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The Polarization of the U.S. Labor Market: Evidence, Explanations and Implications for Higher Education

It is widely known that income inequality is on the rise. What is less clearly understood is that inequality is not increasing across the board; rather, growth in wages in the United States during the last 30 years has been polarized, with rapid wage growth occurring in both the top third and the bottom third of wage levels. The middle, on the other hand, has seen comparatively modest wage growth. David Autor, professor of economics at MIT and a faculty research associate at the National Bureau of Economics, explains this polarization of the U.S. labor market and what it portends for the jobs of the future. Autor divides the jobs of the future broadly into high-wage non-routine occupations that demand abstract skills (e.g., teachers, electricians and physicians) and low-wage, non-routine occupations (e.g., retail salespeople, janitors and waiters). Historically, the middle-wage group has included occupations (e.g., accountants and assembly line workers) involving routine tasks—precisely the types of jobs that have been lost due to dramatic advances in computer technology. The challenge for colleges and universities is to educate students so that they can climb the occupational ladder, even as that ladder is changing and, indeed, missing rungs.

POLARIZATION OF EARNINGS GROWTH

Incomes in the United States are not becoming more unequal across the board, as many assume and the media would lead us to believe. Figure 1 shows changes in wages, by the entire wage distribution across percentiles, in the United States.

The red line shows a steady, monotone rise in income inequality from 1980 – 1990. But around 1990 the trend line of the 1980s changed shape considerably, as illustrated by the blue line showing wage changes from 1990 – 2000. First, all wages reflected productivity growth in the mid-1990s and so the locus has shifted upward. The second, key point, is the U-shape of the wage changes: the middle is relatively flat compared to the tails; that is, rapid wage growth continued in the top third of the distribution and, surprisingly, in the bottom third as well. The middle third shows comparatively modest wage growth.

- Trends in wage and employment data indicate more growth and demand in very high and very low skill occupations than in moderate skill occupations. The share of moderate-wage, moderately skilled jobs has either stagnated or declined—thus the hollowing out of the middle class.
- Computing and automation has led to direct substitution of routine jobs. Routine tasks historically have occupied the middle third of the wage scale, and thus the decline in demand for such tasks and skills has led to a hollowing out of the middle class.
- The skills that remain scarce—and arguably increasingly so—are capabilities in abstract reasoning tasks, involving creativity, innovation, mental flexibility, and problem solving. These are precisely the kinds of skills that we know how to do, but don't know very well how to explain how to do them. Moreover, we don't know how best to teach them.
- The prosperity of nations very much depends on capable and productive people in their economies who create ideas, products, and jobs.
- The challenge for colleges and universities is to educate students so that they can climb the occupational ladder, even as that ladder is changing and, indeed, missing rungs.

Figure 1. Real Log Wage Changes by Wage Percentile 1980–1990 and 1990–2000

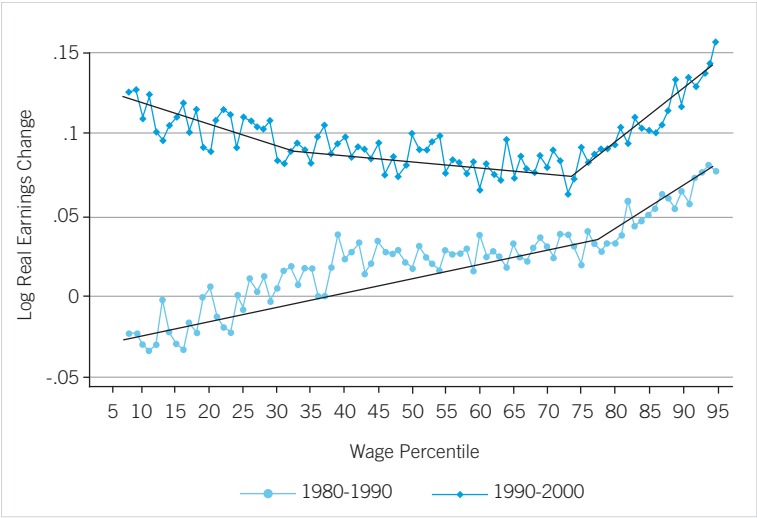
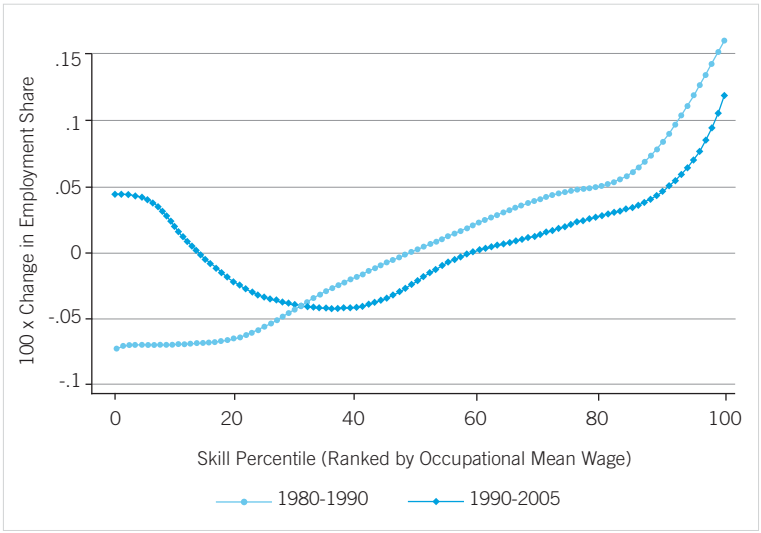


