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Stories to Work By

Narratives of technological inevitability often limit the tools society has at its disposal to promote equality and opportunity.

In Charlie Chaplin's 1936 film *Modern Times*, humans in a factory are reduced to adjuncts to a massive series of cogs and belts. Overlords bark commands from afar to a servant class, and Chaplin's hapless hero is literally consumed by the machine … and then spit out by it. In the film, the bosses have all the power, and machines keep workers in check.

Modern Times's dystopian narrative remains with us today. In particular, it is still held by many policymakers who assume that increasing technological progress, whether mechanical or informational, inevitably means that ordinary workers will lose. This view perpetuates itself when policies that could give workers more power in times of technological change are overlooked, while those that disempower workers are adopted. If we are to truly consider science policy for the future, we need to understand how this narrative about workers and technology functions, where it is misleading, and how deliberate policies can build a better world for all.

In Chaplin's world—then in the depths of the Great Depression and on the brink of World War II—a bleak view of technology's impact on workers is not hard to understand. But the curious thing about *Modern Times* is that it was filmed after a revolutionary period of technological change in travel, mass communication, and medicine that *could* have ushered in an extremely optimistic age.

To see Chaplin's point of view, we need to understand that, unlike today's innovations, the new technologies of *Modern Times* were true discontinuities with the past. No one in the Civil War could fathom the future innovations of World War I—airplanes, poison gas, machine guns, radios. By contrast, infantry units in Afghanistan in 2019 would have called in air support from jets in almost exactly the same way that they did in Vietnam in 1968. Sure, we have cellphones and the internet, but 50 years ago, advertisements touted picture phones that very much resemble today's Zoom calls. Technologically speaking, the world changed more between 1865 and 1917 than it did between 1970 and 2020. Those innovations between the Civil War and World War I created what we think of as the modern era, when limits were shattered that reasonably should have ushered in a golden age.

But that's not what we see in *Modern Times*. When we watch Chaplin get pulled into the machine again and again, we are really seeing a narrative that proposes that technology is destiny for workers. Where did this narrative come from?

Answering this question requires appreciating the way technological advances are accompanied by profound struggles over who will reap the benefits of this change, which are played out in cultural narratives justifying new inequalities in society. Technological disruption creates battle lines between the old guard and new challengers, introducing opportunities for huge fortunes for some first movers. And with each technological transformation, new winners and new losers fight over the rewards as well as the story of why they won and others lost.

Consider how technology disrupted the theater. Musicians and actors who were previously paid for live performances limited to one location were suddenly in a world where their performances were made available endlessly at multiple venues. Should the musician be paid each time a record was played, or should the owner of

1760-1831

the machinery that produced the record reap the profits? Should an actor continue to be paid for each performance, even if it is recorded and shown on many "stages" when films were shown worldwide? Or do the profits belong to the owner of the film, the projector, or the theater? That question galvanized Charlie Chaplin himself, and—with D. W. Griffith, Mary Pickford, and Douglas Fairbanks—he incorporated United Artists in 1919 to give more ownership to the actors than the producers of films. So *Modern Times* was both a product of this struggle between the haves and the new have-nots and a narrative about an ongoing social cleavage in which the brunt of this technological disruption fell upon workers.

At the time, rising inequality was often justified by exploiting race and gender stereotypes to explain that technology was making those defined as "truly skilled" better off and leaving behind those considered inferior. Thus, looking closely at how technological disruptions affected Blacks and women reveals a larger dynamic. Consider, for example, the hundreds of Black male college graduates who served in World War I as part of the US Army Signal Corps with the segregated 325th Field Signal Battalion. These men operated radio communications, a revolutionary technology that put them on the cutting edge.

But when they came home, as I've found in my research, none of those hundreds of Black men who had trained and served in the battalion got jobs involving telegraphy or the new technology of broadcast radio, which began to boom a year after the war ended. Much the way major Silicon Valley companies today employ disproportionately small percentages of Blacks, Latinos, and women, after World War I qualified Black veterans with skills were not hired for cutting-edge jobs.

At the same time, a set of narratives were crafted that explained why Blacks were not part of the technological vanguard. The elite universities that had once been hotbeds for abolitionists now reversed course and excluded Black students. Members of the economics field that emerged during this time, which we now think of as modern economics, openly argued that eugenics made equality inefficient. In 1899, the man who had been the first president of the American Economic Association described immigrants such as the Irish and eastern Europeans as "low-wage races," while other economists around the same time did research to demonstrate that Black workers were unproductive.

