The Global Decline of the Labor Share

(And Follow-up Thoughts)

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The Labor Share

- Stability of labor share is key foundation of macro models
- Implications for shape of production function, growth and macro dynamics, and inequality
- Labor share measurement (in levels) plagued with difficulty, largely due to "mixed income" of proprietors and farmers

What We Do and Why it Matters?

1. Document that corporate (and overall) labor shares across countries and industries experienced a pervasive decline

   Helps with measurement concerns. Argues for focus on global, not idiosyncratic, factors.

2. Show that countries/sectors with larger declines in price of investment goods experienced larger labor share declines

3. Evaluate hypothesis in parallel with alternatives. Demonstrate the decline and explanation are important for welfare

What We Do and Why it Matters?

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2. Show that countries/sectors with larger declines in price of investment goods experienced larger labor share declines

   Leads to mechanism of K-L substitution elasticity > 1.
   Calibrate to the cross-section, generate the time-series.

3. Evaluate hypothesis in parallel with alternatives. Demonstrate the decline and explanation are important for welfare

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3. Evaluate hypothesis in parallel with alternatives. Demonstrate the decline and explanation are important for welfare

   Abstract (here) from inequality, but the sign and magnitude of repercussions depend on cause.

Related Literature

- Labor Shares: Blanchard (1997); Gollin (2002); Harrison (2002); Jones (2003); Blanchard and Giavazzi (2003); Bentolila and Saint-Paul (2003).

- Investment-Specific Technology and Prices: Greenwood, Hercowitz, Krusell (1997); Krusell, Ohanian, Rios-Rull, and Violante (2000); Fisher (2006);

- Estimating the Elasticity of Substitution: Antras (2004); Chirinko (2008); many others.

Agenda

1. **Trends in Labor Shares and Investment Prices**
2. Model of Labor Share
3. Elasticity of Substitution
4. Explaining the Global Decline in Labor Share
5. Conclusions and Brief Discussion of Follow-on Work

Labor Share Data

- "Detailed National Accounts" divide activity into 3 sectors:
  - Corporate (non-financial, financial)
  - Household (including non-profits)
  - Government

- We combine data from Internet, OECD/UN, physical books

- Some cross-country differences, but generally:

$$\begin{aligned} GDP &= GVA_C + GVA_H + GVA_G + \text{Tax}_{\text{products}} \\ GVA_C &= COMP_C + \text{Tax}_{\text{production},C} + \text{Gross Operating Surplus}_C \end{aligned}$$

▸ What is included in "Comp"?

- When possible (i.e. other than state/industry analyses and when reported), we use corporate labor share as our measure:

$$s_L = COMP_c / GVA_c$$

Why Corporate Labor Share?

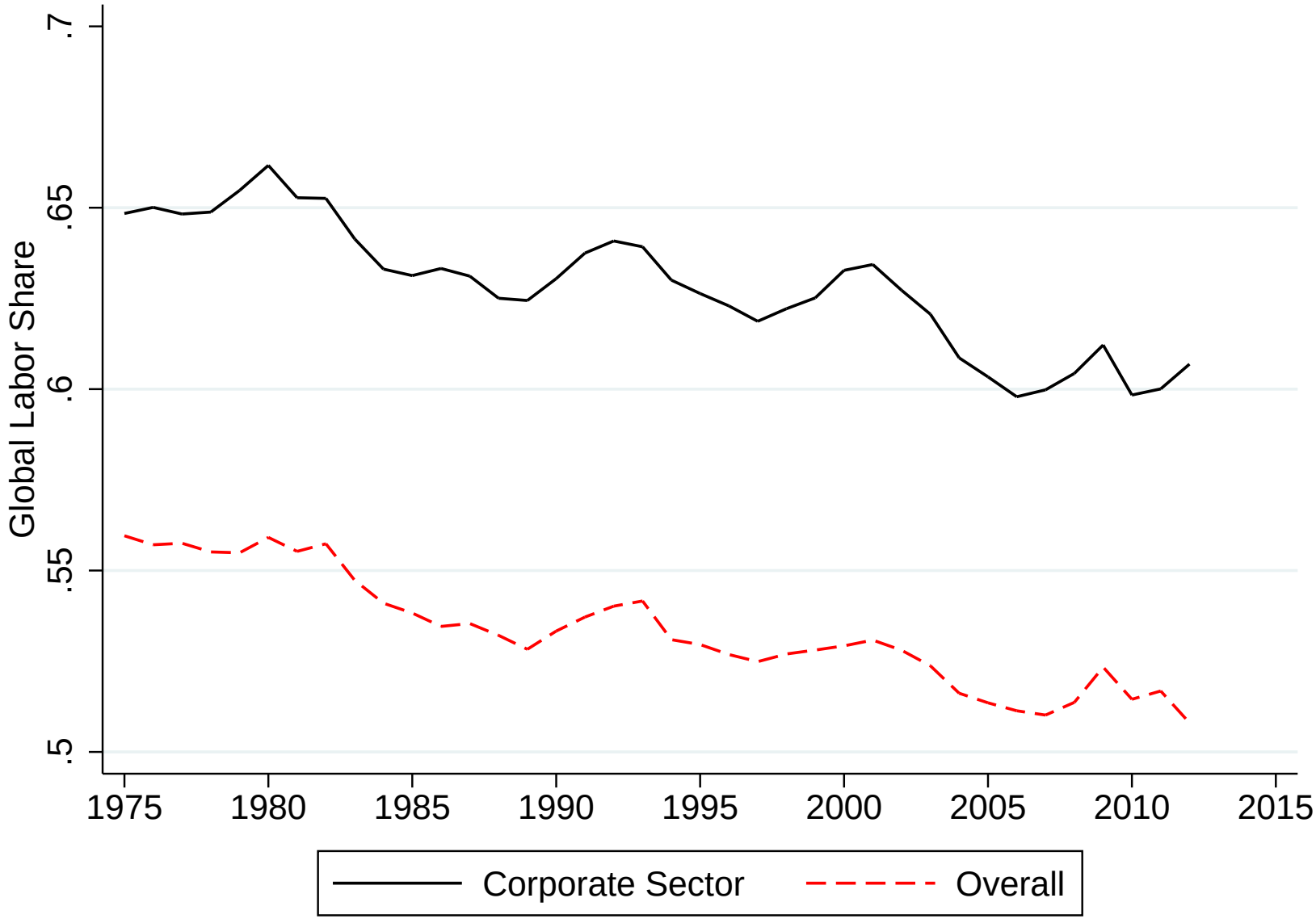
- Avoids need to imputate wages from mixed income of proprietors and unincorporated enterprises (Gollin, 2002)

- What is "corporation"?
  - Must publish a complete set of (opening and closing) balance sheets and other corporate accounts each year.
  - Have shareholders and limited liability.

