Occupation and Growing Wage Inequality in the United States, 1983-2002

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PRC-Brown Bag

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Presentation about...

1. Background

2. Fact Finding:
What is the relation between occupation and wage Inequality?

3. Causality Study:
Why inequality is growing?

Background Question

1. Inequality has been growing during last 25 years in the United States (as well as most other developed countries).

2. Occupation has been the single most important unit of analysis in the studies of stratification and inequality in sociology.

3. Relation between occupation and growing inequality is widely unknown.

Background Question

Occupation has been the single most important unit of analysis in sociology.

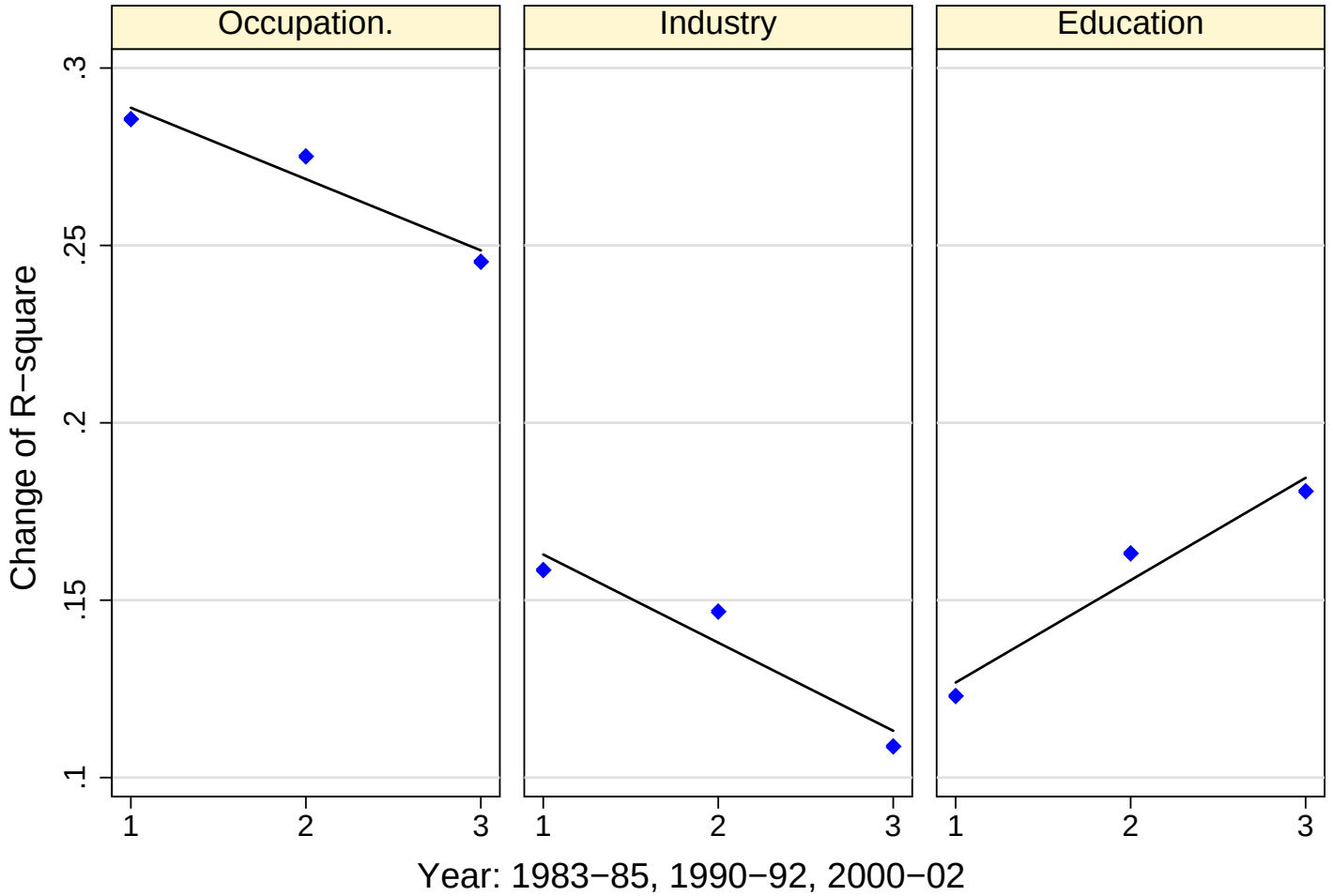
- Marx
- Durkheim
- Conflict Theory: Wright (1984)
- Functional Theory: Status Attainment Theory
- Treiman Constancy (Hout 2003)

Background Question

A new attention on occupation in the studies of social stratification recently.

