Introduction

▶ This lecture starts by thinking about long-term trends in inequality in the U.S., in particular emphasizing the increase inequality over the last 30 years.

▶ One fruitful way to think about inequality focuses on evolution of the supply of workers, by skill-level mix, and the demand, as shaped by skill-biased technological change.

▶ We’ll also think about complications—features of inequality changes not well captured by the simplest supply-demand stories.
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Circa 1980 there seemed to be little reason for concern about inequality trends.

- As Blinder (1980) noted, “... when we turn to the distribution of economic welfare—economic equality, as it is commonly called—the stylized fact is one of constancy.”

One manifestation of the relatively low inequality that existed in the 1970s was a low ratio of earnings of college graduates relative to high school graduates.

- Freeman (1976), in *The Overeducated American*, focused on the over-supply of college graduates.

It would have been difficult to anticipate the rapid rise in inequality that was just beginning.
In fact, there are interesting and important trends. Looking at a variety of sources, here are the stylized facts:

- Early in the twentieth century, inequality was quite high in the U.S.
- Wage and income inequality declined to relatively low levels by the end of World War II.
- The U.S. then had a sustained period of low inequality through about 1980.
- Inequality has increased substantially over the last three decades.

We’ll be looking at long-run trends in inequality using a variety of metrics. Here are some examples:

- the standard deviation of wages or of earnings,
- the Gini coefficient (measured using wages or earnings),
- the ratio of the wage at the 90th percentile relative to the 10th percentile (perhaps standardized by multiplying by a constant),
- the income or wage of high-education groups (e.g., college graduates) relative to lower-education groups (e.g., high school graduates), and
- share of income going to the top 10 percent or top 1 percent.
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**Figure:** Top Decile Income Share, Calculated by Using Data from the IRS (Saez, 2012).

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**Figure:** Trends in the Male Wage Inequality: the Gini Coefficient and Male 90-10 Log Weekly Wage Differential. From Goldin and Katz (2007).
Here are some commonly used data sources for the purpose of studying inequality:

- Data from the Internal Revenue Service (IRS) give a sense of family inequality extending as far back as 1913. These are used, for example, in many papers by Saez and co-authors.
- The U.S. Census: Integrated Public Use Micro-Samples (IPUMS) are available, and useful for looking at wages, starting in 1940. Similarly representative data aren’t available for earlier periods, but Goldin and Katz (2008) use a variety of data for earlier decades (e.g., Census data from Iowa).

Researchers also use the May CPS samples (beginning in 1973) and Merged Outgoing Rotation Group (CPS MORG) samples beginning in 1979. There are a number of complications that arise with CPS data.

Other useful sources mentioned below include the data from National Longitudinal Studies (NLS) program and the Panel Study of Income Dynamics (PSID).

Jan Tinbergen famously sets up the analysis of the wage structure as a race between education and technology (described nicely in Acemoglu and Autor, 2011). The basic ideas in this “textbook model” are:

- There is heterogeneity in “skills” within the workforce, e.g., low-skill \((L)\) and high-skill \((H)\).

- Over time, worker skills are improving. Indeed, as we’ll show shortly, there have been massive increases in educational attainment by the U.S. workforce over the past century.

- Technology has changed in ways that are assumed to “factor augmenting”—increasing the productivity of low-skill workers, high-skill workers, or both.
Let aggregate output be produced according to a constant elasticity of substitution (CES) function:

\[ Y = \left[ (a_L L)^{\frac{\sigma-1}{\sigma}} + (a_H H)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \]

where \( a_L \) and \( a_H \) are the factor-augmenting technology terms and \( \sigma \) is a non-negative elasticity of substitution between the two classes of labor.

The two classes of workers are gross substitutes when \( \sigma > 1 \) and gross complements when \( \sigma < 1 \) (and the knife-edge case, \( \sigma = 1 \), is Cobb-Douglas). Indeed, if \( \sigma \) is close to 0 we get Leontief production (perfect complements), as \( \sigma \) heads to infinity the two types of workers become perfect substitutes.