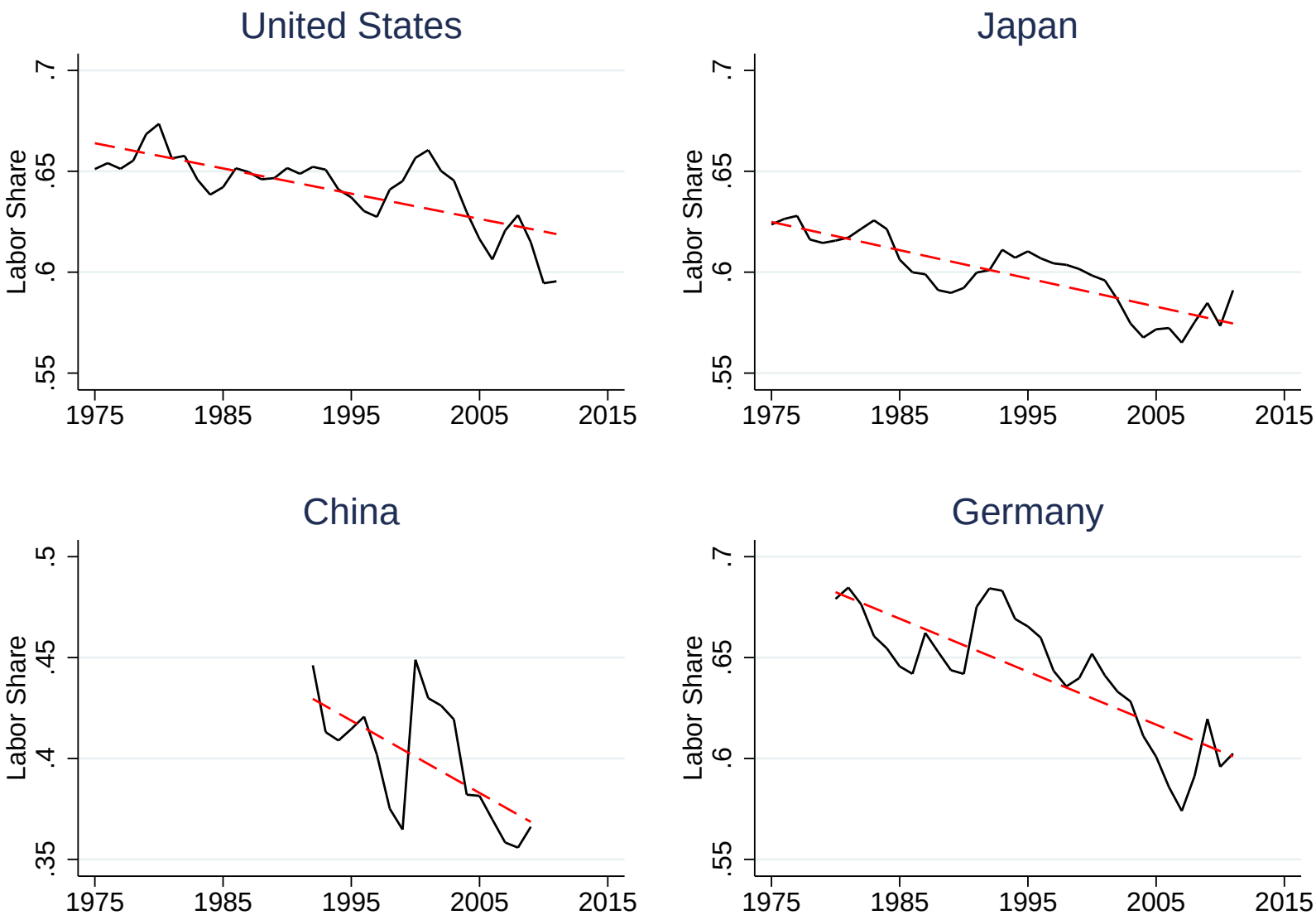
- Solves problem entirely? Not entirely, but progress.
  - Less of a fix in U.S., for example, which includes S-Corps (required to file IRS 1120 series)
  - Likely drops medium sized shops, farms, family biz elsewhere

- Other benefits/concerns?
  - Avoids difficulty in modeling government production function
  - Corporate share of U.S. and global GDPs are stable ▸ Plot

