THE GLOBAL DECLINE OF THE LABOR SHARE

Shi Zhengyang, Huang Yiguo, Ma Chengchao, Xie Yuchen

June 5, 2018

Author-Loukas Karabarbounis

Academic Position

Associate professor, Department of Economics, University of Minnesota

Research Area

Macroeconomics, Labor Economics

Publication

- "Capital Allocation and Productivity in South Europe." *Quarterly Journal of Economics*, 132(4), 1915-1967, November 2017. (With Gita Gopinath, Sebnem Kalemli-Ozcan, and Carolina Villegas-Sanchez.)
- "The Global Rise of Corporate Saving." *Journal of Monetary Economics*, 89, 1-19, August 2017. Lead Article. (With Peter Chen and Brent Neiman.)
- "The Cyclicality of the Opportunity Cost of Employment." *Journal of Political Economy*, 124(6), 1563-1618, December 2016. (With Gabriel Chodorow-Reich.)
- "Home Production, Labor Wedges, and International Business Cycles." *Journal of Monetary Economics*, 64, 68-84, May 2014.
- "The Labor Wedge: MRS vs. MPN." *Review of Economic Dynamics*, 17(2), 206-223, April 2014.
- "The Global Decline of the Labor Share." *Quarterly Journal of Economics*, 129(1), 61-103, February 2014. Winner of the Emerald Citation of Excellence Award. (With Brent Neiman.)

Author-Brent Neiman

Academic Position

Professor, Booth School of Business, University of Chicago

Research Area

Macroeconomics, International Finance

Publication

- "The Global Rise of Corporate Saving" (with Peter Chen and Loukas Karabarbounis) ***Journal of Monetary Economics***, 2017, 89, p.1-19. Lead Article.
- "Trade and the Global Recession" (with Jonathan Eaton, Sam Kortum, and John Romalis) ***American Economic Review***, 2016, 106(11), p. 3401-3438.
- "Currency Unions, Product Introductions, and the Real Exchange Rate" (with Alberto Cavallo and Roberto Rigobon) ***Quarterly Journal of Economics***, 2014, 129(2), p.529-595.
- "The Global Decline of the Labor Share" (with Loukas Karabarbounis) ***Quarterly Journal of Economics***, 2014, 129(1), p.61-103.

Content:

- Introduction
- Model
- Estimation of Elasticity
- Conclusion and Implication

Introduction

$$Y = AK^{\alpha}L^{1-\alpha}$$

$$\frac{E_L}{E} = 1 - \alpha$$

E_L: Expenditure on Labor, E: Total Expenditure

Motivation:

- A significant decline of global labor share since 1980s
- A significant decline in relative price of investment goods.

Trends in Labor Share

Data :

- Country-level statistics in the corporate sector
- Sources: BEA, UN, OECD, KLEMS
- Time Period:1975-2012
- Country: 59 countries that have at least 15 years of data