In film, D. W. Griffith's *The Birth of a Nation* (1915), which was credited with sparking the resurgence of the Ku Klux Klan, became part of an enduring cultural narrative about white supremacy. These stories didn't stay on the screen, but spilled over as white mobs massacred Black citizens and destroyed their homes and businesses in Tulsa, Oklahoma, over two days in 1921—a tragic escalation of the same hate-fueled violence that had poured out in Chicago, Omaha, Washington, DC, and dozens of other cities in 1919. This was the ugly historical backdrop to Chaplin's *Modern Times*.

Damaging narratives about which workers "deserve" to be winners in the new economy persist to this day, and the counterexamples of how Black and women workers profited from technological change are all but forgotten. Stories of how change unfolded in two industries—railroads and telephones—illustrate the complex factors that determine the effects of technological change and the important role of policy and narrative in determining whether the playing field is fair for workers.

If we are to truly consider science policy for the future, we need to understand how this narrative about workers and technology functions, where it is misleading, and how deliberate policies can build a better world for all.

Working on the railroad

The first story, regarding railroads, shows the ways that technology, coupled with institutions and geography, can empower specific groups of workers. In the 1880s, railroads grew dramatically in importance as they hauled more passengers and more freight over more miles of track. In the South, Black men quickly came to dominate the ranks of firemen on steam locomotives. Dirty and hard, the job involved shoveling coal to maintain the heat of the steam engines. The fireman was viewed as a servant to the engineer, who was invariably a white man. But as the demand for rail services grew with the spread of America's manufacturers, so did the demand for rail workers. And this job that had once seemed dirty and unimportant grew to be vital.

Because rail workers organized and formed unions, this form of technological advance resulted in workers gaining meaningful changes. With unions came higher wages; unfortunately for Black workers, they also brought new mechanisms for exclusion—but only in some parts of the country. In the South, Black men proved too

prominent as firemen to be excluded, whereas outside the South, Black workers could not protect that foothold and were rarely to be found in the engine car.

As the railroads expanded, their owners sought new technologies to make trains faster and more powerful—at the time, that generally meant bigger engines, which required more fuel supplied by firemen. From 1880 to 1900, the number of railroad firemen increased from about 10,000 to almost 50,000, according to US Census data. In the South, Black men formed a growing share of the industry, accounting for 15% of firemen in 1880 and 25% by 1920.

The invention of the diesel engine in the 1890s led to the first diesel engine trains in the 1910s, with wider adoption by the 1920s. Of course, diesel engines meant the job of firemen became superfluous, and the number of firemen peaked near 90,000 in 1920. However, unions protected the jobs of incumbent workers through strict seniority rules. Over time, the age of firemen skewed decidedly older.

After 1920, white firemen were able to slow the entrance of Black workers into the field, but a combination of technological and social factors led to an ironic reversal of fate for older workers. As the role of the firemen changed from one of servant to the engineer to apprentice engineer, the racial hierarchy shifted. Railroad owners agreed that only white men would be engineers, which meant that whites who rose through the ranks would shift to being engineers, while Blacks, unable to advance, would remain in the union.

Over time, Blacks in these positions accrued significantly more seniority than many whites—giving them the right to choose the most favorable train assignments, which led to disputes. Unlike other skilled Blacks who fled the South in the early migrations of the twentieth century, Black firemen had to stay in the South to retain their jobs and seniority. By 1940, their numbers were falling.

Many factors drove technological advancement in railroads, but they were shaped by institutions and by a rapid growth in demand that caused productivity to grow at faster rates. Unions made a difference in how the deployment of technology affected workers, and so did institutional geography. Workers were not displaced; instead, work opportunities diminished. And institutions—not skills or talents alone—determined who benefited from the changes. This is an example of a situation in which technology and institutional power enabled some workers to get higher wages, though partly by cutting out other workers.

Operators adapting

The history of the telephone tells a similar story about how institutions, rather than skills or talents, came to distribute rewards to workers—some more than others. In the decade between 1894 and 1904, telephones increased exponentially, growing from 285,000 to 3.3 million. To keep up with demand, the industry was required to train operators at rapid rates. Initially, the job fell to boys, who had been deliverers of telegrams, but boys were not good at customer service, and the technology required a lot of virtual hand-holding. Between 1900 and 1910, some 100,000 operators were trained, and as the decade went on, it became a women's job. Another 100,000 operators were trained by 1920—an average of around 1,000 people a year, about the size of the graduating class of many American universities.