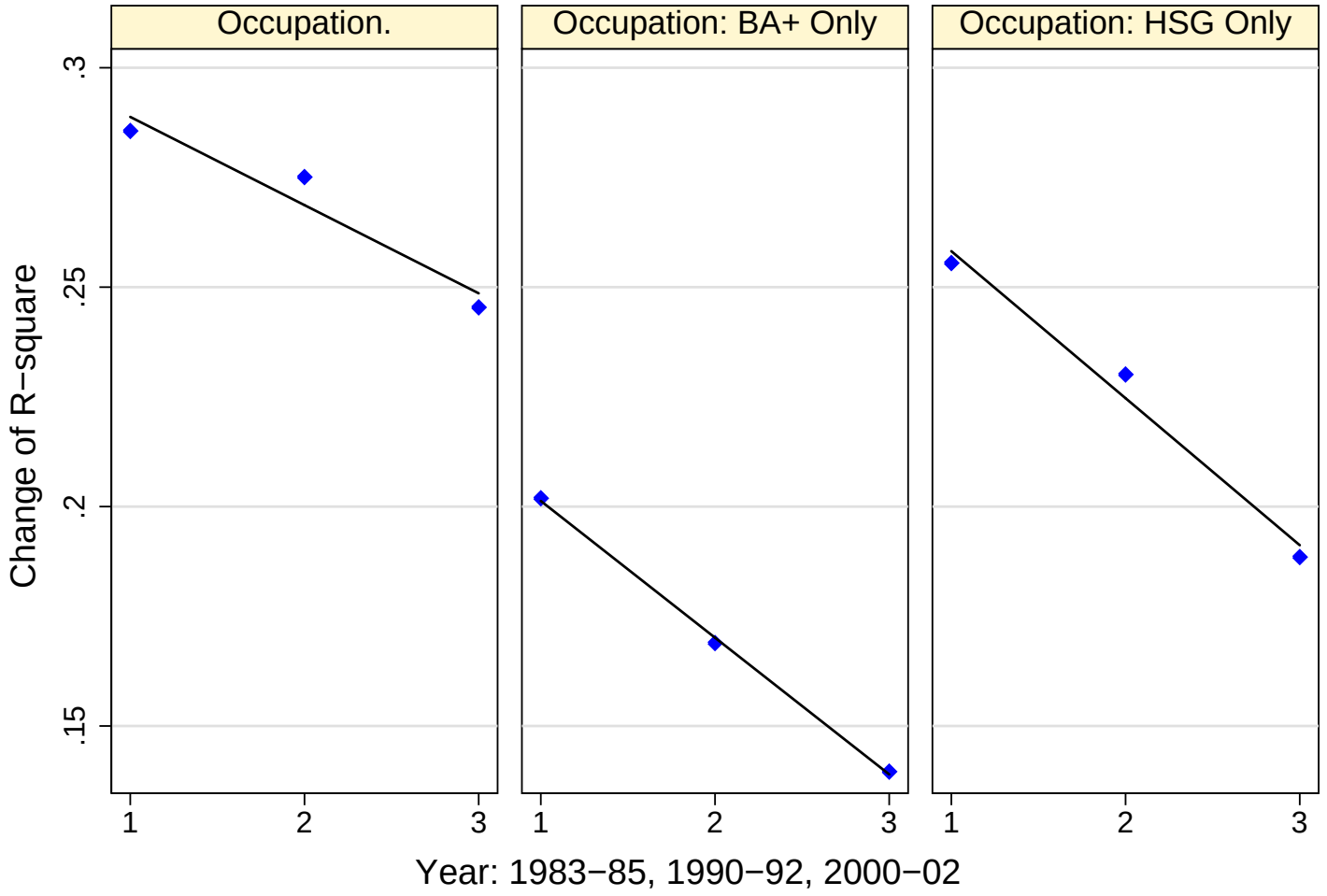
- Grusky and Sørensen (1998, AJS): Possible remedy of the ongoing retreat from class analysis → “Disaggregate structuration"
- Weeden (2002, AJS): Detail occupation is “a promising complement to individualistic explanations of earnings inequality."
- Grusky and Sørensen (1998, AJS): “Does disaggregation greatly increases the explanatory power of class models?"

Explanatory Power of Occupation on Wage



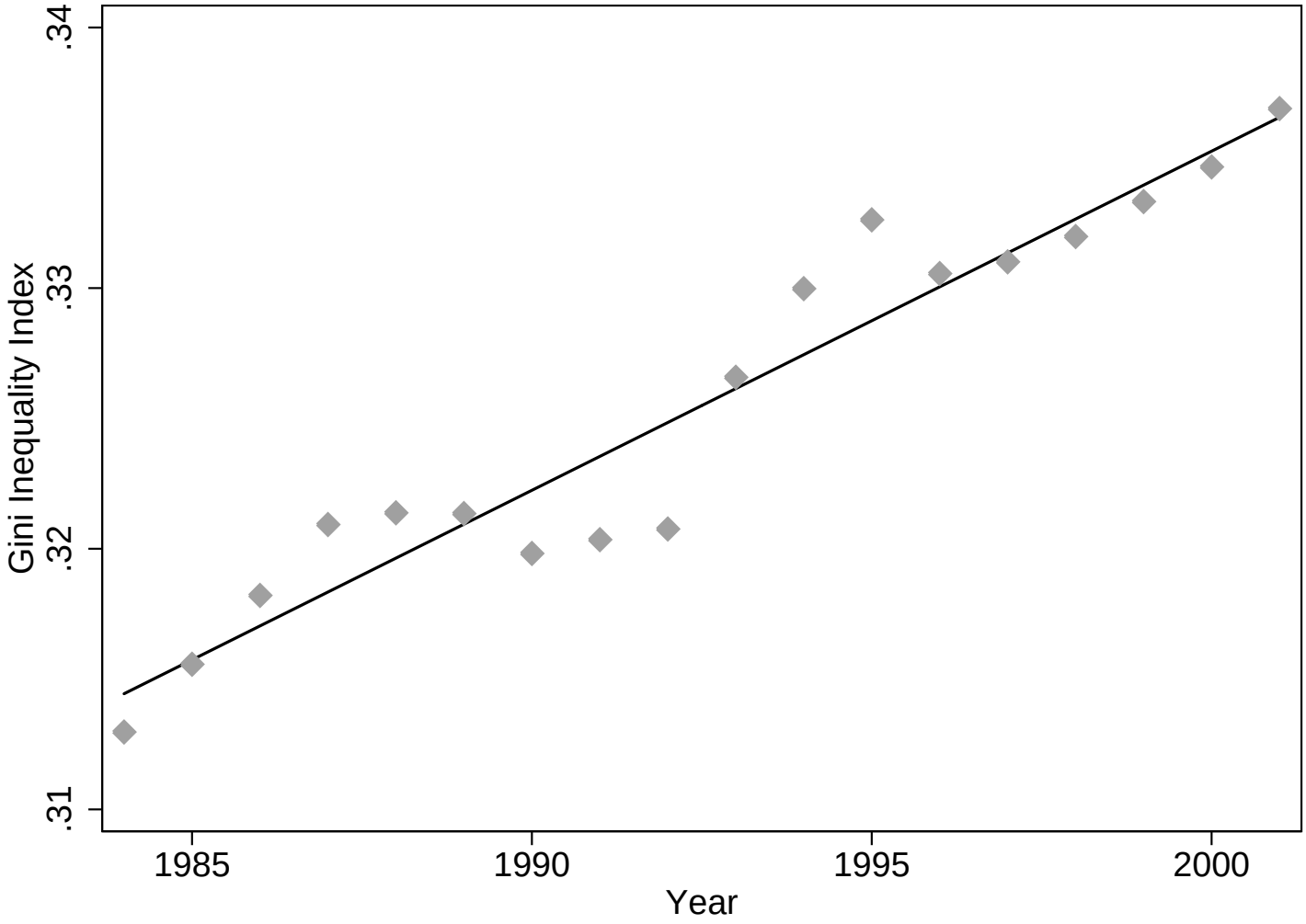
$Wage_i = \alpha + \beta_j OCC_j + \varepsilon_i$ (Y-axis in graph is R^2)