Trends in Labor Share

FIGURE I

Declining Global Labor Share

Trends in Labor Share

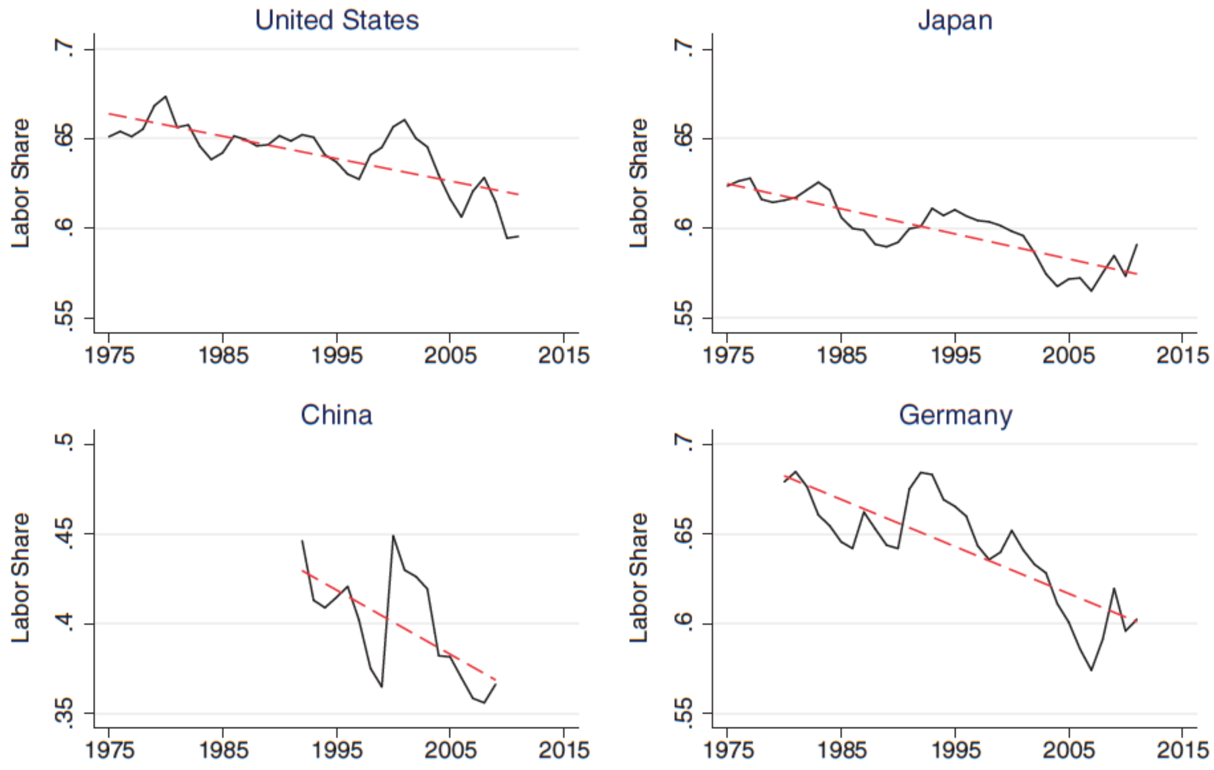


FIGURE II

Declining Labor Share for the Largest Countries

Trends in Labor Share

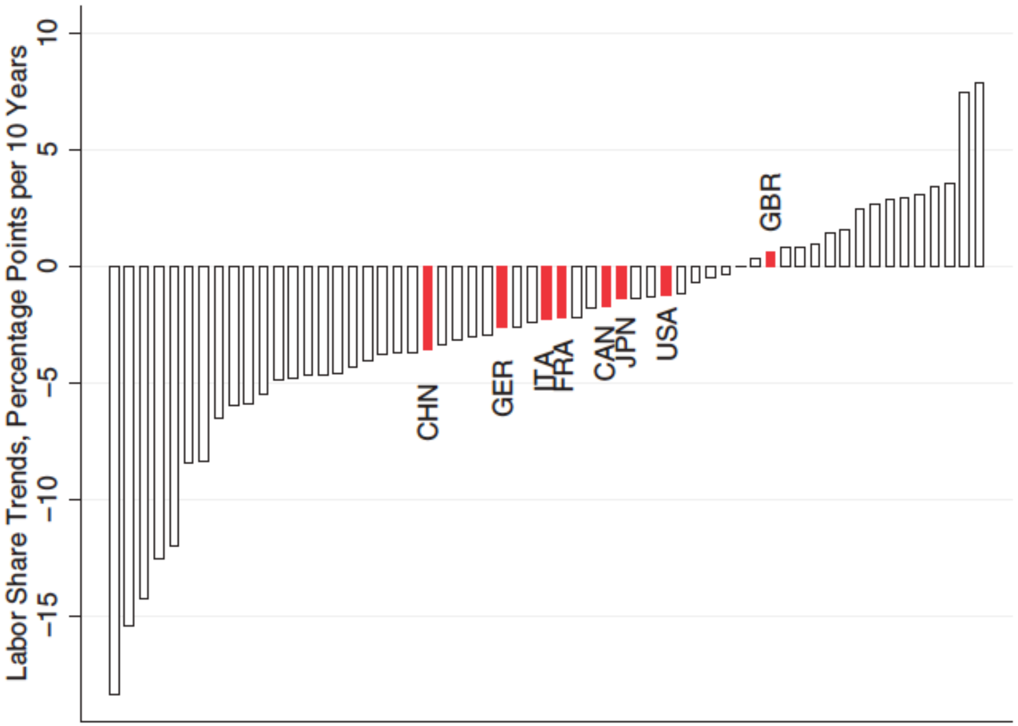


FIGURE III

Estimated Trends in Country Labor Shares

Trends in Labor Share