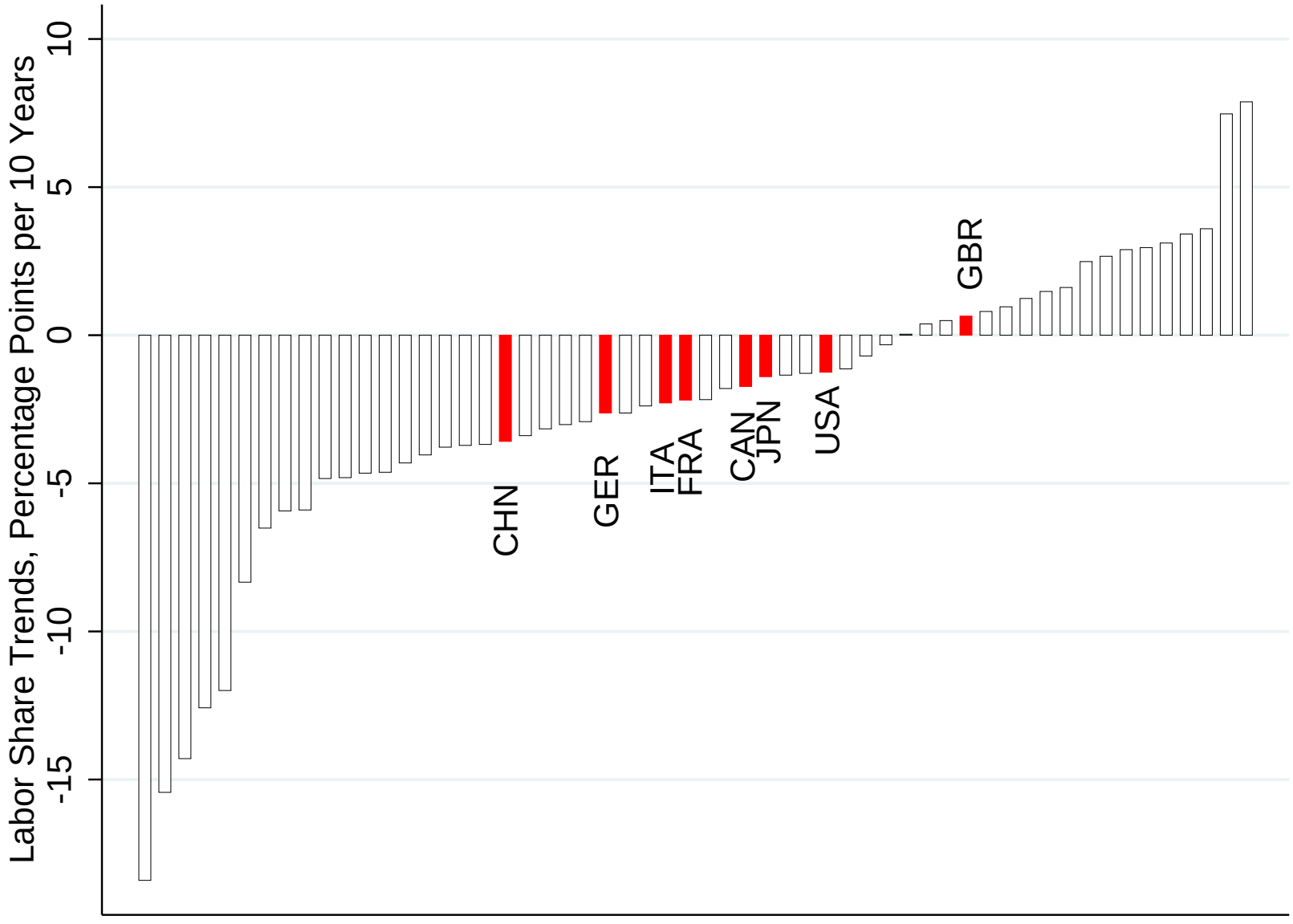
Declining Global Labor Share



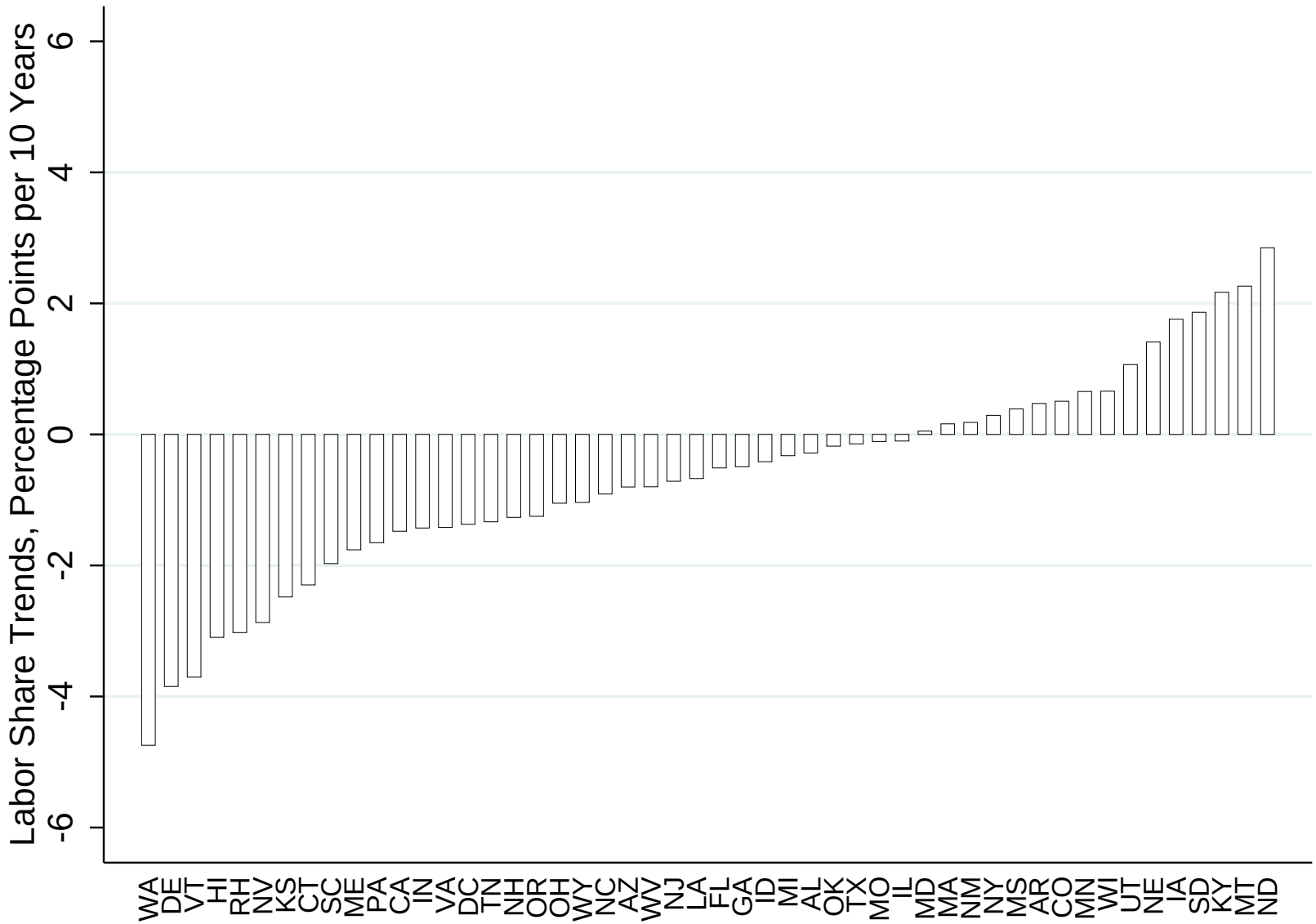
Declining Labor Shares in Largest Economies



