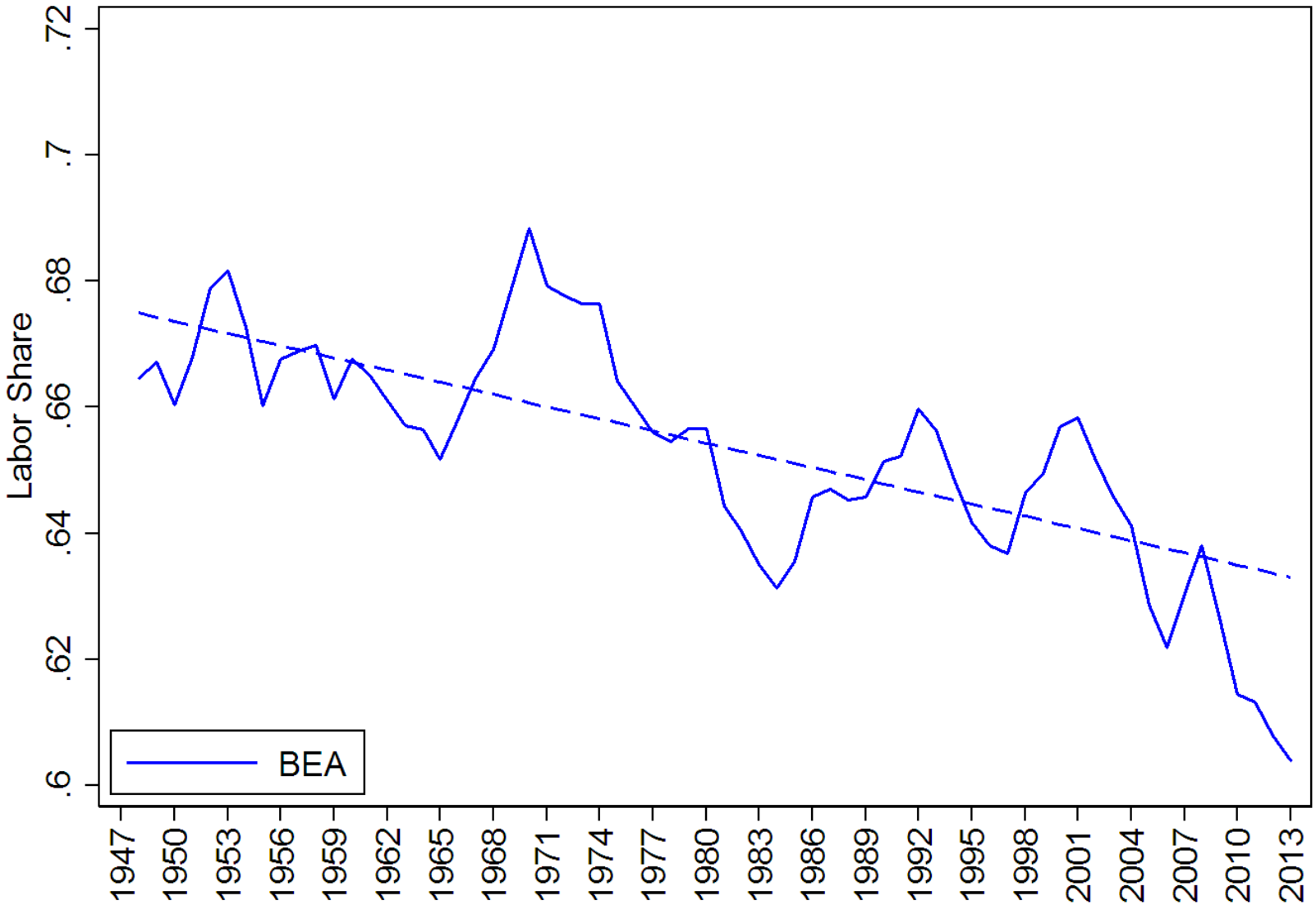
- From firms' investment problem, the gross rate of return to capital is

$$R_{t+1} \equiv \frac{\partial f(k_{t+1}, l_{t+1})}{\partial k} = \frac{1}{v_t}(1 + r_{t+1}) - \frac{1}{v_{t+1}}(1 - \delta_{t+1}) \quad (3)$$

- Labor Share:

$$LS_t = 1 - \frac{R_t k_t^x}{y_t} \quad (4)$$

EFFECTS OF IPP CAPITALIZATION ON LS, US 1947-2013



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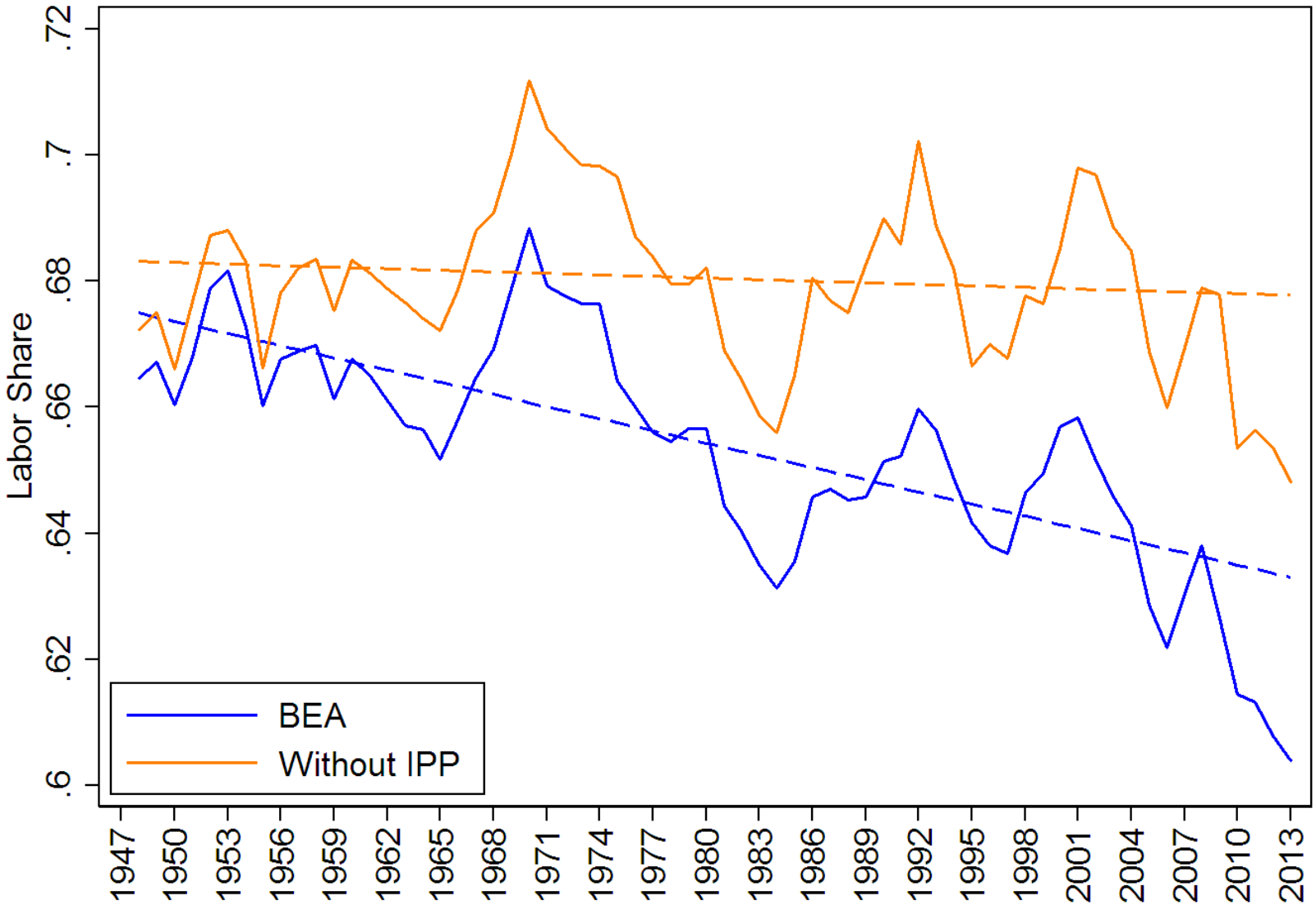


Effects of IPP Capitalization on LS

- The secular decline in the LS can be entirely attributed to the increase in IPP capital.

Effects of IPP Capitalization on LS

- The secular decline in the LS can be entirely attributed to the increase in IPP capital.
- The LS with only structures and equipment capital (i.e., without IPP) is absolutely trendless over the past 65 years.

▸ Vintage LS
▸ LS 1929-2013

Further Decompositions and Robustness

(1) R&D is the most important IPP component behind the LS decline. Software more role since the 1980s. ▸ Appendix

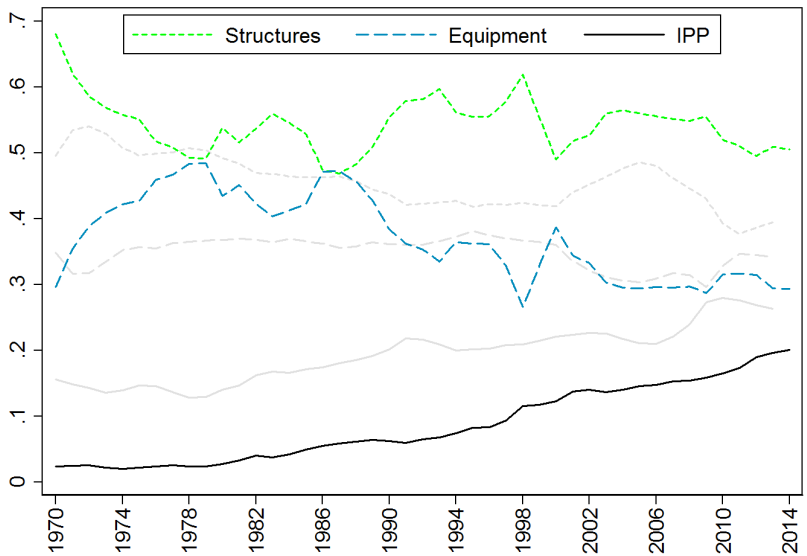
(2) Private IPP is behind the LS decline. Government IPP changes the LS level but not the trend. ▸ Appendix

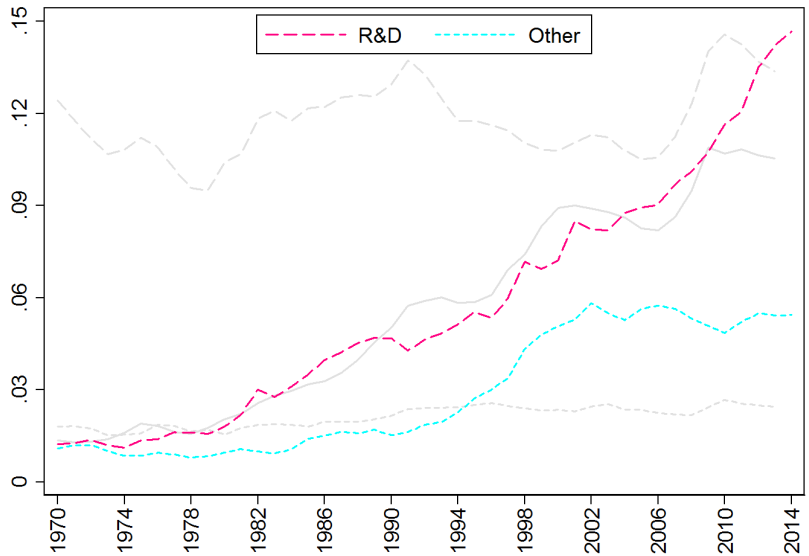
(3) Without IPP capital, the Corporate LS is also absolutely trendless. ▸ Appendix

(4) At the industry level, more IPP capital $\rightarrow$ industry LS declines. Dramatic for the manufacturing sector. ▸ Appendix

(5) Adding advertising to NIPA & FAT shifts the LS down, but minor contributions to the decline. ▸ Appendix

BONUS: IPP EFFECTS ON KOREAN LS





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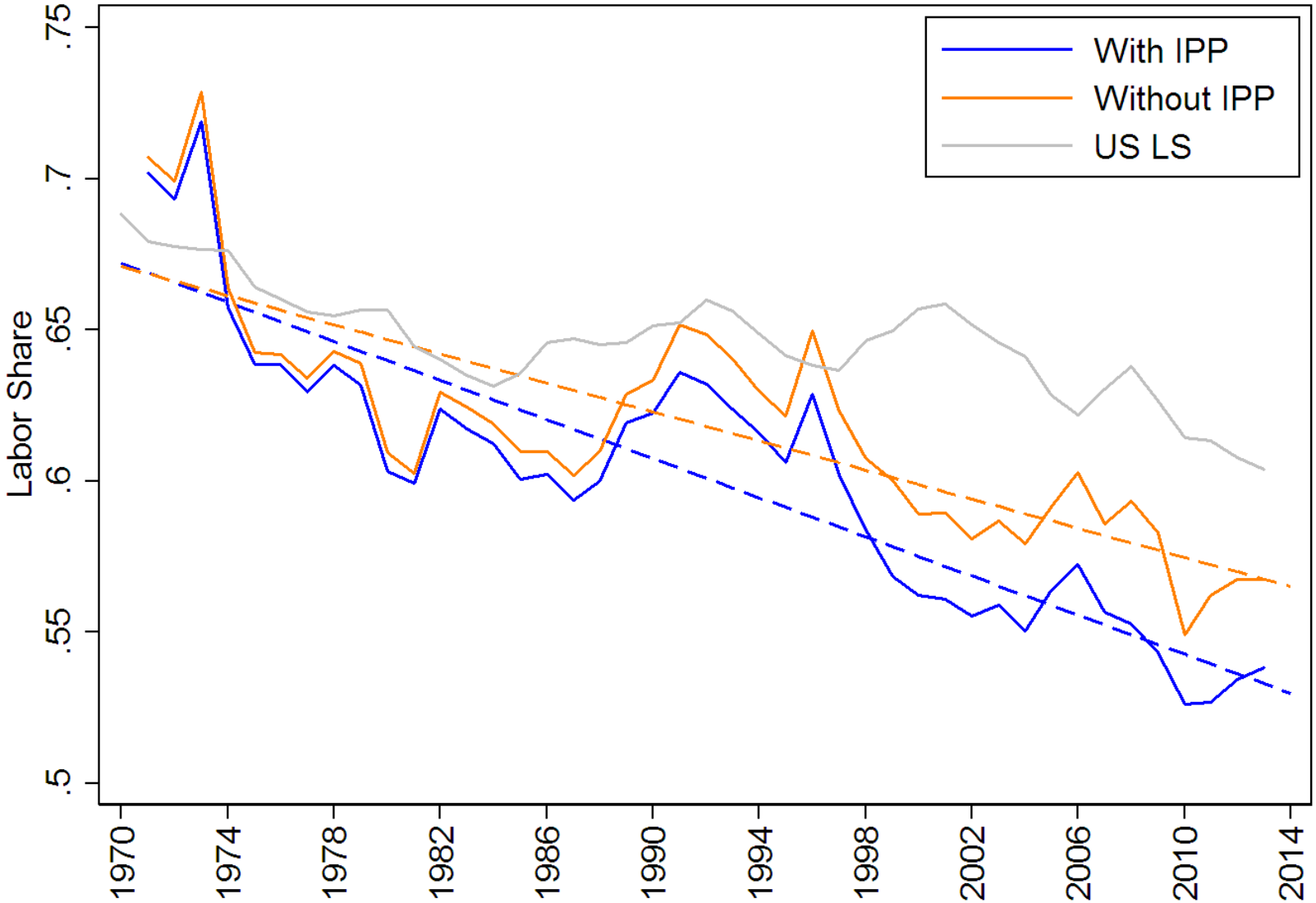