Since this was a new technology and the technology was proprietary, the telephone companies assumed full responsibility for training workers; in fact, the development of technology was so fast that operators had to be trained on both new and older equipment because some would be assigned to places where the newest technology was yet to be deployed.

To attract workers, companies made the job appear attractive and even went to the trouble of making short films that portrayed the training as fun for women. At the same time, as Venus Green writes in *Race on the Line* (2001), racial divisions remained stark: all the women shown in the promotional films were white. Prospective Black operators did not have to contend with discrimination from callers (who couldn't see them), but they were prohibited from working for AT&T, and within the corporate telephone exchanges where they worked, they were never side by side with white women.

As with the railways, demand for telephone service grew faster than the labor-heavy model could accommodate. Even the best-trained operators could handle only so many calls. By the 1930s, AT&T was already introducing technology to let customers dial directly without going through an operator—but the technology was so new that customers had to be shown educational films explaining how to dial.

Unlike railway workers, telephone operators had little success at organizing unions. It wasn't until the passage of the National Labor Relations Act of 1935 that independent unions successfully organized at the local level. The number of operators peaked at just above 200,000 in 1930, but slowing demand during the Great Depression coupled with the expansion of technology meant that by 1940, telephone operators' numbers had fallen.

But here is where the story of the telephone diverges from that of the railroads. The technology continued to improve, so in 1951, customers could call from coast to coast without talking to an operator. (To illustrate the value and convenience of direct dialing long-distance calls—and to encourage trust in the billing system—AT&T produced additional educational films.) But a combination of union power and rising postwar prosperity meant that even as automation increased, the

number of telephone operators rose to just shy of 400,000 by 1950 and continued to edge slowly to a peak of only a little over that in 1970.

What accounts for the telephone operators' ability to hold onto their jobs? Initially, operators were still necessary because they kept handwritten records of calls and charges, including for reverse charges, collect calls, person-to-person calls, and overseas calls. But automation of domestic long-distance calls was accompanied by automated billing, in which the data was coded onto punch cards. Thus, a new set of jobs emerged to operate the computer peripherals and run computer programs to tally and print bills. While women lost jobs in the automating of billing, women were hired to run the new machines.

Ultimately, technology augmented rather than replaced telephone labor because the telephone company was a regulated monopoly: driving down costs while expanding service made technological advancement important. In the context of a rising middle class and expanding incomes, this example shows how workers can make gains when technology is driven to keep up with demand.

Hidden stories

These stories reveal dynamics at play in our still-unequal society, where gender and racial stereotypes continue to shape contemporary narratives about who is "threatened" by technological change. But history shows that technology doesn't always trigger lower wages and permanent displacement for vulnerable workers, and it also reveals how we've failed to understand the times and ways that workers have benefitted. Interestingly, one of the most compelling films of the last decade, 2016's *Hidden Figures,* tells precisely that story, by showing how Black women mathematicians working for NASA benefitted from technological gains. When electronic computers arrived and could have displaced human workers, mathematician Dorothy Vaughan taught other women how to code the computers in Fortran. But, as the movie's title suggests, these stories are often obscured.

Another such hidden story is that of the Black IT workers who created the mystique of Prince George's County, Maryland, as one of the nation's wealthiest Black counties. Despite the often-remarked dearth of Black IT professionals in Silicon Valley, their numbers around Washington, DC, are quite high—recalling the historical concentration of Black railway firemen in the South. And as in that example, a confluence of events enabled the growth of a large skill pool of Black workers—in this case, federal contracting guidelines that encouraged Black-owned small businesses—which coincided with the rapid adoption of computing in the federal government.

Another insight from these historical stories concerns the role of education. Today's companies may point the finger at schools for failing to produce skilled workers, speaking of leaky educational pipelines. But in earlier eras of rapidly evolving technology, companies themselves trained their employees. This model was not unique to the telephone industry. Fully aware that it could not find engineers trained in the proprietary technologies and intricacies of automobile manufacturing, General Motors created its own engineering college in Flint, Michigan, in 1919; the college became Kettering University in 1982.

Technology is not destiny

In our own era, we can still see the shadows cast by Chaplin's *Modern Times*. As in the past, massive technological advances, like the proliferation of the internet and the explosion of social media, might have led to a new golden age, with workers competing on equal footing for jobs around the globe. Instead, as we have seen, the failure of workers from underrepresented minority groups to enter high-wage jobs has been blamed on their backwardness, cultural unsuitability, or poor education. Meanwhile, the internet and social media have become powerful tools of those advancing division and organizing extreme hate groups while recycling the crude memes of a century ago to explain today's grinding inequalities.

