Technological Change and Demand for Redistribution: Micro Evidence and Macro Implications

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Motivation: last four decades in US,

- Rising **income inequality**, non-increasing **tax progressivity**
  e.g. Piketty-Saez ('07), Heathcote et al. ('20), Saez-Zucman ('20)
- Biased **Technical Change (TC)** as a source of inequality
  e.g. Computerization following a sharp drop in equipment prices since 1980s

Conventional wisdom: $\Uparrow$ **inequality** $\Longrightarrow$ $\Uparrow$ **redistribution**

- **Politicians** respond to preferences of the median voter
  Large literature on positive framework, e.g. Meltzer-Richard (1981)

Question: Why did **progressivity** not increase when **inequality** went up?
Focus on the role of **TC**, in particular, **computerization**

Approach

1. Evidence from pseudo-panel approach: **TC** $\Longrightarrow$ $\Downarrow$ **redistribution pref**.

- Exploit timing of **computerization (decline in equipment prices)**
- **Link** social survey, skill contents, labor market outcomes at occ level

2. **Mechanism** for rationalizing the micro evidence and macro trend

- Workers exposed to **TC** have $\Uparrow$ returns to skill investment

$\Longrightarrow$ Larger tax distortions $\Longrightarrow$ less desire for fiscal redistribution

3. Tractable quantitative GE political economy model

- Workers accumulate **skill**, and **vote** for desired tax progressivity
- Estimate the model on micro data to quantify **the mechanism**

Findings

Micro evidence of $\Uparrow$ **TC** $\Longrightarrow \Downarrow$ **redistribution pref.**

- computerization mainly in high paying occupations
- conditional on earnings, political perspective

Macro effects of TC on inequality and progressivity

- **TC ($\Downarrow$ equip. prices)** $\rightarrow \Uparrow$ **inequality** but $\not\Uparrow$ **progressivity**

$\Longrightarrow$ w/o skill investment: **TC** $\rightarrow \Uparrow$ **inequality** and $\Uparrow$ **progressivity**

Contributions Related Literature

1. Document novel empirical relationship between computerization and redistribution preferences at occupation level in the US
2. Study long-run impact of **TC** on inequality and redistribution by embedding structural change in estimated GE pol econ model

Empirics

Data sets and measurement

O*NET-APST ('20AEJ) skill content data

- Requirements, knowledge, skills, activity, context, tools, technology, etc.
- ↑ Computer, social in high paying occupation ▸ computer ▸ social
- ↑ Manual, routine in low paying occupation ▸ manual/routine

General Social Survey (GSS, 1978-2018) ▸ GSS: data overview

- Political attitudes, social characteristics (e.g. socially liberal, abortion)
- Redistribution preferences measure – responses to the GSS questionnaire

[7] The govt. in Washington should reduce income differences
[1] The govt. in Washington should not concern itself with reducing income differences

Construct synthetic panel by age, occupation

- How did synthetic cohorts respond to computerization?

Empirical strategy

Explore diff-in-diffs with the synthetic cohort (a, o):

: Different **TC** exposure to different synthetic persons

a: age group; o: occupation group; t: time period

$$\text{Redist}_{aot} = \beta \text{Task Intensity}_{ot} + \eta_t X_o^{'} \delta + X_{ot}^{'} \lambda + \gamma_a + \eta_t + \gamma_a \times \eta_t + \epsilon_{aot}$$

- β is the coefficient of interest, answers how occupational exposure to technological change affected redistribution preferences
- $\delta' s$ are the coefficients of fixed-occ. characteristics interacted with time, control for (i) political spectrum and (ii) $o \times t$ shocks (e.g. old police officer, young developer)
- $\lambda' s$ are the coefficients of time varying occ.-level characteristics; control for job ads and employment shares by construction of my measures

Wild cluster bootstrap to address **(i) few clusters, (ii) generated regressor**

	Redistributive Preferences (Standardized): 1978-2018 - Synthetic Panel				
	(1)	(2)	(3)	(4)	(5)
Earnings (Occ. Avg.)		**-0.389*****			
		[-0.667,-0.113]			
Computer	**-0.549*****	**-0.312****	**-0.524*****		
	[-0.702,-0.437]	[-0.454,-0.113]	[-0.715,-0.376]		
Social			-0.076		
			[-0.228,0.106]		
Manual				0.057	
				[-0.282,0.371]	
Routine					0.065
					[-0.192,0.319]
Observations	108	108	108	108	108

Confidence intervals are estimated using the wild cluster bootstrap method, and clustering is performed at synthetic cohort groups. Fixed effects include age, year, and interaction of age and year in the synthetic panel. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