Explanatory Power of Occupation on Wage



Total, Among BA+, Among $\leq$HSG

Growth of Hourly Wage Inequality



Between- & Within- Occupational Inequality

	Theil Index	% Δ fr 83-85	% Δ fr 90-92
1983-1985			
Total	.16551		
Between	.06019		
Within	.10532		
% of Within	(.636)		
1990-1992			
Total	.17450	.05432	
Between	.06576	.09254	
Within	.10874	.03247	
% of Within	(.623)	(.380)	
2000-2002			
Total	.19762	.19401	.13249
Between	.06974	.15866	.06052
Within	.12788	.21420	.17602
% of Within	(.647)	(.703)	(.828)

Where is Inequality Growing?

- No matter what is unit of measurement: Hourly Wage, Annual Income, Household Income.

- Everywhere: Universal Phenomenon
  1. No matter which industry
  2. No matter what educational level
  3. No matter which gender
  4. No matter which race

- Within Group Inequality $>$ Between Group Inequality

- Different Inputs, but the Same Results?

Change of Mean Wage and Ineq. within Occ.

		Mean Wage			Total
		Decrease	No Change	Increase	
Ineq-uality	Decrease	38	24	5	67
		(.123)	(.096)	(.011)	(.229)
	No Change	49	63	34	146
		(.103)	(.088)	(.100)	(.291)
	Increase	28	47	43	118
		(.059)	(.254)	(.167)	(.480)
Total		115	134	82	331
		(.285)	(.438)	(.278)	(1.000)

(1) $INEQ_{jt} = \beta_{0j} + \beta_{1j} YEAR + \varepsilon_{jt}$ (331 regressions)

(2) $MEANWAGE_{jt} = \beta_{0j} + \beta_{1j} YEAR + \varepsilon_{jt}$ (331 regressions)

Decrease or Increase: significant β_{1j} at $\alpha = .05$

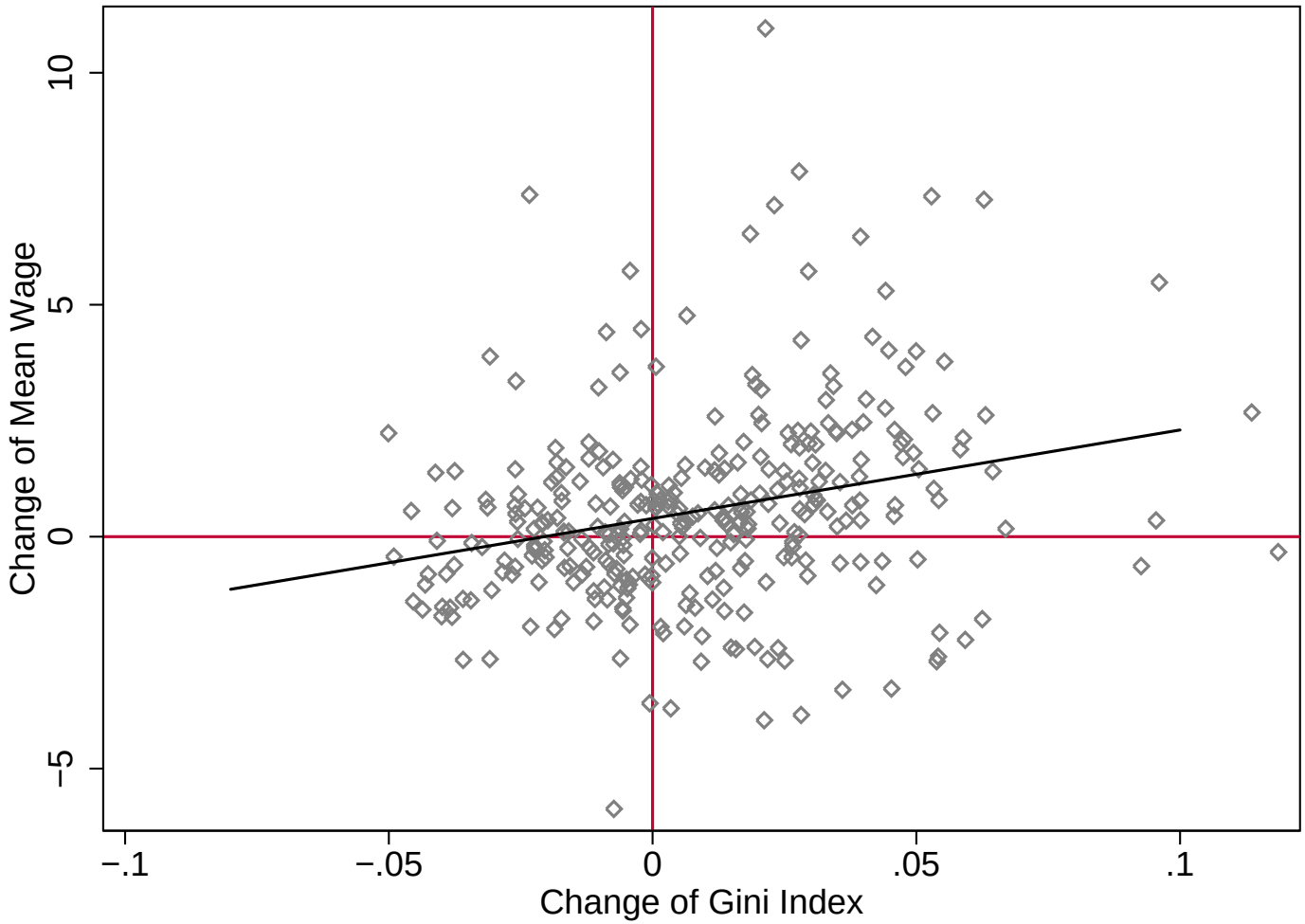
Number in Table: number of occupational categories

Number in ( ): % share of workers in 2002

We, Social Science Teachers?

