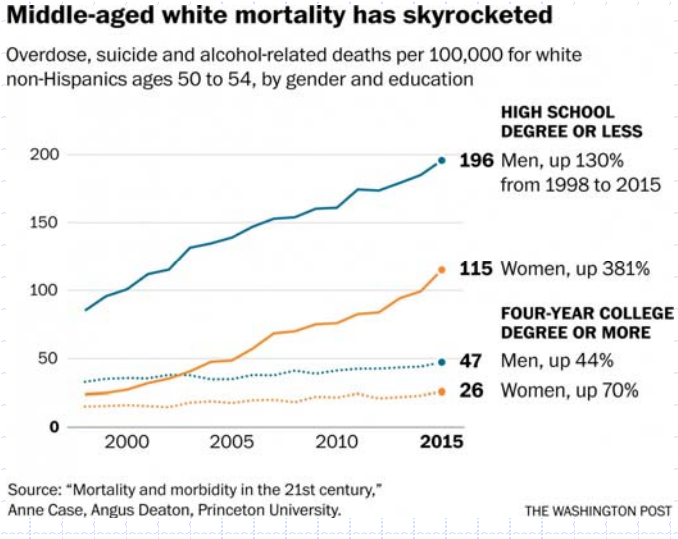
Topic 7.2 Wage Inequality

Skill Premium and Skill-Biased Technical Change

These Changes Matter



Outline

- The Skill Premium: Definition and Data Patterns
- A Theoretical Model of the Skill Premium and Skill-Biased Technical Change (SBTC)
- Empirical Tests of the SBTC Theory: Successes and Limitations
- Alternative Explanations for Changes in Wage Inequality

Stylized Facts on Wage Inequality

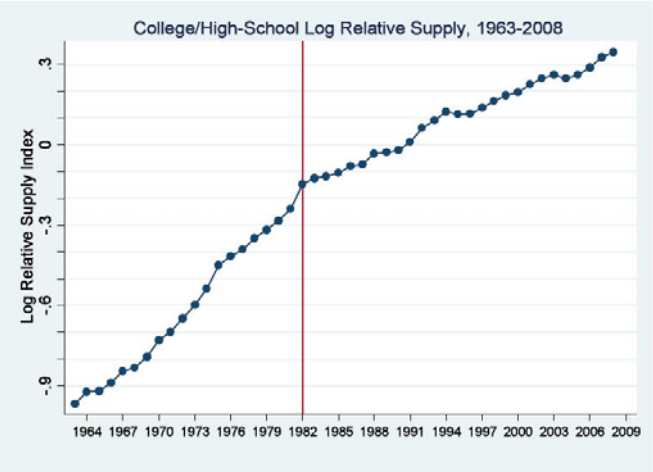
- The gap between the highest and the median earners has been widening since the late 1970s in the US, the UK and Canada.
- These countries experienced a dramatic rise in inequality particularly during the 1980s and early 1990s.
- The increase in the earnings gap is particularly strong when looking at the very high earners (99th percentile).

Changes in Skills and Return to Skills?

- Can differences in the composition and return to skills explain the observed changes in wage inequality?
- We know that people with different education levels earn different wages.
  - The number of people with/without university degrees may be changing over time (changes in **composition**).
  - The return to a university degree may be changing over time (changes in **return to skills**).
- We can see whether the composition has changed by looking at the data.

Relative Supply of College-Educated (US)

Figure 2

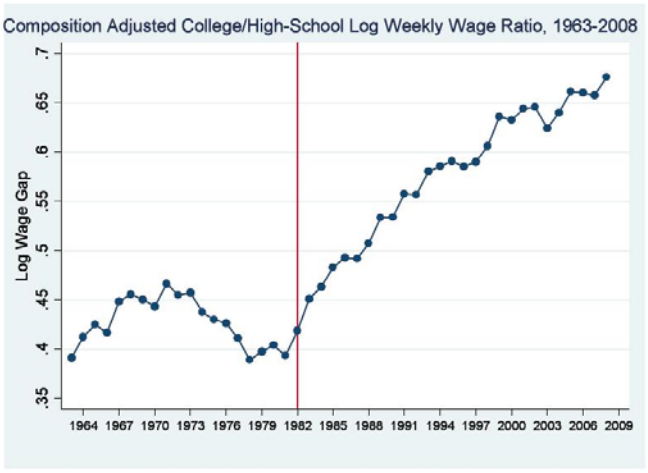


Stylized Facts

- Takeaway: There has been a **substantial increase** in the education levels of the population since the 1960s
- Next: have there been changes in the **return to education**, i.e. the wage gap between workers with high and low education levels?
  - A larger gap between the wages of these two groups would be related to higher inequality levels.
  - The return to education is commonly measured by calculating the **university wage premium**: the **relative wages** of university graduates relative to workers without higher education
- Let's look at the data

College Wage Premium

Figure 1



Aside: Estimating the Premium

- How is the university wage premium estimated?