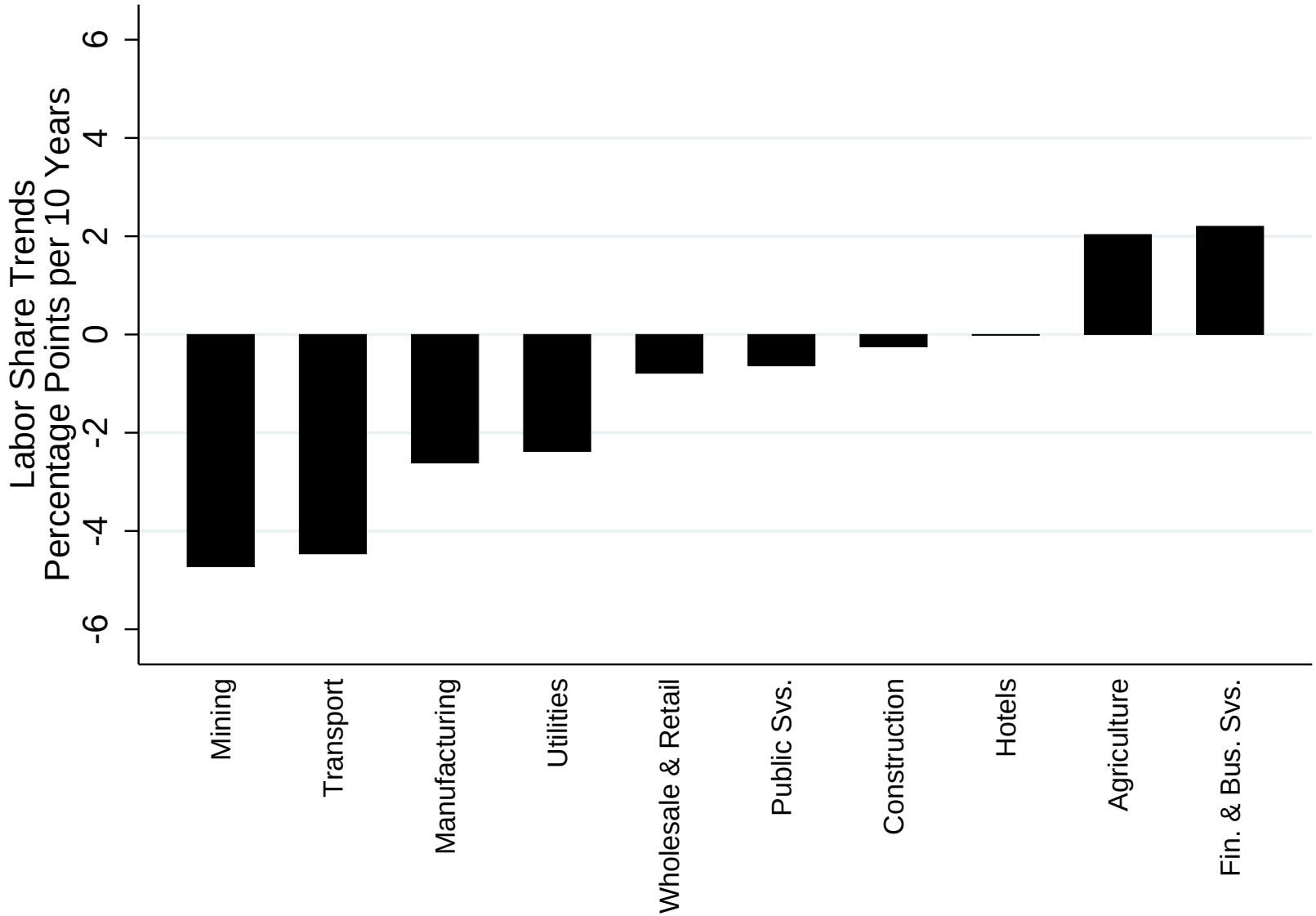
Distribution of Labor Share Trends



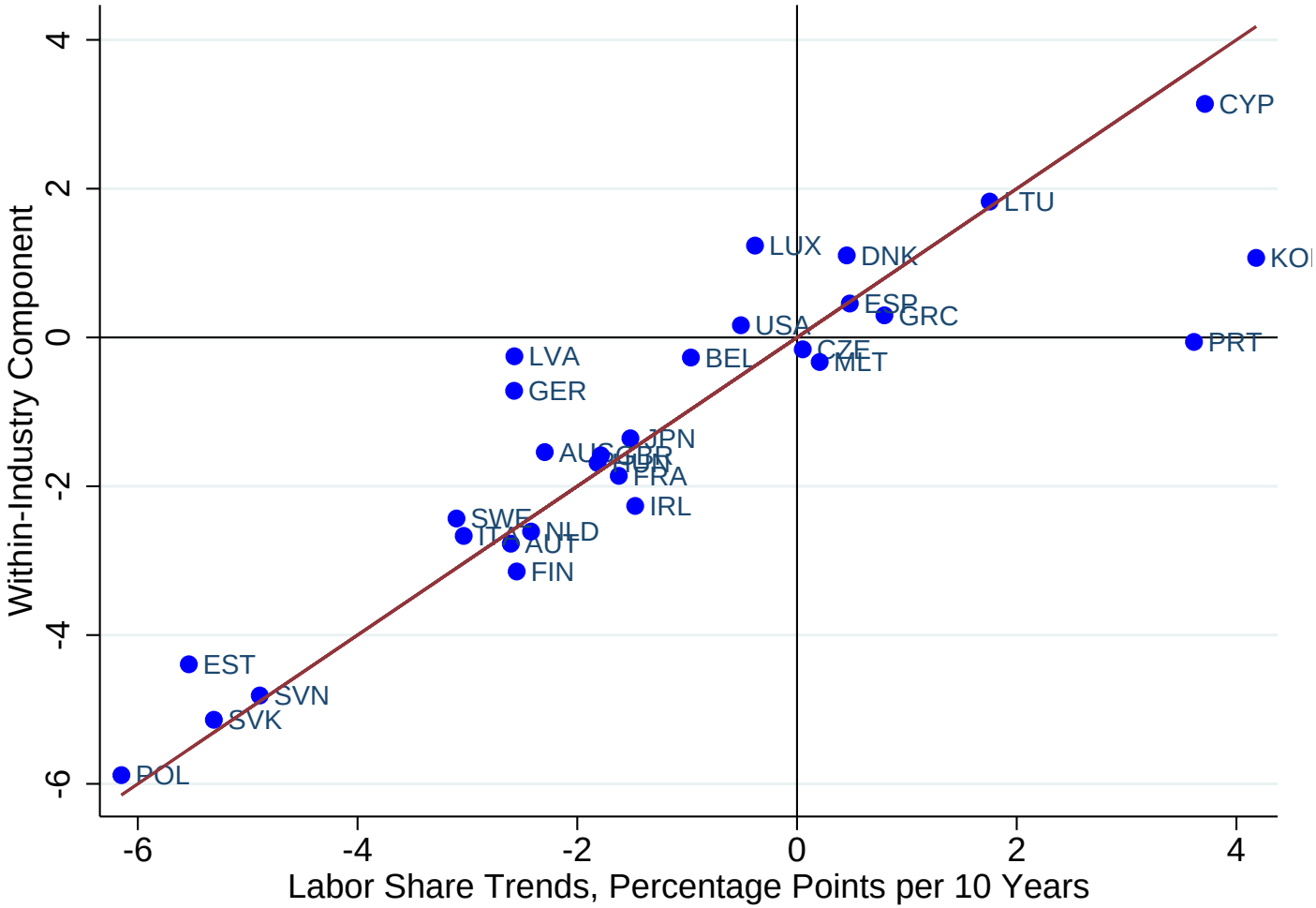
U.S. State Level Labor Shares



Labor Share Declines Across Industries



Within vs. Between Components



$$\Delta s_{Li} = \underbrace{\sum_k \bar{\omega}_{i,k} \Delta s_{Li,k}}_{\text{Within-Industry}} + \underbrace{\sum_k \bar{s}_{Li,k} \Delta \omega_{i,k}}_{\text{Between-Industry}}$$

Relative Price of Investment Data

1. World Bank World Development Indicators:
2. EU KLEMS (country-sector level):

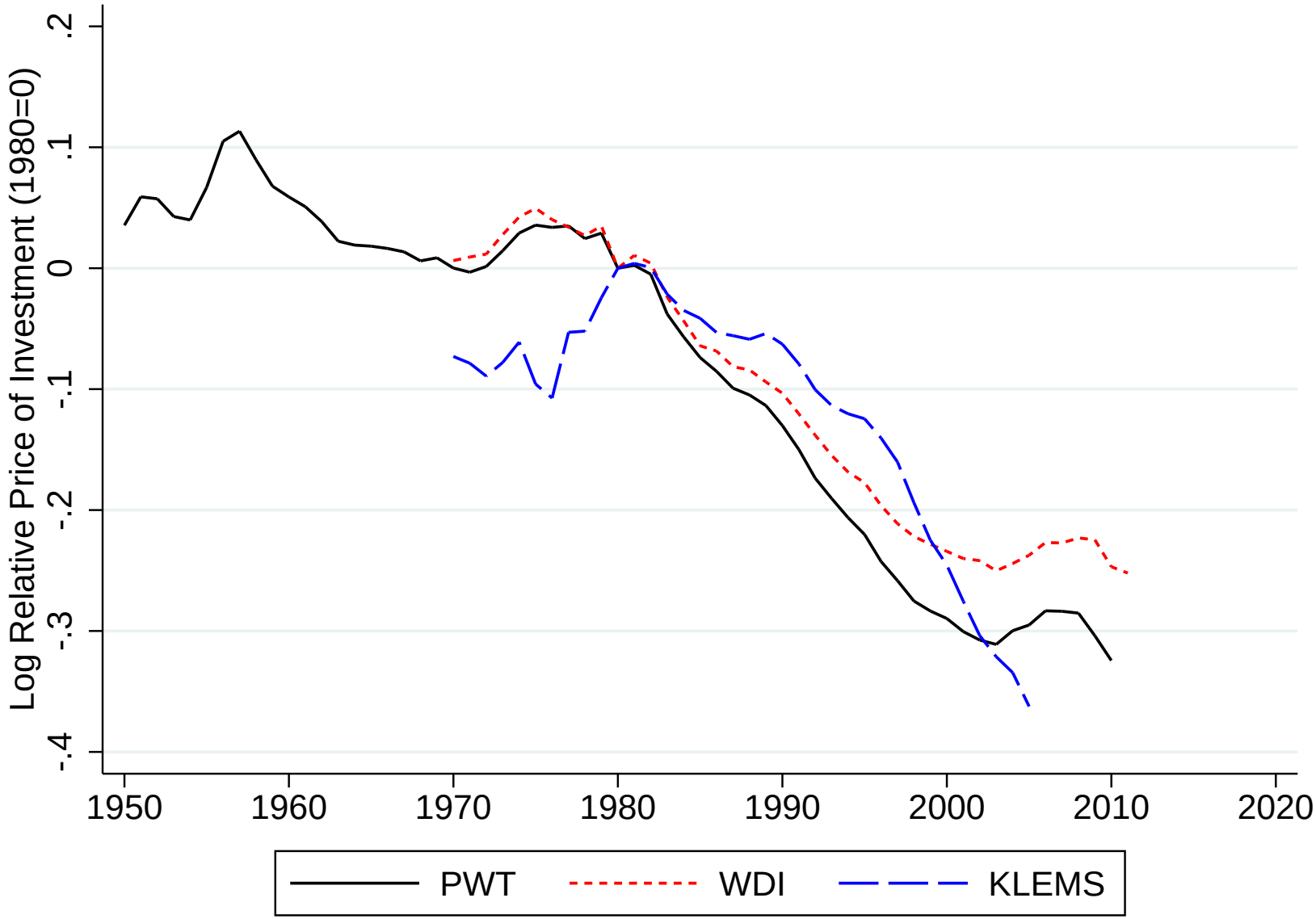
$$\xi_i = \frac{\text{Fixed investment deflator}}{\text{HH Consumption or VA price index}}$$

3. Penn World Tables (using ICP data):
   - Find relative prices *in levels* of similar goods with U.S. in each year, then multiply by NIPA relative price:

$$\xi_i = \frac{\left(P_{I,i}^{\text{PPP}} / P_{I,US}^{\text{PPP}}\right)}{\left(P_{C,i}^{\text{PPP}} / P_{C,US}^{\text{PPP}}\right)} \frac{P_{I,US}^{\text{BEA}}}{P_{C,US}^{\text{BEA}}}$$

   - Relies only on hedonic adjustment made by U.S. BEA

Declining Relative Price of Investment



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Basic Idea

- Two sectors, consumption and investment.
- Exogenous sectoral technology shocks drive fluctuations in relative price of investment.
- Movements in relative price affects rental rate of capital.
- Inputs produced with CES technology combining capital and labor. Inputs are then aggregated into final goods.
- Changes in relative price of capital change optimal K/L ratio. This and other factors (like μ or A_K) affect the labor share.