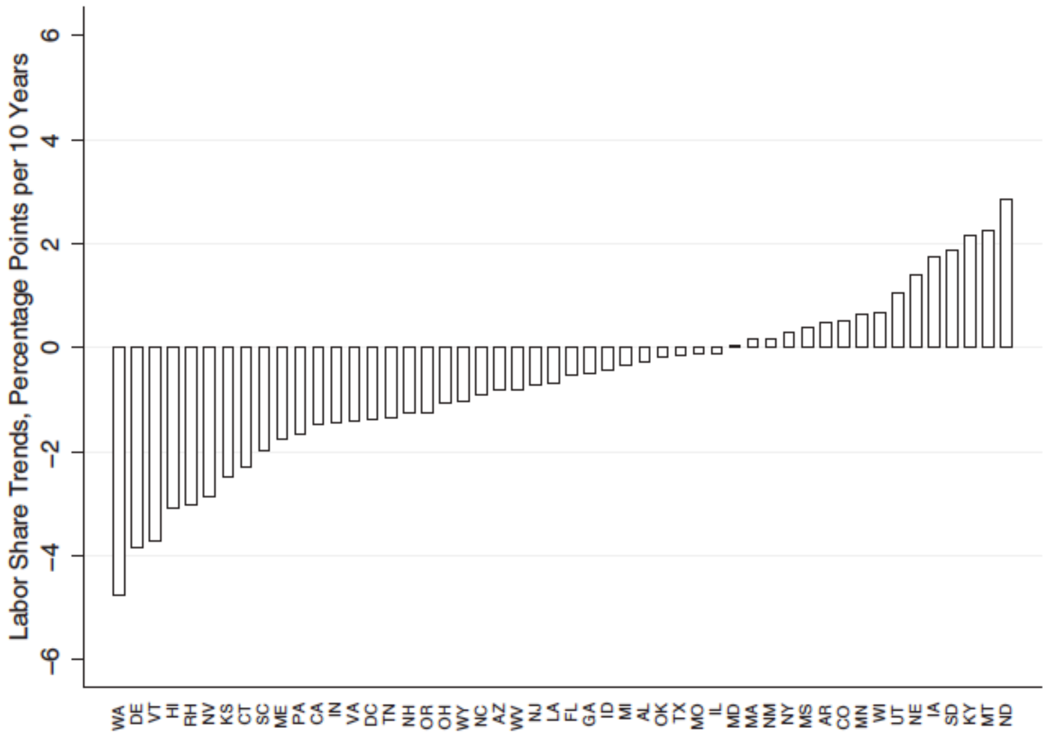


FIGURE IV

Estimated Trends in U.S. State Labor Shares

Trends in Labor Share

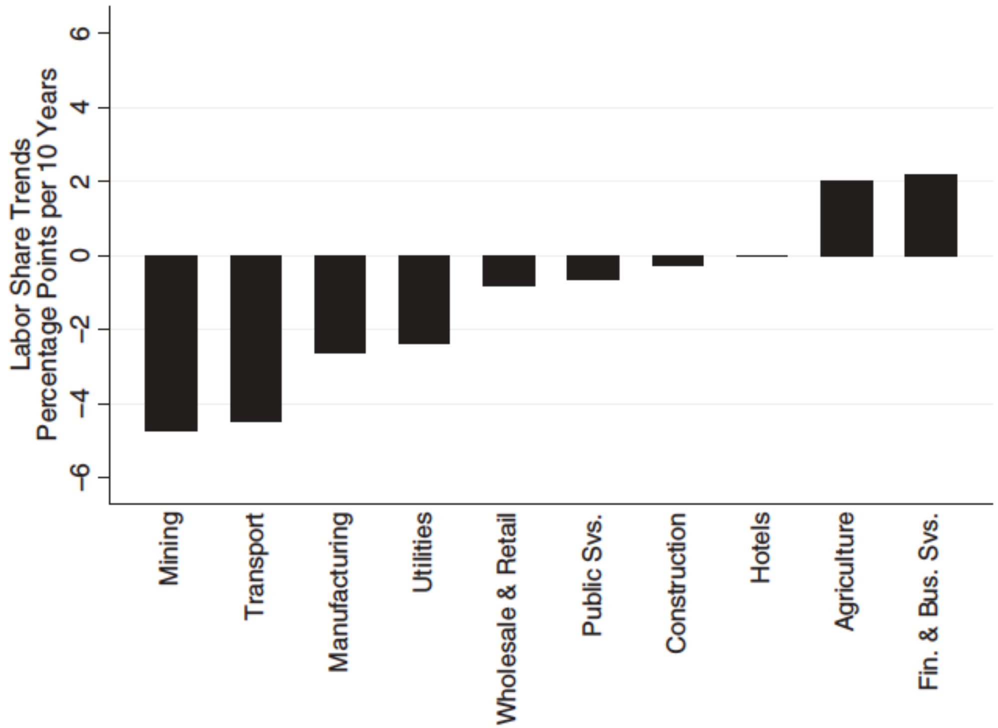


FIGURE V

Estimated Trends in Industry Labor Shares

Trends in Labor Share

Labor share change:

- Changing size of industries with different level of labor share
- Changes in labor shares within industry