Suppose labor markets are competitive. Then for each class of labor the wage is simply the value of marginal product:

\[ w_L = \frac{\partial Y}{\partial L} = a_L^{\frac{\sigma-1}{\sigma}} \left[ a_L^{\frac{\sigma-1}{\sigma}} + a_H^{\frac{\sigma-1}{\sigma}} \left( \frac{H}{L} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{1}{\sigma-1}}, \]

and

\[ w_H = \frac{\partial Y}{\partial H} = a_H^{\frac{\sigma-1}{\sigma}} \left[ a_L^{\frac{\sigma-1}{\sigma}} \left( \frac{H}{L} \right)^{\frac{\sigma-1}{\sigma}} + a_H^{\frac{\sigma-1}{\sigma}} \right]^{\frac{1}{\sigma-1}}. \]

Notice that:

- \( \frac{\partial w_L}{\partial (H/L)} > 0 \), while \( \frac{\partial w_H}{\partial (H/L)} < 0 \).

\[ \triangleright \text{ wages of both skill types are increasing in } a_L \text{ and } a_H, \]

\[ \triangleright \text{ wages of both skill types are increasing in } a_L \text{ and } a_H, \text{ and} \]

\[ \frac{\partial w_L}{\partial (H/L)} > 0, \text{ while } \frac{\partial w_H}{\partial (H/L)} < 0. \]
The ratio of wages for high-skill relative to low-skill workers solves
\[
\ln \left( \frac{w_H}{w_L} \right) = \frac{\sigma - 1}{\sigma} \ln \left( \frac{a_H}{a_L} \right) - \frac{1}{\sigma} \ln \left( \frac{H}{L} \right).
\]
(1)

This log skill premium (an important inequality measure) gives us a nice way to think about the race between the race between education and technology. All else equal:

- An upgrades in workforce skills reduce inequality,
  \[
  \frac{\partial \ln(w_H/w_L)}{\partial \ln(H/L)} = -\frac{1}{\sigma} < 0.
  \]

- Given that
  \[
  \frac{\partial \ln(w_H/w_L)}{\partial \ln(a_H/a_L)} = \frac{\sigma - 1}{\sigma},
  \]
  skill-biased technological change that increases \(a_H/a_L\) increases inequality if \(\sigma > 1\) (as seems to the case empirically).
Many papers use (1) as the starting point for empirical work. We cannot observe the term \( \ln\left(\frac{a_H}{a_L}\right) \), but we might assume it follows a smooth time trend. For instance, in an analysis of 1962–1987 relative wages, Katz and Murphy (1992) find that a linear trend works well. Let \( \ln\left(\frac{a_H}{a_L}\right) = \alpha_0 + \alpha_1 t \), and substitute into (1):

\[
\ln\left(\frac{w_H}{w_L}\right) = \sigma - \frac{1}{\sigma} \alpha_0 + \frac{\sigma - 1}{\sigma} \alpha_1 t - \frac{1}{\sigma} \ln\left(\frac{H}{L}\right).
\]

Katz and Murphy (1992) estimate

\[
\ln\left(\frac{w_H}{w_L}\right) = \text{constant} + 0.033 t - 0.709 \ln\left(\frac{H}{L}\right),
\]

with coefficient standard errors (0.007) and (0.150) respectively.

- The implied elasticity of substitution between high-skill and low-skill workers (essentially college and high school) is 1.41.

In a series of papers and in an important book, *The Race Between Education and Technology* (2008), Goldin and Katz give an accounting of inequality that draws on the approach outlined above.

We’ll use the evidence presented in Goldin and Katz (2007).

- Let \( H \) be “college equivalents”—college graduates plus half of those with some college.
- Let \( L \) be “high school equivalents”—those with 12 or fewer years of schooling plus half of those with some college.

Goldin and Katz suggest that with these definitions for the U.S., 1915–2005, a good value of \( \sigma \) is 1.64 (a little higher than the Katz-Murphy estimate).
The following table, from Goldin and Katz (2007), gives annual log changes × 100. The authors set \( \sigma = 1.64 \). In conducting the exercise, they make composition adjustments for systematic differences in productivity (i.e., wages) by age, sex, and education. See their paper for details.

