

The Evolution of the Price and Quantity of Occupational Human Capital

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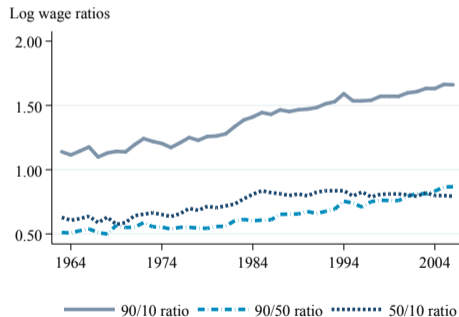
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U.S. male wage inequality

- Overall male wage inequality in the U.S. has expanded ← widening of educational wage differentials.
- Trends in top and bottom inequality diverged ← changes in wage gap between occupations.
 - Top inequality has been steadily rising.
 - Bottom inequality has compressed.

Figure: Trends in 90/10, 90/50 and 50/10 male wage ratios.

Source: Autor, Katz, and Kearney (2008).



Wage inequality growth and technical change

$$Wage = Price \times Quantity \text{ of Human Capital}$$

Sources of inequality:

1. Growth in relative price:

Wage differential driven by changes in relative price of human capital

- **Skill-biased technical change:** increase in the demand for high-skill (college-educated) relative to low-skill (high-school-educated) labour.
- **Routine-biased technical change:** increase in demand for high-skill abstract occupations and low-skill manual occupations relative to middle-skill routine occupations. RBTC

Measuring growth in relative quantities: Cohort quality

$$Wage = Price \times Quantity \text{ of Human Capital}$$

Source of inequality:

2. Growth in relative quantities

Wage differentials driven by changes in distribution of human capital.

- Education-based human capital.
 - Changes in educational composition of workforce give rise to *cohort effects* in the human capital distribution (Carneiro and Lee, 2011, Bowlus and Robinson, 2012).
- Occupational human capital.
 - Methods based on the Roy-model of selection into occupation assume no cohort changes in the distribution of human capital (Gottshalk, Green, and Sand, 2015, Cortes, 2016, Böhm, 2020, Cavaglia and Etheridge, 2020).

Research Question

1. What is the role of cohort quality changes in the evolution of occupational human capital prices and quantities?
2. Reexamine the routine-biased technical change explanation of the inequality driven by falling demand for routine occupations.

Data and occupational grouping

Data: March Current Population Survey (MCPS) 1971-2018.

- Full-Time Full-Year (at least 35 hours per week and 40 weeks per year) male workers 30-60 years old.

$$\textit{Hourly Wage} = \frac{\textit{Annual Earnings}}{\textit{Hours Per Week} * \textit{Weeks Per Year}}$$

Occupational Grouping: classification based on MCPS 3-digit occupational coding (Acemoglu and Autor, 2011):

1. Abstract Group: Managerial, professional, and technical occupations.
2. Routine Group: Sales, clerical, and administrative; and production, crafts, repair, and operative occupations.
3. Manual Group: Services occupations.

Price identification: Flat spot method

- The life-cycle human capital profile exhibits a concave shape with a flat spot prior to the retirement (Ben-Porath 1967).
- Human capital *stock* of worker of age a in the occupation group j : $H_t^{j,a}$.
- Period t price for and efficiency unit of occupational human capital j : P_t^j .

$$\ln W_t^{j,a} = \ln P_t^j + \ln H_t^{j,a}$$

- **Identification assumption:** Workers in their flat spot age range have stable stocks of human capital.

$$\ln H_t^{j,a} - \ln H_{t-1}^{j,a} = 0.$$

- The wage growth in the spot age range reflects the price change for human capital: Impl

$$\ln W_t^{j,a} - \ln W_{t-1}^{j,a} = \ln P_t^j - \ln P_{t-1}^j.$$

Application to occupational groups

Occupational switching: Sens

> 80% stay in occupational group over a year
(Merged Outgoing Rotation Group 1983-2017).