CONCLUSION

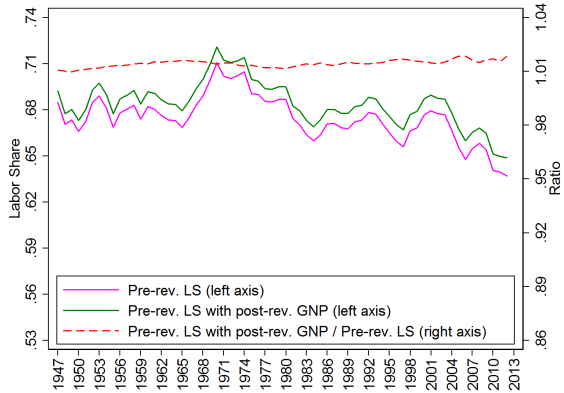
- IPP capital explains US LS decline.
  - Structures and equipment capital $\rightarrow$ LS is trendless for the past 65 years.

- LS decline should therefore be seen as the result of a transition toward a more IPP-intensive economy, a shift induced by continuing technological change.

- What is next?
  - IPP-skilled labor complementarity to link aggregate inequality to wage inequality.
  - To jointly explain the US LS decline and the increase in inequality, we must focus on innovators generating IPP.
  - IPP explains US LS decline & is a source of growth $\rightarrow$ welfare depends on growth-inequality tradeoff.

Appendix

LS By National Income Component



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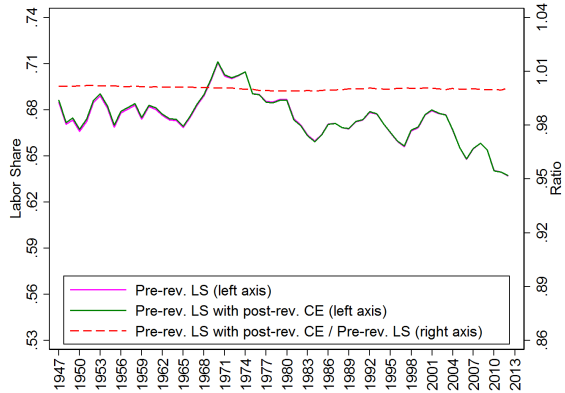
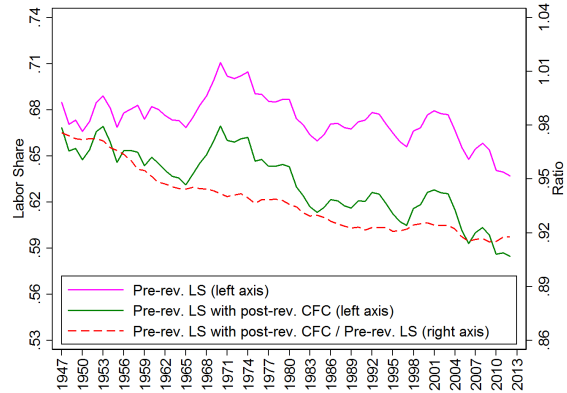
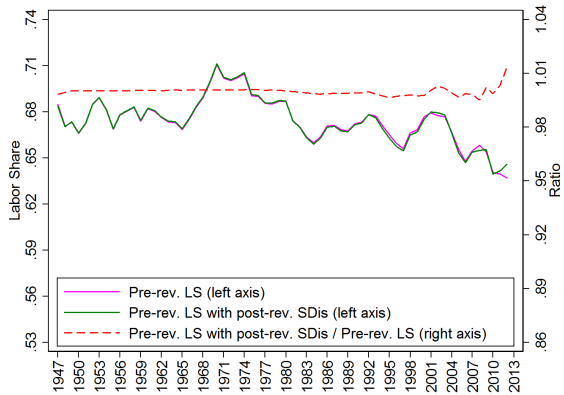


