Organization of Knowledge and Taxation

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Motivation

A classic question:

- How should people's incomes be taxed?

Renewed interest:

- Recent large changes in wage (and income) inequality.
- Wages change differently at the top and bottom.

Motivation

Answer (to the classic question) typically given in models with:

1. Exogeneous wage inequality, and/or
2. limited interaction between top and bottom wages.

This paper:

1. Optimal (labor) taxes in model with (i) endogeneous wages, (ii) rich interaction between top and bottom wages.
2. Model can match the wage structure and (potentially) its changes over time.

This Paper

- Model of knowledge based hierarchies of Garicano (2000), Garicano and Rossi-Hansberg (2006).
- People choose to become workers or managers.
- Form organizations in which knowledge efficiently combined.
- We extend the model to match observed wage inequality.
- Study labor income taxation in this model.

(Quantitative) Results

With a constant-rate-of-progressivity income tax function:

- More progressive taxes **decrease** wage inequality in upper tail: more managers supervise fewer (less diverse) workers.
- More progressive taxes **increase** wage inequality in lower tail: workers matched with more diverse managers.
- Nontrivial trade-off. However, in the optimum, taxes are:
  1. **modestly more progressive** than in the U.S,
  2. **much less progressive** than when wages are exogeneous.

Rest of the Talk

- Model
  1. Environment
  2. Competitive Equilibrium
  3. Comparative Statics
- Quantitative Analysis
  1. Calibration
  2. Optimal Taxes
- Empirical evidence
- Conclusion

Model

Setup

- Static model.
- Two goods: time and general consumption/output good.
- Government and measure one of agents: $U(c) - V(\ell)$.

$$U(c) = \ln c, \quad V(\ell) = \kappa \frac{\ell^{1+\eta}}{1+\eta}.$$

Technology

- Output produced by solving tasks.
- Agents heterogeneous in skill $z \in [\underline{z}, \overline{z}] \sim G(z)$.
- Every unit of time, continuum of tasks arrives $\sim F(z)$.
- Agent with skill z can solve $[\underline{z}, z]$ tasks.

- Agents form organizations with one manager and n production workers.
- Worker of type z_p solves $F(z_p)$ tasks, and asks the manager for help with $1 - F(z_p)$ tasks.
- Manager of type $z_m > z_p$ explains $F(z_m) - F(z_p)$ tasks to worker.
- After receiving advice, worker produces output $F(z_m)$ per unit of time, and $F(z_m)\ell_p$ total (team) output.

- Communication between worker and manager takes time; number of workers n a manager working ℓ_m can supervise:

$$n\theta(z_p) = \ell_m$$

Example 1
(Garicano, 2000, constant communication costs h):

$$\theta(z_p) = h \cdot [1 - F(z_p)]$$

- **Example 2**
(this paper, heterogeneity in communication costs):

$$\theta(z_p) = h(z_p) \cdot [1 - F(z_p)], \quad h'(z_p) < 0.$$

Output

- Output of organization is

$$nF(z_m)\ell_p = \frac{\ell_p}{\theta(z_p)} F(z_m)\ell_m$$

- Complementarity between i) skills, ii) hours worked

- Effective communication costs $\frac{\theta(z_p)}{\ell_p}$ critical

Incomes and Wages

- Individuals sort to be production workers or managers.
- Production workers receive wage $w(z_p)$. Earnings

$$y_p = w(z_p)\ell_p$$

- Managers z_m teaming with n workers z_p have earnings

$$y_m = n\,[F(z_m) - w(z_p)]\,\ell_p = \frac{\ell_p}{\theta(z_p)} \cdot [F(z_m) - w(z_p)]\ell_m$$

with wages $w(z_m) = y_m/\ell_m$.

Government

- Income taxed by a type-independent *constant-rate-of-progressivity* tax function:

$$T(y) = y - \lambda y^{1-\tau}$$

- Government consumption G, budget constraint

$$\mathbb{E}_y T(y) = G,$$

- **Remark:** With this tax and utility functions, labor hours constant across agents; $\bar{\lambda}(\tau)$.

Equilibrium

CE is an allocation (assignment, labor hours and consumption) and prices (wages) s.t.:

(a) Individuals optimally choose to be managers or workers.