Final Goods Producers Minimize Cost

- Production of final **consumption** good:

$$C_t = \left(\int_0^1 c_t(z)^{\frac{\epsilon_t - 1}{\epsilon_t}} dz \right)^{\frac{\epsilon_t}{\epsilon_t - 1}}.$$

$$P_t^c = \left(\int_0^1 p_t(z)^{1-\epsilon_t} dz \right)^{\frac{1}{1-\epsilon_t}} = 1. \tag{1}$$

- Production of final **investment** good:

$$X_t = \left(\frac{1}{\xi_t} \right) \left(\int_0^1 x_t(z)^{\frac{\epsilon_t - 1}{\epsilon_t}} dz \right)^{\frac{\epsilon_t}{\epsilon_t - 1}}.$$

$$P_t^x = \xi_t \left(\int_0^1 p_t(z)^{1-\epsilon_t} dz \right)^{\frac{1}{1-\epsilon_t}} = \xi_t. \tag{2}$$

Producers of Intermediate Varieties Maximize Profits

- Monopolist/producer of variety z:

$$\max_{p_t(z),y_t(z),k_t(z),n_t(z)} \Pi_t(z) = p_t(z)y_t(z) - R_t k_t(z) - w_t(z)n_t(z)$$

$$y_t(z) = c_t(z) + x_t(z) = p_t(z)^{-\epsilon_t}(C_t + \xi_t X_t) = p_t(z)^{-\epsilon_t} Y_t$$

- Optimal capital and labor demand:

$$p_t(z)F_{k,t}(z) = \mu_t R_t$$

$$p_t(z)F_{n,t}(z) = \mu_t w_t(z)$$

$$\mu_t = \frac{\epsilon_t}{\epsilon_t - 1}$$

Households Maximize Utility

- Household's problem:

$$\max_{\{C_t,\{n_t(z)\},X_t,K_{t+1},B_{t+1}\}_{t=t_0}^{\infty}} \sum_{t=t_0}^{\infty} \beta^{t-t_0} V\left(C_t, N_t; \chi_t\right)$$

subject to K_0, B_0, the law of motion for capital:

$$K_{t+1} = (1-\delta)K_t + X_t,$$

and the intertemporal budget constraint:

$$C_t + \xi_t X_t = \int_0^1 \left(w_t n_t(z) + R_t k_t(z) + \Pi_t(z)\right) dz$$

- Optimality condition with respect to capital:

$$R_{t+1} = \xi_t \left(1 + r_{t+1}\right) - \xi_{t+1}\left(1-\delta\right),$$

where $1 + r_{t+1} = V_{C,t}/(\beta V_{C,t+1})$.

Income Shares

- Symmetric equilibrium: $k_t(z) = K_t$, $n_t(z) = N_t$, $x_t(z) = \xi_t X_t$, and $y_t(z) = Y_t = F(K_t, N_t) = C_t + \xi_t X_t$

- We can then define labor, capital, and profit shares as:

$$\begin{aligned} s_{L,t} &= \frac{W_t N_t}{Y_t} = \left(\frac{1}{\mu_t}\right)\left(\frac{W_t N_t}{W_t N_t + R_t K_t}\right) \\ s_{K,t} &= \frac{R_t K_t}{Y_t} = \left(\frac{1}{\mu_t}\right)\left(\frac{R_t K_t}{W_t N_t + R_t K_t}\right) \\ s_{\Pi,t} &= \frac{\Pi_t}{Y_t} = 1 - \frac{1}{\mu_t}, \end{aligned}$$

with: $s_{L,t} + s_{K,t} + s_{\Pi,t} = 1$.

Production Function

- CES production function with elasticity of substitution σ:

$$Y_t = F(K_t, N_t) = \left(\alpha_k \left(A_{K,t} K_t \right)^{\frac{\sigma-1}{\sigma}} + (1-\alpha_k) \left(A_{N,t} N_t \right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

- Firms' first-order conditions:

$$\begin{aligned} F_{K,t} &= \alpha_k A_{K,t}^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_t}{K_t} \right)^{\frac{1}{\sigma}} = \mu_t R_t \\ F_{N,t} &= (1-\alpha_k) A_{N,t}^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_t}{N_t} \right)^{\frac{1}{\sigma}} = \mu_t W_t \end{aligned}$$

The Labor Share

- Using capital's FOC:

$$1 - s_{L,t}\mu_t = \alpha_k^{\sigma} \left(\frac{A_{K,t}}{\mu_t R_t} \right)^{\sigma - 1}$$

- Given σ and share parameter α_k, labor share depends on:
  1. rental rate of capital R_t
  2. price markups μ_t
  3. capital-augmenting technology $A_{K,t}$
- Cobb-Douglas production function ($\sigma \to 1$):

$$s_{L,t} = \frac{1 - \alpha_k}{\mu_t}$$

Estimating Equation

- Let $1+\hat{x}$ denote the gross rate of growth in x and take difference to write:

$$\left(\frac{1}{1-s_L\mu}\right)\left(1-s_L\mu\left(1+\hat{s}_L\right)\left(1+\hat{\mu}\right)\right)=\left(\frac{1+\hat{A}_K}{\left(1+\hat{\mu}\right)\left(1+\hat{R}\right)}\right)^{\sigma-1}$$

- Change form allows for some heterogeneity

- We will think of our trends as steady state to steady state transitions. Holding constant β and δ over time, $\hat{R}=\hat{\xi}$
  - Better and more internationally comparable data on $\hat{\xi}$ than $\hat{W}$
  - Paper demonstrates robustness to trends in depreciation
  - WP considers dynamic path. Decline in ξ outweights capital loss $\hat{\xi}$ (under assumptions), producing decline in cost of capital

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1. Relative Price of Investment