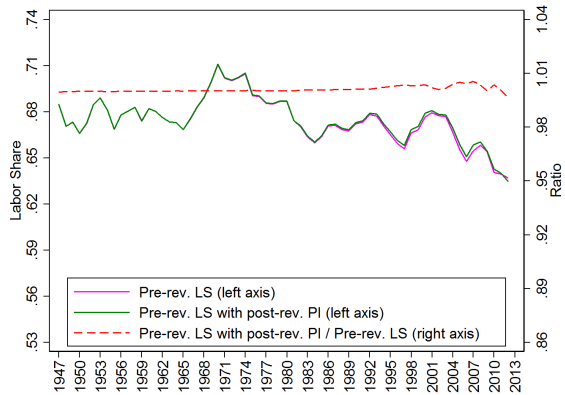
(b) CE



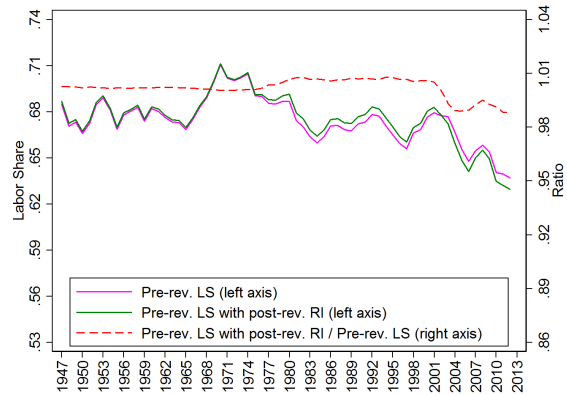
(c) CFC



(d) SDis

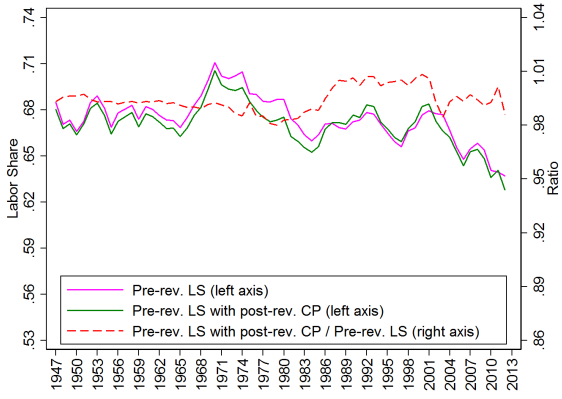


(e) PI

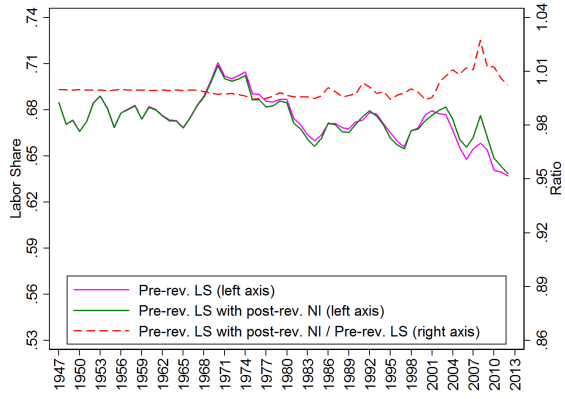


(f) RI

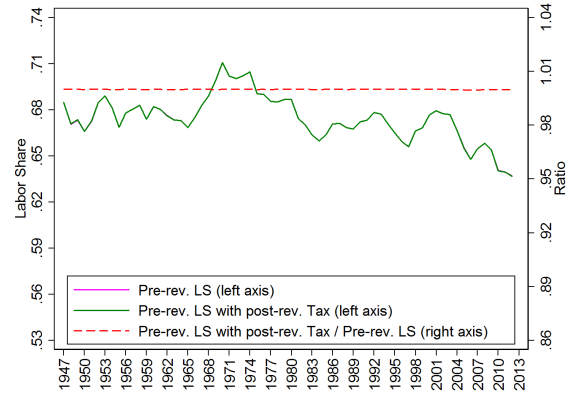
LS By National Income Component



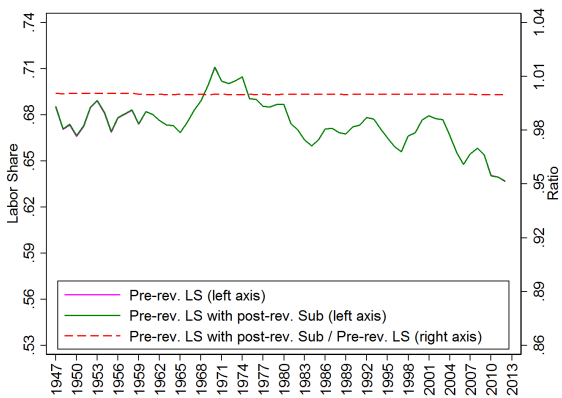
(g) CP



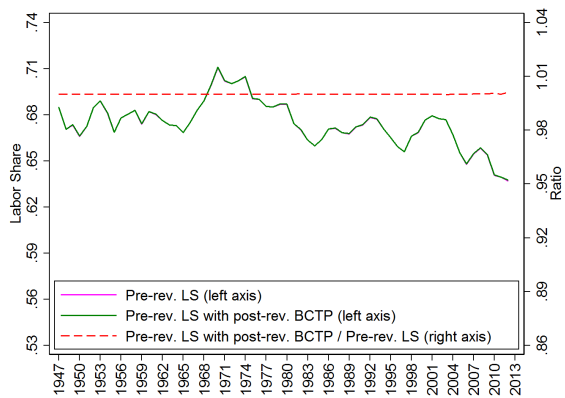
(h) NI



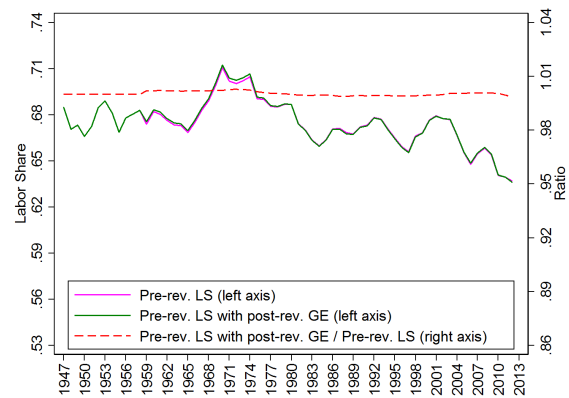
(i) Tax



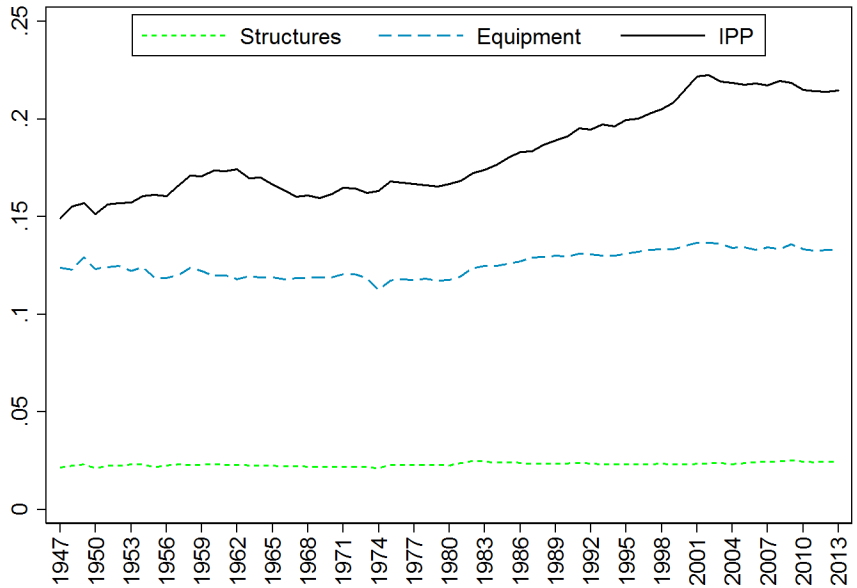
(j) Sub



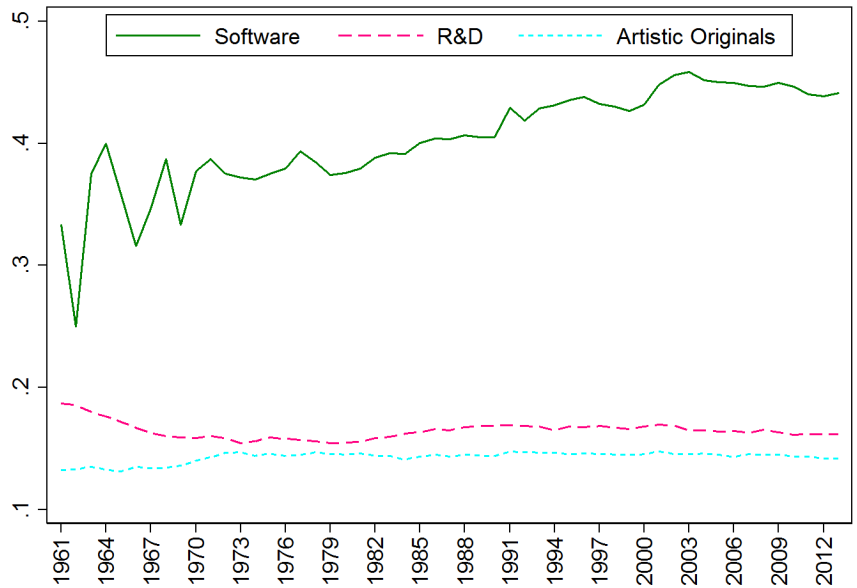
(k) BCTP



(l) CSGE



(a) Depreciation Rates of Structures, Equipment and IPP

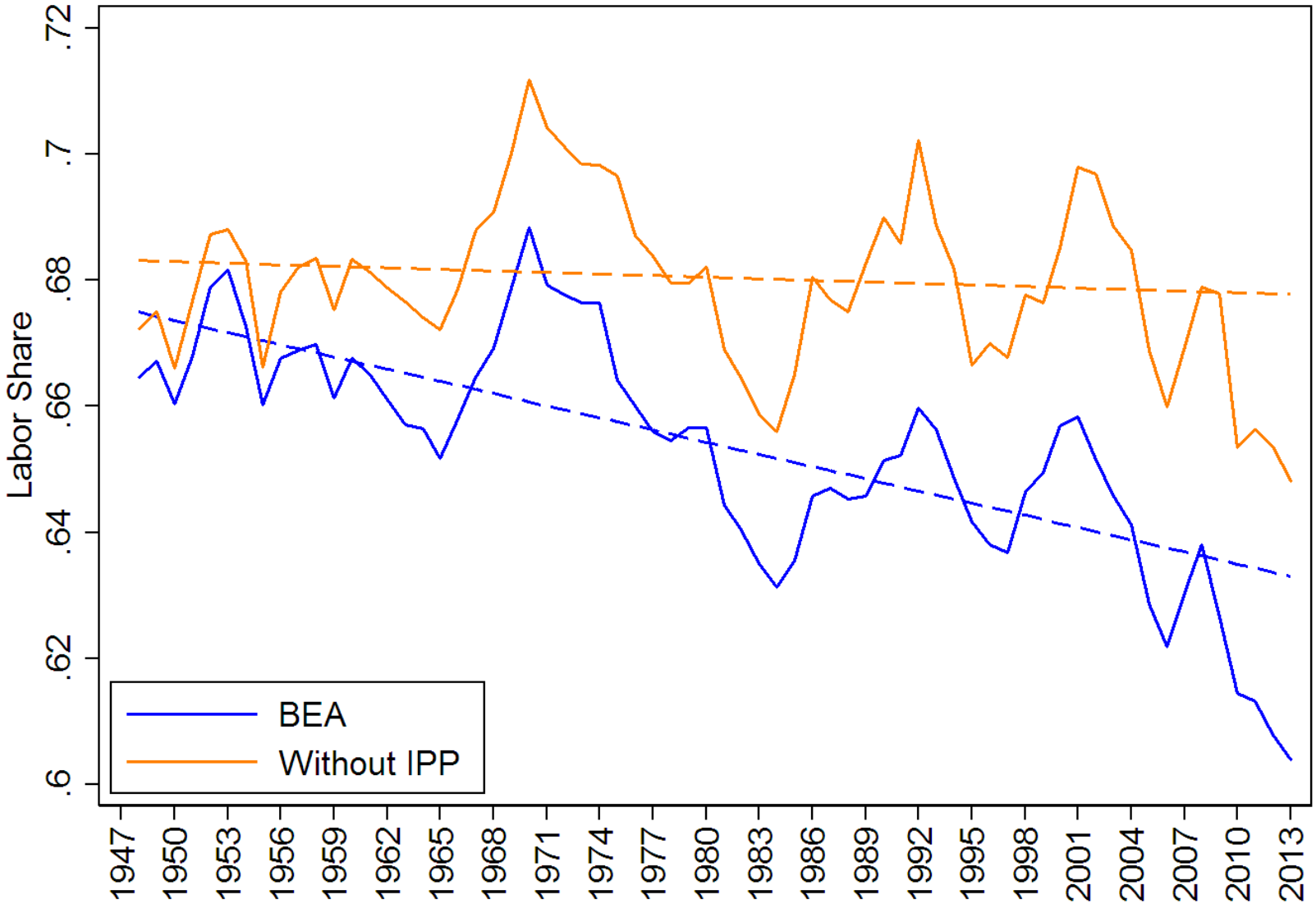


(b) Depreciation Rates of IPP Components

▸ Back

Vintage Labor Share: Only Software Was Capitalized

Pre-2013 BEA Revision Era



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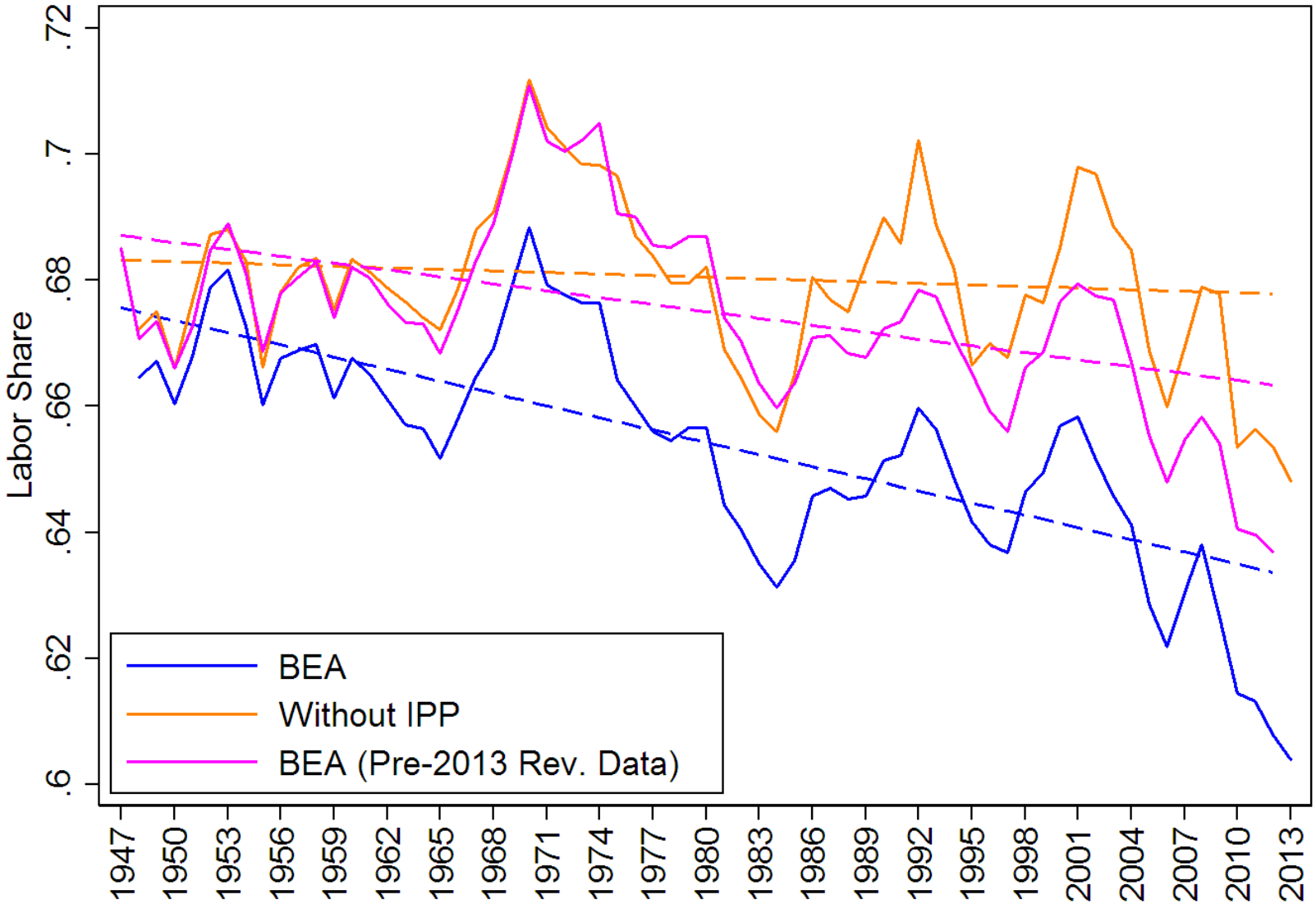
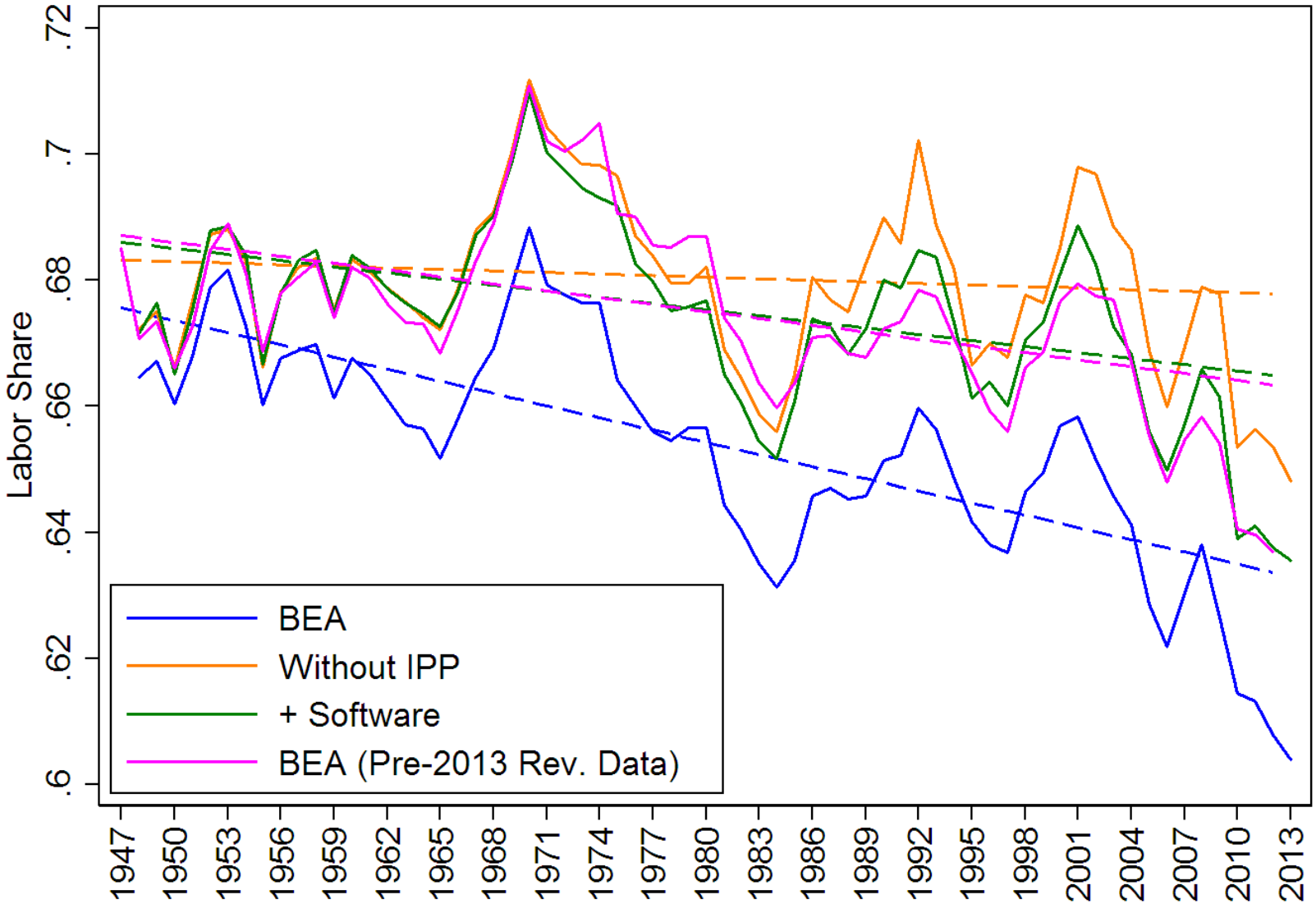