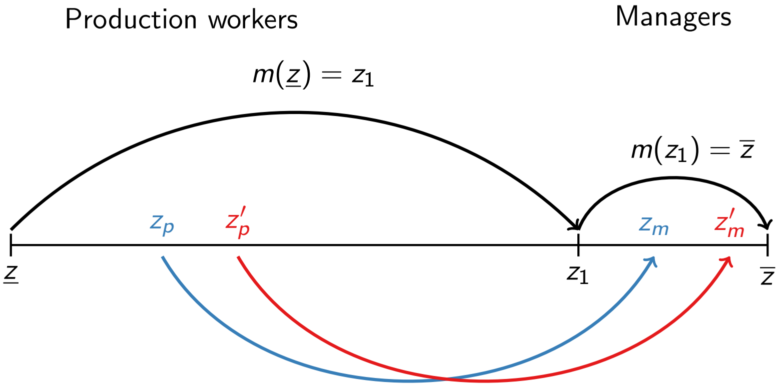
(b) Workers choose ℓ and c optimally given wages.

(c) Managers choose workers and ℓ and c optimally, taking wage schedule and labor hours of production workers as given.

(d) Supply of managers/workers equal to demand for managers/workers.

(e) Supply of goods equal to demand for goods.

Occupational Choice



Assortative matching: $m'(z_p) > 0$

Comparative Statics in τ

What happens when τ increases?

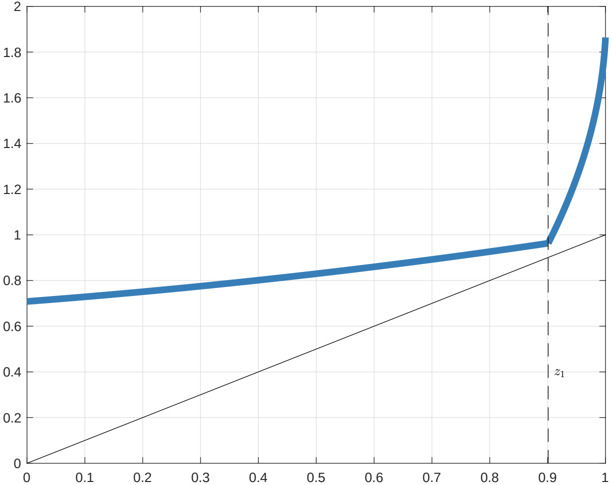
- Labor hours $\bar{\lambda}(\tau)$ decrease, effective com. costs $\frac{\theta(z_p)}{\ell_p}$ increase.
- Threshold z_1 decreases.
- Wage structure changes.

An Increase in Tax Progressivity

Consider a simple example with a closed form solution:

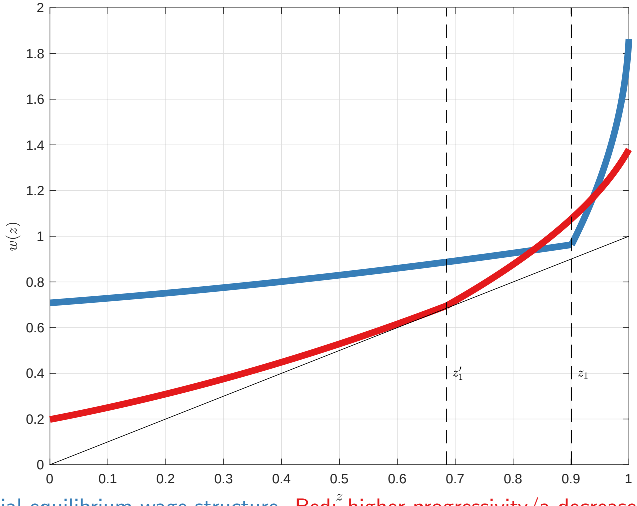
- $z \in [0, 1]$
- F and G are uniform
- $\theta(z_p) = h(1 - z_p)$
- The effective communication costs are $h/\bar{\ell}(\tau)$

Initial Equilibrium



Blue: Initial equilibrium wage structure.