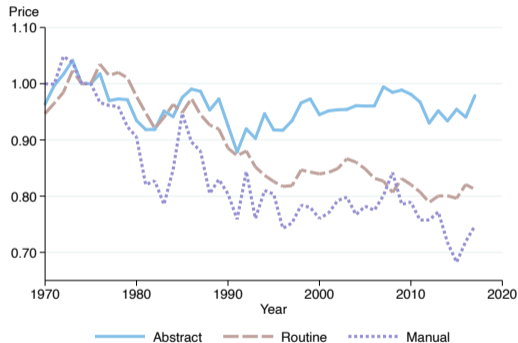
Flat spot age range identification: Sens

- Abstract group: 51-60. CS
- Routine group: 46-55.
- Manual group: 46-55.

Results Roadmap

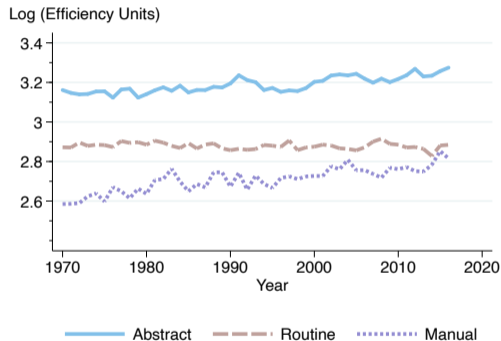
- Price series.
- Quantity series.
- Decomposition of the wage premium.
- Within abstract occupations:
Higher-skill (postgraduate degree) vs high-skill (undergraduate degree).

Price series for occupation groups



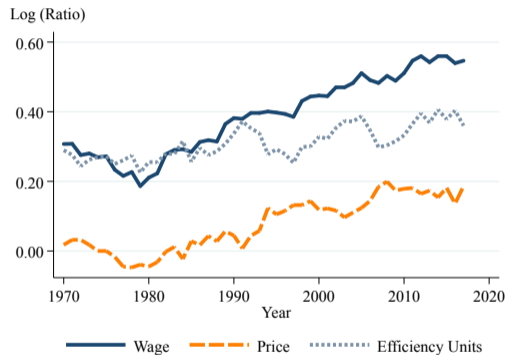
- The price series for the abstract group remains stable.
- Price series for manual and routine groups decline and are highly correlated.

Log quantity series for occupation groups



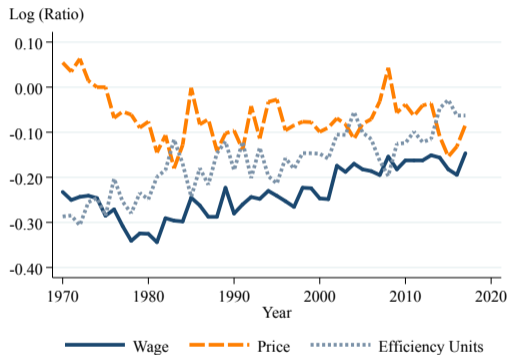
- Human capital of the abstract group slightly increases.
- Human capital of the routine group remains stable.
- Manual group accumulates human capital stock.

Wage premium decomposition: Abstract vs Routine



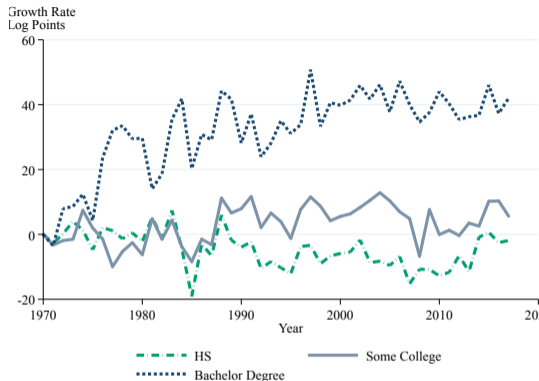
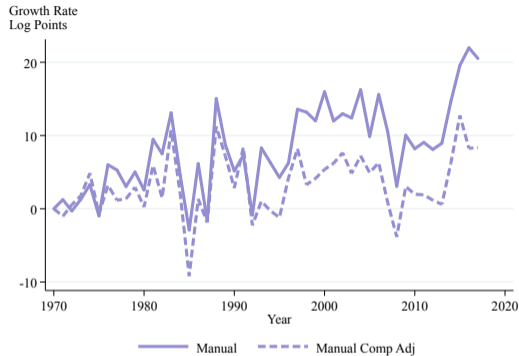
- Both relative price and relative quantity increase.
- Consistent with the increase in the demand for abstract occupations relative to the routine occupations.
- Consistent with the routine-biased technical change and skill-biased technical change.