- Basic Approach:

1. Take individual-level data from a large nationally-representative survey (e.g. the Labour Force Survey).
2. Calculate the average weekly wages among all full-time employees who have a university degree and the average weekly wages among all full-time employees who have only a high school degree or less.
3. Take the **ratio** of the two.

Aside: Estimating the Premium

- Issue: Simply taking the ratio of the average wages of the two groups does not lead to a very accurate measure of the return to education.

- This is because these average wages would differ for reasons **other than education**.
  - For example, the composition of the two groups (university and high school) will be quite different in terms of their work experience, their age, the fraction living in different regions, the fraction of females, etc.

- Ideally you want to get an estimate of the return to education after controlling for all these other factors. That is, you want to compare people with the **same observable characteristics**

Aside: Estimating the Premium

- We can use individual-level data to run an OLS regression of the following form

$$\ln w_i = \beta_0 + \beta_1 Uni_i + \beta_2 X_i + \varepsilon_i$$

- Uni_i is a dummy equal to 1 if individual i has a university degree, and X_i includes a number of demographic and labour market characteristics of the individual
- The estimated coefficient $\widehat{\beta_1}$ will be the estimated return to a university degree (all else equal).

Aside: Estimating the Premium

- Note that this does **not** identify a causal relationship
  - Education is not randomly assigned.
  - People with a university degree may be different from those without one along a number of unobservable characteristics (such as general ability) which would be included in the error term
- However, β_1 as a descriptive statistic is still informative and interesting.

Stylized Facts

- So we have established two basic facts

1. Large increase in the fraction of the population with a university degree since the mid-1960s.
2. Large increase in the university wage premium since the early 1980s.

The Skill Premium Model

- The increase in the university wage premium (or **skill premium**) will lead to **increases in wage inequality** (larger gap between people with high and low education).
- Understanding how the skill premium is determined can help us **understand the patterns** over time in wage inequality that we observe in the data
- How do we do this? ➔ Need a theoretical model.
- We call this the skill premium model

Model features

- There are 2 types of workers: high (H) and low (L) skill (think of people with and without a university degree).
- Simple supply and demand framework determines wages: workers supply their labour and firms hire workers.
- Labour markets are competitive (workers are paid the value of their marginal product).
- The skill premium is determined by the relative supply and the relative demand for skills.

Model Features

- We assume that all workers want to work full-time (regardless of the equilibrium wage), so labour supply is given simply by the number of workers of each type (e.g. number of university graduates).
- Moreover, we assume that changes over time in the relative supply of skilled workers are exogenous.
- Labour demand depends on worker productivity, which in turn depends on technology.

Skill-Biased Technical Change

- Technological progress makes workers more productive, but we assume that it is '**skill-biased**', in the sense that new technologies are more complementary to high than to low skill workers.
- Therefore, technological progress increases the relative demand for high skill workers over time.
- This is a model of **Skill-Biased Technical Change (SBTC)**.

Implications

- $\frac{\partial w_L}{\partial H/L} > 0$: as the fraction of high skill workers in the labor force increases, the low skill wage rises
- $\frac{\partial w_L}{\partial A_L} > 0$ and $\frac{\partial w_L}{\partial A_H} > 0$: either kind of factor-augmenting technical change increases wages of low skill workers
- $\frac{\partial w_H}{\partial H/L} < 0$: as the fraction of high skill workers in the labor force
- increases, their wages fall.
- $\frac{\partial w_H}{\partial A_L} > 0$ and $\frac{\partial w_H}{\partial A_H} > 0$: either kind of factor-augmenting technical change increases wages of high skill workers

Skill Premium and Technical Change

- The model implies that:

$$\frac{\partial \ln w}{\partial \ln \frac{H}{L}} < 0$$

- For a given skill bias of technology (captured by $\frac{A_H}{A_L}$), **an increase in the relative supply of skills reduces the skill premium**

Skill Premium and Technical Change

- The model also implies that:

$$\frac{\partial \ln w}{\partial \ln \left(\frac{A_H}{A_L}\right)} > 0$$

- Here we have the essence of **Skill-Biased Technical Change: As skilled workers become relatively more productive, their relative wages increase**

Thus the Skill Premium Depends On…

- The **relative supply of skills**, which is given by the **number of workers** with/without a university degree
  - Increases in the relative supply of skilled workers reduce the skill premium.
- The **relative demand for skills**, which is a function of the relative productivity of the two types of workers, which is in turn driven by **technology**.
  - Increases in A_H/A_L, or skill-biased technical change, increase the skill premium (under certain assumptions).
- Therefore, the model suggests that there is a **'race' between technological change and the supply of skills**.