- Synthetic persons faced w/ $\Uparrow$ **computer task intensity** want less redistribution
- **Computerization** effect is **sizeable** with controlling for earnings, spectrum

Macro Effect of TC on Inequality and Redistribution

Quantitative Model: Summary

1. Task-based sorting + progressive tax + electoral competition
2. Goods are produced by combining **tasks** and **equipment**
3. Workers choose **occupation-equipment** and produce **tasks**
   - In occupations, workers accumulate skills and produce tasks better
   - Before entering labor market**,** **young** consider **college**
4. Earnings are taxed; workers **vote** for their most preferred **tax policy**
   - Politicians propose **tax policy** that maximizes expected vote share
   - (1) indirect utility for policy; (2) political weight of voter groups

     e.g. old police officer - conservative; young developer - liberal

Technology ‣ Time alloc.

o: occupation; e: equipment; g: demographic group; s: task

- Final output Y is a CES aggregator of occupational outputs Y_o:

$$Y = \left(\sum_o Y_o^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$$

- Occupations are output sum of efficiency hours weighted prod. units:

$$\underbrace{Y_{oeg}}_{\text{prod. unit}} = \underbrace{\left[\prod_s (T_{oegs})^{\alpha_{oes}} k_e^{1-\sum_s \alpha_{oes}} \right]}_{\text{bundle of tasks and equipment}} \quad \text{where} \quad \underbrace{T_{oegs}}_{\text{task unit}} = \underbrace{H_g \times h^{\phi_o} \times l_{oegs}}_{\text{returns to skill}\times\text{time}}$$

1. "Ricardian-Roy" task-based assignment framework
2. E-type equipment k_e is supplied by $k_e = q_e Y_e$; q_e is equipment efficiency
3. α_{oes} captures heterogeneous task importance by equipment and occupation

Politicians' primitives and fiscal institution

- Office-motivated candidates from party $x \in \{L, R\}$ has preferences:

$$U_x = \begin{cases} 1 & \text{if } x \text{ wins} \\ 0 & \text{otherwise} \end{cases}$$

  - Forecast R_{igt}, **propose policy** (λ_x, τ_x)
  - (λ_x, τ_x) parameters of HSV tax function (Benabou '02, HSV '17)
  - $\psi_g \in (0, 1)$ frac. of voter group g participates in voting (i.e., turnout)

- Subject to constraints

Market clearing

Balanced government budget

$$\underbrace{y_i - \mathcal{T}(y_i; \lambda, \tau)}_{\text{pre-gov income - (net tax)}} = \underbrace{(1 - \lambda)\, y_i^{1-\tau}}_{\text{post-gov income}}$$

Individual preferences and demographics

- Atomistic worker i is endowed with productivity H_g and preferences:

$$U_i = \underbrace{\log c_i - \varphi \frac{h_i^{1+\frac{1}{\xi}}}{1+\frac{1}{\xi}} - \chi_{d,g=y} + \zeta_{id,g=y}}_{\text{economic}} + \underbrace{R_{igt} + \eta_{ig} + \eta_i}_{\text{political}}$$

  - g: defined by age/gender/education; population share π_g
  - Education choice d for young $g = y$: costs χ, shocks ζ

- Political preferences (e.g. same-sex marriage)
  - $R_{igt} \sim \texttt{normal}\left(\mu_{gt}, \sigma_{gt}^2\right)$; $\eta_{ig} \sim \texttt{normal}\left(0, \sigma_g^2\right)$; $\eta_i \sim \texttt{normal}\left(0, \sigma^2\right)$
  - Induce politicians to trade-off economic vs. social policy

    e.g. old police officer - conservative; young developer - liberal

Worker allocation and occupation choice

P_{oeg}: wage per efficiency hour units from workers in group g who chooses (o, e) pair

- Worker i supplies h_i time to (o, e) pair, based on earnings $P_{oeg} h_i \epsilon_{ioe}$
- Worker i draws $\{\epsilon_{ioe}\}_{oe}$ from i.i.d. $\epsilon_{ioe} \sim \texttt{Frechet}(\theta)$

$$\max_{(o,e),h_i} V_{ioeg}(\lambda_x, \tau_x) = \log \overbrace{(1-\lambda_x)(P_{oeg} h_i \epsilon_{ioe})^{1-\tau_x}}^{\text{post-tax labor income via earnings compression}} - \varphi \frac{h_i^{1+\frac{1}{\xi}}}{1+\frac{1}{\xi}}$$

