Hours, Occupations, and Gender Differences in Labor Market Outcomes

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Canon Institute for Global Studies
Tokyo, May 27-28, 2019

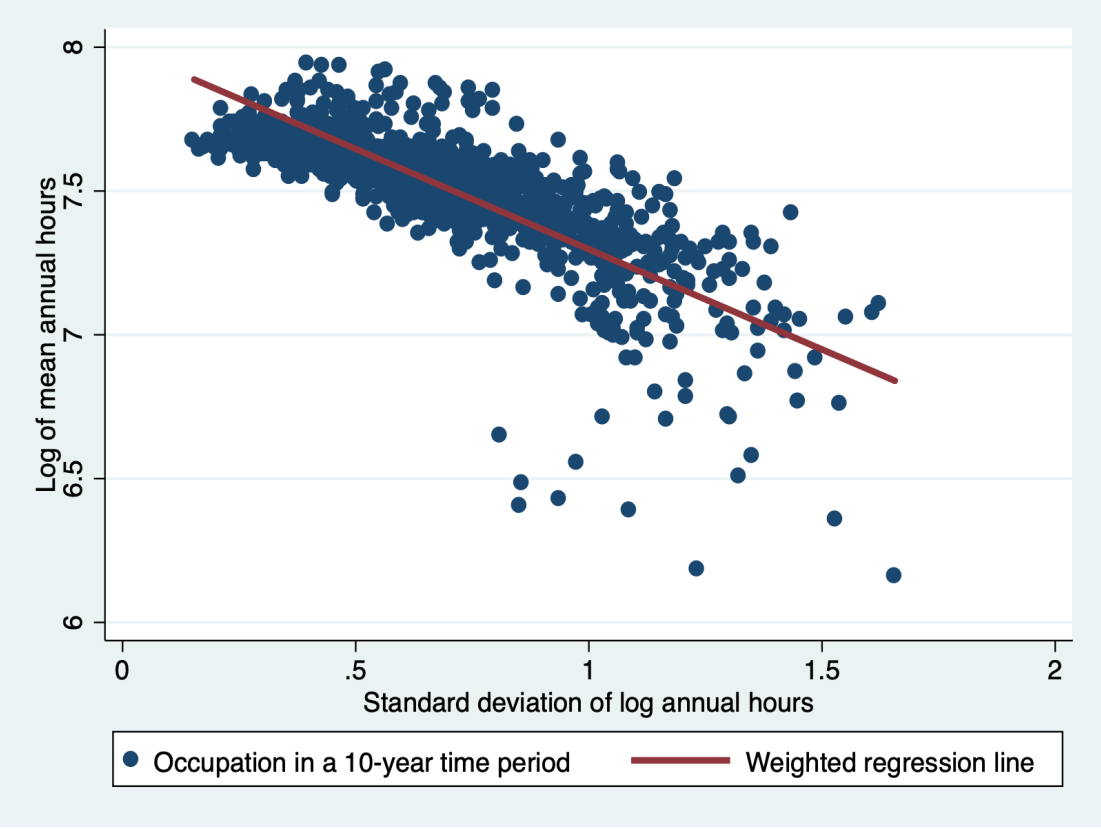
Motivation

- Two classic topics of labor supply are
  - time allocation
  - occupational choice
- These topics are studied in isolation of each other
- We provide evidence of important interactions between them
- Argue in favour of a framework that considers them jointly
- Insightful for analyzing gender differences in labor market outcomes

Motivation

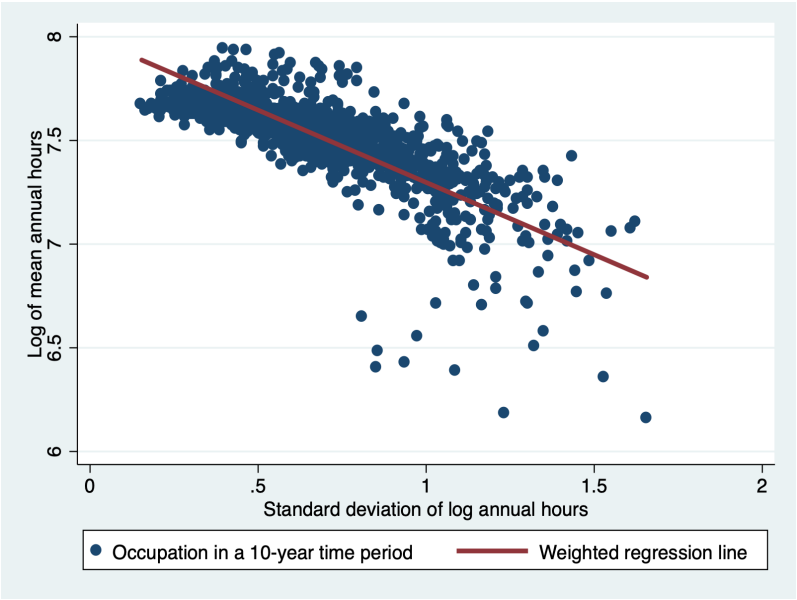
- Consider a particular 3-digit occupation
  - physicians, financial managers, hairdressers, welders and cutters
- Compute two statistics (of annual hours)
  - log of mean annual hours in an occupation
  - standard deviation of log annual hours in an occupation

1976-2015



- Occupations differ in terms of the patterns of hours worked within an occupation
- Negative mean-dispersion relationship in occupational hours

Motivation



- High-mean low-dispersion occupations (TL, sector 1, nonlinear)
  - managers and supervisors
  - professional (accountants, physicians, lawyers), engineers
  - some machine operators, technicians, mechanics

- Low-mean high-dispersion occupations (BR, sector 2, linear)
  - some professional (carpenters, cooks)
  - some machine operators, technicians
  - teachers, sales workers, waiters, janitors

Overview

- Extend a two-sector Roy model of occupational sorting to incorporate
  - : labor-leisure choice (time allocation)
  - : **non-linear earnings (nonconvexity)**
- Non-linear earnings
  - : hourly wages increase in hours worked
  - : differs across occupations
- Link between occupational choice and time allocation
  - : $\uparrow$ in the desired hours of work $\Rightarrow$ bias occupational choice towards occupations in which the non-convexity is more severe

Overview: Gender Differences

- Document further that
  - men more likely to sort in TL occupations
  - women work less hours than men, within an occupation
  - women receive lower hourly wages, within an occupation
- Use a richer version of the model to understand these gender differences
  - two-member households
  - key feature – **women have a lower time endowment**
- Analyze gender differences in
  - occupational choice
  - hours worked
- Analyze gender wage gap
  - model accounts for **29%** of the gap
  - between occupations – women sort into low wage occupations
  - within occupations – women earn less than men

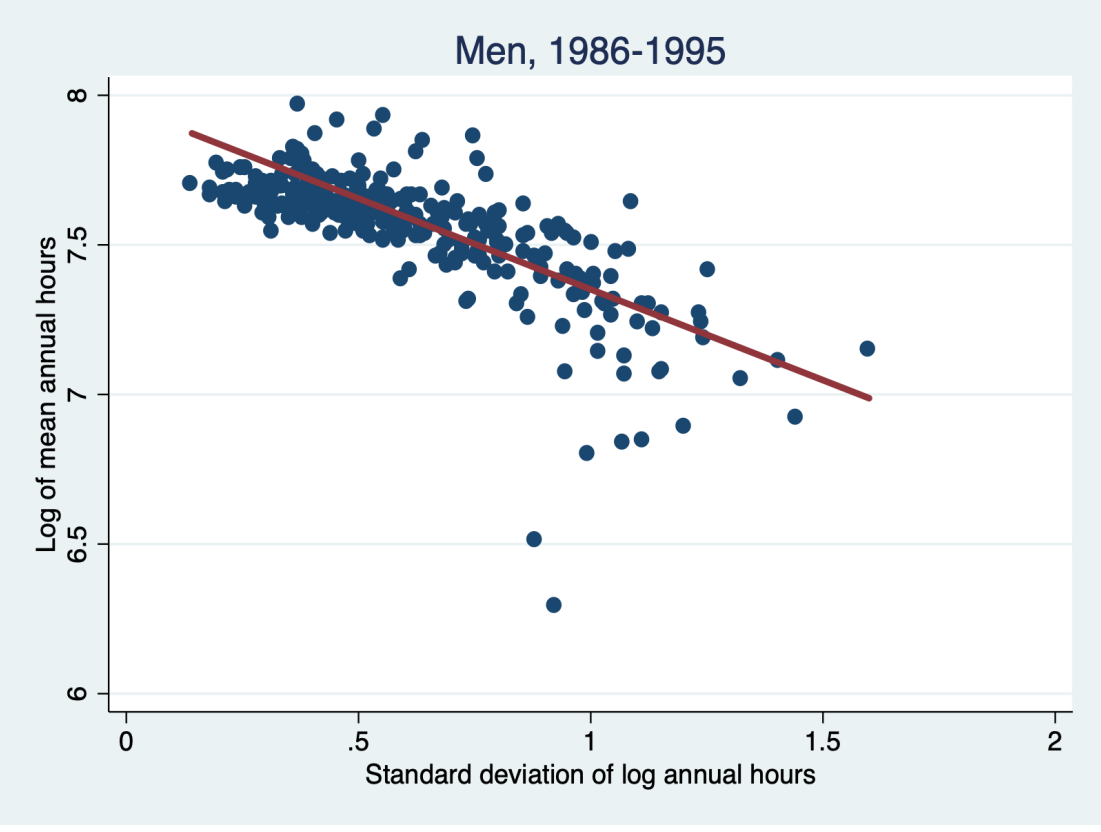
Data

- IPUMS-CPS: 1976-2015
  - benchmark period: 1986-1995
  - large, analysis by 3-digit occupations and gender
  - age: 16-64
  - four 10-year periods: 1976-1985, 1986-1995, 1996-2005, 2006-2015
  - at least 30 observations in an occupation: 96% of occupations for men and 77% of occupations for women
  - use consistent 1976-2015 occupational codes (Autor and Dorn, 2013)