Implication

- If technology had remained roughly constant over recent decades, **the remarkable increase in the supply of skills** (which we saw earlier) would have led to a significant **decline in the skill premium**.
- For this reason, economists believe that **technological changes occurring throughout the 20th century must have increased the demand for skills** – that is, technological change must have been **skill biased**.

Empirical Evidence

Estimate: $\ln w_t = \beta_0 + \beta_1 t - \beta_2 \ln\left(\frac{H_t}{L_t}\right)$

- This specification assumes that there is a constant rate of technological increase) → Changes in the skill premium will occur when the growth rate of the supply of skills differs from the pace of technological progress (thus embodying the 'race' between technology and the supply of skills).
- Estimation**:** regress the time-series wage premium data on a constant (estimated coefficient will be $\widehat{\beta_0}$), a time trend (estimated coefficient will be $\widehat{\beta_1}$) and on the observed time-series data on the relative supply of university-educated workers (estimated coefficient will be $\widehat{\beta_2}$).
- We expect:$\widehat{\beta_1} > 0$ and $\widehat{\beta_2} < 0$

Table 8. Regression Models for the College/High-School Log Wage Gap, 1963-2008

	1963-1987		1963-2008		
	(1)	(2)	(3)	(4)	(5)
CLG/HS Relative Supply	-0.612 (0.128)	-0.339 (0.043)	-0.644 (0.066)	-0.562 (0.112)	-0.556 (0.094)
Time	0.027 (0.005)	0.016 (0.001)	0.028 (0.002)	0.029 (0.006)	0.020 (0.006)
Time X post-1992			-0.010 (0.002)		
Time^2/100				-0.013 (0.006)	0.036 (0.012)
Time^3/1000					-0.007 (0.002)
Constant	-0.217 (0.134)	0.059 (0.039)	-0.254 (0.066)	-0.189 (0.122)	-0.145 (0.103)
Observations	25	46	46	46	46
R-squared	0.558	0.935	0.961	0.941	0.960

Source: March CPS data for earnings years 1963-2008. See notes to Figures 2 and 21.

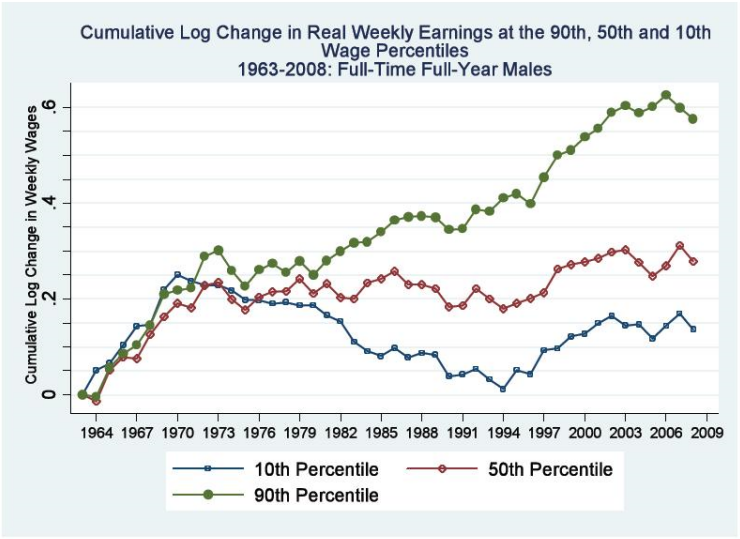
SBTC Summary

- The model provides a simple framework for thinking about **the skill premium, its determinants and its implications for the aggregate distribution of earnings**: inequality rises if the skill premium rises.
- Changes in the wage structure are associated with **changes in factor-augmenting technologies and in the relative supplies of skill groups**.
- Assuming a constant rate of technological progress, the model **successfully accounts for some of the key empirical patterns in the evolution of the wage premium**, particularly up until the early 1990s.