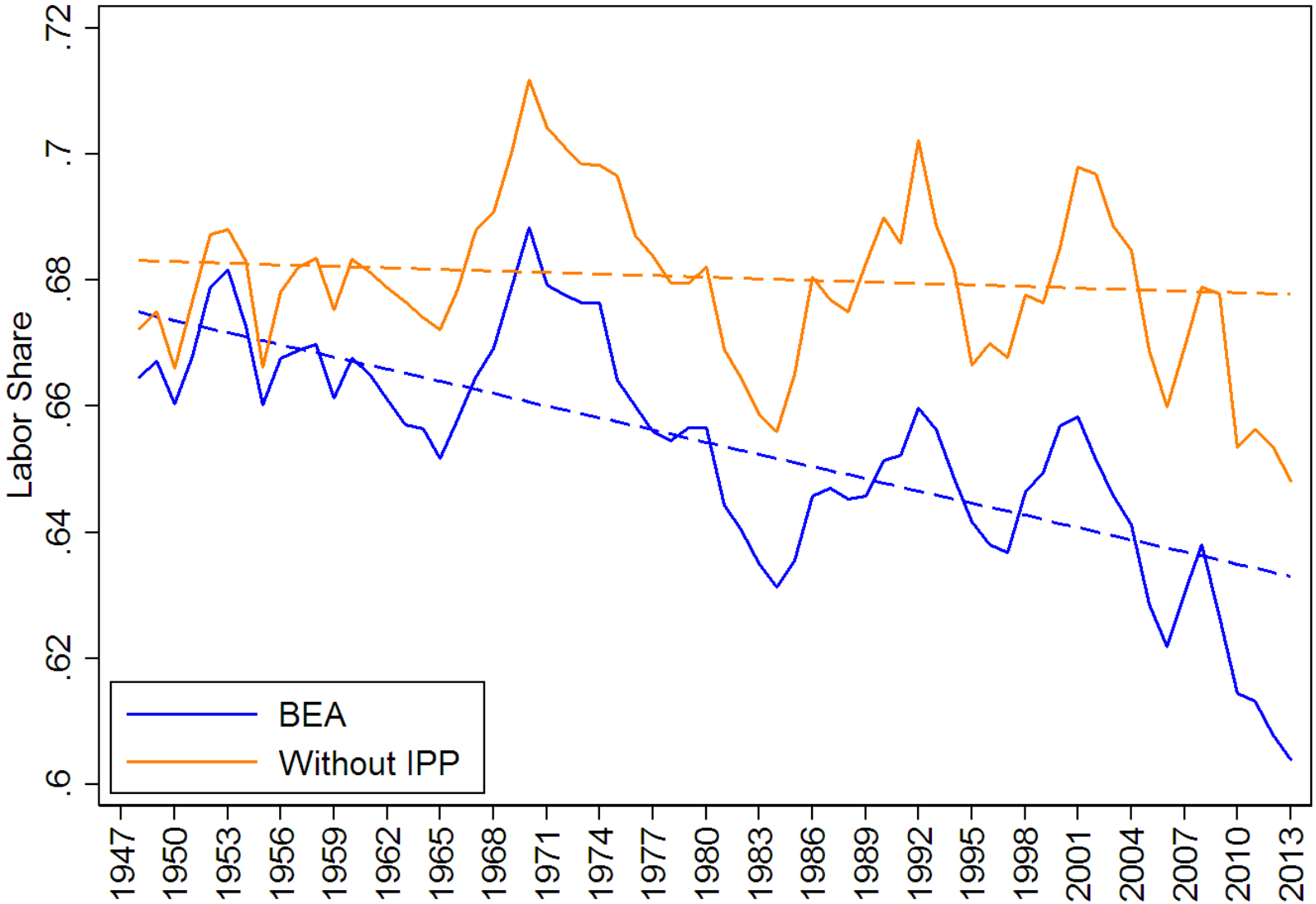
VINTAGE LABOR SHARE: ONLY SOFTWARE WAS CAPITALIZED

PRE-2013 BEA REVISION ERA



Vintage Labor Share: When IPP Was Not Capitalized

Pre-1999 BEA Era



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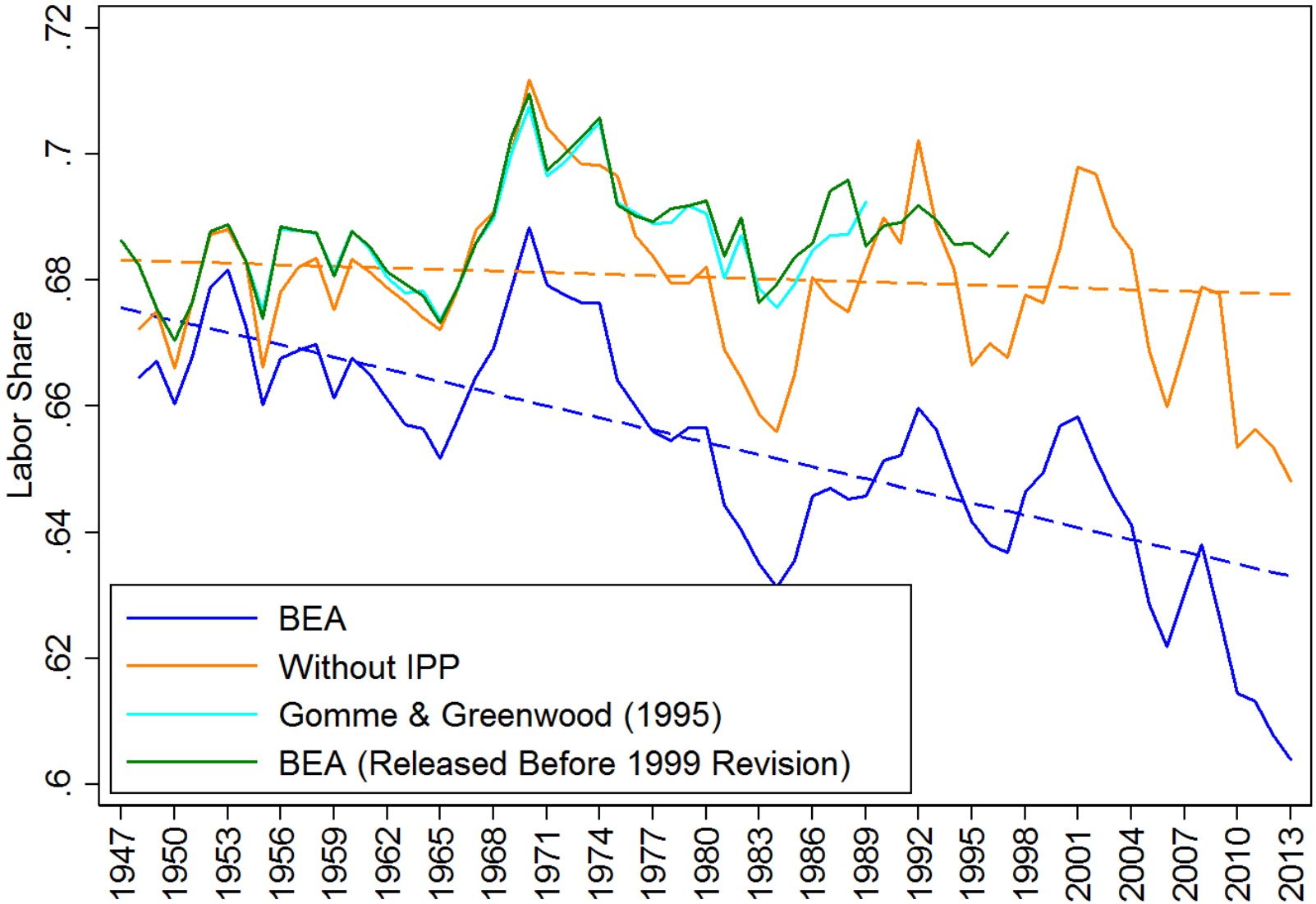


Refreshing the Main Take-Aways

1. **From investment model: LS decline can be entirely attributed to IPP capital.**

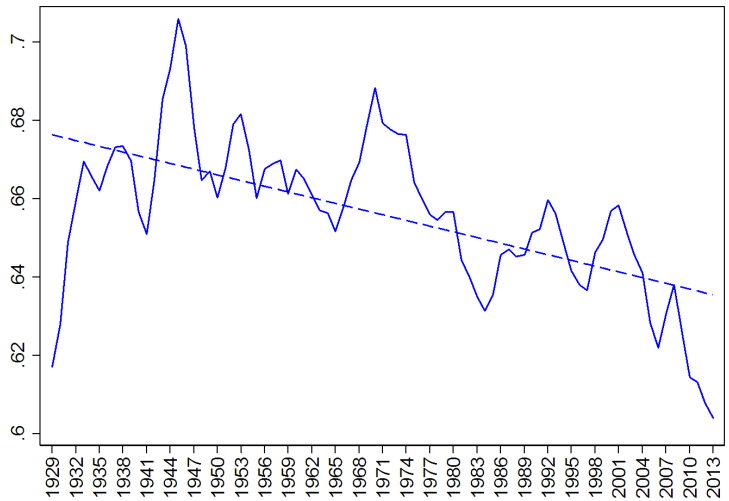
2. **Direct evidence from vintage data:**

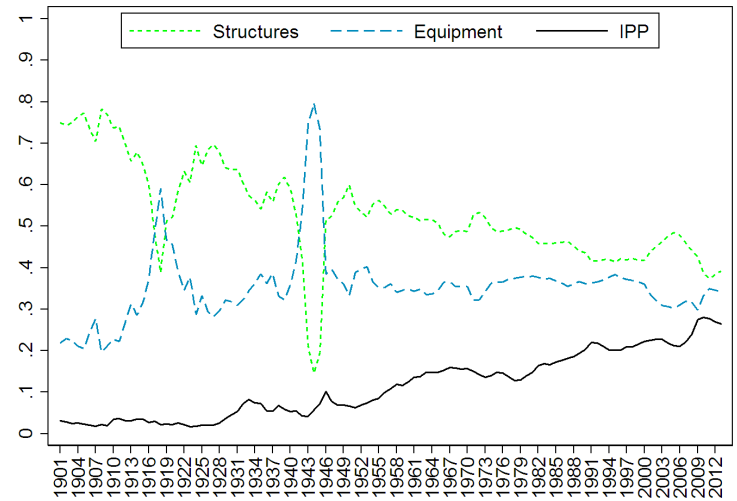
   2.1 Pre-1999 BEA Revision: When IPP was not capitalized
   $\rightarrow$ LS is trendless.

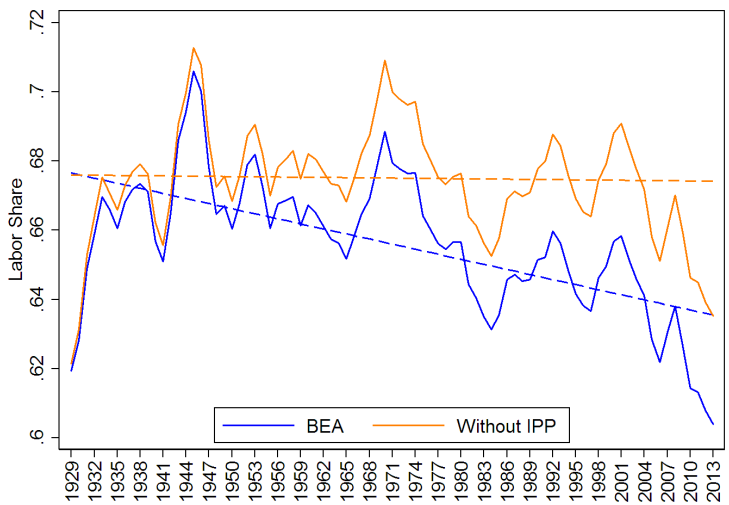
   2.2 Pre-2013 BEA Revision: Only software was capitalized
   $\rightarrow$ LS decline is minor, starts in the mid 1970s.

▸ Back

US Labor Share, BEA 1929-2013







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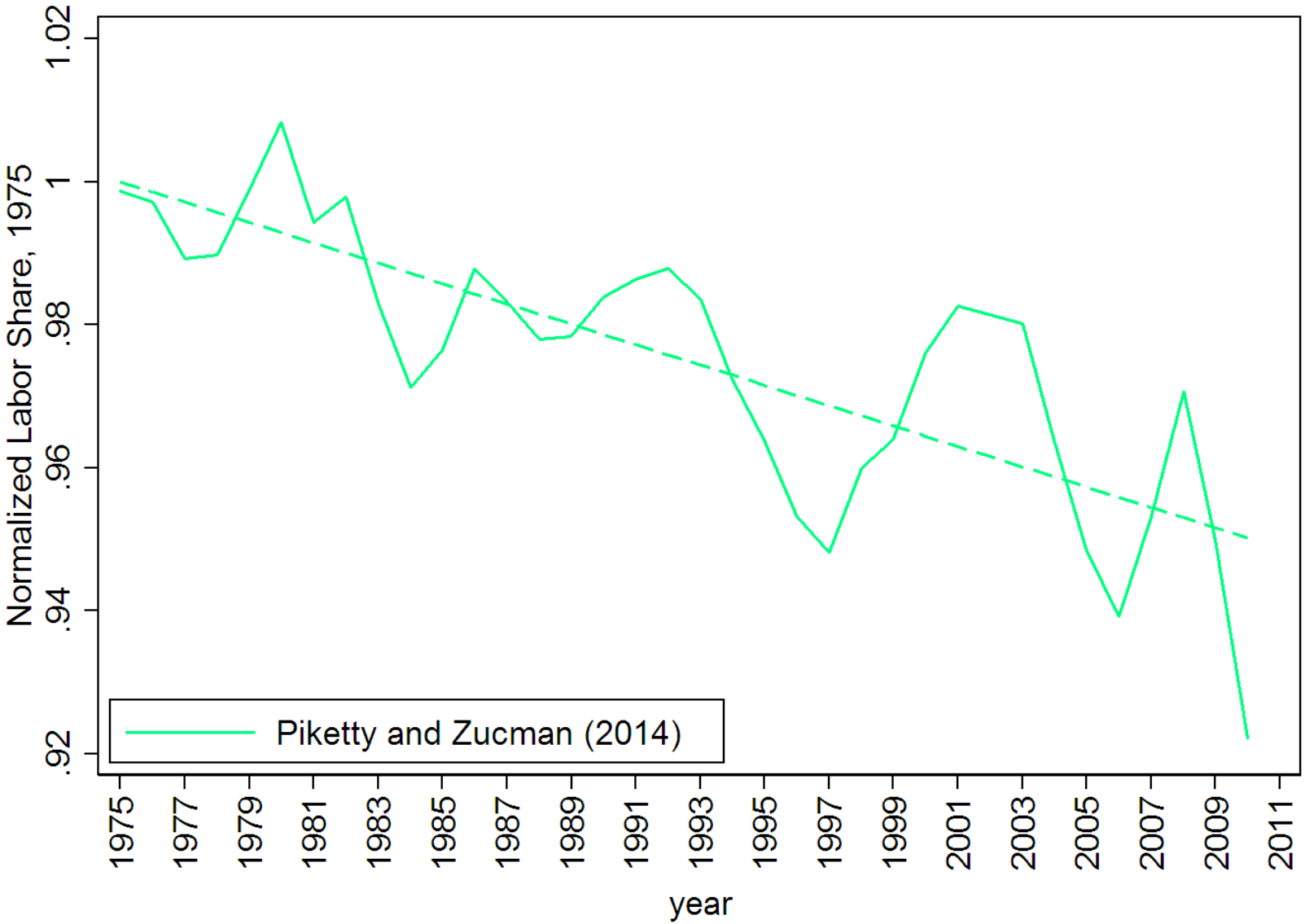
PIKETTY AND ZUCMAN '14, PIKETTY '14 SAMPLE PERIOD



