From Wages to Welfare:
Decomposing Gains and Losses From Rising Inequality

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Rising wage inequality

Major transformation in the structure of relative wages in the U.S.

1. Increase in the education wage premium

2. Increase in wage dispersion within education groups
   
   ▶ Both permanent and transitory components ↑
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Among sources of this trend: skill-biased demand shift (technology, trade/offshoring), deunionization, shift in contractual arrangements

Trend in wage inequality from CPS

Variance of Log Wages

College Wage Premium

Male workers aged 25-60. Hourly wage = annual earnings/annual hours
The question

**What are the welfare implications of this shift in the wage structure?**
Contrasting views of rising inequality
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• Implies lower expected welfare for U.S. households

  (i) Higher permanent wage risk and imperfect risk sharing
Contrasting views of rising inequality

- Implies lower expected welfare for U.S. households
  (i) Higher permanent wage risk and imperfect risk sharing

- Presents new opportunities to U.S. households
  (ii) Higher returns to education and investment in human capital
  (iii) Higher transitory wage volatility and flexible labor supply
Contrasting views of rising inequality

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Challenge: quantifying the relative importance of these three channels
Two alternative methodologies

Welfare is a function of consumption and leisure, not of wages
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1. Empirical approach
   - Looks directly at shifts in the empirical distribution of consumption and leisure through a social welfare function
   - In comparing distributions, data are demeaned
Two alternative methodologies

Welfare is a function of consumption and leisure, not of wages

1. Empirical approach
   - Looks directly at shifts in the empirical distribution of consumption and leisure through a social welfare function
   - In comparing distributions, data are demeaned

2. Structural approach
   - Uses a model to draw mapping from shift in wage distribution to shift in the distribution of consumption and leisure
   - Allows for relative wage movements to affect mean consumption and mean leisure ("level effects")
THE EMPIRICAL APPROACH
Trend in consumption inequality from CEX

Equivalized consumption expenditures = nondurables, services, small durables and estimated flow from vehicles and housing

Combining CEX Interview Survey (IS) and Diary Survey (DS), one finds larger increase in consumption inequality


Heathcote-Storesletten-Violante, "From Wages to Welfare: Decomposing Gains and Losses From Rising Inequality" – p. 9/30
Trend in leisure/hours inequality from CPS

If leisure is valued, then the distribution of hours worked affects welfare
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Trend in leisure/hours inequality from CPS

If leisure is valued, then the distribution of hours worked affects welfare

\[ Leisure = 1 - h^{market} - h^{home}, \]  
but \( h^{home} \) is poorly measured

\[ \star \text{Aguiar-Hurst (2006), Ramey (2006), Knowles (2009)} \]
Social welfare function

\[ W(c, h) = \sum_{j=0}^{J} \int \mu_{ij} U_{ij} di \]

Consumption equivalent welfare change \( \omega \) solves:

\[ W((1 + \omega)c^*, h^*) = W(c^{**}, h^{**}) \]
Social welfare function

$$\mathcal{W}(c, h) = \sum_{j=0}^{J} \int \mu_{ij} U_{ij} di$$

Consumption equivalent welfare change $\omega$ solves:

$$\mathcal{W}((1 + \omega) c^*, h^*) = \mathcal{W}(c^{**}, h^{**})$$

Assuming $\mu_{ij} = \beta^{-j}$, the social welfare function $\mathcal{W}$ reduces to average period utility in the cross-section:

$$\mathcal{W}(c, h) = \sum_{j=0}^{J} s_j \int u(c_{ij}, h_{ij}) di,$$

Enough to compare distributions of $(c, h)$ before and after the shift
Social welfare function

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average period utility in the cross-section:

\[ \mathcal{W}(c, h) = \sum_{j=0}^{J} s_j \int u(c_{ij}, h_{ij}) \, di, \quad \text{with} \quad u(c_{ij}, h_{ij}) = \frac{c_{ij}^{1-\gamma}}{1-\gamma} - \varphi \frac{h_{ij}^{1+\sigma}}{1+\sigma} \]

Enough to compare distributions of \((c, h)\) before and after the shift

Percentage of Lifetime Consumption

Risk Aversion ($\gamma$)

σ = 1
σ = 5

Heathcote-Storesletten-Violante, "From Wages to Welfare: Decomposing Gains and Losses From Rising Inequality" – p. 12/30
In the log case ($\gamma = 1$), $\omega \approx -2\%$ of lifetime consumption