- P_{oeg} reflects worker's **comparative advantage**

$$\begin{aligned} P_{oeg}(\tau_x) = {} & \bar{\alpha}_e (1-\bar{\alpha}_e)^{\frac{1-\bar{\alpha}_e}{\bar{\alpha}_e}} : \text{ factor income share} \\ & \times P_o^{\frac{1}{\bar{\alpha}_e}} : \text{ GE effect via occupation prices} \\ & \times q_e^{\frac{1-\bar{\alpha}_e}{\bar{\alpha}_e}} : \text{ equipment efficiency} \\ & \times \prod_s \left(H_g h^{\phi_o} \frac{\alpha_{oes}}{\sum_s \alpha_{oes}} \left(\frac{1-\tau_x}{\varphi} \right)^{\frac{\xi}{\xi+1}} \right)^{\frac{\alpha_{oes}}{\bar{\alpha}_e}} : \text{ task-labor productivity} \end{aligned}$$

Education choice of young workers

Before entering the labor market:

- **Young** consider whether or not to attend college $d \in \{\text{HS}, \text{Coll}\}$
- **Young** compare expected utility from post-tax earnings $V_{d,g=y}(\lambda_x, \tau_x)$

↑ redistribution & HS *versus* ↓ redistribution & College

- d depends on (λ_x, τ_x), determined by voter distribution $\pi_g(\lambda_x, \tau_x)$
- College share of young $\pi_{g=y}$ is implied by education choice d

$$\pi_{g=y}(\lambda_x, \tau_x) = \arg\max_d \overbrace{V_{d,g=y}(\lambda_x, \tau_x) - \chi_{d,g=y}}^{\text{expected utility net of college cost}} + \zeta_{id,g=y}$$

$$\text{where} \quad V_{d,g=y}(\lambda_x, \tau_x) = \mathbb{E}_\epsilon \left[\max_{oe} \{ V_{ioe,g=y}(\lambda_x, \tau_x) \} \right]$$

Dissecting demand for redistribution ▸ PE intuition

Proposition: expected indirect utilities up to policy proposal (λ_x, τ_x)

$$V_g(\lambda_x, \tau_x) = \log \sum_{o,e} P_{oeg}(\tau_x)^{1-\tau_x} : \text{ compress } \textbf{comp.adv.} \text{ ("hard work")}$$

$$+ \frac{\gamma_{em}}{\theta}(1-\tau_x) : \text{ compress } \textbf{idiosyn.productivity} \text{ ("luck")}$$

$$+ \log h(\tau_x)^{1-\tau_x} : \text{ counteracting effects on } \textbf{hours}$$

$$- (1-\tau_x)\frac{\xi}{1+\xi} : \text{ utility gains from less } \textbf{hours}$$

$$+ \log(1-\lambda_x) : \textbf{ net transfer} \text{ gains from redistribution}$$

Mechanism:

	↗	redistribution role for "hard work"
progressve taxes	→	counteracting effects on hours
	↘	insurance role for "luck"

Political process: estimable probabilistic voting ▸ CE block

Proposition: symmetric best responses of candidates in electoral game

$$(\lambda^*, \tau^*) = \arg \max_{(\lambda_x, \tau_x)} \sum_g \underbrace{\omega_g}_{\text{pol weight}} \times \underbrace{\psi_g}_{\text{voter turnout}} \times \underbrace{\pi_g (\lambda_x, \tau_x)}_{\text{pop. share}} \times \underbrace{V_g (\lambda_x, \tau_x)}_{\text{policy pref.}}$$

$s.t.$ balanced government budget

$$\text{indirect utility}: \; V_g (\lambda_x, \tau_x) \equiv \mathbb{E}_\epsilon \left[\max_{oe,h} \{ V_{ioeg} (\lambda_x, \tau_x) \} \right]$$

$$\text{political weight}: \; \omega_g = \texttt{std. normal} \left[\sigma_{gt}^{-1} (-\mu_{gt} - \eta_g - \eta) \right]$$

1. (λ^*, τ^*) is the behavioral rule of utility-maximizing politicians
2. Politicians weigh groups' redist. pref. differently with ψ_g, ω_g
3. (λ^*, τ^*) and $CE (\lambda^*, \tau^*)$ are mutually consistent in equilibrium

Parametrization

Estimation overview ▸ external ▸ internal

- Match patterns in US micro & macro data in 1978-1980
- Two-step procedure
  - Estimate parameters directly observed and/or use standard values
  - MLE politician's trade-off using social survey
  - Calibrate the rest of parameters using method of moments
- Model exactly fits targeted moments
- Model generates untargeted moments close to data

Object	Description	Data	Value
τ	Tax progressivity	0.186	0.168
$\text{Var}(\log(w_g))$	Income Inequality	3.3455	2.4817