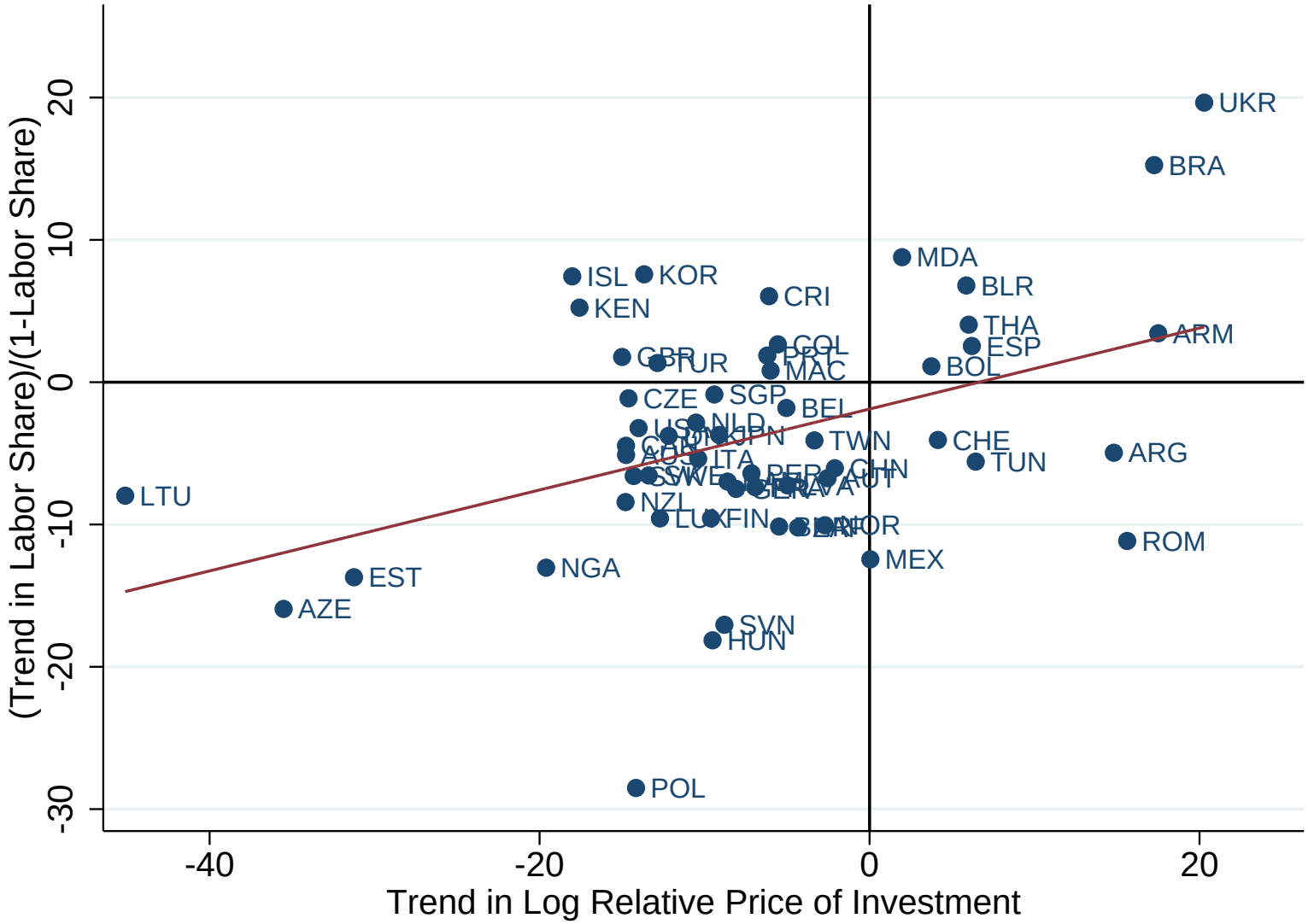
- For now, assume $\mu, A_K = 1$ and linearlize around $\hat{\xi} = 0$ to get:

$$\frac{s_{L,j}}{1 - s_{L,j}} \hat{s}_{L,j} = \gamma + (\sigma - 1)\, \hat{\xi}_j + u_j$$

- We add constant γ to ensure estimate is driven by cross-section, not global component we want to explain

- Only consider low-frequency variation – less likely to be affected by adjustment costs, financial frictions, etc.

Labor Shares and Relative Price of Investment



Baseline Estimates of σ

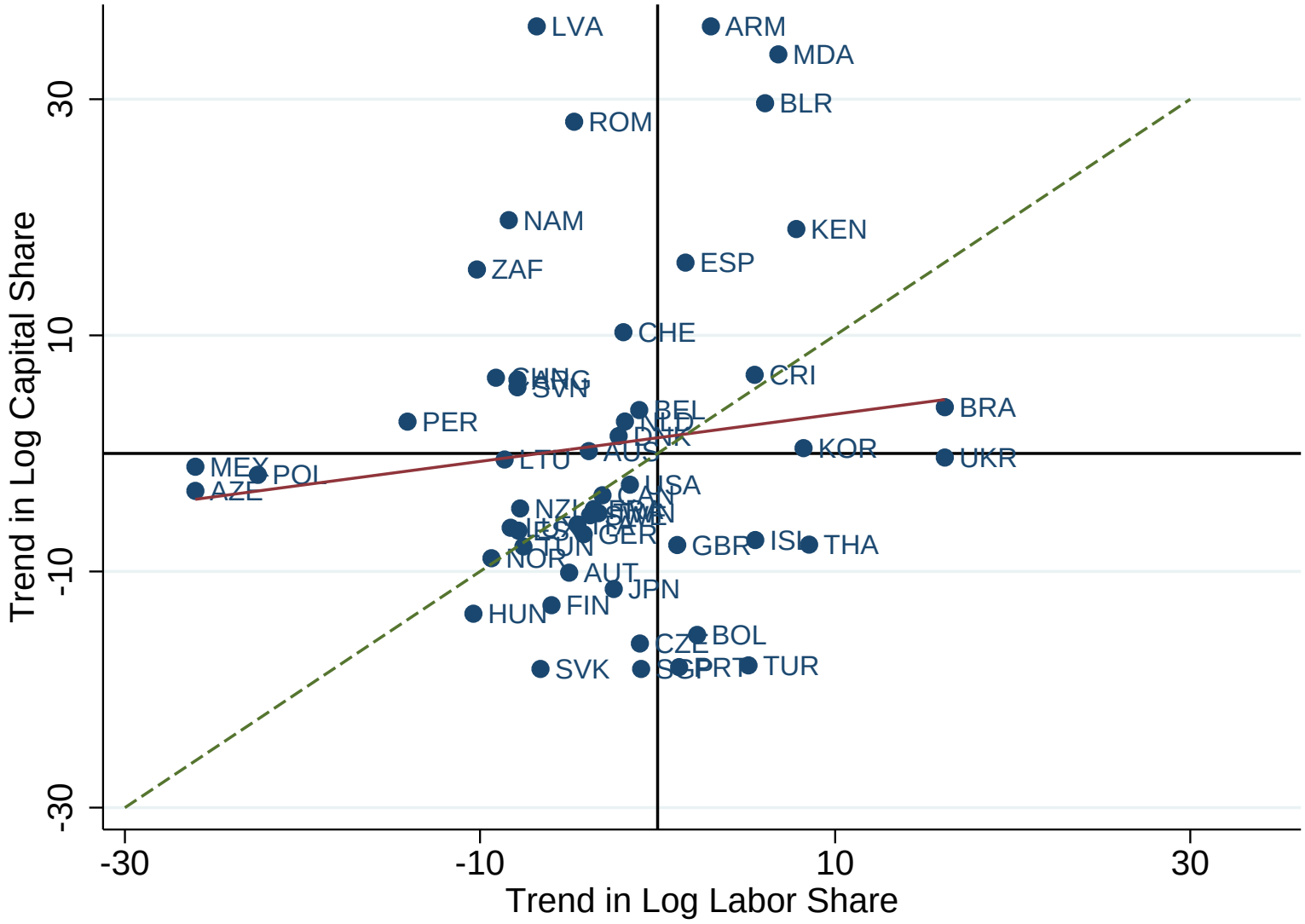
s_L Data	ξ Data	$\hat{\sigma}$	S.E.	90% CI	Obs.
KN Merged	PWT	1.25	0.08	[1.11,1.38]	58
KN Merged	WDI	1.29	0.07	[1.18,1.41]	54
OECD/UN	PWT	1.20	0.08	[1.06,1.34]	50
OECD/UN	WDI	1.31	0.06	[1.20,1.42]	47
KLEMS 1	KLEMS	1.17	0.06	[1.06,1.27]	129
KLEMS 2	KLEMS	1.49	0.13	[1.29,1.70]	129

- Note: KLEMS results only use developed countries
- Robust to: Only using countries with corporate labor shares
- Robust to: Allowing for $\hat{\delta}_j$ at country-industry level
- Robust to: Meidan of time series estimates for each country

2. Price Markups

- We now allow for $\mu \neq 0$. $\hat{\mu} > 0$ drives an increasing wedge between labor's share of costs and labor's share of revenues.
- What is concern? Imagine $\sigma = 1$, but countries with $\hat{\xi}_i < 0$ also have $\hat{\mu}_i > 0$. This would spuriously estimate $\sigma > 1$.
- Consider prediction if labor share decline was entirely driven by markups: proportional declines in L- and K- shares ($\hat{s_L} = \hat{s_K}$).
- Assuming constant β and δ and SS to SS transition, we calculate $\hat{s}_{K,j} = \widehat{(\xi X/Y)}_j$ to visualize this.