A Lucas-style calculation

Since shift in hours distribution has small effect, ignore it for now

Assume log-normality of consumption: \( \log c \sim N\left(\frac{-\mu_c}{2}, \sigma_c^2\right) \)

\(\ast\) Battistin-Blundell-Stoker (2010)
A Lucas-style calculation

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Following the derivations in Lucas (1987):

\[
\omega_L \approx -\frac{\gamma}{2} \Delta v_c
\]

\( \gamma = 1 \) and \( \Delta v_c = 0.036 \) \( \Rightarrow \) \( \omega_L = -1.8\% \)
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Caveat: If the “revisionists” are correct and true rise in the variance of log consumption is twice as big \( \Rightarrow \omega_L = -3.6\% \)
THE STRUCTURAL APPROACH
Demographics, preferences, and education choice

- **Demographics**: Continuum of individuals indexed by $i$ facing constant survival probability $\pi$ from age $j$ to $j + 1$
Demographics, preferences, and education choice

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- **Preferences** over sequences of consumption and hours worked:

$$U = \mathbb{E}_0 \sum_{j=0}^{\infty} (\beta \pi)^j \left[ \log(c_{ij}) - \varphi_i \frac{h_{ij}^{1+\sigma}}{1 + \sigma} \right]$$
Demographics, preferences, and education choice

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- Two education levels $e \in \{L, H\}$ denoting high-school and college
  - Idiosyncratic utility cost $\chi_i$ of attending college
  - Fraction $q$ of individuals with $\chi_i < U_H - U_L$ chooses college
Technology and labor market

• CES aggregate technology:

\[ Y = Z \left[ \zeta N_H^\theta + (1 - \zeta) N_L^\theta \right]^{\frac{\theta}{\theta - 1}} \]

• Competitive labor markets: \( P_e = MPL_e \), with \( e \in \{L, H\} \)

\[ \log \left( \frac{P_H}{P_L} \right) \equiv p_H - p_L = \log \left( \frac{\zeta}{1 - \zeta} \right) - \frac{1}{\theta} \log \left( \frac{N_H}{N_L} \right) \]

▶ Rise in \( \frac{\zeta}{1 - \zeta} \) represents skill-biased demand shifts

Individual wages

Log individual wage is the sum of three orthogonal components

$$\log w_{ij} = p_{e(i)} + \alpha_{ij} + \varepsilon_{ij}$$

- $p_{e(i)}$ is the log price per efficiency unit of labor of type $e$
- $(\alpha_{ij}, \varepsilon_{ij})$ shocks determining within-group wage dispersion
  - $\alpha$ follows a unit root process
  - $\varepsilon$ is uncorrelated over time
Private risk-sharing

- Agents can save and borrow through a risk-free bond

- Additional private risk sharing (e.g., financial markets and family)
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- Equilibrium outcome: $\alpha$ uninsurable and $\varepsilon$ insurable

Government

- Runs a **progressive tax/transfer scheme** to redistribute and to finance (non-valued) expenditures

- Balances the budget every period
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- Relationship between pre-tax ($y_i$) and disposable ($\tilde{y}_i$) earnings:

\[
\tilde{y}_i = \lambda y_i^{1-\tau}
\]

- $\tau \geq 0$ is the **progressivity parameter** of the system

- Empirical fit of this tax/transfer system quite good on U.S. data
Summary of the model

- Three sources of shift in the wage structure:
  1. education differentials: \( \Delta \zeta \)
  2. uninsurable within-group differentials: \( \Delta v_\alpha \)
  3. insurable within-group differentials: \( \Delta v_\varepsilon \)
Summary of the model

• Three sources of shift in the wage structure:
  1. education differentials: $\Delta \zeta$
  2. uninsurable within-group differentials: $\Delta v_\alpha$
  3. insurable within-group differentials: $\Delta v_\varepsilon$

• Four key channels of adjustment/insurance:
  1. education: $q$
  2. private risk-sharing: $\frac{v_\varepsilon}{v_\alpha}$
  3. flexible labor supply: $\sigma$
  4. progressive taxation: $\tau$
Equilibrium allocations for consumption and hours