	Inequality	Progressivity
Baseline calibration	2.4871	0.168
(1) Change q_e ($\Downarrow$ equip. price)	3.7726 ($\uparrow$)	0.168 ($\not\uparrow$)
(2) Change q_e, $\omega_g = \psi_g = 1$	3.7340 ($\uparrow$)	0.173 ($\uparrow$)
TC leads to ($\uparrow$) inequality but ($\not\uparrow$) progressivity		
(3) Change q_e, $\phi_o = 1$ (w/o skill inv.)	4.4944 ($\uparrow$)	0.259 ($\uparrow$)
(4) Change q_e, $\omega_g = \psi_g = \phi_o = 1$	4.4526 ($\uparrow$)	0.265 ($\uparrow$)
w/o skill investment, back to conv puzzle: ($\uparrow$) inequality, ($\uparrow$) progressivity		

- **Mechanism** behind quantitative results

$\nearrow$ $\not\Uparrow$ **progressivity**

TC ($\Uparrow q_e$) $\rightarrow$ $\Downarrow$ **redistribution preferences**

($\because \Uparrow$ gains from skill invest.) $\searrow$ $\Uparrow$ **inequality**

Conclusion

Puzzle: **tax progressivity** has **not gone up**, despite **surge** in **inequality**

This paper explains the puzzling trends by:

1. document **TC** is associated with lower **redistribution pref.**
2. different exposure and returns by **TC** is quantitatively important

Policy implications

- Call for **comprehensive** redistribution policy design
- Incorporate **skill investment** in redistribution (ex. educ, job training)

Extra slides

Related Literature Back

Technical change, inequality, redistribution

Katz, Murphy ('92QJE); Krueger ('93QJE); Krusell, Ohanion, Rios-Rull, Violante ('00EMA); Autor, Levy, Murnane ('03QJE); Acemoglu, Autor (2011); Deming ('17QJE); Braxton, Taska ('23AER); Acemoglu, Aghion, Violante (2001); Benabou (2005); [political science] Iversen, Soskice ('00 American Political Science Review); Cusack, Iversen, Rehm (2005)

Determinants of redistribution/political preferences

Benabou, Ok ('02AER); Hassler, Mora, Storesletten, Zilibotti ('03AER); Karabarbounis ('10EJ); Alesina, Giuliano (2011); Giuliano, Spilimbergo ('14ReStud); Fuchs-Schundeln, Schundeln ('15 Science), Kuziemko, Norton, Saez, Stantcheva ('15AER); Autor, Dorn, Hanson, Majlesi ('20AER); [political science] Thewissen, Rueda ('17 Comparative Political Studies (CPS)); Kurer ('20 CPS)

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GSS: summary statistics

Back

Sample: ages 25-64		
Demographics		
Age (Avg./Stdev.)	42.1	10.7
Female	0.49	
Married	0.64	
White	0.78	
Black	0.14	
Work, Education		
Full Time	0.53	
HS Dropout	0.13	
HS Diploma	0.49	
Some College	0.07	
College Degree	0.31	
Political Identity		
Political Spectrum (Avg./Stdev.)	3.90	1.38
(1-Conservative, 7-Liberal)		
Party affiliation (Avg./Stdev.)	4.27	1.94
(1-Republican, 7-Democrat)		
Observations	21312	

9. Computers and Electronics

Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

A. How important is knowledge of COMPUTERS AND ELECTRONICS to the performance of *your current job*?

Not Important*	Somewhat Important	Important	Very Important	Extremely Important
1	2	3	4	5

* If you marked Not Important, skip LEVEL below and go on to the next knowledge area.

B. What level of knowledge of COMPUTERS AND ELECTRONICS is needed to perform *your current job*?

Operate a media player to watch a training video		Use a computer to format a document			Create a program to scan a computer for viruses	
1	2	3	4	5	6	7
						Highest Level

- Work with Computers: e.g. "Enter employee information into a computer database"
- APST: e.g. "(mini)computer", "software","website", "microprocessor" Back

Details of task intensity measure ◂ Back

Computer - Computer & Electronics Knowledge Requirement, Working with Computers

- Software developer, Economist, Broadcast technician

Social - Social Perceptiveness, Coordination, Persuasion, Negotiation (Deming '17)

- Lawyer, Salesperson, Personal service

Manual - "Routine Manual" + "Non-routine Manual Physical" (SO '06; AA '11)

- Home appliance repairers, Building maintenance

Routine - "Routine Cognitive" (SO '06; AA '11)