Comparative Statics



Blue: Initial equilibrium wage structure. Red: higher progressivity/a decrease in hours.

Comparative Statics

Tax progressivity $\tau \uparrow$ (effective communication cost $\uparrow$):

1. Managers work less: More managers, smaller organizations.
2. Wage inequality among managers decreases.
   - Intuition: Managers now matched with more similar workers.
   - Workers' hours decrease.
3. Wage inequality among workers increases.
   - Intuition: Workers matched with more diverse managers.

Summary: Endo wages affect the E-E tradeoff and make redistribution through progressive taxes less attractive.

Quantitative Analysis

Overview

- Calibrate model to U.S. wage moments.
- Compute optimal taxes (progressivity):
  1. When wages are endogeneous.
  2. When wages are exogeneous.
- Extensions/additional exercises.

Calibration: Functional Forms

- Skill types and tasks on $[0, 1]$.
- Skill types and task arrival:

$$G(x) = 1 - (1 - x)^{1+\rho}$$
$$F(x) = x$$

- **Note:** $F \sim U[0, 1]$ WLOG. Degree of freedom in G and F.
- $\theta(x) = h(1 - x)^{\gamma} [1 - F(x)] = h(1 - x)^{1+\gamma}$.

Calibration: Parameters

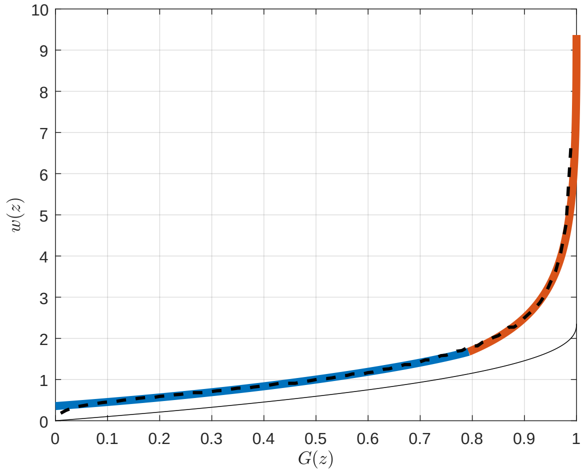
Parameters set outside the model

- Gvt policy
  1. $T(y) = y - \lambda y^{1-\tau}$, $\tau = 0.181$ (HSV, 2016),
  2. gvt expenditure $G = 0$.
- Utility $\ln c - \kappa \frac{\ell^{1+\eta}}{1+\eta}$
  1. $\eta = 2$ (Frisch elasticity of labor $= 0.5$),
  2. normalize $\kappa = 1$.

Calibration: Parameters

- 3 remaining model parameters: ρ, γ and h.
- 3 targets:
  1. $1 - G(z_1) = 0.207$ (fraction of managers, CPS 2017)
  2. $\log 90/50 = 0.916$ (CPS 2017)
  3. $\log 50/10 = 0.788$ (CPS 2017)

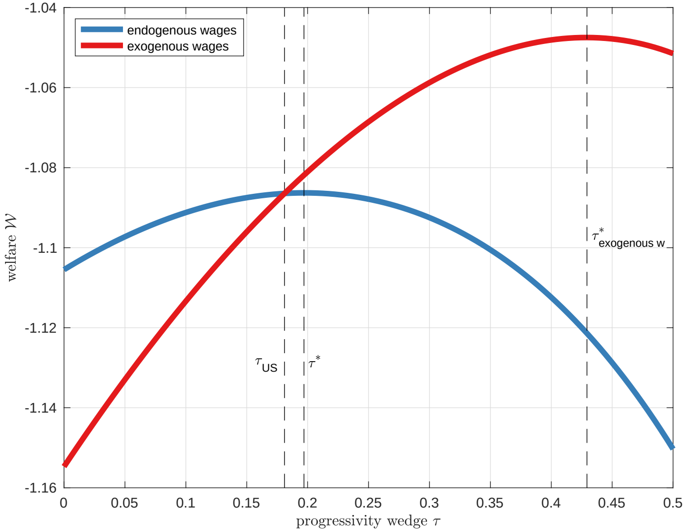
Benchmark Model Fit



Thick line: Model wages. Dashed line: CPS data. Thin line: ‘Autarky’.