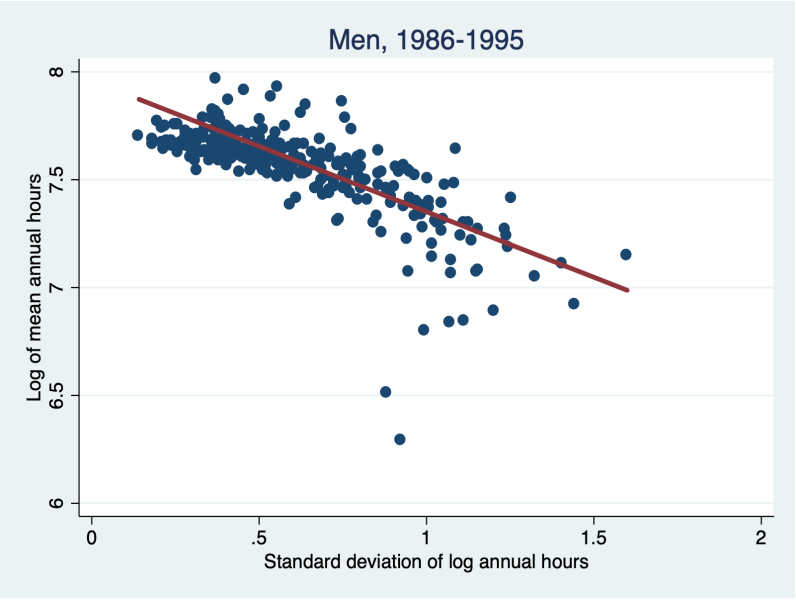
Preview of Main Facts

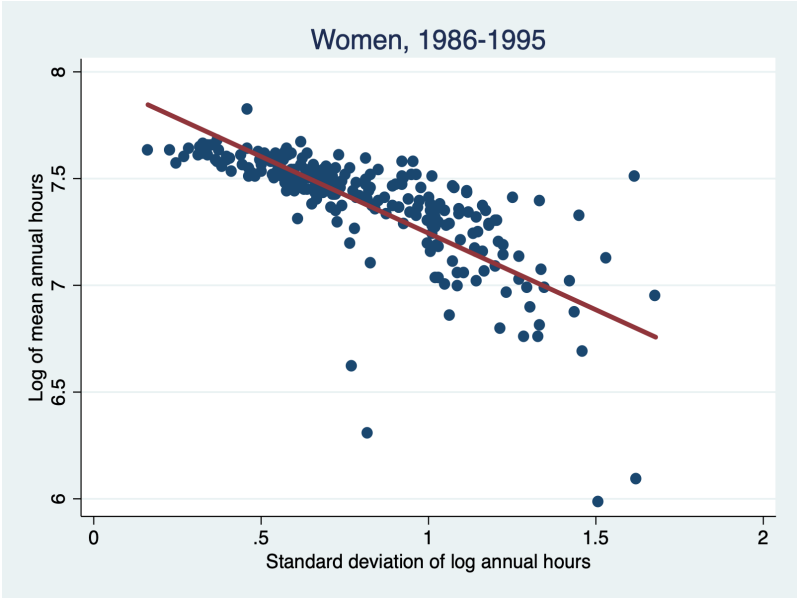
1. Negative relationship between the mean and the dispersion in hours in an occupation
    - robust across age, gender, and education groups
2. Fraction of men, relative to women, higher in TL occupations
3. Women work less hours than men, in (almost) all occupations
    - women have higher dispersion in hours than men, in (almost) all occupations
4. Hourly wages decline as we move from TL to BR occupations
5. Women have lower hourly wages than men, in (almost) all occupations

Mean and Dispersion in Occupational Hours



Mean and Dispersion in Occupational Hours



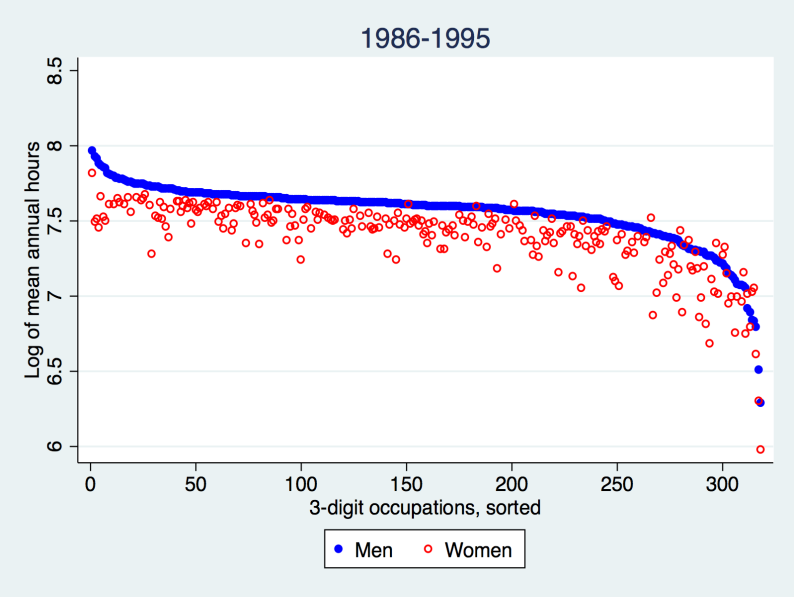


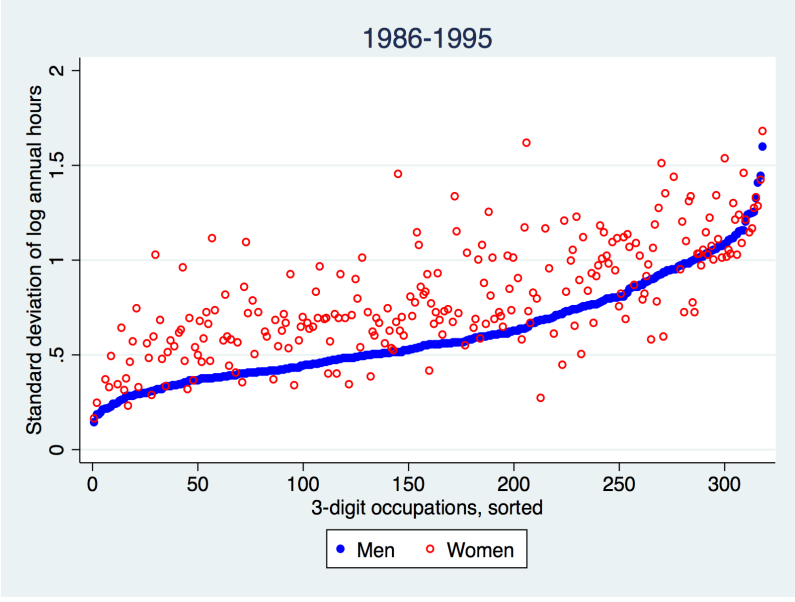
- robust across age, gender, and education groups [More]

  [Changes in Hours Worked for Occupation Switchers]

- robust over time [More]

Hours Worked: Men and Women





- Women work less than men, in (almost) all occupations
- Women have a higher dispersion in hours than men, in (almost) all occupations

Occupational Hours Distribution

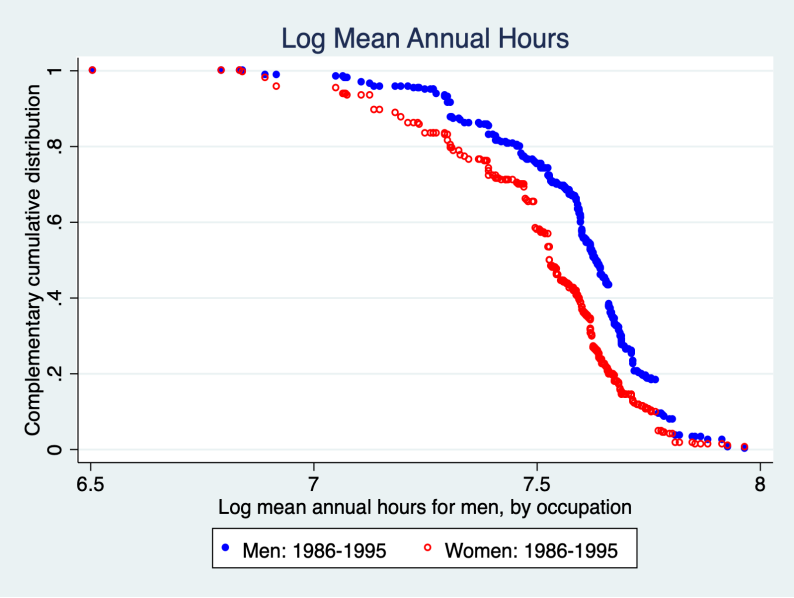
- Complementary Cumulative Distribution Function for men $\overline{F}_{g,t}(x)$:

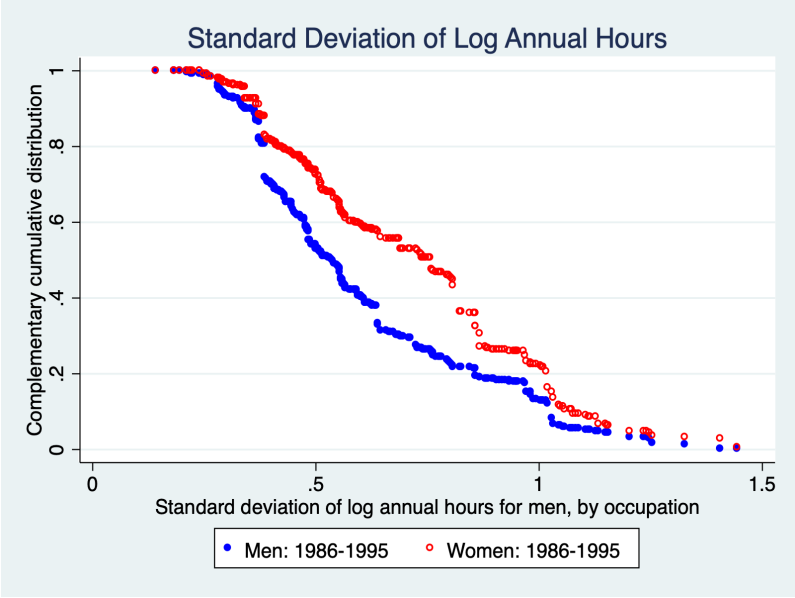
$$\overline{F}_{g,t}(x) = Prob(X > x)$$

where x is the:

  - log of mean (male) annual hours in an occupation in period t; or
  - standard deviation of log (male) annual hours in an occupation in period t

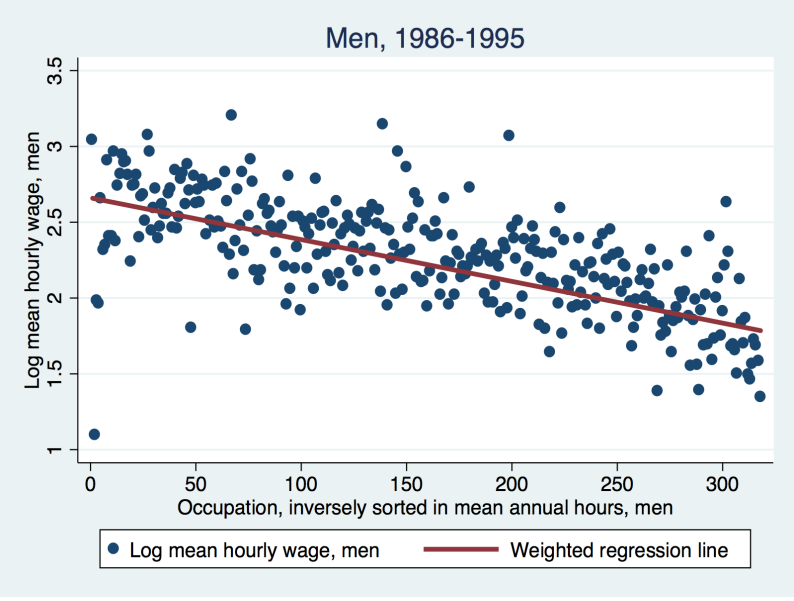
Occupational Hours Distribution

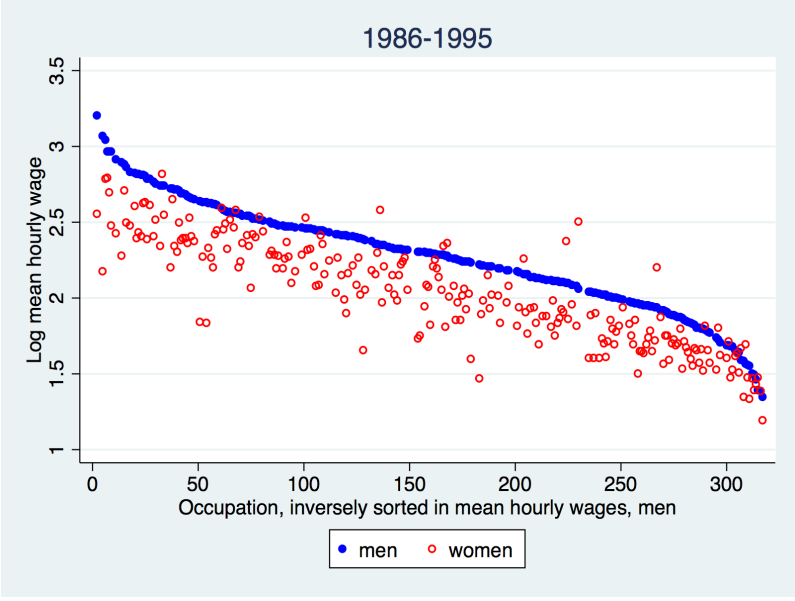




- Men more likely to be in high-mean low-dispersion (TL) occs. [More]
- Distribution mostly stable for men over time
- Women have reallocated towards high-mean low-dispersion (TL) occs. over time

Hourly Wages





- Men, on average, earn higher hourly wages in the TL than the BR occupations
  - holds also after controlling for education

- Women earn lower hourly wages than men, in (almost) all occupations

Multi-Member Households Model

- Two-sector Roy model of occupational sorting
  - : sectoral abilities
- Extend the model by introducing
  - : time allocation decision
    - individuals value leisure
  - : heterogeneous preferences over leisure
  - : nonlinear production technology in one of the sectors
    - positive effect of hours worked on wages

Multi-Member Households Model

- Unit mass of households with a male (m) and a female (f)
- Preferences:

$$U(c_m, c_f, h_m, h_f) = u_m(c_m, h_m) + u_f(c_f, h_f)$$
$$u_g(c_g, h_g) = \ln c_g + \phi_g \frac{(T_g - h_g)^{1-\gamma}}{1-\gamma} \quad \text{for } g = m, f$$

: (T_m, T_f) – time endowment for m and f

: (c_m, c_f) – consumption for m and f

: (h_m, h_f) – (market) hours worked for m and f

Distributional Assumptions

- Individuals are heterogeneous in three dimensions
  - ϕ: taste for leisure
  - a_1: skills in sector 1
  - a_2: skills in sector 2
- A household is characterized by the 6-tuple $(a_{i1}, a_{i2}, \phi_i)_{i=m,f}$
  - drawn from a multivariate log-normal distribution

Technology

- One homogeneous good is produced with two production technologies (occupations) $j = 1, 2$

$$Y_j = A_j E_j$$

where Y_j is aggregate output from occupation j and E_j is the aggregate efficiency units of labor in occupation j.

- The mapping from individual hours to efficiency units of labor in occupation j satisfies

$$e_{ij} = a_{ij} h_{ij}^{1+\theta_j},$$

a_{ij} is the ability of individual i to produce labor services in sector j.

  - sector 1: $\theta_1 = \theta > 0$ (nonlinear, TL)
  - sector 2: $\theta_2 = 0$ (linear, BR)

Effect of Longer Hours on Hourly Wages

- Static effects: Conditional on numerous controls, individuals who decide to work fewer hours do get offered lower hourly wages
  - Gustman and Steinmeier (ECMA 1986), Moffit (JLE 1984), Keane and Wolpin (IER 2001), Aaronson and French (JLE 2004), Ameriks, Briggs, Caplin, Lee, Shapiro, and Tonetti (2018)
- Dynamic effects: Human Capital
  - Imai and Keane (2004), and others
- Different across occupational sectors:
  - Dustmann and Meghir (2008), Zangelidis (2008), Sullivan (2010), Goldin (2014), Cortes and Pan (2016), Adda, Dustmann, and Stevens (2016)

[Wage Profiles in 3-Digit Occupations]

The Household's Problem

$$\max \left\{ \ln c_m + \ln c_f + \phi_m \frac{(T_m - [l_1^m h_{m1} + l_2^m h_{m2}])^{1-\gamma}}{1-\gamma} + \phi_f \frac{(T_f - [l_1^f h_{f1} + l_2^f h_{f2}])^{1-\gamma}}{1-\gamma} \right\}$$

subject to:

$$c_m + c_f = \left\{ \sum_{j=1}^{2} l_j^m a_{mj} h_{mj}^{1+\theta_j} + \sum_{j=1}^{2} l_j^f a_{fj} h_{fj}^{1+\theta_j} \right\}.$$

: l_j^m takes the value of 1 if m works in sector j

: l_j^f takes the value of 1 if f works in sector j

FOC in a Multi-Member Household

$$\frac{a_{mj}(1+\theta_j)h_{mj}^{\theta_j}}{a_{mj}h_{mj}^{1+\theta_j}+a_{fi}h_{fi}^{1+\theta_i}} = \phi_m(T_m - h_{mj})^{-\gamma},$$

$$\frac{a_{fi}(1+\theta_i)h_{fi}^{\theta_i}}{a_{mj}h_{mj}^{1+\theta_j}+a_{fi}h_{fi}^{1+\theta_i}} = \phi_f(T_f - h_{fi})^{-\gamma},$$

- occupational choice and hours are joint decisions
- income effect from the choice of one member,
  - affects **hours and occupational choice** of other member of the couple
- if ϕ_g increases for $g = \{m, f\}$, it **increases the incentives** for other member of **working long hours** and **choosing sector 1**
- correlation of skills and taste for leisure are crucial

Single Individual Problem

$$\max \left\{ \ln c + \phi \frac{(T - [lh_1 + (1-l)h_2])^{1-\gamma}}{1-\gamma} \right\}$$

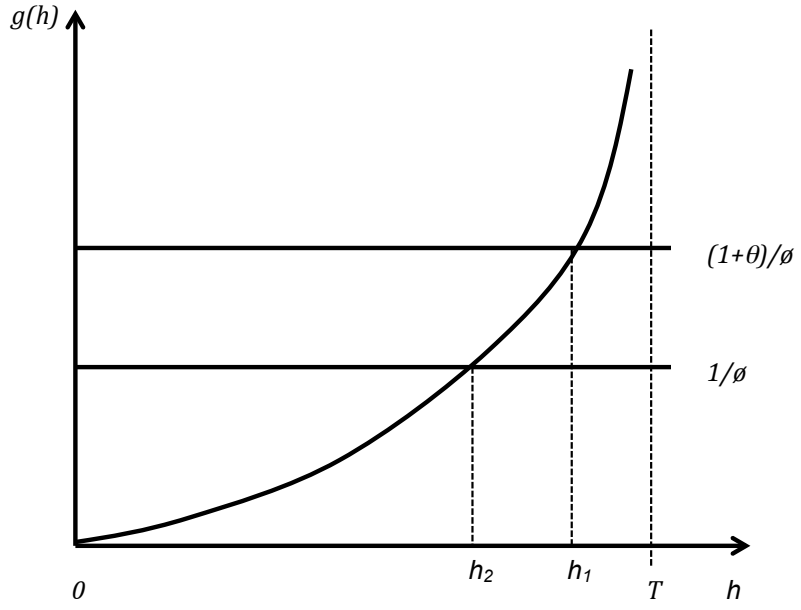
subject to:

$$c = la_1 h_1^{1+\theta} + (1-l)a_2 h_2,$$

If the individual chooses to work in occupation j, the optimal choice of hours h_j satisfies:

$$\frac{1+\theta_j}{\phi} = h_j(T - h_j)^{-\gamma} \equiv g(h_j)$$

Single Individual Problem



- Conditional on occupation j
  - : h_j are independent of occ. productivities a_j
  - : h_j is decreasing in ϕ
  - : $\theta > 0 \Rightarrow$ conditional on ϕ, $h_1 > h_2$
  - : convexity of $g(\cdot) \Rightarrow$ variance of hours is lower in sector 1 than 2

Sorting of Workers across Occupations

The probability that an individual with a taste for leisure ϕ works in sector 1 is

$$P(I = 1|\phi) = P\left[\ln\left(\frac{a_1}{a_2}\right) > z(\phi)\right]$$

where $z'(\phi) > 0$.