- Secretaries, Bookkeepers, Bank tellers

Measuring technological exposure Back

Technological exposure of skill s at OCC groups $o's$

Within-occupation skill intensity level, relative to all other occupations

- Composite of skill contents $c \in s$ at disaggregated job $j \in o$

$$z^s_{o,t} \equiv \sum_{j \in o} \omega^s_{j,t} z^s_{j,t} \quad \text{where} \quad z^s_{j,t} \equiv \sum_{c \in s} z^c_{j,t} \quad \omega_{j,t} \equiv \frac{L_{j,t}}{\sum_{j'} L_{j',t}}$$

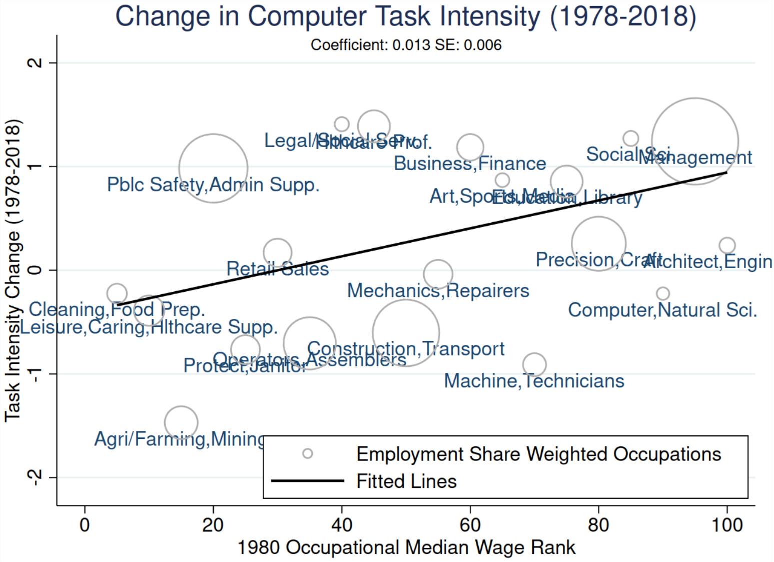
1. Across disaggregated OCC $j's$, weighted average of skill composite

   $L_{j,t}$: OCC employment from OES (O*NET); number of job ads (APST) as weights

2. Weighted studentization of skill measure for each year

   Purge potential differences in data reporting standard (e.g. Acemoglu-Autor '11)

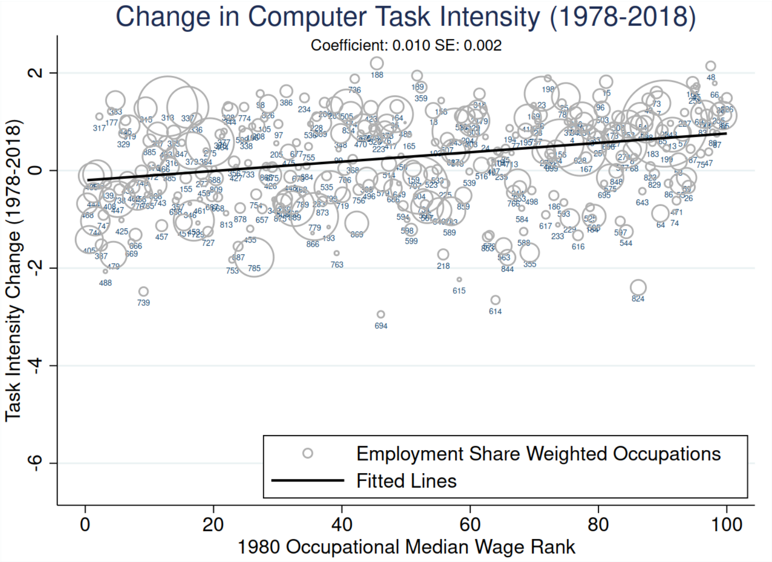
Biased technical change in computer ‣ Back



⇑ computer task intensity mainly at high-paying occupations ‣ computer: 3-digit

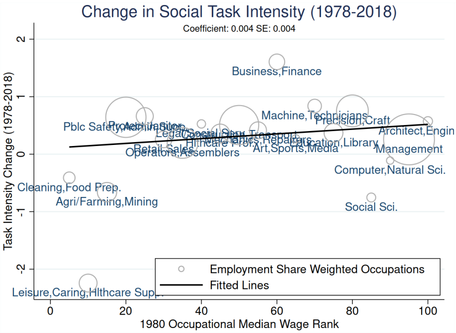
Biased technical change in computer: 3-digit