Wage premium decomposition: Manual vs Routine



- Higher wage premium for manual occupations is driven by accumulation of human capital.
- Price for manual group decreases relatively to routine.
- At odds with the routine-biased technical change which predicts increase in relative price of manual group.

Quantity growth in manual group: Composition

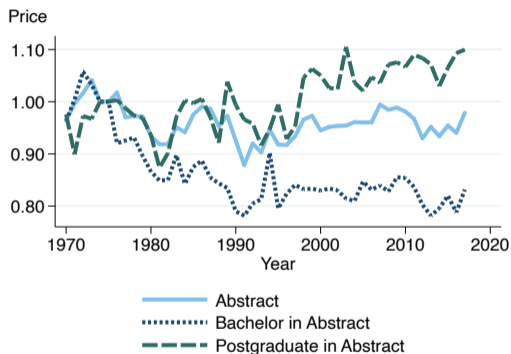


(a) Median quantity growth relative to 1970: Fixed educational composition.

(b) Median quantity growth within manual group by education.

- Positive effect of the changing educational composition.
- The growth in efficiency units for workers with a bachelor degree dominates the decline in efficiency units for high school graduates.

Wage premium within the abstract group

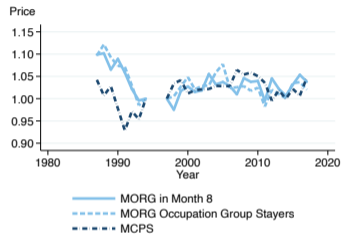


- Growing wage premium for postgraduate degrees driven by relative price increase.
- Within the abstract occupational group, the demand has increased for the higher skill group relative to the high-skill group.
- Evidence in line with skill-biased technical change.

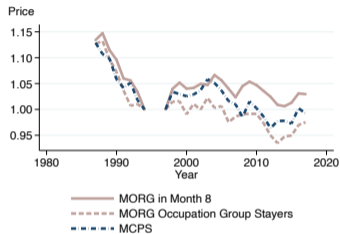
Conclusion

- Accounting for cohort effects in the distribution of human capital provides new evidence on the evolution of occupational human capital and prices.
- Wage gaps between the abstract, routine, and manual occupational groups are driven by different forces.
 - The price of the abstract occupational group has increased relative to both routine and manual groups → skill-biased technical change.
 - The growth of the wage of the manual group relative to the routine group is driven by the growth in relative quantities of human capital.
- Top and bottom inequality are driven by different forces:
 - Top inequality is driven by increase in relative prices for the high-skill human capital.
 - Bottom inequality is driven by accumulation of human capital.

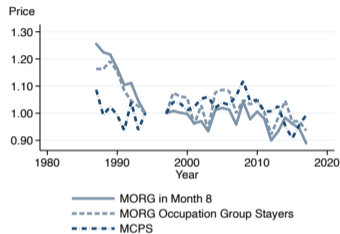
Figure: Sensitivity of Price Series to the Occupational Group Switching



(a) Abstract Group



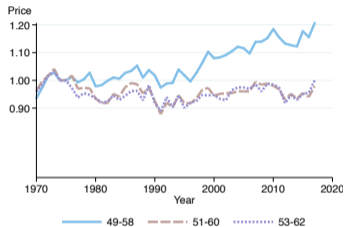
(b) Routine Group



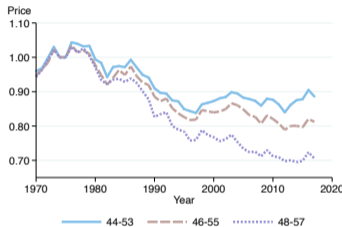
(c) Manual Group

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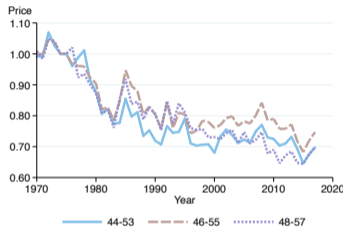
Figure: Sensitivity of Price Series to Changing the Flat Spot Age Range



(a) Abstract Group



(b) Routine Group



(c) Manual Group

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Routine-biased technical change model(Autor, Katz, Kearney, 2006)

- Computer capital:
 - perfect substitute for routine occupations (R)
 - complements abstract occupations (A)
 - neither strongly complements nor substitutes manual occupations (M)
- Cobb-Douglas production function [$\alpha + \beta + \gamma = 1$]:

$$Y = A^\alpha (R + K)^\beta M^\gamma$$

- Each factor (j) is paid its marginal product per efficiency unit:

$$\omega^A = \frac{dY}{dA} \quad \omega^R = \frac{dY}{dR} \quad \omega^M = \frac{dY}{dM}$$

- The price of routine human capital is equal to the endogenously declining price of capital:

$$\omega^R = \rho$$

- Relative wage increases as the cost of computer capital goes down.