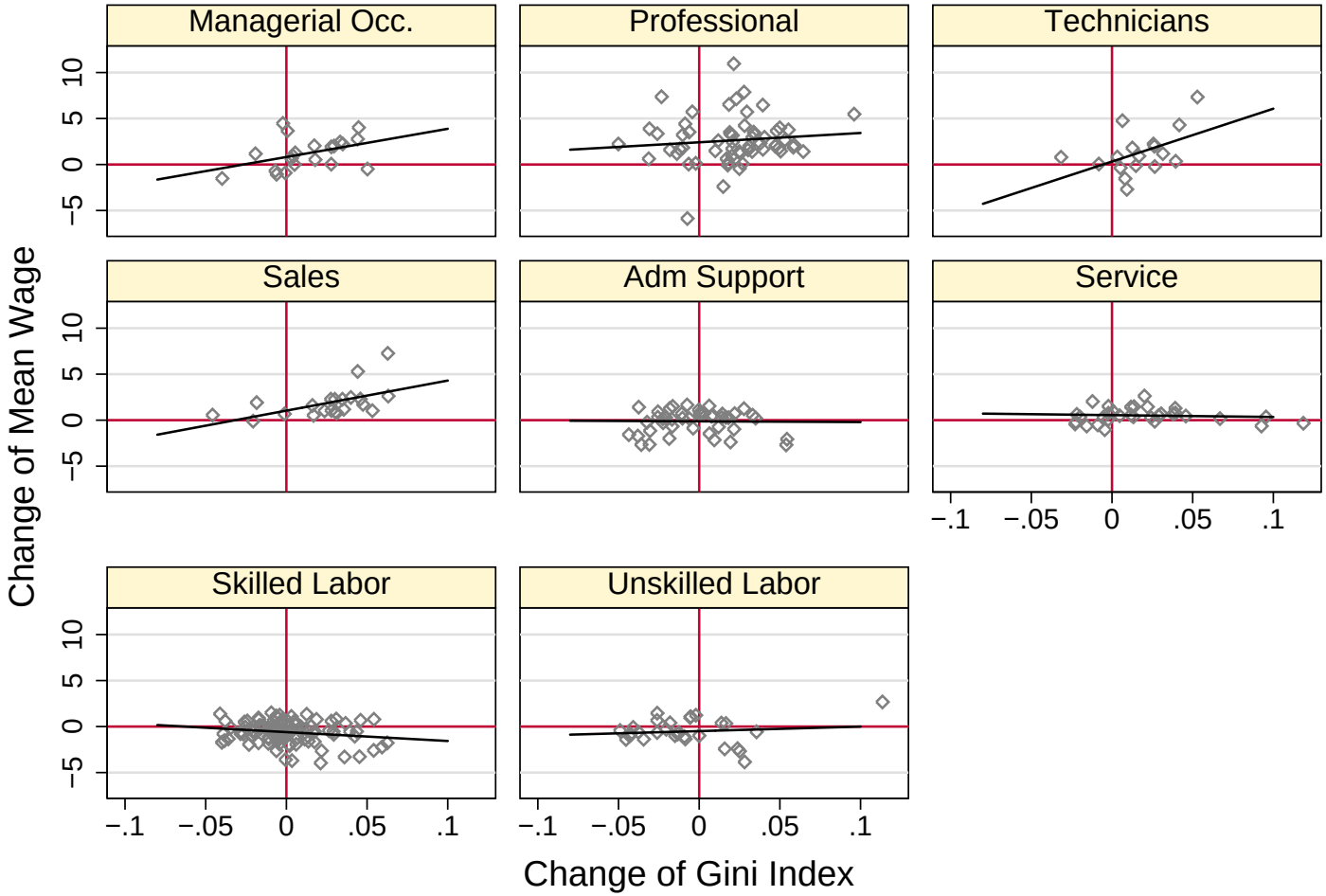
- One of the fastest inequality growing occupations.
- Ranked 42nd among 331 occupations.
- Gini Index: from .26268 in 1983-85 to .29641 in 2000-02

Change of Mean Wage and Ineq. within Occ. from 1983 to 2002



Point in Graph: Occupation

Change of Mean Hourly Wage and Wage Inequality, between 1983-85 and 2000-02



Point in Graph: Occupation

Summary: Occupation and Inequality

1. Explanatory power of occupation on hourly wage has declined over last two decades
2. Within-occupational-inequality has grown faster than between-occupational-inequality.
3. Heterogeneity within an occupation has increased and homogeneity in an occupation has diminished.
4. But increasing within-occupational-inequality is not universal across occupation, there is variability across occupation.

Theory

Why inequality has increased over time?

1. Influx of Female Workers
2. Deindustrialization (Declining Manufacturing Sector)
3. Privatization (Declining Public Sector)
4. Skill Biased Technological Change (College Premium)
5. Union Effect (Declining Union Membership)
6. Insecure Employment Relation (Part Time)
7. Organizational Culture Change

Data

- ***Stage 1***:
  1. Raw Data: Current Population Survey-MORG, 1983-2002
     $\longrightarrow$ Combine each three consecutive years' data (18 periods)
  2. Population: Aged 18-65, Employed, Both male and female
  3. Hourly Wage: Earn at least 50cents per hour. Top Coding: Log Normal Distribution, Inflation: Adjusted by CPI-X.
  4. Occupation: At least 100 samples per each year, otherwise record. 331 occupations.