- increases with skill ratio $\frac{a_1}{a_2}$
- decreases with taste for leisure ϕ
  - : individuals working long hours are more likely to work in sector 1
- convexity of $g(\cdot)$ acts as force in reducing variance of hours in sector 1

Calibration

- $\gamma = 4$, $\theta = 0.60$, $T_m = 5200$, $T_f = 4700$.
- further sample restrictions: married individuals, aged 22-64
- create two sectors of occupations
  - : rank occupations by the level of mean hours for men
  - : separate into two groups of equal employment size (men plus women)
- 1986-1995 CPS
  - employment shares, annual hours worked, hourly wages
- 1986-1995 PSID
  - correlation in spousal log wages: 0.43
  - correlation in spousal log hours: 0.02

Data Moments

	Males				
	E	$\ln \overline{h}$	$sd(\ln h)$	$\ln \overline{w}$	$sd(\ln w)$
Non-Linear	0.61	7.73	0.22	2.56	0.45
Linear	0.39	7.57	0.32	2.19	0.46
Aggregate	1.00	7.67	0.26	2.46	0.45
	Females				
	E	$\ln \overline{h}$	$sd(\ln h)$	$\ln \overline{w}$	$sd(\ln w)$
Non-Linear	0.37	7.49	0.39	2.21	0.49
Linear	0.63	7.33	0.50	1.86	0.47
Aggregate	1.00	7.40	0.46	2.04	0.48

- Patterns for men similar to those presented earlier
  - mainly in the TL occupations
  - hours: higher mean and lower dispersion in the nonlinear sector
  - wages: higher in the nonlinear sector

Data Moments

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- Patterns for women similar to those presented earlier
  - mainly in the BR occupations
  - hours: work less than men, overall and in each sector
  - wages: lower than for men, overall and in each sector
  - wages: the gender gap is similar in both sectors

Baseline Economy

- Men and women are identical, except for the time endowment (T_m, T_f)
- Additional assumptions/restrictions:
  - $\rho_{a_1,\phi} = \rho_{a_2,\phi} = 0$
  - $\rho_{a_{1m},a_{1f}} = \rho_{a_{2m},a_{2f}}$
- Parameters to be calibrated:
  - μ_{a_2} – mean value of log ability in sector 2, $(\mu_{a_1} = 0)$
  - μ_ϕ – mean value of log taste for leisure
  - $\sigma^2_{a_1}$ – variance of log ability in sector 1
  - $\sigma^2_{a_2}$ – variance of log ability in sector 2
  - σ^2_ϕ – variance of log taste for leisure
  - ρ_{a_1,a_2} – correlation of abilities in occupations 1 and 2
  - $\rho_{a_{1m},a_{1f}}$ – correlation of ability 1 within couples
  - ρ_{ϕ_m,ϕ_f} – correlation of the taste for leisure within couples

Targets and Fit of the Model

Parameter	Value	Target	Data	Model
μ_{a_2}	-0.164	E_m^{NL}	0.61	0.61
$\sigma^2_{a_1}$	0.308	$sd(\ln w_{m,NL})$	0.45	0.48
$\sigma^2_{a_2}$	0.198	$sd(\ln w_{m,L})$	0.46	0.43
μ_ϕ	0.670	$\ln \overline{h_m}$	7.67	7.67
σ^2_ϕ	0.377	$sd(\ln h_m)$	0.26	0.26
ρ_{a_1,a_2}	0.330	$\ln \overline{w_{m,NL}} - \ln \overline{w_{m,L}}$	0.37	0.37
ρ_{a_m,a_f}	0.660	gender corr. of log wages	0.43	0.43
ρ_{ϕ_m,ϕ_f}	0.815	gender corr. of log hours	0.02	0.02

Baseline Economy

Males

	E	$\ln \overline{h}$	$sd(\ln h)$	$\ln \overline{w}$	$sd(\ln w)$
Non-Linear	**0.61**	7.75	0.16	**2.59**	**0.48**
Linear	0.39	7.51	0.31	**2.22**	**0.43**
Aggregate	1.00	**7.67**	**0.26**	**2.46**	0.49

Females

	E	$\ln \overline{h}$	$sd(\ln h)$	$\ln \overline{w}$	$sd(\ln w)$
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Linear	0.57	7.13	0.58	2.17	0.43
Aggregate	1.00	7.31	0.51	2.34	0.48

Hours Worked and Occupational Choice: Men

- Log of mean hours
  - Data: $\ln \overline{h_{m,1}} = 7.73$, $\ln \overline{h_{m,2}} = 7.57$
  - Model: $\ln \overline{h_{m,1}} = 7.75$, $\ln \overline{h_{m,2}} = 7.51$
- SD of log hours
  - Data: $sd(\ln h_{m,1}) = 0.22$, $sd(\ln h_{m,2}) = 0.32$
  - Model: $sd(\ln h_{m,1}) = 0.16$, $sd(\ln h_{m,2}) = 0.31$
- Occupational choice
  - 61% in sector 1 (targeted)
- Mechanism
  - illustrated with the single individual problem

Gender Gaps in Hours and Occupational Choice

- Gender asymmetry: Time endowments $T_f < T_m$
- Gender gap in occupational choice
  - : only 43% of women are in sector 1
  - : model accounts for 75% of occupational gap (0.24 data vs 0.18 model).
- Gender gap in hours
  - : Women work less $-$ overall and in each sector

Gender Gap in Wages

- Model accounts for 29% of the gender wage gap
- Nonlinear sector
  - : model accounts for 17% of the gender wage gap
  - : $\ln \overline{h_{f,1}} < \ln \overline{h_{m,1}} \Rightarrow$ women earn less
  - : partially offset $-$ women better selected in terms of $\left(\frac{a_1}{a_2}\right)$
- Linear sector
  - : model accounts for 15% of the gender wage gap
  - : women worse selected in terms of a_2
- Aggregate wage gap: large fraction is due to within-occupation gender wage gap, as in the data.

The Role of Selection

	Gender Differences in log			
	skills	ϕ	$\overline{\left(\frac{a_1}{a_2}\right)}$	$\overline{\left(\frac{a_2}{a_1}\right)}$
NL	-0.10	0.13	-0.11	–
L	0.06	0.01	–	0.17

Relative to men, women in NL are:

- more positively selected in skill ratio $\frac{a_1}{a_2}$
- more negatively selected in ϕ.

Relative to men, women in L are more negatively selected in skill ratio $\frac{a_2}{a_1}$

The Role of Household Interactions

	Everyone Single	Baseline Economy
Wage Gap (%)	7	12
Hours Gap (%)	20	36
Occupational Gap (%)	8	18

Key finding: Introducing household interactions

- gender wage gap ↑ by 5 p.p.
- hours gap ↑ by 16 p.p.
- occupational gap by ↑ 10 p.p.

Sensitivity Analysis: Heterogeneity in Occupations

θ_1	**0.6**	0.6	0.8	0.8
θ_2	**0**	0.2	0.2	0.4
Gender Differences				
Wage	**0.12**	0.11	0.16	0.13
Hours	**0.35**	0.29	0.32	0.26
Share Emp NL	**0.17**	0.11	0.17	0.11

Misallocation and Welfare

- How costly is the gender asymmetry in the time endowment?
  - This question relates to the recent work by Hsieh et al (2016) on the misallocation of talent
- Households optimally choose how to assign discretionary time
  - men and women identical
  - optimal for one member to specialize in home production activities
  - women (men) perform home production activities in half of the households
- Large reallocation of hours worked
  - male hours decrease by 18% (and less likely to be in sector 1)
  - female hours increase by 20.4% (and more likely to be in sector 1)

Misallocation across Economies

θ_1	**0.6**	0.6	0.8	0.8
θ_2	**0**	0.2	0.2	0.4
Percentage change in:				
Welfare	**10.4**	11.7	14.6	18.4
Output	**2.7**	4.0	5.1	6.6
Output per Hour	**5.3**	7.5	9.7	12.4

- Large welfare gains of 10.4%
  - : welfare gain at the 90th percentile is 33%
- Labor productivity increases by 5.3%
  - : higher for women (11%) than men (1.8%)
  - : higher for those in occ. 1