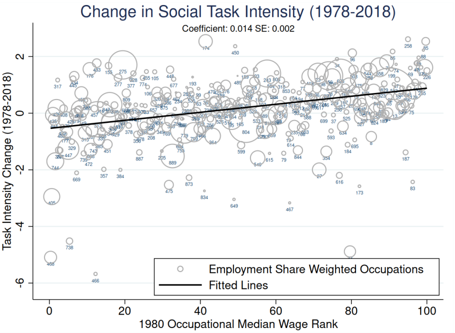
group



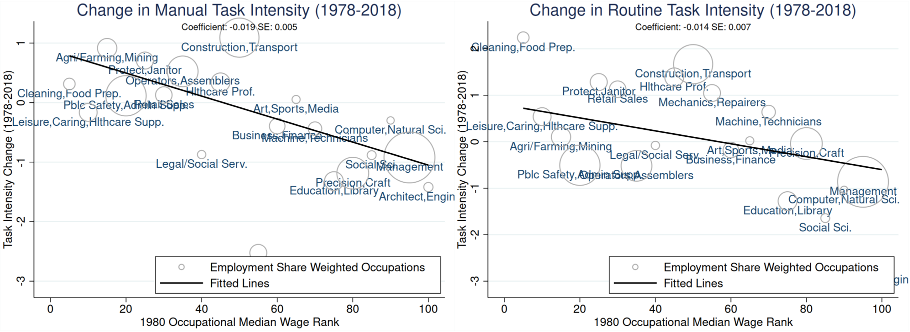
Biased technical change in social: group/3-digit

Back





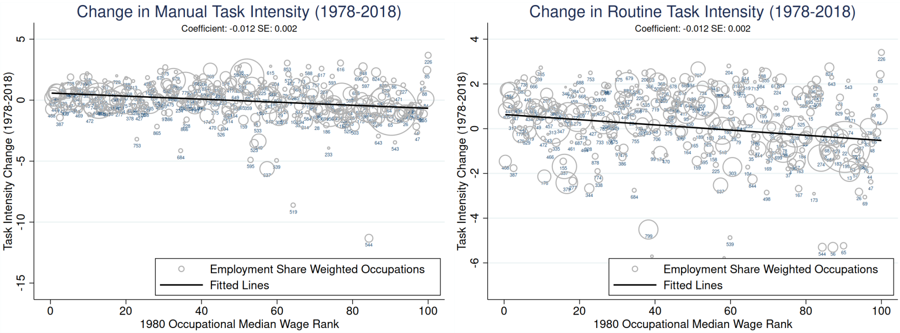
Biased technical change in manual/routine ▸ Back



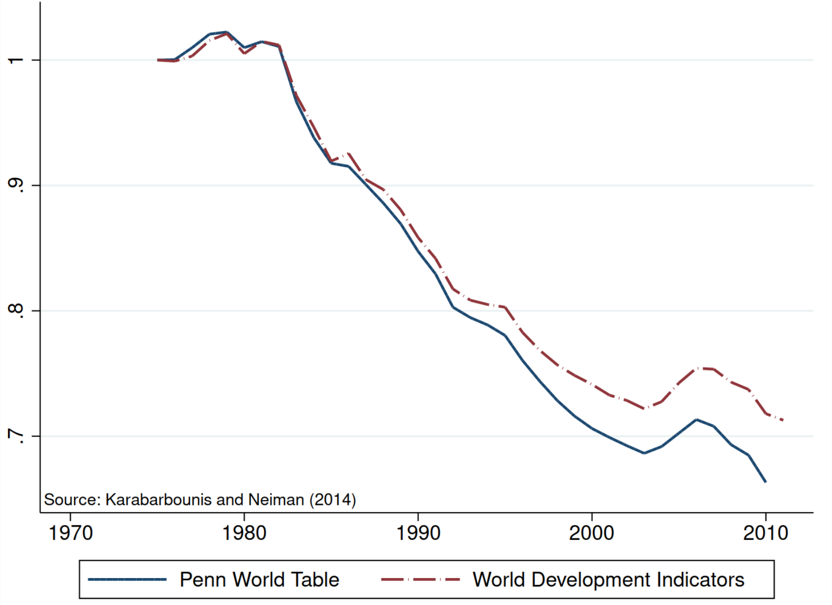
⇑ routine/manual task intensity concentrated at low-paying occupations ▸ 3-digit