Figure 2. Smoothed Changes in Employment by Occupational Skill Percentile 1980–2005



Equally striking is that growth in wages is paralleled by growth in occupations by skill level. Figure 2 ranks occupations by the level of skill they demand (based on wages earned, which economists use as a measure of skill, albeit a rough—and sometimes offensive—one).

The red line shows that from 1980 – 1990, the share of high-wage, high-education occupations is rising and the share of low-wage, low-education jobs is contracting. But from 1990 – 2000, again the trend line is U-shaped. In other words, both high-wage, high-education jobs and low-wage, low-education jobs continued to expand while the share of moderate-wage, moderately skilled jobs either stagnated or declined. Data available from 2000 – 2005 show the U-shape becoming even more pronounced; thus this phenomenon appears to be accelerating.

If wages for an occupation are rising at the same time that the number of people employed in it is growing, that suggests that demand for that occupation is rising. Thus the U-shaped lines in Figures 1 and 2 indicate greater growth and demand in the very high and very low skill occupations than in the moderate skill occupations. This is true not only in the United States, but also in 14 of the 16 European countries for which comparable data are available: this phenomenon appears to be broadly spread across other developed economies in countries that the U.S. often compares itself to.

TECHNOLOGICAL CHANGE AND JOB TASKS

Technological advances are largely responsible for the hollowing out of moderate-wage, moderate skill occupations. Computerization has changed the demand for skills for which the procedures are clear and that can be explicitly described as a set of rules. A non-sentient object (a computer) can follow instructions, but cannot improvise—so if a computer is to accomplish a task, we must be able to spell out the set of activities we want it to do and specify exceptions and how to handle them. Any task that follows a routine can be readily scripted for a machine to do and, indeed, the trillion-fold-plus drop in the cost of computing has led to its widespread use to accomplish routine tasks at low cost and great speed. But there are many tasks that we actually don't know the procedures for, even though we do them all the time. As the scientist-philosopher Michael Polanyi said, we know far more than we can tell. In other words, we tacitly understand much of what we do, but don't know explicitly how we do it. Consider engaging in spoken language, driving a car through a city, coming up with a persuasive argument, seeing the intuition for a proof, developing a new idea, and so on. These are tasks that educated and uneducated people do all the time, yet because we don't know the explicit procedure for how we do them, they are very difficult to automate.

The labor market can be broken down into three broad task categories: routine tasks (e.g., accountants and assembly line workers), non-routine tasks that demand abstract skills (e.g., scientists and attorneys), and non-routine tasks that demand manual skills (e.g., truck drivers and security guards). Table 1 summarizes these categories and the impact of computerization on them.

Computing and automation has led to direct substitution of routine jobs. Routine does not necessarily mean mundane or trivial. In fact, clerks and bookkeepers, for example, were considered very skilled workers at the outset of the twentieth century. They were high school graduates, almost exclusively male, and were able to act on symbolic information. They were the information technology of the early industrial age, allowing corporations to grow because they could do the

filing and accounting it took to manage growth. With regard to abstract tasks, which involve skills for which we cannot yet describe explicit procedures, not only is it difficult to directly substitute technology, but a good argument could be made for very strong complementarity of the two: computerization makes these professionals more productive. Manual tasks, on the other hand, while not considered skilled tasks, are nevertheless very difficult to automate in that they require environmental and interpersonal adaptability and, likewise, the impact of computerization on them has been quite limited.