Proportional Change in Labor and Capital Shares?



2. Price Markups

- Previous plot suggests that markups played some, but not entire, role. We therefore add back μ and derive:

$$\left(\frac{s_{L,j}\mu_j}{1-s_{L,j}\mu_j}\right)\left(\left(1+\hat{s}_{L,j}\right)\left(1+\hat{\mu}_j\right)-1\right)=\gamma+(\sigma-1)\left(\hat{\xi}_j+\hat{\mu}_j\right)+u_j$$

- Similar to Rotemberg and Woodford (1995), we compute the levels of capital share as:

$$s_{K,j}=\left[\left(\frac{1}{\beta}-1+\delta\right)/\delta\right]\left[\xi_j X_j/Y_j\right]$$

- With levels and changes of s_L and s_K, we can then back out level and growth of μ for estimation

Estimates of σ with Price Markups

s_L **Data**	ξ **Data**	$\xi X/Y$ **Data**	$\hat{\sigma}$	**S.E.**	**90% CI**	**Obs.**
KN Merged	PWT	Corporate	1.03	0.09	[0.87,1.19]	55
KN Merged	WDI	Corporate	1.29	0.08	[1.16,1.42]	52
OECD/UN	PWT	Corporate	1.24	0.11	[1.05,1.43]	46
OECD/UN	WDI	Corporate	1.43	0.08	[1.28,1.57]	44
KN Merged	PWT	Total	1.11	0.11	[0.93,1.29]	54
KN Merged	WDI	Total	1.35	0.08	[1.22,1.49]	52
OECD/UN	PWT	Total	1.24	0.11	[1.06,1.343	46
OECD/UN	WDI	Total	1.42	0.09	[1.27,1.56]	44

3. Capital-Augmenting Technological Progress

- We similarly add back $\hat{A_K}$ and derive:

$$\frac{s_{L,j}}{1-s_{L,j}}\hat{s}_{L,j} = \gamma + (\sigma - 1)\,\hat{\xi}_j + (1-\sigma)\,\hat{A}_{K,j} + u_j$$

- Bias from omitting capital-augmenting technology growth:

$$\hat{\sigma} - \sigma = (1-\sigma)\text{corr}\left(\hat{A}_K, \hat{\xi}\right)\frac{\text{sd}\left(\hat{A}_K\right)}{\text{sd}\left(\hat{\xi}\right)}$$

- To assess bias we estimate following moments with PWT/WDI data on $\hat{\xi}$ and Conference Board data on TFP:

$$\text{corr}(\hat{A}_K, \hat{\xi}) = -0.28, \text{sd}(\hat{A}_K) = 0.10, \text{sd}(\hat{\xi}) = 0.11$$

$$\Longrightarrow \sigma = 1.20 \text{ when } \hat{\sigma} = 1.25.$$

- Also back out $\hat{A_K}$ assuming it accounts for entire "residual". Properties not unreasonable.

4. Skill Composition of Labor Force

- What if labor is heterogeneous and differentially substitutable with capital? We consider KORV (2000) production function:

$$Y_t = \left(\phi_1 \left(\left(\phi_2 K_t^{\frac{\rho-1}{\rho}} + (1-\phi_2) S_t^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \right)^{\frac{\sigma-1}{\sigma}} + (1-\phi_1) U_t^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

- Same linearization as done earlier yields:

$$\frac{s_{L,j}}{1-s_{L,j}} \hat{s}_{L,j} = \gamma_c + \gamma_s + (\sigma - 1)\, \hat{\xi}_j + \kappa_S \left(\widehat{S/K}_j \right) + u_j$$

or the identical expression with $\widehat{U/K}_j$ replacing $\widehat{S/K}_j$ if we reverse their locations in the production function.

Estimates of σ with Skills (KLEMS data)

s_L Data	Labor Input	$\hat{\sigma}$	S.E.	90% CI	Obs.
KLEMS 1	Skilled	1.23	0.08	[1.11,1.36]	100
KLEMS 1	Middle and Low	1.19	0.08	[1.05,1.33]	100
KLEMS 1	Low	1.19	0.09	[1.04,1.34]	100
KLEMS 2	Skilled	1.34	0.16	[1.07,1.60]	100
KLEMS 2	Middle and Low	1.31	0.17	[1.03,1.60]	100
KLEMS 2	Low	1.31	0.18	[1.02,1.61]	100

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Explaining the Global Decline in the Labor Share

- We now calibrate otherwise equivalent versions of the CD and CES models and solve for the GE to ask:
- Given $\hat{\xi} = -0.25$, how much does s_L decline when $\sigma = 1.25$?
- How does this compare to same decline in s_L generated by μ?
- What are the welfare effects of ξ shock in CES versus in CD?
- How does welfare differ if decline in s_L is due to ξ shock vs. μ shock vs. both?

Results (Percent Changes from Initial Steady State)

	$\hat{\xi}$	$\hat{\xi}$	$\hat{\mu}$	$\hat{\mu}$	$\left(\hat{\xi}, \hat{\mu}\right)$	$\left(\hat{\xi}, \hat{\mu}\right)$
Variable	**CD**	**CES**	**CD**	**CES**	**CD**	**CES**
Labor Share (PP)	0.0	-2.6	-3.1	-2.6	-3.1	-4.9
Capital Share (PP)	0.0	2.6	-1.9	-2.4	-1.9	-0.1
Profit Share (PP)	0.0	0.0	5.0	5.0	5.0	5.0
Consumption	18.1	20.1	-5.2	-5.4	10.7	12.7
Nominal Investment	18.1	30.8	-11.1	-12.7	3.7	11.9
Output	18.1	22.8	-6.3	-6.8	9.4	12.3
Welfare Eq. Consumption	18.1	22.1	-3.0	-3.4	13.2	15.8

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Conclusions and Next Steps

- Document large and widespread decline in global labor share
- Declining relative price of investment drove shift to capital
- Our follow-on work evaluates implications for:
  - Corporate Saving and Labor Shares
  - Labor Shares and Inequality
- On inequality:
  - This paper has nothing to say
  - With homogenous labor and concentrated capitalists, labor share fully captures changes in inequality
  - Adams, Karabarbounis, and Neiman (2014) merges Aiyagari (1994) with KORV (2000) to capture richer relationship

Inequality Decomposition

- If divided into capital and labor income, total income inequality can be decomposed (Shorrocks 1982):

$$CV(y) = s_L \rho\left(y^l\right) CV\left(y^l\right) + (1 - s_L)\,\rho\left(y^k\right) CV\left(y^k\right)$$

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- KORV: Shocks can change labor inequality and income share
- Aiyagari: Generates capital inequality given wage process
- AKN: Single shock may produce joint movements in all terms

▸ Time for more?