- ***Stage 2***:

- ***Stage 3***:

Data

- ***Stage 1***:

- ***Stage 2***:
  1. Inequality: 331 occupations' within-occupational-inequality. Gini Index, Entrophy Indexes, Atkinson Indexes (7 indexes)
  2. Meanwage: 331 occupations' mean wage
  3. Explanatory Variables: 331 occupations' characteristics (ex. % of female, % of BA+)
  4. Repeat 18 periods

- ***Stage 3***:

Data

- ***Stage 1***:

- ***Stage 2***:

- ***Stage 3***:
  1. Merge them.
  2. 331 occupation $\times$ 18 periods = 5,958 cases

Data

Year	Occ	Inequality	Meanwage	Female
1984	1	.1583	20.33	.2358
1985	1	.1682	22.85	.2544
1986	1	.1699	22.99	.2613
		:		
		:		
2001	1	.1721	23.11	.2812
1984	2	.1583	20.33	.2358
1985	2	.1682	22.85	.2544
1986	2	.1699	22.99	.2613
		:		
		:		
2001	2	.1721	23.11	.2812

Multilevel Growth Model

OLS Model

$$INEQ_{jt} = \alpha + \beta T_t + \varepsilon_{jt} \tag{1}$$

Multilevel Model

$$\begin{aligned} INEQ_{jt} &= \alpha_j + \beta_j T_t + \varepsilon_{jt} \\ \alpha_j &= \alpha + u_{1j} \\ \beta_j &= \beta + u_{2j} \end{aligned} \tag{2}$$

Multilevel Model in Composite Form

$$INEQ_{jt} = \alpha + \beta T_t + [u_{1j} + u_{2j} T_t + \varepsilon_{jt}] \tag{3}$$

where j occupation, t time.

Multilevel Growth Model

$$INEQ_{jt} = \alpha_j + \beta_j T_t + \boldsymbol{\gamma} X_{jt} + \boldsymbol{\delta}(T_t \times \bar{X}_{j.}) + \boldsymbol{\zeta} \bar{X}_{j.} + \varepsilon_{jt} \quad (4)$$

- T_t: Time t centered to initial value (1983-85).
- X_{jt}: change of proportion.
- $T_t \times \bar{X}_{j.}$: interaction of mean of explanatory variables over time with time itself.
- $\bar{X}_{j.}$: group mean of each explanatory variable.

- $\boldsymbol{\gamma}$: effect of independent variable by 1% point change.
- $\boldsymbol{\delta}$: change of the effect of explanatory variable itself without compositional change

Multilevel Growth Model

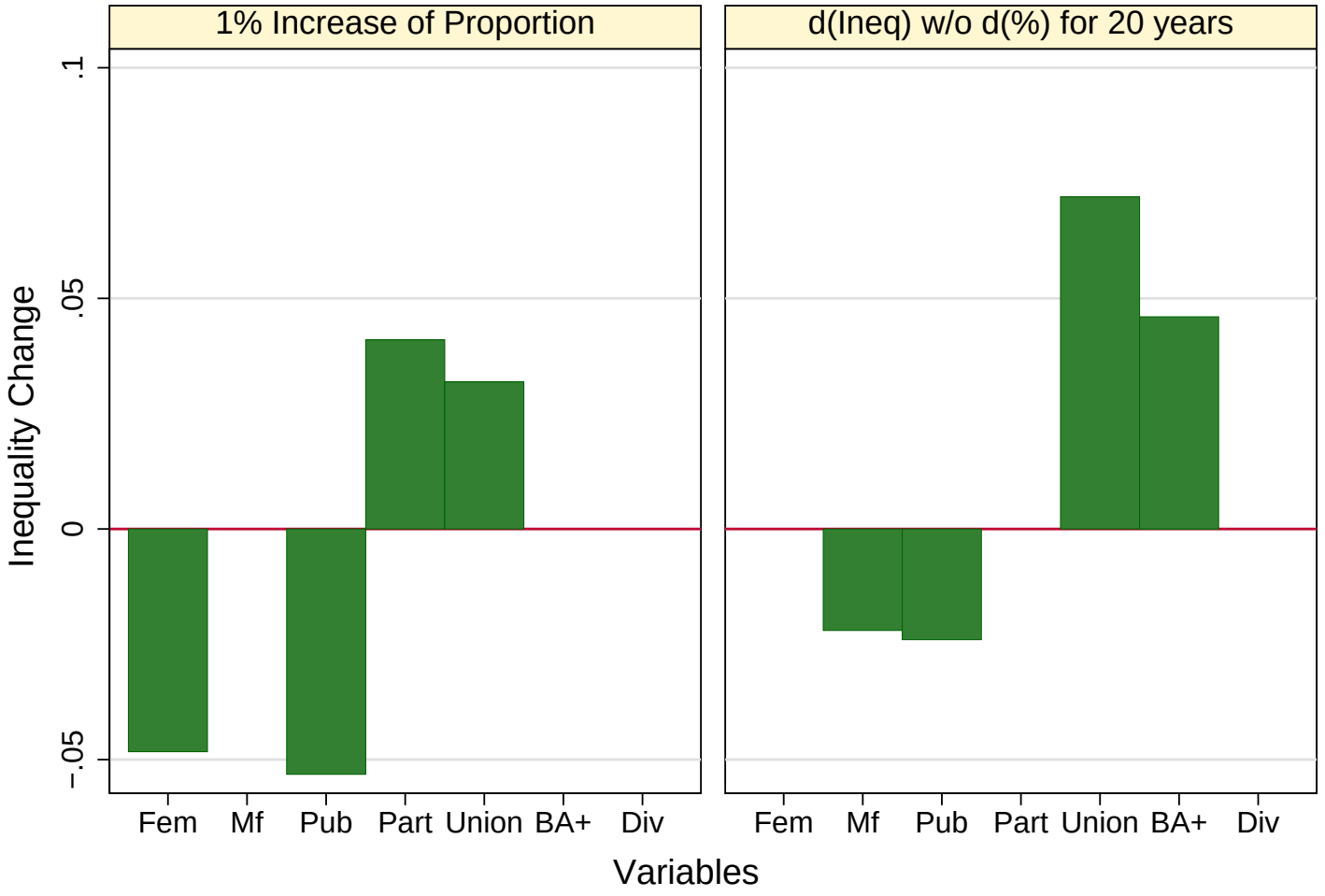
$$INEQ_{jt} = [\alpha + \beta T_t + \boldsymbol{\gamma} X_{jt} + \boldsymbol{\delta}(T_t \times \bar{X}_{j.}) + \boldsymbol{\zeta}\bar{X}_{j.}] + [u_{1j} + u_{2j}T_t + \varepsilon_{jt}] \quad (5)$$

$$MEANWAGE_{jt} = [\alpha + \beta T_t + \boldsymbol{\gamma} X_{jt} + \boldsymbol{\delta}(T_t \times \bar{X}_{j.}) + \boldsymbol{\zeta}\bar{X}_{j.}] + [u_{1j} + u_{2j}T_t + \varepsilon_{jt}] \quad (6)$$

$$\varepsilon_{jt} \sim N(0, \sigma_\varepsilon^2 \Sigma) \quad \text{and} \quad \begin{bmatrix} u_{1j} \\ u_{2j} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix} \right) \quad (7)$$