<table>
<thead>
<tr>
<th>Period</th>
<th>Change in the Relative Wage</th>
<th>Change in the Relative Supply</th>
<th>Change in the Relative Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1915-40</td>
<td>-0.56</td>
<td>2.82</td>
<td>1.90</td>
</tr>
<tr>
<td>1940-60</td>
<td>-0.51</td>
<td>2.96</td>
<td>2.12</td>
</tr>
<tr>
<td>1960-80</td>
<td>-0.02</td>
<td>3.89</td>
<td>3.85</td>
</tr>
<tr>
<td>1980-2005</td>
<td>0.90</td>
<td>2.27</td>
<td>3.76</td>
</tr>
<tr>
<td>1915-2005</td>
<td>-0.02</td>
<td>2.94</td>
<td>2.90</td>
</tr>
</tbody>
</table>

To keep track of a potential role for immigration, let

\[
H = H^N + H^M, \quad \text{and} \quad L = L^N + L^M,
\]

where \( N \) indexes native and \( M \) indexes immigrant. Goldin and Katz (2007) use the decomposition:

\[
\ln \left( \frac{H}{L} \right) = \ln \left( \frac{H^N}{L^N} \right) + \left[ \ln \left( 1 + \frac{H^M}{H^N} \right) - \ln \left( 1 + \frac{L^M}{L^N} \right) \right].
\]

where the first term on the right-hand side is the native contribution, and the second term is the immigrant contribution. Notice that we’re making a fairly strong assumption about the substitutability of workers here.
Now the change in relative supply has two components. The following is from Goldin and Katz (2007), Table 1.

<table>
<thead>
<tr>
<th>Period</th>
<th>Change in Rel. wage</th>
<th>Change in Rel. S. Native</th>
<th>Change in Rel. S. Immigrant</th>
<th>Change in Relative Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1915-40</td>
<td>-0.56</td>
<td>2.57</td>
<td>0.25</td>
<td>1.90</td>
</tr>
<tr>
<td>1940-60</td>
<td>-0.51</td>
<td>2.75</td>
<td>0.21</td>
<td>2.12</td>
</tr>
<tr>
<td>1960-80</td>
<td>-0.02</td>
<td>3.83</td>
<td>0.06</td>
<td>3.85</td>
</tr>
<tr>
<td>1980-2005</td>
<td>0.90</td>
<td>2.43</td>
<td>-0.16</td>
<td>3.76</td>
</tr>
<tr>
<td>1915-2005</td>
<td>-0.02</td>
<td>2.85</td>
<td>0.08</td>
<td>2.90</td>
</tr>
</tbody>
</table>

**Figure:** Mean Years of Schooling by Native-Born Cohorts, for individuals aged 25–64. Goldin and Katz (2009), using Census and CPS data.
The main messages from the Goldin and Katz (2007) analysis are:

- During the twentieth century successive cohorts experienced dramatic increases in completed schooling. The trend decelerated toward the end of the century.
- “The decline in the immigrant share of the workforce contributed modestly to relative skill supply growth from 1915 to 1970, and the recent surge in unskilled immigration has played a small role in the slowdown of that growth.”
- “Technology . . . has been racing ahead of education in the recent period because growth in educational attainment has been sluggish.”

Wage changes since 1980 require a more nuanced treatment than can be accommodated with a two-input CES framework. Let’s focus on that period more carefully, using figures and insights from Acemoglu and Autor (2011):

- As we’ve seen, the composition-adjusted college/HS log wage ratio increased starting in the early 1980s—corresponding to a period of decelerating increase of the college/HS relative supply of labor.
- Importantly, there were reductions in real wages for low-skill groups during the 1980s. (Note that this is inconsistent with the textbook model.)
- Acemoglu and Autor make the following observation about trends since the late 1980s: “Most notable is the ‘polarization’ of wage growth—by which we mean the simultaneous growth of high and low wages relative to the middle . . . “ (This last feature also requires a modification to the textbook model.)
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Figure: Calculated by Acemoglu and Autor (2011) using March CPS data.