Routine tasks historically have occupied the middle third of the wage scale, and thus the decline in demand for such tasks has led to a hollowing out of moderate-wage, moderate-education occupations.

Table 1. The Impact of Computerization on Three Broad Task Categories

	Task Description	Example Occupations	Potential Impact of Computerization
Routine Tasks	• Rules-based • Repetitive • Procedural	• Bookkeepers • Assembly line workers	• Direct Substitution
Abstract Tasks	• Abstract problem-solving • Mental flexibility	• Scientists • Attorneys • Managers • Doctors	• Complementarity
Manual Tasks	• Environmental Adaptability • Interpersonal Adaptability	• Truck drivers • Security guards • Waiters • Maids/Janitors	• Limited Complementarity or Substitution

JOBS OF THE FUTURE AND THE DEMAND FOR EDUCATION

Economists Maarten Goos and Alan Manning (2007) succinctly captured the fundamental change in the labor market during the last 20 years when they described it as the rise of "lovely and lousy" jobs. We see growth in both demand for high-wage abstract, analytical and managerial work, such as scientists, engineers, physicians and teachers, and growth in the demand for low-wage service occupations that demand hands-on interaction with people and things, such as housekeepers, salespeople, and health aides.

How do these changes affect the demand for higher education? Figure 3 shows the level of education of workers in manual, abstract and routine tasks.

It is no surprise that high school dropouts and high school graduates do most of the manual tasks and college graduates do the least. Just the reverse is true for abstract tasks. Routine tasks that are most concentrated among workers with high school diplomas and some college education are not unskilled activities, but nor are they highly skilled. They can be thought of as the production jobs of the information era, similar to the blue collar jobs of the manufacturing era. These are the moderately well paid jobs, with moderately good working conditions, that have disappeared.

Where these routine workers go as their jobs disappear depends upon their age and education. In-depth analyses indicate that college-educated workers who lose routine jobs end up split equally between high-wage and low-wage non-routine jobs. Non-college routine workers all shift down to low-wage non-routine jobs. Further, analysis of the movement of college-educated routine workers by age groups shows that younger workers (ages 16-29) overwhelmingly shift into high-skill non-routine jobs (of course, most college-educated workers in this age bracket, which the data are broken down by, are in their twenties, while non-college workers may be as young as sixteen). On the other hand, virtually all older college-educated routine workers (ages 55-64) shift into low-skill non-routine jobs. A plausible explanation is that when these older workers lose a middle management job mid-career, they may be less likely to go back to school for re-training, and more likely to take a job that doesn't demand the same skill sets as their previous job. Again, non-college routine workers shift down across all age groups, other than a very small fraction of the youngest workers.

IMPLICATIONS FOR HIGHER EDUCATION

The polarization of the labor market and the outlook for jobs in the future raise a number of implications and questions for colleges and universities.

For much of the 20th century, the ability to perform calculations rapidly and accurately, keep orderly records, and process information systematically were relatively scarce, and earned a high return in the labor market. These skills are still valuable, but

Figure 3. How Does Task Demand Affect Demand for Education?

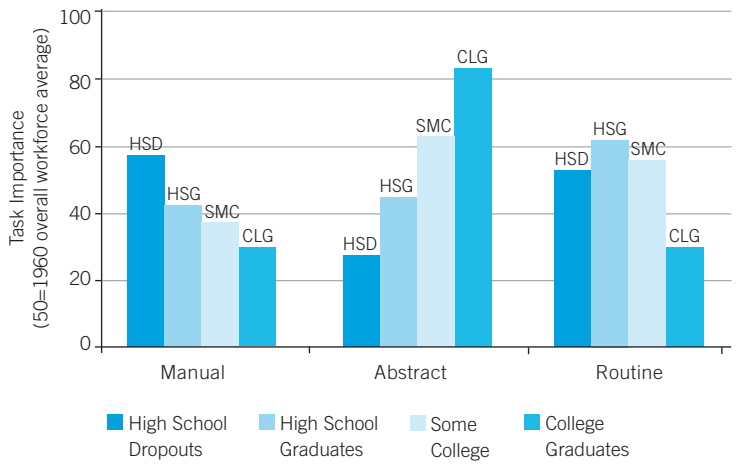


Table 2. Share of US degrees to non-citizens/permanent residents, 1985-2005

	ALL		NATURAL S&E		ENGINEERING	
	1985	2005	1985	2005	1985	2005
Bachelor's	3.0	3.1	5.4	5.2	7.2	8.0
Master's	9.4	12.8	27.2	38.6	26.2	39.7
Doctorate	25.3	39.3	33.1	50.9	59.6	68.8