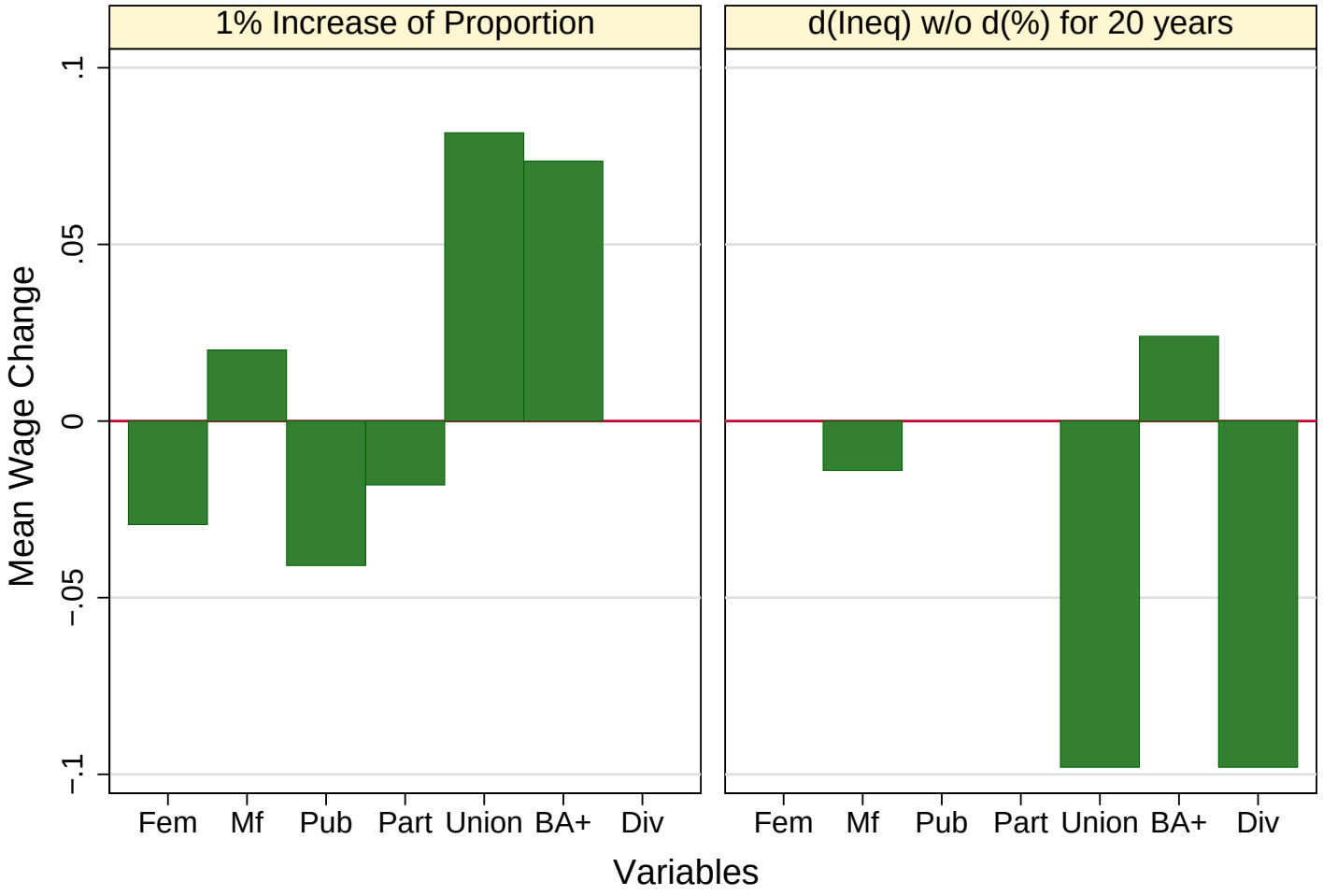
where Σ is assumed to be two band toeplitz. j occupation, t time.

Net Effect of Predictors on Within Inequality



$$INEQ_{jt} = \alpha_j + \beta_j T_t + \boldsymbol{\gamma} X_{jt} + \boldsymbol{\delta}(T_t \times \bar{X}_{j.}) + \boldsymbol{\zeta} \bar{X}_{j.} + \varepsilon_{jt}$$

Net Effect of Predictors on Mean Wage



$$Meanwage_{jt} = \alpha_j + \beta_j T_t + \boldsymbol{\gamma} X_{jt} + \boldsymbol{\delta}(T_t \times \bar{X}_{j.}) + \boldsymbol{\zeta}\bar{X}_{j.} + \varepsilon_{jt}$$

Estimated Within Inequality Change

Variable Variable	Coefficient Estimate	% Change btw 83-85 and 00-02	Inequality Change (Sig.)	
Female	-.0470	2.9101	-.1368	***
BA+	.0056	2.1057	.0118	
Edu.Div	.0078	-.9426	-.0074	
Public	-.0535	-2.9130	.1558	***
PartTime	.0131	-2.6564	-.0348	
Union	.0294	-6.3536	-.1868	**
Manuf	-.0079	-3.2955	.0260	
YEAR$\times\overline{\text{BA+}}$	.0023	24.86$\times$17	.9720	***
YEAR$\times\overline{\text{Edu.Div}}$	.0006	64.03$\times$17	.6531	
YEAR$\times\overline{\text{Public}}$	-.0012	17.22$\times$17	-.3513	*
YEAR$\times\overline{\text{PartTime}}$	-.0008	15.30$\times$17	-.2081	
YEAR$\times\overline{\text{Union}}$	.0036	18.16$\times$17	1.1114	***
YEAR$\times\overline{\text{Manuf}}$	-.0011	24.69$\times$17	-.4617	**
Total Inequality Change			1.5992	
(Actual Average Inequality Change btw 83-85 and 00-02)			(1.6400)	