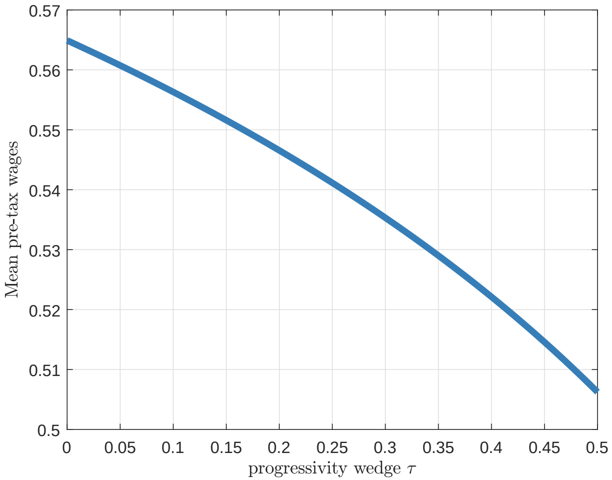
Optimal Taxes

Optimal Taxes



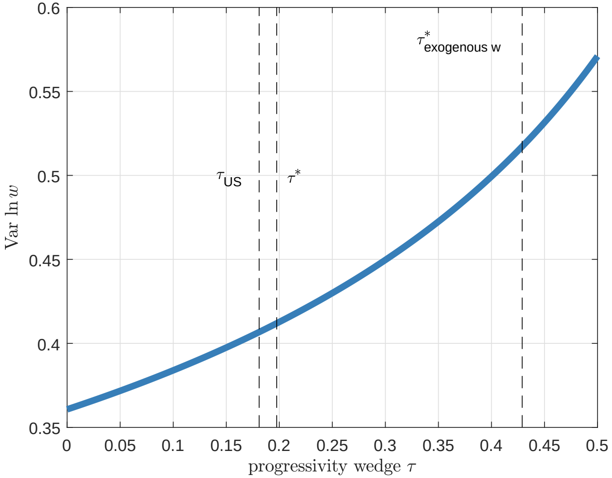
Red line: endogenous wages. Blue line: exogenous wages

Mean Wages

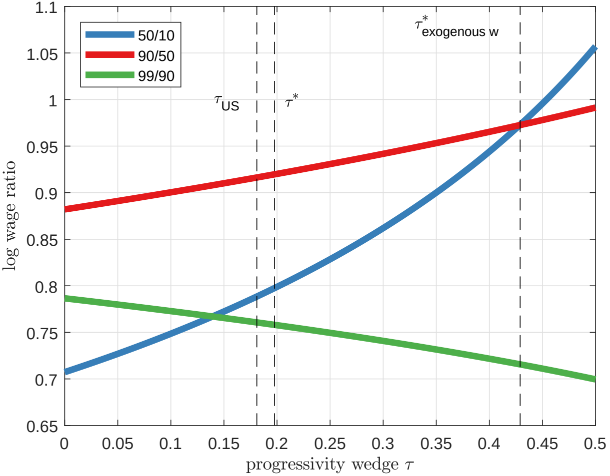


0.57
0.56
0.55
0.54
0.53
0.52
0.51
0.5
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Mean pre-tax wages
progressivity wedge τ

Variance of log Wages



Wage Inequality Measures



Optimal Tax Reform

- $\tau_{US} = 0.181, \tau^* = 0.197, \tau^*_{exogenous\ w} = 0.429$.
- Welfare gains $\tau^* = 0.01\%, \tau^*_{exogenous\ w} = -3.45\%$.
- In addition to more redistribution and standard labor supply effects, higher progressivity:
  1. $\downarrow$ average pre-tax wages,
  2. $\downarrow$ wage inequality at top, but $\uparrow$ wage inequality elsewhere (at bottom): $\uparrow$ overall wage inequality.
- These effects $\downarrow$ optimal tax progressivity from 0.429 to 0.197.