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

$\omega_{i,k}$: *industry k's share in coutry i's value added*

$S_{Li,k}$: *labor share in countr i's industry k*

Trends in Labor Share

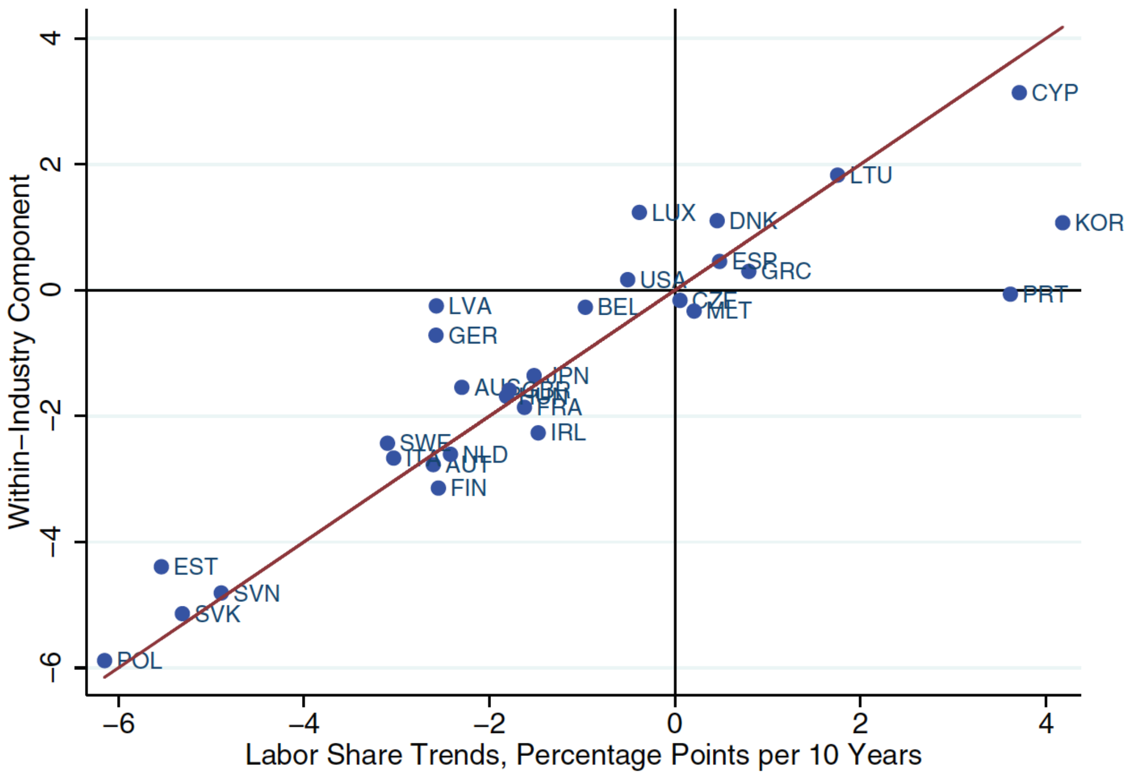


FIGURE VI

Trends in Relative Price of Investment Goods

Data :