Conclusion

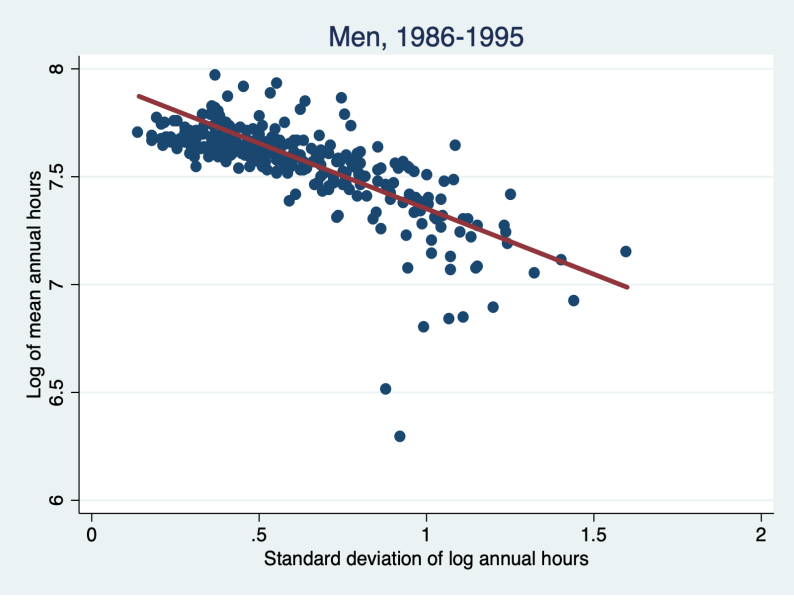
- Facts on hours worked (and wages) in occupations
  - : negative mean-dispersion relationship in occupational hours
  - : hours in an occupation – lower mean and higher dispersion for women
  - : wages in an occupation – lower for women
- Two-sector Roy model of occupational sorting
  - : sectoral abilities
  - : time allocation decision (individuals value leisure)
  - : heterogeneous preferences over leisure
  - : nonlinear production technology in one of the sectors
  - : couples

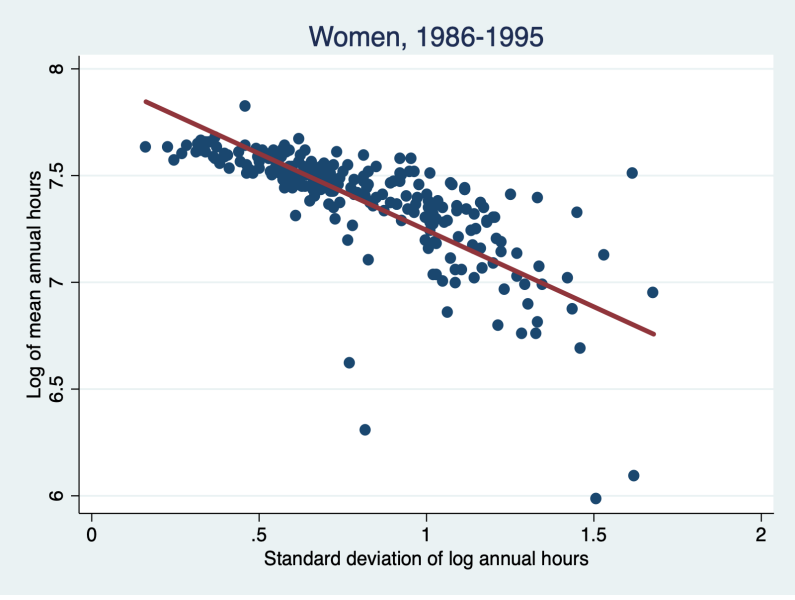
Conclusion

- Model is consistent with the facts on occupational hours and wages for men and women
- Gender differences in discretionary times, accounts for 29% of the gender wage gap
  - : large fraction is due to within-occupation gender wage gap, as in the data
- Misallocation: gender equalization leads to large gains in welfare and output per worker.

Additional Slides

Mean and Dispersion in Occupational Hours: by Gender





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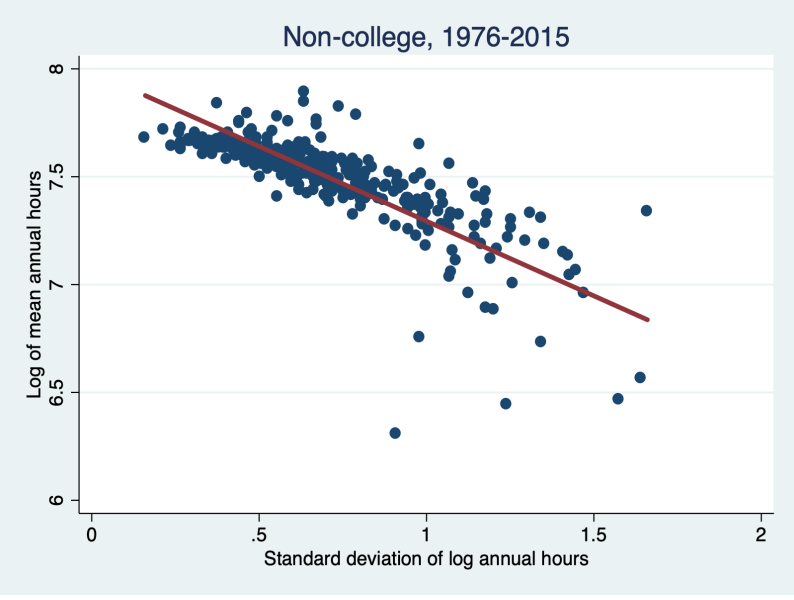
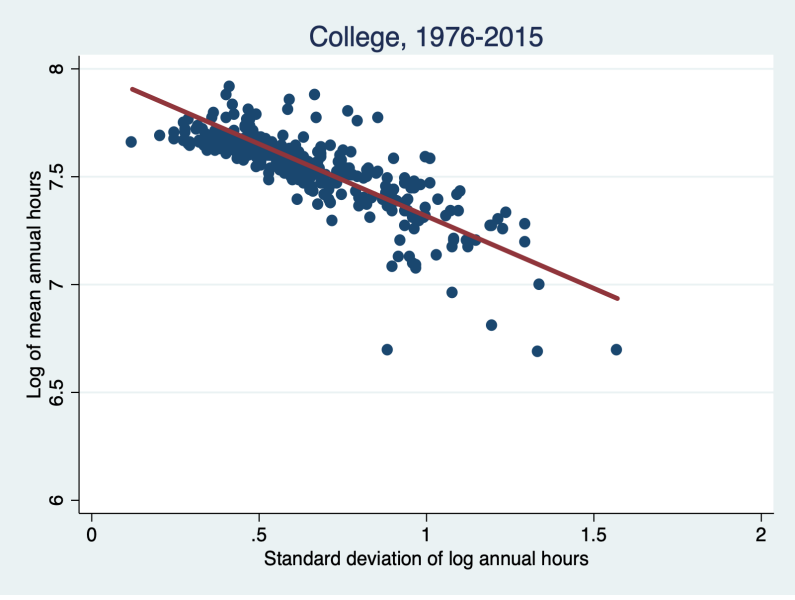
Mean and Dispersion in Occupational Hours: by Education





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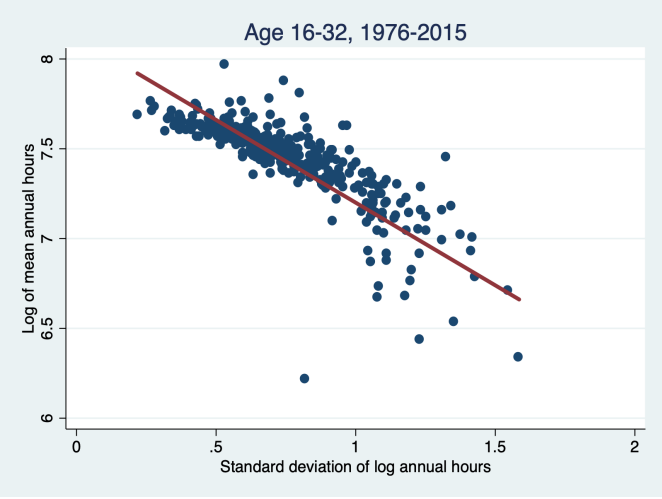
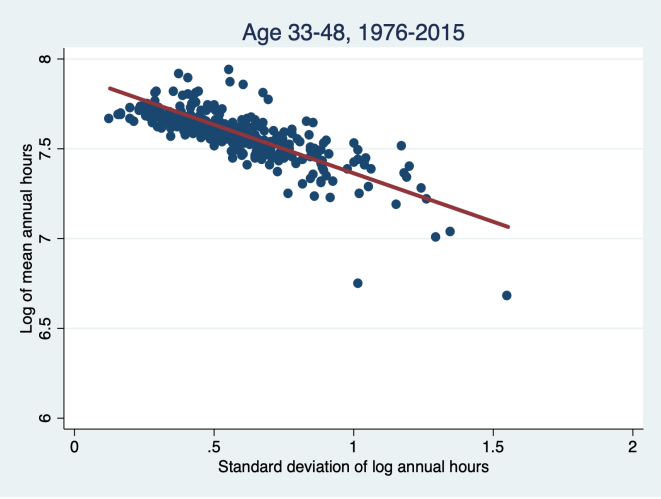
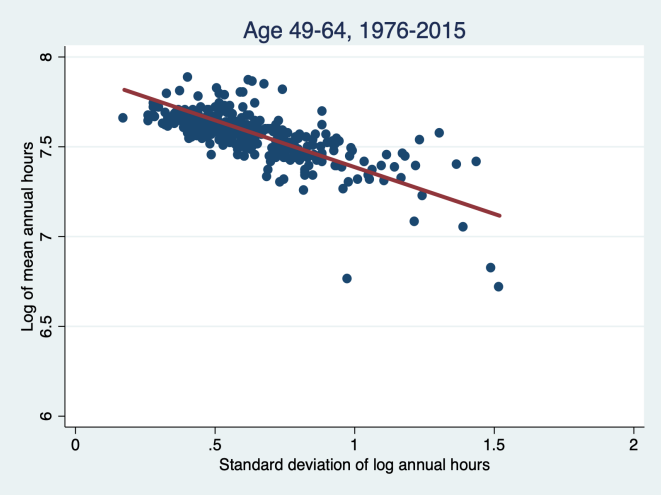
Mean and Dispersion in Occupational Hours: by Age







