

Technology and the Labor Market

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Three Propositions

- Three widely-held propositions about technology and the labor market.
 - ① Technology is *by its nature* skill biased (e.g., because it automates and replaces tasks performed by lower-skill workers).
 - ② In recent decades, technological change has benefited the more skilled workers, particularly college graduates, at the expense of less skilled high school graduates or high school dropouts.
 - ③ Technological change has recently been and will continue to be a force towards greater unemployment or nonemployment (in Leontief's imagery, sending human labor to the same place as horses went in the early 20th century).
- I will argue during this brief talk that all three of these propositions are on shaky grounds.

Technology and Skill Bias

- It is often maintained that because only some types of tasks can be automated, or because some types of tasks are easier to automate, or because new technologies by their nature require skilled workers, new technology has an inherent skill bias.
- This argument is on thinner grounds than often presumed, however.
- There is nothing inherently skill biased in the combustion engine or the dynamo or the silicon chip or the use of more data in business decisions. What makes new technologies embedding these new forms of technological paradigms skill biased (or not skill biased) is the decisions we make as society (Acemoglu, 1998).
- Sometimes these decisions are to develop these “macro inventions” in the direction of production technologies with greater skill bias (e.g., design tools and computer-controlled machinery), but sometimes not (e.g., assembly lines or scanners).

Technologies Harming the More Skilled

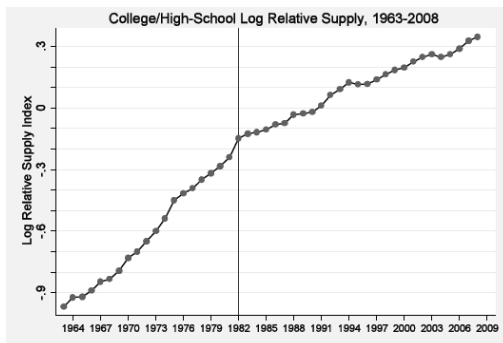
- There are several salient examples of technologies reducing skill bias come from the 19th century.
- As Andrew Ure, historian of the first half of the 19th century and author of *The Philosophy of Manufacturers*, noted:
“It is. . . the constant aim and tendency of every improvement in machinery to supersede human labor altogether, or to diminish its costs, by substituting the industry of women and children for that of men; of that of ordinary labourers, for trained artisans.” (quoted in Habakkuk, 1962, p. 154).
- Habakkuk himself:
“in both countries [the US and England] this provided manufacturers with an incentive to adopt and devise methods which replaced skilled by non-skilled. . .” (1962, p. 150).

Technologies Harming the More Skilled (continued)

- And in fact, much of the technological improvements of the 19th century appear to have achieved this:
“First in firearms, then in clocks, pumps, locks, mechanical reapers, typewriters, sewing machines, and eventually in engines and bicycles, interchangeable parts technology proved superior and replaced the skilled artisans working with chisel and file.” (Mokyr 1990, p. 137).
- And perhaps as a result, James and Skinner’s (1985) evidence indicates that new technologies and capital appear to be complements not to skilled but to unskilled labor in 19th century United States.

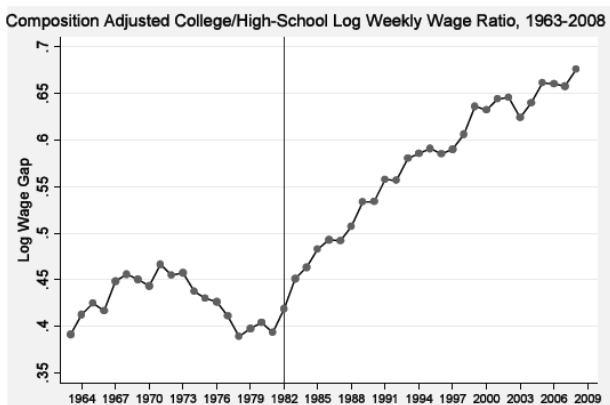
Why Technology Has Been More Skill Biased Lately

- The models of directed technological change give a simple answer.
- Technological change should *always and everywhere* move in the direction of bias of the factor that becomes more abundant (Acemoglu, 2002, 2007). For most of the 20th century and everywhere in the Western world, skilled labor has become more abundant. For example:



Why Technology Has Been More Skill Biased Lately (continued)

- Simultaneously, sharply increasing college wage premium, indicates that technology must have turned more skill biased exactly around this time.