Biased technical change in manual/routine: 3-digit

◂ occ. group



Decline in investment prices after since 1980s ▸ Back



Time allocation across tasks ◂ Back

- Conditional on h, allocate time to maximize profits:

$$\max_{l_{oegs}} P_o Y_{oeg} \quad s.t. \quad \sum_s l_{oegs} = h$$

- Allocated time across tasks:

$$\therefore l_{oegs} = \frac{\alpha_{oes}}{\sum_s \alpha_{oes}} h$$

Intuition in partial equilibrium ◂ Back

- Size of earnings is determined by both level λ_x and progressivity τ_x:

$$w_g(\lambda_x, \tau_x) = (1 - \lambda_x)\, h(\tau_x)^{1-\tau_x}\, \Gamma\left(1 - \frac{1-\tau_x}{\theta}\right) \left\{ \sum_{oe} P_{oeg}(\tau_x)^{\theta} \right\}^{\frac{1-\tau_x}{\theta}}$$

- Progressive tax τ_x compresses comparative advantage:

$$\underbrace{\pi_{oeg}(\lambda_x, \tau_x)}_{\text{worker alloc.}} = \frac{P_{oeg}(\tau_x)^{\theta}}{\sum_{(o,e)'} P_{(o,e)'g}(\tau_x)^{\theta}}$$

Government and resource constraints [Back]

Ω_{oeg}: the set of workers from demographic group g who choose (o, e) pair

- Final goods market clears:

$$Y = \underbrace{\sum_e Y_e}_{\text{equip. production}} + \underbrace{\sum_{o,e,g} N_g \int_i c_{i(o,e)^* g} di}_{\text{consumption}} + G$$

- Govt. budget is respected by candidates $x \in \{L, R\}$:

$$G = \sum_{o,e,g} N_g \int_{i \in \Omega_{oeg}} \left[P_{oeg} h_i \epsilon_{ioe} - (1 - \lambda_x) \left(P_{oeg} h_i \epsilon_{ioe} \right)^{1-\tau_x} \right] dF(\epsilon)$$

Bringing the model to the data (1) Back

- Direct data measurement

	Parameter (#)	Data / Source	Details
α_{oes}	Task importance (48)	Task intensity, **ICT usage** (APST, O*NET)	More
q_e	Equip. efficiency (2)	**ICT usage**, quality-adj. prices (CJK)	More
π_g	Population shares (12)	Employment shares (ACS)	
ψ_g	Turnout rates (12)	Voter turnout (CPS-Vote)	More
ξ	Labor hour elasticity	tax-adjusted Frisch elasticity	$\xi(1-\tau)=1$
θ	Wage dispersion	Caunedo et al. (2021)	1.24
α_e	Equipment share (2)	Burstein et al. (2013)	0.24
ρ	Demand elasticity	Burstein et al. (2019)	1.78
G	Govt. expenditures	Krusell and Rios-Rull (1999)	0.191

- **ICT usage** rate: APST/O*NET Tools & Technology

$$\text{ICT Usage}_{ot} = \begin{cases} \dfrac{\sum_k \text{Mentions of Technology } k \text{ at job } j \text{ in occ } o}{\#\text{Job ads at job } j \text{ in occ } o} & :\text{APST} \\ \dfrac{\#\text{Technology Used at job } j \text{ in occ } o}{\#\text{All Types of Tools Used at job } j \text{ in occ } o} & :\text{O*NET} \end{cases}$$

Task importance ◂ Back

- Project task intensity onto ICT usage, and factor out relative importance:

$$\text{Task Intensity}_{oest} = \beta_s \text{ICT Usage}_{ot} + \gamma \text{Relative Imp}_{ot} + \delta_o + \eta_t + \epsilon_{oest}$$

- Use the predicted values as proxy for task importance:

$$\widehat{\text{Task Intensity}}_{oest} = \hat{\beta}_s \widetilde{\text{ICT Usage}}_{ot} + \hat{\delta}_o$$

$$\text{where} \quad \widetilde{\text{ICT Usage}}_{ot} = \begin{cases} \overline{\text{ICT Usage}} & \text{if } e = \text{ICT} \\ 0 & \text{if } e = \text{non-ICT} \end{cases}$$

- where predicted values are normalized to bridge from data to the model:

$$\alpha_{oest} = \bar{\alpha}_e \times \frac{\widehat{\text{Task Intensity}}_{oest}}{\sum_{s'} \widehat{\text{Task Intensity}}_{oes't}}$$

Equipment efficiency

Back

- In the model, profit maximization of equipment producers implies:

$$\max_{Y_e} P_e q_e Y_e - Y_e \implies \therefore q_e = \frac{1}{P_e}$$

- In the data, define whether a job (3-digit) is ICT-intense or not:

$$j \in \begin{cases} o_{e=\text{ICT}} & \text{if} \quad j\text{'s rank} > p_{50}\left(\text{ICT Intensity}_j\right) \\ o_{e=\text{non-ICT}} & \text{if} \quad j\text{'s rank} \leq p_{50}\left(\text{ICT Intensity}_j\right) \end{cases}$$