- Country-level
- Sources: PWT, WDI, KLEMS
- Time Period:1950-2012

Trends in Relative Price of Investment Goods

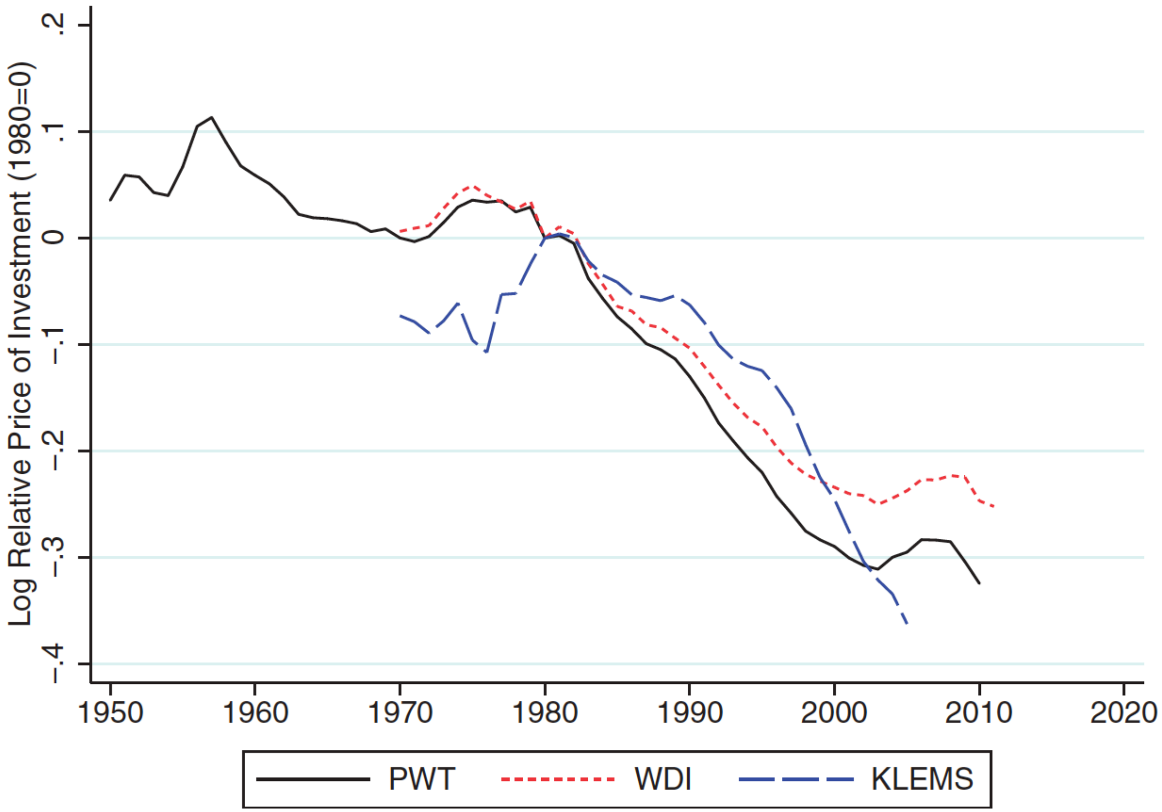


FIGURE VII

Declining Global Price of Investment Goods

A Model of The Labor Share

A. Final Consumption Good

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

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

$$c_t(z) = \left(\frac{p_t(z)}{P_t^c}\right)^{-\varepsilon_t} C_t$$

Proof for cost minimization:

$$\pi = P_t^c C_t - \int_0^1 p_t(z) c_t(z) dz$$

$$\frac{d\pi}{dc_t(z)} = P_t^c \frac{\varepsilon_t}{\varepsilon_t - 1} C_t^{\frac{1}{\varepsilon_t}} \frac{\varepsilon_t - 1}{\varepsilon_t} c_t(z)^{-\frac{1}{\varepsilon_t}} - p_t(z) = 0$$

B. Final Investment Good

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

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

$$x_t(z) = \xi_t\left(\frac{p_t(z)}{P_t^c}\right)^{-\varepsilon_t} X_t = \xi_t p_t(z)^{-\varepsilon_t} X_t$$

C. Producers of Intermediate Inputs

$$\textit{Given:} y_t(z) = F(k_t(z), n_t(z))$$

$$\textit{Capital} \rightarrow R_t$$

$$\textit{Labor} \rightarrow W_t$$

$$\textit{Aggregate Demand:} \quad Y_t = C_t + \xi_t X_t$$

$$\max \Pi_t(z) = p_t(z) y_t(z) - R_t k_t(z) - W_t n_t(z)$$

$$s.t. \, y_t(z) = c_t(z) + x_t(z) = p_t(z)^{-\varepsilon_t}(C_t + \xi_t X_t) = p_t(z)^{-\varepsilon_t} Y_t$$

C. Producers of Intermediate Inputs

The first order condition with respect to capital:

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

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

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

Proof:

$$\Pi_t(z) = (\frac{Y_t}{y_t(z)})^{\frac{1}{\varepsilon_t}} y_t(z) - R_t k_t(z) - W_t n_t(z) = Y_t^{\frac{1}{\varepsilon_t}} y_t(z)^{1-\frac{1}{\varepsilon_t}} - R_t k_t(z) - W_t n_t(z)$$

$$\frac{\partial \Pi_t(z)}{\partial k_t(z)} = (1 - \frac{1}{\varepsilon_t})(\frac{Y_t}{y_t(z)})^{\frac{1}{\varepsilon_t}} F_{k,t}(z) - R_t = 0$$

D. Household

$$\max \sum_{t=t_0}^{\infty} \beta^{t-t_0} V(C_t, N_t; \chi_t)$$

$s.t.$

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

$$C_t + \xi_t X_t + B_{t+1} - (1+r_t)B_t = \int_0^1 (W_t n_t(z) + R_t k_t(z) + \Pi_t(z))dz$$

$$N_t = \int_0^1 n_t(z)dz$$

$$K_t = \int_0^1 k_t(z)dz$$

The first order condition with respect to capital:

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

$$1 + r_{t+1} = \frac{V_c(C_t, N_t)}{\beta V_c(C_{t+1}, N_{t+1})}$$

Lagrange

$$L = \sum_{t=t_0}^{\infty} \beta^{t-t_0} V(C_t, N_t; \chi_t) +$$

$$\lambda_t \left[K_{t+1} + (\delta - 1)K_t - \frac{1}{\xi_t} (\int_0^1 \Pi_t(z)dz + W_t N_t + R_t K_t + (1 + r_t)B_t - B_{t+1} - C_t \right]$$

$$\frac{\partial L}{\partial C_t} = \beta^{t-t_0} V_C(C_t, N_t) + \lambda_t / \xi_t = 0$$

$$\frac{\partial L}{\partial K_t} = \lambda_{t-1} + \lambda_t (\delta - 1 - R_t / \xi_t) = 0$$