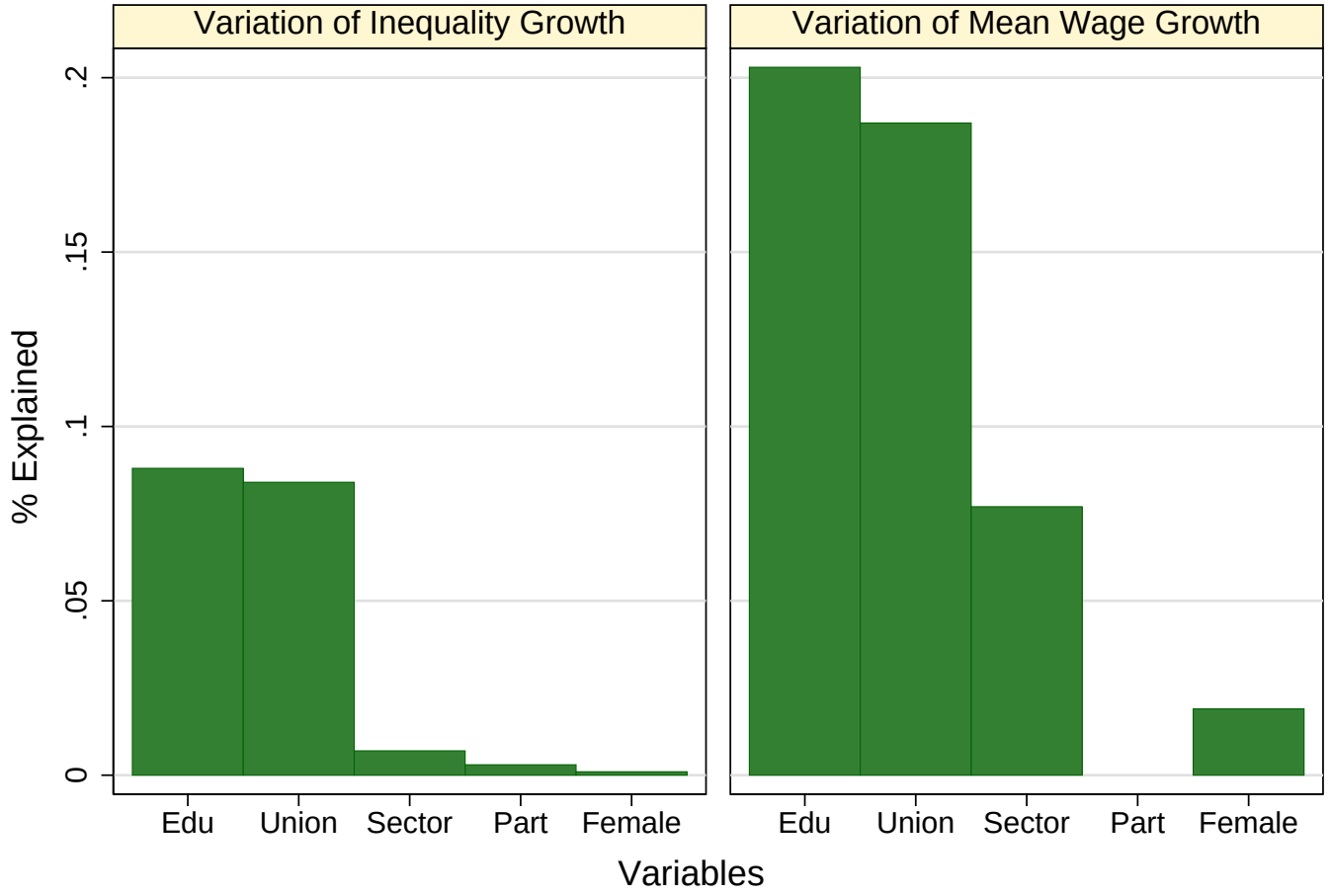
Hypothesis and Result: Within Occupational Inequality

		Hypothesis	Result	Amount
Female		+	−	small
Manuf		−	○	small
Public		−	−	moderate
Part		+	+	small
Union	%p Δ	−	+	big
	Within	○	+	
BA+	%p Δ	+	○	big
	Within	+	+	
Edu.Div.	%p Δ	+	○	small
	Within	+	○	

Hypothesis and Result: Mean Wage

		Hypothesis	Result	Amount
Female		$-$	$-$	small
Manuf		$+$	$+$	moderate
Public		$\circ$	$-$	moderate
Part		$-$	$-$	small
Union	%p Δ	$+$	$+$	big
	Within	$\circ/-$	$-$	
BA+	%p Δ	$+$	$+$	big
	Within	$+$	$+$	
Edu.Div.	%p Δ	$\circ/-$	$\circ$	big
	Within	$\circ/-$	$-$	

Explanatory Power of Predictor on Variation



% Explained: $r^2 = (\sigma_t^{2,TestedModel} - \sigma_t^{2,FullModel})/\sigma_t^{2,BaseModel}$.

Tested Model: Full Model without tested predictors.

Conclusion: Between Occupational Inequality

Explained well by current hypothesis.

1. Education, Union, and Public Sector
2. Female participation reduces inequality.

Conclusion: Within Occupational Inequality

- Facts
  1. Current Hypotheses do not fit well.
  2. Not % Change of union, but change within union members.
  3. Not widening gap between different educational level, but change within the same education.
  4. Lagged. First between-occupational change in 80s, then within-occupational change in 90s.
  5. % increase of public sector reduces inequality.
  6. (Moving southern area increases inequality.)

- Suggestion

- Future Research

Conclusion: Within Occupational Inequality

- Facts

- Suggestion: Organizational Culture Change
  1. Related with skill change. Lagged.
  2. Emphasis on versatile abilities.
  3. Know individual productivity better than before.
  4. Accept individual differences.