Quantity changes

- The quantity of human capital stock of worker in occupational group j : H_t^j .
- Observed hourly wage of a worker in occupational group j :

$$w_t^j = \omega_t^j H_t^j$$

- Relative wage increases can be driven by changing relative quantities of human capital $\frac{H_t^M}{H_t^R}$:

$$\frac{w_t^M}{w_t^R} = \frac{H_t^M}{H_t^R} \frac{\omega_t^M}{\omega_t^R}$$

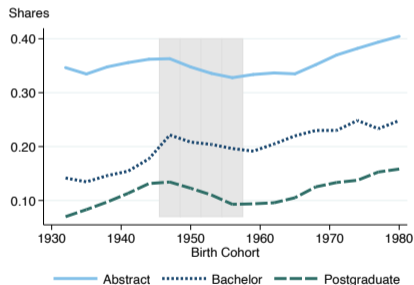
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Flat spot age range: Abstract group

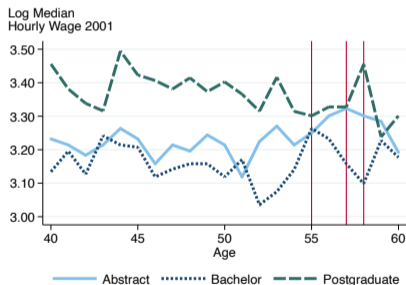
- Positive cohort effect for birth cohorts 1947-1956: reach flat spot in 2001 (Bowlus and Robinson, 2012).

$$\ln W_a^c - \ln W_{a-1}^{c+1} < \Delta \ln H_a.$$

- Human capital for abstract group peaks later than for bachelor degree group.



(a) Share in 35-40 aged workers



(b) 2001 wage profile

Implementation

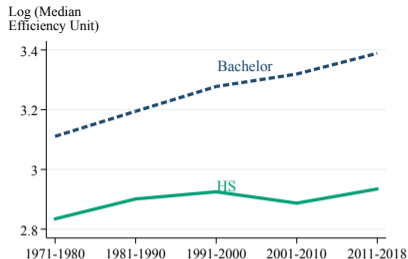
- Use median inflation-adjusted hourly wages (Bowlus and Robinson 2012, Gottshalk, et al., 2015).
- **Price change estimation:**
 - Sample of workers in their flat spot age range: in period t synthetic cohorts $c = 1, \dots, C$ are in flat spot age range.
 - Price change for occupational group j between periods $t - 1$ and t

$$\widehat{\Delta \ln P_t^j} = \frac{1}{C} \sum_{c=1}^C (\ln W_t^{c,j} - \ln W_{t-1}^{c,j}).$$

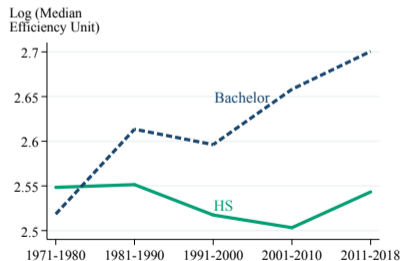
- **Quantity change estimation:**
 - Sample of 30-60 years old workers.
 - Quantity change for occupational group j between periods $t - 1$ and t

$$\widehat{\Delta \ln H_t^j} = \ln W_t^j - \ln W_{t-1}^j - \widehat{\Delta \ln P_t^j}.$$

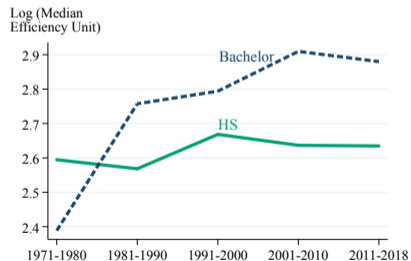
Manual occupations



(a) Protective



(b) Food and Cleaning



(c) Personal and Health