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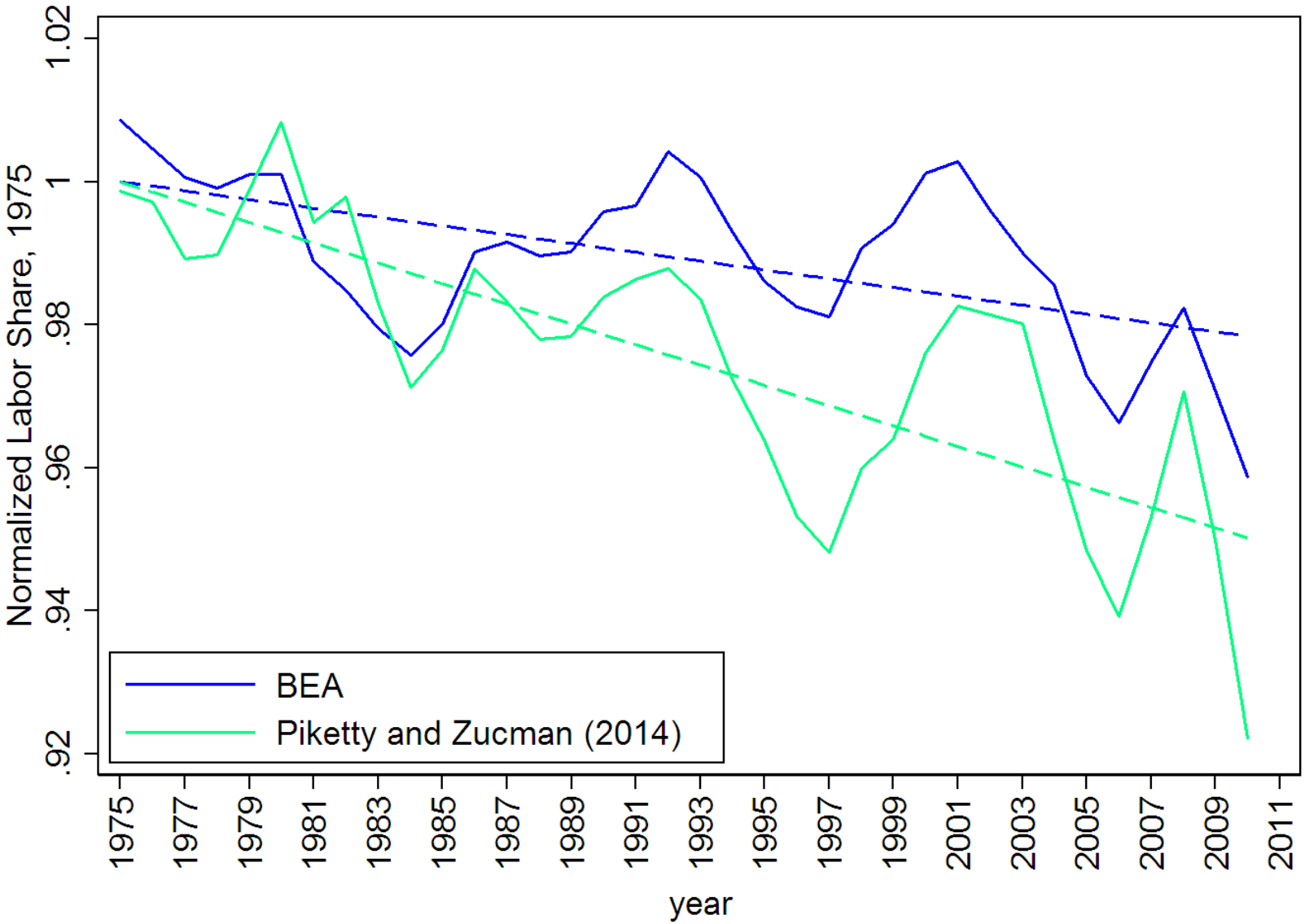

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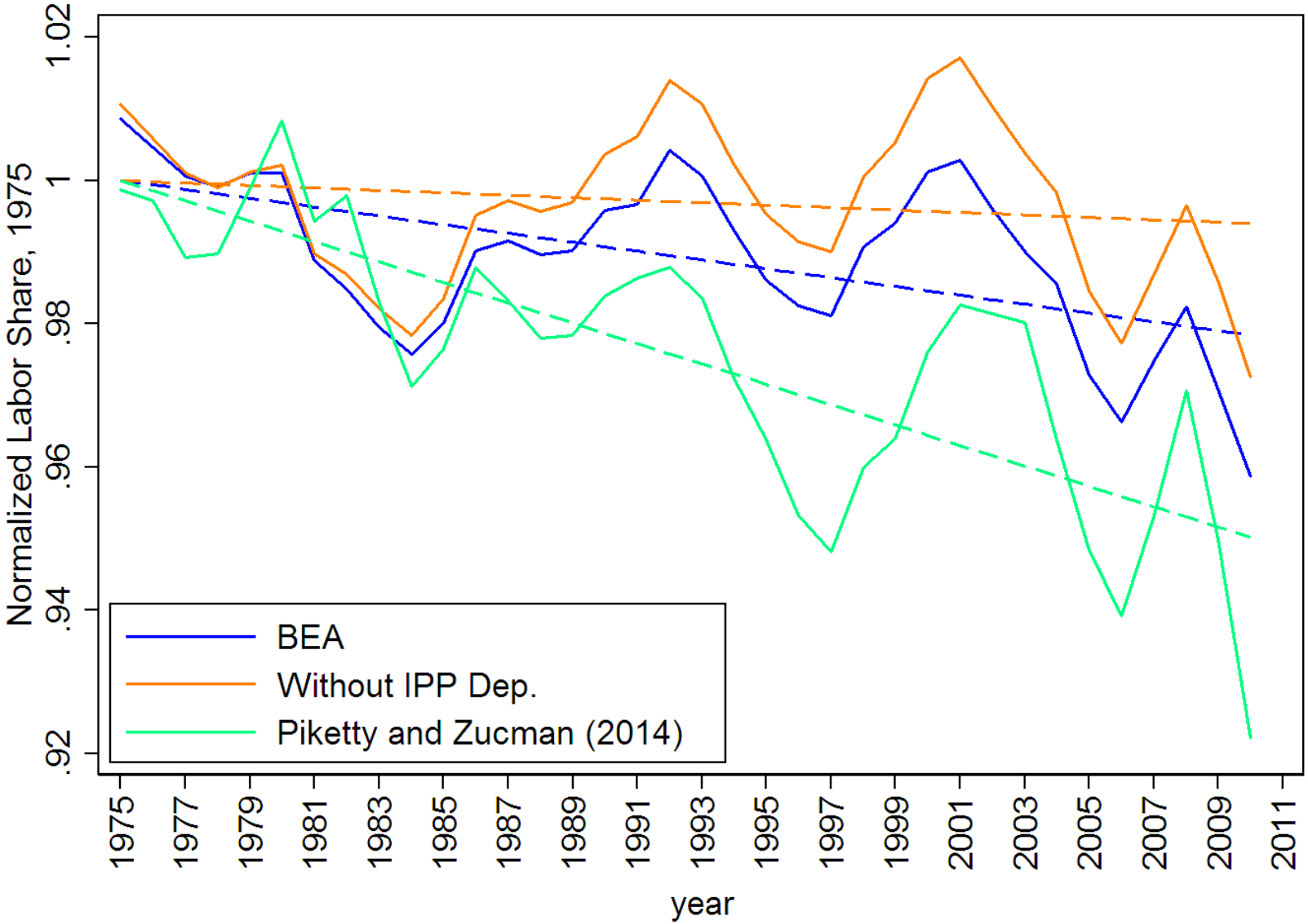


Decomposition of Total Effects

(1) Removing IPP depreciation:

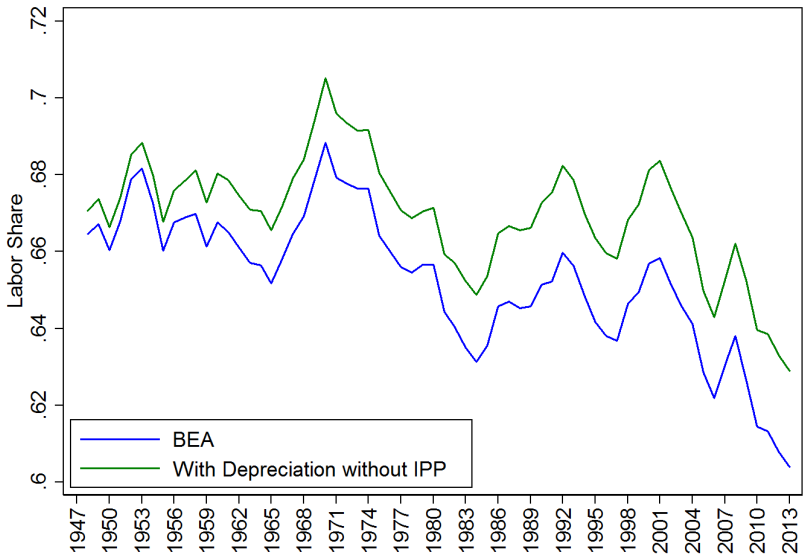
$$R_t k_t^x = \left(\frac{1 + r_t}{v_{t-1}} - \frac{1}{v_t} \right) k_t^x + \frac{1}{v_t} \delta_t k_t^x = \left(\frac{1 + r_t}{v_{t-1}} - \frac{1}{v_t} \right) k_t^x + DEP.$$

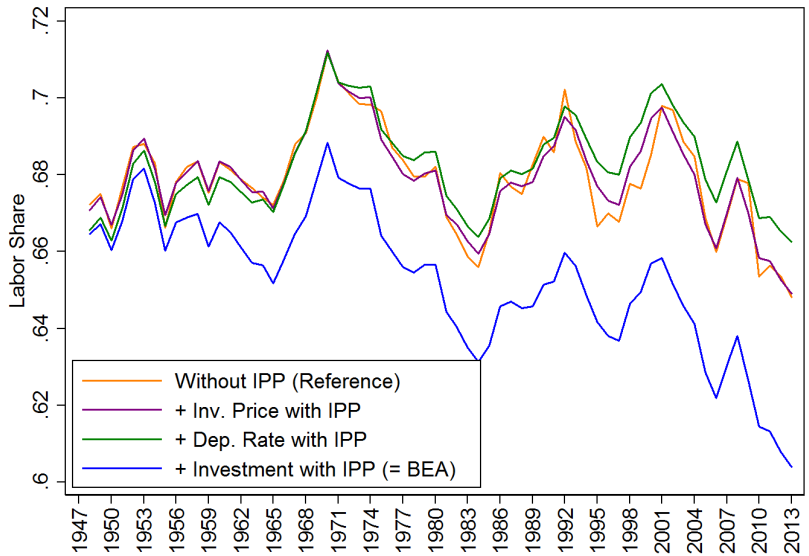
(2) Adding back IPP effects on $1/v_t$, δ_t, and i_t.

(3) IPP effect in $1/v_t$ through R_t and capital accumulation

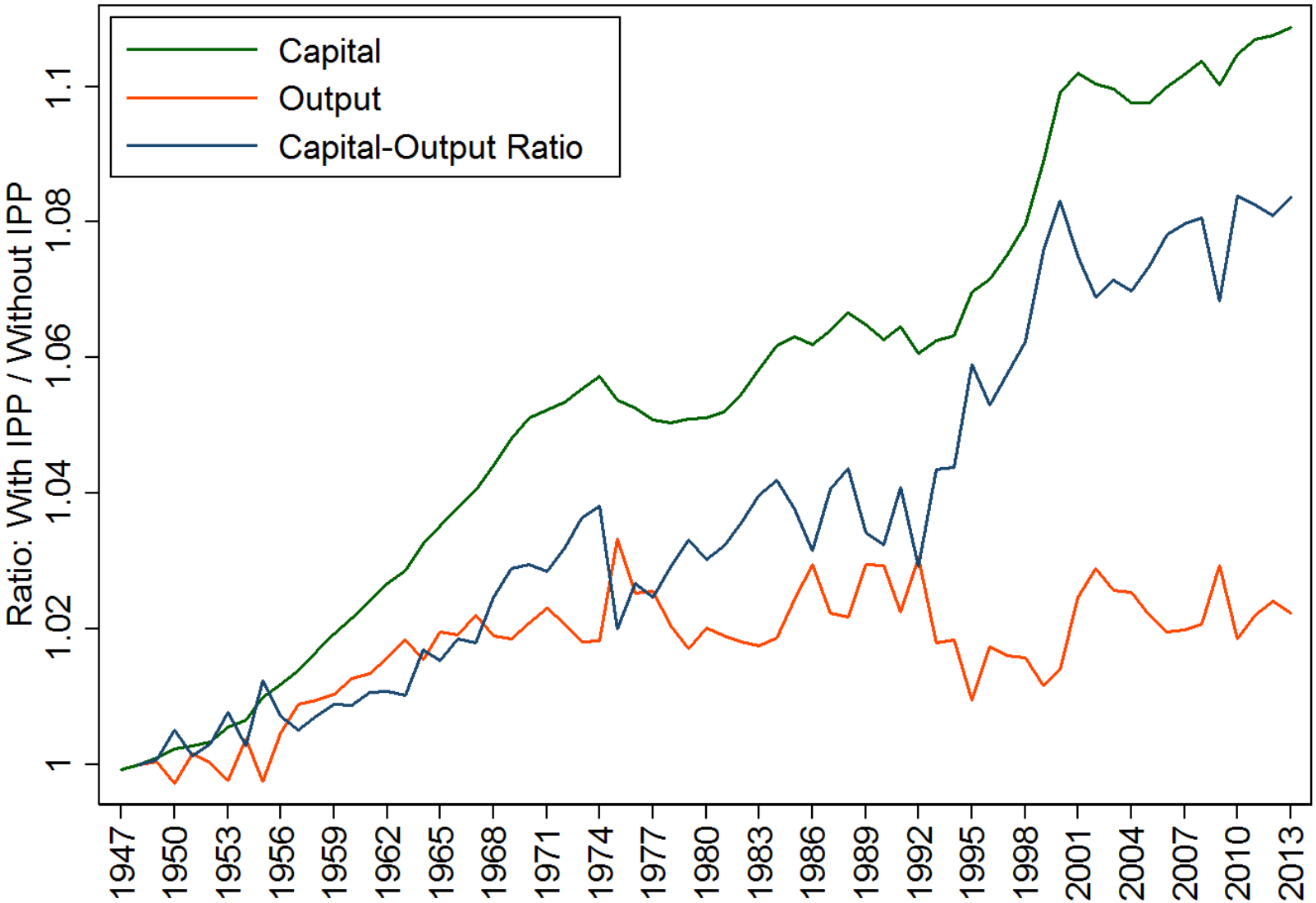
(4) IPP effect in δ_t through R_t and capital accumulation