Hamilton

$$H = \beta^{t-t_0} V(C_t, N_t; \chi_t) +$$

$$\lambda_t \left[-\delta K_t + \frac{1}{\xi_t} \left(\int_0^1 \Pi_t(z) dz + W_t N_t + R_t K_t + (1 + r_t) B_t - B_{t+1} - C_t \right. \right]$$

$$\frac{\partial H}{\partial C_t} = \beta^{t-t_0} V_C(C_t, N_t) - \lambda_t / \xi_t = 0$$

$$\frac{\partial H}{\partial K_t} = \lambda_t(-\delta + R_t / \xi_t) = \lambda_{t-1} - \lambda_t$$

Bellman

$$U(C_t, \{n_t(z)\}, X_t, K_{t+1}, B_{t+1}) = \max V(C_t, N_t, \chi_t) + \beta V(C_{t+1}, N_{t+1}, \chi_{t+1})$$

$$\frac{\partial U}{\partial K_{t+1}} = \frac{\partial V(C_t, N_t, \chi_t)}{\partial C_t} \frac{\partial C_t}{\partial K_{t+1}} + \beta \frac{\partial V(C_{t+1}, N_{t+1}, \chi_{t+1})}{\partial C_{t+1}} \frac{\partial C_{t+1}}{\partial K_{t+1}}$$

$$= -V_C(C_t, N_t)\xi_t + \beta V_C(C_{t+1}, N_{t+1})[R_{t+1} - \xi_{t+1}(\delta - 1)] = 0$$

E. Equilibrium

$$p_t(z) = P_t^c = 1, k_t(z) = K_t, n_t(z) = N_t, c_t(z) = C_t,$$

$$x_t(z) = \xi_t X_t, y_t(z) = C_t + \xi_t X_t, Y_t = F(K_t, N_t)$$

$$s_{L,t} = \frac{W_t N_t}{Y_t} = \frac{1}{\mu_t} \frac{W_t N_t}{W_t N_t + R_t K_t}$$

$$s_{K,t} = \frac{R_t K_t}{Y_t} = \frac{1}{\mu_t} \frac{R_t K_t}{W_t N_t + R_t K_t}$$

$$s_{\Pi,t} = \frac{\Pi_t}{Y_t} = 1 - \frac{1}{\mu_t}$$

Where $\quad s_{L,t} + s_{K,t} + s_{\Pi,t} = 1$

F. The Production Function

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

$$F_{K,t} = \alpha_k A_{K,t}^{\frac{\sigma-1}{\sigma}} (\frac{Y_t}{K_t})^{\frac{1}{\sigma}} = \mu_t R_t$$

$$F_{N,t} = (1-\alpha_k) A_{N,t}^{\frac{\sigma-1}{\sigma}} (\frac{Y_t}{N_t})^{\frac{1}{\sigma}} = \mu_t W_t$$

G. The Labor Share

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

$$1 - s_{L,t'}\mu_{t'} = \alpha_k^{\sigma}(\frac{A_{K,t'}}{\mu_{t'} R_{t'}})^{\sigma-1}$$

$$Z = \frac{Z_{t'}}{Z_t} - 1$$

$$\frac{1}{1 - s_L\mu}(1 - s_L(1+\hat{s}_L)\mu(1+\mu)) = (\frac{1 + A_K}{(1+\mu)(1+R)})^{\sigma-1}$$

IV. The Elasticity of Substitution

A. Relative Price of Investment

B. Markups

C. Capital-Augmenting Technological Progress

D. Skilled versus Unskilled Labor

A. Relative Price of Investment

$$\frac{1}{1-s_L\mu}(1-s_L(1+\hat{s}_L)\mu(1+\mu)) = (\frac{1+A_K}{(1+\mu)(1+R)})^{\sigma-1}$$

$$R_j = \xi_j(\frac{1}{\beta_j} - 1 + \delta_j)$$

Set $\mu = 1, \hat{\mu} = 0, \hat{A}_K = 0$

First-order approximation:

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

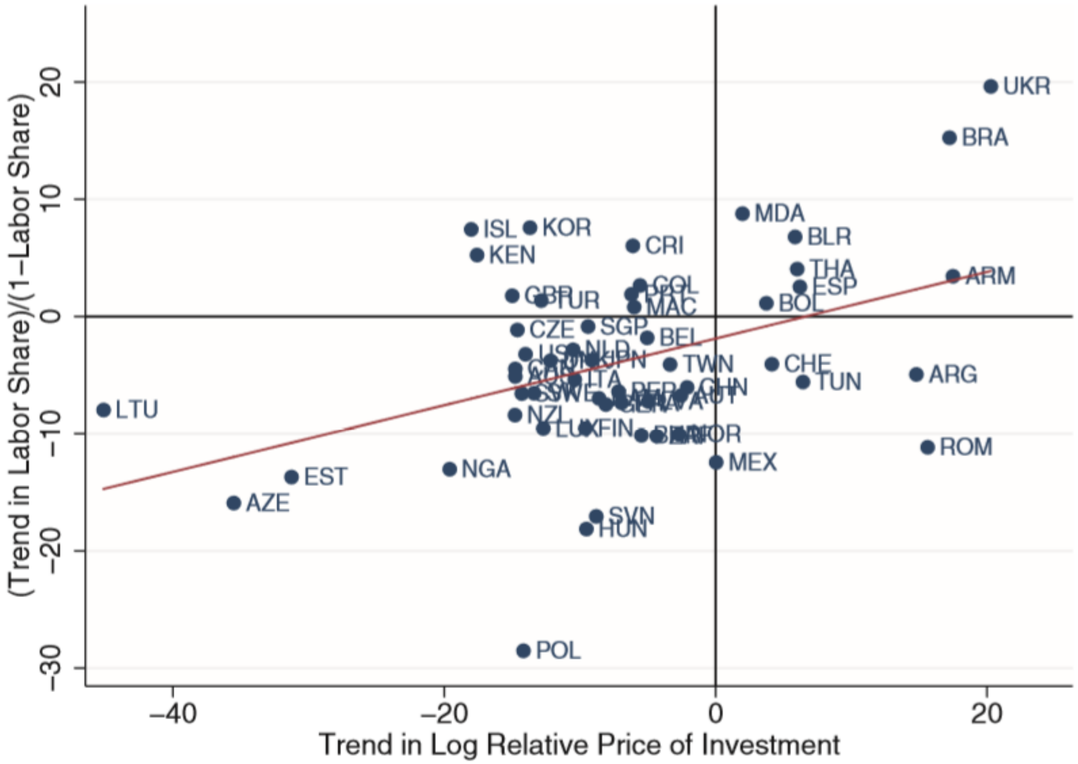
$\hat{s}_{L,j} = ln\, s_{L,j}$, $\hat{\xi} j = ln\, \xi_j$

A. Results

TABLE I
BASELINE ESTIMATES OF ELASTICITY OF SUBSTITUTION

	Labor share	Investment price	$\hat{\sigma}$	Std. err.	90% Conf. interval	Obs.
(i)	KN Merged	PWT	1.25	0.08	[1.11,1.38]	58
(ii)	KN Merged	WDI	1.29	0.07	[1.18,1.41]	54
(iii)	OECD and UN	PWT	1.20	0.08	[1.06,1.34]	50
(iv)	OECD and UN	WDI	1.31	0.06	[1.20,1.42]	47
(v)	KLEMS 1	KLEMS	1.17	0.06	[1.06,1.27]	129
(vi)	KLEMS 2	KLEMS	1.49	0.13	[1.28,1.70]	129
	Average		**1.28**			

A. Visualization



B. Markups

$$\mu_j = \frac{1}{1 - s_{\pi,j}} = \frac{1}{s_{L,j} + s_{K,j}}$$

$$R_j = \xi_j \left(\frac{1}{\beta_j} - 1 + \delta_j\right)$$

$$K_j = \frac{X_j}{\delta_j}$$

$$s_{K,j} = \frac{R_j K_j}{Y_j} = \left(\frac{\xi_j X_j}{Y_j}\right)\left(\frac{1/\beta_j - 1 + \delta_j}{\delta_j}\right)$$

$$\hat{\mu}_j = \frac{1}{\mu_j (s_{L,j}\hat{s}_{L,j} + s_{K,j}\hat{s}_{K,j})}$$

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

B. Results

TABLE II

ESTIMATES OF ELASTICITY OF SUBSTITUTION ALLOWING FOR MARKUPS

	Labor share	Investment price	Investment rate	$\hat{\sigma}$	Std. err.	90% Conf. interval	Obs.
(i)	KN Merged	PWT	Corporate	1.03	0.09	[0.87,1.19]	55
(ii)	KN Merged	WDI	Corporate	1.29	0.08	[1.16,1.42]	52
(iii)	OECD and UN	PWT	Corporate	1.24	0.11	[1.05,1.43]	46
(iv)	OECD and UN	WDI	Corporate	1.43	0.08	[1.28,1.57]	44
(v)	KN Merged	PWT	Total	1.11	0.11	[0.93,1.29]	54
(vi)	KN Merged	WDI	Total	1.35	0.08	[1.22,1.49]	52
(vii)	OECD and UN	PWT	Total	1.24	0.11	[1.06,1.43]	46
(viii)	OECD and UN	WDI	Total	1.42	0.09	[1.27,1.56]	44
	Average			**1.26**			

C. Capital-Augmenting Technological Progress

$$\frac{1}{1-s_L\mu}(1-s_L(1+\hat{s}_L)\mu(1+\mu)) = (\frac{1+A_K}{(1+\mu)(1+R)})^{\sigma-1}$$

$$Set\ \mu = 1, \hat{\mu} = 0$$

First-order approximation:

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

C. Capital-Augmenting Technological Progress

$$\tilde{\sigma} - \sigma = (1 - \sigma) corr\left(\hat{A}_{K,j}, \hat{\xi}_j\right) \frac{sd\left(\hat{A}_K\right)}{sd\left(\hat{\xi}\right)}$$

$$\tilde{\sigma} = 1.25$$

$$\sigma = 1.20$$

D. Skilled versus Unskilled Labor

How to nest the three inputs: skilled labor, unskilled labor and the capital stock?