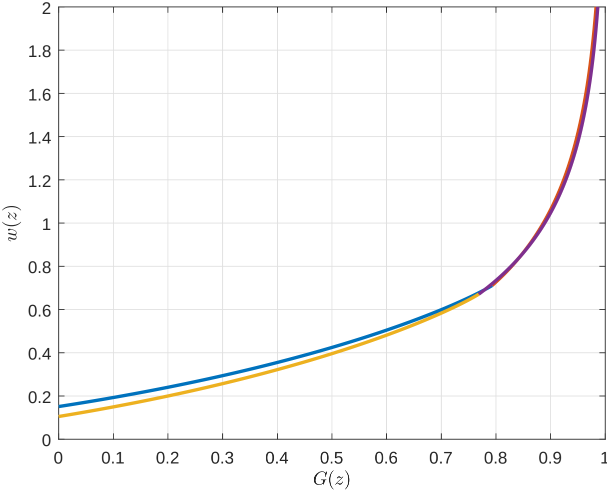
Distributional Consequences

Distributional Consequences

- Compare status-quo tax progressivity $\tau = 0.181$ with optimal exo-wage $\tau = 0.429$

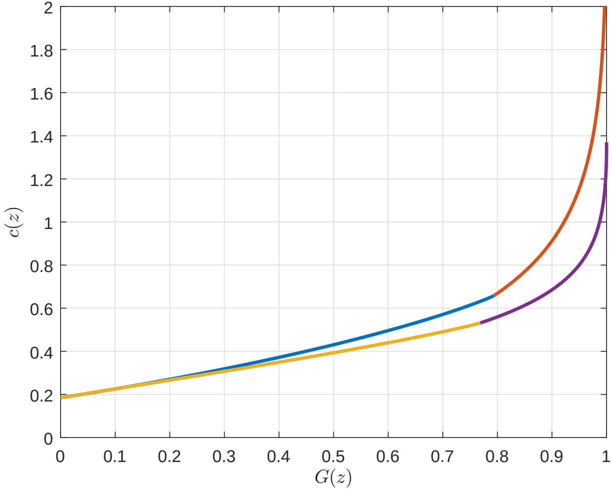
- Recall: optimal endo-wage $\tau = 0.197$.

Benchmark Additional Results - Wages



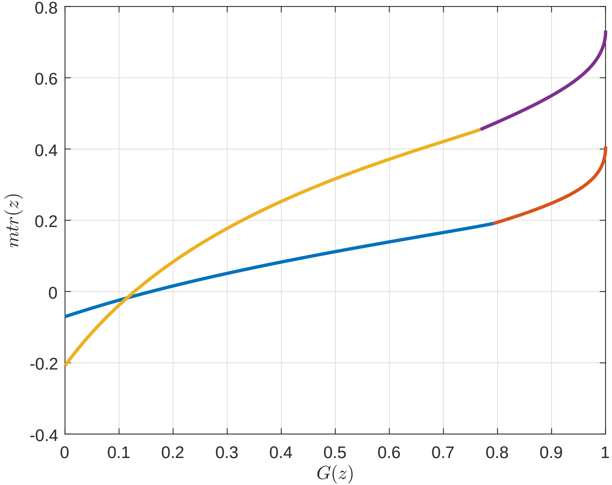
Blue+red: status quo $\tau = 0.181$, yellow+purple $\tau = 0.429$.

Benchmark Additional Results - Consumption



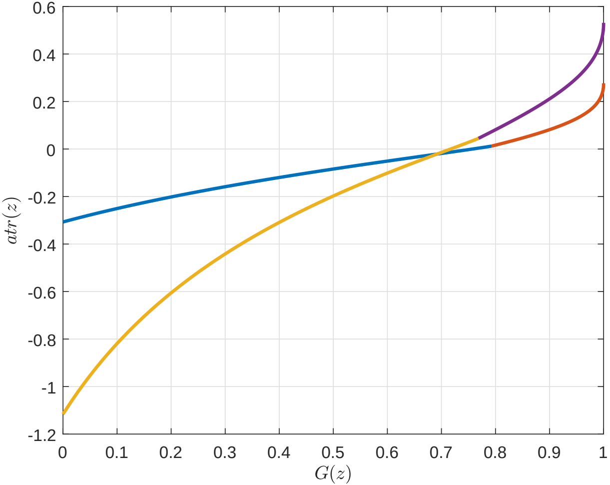
Blue+red: status quo $\tau = 0.181$, yellow+purple $\tau = 0.429$.