Decomposition of Total Effects

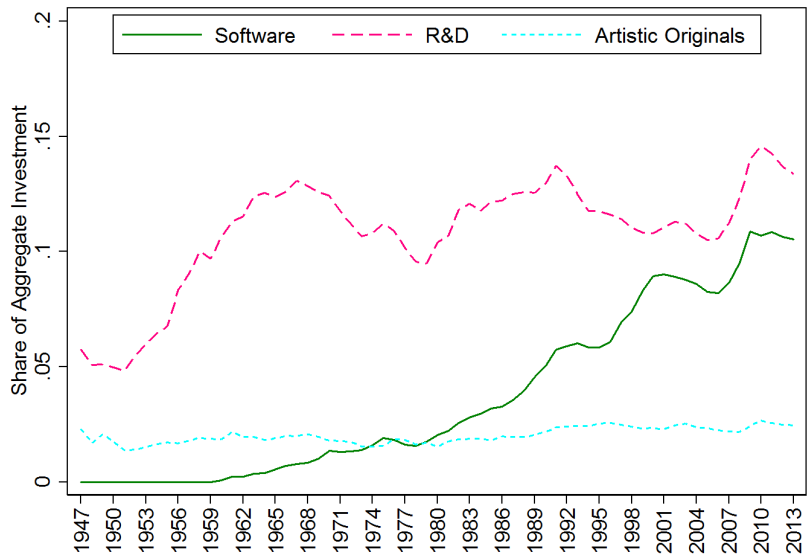




THE EFFECTS OF IPP CAPITALIZATION ON AGGREGATE CAPITAL



SOFTWARE, R&D, AND ARTISTIC ORIGINALS



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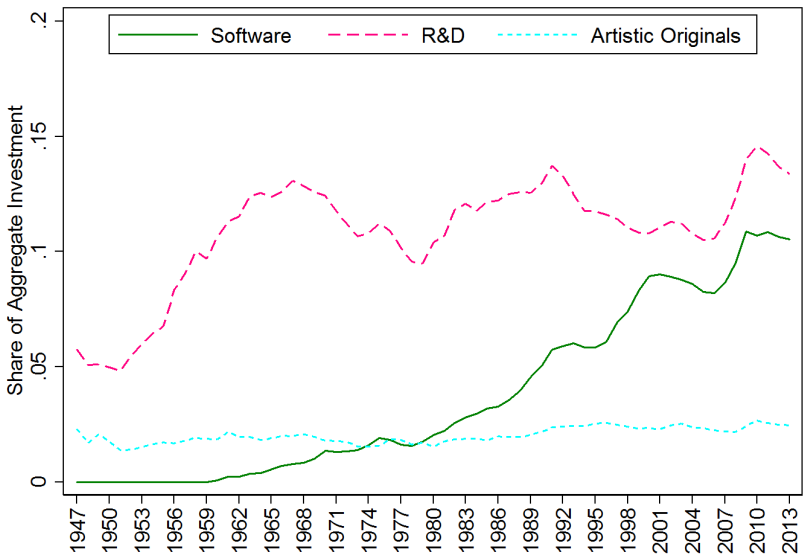

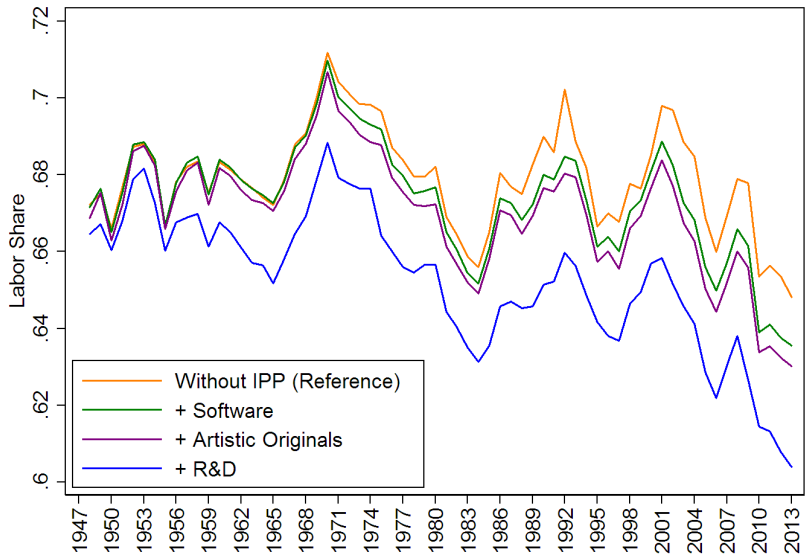

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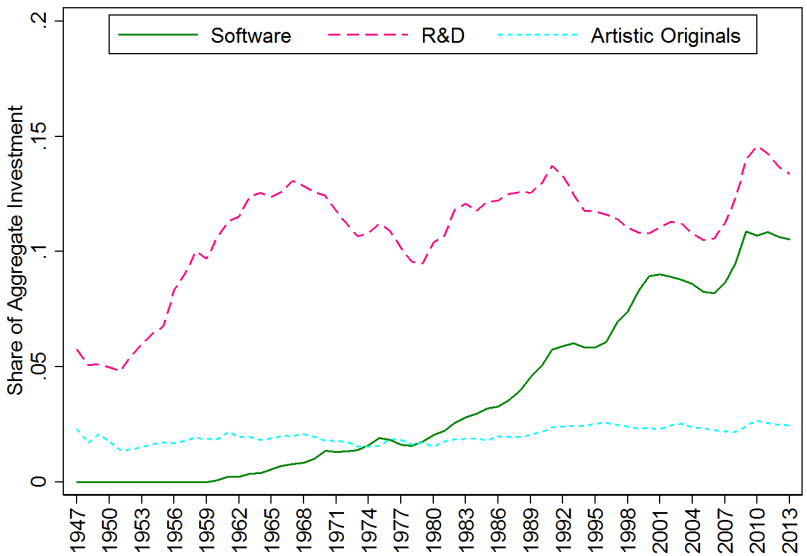

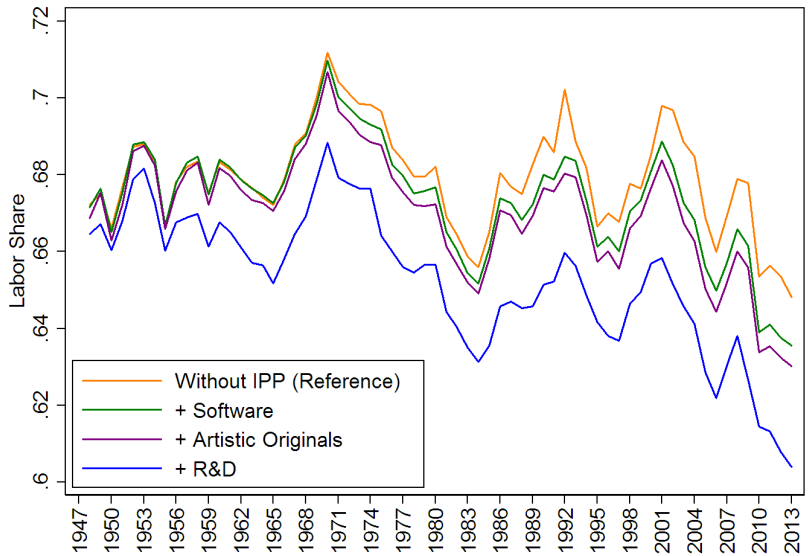

R&D is the most important IPP component behind the LS decline. Software more role since the 1980s.

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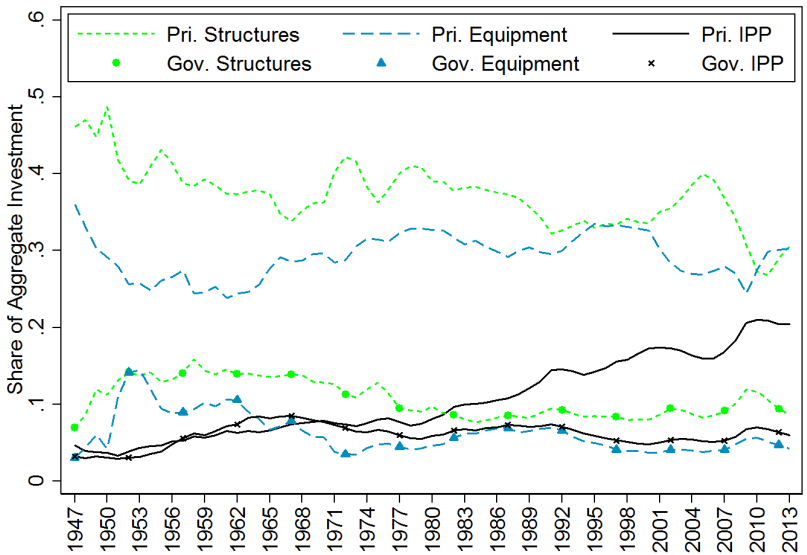
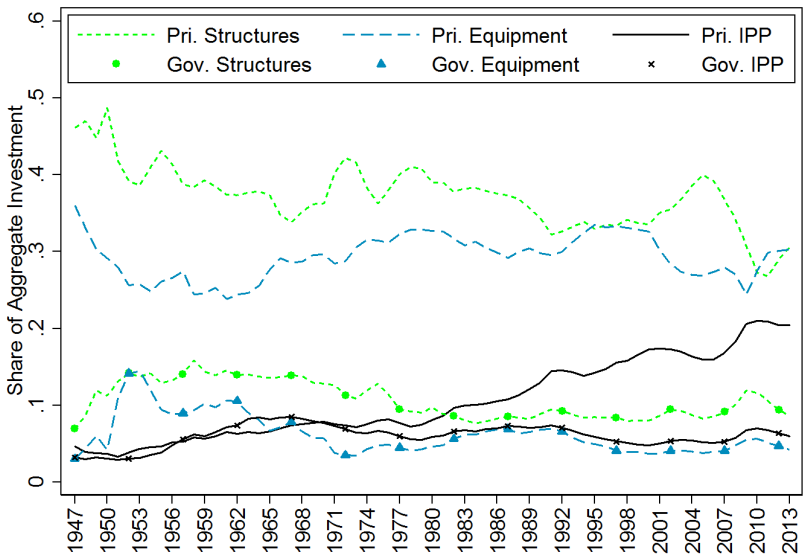
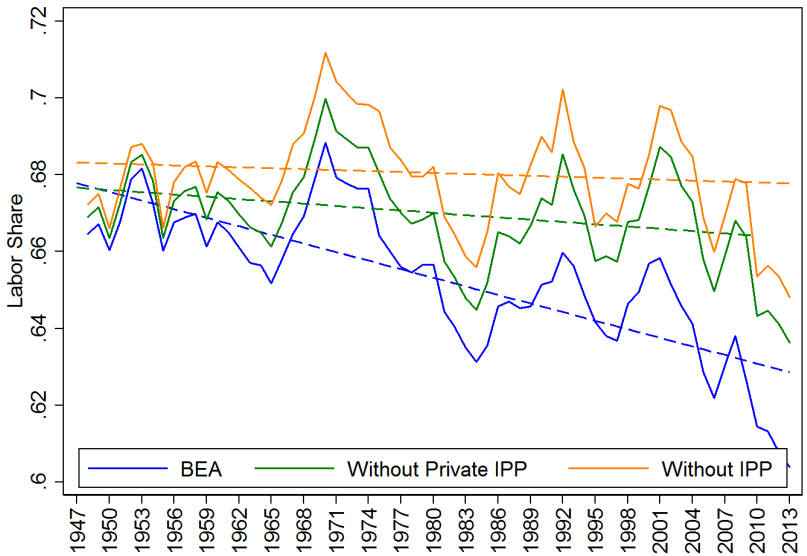
PRIVATE AND GOVERNMENT IPP