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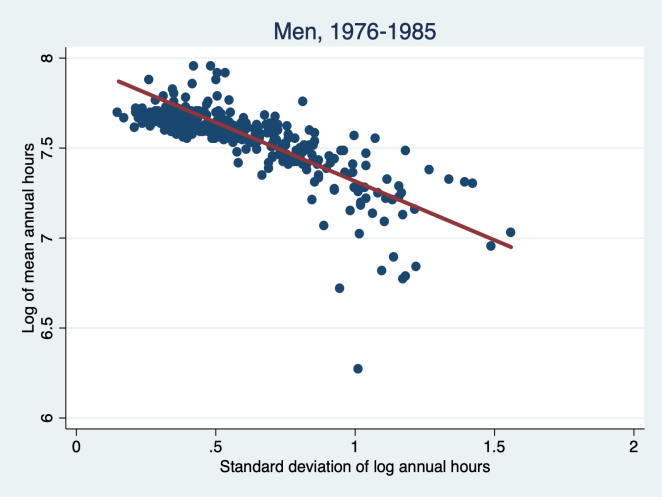
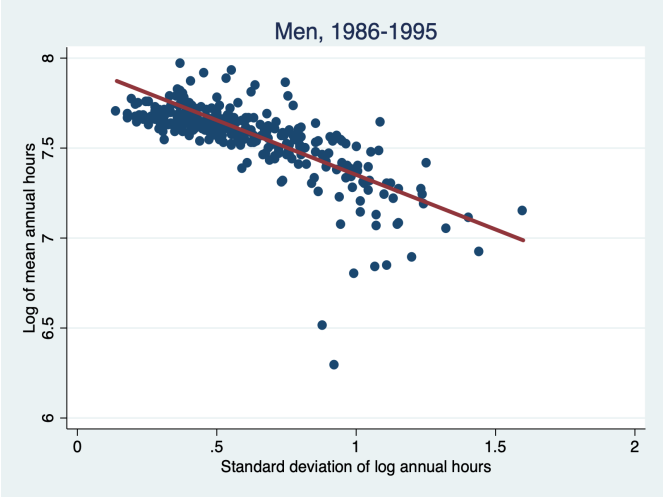
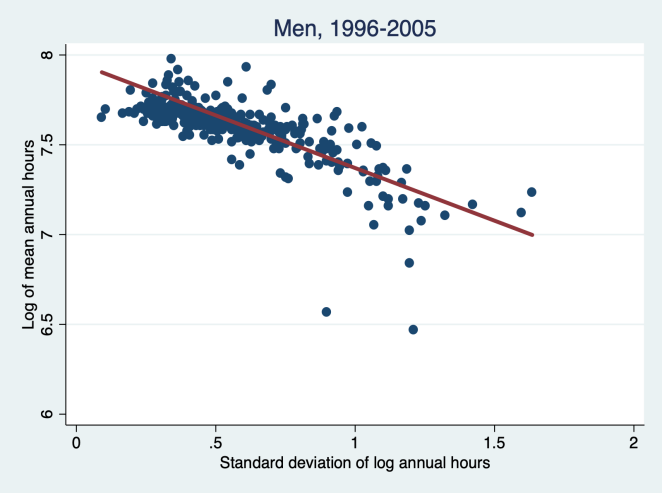
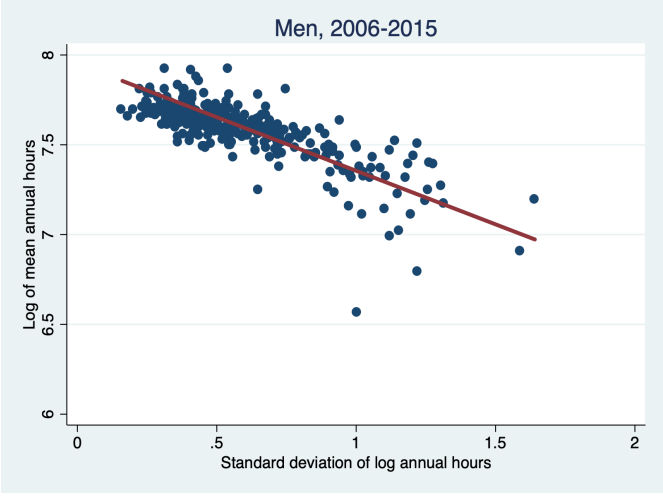
Over Time: 1976-2015









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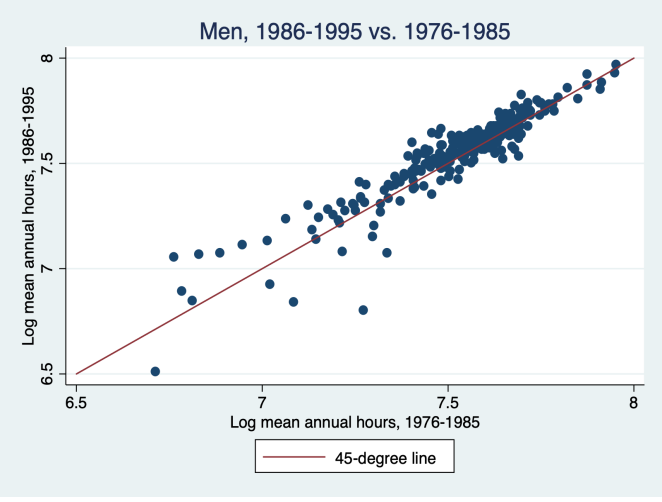
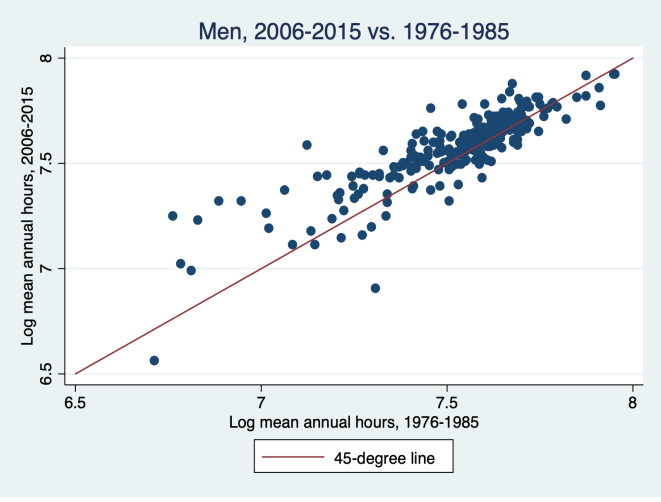
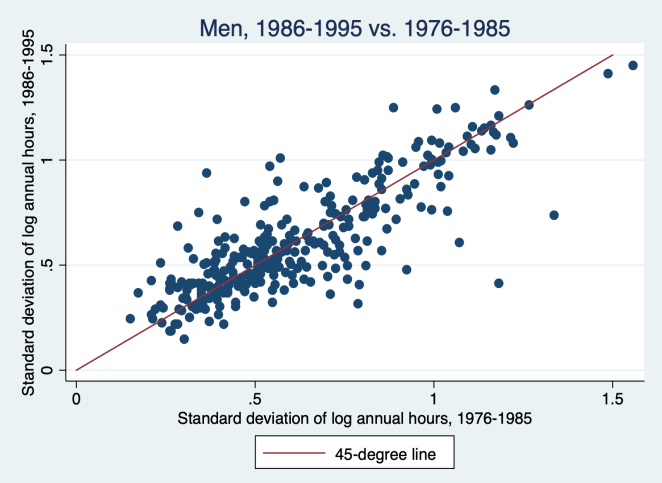
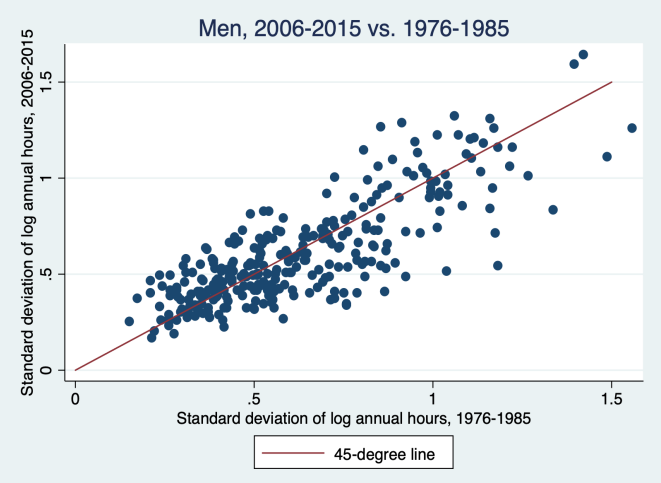
Over Time: 1976-2015