Individual allocations depend on \((e, \varphi, \alpha, \varepsilon)\), but not on wealth ⇒ tractability
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Individual allocations depend on \((e, \varphi, \alpha, \varepsilon)\), but not on wealth \(\Rightarrow\) tractability

\[
\log c(e, \varphi, \alpha) = \kappa_c + (1 - \tau) (p_e + \alpha - \varphi)
\]

- Consumption’s response to \((p_e, \alpha)\) mediated by progressivity
- Consumption invariant to insurable shock \(\varepsilon\)
Equilibrium allocations for consumption and hours

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- Consumption’s response to \((p_e, \alpha)\) mediated by progressivity
- Consumption invariant to insurable shock \(\varepsilon\)

\[
\log h(\varphi, \varepsilon) = \kappa_h - \varphi + \frac{1-\tau}{\sigma+\tau} \varepsilon
\]

- Hours respond to \(\varepsilon\) in proportion to tax-modified Frisch elasticity
- Hours invariant to skill price \(p_e\) and uninsurable shocks \(\alpha\)
Parametrization

- Use data on skill premium, enrollment, and (co-)variances of joint distribution of \((w, c, h)\) to recover values for structural parameters

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- Use data on skill premium, enrollment, and (co-)variances of joint distribution of \((w, c, h)\) to recover values for structural parameters


<table>
<thead>
<tr>
<th>Model parameter</th>
<th>Value</th>
<th>Empirical moment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\Delta \zeta)</td>
<td>0.11</td>
<td>(\Delta (p_H - p_L))</td>
</tr>
<tr>
<td>(\Delta v_\alpha)</td>
<td>0.05</td>
<td>(\Delta \text{var}^{\text{with}} (\log c))</td>
</tr>
<tr>
<td>(\Delta v_\varepsilon)</td>
<td>0.03</td>
<td>(\Delta \text{var}^{\text{with}} (\log w) - \Delta \text{var}^{\text{with}} (\log c))</td>
</tr>
<tr>
<td>((\mu_\chi, v_\chi))</td>
<td>(3.26, 6.20)</td>
<td>((q^*, \Delta q))</td>
</tr>
<tr>
<td>(\tau)</td>
<td>0.31</td>
<td>(\text{var} (\log \tilde{y}) / \text{var} (\log y))</td>
</tr>
</tbody>
</table>

- \(\sigma = 2 \Rightarrow \text{tax-modified Frisch elasticity } 1 - \frac{\tau}{\sigma + \tau} = 0.30\)

Welfare analysis

- **Neutrality conditions**: normalizations s.t. absent change in agents’ behavior, \((\Delta \zeta, \Delta v_\alpha, \Delta v_\varepsilon)\) leave average wage level unaffected
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- **Neutrality conditions:** normalizations s.t. absent change in agents’ behavior, \((\Delta \zeta, \Delta v_\alpha, \Delta v_\varepsilon)\) leave average wage level unaffected

- Compare two steady-states, pre \((*)\) and post \((***)\) shift in wage structure, corresponding to 1980-1984 and 2001-2005

- Assume **Normal distributions** for \((\alpha, \varepsilon, \varphi, \log \chi)\)

- Plug \((c, h)\) allocations into social welfare function \(\mathcal{W}\), and from

\[
\mathcal{W}((1 + \omega)c^*, h^*) = \mathcal{W}(c^{**}, h^{**})
\]

solve for \(\omega\) in closed form as function of structural parameters
Analytical expression for $\omega$

$$
\omega \approx -\frac{(1-\tau)^2}{2} \Delta \left[ q (1-q) (p_H - p_L)^2 \right] - \frac{(1-\tau)^2}{2} \Delta v_{\alpha} \\
- \frac{\sigma}{2} \left( \frac{1-\tau}{\sigma + \tau} \right)^2 \Delta \varepsilon \\\n+ \left( \frac{1-\tau}{\sigma + \tau} \right) \Delta \varepsilon + \Delta \log \mathbb{E} [P_e] - (1-\pi) \Delta (\bar{\chi} q)
$$