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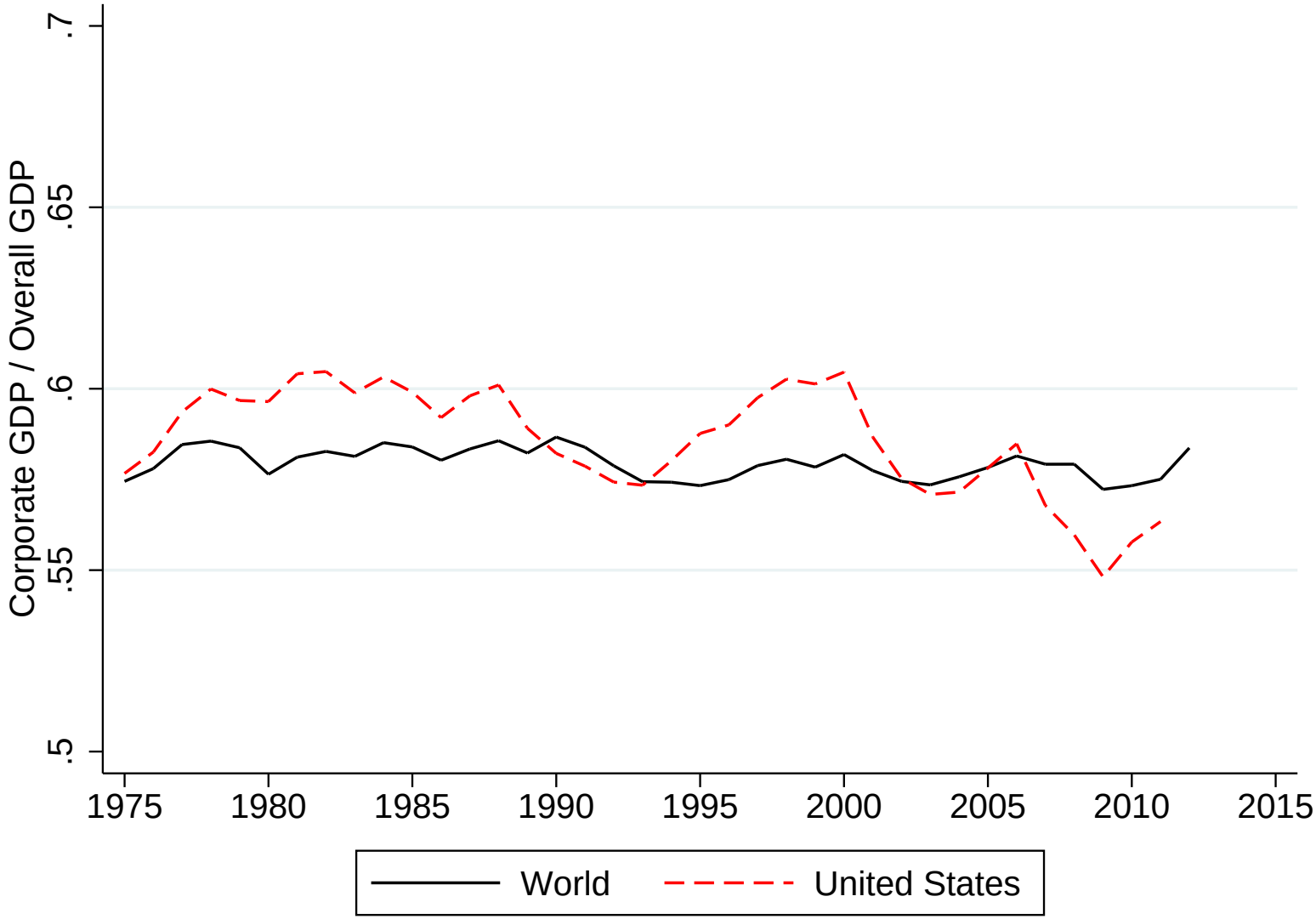
Corporate Sector's Share of Economic Activity is Stable



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What's in Compensation of Employees?

- Compensation Includes:
  - **Wages and salaries in cash**. Examples: Overtime, housing allowances, holidays, sickness, bonuses, commissions, and tips.
  - **Wages and salaries in kind**. Examples: Meals, housing services, transportation to/from work, and parking.
  - **Employers' social contributions** for sickness, accidents, and retirement (whether to social security or insurance firms).
- Compensation excludes unfunded benefits such as maternity leave and medical services not related to work.
- Most developed countries try to account for value of stock options granted to employees, but treatment and quality unlikely to be of high quality in developing countries

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Implications of CES > 1

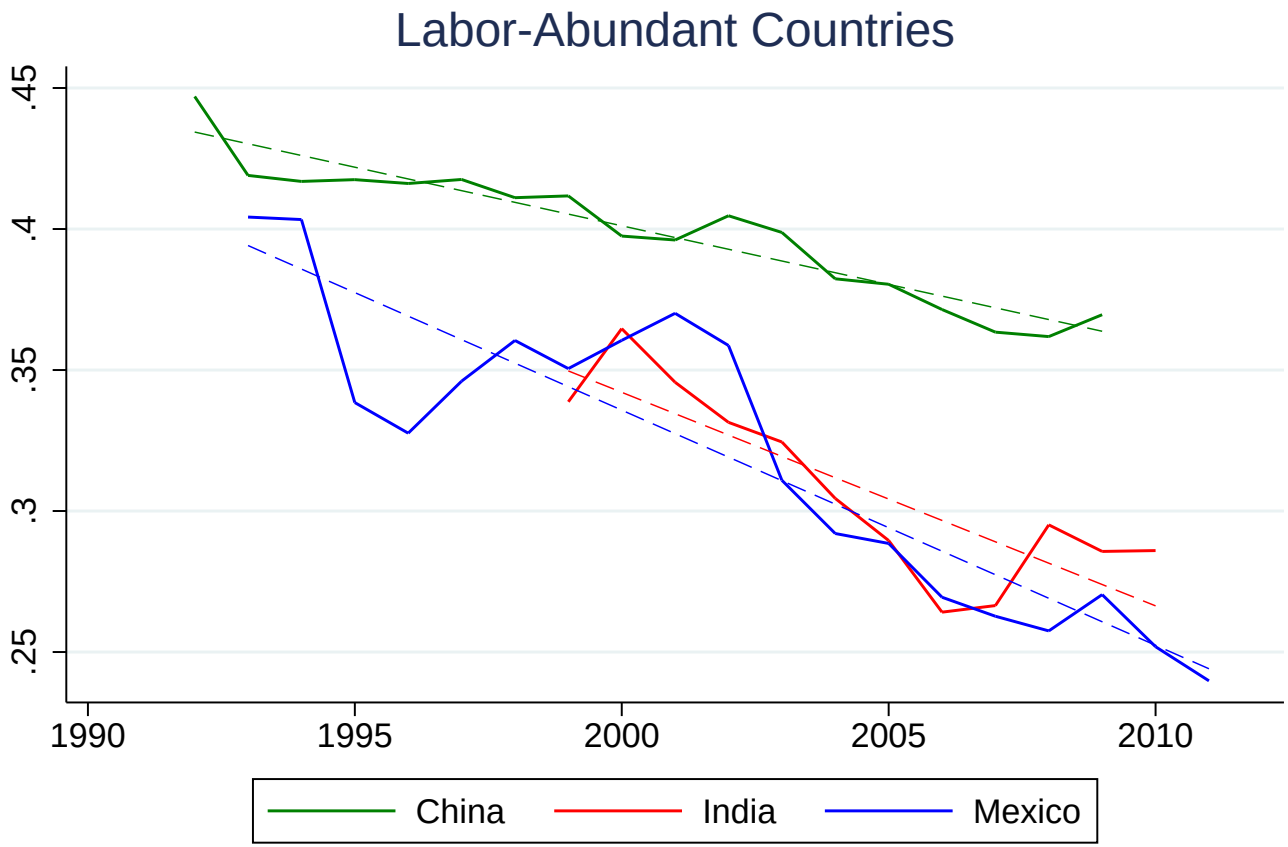
- We don't have opinion on what will happen moving forward, but can't rule out LR trends in factor shares (measurement gets quite tricky if $s_L \to 0$)

- But even the upper bound of $\sigma = 1.4$ is reasonable in historical context of medium run movements. Example:
  - Taiwan 7.1% annual growth in K/N over 1966-1990
  - CRS and Hicks-neutral tech growth: 10pp decline in s_L
  - Big, but not unusual relative to other countries in our dataset

Difficulties with Simple trade Story

What is mechanism linking imports and labor share?:

- Outsourcing? If so, then where to?



Notes: Labor shares from Karabarbounis and Neiman (2013). Brazil, not shown, had labor share increase. China plots scaled total labor share to smooth 2000 reclasification-jump.

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