- Future Research

Conclusion: Within Occupational Inequality

- Facts

- Suggestion

- Future Research: Increased horizontal mobility among high skill workers?

Thank you.

Inequality Index

Theil Index (Entrophy Index)

$$Theil = \frac{1}{N} \sum_{i=1}^{N} \frac{y_i}{\bar{y}} \ln \frac{y_i}{\bar{y}} \tag{8}$$

They can be additively decomposed as $GE = GE_w + GE_b$, where GE_w refers to within-group-inequality, and GE_b refers to between-group-inequality. Within-group-inequality is weighted sum of each subgroup inequality, T_j and between-group-inequality is derived assuming every person within a given subgroup j received its mean income, y_j. Theil index is decomposed as;

$$Theil = \sum_{k} \frac{y_k}{\bar{y}} T_k + \sum_{k} \frac{y_k}{\bar{y}} \ln \frac{y_k/\bar{y}}{n/N} \tag{9}$$

where N refers to number of persons, y_i refers to wage of individual i, $\bar{y}$ refers to the grand mean and y_k refers to mean wage of subgroup k.

Error Structure of Multilevel Model

$$\varepsilon_{jt} \sim N(0, \sigma_{\varepsilon}^2 \Sigma) \tag{10}$$

,where

$$E(\varepsilon\varepsilon') = \begin{bmatrix} \sigma^2\Sigma & 0 & \cdots & 0 \\ 0 & \sigma^2\Sigma & \cdots & 0 \\ & \vdots & & \\ 0 & 0 & \cdots & \sigma^2\Sigma \end{bmatrix}, \sigma^2\Sigma = \begin{bmatrix} \sigma^2 & \sigma_1 & 0 & 0 \\ \sigma_1 & \sigma^2 & \sigma_1 & 0 \\ 0 & \sigma_1 & \sigma^2 & \sigma_1 \\ 0 & 0 & \sigma_1 & \sigma^2 \end{bmatrix}$$

$$\begin{bmatrix} u_{1j} \\ u_{2j} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix} \right) \tag{11}$$

$$E(\varepsilon u_1') = E(\varepsilon u_2') = 0 \tag{12}$$

Net Effect of Female

✓ Hypothesis

Inequality	% Female ↑, Inequality ↑	+
Mean Wage	% Female ↑, Wage of LWO ↓	−
	% Female ↑, Wage of HWO ↑	+

LWO: Low-Wage-Occupation ($\leq \bar{\mu} - \sigma$)

HWO: High-Wage-Occupation ($\geq \bar{\mu} + \sigma$)

✓ Result

Inequality	% Female	-.0470	***
Mean Wage	% Female	-.0293	***
	% Female×LowWage	Insignificant	
	% Female×HighWage	-.0406	***

Net Effect of Manufacturing Sector

✓ Hypothesis

Inequality	% Manufacture ↓, Inequality ↑	−
	Within Manufacture	No Change
Mean Wage	% Manufacture ↓, Mean Wage ↓	+
	Mean Wage of Manufacture	−

✓ Result

Inequality	% Manuf	-.0079	Insig.
	Year$\times\overline{\text{Manuf}}$	-.0010	**
Mean Wage	% Manuf	-.0293	***
	Year$\times\overline{\text{Manuf}}$	-.0007	***

Net Effect of Public Sector

✓ Hypothesis

Inequality	% Public Sector ↓, Inequality ↑	−
	Within Public Sector	No Change
Mean Wage	% Public Sector ↓, Mean Wage ↓	+
	Mean Wage of Public Sector	No Change

✓ Result

Inequality	% Public Sector	-.0535	***
	Year$\times\overline{\text{Public}}$	-.0012	*
Mean Wage	% Public Sector	-.0409	***
	% Public$\times$LowWage	.0666	***
	Year$\times\overline{\text{Public}}$	-.0003	Insig.

Net Effect of Part Time Worker

✓ Hypothesis

Inequality	% Part Time ↑, Inequality ↑	+
	Within Part Time Workers	No Change
Mean Wage	% Part Time ↑, Mean Wage ↓	−
	Mean Wage of Part Time	−(No Change)

✓ Result

Inequality	% Part Time	.0410	***
	% Part Time × Sales	-.0589	**
	% Part Time × Service	-.0645	***
	Year × $\overline{\text{PartTime}}$	-.0010	Insig.
Mean Wage	% Part Time	-.0265	***
	% Part Time × HighWage	.0696	***
	Year × $\overline{\text{PartTime}}$	-.0005	Insig.

Net Effect of Union

✓ Hypothesis

Inequality	Spillover: % Union ↓, Inequality ↑	$-$
	Barrier: % Union ↓, Inequality ↓	$+$
	Within Union Workers	No Change
Mean Wage	% Union ↓, Mean Wage ↓	$+$
	Mean Wage of Union Workers	$-$(No Change)

✓ Result

Inequality	% Union	.0294	**
	Year$\times\overline{\text{Union}}$	.0036	***
Mean Wage	% Union	.0847	***
	% Union$\times$LowWage	-.0441	***
	Year$\times\overline{\text{Union}}$	-.0011	**

Net Effect of Education

✓ Hypothesis

Inequality	% BA+ ↑, Inequality ↑	+
	% EduDiv ↑, Inequality ↑	+
	Within BA+ Workers	+
	At the same EduDiv over Time	+
Mean Wage	% BA+ ↑, Inequality ↑	+
	% EduDiv ↑, Inequality ↑	−(No Change)
	Within BA+ Workers	+
	At the same EduDiv over Time	−(No Change)

Net Effect of Education

✓ Result

Inequality	% BA+	.0056	Insig.
	% EduDiv	.0078	Insig.
	Year$\times\overline{\text{BA+}}$	.0023	***
	Year$\times\overline{\text{EduDiv}}$	.0006	Insig.
Mean Wage	% BA+	.0736	***
	% EduDiv	.0085	Insig.
	Year$\times\overline{\text{BA+}}$	.0012	***
	Year$\times\overline{\text{EduDiv}}$	-.0050	***