Source: Freeman 2009

it is also true that many of these same tasks can now be accomplished cheaply, reliably and conveniently by information technology, meaning that there is less demand for workers to do jobs that primarily require these tasks. The skills that remain scarce—and arguably increasingly so—are capabilities in abstract reasoning tasks, involving creativity, innovation, mental flexibility, and problem solving. These are precisely the kinds of skills that we know how to do, but don't know very well how to *explain* how to do them. Moreover, we don't know how best to *teach* them.

The return on education in terms of higher lifetime wages has been well documented and is widely acknowledged. What is less well known, though, is that today the returns on education are highest among those with a master's degree or Ph.D. (In the 1970s, earning a Ph.D. was likely to reduce lifetime income, but today it's a reliable way to increase it.) Perhaps this means that the skills colleges know best how to produce in their undergraduates are no longer the scarcest, most valuable skills.

The stakes for institutions to figure out how to produce the scarcest skills most efficiently are high. Competition for students who are capable of performing and honing scarce, abstract skills is fierce, and the need for such people is important and increasing. This competition is not just among universities; it's a competition among nations as well. The prosperity of nations very much depends on capable and productive people in their economies who create ideas, products, and jobs. Likewise, to ensure our nation's future prosperity, it is crucial that we continue to attract and produce the brightest, most educated people in the world.

Higher education in the United States, overall, is better than anywhere else in world. That is inarguably our strongest suit, and American colleges and universities do indeed attract the brightest students from around the globe. Table 2 shows the growth during the last 20 years of the share of U.S. degrees awarded to non-U.S. citizens or permanent residents.

Clearly, the United States is doing an excellent job competing with the rest of the world for top students. What we're not doing well is cultivating such students in our own country. Unlike higher education, there is no evidence that primary and secondary education in the United States leads the world. Yet if our nation's colleges and universities are going to produce graduates with the scarce, abstract skills that will be the key to our prosperity, we need to develop the foundational skills that will prepare our students for the next level. Historically, though, the disjuncture between higher education policy and primary and secondary policy in the United States has been great.

The polarization of the labor market seemingly raises a dilemma: if the middle is contracting—though it would be an overstatement to say that it is disappearing—and the labor market is increasingly split into a professional echelon and a service echelon, then how do we educate our population so that they can climb a career ladder that's missing rungs? The challenge for social policy is clear. The American value system is based on social and economic mobility, and higher education is widely viewed as the vehicle for achieving that mobility. Generational mobility, then, depends upon equality of opportunity to pursue higher education. Regardless of who their parents are, all students who are capable of benefitting from a college education should be able to attend.

That said, a college education is not the guarantee to a middle-income middle class life that it used to be. Simply meeting college-completion goals and quotas will not in itself guarantee prosperity—particularly if we cannot teach critical abstract skills to a far larger set of students. Finally, the needs of those who don't go to college must be addressed as well.

CONCLUSION

We are not in danger of overeducating our population. The benefits of education extend well beyond higher pay: some of the documented social benefits include better health, longer lives, longer marriages, better decision-making, and greater civic engagement—and undocumented benefits likely accrue on a daily basis as well.

The challenge to the primary and secondary sector is at least as great as that faced by higher education. Together, both can contribute to maintaining the intergenerational mobility that is fundamental to American culture by ensuring that all students have the opportunity to reach upper-echelon occupations and, importantly, derive the considerable social benefits of education that go far beyond earnings.

DAVID AUTOR is professor of economics at MIT and a faculty research associate at the National Bureau of Economics. He is also editor-in-chief of the Journal of Economic Perspectives. Autor is the recipient of a National Science Foundation CAREER award for his research on labor market intermediation, an Alfred P. Sloan Foundation Fellowship, and the Sherwin Rosen Prize in 2008 for outstanding contributions in the field of Labor Economics. In 2005, he was awarded the MIT Undergraduate Economics Association's Teaching Award. Autor can be reached dautor@mit.edu.