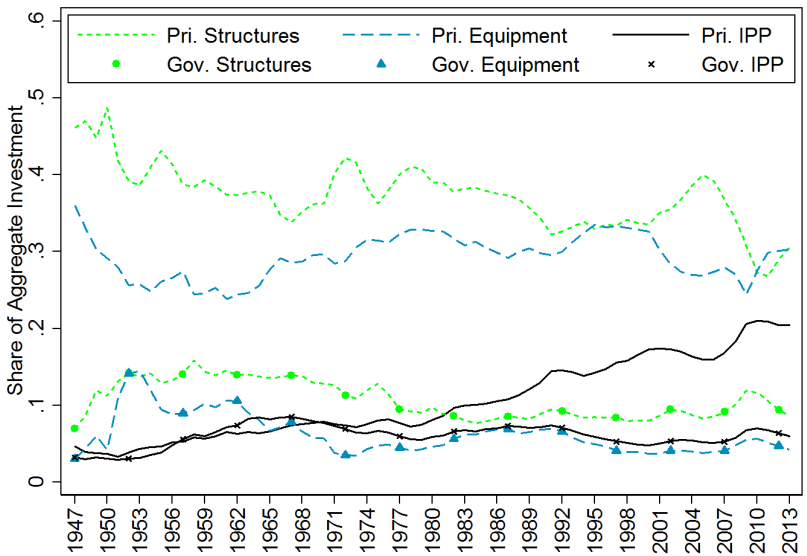


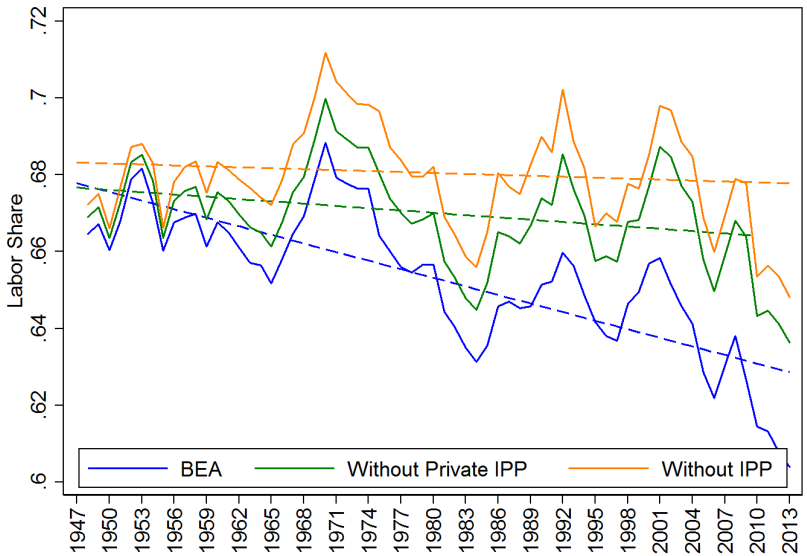
PRIVATE AND GOVERNMENT IPP





PRIVATE AND GOVERNMENT IPP





Private IPP is behind the LS decline. Government IPP changes the LS level but not the trend.

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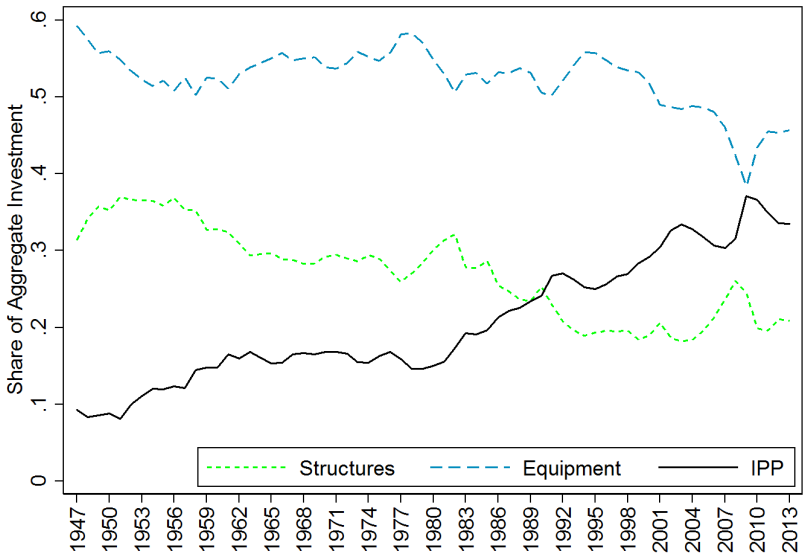
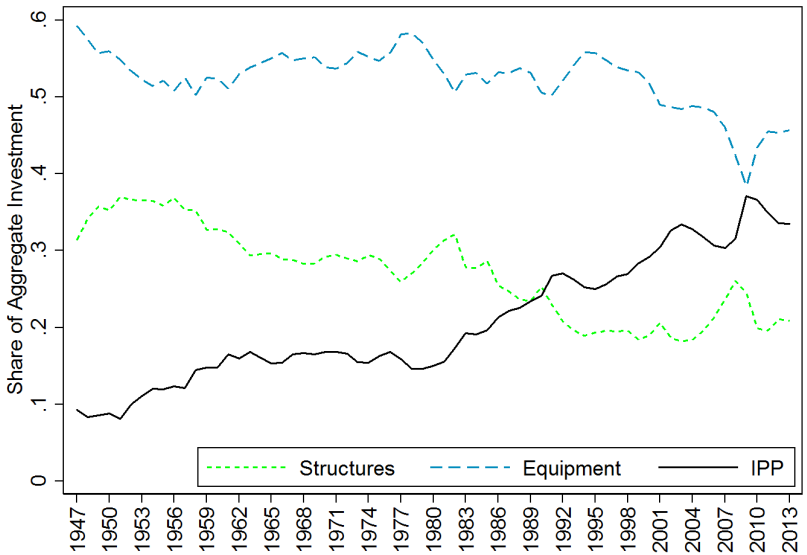
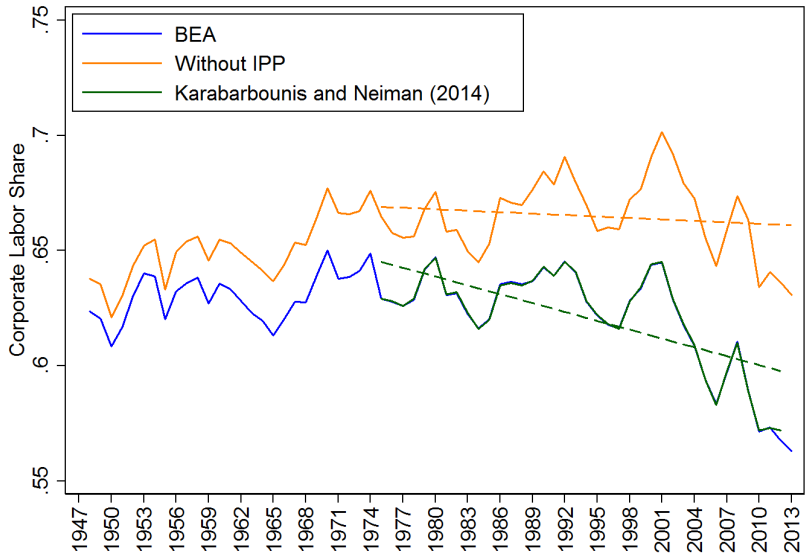
ROBUSTNESS TO CORPORATE LS

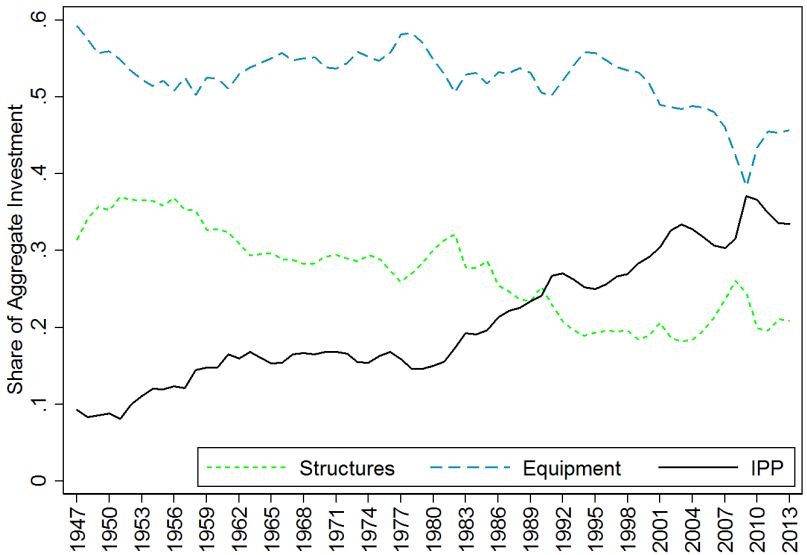


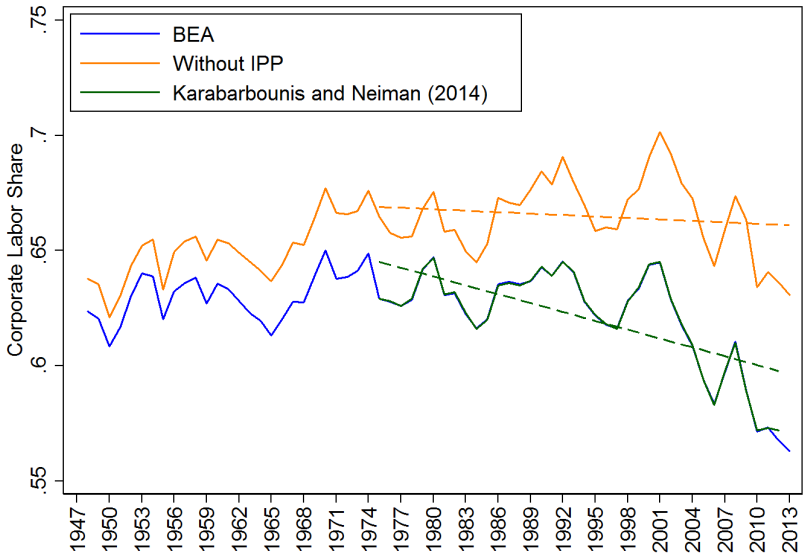
ROBUSTNESS TO CORPORATE LS





Robustness to Corporate LS





Without IPP capital, the Corporate LS is also absolutely trendless.

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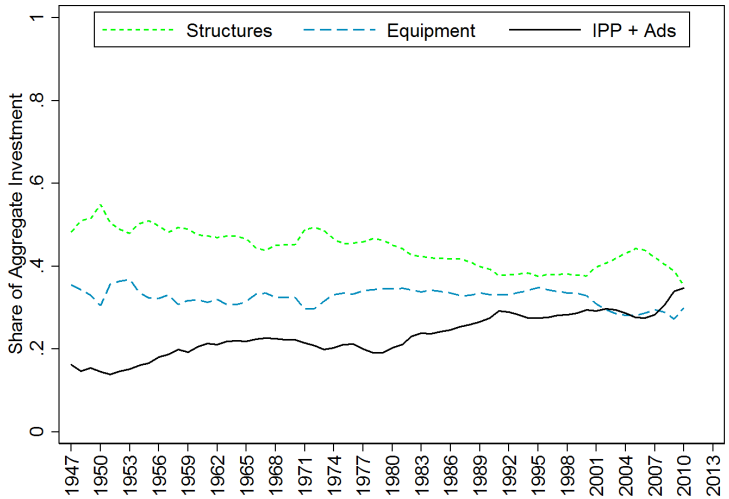
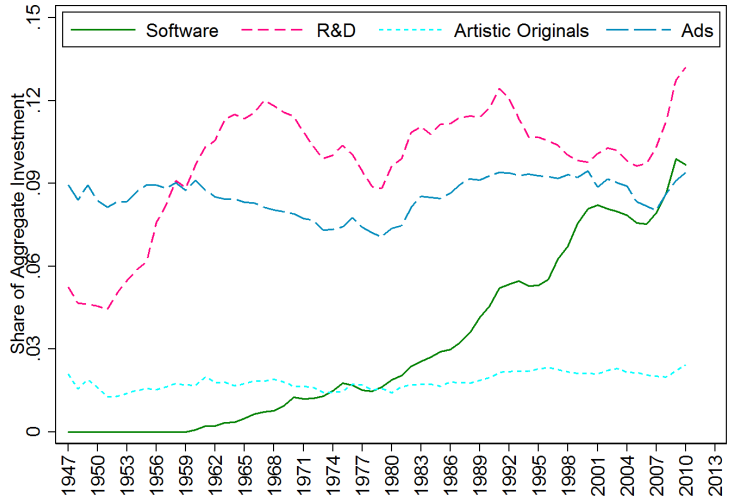
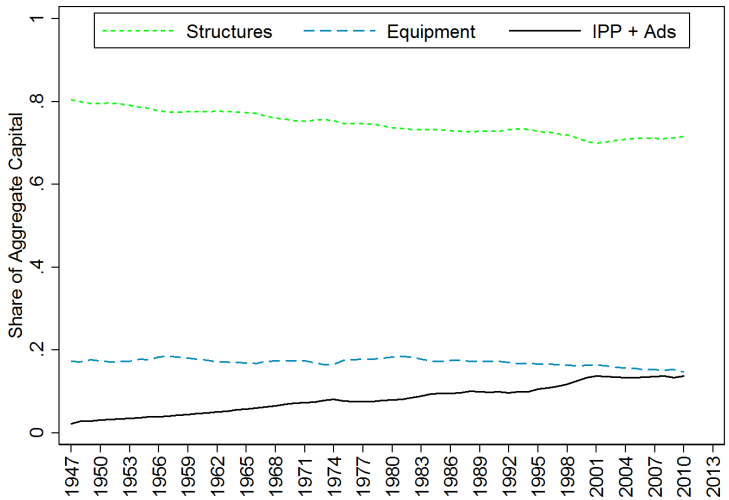
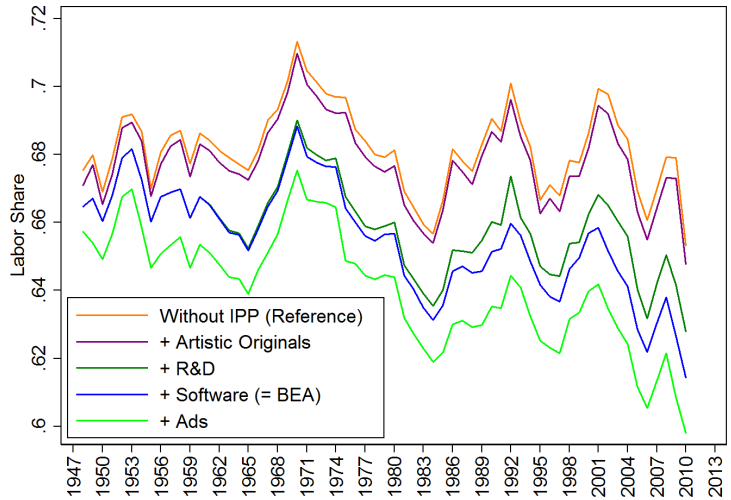
ADDING ADVERTISING TO BEA IPP ACCOUNTS