Figure: Calculated by Acemoglu and Autor (2011) using March CPS data, for individuals aged 16-64 who worked at least one week.
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Figure: Calculated by Acemoglu and Autor (2011) using March CPS data. Education groups are high school dropout, high school graduate, some college, college graduate, and greater than college.
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Figure: Calculated by Acemoglu and Autor (2011) using March CPS data. Percentiles of log weekly wages for full-time, full-year workers.

Lowell J. Taylor  Inequality
We next briefly talk about some extensions to the basic story, in particular looking at five issues:

1. Polarization. How should we be thinking about the hollowing out of the wage distribution?
2. How sure are we that technology is the driving force for unobserved components of changes in the wage distribution?
3. What more is there to say about the role of immigration?
4. Is there an important role for globalization?
5. Is there an interesting story to be told about *transitory* income shocks?

An explanation for the hollowing out of the wage distribution (documented for the time periods since say 1988), provided by Autor, Levy, and Murnane (2003), is known as the *“routinization” hypothesis*.

- Over the last three decades there have been rapid improvements in information and communications technologies. From 1980–2006 the real cost of computations fell by 60 to 75 percent *each year* (Nordhaus, 2007).
- Think of the technological changes as exogenous (though it is also interesting also to think about an endogenous response).
Continuing with the Autor, Levy, and Murnane (2003) arguments:

▶ Some *routine tasks* are well suited for execution by computers, e.g., clerical work and repetitive production tasks. Disproportionately, these tasks may have involved mid-level manual or cognitive skills.

▶ *Non-routine tasks*, which are less well suited for computers, often seem to be at opposite ends of the skills distribution:

1. At the high end are tasks requiring creativity and intuition—the ability to interpret information and make appropriate decisions.

2. At the low end are non-routine manual tasks. These tasks may require good interpersonal, language, or physical skills, but often require relatively little in the way formal schooling.

Acemoglu and Autor (2011) give an engaging account of job polarization, and set up a new theoretical structure for studying the phenomenon.

Of course, in the basic set-up of the race between education and technology, we never actually observe technology. For instance, in the regression used by Katz-Murphy and many others,

\[
\ln \left( \frac{W_H}{W_L} \right) = \beta_0 + \beta_1 t + \beta_2 \ln \left( \frac{H}{L} \right),
\]

\(\beta_1\) is intended to reflect skill biased technological change, and \(\beta_2\) might estimate \(-\frac{1}{\sigma}\). But there are certainly other possibilities.

▶ It is something of a tautology to simply label as “technology” the trend component of relative wage evolution (Card and DiNardo, 2002).
It seems likely that skill biased technological change has been an important driver for long-run trends in labor market inequality, but it also seems likely that there are important mediating roles for other forces.

- Changes in the minimum wage could matter.
- Changes in union power, or other institutional changes, might make a big difference.
- Is there a role for rents, efficiency wages, or other wage-setting mechanisms?

A number of papers look at these questions, including Dinardo, Fortin, and Lemieux (1996), Card, Lemieux, and Riddell (2004), Lemieux (2008), and many others.

One useful way to proceed is to focus on establishment-specific wages. An example is Card, Heining, and Kline (2012), who study the evolution of wages among male workers in Germany. They document a big increase in inequality; this happened somewhat later than in the U.S. (i.e., starting in the 1990s), and was even more dramatic than in the U.S.

A decomposition, conducted with high quality administrative data, shows:

- “The gap between consistently high and low wage workers has grown . . .” This is as in our textbook model.
- They also find that there seem to be high-wage firms and low-wage firms and “. . . the gap between good and bad jobs has also grown, suggesting that job search and matching is an increasingly high stakes process—one that appears to be increasingly mediated through the education system.”
The graph on the next page gives you a flavor for the Card-Heining-Kline analysis. Notice:

- The “return to education” as estimated by OLS is rising in Germany; by this measure, inequality is increasing.
- Also, and more strikingly, the “return co coworker schooling” is rising. At the same time, the return within establishment is not rising.
- In short, the increase in the return to education “... is driven by a combination of increasing returns to working with well-educated co-workers, coupled with a rise in the segmentation of education groups across establishments.”