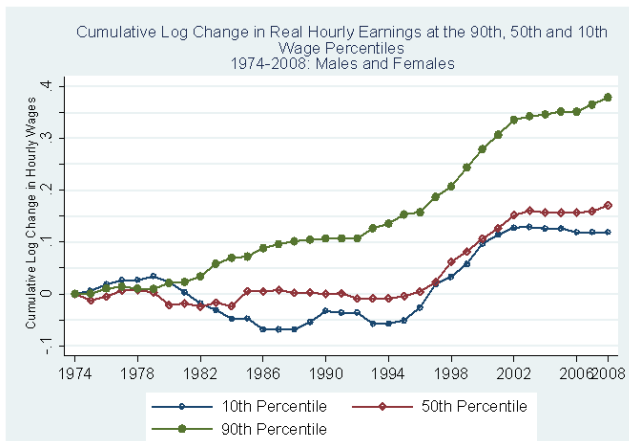


Why Technology Has Been More Skill Biased Lately (continued)

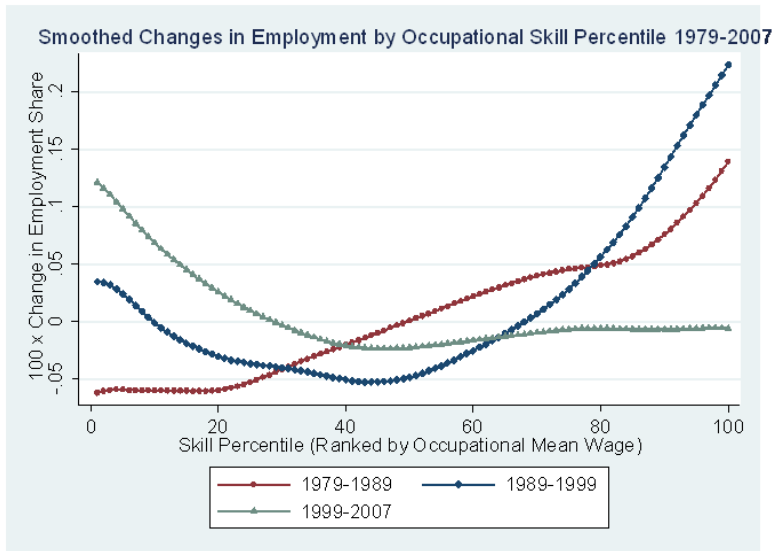
- Are the simultaneous increases in the supply of skills and skill premia a coincidence? Unlikely.
- Could they be because of the response of the supply of skills to anticipated rises in skill premia? Definitely not. (The upcoming increases in skill premia were not even anticipated by the most sophisticated experts, e.g., Freeman, 1976, who worried about Americans being “overeducated”).
- Rather, as anticipated by Welch (1970, p. 36):
“With the phenomenal rise in average education, why have rates of return failed to decline?... It is obvious that changes have occurred to prevent the decline in returns to acquiring education that would normally accompany a rise in average educational level. Presumably, these changes have resulted in growth in demand for ... education... sufficient to absorb the increased supply with constant or rising returns.”

Has Technology Harmed Less Skilled Workers Lately?

- Yes and no. Acemoglu and Autor (2011): low-skill workers have fared relatively well since the late 1990s (especially relative to middle-skill workers).



Corroborated by Demand and Employment Changes



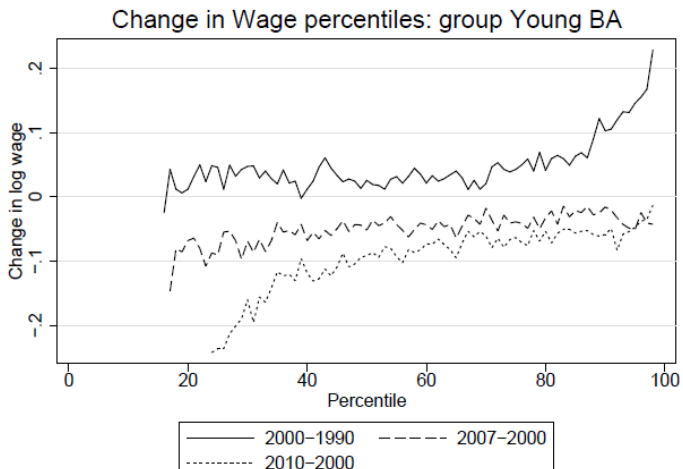
And Some Measures of Task Prices

- From Beaudry, Green and Sand (2014):



Perhaps Worse When You Turn to College Graduates in the 2000s

- From again Beaudry, Green and Sand (2014):



Why?

- Acemoglu and Autor (2011): the standard framework with factor-augmenting technological change is inadequate for explaining a variety of regularities (including possible declines and wages of some groups due to technological change).
- A task-based framework combined with technological change automating subsets of tasks provides a different set of perspectives.
- But in that case, the implications for employment and wages crucially depend on what sets of tasks are being automated.
- When it is tasks in the middle of the distribution, it could be the highest wage workers but also low-wage occupations that gain, reminiscent to the patterns we observe since the late-1990s.