(1) $$N_t = N_t\left(S_t, U_t\right)$$

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

(2) $$\frac{s_{L,j}}{1-s_{L,j}} \hat{s}_{L,j} = \gamma + (\sigma-1)\hat{\xi}_j + \kappa \widehat{\left(\frac{U_j}{K_j} \right)} + u_j$$

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

(3) $$\frac{s_{L,j}}{1-s_{L,j}} \hat{s}_{L,j} = \gamma + (\sigma-1)\hat{\xi}_j + \kappa \widehat{\left(\frac{S_j}{K_j} \right)} + u_j$$

D. Results

TABLE III

ESTIMATES OF ELASTICITY OF SUBSTITUTION WITH DIFFERENT PRODUCTION FUNCTIONS

	Labor share	Nested input with capital	$\hat{\sigma}$	Std. err.	90% Conf. interval	Obs.
(i)	KLEMS 1	High skill	1.23	0.08	[1.11,1.36]	100
(ii)	KLEMS 1	Middle and low skill	1.19	0.08	[1.05,1.33]	100
(iii)	KLEMS 1	Low skill	1.19	0.09	[1.04,1.34]	100
(iv)	KLEMS 2	High skill	1.34	0.16	[1.07,1.60]	100
(v)	KLEMS 2	Middle and low skill	1.31	0.17	[1.03,1.60]	100
(vi)	KLEMS 2	Low skill	1.31	0.18	[1.02,1.61]	100
	Average		**1.26**			

V. The Decline in the Labor Share

TABLE IV

Evaluating Labor Share's Decline (Percent Changes Across Steady States)

		CD $\hat{\xi}$	CES $\hat{\xi}$	CD $\hat{\mu}$	CES $\hat{\mu}$	CD $(\hat{\xi}, \hat{\mu})$	CES $(\hat{\xi}, \hat{\mu})$
(i)	Labor share (percentage points)	0.0	−2.6	−3.1	−2.6	−3.1	−4.9
(ii)	Capital share (percentage points)	0.0	2.6	−1.9	−2.4	−1.9	−0.1
(iii)	Profit share (percentage points)	0.0	0.0	5.0	5.0	5.0	5.0
(iv)	Consumption	18.1	20.1	−5.2	−5.4	10.7	12.4
(v)	Nominal investment	18.1	30.8	−11.1	−12.7	3.7	11.9
(vi)	Labor input	0.0	−1.4	−3.2	−2.9	−3.2	−4.2
(vii)	Capital input	51.6	67.8	−11.1	−12.7	33.2	43.6
(viii)	Output	18.1	22.8	−6.3	−6.8	9.4	12.3
(ix)	Wage	18.1	19.2	−8.2	−8.2	7.1	7.7
(x)	Rental rate	−22.1	−22.1	0.0	0.0	−22.1	−22.1
(xi)	Capital-to-output	28.4	36.6	−5.2	−6.4	21.8	27.9
(xii)	Welfare equivalent consumption	18.1	22.1	−3.0	−3.4	13.2	15.8

VI . Conclusion

- Offer an explanation for the decline of global labor share

- Estimate the shape of the production function

- Explore the macroeconomic and welfare implications

Implication

How does S change with μ, A, R

$$\left(\frac{1}{1-S_L\mu}\right)\left[1-S_L\left(1+\hat{S}\right)\mu\left(1+\hat{\mu}\right)\right]=\left[\frac{1+\hat{A}}{\left(1+\hat{\mu}\right)\left(1+\hat{R}\right)}\right]^{\sigma-1}$$

$$\sigma=1$$

$$\hat{S}=\frac{1}{1+\hat{\mu}}-1$$

$$\sigma>1$$

$$\hat{S}=\frac{1-\left(1-S_L\mu\right)\left[\frac{1+\hat{A}}{\left(1+\hat{\mu}\right)\left(1+\hat{R}\right)}\right]^{\sigma-1}}{S_L\mu\left(1+\hat{\mu}\right)}-1$$

$$\frac{d\hat{S}}{d\hat{\mu}}=\frac{\sigma\left(1-S_L\mu\right)\left[\frac{1+\hat{A}}{\left(1+\hat{\mu}\right)\left(1+\hat{R}\right)}\right]^{\sigma-1}-1}{S_L\mu\left(1+\hat{\mu}\right)^2}$$

$$\frac{d\hat{S}}{d\hat{\mu}}=0\Rightarrow\hat{\mu}=\frac{1+\hat{A}}{1+\hat{R}}\left[\frac{1}{\sigma\left(1-S_L\mu\right)}\right]-1$$

Thank you