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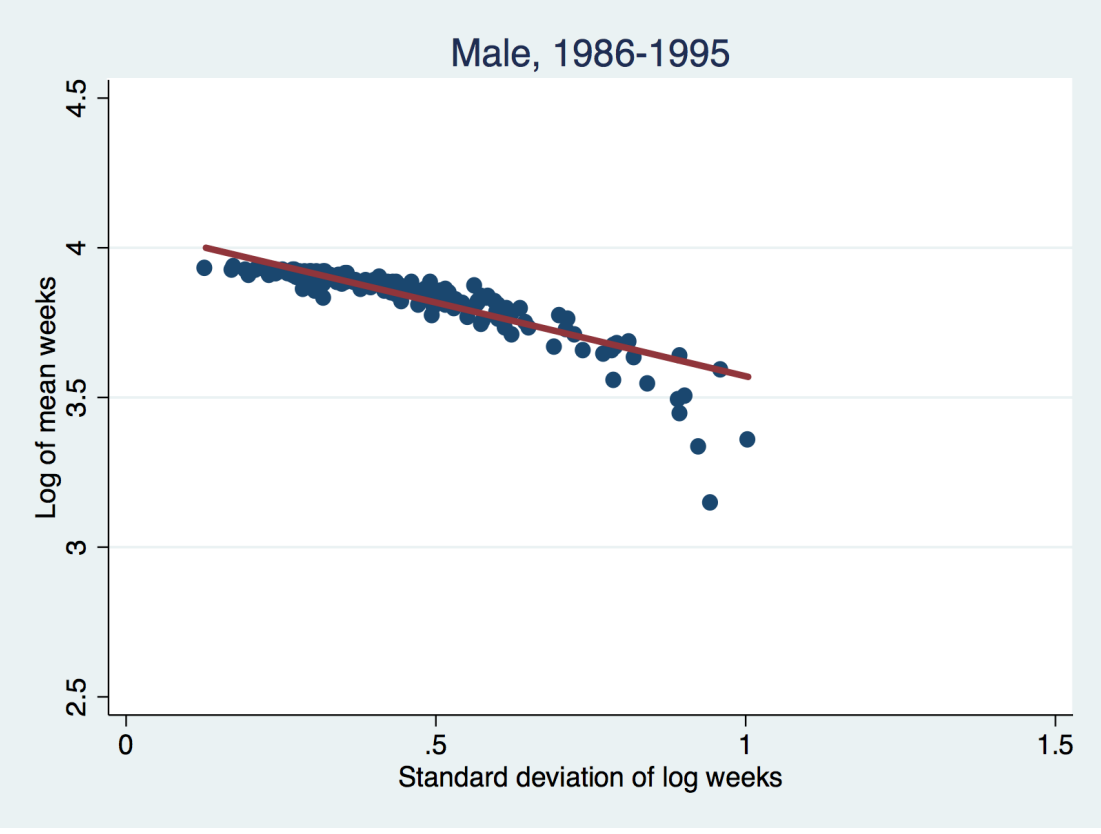
Extensive Margin: Weeks Worked



- Number of weeks worked last year

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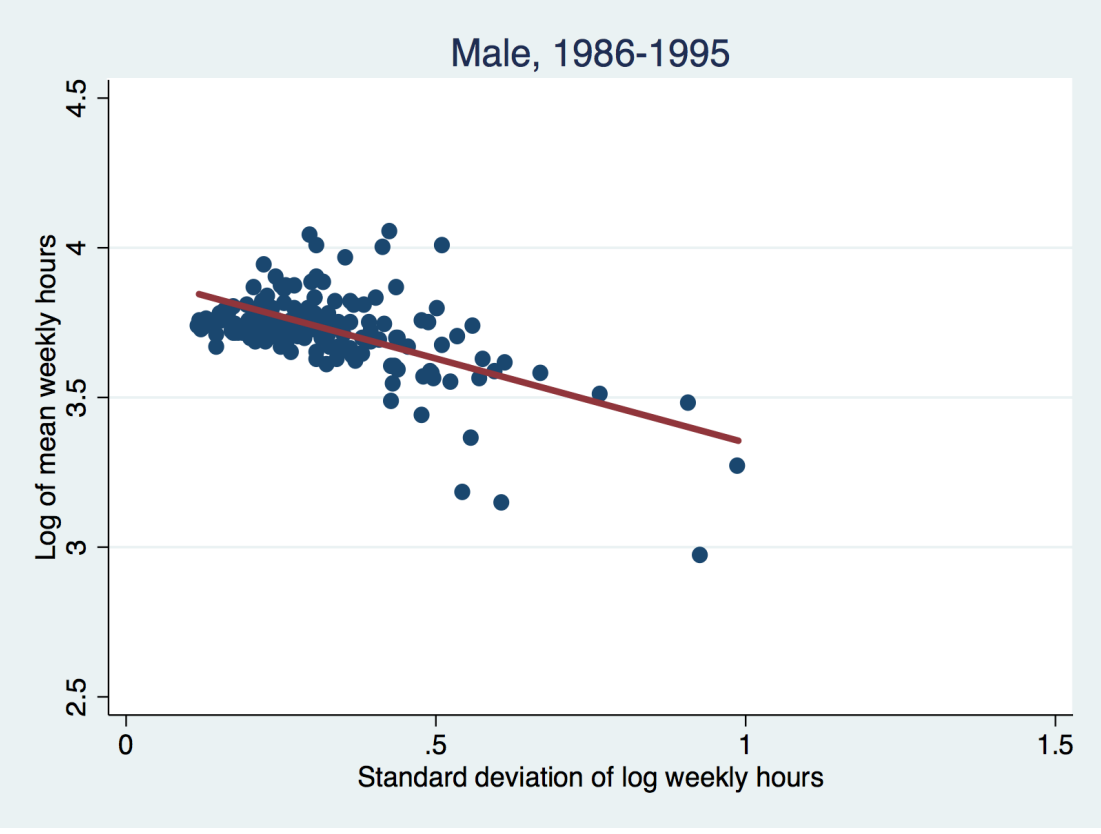
Intensive Margin



- Usual hours per week last year

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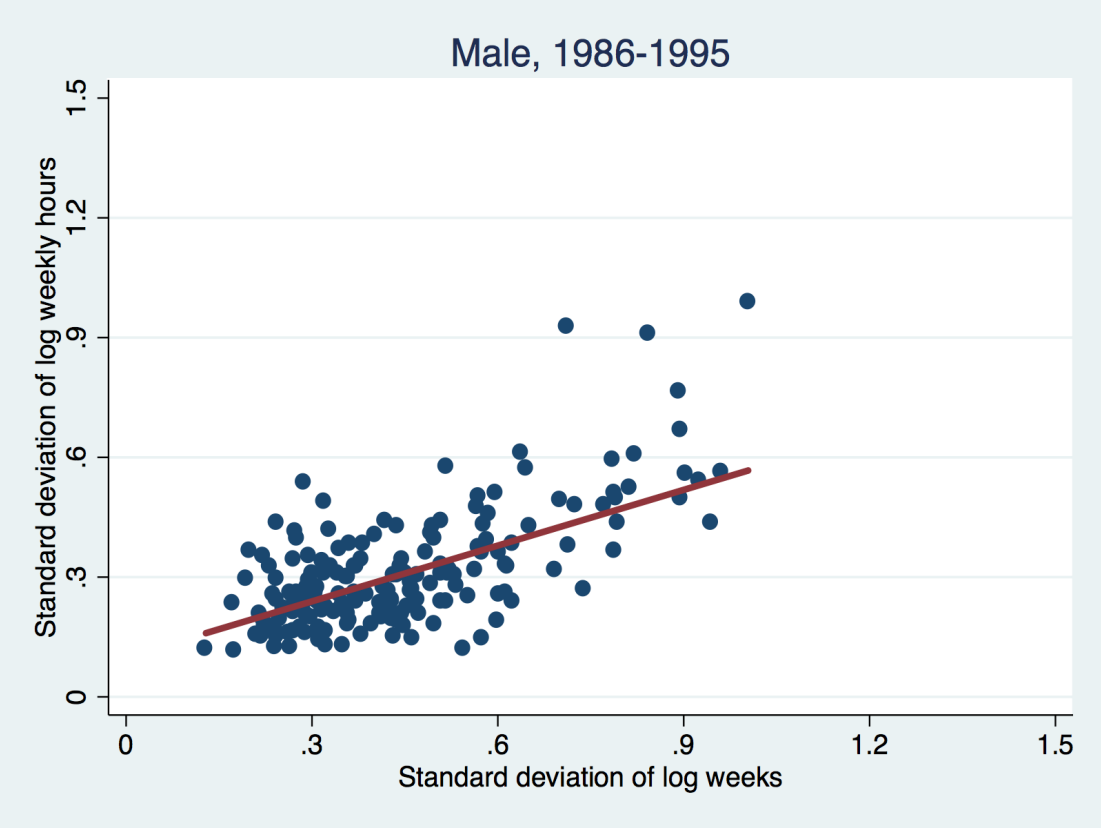
Correlation: Intensive vs. Extensive Margin



- Strong positive correlation

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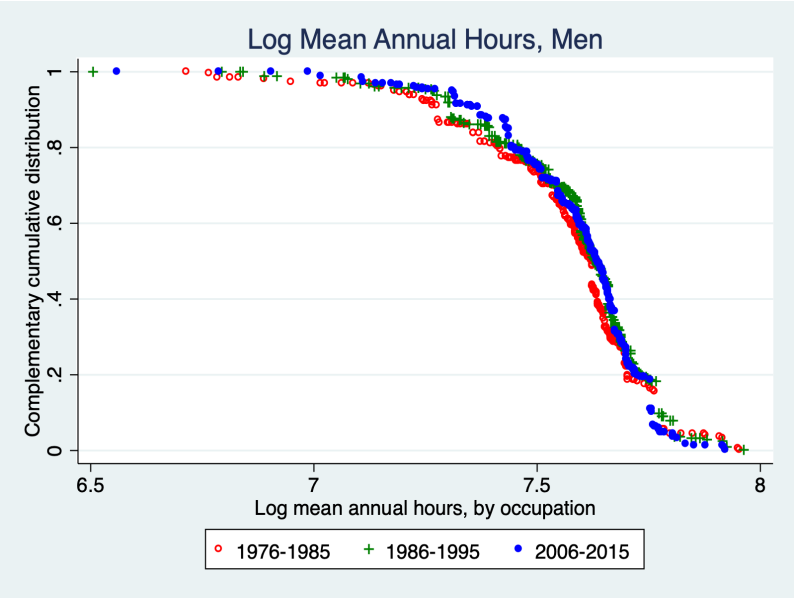
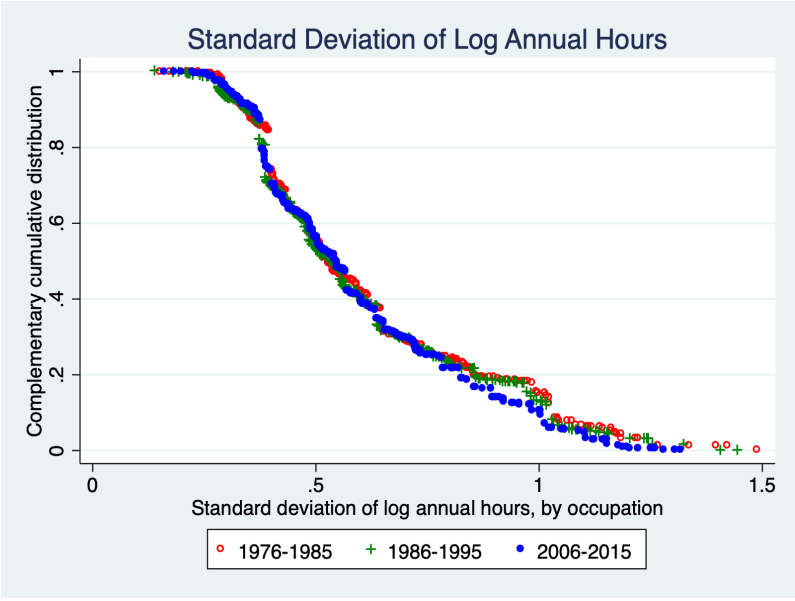
Occupational Hours Distribution over Time: Men