... where tractability of the equilibrium model pays off
Interpreting each component of $\omega$

$$\omega \approx -\frac{1}{2} (1 - \tau)^2 \Delta \left[ q (1 - q) (p_H - p_L)^2 \right] \Delta \text{var}^{\text{bet}}(\log c)$$

$$- \frac{\sigma}{2} \left( \frac{1 - \tau}{\sigma + \tau} \right)^2 \Delta v_\varepsilon \Delta \text{var}(\log h)$$

$$+ \left( \frac{1 - \tau}{\sigma + \tau} \right) \Delta v_\varepsilon \left( \frac{\partial \log(Y/N)}{\partial v_\varepsilon} \right)$$

$$+ \Delta \log \mathbb{E}[P_\varepsilon] \left( \frac{\partial \log(Y/N)}{\partial \zeta} \right)$$

$$- (1 - \pi) \Delta (\bar{\chi}q) \Delta \text{edu cost}$$
Interpreting each component of $\omega$

$$\omega \approx -\frac{1}{2} (1 - \tau)^2 \Delta \left[ q (1 - q) (p_H - p_L)^2 \right] - \frac{1}{2} (1 - \tau)^2 \Delta v_\alpha$$

Welfare cost from rise in consumption inequality

$$-\frac{\sigma}{2} \left( \frac{1 - \tau}{\sigma + \tau} \right)^2 \Delta v_\varepsilon$$

Welfare cost from rise in hours inequality

$$+ \left( \frac{1 - \tau}{\sigma + \tau} \right) \Delta v_\varepsilon + \Delta \log \mathbb{E} [P_e] - (1 - \pi) \Delta (\bar{\chi} q)$$

Additional level effects from structural approach
Welfare calculation

\[
\omega \approx -\frac{1}{2} (1 - \tau)^2 \Delta \left[ q (1 - q) (p_H - p_L)^2 \right] - \frac{1}{2} (1 - \tau)^2 \Delta v_\alpha
\]

\[
-2.2%
\]

\[
-\frac{\sigma}{2} \left( \frac{1 - \tau}{\sigma + \tau} \right)^2 \Delta v_\epsilon
\]

\[-0.3%
\]

\[
+ \left( \frac{1 - \tau}{\sigma + \tau} \right) \Delta v_\epsilon + \Delta \log \mathbb{E} [P_e] - (1 - \pi) \Delta (\bar{\chi}q)
\]

\[+3.0\%
\]

Gains (+3.9%) minus losses (−2.5%) ⇒ \( \omega = +1.4\% \) of lifetime consumption
Distribution of welfare gains and losses

• Our welfare calculation is a cross-sectional average

• How are welfare gains and losses distributed in the population?
Distribution of welfare gains and losses

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<table>
<thead>
<tr>
<th>Indiv. type $\chi_i$</th>
<th>Fraction of pop. $\omega$</th>
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<tbody>
<tr>
<td>$L^* &amp; H^* \rightarrow H^{**}$</td>
<td>0.28</td>
</tr>
<tr>
<td>$L^* \rightarrow L^{**}$</td>
<td>0.72</td>
</tr>
</tbody>
</table>

At least 70% of households (all <= HS grads) expect welfare losses
Role of insurance mechanisms

Shut down one insurance mechanism at a time and recompute $\omega$
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<tr>
<th>Model</th>
<th>Insurance channel missing</th>
<th>$\omega$</th>
</tr>
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<tbody>
<tr>
<td>Baseline</td>
<td>None</td>
<td>+1.4%</td>
</tr>
<tr>
<td>$\sigma = \infty$</td>
<td>Flexible labor supply</td>
<td>+0.8%</td>
</tr>
<tr>
<td>$\varepsilon \rightarrow \alpha$</td>
<td>Private risk-sharing</td>
<td>+0.1%</td>
</tr>
<tr>
<td>$\tau = 0$</td>
<td>Public insurance</td>
<td>+0.1%</td>
</tr>
<tr>
<td>$\Delta q = 0$</td>
<td>Rise in college enrollment</td>
<td>−6.0%</td>
</tr>
</tbody>
</table>

Private and public insurance equally important

Education choice paramount to take advantage of new wage structure

Heathcote-Storelletten-Violante, “From Wages to Welfare: Decomposing Gains and Losses From Rising Inequality” – p. 29/30
What did we learn?

• **Empirical approach too pessimistic** on the welfare consequences of the recent shift in the U.S. wage structure ($\omega = -2\%$)

• With model-based approach which quantifies “level effects”, average losses turn into average gains ($\omega = +1.4\%$)

• **Qualifier**: majority of individuals experienced significant losses (choice of welfare function matters!)

• **Policy**: promoting human capital investment vs. progressive taxes