Limitations

- The model attributes a lot of the changes over time to something that we cannot measure directly (technological change).
- The model has a hard time explaining differences in the patterns of inequality across different countries (we would expect technological progress to occur at a similar rate across most developed countries).
- Also, the model is unable to explain the different patterns for the 90-50 wage gap and the 50-10 wage gap.

Figure 7b



Limitations

- The model predicts that the real wage of each skill group should increase as a result of technological progress.
  - **We do not observe this in the data**. In fact, we observe that the real wages for low-educated males are lower now than they were in the mid-1960s.
- The model suggests that **the pace of technological progress slowed down after the 1990s**, but most people believe that it has accelerated
- The model treats the supply of skills as **exogenous**
  - Presumably the fraction of people who decide to go to university will depend on the relative wages of university graduates
- The model treats technological change as **exogenous**.
  - Presumably technology responds to changes in the availability of skills

Other Explanations

- In addition to 'supply and demand' explanations for changes in wage inequality, such as SBTC, researchers have suggested a number of alternative institutional-based explanations, such as the following
- Minimum wages
  - Much of the growth in the 50-10 wage gap during the 1980s can be linked to a fall in the minimum wage.
  - The minimum wage has been approximately constant since 1990, so it cannot explain any recent changes.
  - This also cannot explain changes at the top end of the distribution

Other Explanations

- De-unionization.
  - Unions tend to 'compress' wages (reduce wage dispersion), so the fall in unionization rates may help explain the increase in inequality.
  - In fact, unionization rates fell most dramatically precisely in the countries where top-end inequality increased the most (US, UK, Canada).
- Deregulation.
  - Industries that were deregulated in the late 1970s (airlines, trucking, etc) did not experience more growth in inequality than industries that were unaffected by deregulation.

Other Explanations

- Changes in the pay-setting institutions and social norms that determine the pay of top executives, which have changed in some countries like the United States, but not in others such as France.
  - Difficult to test.
  - Earnings growth at the top end not driven exclusively by top executives.
- Shift towards performance-pay jobs.
  - The fraction of workers on performance-pay jobs has been increasing, and wages are less equally distributed in those types of jobs (returns to education are higher in performance-pay jobs).

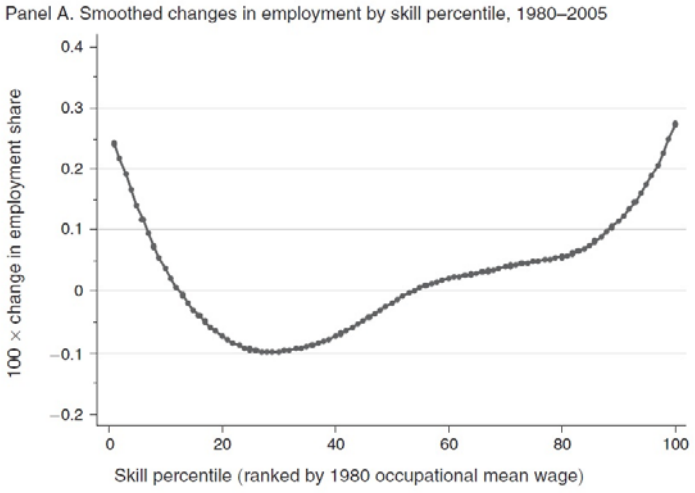
Take-Aways

- One driver of inequality is the change in the university (skill) wage premium.
- In a neoclassical model with no frictions, the skill premium depends on the relative supply of skills and on the relative demand for skills, which is driven by technology.
- The skill-biased technological change (SBTC) hypothesis has had a large influence
  - There is some empirical support for the SBTC hypothesis, but there are also some challenges.
  - Inequality may also be driven by other factors such as institutional and regulatory changes.

Augmented SBTC Hypothesis

- "Skills" have been refined into "tasks"
- Autor, Levy and Murnane (2001) takes approach to understanding the "skill-content" of technical change: modeling the human tasks that computers complement and those for which they substitute
- Model the fact that computers substitute for "routine" tasks – those that are readily formalized and "routinized" in computer code – while complementing "non-routine" cognitive tasks such as problem solving or customer service

Job Polarization



Job Polarization

Limitations

- This model does not readily explain differences across countries (Canada did not experience wage polarization)
- Patterns since the 1990s not as well explained
- Questions about choice of how they defined "tasks"
- Many models combine this with a theory of outsourcing

Summary

- Changes in wage inequality over time is likely due to some combination of technological change and institutional change
- There are still open questions in the literature on how to understand this phenomena and its implications