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Changes in Hours Worked for Occupation Switchers

- Use 1986-1995 IPUMS-CPS data
  - : compute mean hours worked in an occupation j, $\overline{H}_j$
- Use the 1990 SIPP dataset
  - : identify occupational switchers, from occupation $(j-1)$ to occupation j, between months $t-1$ to t
  - : compute average change in hours worked between months $t+1$, $t+2$, and $t+3$ and months $t-2$, $t-3$, and $t-4$ (occupational switching during this period is only between months $t-1$ and t)
  - : denote the resulting change in log hours for individual i as $\Delta \ln h^i_{j,j-1}$
  - : assign to the origin occ. $(j-1)$ the mean hours worked in that occ., $\overline{H}^j_{j-1}$
  - : assign to the destination occ. j the mean hours worked in that occ., $\overline{H}^j_j$
  - : dummy variable S_1 equal to one if the switch is towards an occup. with lower mean hours worked and zero otherwise
  - : dummy variable S_2 equal to one if the switch is towards an occup with higher mean hours worked and zero otherwise [Back]

Changes in Hours Worked for Occupation Switchers

$$\Delta \ln h^{i}_{j,j-1} = \beta_0 + \beta_1 S_1 + \beta_2 S_1 |\Delta \ln \overline{H}^{i}_{j,j-1}| + \beta_3 S_2 + \beta_4 S_2 |\Delta \ln \overline{H}^{i}_{j,j-1}|$$

	β_0 Constant	β_1 S_1	β_2 $S_1 \lvert\Delta \ln \overline{H}\rvert$	β_3 S_2	β_4 $S_2 \lvert\Delta \ln \overline{H}\rvert$
all	-0.003***	0.022***	-0.245***	0.024**	0.217***

*** – statistically significant at 1%; ** – statistically significant at 5%.

- Results are for men only
  - : results for women are similar

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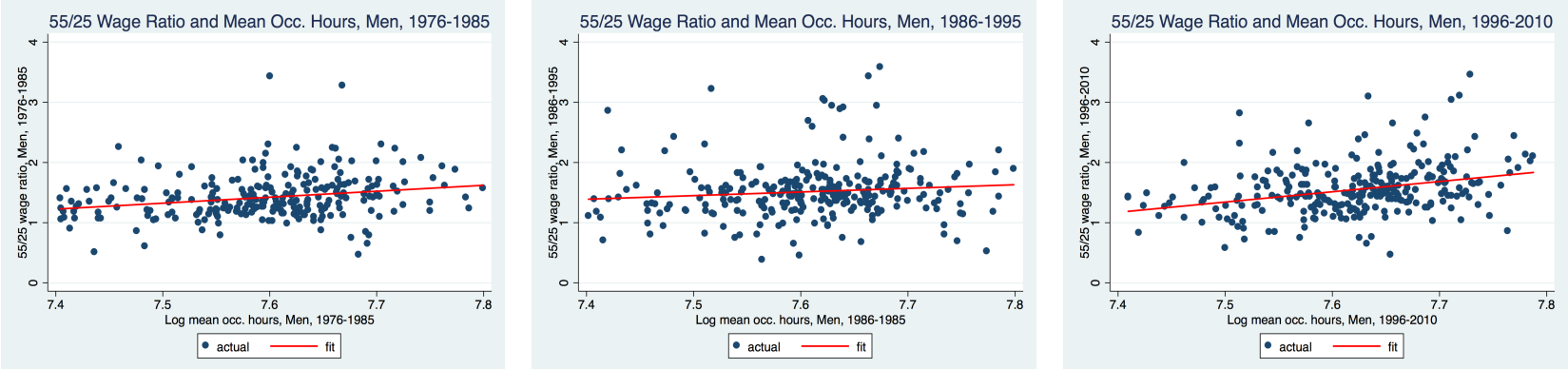
Wage Profiles in 3-Digit Occupations

- Use the IPUMS-CPS data
  - : divide sample into three periods: 1976-85, 1986-95, and 1996-10
  - : for each occupation, construct the wage ratios for ages 55 and 25

Figure: 55/25 Wage Ratio and Mean Occupational Hours, Men



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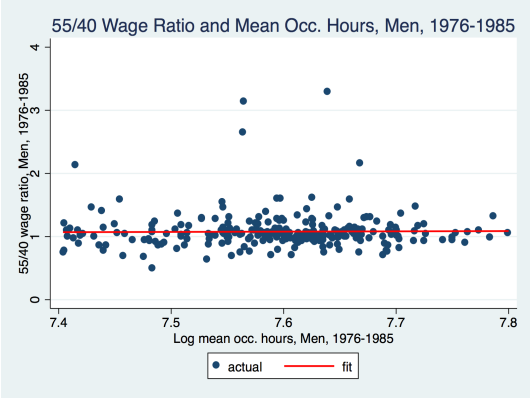
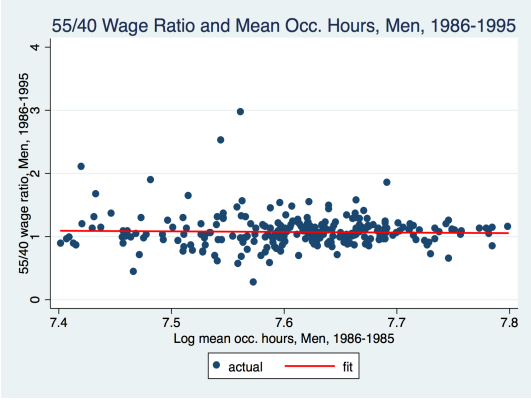
Wage Profiles in 3-Digit Occupations

Figure: 55/40 Wage Ratio and Mean Occupational Hours, Men





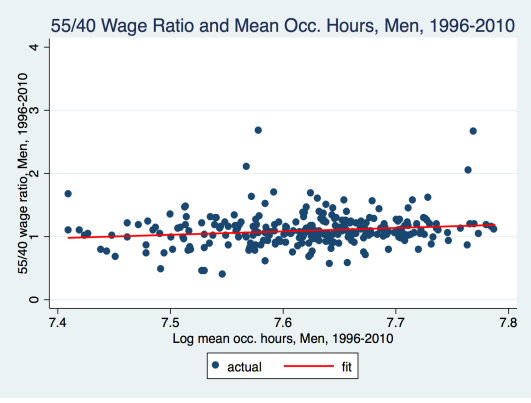
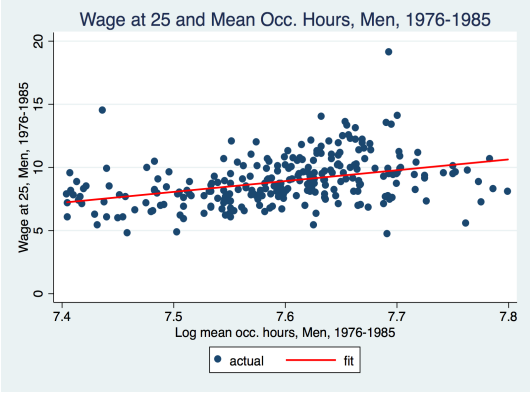
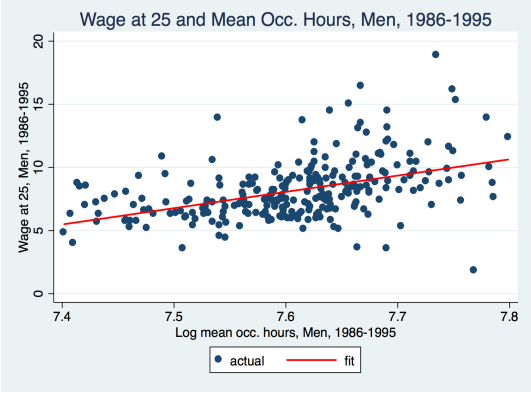
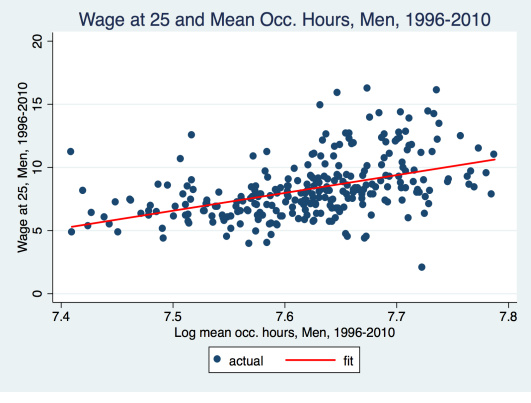


Figure: Wage at Age 25 and Mean Occupational Hours, Men







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