Benchmark Additional Results - Marginal Tax Rates



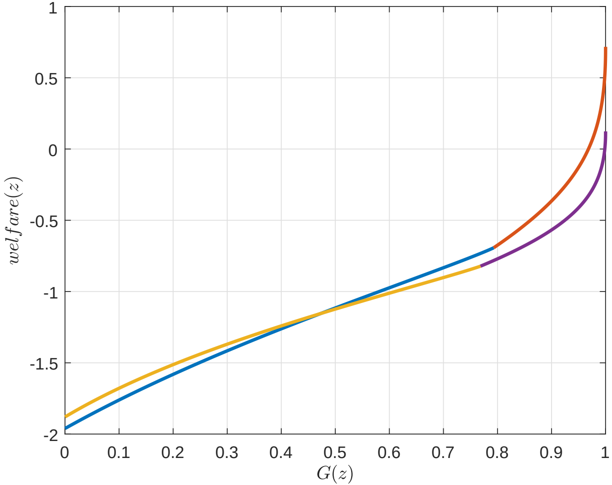
Blue+red: status quo $\tau = 0.181$, yellow+purple $\tau = 0.429$.

Benchmark Additional Results - Average Tax Rates



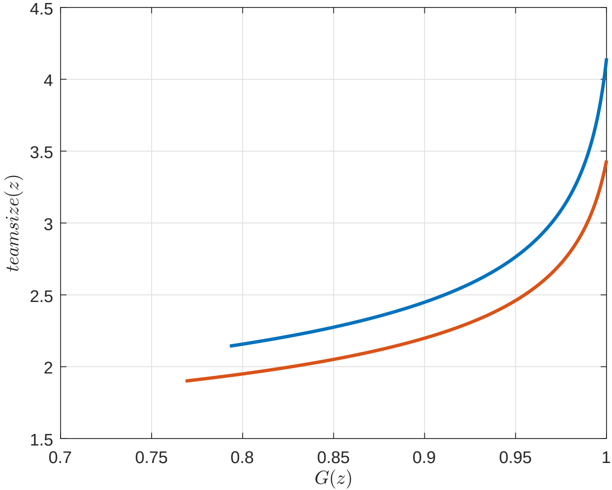
Blue+red: status quo $\tau = 0.181$, yellow+purple $\tau = 0.429$.

Benchmark Additional Results - Welfare



Blue+red: status quo $\tau = 0.181$, red $\tau = 0.429$.

Benchmark Additional Results - Teamsize



Blue+red: status quo $\tau = 0.181$, yellow+purple $\tau = 0.429$.

Empirical Evidence

Empirical Evidence

Our mechanism: Progressivity affects pre-tax wages.

- Large empirical literature on how taxes affect labor supply and on how taxes affect pre-tax income.
- Smaller literature on how taxes affect pre-tax wages.
- Comparing our results to empirical literature work in progress.

Empirical Evidence

Papers estimate wage responses to marginal tax rate (MTR) and average tax rate (ATR) changes:

- Scandinavian data (search-and-matching bargaining context):
  1. Arronson et al (1997), Hansen et al (2000): increasing MTR decreses wages; opposite for ATR
  2. Blomquist and Selin (2010): increasing MTR decreases wages for both men and women using Swedish data
  3. Holmlund and Kolm (1995): increasing progressivity leads to lower wages (and hence higher empoyment)

Our model predicts distributional consequences of changes in progressivity:

- Schneider (2005): German tax reforms, increasing progressivity reduces wages, stronger for lower income workers
- Frish, Zussman, Igdalov (2020): Israeli tax cuts, wage elasticity increases with income
- Moffitt, Wilhelm (1998): Wages of rich men have increased due to the 1986 U.S. tax rate cuts

Conclusion

- Model in which taxes interact with top/bottom wage inequality.
- Top/bottom inequality moves in opposite directions: more progressive taxes decrease top but increase bottom inequality.
- Optimal progressivity close to current U.S. tax code and substantially smaller relative to exogenous wages.