Does Automation Create Unemployment?

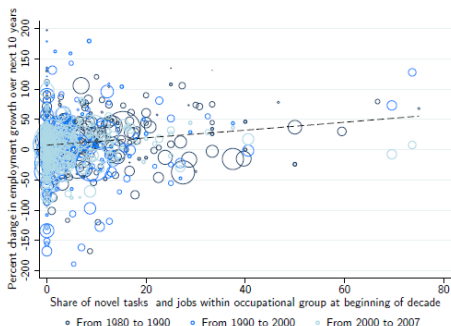
- That's what many prominent economists have argued for the last 100 years.
- Keynes thought in 1930 that the future would bring steady growth but also widespread unemployment/nonemployment.
- Robert Heilbroner (1965) argued:
“as machines continue to invade society, duplicating greater and greater numbers of social tasks, it is human labor itself — at least, as we now think of ‘labor’ — that is gradually rendered redundant” .
- Leontief (1952), drawing an analogy between human labor and horses, suggested
“Labor will become less and less important. . . More and more workers will be replaced by machines. I do not see that new industries can employ everybody who wants a job” .

Why Not?

- But none of this has come to pass.
- Acemoglu and Restrepo (2015) argue that this is because humans have a *comparative advantage* in more complex tasks that horses did not.
- As some existing tasks are being automated, new more complex tasks are being created, generating employment for humans.
- For example, during the Second Industrial Revolution, the stagecoach was replaced by the railroad, sailboats by steamboats, and of manual dock workers by cranes, but society also also witnessed the creation of new labor-intensive tasks — including a new class of engineers, machinists, repairmen, and conductors as well as modern managers and financiers involved with the introduction and operation of these new technologies

New Tasks and Employment

- In fact, even in recent decades, new tasks are key for employment creation. Using the classification of Lin (2011), we see:



- From 1980 to 2007, employment grew by 15.8%, out of which about half (8.3%) is explained by the additional growth in occupations with more novel tasks and jobs.

New Tasks and Employment (continued)

- This relationship appears robust.

Table A1: Differential employment growth in occupational groups with more new jobs and tasks

	(1)	(2)	(3)	(4)	Weighted by size	
					(5)	(6)
Panel A: Stacked differences over decades.						
Share of novel tasks and jobs at start of decade	0.522*** (0.131)	0.584*** (0.130)	0.495*** (0.140)	0.381*** (0.144)	0.199 (0.176)	0.441*** (0.140)
log of employment at start of decade		-0.035*** (0.012)	-0.048*** (0.014)	-0.044*** (0.013)	-0.000 (0.011)	0.004 (0.010)
Average years of education at start of decade				10.574*** (1.841)	8.494*** (1.828)	8.356*** (1.795)
R-squared	0.03	0.04	0.11	0.15	0.13	0.15
Observations	986	986	986	986	986	977
Employment growth by decade in p.p.	5.7	5.7	5.7	5.7	5.7	5.7
Contribution of novel tasks and jobs	3.0	3.3	2.8	2.2	1.1	2.5
Panel B: Long differences from 1980-2007.						
Share of novel tasks and jobs in 1980	1.241*** (0.391)	1.401*** (0.343)	1.452*** (0.347)	1.153*** (0.322)	0.056 (0.492)	0.516 (0.407)
log of employment in 1980		-0.155*** (0.031)	-0.193*** (0.035)	-0.164*** (0.034)	-0.048 (0.031)	-0.038 (0.030)
Average years of education in 1980				23.943*** (4.128)	16.357*** (4.390)	16.067*** (4.354)
R-squared	0.02	0.08	0.17	0.26	0.17	0.17
Observations	328	328	328	328	328	325
Employment growth from 1980-2007 in p.p.	15.8	15.8	15.8	15.8	15.8	15.8
Contribution of novel tasks and jobs	7.0	7.9	8.2	6.5	0.3	2.9
<i>Covariates:</i>						
Decade fixed effects	✓	✓	✓	✓	✓	✓
Demographics × decade effects			✓	✓	✓	✓

Can We Expect New Tasks to Play a Similar Role in the Future?

- Acemoglu and Restrepo (2015): yes.
- In a task-based framework, automation of tasks previously performed by labor will reduce the share of labor in national income and employment, and may even reduce wages — as technology pessimists argue.
- But in such a framework these changes will also impact the direction of technological change between automation and creation of new tasks. In fact, in task-based frameworks, it turns out to be relative factor prices that guide the direction of technological change (as initially anticipated by Hicks, 1932).
- Endogenous incentives will feed into the creation of more new, complex tasks (in which labor has a comparative advantage) when automation goes on for a while reducing wages relative to the return to capital.