- Weighted average of quality-adjusted prices

$$P_{j \in o_e} = \frac{1}{q_e}$$

  - from Caunedo et al.'s (2021) dataset and ICT usage measure

Bringing the model to the data (2) Back

- Parameters estimated jointly (exact fit):

	Parameter (#)	Data / Source	Details
H_g	Worker productivity (12)	Post-tax wage (CPS, NBER TAXSIM)	More
ω_g	**Political weight** (12)	Stated economic/social preferences (GSS)	More
ϕ_o	**Returns to skill invest. (6)**	Occupation employment share (ACS)	More
χ_g	Education costs (2)	Young college share (CPS)	1.064, 1.439
φ	Disutility of work	Employment-population ratio (FRED)	1.405

- Maximum-likelihood estimation of **political weight**
  - Trade-off between voters' economic and social preferences
  - Need panel data $\Longrightarrow$ synthetic panel of voter groups (GSS)

(1) redistribution, (2) political spectrum, (3) controversial social issues

Productivity H_g, returns to HC invest., edu. cost χ_g ◂ Back

- H_g: Expected wage per demographic group (base: young, male, HS)

$$\frac{w_g^{\texttt{Data}}}{w_{g_{\text{base}}}^{\texttt{Data}}} = \frac{w_g^{\texttt{Model}}}{w_{g_{\text{base}}}^{\texttt{Model}}}$$

- ϕ_o: Occupation employment ratio (base: managers/professionals)

$$\frac{\pi_o^{\texttt{Data}}}{\pi_{o_{\text{base}}}^{\texttt{Data}}} = \frac{\pi_o^{\texttt{Model}}}{\pi_{o_{\text{base}}}^{\texttt{Model}}}$$

- χ_g: Population ratio between college grads vs. HS grads

$$\frac{\pi^{\texttt{Data}}_{\{\text{Young}\}\times\text{Gender}\times\{\text{Coll}\}}}{\pi^{\texttt{Data}}_{\{\text{Young}\}\times\text{Gender}\times\{\text{HS}\}}} = \frac{\pi^{\texttt{Model}}_{\{\text{Young}\}\times\text{Gender}\times\{\text{Coll}\}}}{\pi^{\texttt{Model}}_{\{\text{Young}\}\times\text{Gender}\times\{\text{HS}\}}}$$

Political bias ◂ Back

- Parametrize $\mu_{gt} = X_{1gt}\beta_\mu$ and $\sigma_{gt} = X_{2gt}\beta_\sigma$:

$$\Phi^{-1}(\omega_{gt}) = \gamma_{gt} = -\sigma_{gt}^{-1}\left[\mu_{gt} + \eta_{gt} + \eta_t\right]$$

- Maximum likelihood to obtain $\{\hat{\mu}_{gt}, \hat{\sigma}_{gt}, \hat{\sigma}\}$

$$\log \mathcal{L}(\gamma_t) = -\frac{1}{2}\left\{\log\left(1 + \sum_g \left(\frac{\sigma}{\sigma_g}\right)^2\right) + \sum_g \log\left(\frac{\sigma_g}{\sigma_{gt}}\right)^2 + G\log(2\pi) + \sum_g \left(\frac{\gamma_{gt}\sigma_{gt} + \mu_{gt}}{\sigma_g}\right)^2 - \sigma^2 \frac{\left(\sum_g \frac{[\gamma_{gt}\sigma_{gt} + \mu_{gt}]}{\sigma_g^2}\right)^2}{1 + \sum_g \left(\frac{\sigma}{\sigma_g}\right)^2}\right\}$$

- Estimates of political weight $\hat{\omega}_{gt}$:

$$\hat{\omega}_g = \frac{1}{T}\sum_{t=1}^{T}\hat{\omega}_{gt} \quad \text{where} \quad \hat{\omega}_{gt} = \phi\left(-\frac{\hat{\mu}_{gt}}{\hat{\sigma}_{gt}}\right)$$

Political bias: result Back

Groups	ω_g	ψ_g	Groups	ω_g	ψ_g
Young, Male, HS	0.0845	0.462	Middle, Male, Coll	0.0827	0.860
Young, Female, HS	0.0847	0.498	Middle, Female, Coll	0.0841	0.850
Young, Male, Coll	0.0837	0.752	Old, Male, HS	0.0824	0.718
Young, Female, Coll	0.0847	0.736	Old, Female, HS	0.0825	0.712
Middle, Male, HS	0.0836	0.613	Old, Male, Coll	0.0803	0.890
Middle, Female, HS	0.0841	0.647	Old, Female, Coll	0.0826	0.913