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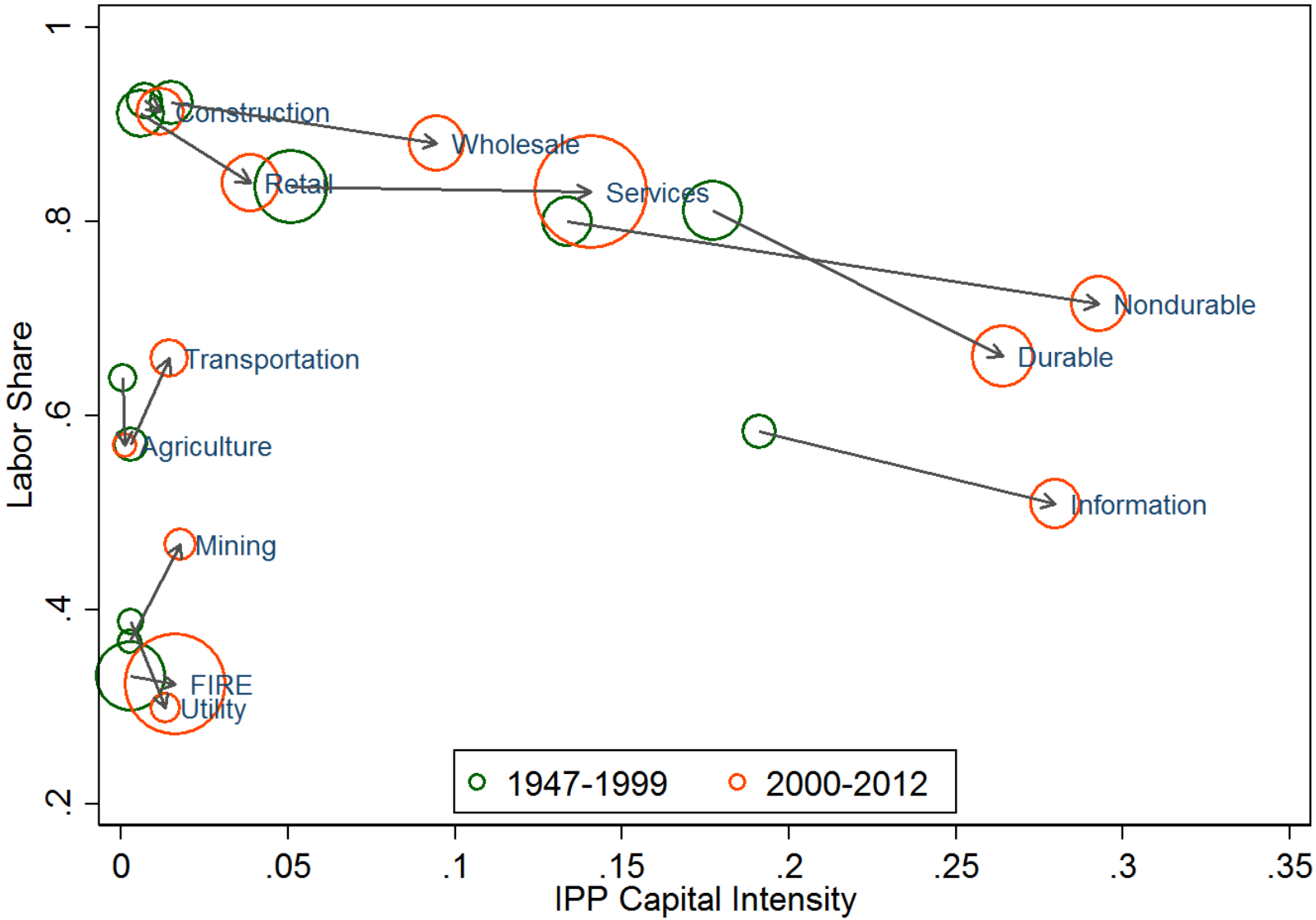
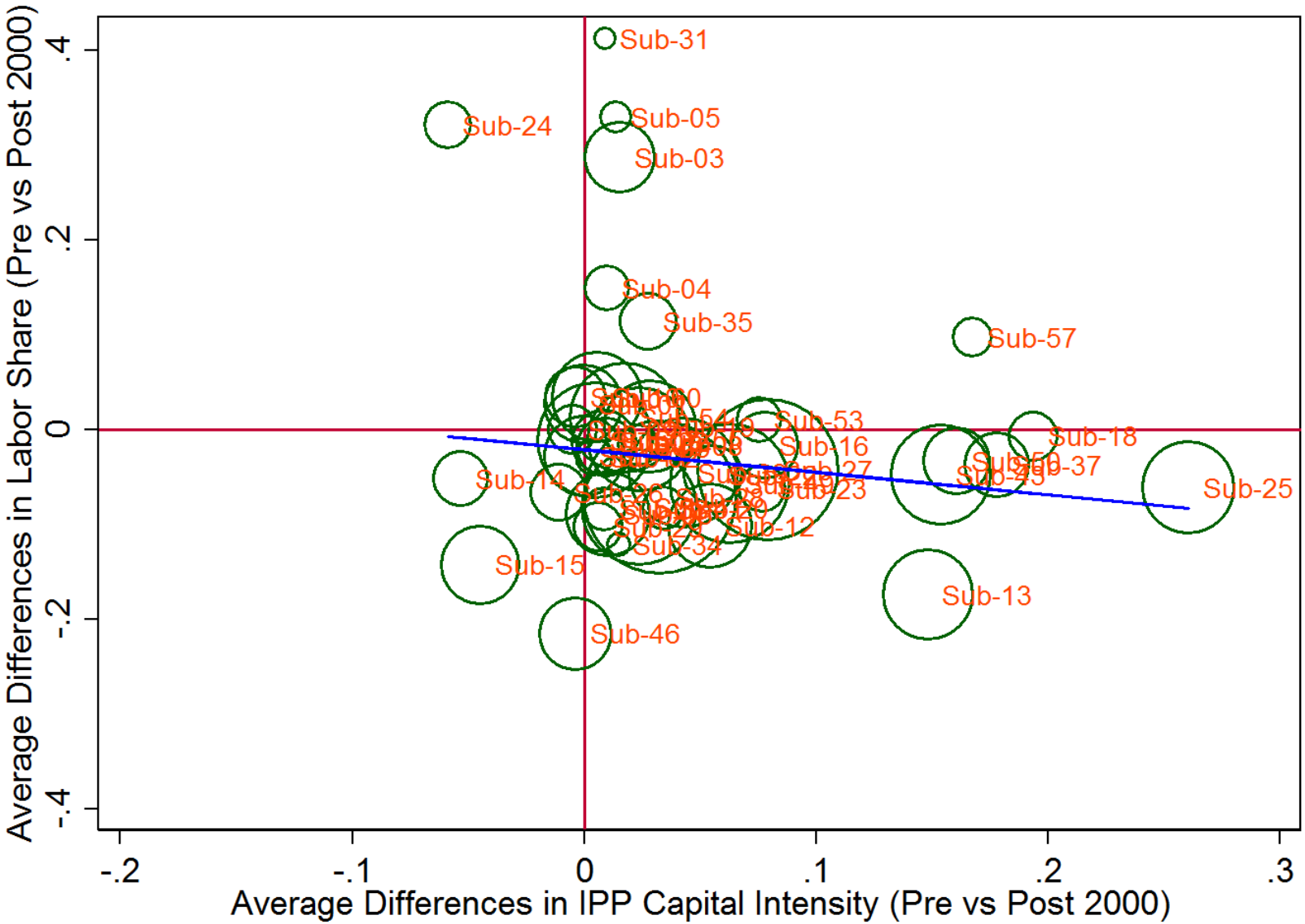
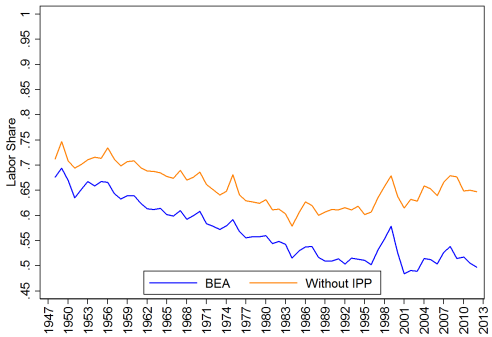
LS AND IPP CAPITAL INTENSITY BY INDUSTRY



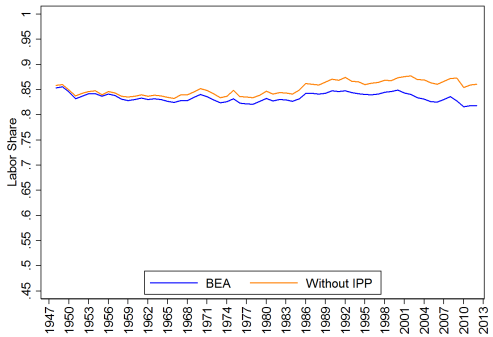
... BY SUB-INDUSTRY



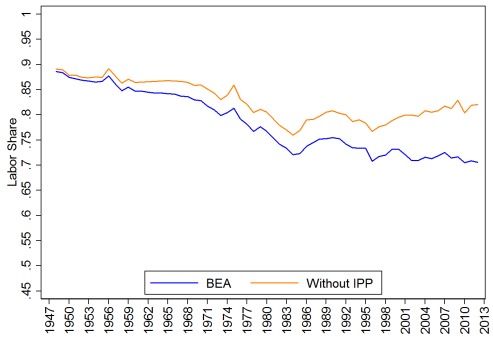
LS Decline by Industry



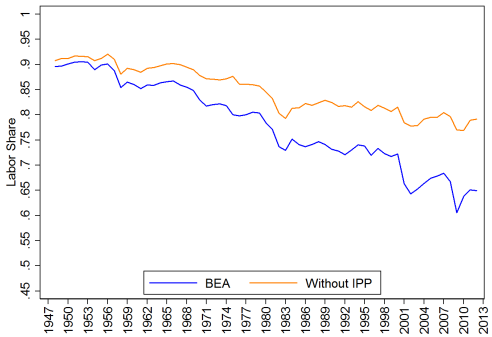
(a) Information



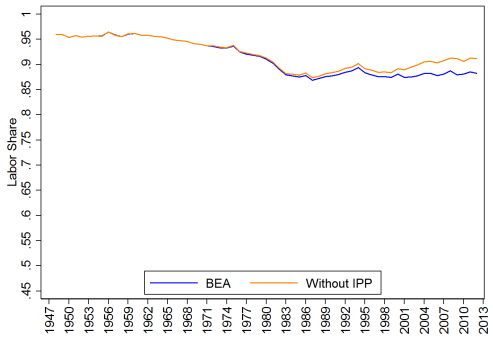
(b) Services



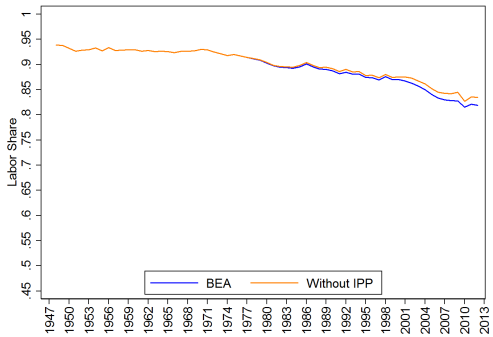
(c) Manufacturing: Nondurable goods



(d) Manufacturing: Durable goods



(e) Wholesale Trade



(f) Retail Trade

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An Interpretation of Our Results

- Main result: The decline in the US LS is driven by IPP capital.
- Any US model that features LS decline needs to allow for IPP capital.
- We examine this point with a two-sector model almost identical to McGrattan and Prescott (2010,12)

A Two-Sector Model with IPP

- Utility maximizing planner's problem:

$$\max E \sum_{t=0}^{\infty} \beta^t u(c_t, l_t)$$

- The final good sector produces a consumption good:

$$y_t = A_{1,t}(k_{1,t})^{\theta_1}(d_t)^{\phi_1}(l_{1,t})^{1-\theta_1-\phi_1}.$$

- IPP sector produces an IPP investment good:

$$x_t^d = A_{2,t}(k_{2,t})^{\theta_2}(d_t)^{\phi_2}(l_{2,t})^{1-\theta_2-\phi_2}.$$

- Laws of motion of two capitals are

$$k_{t+1} = (1-\delta_k)k_t + x_t^k,$$
$$d_{t+1} = (1-\delta_d)d_t + x_t^d,$$

A Two-Sector Model with IPP

- The resource constraint is

$$c_t + \frac{1}{v_t^k} x_t^k + \frac{1}{v_t^d} x_t^d = y_t$$

- Total capital and labor are

$$k_t = k_{1,t} + k_{2,t} \text{ and } l_t = l_{1,t} + l_{2,t}$$

- The LS in the final good sector, $1 - \theta_1 - \phi_1$, and in the IPP sector, $1 - \theta_2 - \phi_2$, are constant.
- The aggregate LS can be expressed as

$$\text{LS}_t = (1 - \theta_1 - \phi_1) \frac{y_t}{y_t + \frac{1}{v_t^d} x_t^d} + (1 - \theta_2 - \phi_2) \frac{\frac{1}{v_t^d} x_t^d}{y_t + \frac{1}{v_t^d} x_t^d}.$$

A Two-Sector Model with IPP

- Our empirical results suggest that the LS in the IPP sector may well be lower than that in the rest of the economy.
- That is, $1 - \theta_1 - \phi_1 > 1 - \theta_2 - \phi_2$.
- This mechanism declines the aggregate LS in response to increases in the IPP output share.
- If, however, the ratio between IPP and non-IPP output remains constant, the aggregate LS must be constant as well.
- This implies that the US economy is still in transition to a larger IPP sector.