In 2022, our struggle has less to do with technology itself than with the social norms and economic rules that determine who profits—and the narratives that justify the resulting growth of income inequality.

Recent changes in technology could have created broad societal benefits by improving efficiencies in everything from coordinating transportation to letting people control their own work schedules. Instead, much technology has been leveraged to avoid regulations: consider how Uber has skirted taxi regulations and how internet companies and other advocates successfully argued for many years that internet commerce should be exempt from local sales taxes, thus gaining unfair advantages over their non-tech-enabled competition. And using scheduling technologies that could have accommodated workers' desire for flexibility, companies have instead used the software to disadvantage workers with irregular schedules, disrupting their bargaining power and pushing wages down.

Describing this upheaval as the result of technology overlooks the political and economic choices the United States has made over the last four decades that have let minimum wages fall, weakened collective bargaining laws, and defined corporations' fiduciary duty as being to stockholders rather than workers and communities. These choices are reinforced by an economics profession that often disregards the role of institutions like unions and government, as well as the advantages management has over workers. The persistent argument that some workers are

deficient and cannot attain high-earning jobs should be seen in its proper context of being used to gain political advantage and excuse massive inequalities.

By contrast, the fastest productivity growth on record in the United States occurred from 1946 to the early 1970s, when output per worker doubled. During that same period, child poverty fell at its fastest rate ever, as the real wages of American workers rose with productivity. Several factors played a key role in making this possible. Perhaps most important was the strength of the labor movement: unions bargained in the private sector for a broad and diverse set of workers, and minimum wages rose with other wages, ensuring an impetus to compete based on rising productivity even in lower-wage industries. These gains for labor were particularly consequential for workers of color. Unsurprisingly, the share of unionized Black workers was greater than the share of unionized whites, given that whites were far more likely to be managers and others outside bargaining units.

Among the policy choices that led to this period of prosperity were substantial federal government investments in education. The GI Bill of 1944 and the National Defense Student Loan program established in 1958 expanded help in paying for college, giving the US workforce the highest share of college graduates in the world and laying the groundwork for the Hewlett-Packards and Apples of today. And the 1990s saw the fruition of President Johnson's Executive Order 11246, which made federal contractors take affirmative steps to live up to the Civil Right Acts of 1964's non-discrimination in hiring provisions. Also in that decade, the federal government began using its leverage to open state and local public sector jobs, which allowed Black college graduates to escape the confines of teaching in segregated school systems to become managers and computer programmers.

The postwar period was also one of renewed optimism, with rapid civil rights advancement, the end of legal segregation, and the extension of voting rights, along with the ending of overt codes of discrimination in the labor and housing markets. This is not to say the period did not continue to see significant disruptions from technology; many jobs were wiped out by greater productivity. In the railroad industry, construction of the interstate highway system, greater reliance on cars, and a new commercial airline industry meant the end of Pullman sleeping cars on trains, meaning thousands of Black men lost their jobs as Pullman porters. Productivity gains also meant the prices of many items could fall and, with rising wages, create a different landscape for labor. For example, the drop in prices for washing machines, clothes dryers, and dishwashers reduced the demand for domestic workers, displacing large numbers of Black women.

But at the same time, removing discriminatory barriers and investing in education meant those workers displaced by automation could make their way to better and higher-paying jobs. Popular culture shifted the dialogue as well—in sports, where Black athletes like Jackie Robinson were elevated, and on film. A half century after Griffiths's *Birth of a Nation*, Norman Jewison adapted John Ball's 1965 novel, *In the Heat of the Night,* into a driving commentary on southern racism, with a scene in which the Black protagonist slaps a wealthy white landowner in front of the local white sheriff.

Today's tales of pending technological dystopia—echoed in economics papers as well as in movies and news reports—blind us to the lessons we could glean from the massive disruptions of earlier periods of even greater change. Today the threat of AI is portrayed as revolutionary, and previous technological change as slow and inconsequential—but this was never the case. These narratives of technological inevitability limit the tools we have at our disposal to promote equality and opportunity.

History shows that technology doesn't always trigger lower wages and permanent displacement for vulnerable workers, and it also reveals how we've failed to understand the times and ways that workers have benefitted.

The challenges we face today are far from insurmountable: technology is not destiny. Workers are not doomed to be Chaplin's victim of technology with one toe caught in the gears of progress. We have choices, and the central challenge of science and technology policy for the next century will be confronting those choices head on. Policymakers should focus on the fundamental tasks of shaping how technology is deployed and enacting the economic rules we need to ensure that technology works for us all, rather than only the few.

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