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**Figure 13: Mundlak Decomposition of Return to Education**

- OLS return (left scale)
- Within-establishment return (left scale)
- Return to co-worker schooling (left scale)
- Education sorting index (right scale)

*Note: Figure shows components of decompositions of conventional OLS returns to education in each year. The OLS return (light blue) is the sum of the within-establishment returns (light blue lines) and the product of the return to co-worker schooling (light blue with yellow markers) and the education sorting index (light blue with pale green markers). See text for formula. See Shikin (1982) or Mundlak (1978). This return is coefficient age in a regression model for log real daily wages that have controls for cohort and experience.*

**Figure:** Table from Card, Heining, and Kline (2012). See that paper for details.
A large literature asks if immigration to the U.S. has contributed to the rise in inequality. There are some differences in the estimated impacts, but immigration likely played at most a moderate role.

- New work by Lewis (2011) provides evidence that decisions to invest in automation machinery by U.S. manufactures depended in part on the skill mix of the local labor supply, which in turn was affected in part by recent waves of immigration. In consequence, immigration had relatively little impact on wages in local labor markets.

Autor, Dorn, and Hanson (forthcoming) provide persuasive evidence that dramatic increases in Chinese import competition had important impacts on local labor markets over the past 20 years. Labor markets with high “import exposure” (i.e., that initially disproportionately housed import-competing manufacturing) tended to have:

- higher unemployment, lower labor force participation, and depressed wages, and
- increased transfer payments from disability and retirement benefits.

That paper also provides links to other research on the topic.
The rise in income inequality could reflect either increasing disparity of permanent income, increasing disparity of transitory shocks (i.e., earnings instability), or both. Gottschalk and Moffitt (2009) suggest that both forces are at work:

- Instability in male earnings increased substantially over the 1980s and 1990s. This increase was not simply a business-cycle phenomenon.
- The same is not true for women.

The causes of the increased stability are not obvious, and it isn’t clear how they relate to increases in permanent inequality.

- Labor markets are generally local.
- How should we think about inequality—for example, as measured by differences in earnings by HS and College graduates—when wages and prices vary across location?
- Example: According to a real-earnings calculator from CNN-Money-Forbes, a person earning $100,000 in Austin would need an income of $235,030 in Manhattan. (By way of comparison, the CPI in 2013 is approximately 233 relative to a base of 100 in 1983.)
- Dan Black, Natalia Kolesnikova and I are currently working on this issue (in a paper tentatively titled “Local Labor Markets and the Evolution of Inequality”).
We have seen that the big changes in wages are at the high end of the wage distribution.

The same is true for income, and is true for many (but not all) countries. Evidence on the next two slides comes from Atkinson, Piketty, and Saez (2011).
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Figure: Income Share to Top One Percent, Various Countries (From Atkinson, Piketty, and Saez, 2011).

Figure: Income Share to Top 1/100 of One Percent in the U.S., Calculated by Using Data from the IRS (Saez, 2012).
Moral Grounds. How would we want society to look if we shaped that society from behind a “veil of ignorance”?

Inequality may be harming the long-run wellbeing of the economy. Here is a quote from the new book by Joseph Stiglitz, *The Price of Inequality*:

“While there may be underlying economic forces at play, politics have shaped the market, and shaped it in ways that advantage the top at the expense of the rest. Any economic system has to have rules and regulations; it has to operate within a legal framework. There are many different such frameworks, and each has consequences for distribution as well as growth, efficiency, and stability. The economic elite have pushed for a framework that benefits them at the expense of the rest, but it is an economic system that is neither efficient nor fair.”

What are appropriate policy responses? This strikes me as one of the fundamental issues of the day.

- Policies related to human capital development seems crucial.
- There is a strong case to be made for tax reform, e.g., for a more progressive tax structure. See, for instance, work by Peter Diamond and Emmanuel Seaz.
References:


