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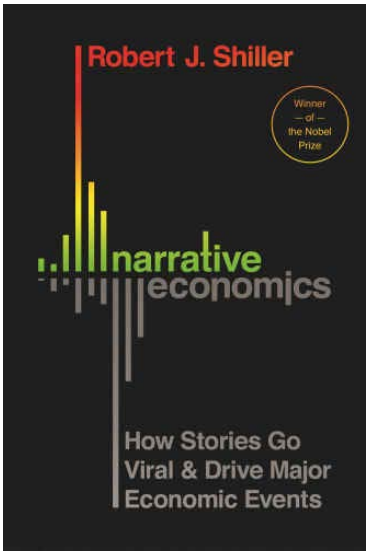
Narrative Economics



Chapter 13
Labor-Saving Machines Replace Many Jobs

Chapter 14
Automation and Artificial Intelligence Replace Almost All Jobs

Concerns that inventions of new machines that are powered by water, wind, horse, or steam, or that use human power more efficiently, might replace workers and cause massive unemployment have an extremely long history. These perennial narratives are reappearing with modification in the twenty-first century and could become important problems damaging confidence, as they did in the past.

In this chapter, we consider a number of technology narratives, often using the terms *labor-saving machinery* or *technological unemployment*, that went epidemic and then faded (Figure 13.1), including the Luddite event in 1811, the Swing Riots in 1830, the depression scare of 1873–79, the depression of 1893–97, and the extended Great Depression of 1930–41.

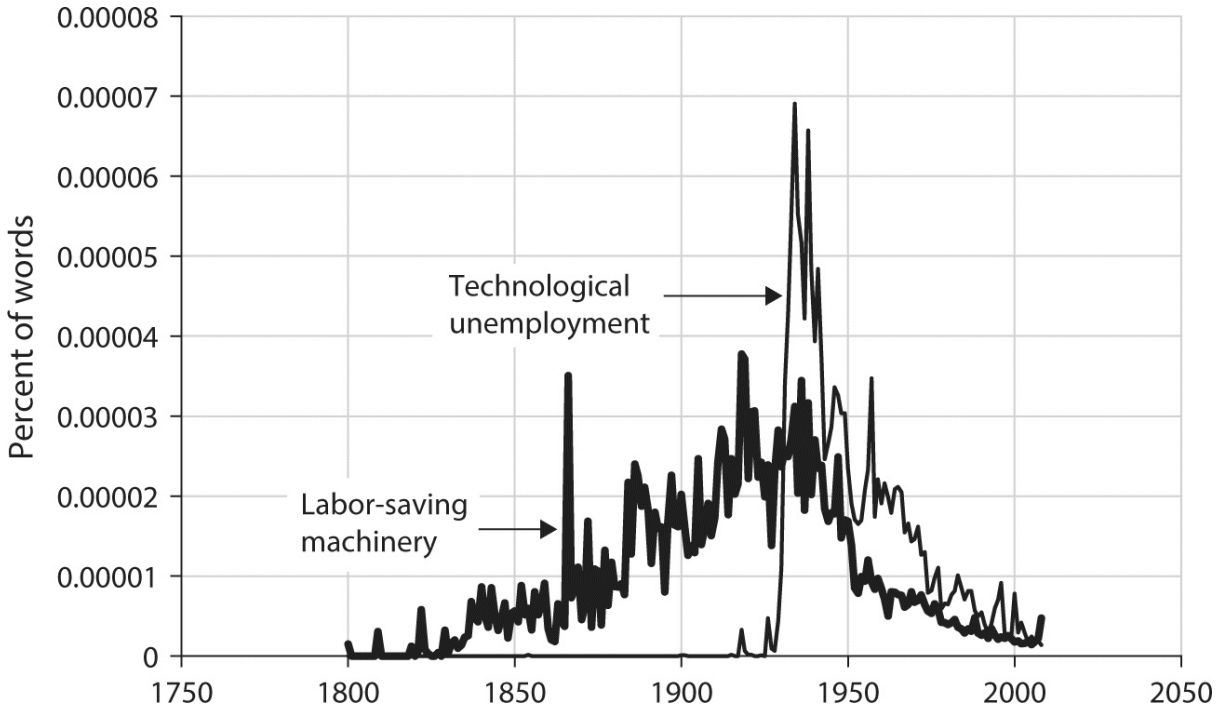


FIGURE 13.1. Frequency of Appearance of *Labor-Saving Machinery* and *Technological Unemployment* in Books, 1800–2008 Narratives of losing one's job to a machine have a long history, with mutations creating different epidemics. *Source*: Google Ngrams, no smoothing.

From Ancient Times to the Swing Riots

Talk of automatic machinery replacing human muscle power goes back to the ancient world. The *Iliad*, Homer's eighth-century BCE epic, describes a driverless vehicle, the tripod of Hephaestus, that navigates on its own. Homer refers to the vehicle as "automatic."[1] Aristotle, around 350 BCE, raised the possibility of machines replacing humans:

> For if every instrument could accomplish its own work, obeying or anticipating the will of others, like the statues of Daedalus, or the tripods of Hephaestus, which, says the poet, "of their own accord entered the assembly of the Gods"; if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, chief workmen would not want servants, nor masters slaves.[2]

The statues of Daedalus were said to be able to walk or run, like modern-day robots. Hero of Alexandria in the first century BCE wrote a book, *Automata*, describing how to make a programmable tripod of Hephaestus, as well as a coin-operated vending machine and other remarkable devices. Water-powered mills began grinding grain into flour by the first century BCE. So the idea of machines replacing jobs was in place long before the start of the Common Era, along with fears of unemployment.

Searching eighteenth-century newspapers, we find evidence of great interest in how technological advances are changing the economy, but without much alarm about technology's effects on jobs. The term *industrial revolution* does not come up at all in a search of eighteenth-century newspapers—historians introduced that term later on. But by the nineteenth century, concerns about technology-based unemployment took center stage. The narrative was particularly contagious during economic depressions when many were unemployed.

The defining event was a protest in 1811 in the United Kingdom by a group that claimed a mythical man, Ludd, as their spiritual leader. The mutation that renewed the old narrative and made it so virulent in 1811 was a new kind of power loom that was eliminating weavers' jobs. The word *Luddite* continued to appear regularly in newspapers in following years and today remains a synonym for a person who resists technological progress.

In 1830, the Swing Riots in Britain were a response to the loss of farm jobs that occurred when the new mechanical thresher entered widespread use. The rioters' spiritual leader was the imaginary "Captain Swing," and again rioters destroyed the machinery. Certainly the decline in agricultural employment due to mechanization was widely noted. It was a frightening change for the people in the advanced countries undergoing the fastest mechanization. Living on and working the land was an ancient tradition, and now workers had to do something entirely new to earn their keep, and the new jobs probably required moving to crowded urban areas. In describing their fears, they did not use the words *technological unemployment*, *computers*, or *artificial intelligence*, but they did have their own terms for the phenomenon, including *labor-saving*, as in labor-saving appliances, labor-saving devices, labor-saving inventions, labor-saving machines, and labor-saving processes.

Depression Narratives of the 1870s

In the depression of 1873–79, a particularly strong depression in the United States and Europe, concern that labor-saving inventions were at least partly to blame for high unemployment took center stage in the popular consciousness, likely worsening the depression. In the United States, this depression is typically attributed to financial speculation leading to the banking panic of 1873, but the fear-inducing narrative about a long-term loss of jobs and job prospects due to labor-saving inventions may help to explain why the depression went global. Certainly the depression of the 1870s was accompanied by farmers' accelerated adoption of labor-saving machinery, along with more workers destroying machines and hired farm laborers threatening violence.[3] Underneath the violence was widespread concern about the outlook for the common laborer.

In the middle of that depression, the famous 1876 Centennial Exhibition in Philadelphia, a celebration of one hundred years of US independence, turned out to be more a testimony to labor-saving machinery than a remembrance of the American Revolution. The exhibition did display some of George Washington's personal items, but not much more about history. Instead, it presented examples of modern industry from twenty countries. The visitor's guide describes one of the most dramatic exhibits in the gigantic Machinery Hall:

> In the centre of this building is located a 1400 horse-power Corliss engine, capable of driving (if required) the entire shafting necessary to run all the machinery exhibits. This engine has a 40-inch cylinder with 120-inch stroke, and was constructed for this especial service. It will be run when required, but it is expected that the engines on exhibition will do a portion of the work of driving the shafting. The main lines of shafting are at a height of 18 feet above the floor, and extend almost the entire length of the building; countershafts extend from the aisles into the avenues at necessary points.[4]

The exhibition also gave reason for alarm regarding jobs in agriculture:

> Among the most extensive and interesting exhibits will be the agricultural machines in active operation, comprising everything used on the farm or plantation, in tillage, harvesting, or preparation for market; manufactured foods of all kinds, and all varieties of fish, with the improved appliances for fish-culture.[5]

Though impressive, the Centennial Exhibition's technological exhibits led to fears about jobs and about the horrible human effects of unemployment. The *Philadelphia Inquirer* in 1876 wrote:

> Want of employment leads to discouragement, hopelessness and despair. It overflows almshouses, charitable institutions, prison houses and penitentiaries. It degrades manhood. It ruins families. Misery, crime and suicide follow in its wake. It supplies ready victims for the gallows.… To-day one man does what would have been the work of a hundred, fifty years ago. The steam-power of seven tons of coal is sufficient to make 33,000 miles of cotton thread in ten hours, while, without machinery, this would equal the hand labor of 70,000 women! Consumption does not keep pace with the production by machinery. Markets become glutted.[6]

As a result of these fears, in 1879 Senator George Frisbie Hoar of Massachusetts set up a

committee to “enquire and report as to the extent to which labor-saving processes have entered into production and distribution of products to the displacement of manual labor.”[7]

However, by 1879, a counternarrative had already developed: labor-saving processes will increase the number of jobs, not decrease them. One editorial in the *Daily American*, dismissing the worries about replacement of labor by machines, noted,

> The whole tendency of labor-saving processes is towards the elevation of the laboring classes, and if the change is accompanied by some hardship, so is every step in the progress of the human race.[8]

This editorial sounds very much like arguments made today to reassure workers regarding their fear of job loss, but the overall discussion of labor-saving machinery during the depression of the 1870s suggests that such arguments were not persuasive.

Henry George’s 1879 best seller, *Progress and Poverty*, faced these issues head on. The book held that the immense technological advances of the time were creating inequality and increasing the number of people who lived in poverty. The book asserted:

> For, if labor-saving inventions went on until perfection was attained, and the necessity of labor in the production of wealth was entirely done away with, then everything that the earth could yield could be obtained without labor, and the margin of cultivation would be extended to zero. Wages would be nothing, and interest would be nothing, while rent would take everything. For the owners of land, being enabled without labor to obtain all the wealth that could be procured from nature, there would be no use for either labor or capital, and no possible way in which either could compel any share of wealth produced. And no matter how small population might be, if any body [*sic*] but the land owners continued to exist, it would be at the whim or by the mercy of the land owners—they would be maintained either for the amusement of land owners, or, as paupers, by their bounty.[9]

At this time, the phrase *push a button* arose to indicate a mechanical actuation that completes an electrical circuit. For example, in 1879, the news described an invention in France that would allow a horse’s rider to push a button to deliver an electrical shock to the horse, a system that could be used to discipline a misbehaving horse.[10]

Such inventions only exacerbated fears of unemployment. An 1894 editorial in the *Los Angeles Times* blamed the severity of the 1890s depression on labor-saving inventions:

> There is no doubt that the introduction of labor-saving machinery and the consequent increase of production has had more than a little to do with the present depression in business.… It is true that during the past few years the increase in the invention and adoption of labor-saving machinery has been so great that the community has scarcely been able to keep up with it.[11]

The article then went on to list recent examples of labor-saving innovations:

> In the manufacture of hats machinery has multiplied the productive power of labor nearly nine times. Manifestly we can't wear nine times as many hats as formerly.
>
> By the adoption of improved processes the labor involved in the production of flour has been reduced 80 percent, yet we can each eat no more flour.[12]

That same year, the *San Francisco Chronicle* chimed in with an editorial about labor-saving machinery. The editorial was entitled "The Great Problem":

> The rich have grown richer and the poor have grown poorer. Side by side with the growth of enormous fortunes the hovels of the struggling laborers have become more dilapidated. … And to further emphasize the seriousness of these considerations it may be said that this problem must soon be solved or there will come a cataclysm which will destroy modern civilization.[13]

In 1895 a new dumbwaiter system was installed in US kitchens in multifloor buildings. The dumbwaiter had an array of buttons, one for each floor of the building. Press the number of the floor, and the elevator would automatically ascend to that floor and stop there, to return if a button was then pressed from that floor.

In "Stores Are Merely Labor-Saving Machines," an 1897 letter to the editor of the *Chicago Daily Tribune*, the letter writer adds to the growing list of labor-saving innovations. He refers to the department store movement, the movement to build gigantic stores that sold everything imaginable under one roof. The movement had started in 1838 with the Bon Marché department store in Paris. By the 1890s, department stores were an accelerating international epidemic, with continued expansions, glamorizing, and advertising over succeeding decades. The letter writer notes that even further expansion of department stores could yet "do away with so many people employed to distribute where one-third of them could do as well."[14]

In Chicago, Marshall Field & Co., established in 1881, built a seven-story department store in downtown Chicago in 1887. It then built an even more glamorous nine-story store in 1893, to coincide with the large crowds expected to attend the international fair, the 1893 Columbian Exposition. In 1897, Chicago's elevated street railway, called "The Loop," was completed, connecting many more people to Marshall Field's, marking an innovation in efficient retailing that may have prompted this letter writer.

Particularly striking during the 1893–99 depression was a spike in public anger about trusts, combinations of companies that fixed prices at a high level. In an 1899 talk in New York, John C. Chase, mayor of Haverhill, Massachusetts, and former trade unionist, said, "The trust is, in my opinion, a labor saving machine," apparently meaning that the modern trust adopts such machines in its inhuman effort to dispense with labor.[15]

Machines, Robots, and Future Technological Unemployment

The notion of a world without labor became more vivid with E. M. Forster, the English novelist famous for such classics as *A Room with a View*, *A Passage to India*, and *Howards End*. Forster's 1909 science fiction story "The Machine Stops" described a future in which machines do everything:

> Then she generated the light, and the sight of her room, flooded with radiance and studded with electric buttons, revived her. There were buttons and switches everywhere—buttons to call for food, for music, for clothing. There was the hot-bath button, by pressure of which a basin of (imitation) marble rose out of the floor, filled to the brim with a warm deodorized liquid. There was the cold-bath button. There was the button that produced literature, and there were of course the buttons by which she communicated with her friends. The room, though it contained nothing, was in touch with all that she cared for in the world.[16]

Forster's story ends when the machine unexpectedly malfunctions, bringing death and destruction to a world that has grown too dependent on it.

A little more than a decade later, during the 1920–21 depression, the labor-saving machine narrative mutated again, leading to the idea of robots. A 1921 Czech play, *R.U.R.: Rossum's Universal Robots*, by Karel Čapek, coined the word *robot*, from the Czech word for *worker*, to replace the earlier terms *labor-saving invention* and *automaton.* The play first appeared in English translation in New York in October 1922, to strong reviews. The play was not a big immediate success, and it was not made into a movie until 1948. But it started a narrative epidemic.

The play and its ideas went viral enough to cause the word *robot* to enter most of the world's languages. The play tells the story of the scientist Rossum, who invents a robot, and the businessman Domin, who starts manufacturing robots and who ultimately faces a revolt of the robots, who have developed minds of their own. The idea of a mechanical man who walks, talks, and fights might seem to be more inherently contagious than stories of push-button devices, but Čapek's initial story reached only a small base of people, and so the robot epidemic was gradual. Perhaps the recovery rate was also low because of the constant reminders of technological innovations in the following decades. Very few newspapers mentioned robots in the 1920s, but use of the term grew over the decades. To become more contagious, the idea of a robot may have needed further development by creative people.

Before 1930: Increasingly Vivid Narratives of Machines Replacing People

The story of an automated future was growing more and more vivid, but the stories still seemed mostly remote. The word *robot* did not become common in newspapers and books until the 1930s, though there were some dramatic exceptions, such as a traffic light, described in the *Los Angeles Times* in July 1929, that replaced policemen who had been directing traffic at an intersection in Medford, Massachusetts:

> The robot, which is made up in the usual form of red, yellow and green-light traffic tower, is operated automatically by the automobiles themselves as they pass over sensitive plates set in the street surface. No car is required to wait when there is no opposing traffic. When the car reaches an intersection and the way is clear the control from the plate in the pavement will give it a green light. If a car is waiting to cross an intersection and the opposing traffic is heavy the light permitting the car to cross will automatically set in its favor whenever there is a gap and will immediately return in favor of the heavy traffic once the car is clear. The robot handles multiple numbers of machines on the same principle, the streets containing the greatest amount of traffic being emptied or partially emptied first, thus using a smooth even flow of traffic through all parts of the complicated square here.[17]

Reading this paragraph today, almost a century later, we may wonder why we still find ourselves occasionally waiting in our cars at a red light when there is no opposing traffic. There must have been problems with this particular robot, problems that still do not have an inexpensive and practical solution. But this 1929 story was beginning to have an impact.

A decade earlier, a new phrase had appeared in the English language to describe the effects of labor-saving inventions. The phrase was *technological unemployment*. This phrase appeared first in 1917, but it started its epidemic upswing in 1928. The count for *technological unemployment* skyrockets in the 1930s in Google Ngrams into an epidemic curve much like the Ebola epidemic curve in Figure 3.1. The *technological unemployment* curve peaked in 1933, the worst year of the Great Depression. A parallel epidemic occurred with the term *power age*, which is now mostly gone. The power age referred to the perception that activities once done by muscle are now done by powerful machines. During the 1870s depression, about half the US labor force worked in agriculture, and the labor-saving machinery of that decade tended to be agricultural equipment, pulled by horses. By 1880, only a fifth of the US labor force worked in agriculture, and the narratives focused instead on new fuel-powered and electronic machines, threatening the jobs to which agricultural people fled from the farms. (Less than 2% of the US workforce is in agriculture today.) Technological unemployment became a new and persistent worry.

It is curious that the narrative epidemic of technological unemployment began in 1928, a time of prosperity well before the Great Depression. Still, 1928 was a time of heightened concern about unemployment, which was blamed entirely on technological unemployment and not connected in public talk to any weakness in the US economy. Philip Snowden, former and future chancellor of the Exchequer in the United Kingdom, wrote in the *New York Times* in 1928 that the United States, then the leader in developing labor-saving devices, had a unique problem of technological unemployment:

> But if other countries are compelled to follow America in specialization and in the

displacement of human labor, the problem of unemployment in these countries will assume the feature of the existing unemployment problem in America.

This, indeed, is the great problem which every industrial nation must face, namely, to avoid the present hardship which mechanical and scientific advance inflicts upon a mass of the wage-earning class. In other words, the problem is to free the human being from slavery to the iron man.[18]

By the 1920s, there was much talk about "efficiency experts" whose "time and motion studies" treated workers as if they were machines. The experts' goals were to eliminate any unnecessary motions, thereby saving time and labor cost. Like other narratives that took form in the late 1920s and went viral in the Great Depression of the 1930s, efficiency was associated with technological unemployment.

How did the epidemic of technological unemployment fears start? In March 1928, US senator Robert Wagner stated his belief that unemployment was much higher than recognized, and he asked the Department of Labor to do a study of unemployment. Later that month, the department delivered the study that produced the first official unemployment rates published by the US government. The study estimated that there were 1,874,030 unemployed people in the United States and 23,348,602 wage earners, implying an unemployment rate of 7.4%.[19] This high estimated unemployment rate came at a time of great prosperity, and it led people to question what would cause such high unemployment amidst abundance.

In April 1928, a month later, the *Baltimore Sun* ran an article referring to the theories of Sumner H. Slichter, who later became a prominent labor economist in the 1940s and 1950s. In the article, readers are told that Slichter noted several causes of unemployment but pointed out that "at present the most serious is technological unemployment." Specifically, "The reason we have this unemployment is because we are eliminating jobs through labor-saving methods faster than we are creating them."[20] These words, alongside the new official reporting of unemployment statistics, created a contagion of the idea that a new era of technological unemployment had arrived, and the Luddites' fears were renewed. The earlier agricultural depression, with its associated fears of labor-saving machinery, began to look like a model for an industrial depression to follow.

Stuart Chase, who later coined the term the "New Deal" in the title of a 1932 book, published *Men and Machines* in May 1929, during a period of rapidly rising stock prices. The real, inflation-corrected, US stock market, as measured by the S&P Composite Index, rose a final 20% in the five months after the book's publication, before the infamous October 1929 crash. But concerns about rising unemployment were apparent even during the boom period. According to Chase, we were approaching the "zero hour of accelerating unemployment":[21]

Machinery saves labour in a given process; one man replaces ten. A certain number of these men are needed to build and service a new machine, but some of them are permanently displaced.… If purchasing power has reached its limits of expansion because mechanization is progressing at an unheard of rate, only unemployment can result. In other words, from now on, the better able we are to produce, the worse we shall be off. Even if the accelerating factor has not arrived, the misery of normal unemployment continues unabated.

This is the economy of the madhouse.[22]

The book conveyed a sense that the beginnings of the catastrophe were imminent:

“Accelerating unemployment … if not already here, may conceivably arrive at any moment.”[23] This is significant: the narrative of out-of-control unemployment was already starting to go viral before there was any sign of the stock market crash of 1929.

During the days of sharp US stock market drops the week before the October 28–29, 1929, stock market crash, a nationally reported National Business Show was running in New York, October 21–26, in a convention center (since demolished) adjacent to Grand Central Station that many Wall Street people passed through to and from work. The show emphasized immense progress in robot technology in the office workplace. It was described after the show moved to Chicago in November thus:

> Exhibits in the national business show yesterday revealed that the business office of the future will be a factory in which machines will replace the human element, when the robot —the mechanical man—will be the principal office worker.…
>
> There were addressers, autographers, billers, calculators, cancelers, binders, coin changers, form printers, duplicators, envelope sealers and openers, folders, labelers, mail meters, pay roll machines, tabulators, transcribers, and other mechanical marvels.…
>
> A typewriting machine pounded out letters in forty different languages. A portable computing machine which could be carried by a traveling salesman was on exhibit.[24]

The 1930s: A New Form of Luddism Prevails

Soon after the 1929 stock market crash, by 1930, the crash itself was often attributed to the surplus of goods made possible by new technology:

> When the climax was reached in the last months of 1929 a period of adversity was inevitable because the people did not have enough money to buy the surplus goods which they had produced.[25]

As noted above, fear of robots was not strong in most of the 1920s, when the word *robot* was coined. The big wave of fear had to wait until the 1930s. Historian Amy Sue Bix (2000) offers a theory to explain why the 1920s were fearless: the kinds of innovations that received popular acclaim in the 1920s didn't obviously replace jobs. If asked to describe new technology, people in most of the 1920s would perhaps think first of the Model T Ford, whose sales had burgeoned to 1.5 million cars a year by the early part of the decade. Radio stations, which first appeared around 1920, provided an exciting new form of information and entertainment, but they did not obviously replace many existing jobs. More and more homes were getting wired for electricity, with many possibilities for new gadgets that required electricity. Labor unions in the 1920s tried to sound alarms about machines replacing jobs—and they sounded those alarms with increasing force as the 1920s proceeded—but the public didn't react much. The labor unions' alarms were not contagious because people had not heard many stories about inventions replacing jobs.

By the 1930s, Bix notes, the news had replaced stories of exciting new consumer products with stories of job-replacing innovations. Dial telephones replaced switchboard operators. Mammoth continuous-strip steel mills replaced steel workers. New loading equipment replaced coal workers. Breakfast cereal producers bought machines that automatically filled cereal boxes. Telegraphs became automatic. Armies of linotype machines in multiple cities allowed one central operator to set type for printing newspapers by remote control. New machines dug ditches. Airplanes had robot copilots. Concrete mixers laid and spread new roads. Tractors and reaper-thresher combines created a new agricultural revolution. Sound movies began to replace the orchestras that played at movie theaters. And of course the decade of the 1930s saw massive actual unemployment in the United States, with the unemployment rate reaching an estimated 25% in 1933.

It is difficult to know which came first, the chicken or the egg. Were all these stories of job-threatening innovations spurred by the exceptional pace of such innovations? Or did the stories reflect a change in the news media's interest in such innovations because of public concern about technological unemployment? The likely answer is "a little of both."

Underconsumption, Overproduction, and the Purchasing Power Theory of Wages

Unlike the technological unemployment narrative, the labor-saving machines narrative was strongly connected to an underconsumption or overproduction theory: the idea that people couldn't possibly consume all of the output produced by machines, with chronic unemployment the inevitable result. This theory's origins date back to the mercantilists in the 1600s, but popular use of the terms *underconsumption* and *overproduction* first appears in ProQuest and Google Ngrams around the time of the depression of the 1870s. Henry George described the overproduction theory in his 1879 book *Progress and Poverty*, during the depression of the 1870s, concluding it was an "absurdity."[26]

The theory of overproduction or underconsumption picked up steam in the 1920s. It was mentioned within days of the stock market crash of October 28–29 1929, in interpreting the crash.[27]

The real peak of these narratives was in the 1930s. Underconsumption narratives appeared five times as often in ProQuest News & Newspapers in the 1930s as compared with any other decade. The narrative has virtually disappeared from public discourse, and the topic now appears largely in articles about the history of economic thought. But it is worth considering why it had such a strong hold on the popular imagination during the Great Depression, why the narrative epidemic could recur, and the appropriate mutations or environmental changes that would increase contagion. Today, *underconsumption* sounds like a bland technical phrase, but it had considerable emotional charge during the Great Depression, as it symbolized a deep injustice and collective folly. At the time, it was mostly a popular theory, not an academic theory.

Despite the obvious reality that deflation necessitates wage cuts, an opposing "purchasing power theory of wages" became popular in the 1930s. This theory said that "excessive competition" had forced down wages to such an unfair low level that workers could not afford to consume the output. Thus the Depression could be cured by forcing all employers to raise wages. The economist Gustav Cassel in 1935 called these ideas "charlatan teachings" that "have recently taken a conspicuous place in popular discussion of social economy as well as in political agitation."[28]

But the public did not dismiss such charlatan teachings. In the 1932 presidential campaign, Franklin Roosevelt ran against incumbent Herbert Hoover, who had been unsuccessful with deficit spending to restore the economy. Roosevelt gave a speech in which he articulated the already-popular theory of underconsumption. His masterstroke was putting it in the form of a story inspired by Lewis Carroll's famous children's book *Alice's Adventures in Wonderland*. In that book, a bright and inquisitive little girl named Alice meets many strange creatures that talk in nonsense and self-contradictions. Roosevelt's version of this story replaced his opponent Hoover with the Jabberwock, a speaker of nonsense:

> A puzzled, somewhat skeptical Alice asked the Republican leadership some simple questions.
>
> Will not the printing and selling of more stocks and bonds, the building of new plants and the increase of efficiency produce more goods than we can buy? No, shouted the Jabberwock, the more we produce the more we can buy.
>
> What if we produce a surplus? Oh, we can sell it to foreign consumers.

How can the foreigners buy it? Why we will lend them the money.

Of course, these foreigners will pay us back by sending us their goods? Oh, not at all, says Humpty Dumpty. We sit on a high wall of a Hawley-Smoot Tariff.

How will the foreigners pay off these loans? That is easy. Did you ever hear of a moratorium?[29]

Roosevelt used this story to point out the folly of Republican policy, with its attempts at economic stimulus, but his campaign did not suggest any solution to the problem. Instead, in his "Alice" speech, he proposed to install investor protections. He also promised not to make the overly optimistic statements that President Hoover had, and he noted that he would not encourage more stock market speculation. Elected in 1932, Roosevelt signed in 1933 the National Industrial Recovery Act, creating the National Recovery Administration, which attempted to enforce fair wages. We discuss the outcome of this experiment in chapter 17.

On the face of it, underconsumption seemed to explain the high unemployment of the Great Depression, but academic economists never seriously embraced the theory, which had never been soundly explained. Often the theory was presented as an adjunct to technological unemployment: underconsumption suddenly became a problem in the 1930s because of the nation's newfound ability to produce more than it needed. But other accounts of underconsumption make no mention of technology. For example, in 1934, Chester C. Davis, administrator of the Agricultural Adjustment Administration, described how his agency was "redistributing purchasing power to the masses" so as to help them spend more and thereby deal with underconsumption. He explained why he thought technological unemployment had suddenly become so important:

> Why does our nation seem to need this supplement to the market mechanism, after 158 years? You have the answer if you will go back into history and consider the gradual concentration of business into great corporations, of farmers into marketing cooperatives, of labor into collective bargaining associations. These have reduced the area of the free market and have increased the power of individuals controlling these concentrations.[30]

In other words, Davis saw the concentration of business as amplifying the problem of technological unemployment.

The massive unemployment set off serious social problems. For example, in the United States it caused the forced deportation (then called *repatriation*) of a million workers of Mexican origin. The goal was to free up jobs for "real" Americans.[31] The popular narrative supported these deportations, and there was little public protest. Newspaper reports showed photos of happy Mexican Americans waving goodbye at the train station on their way back to their original home to help the Mexican nation.

The dial telephone also played an important part in narratives about unemployment and the associated underconsumption. The older telephone, which had no dial, required a caller to pick up the phone receiver and connect to a telephone operator, who said, "Number please?" The caller had to tell the operator to make the connection. The dial telephone, which required no contact with an operator, was not invented during the Great Depression; in fact, the first patent for a dial telephone dates to 1892. The transition from the non-dial telephone to the dial telephone took many decades. However, during the Great Depression, there rose a narrative focus on the loss of telephone operators' jobs, and the transition to dial telephones was troubled by moral qualms that by adopting the dial phone one was complicit in

destroying a job. For example, the US Senate in Washington, DC, replaced its non-dial phones with dial telephones in 1930, the first year of the Great Depression. Three weeks after their installation, Senator Carter Glass introduced a resolution to have them torn out and replaced with the older phones. Noting that operators' jobs would be lost, he expressed true moral indignation against the new phones:

> I ask unanimous consent to take from the table Senate resolution 74 directing the sergeant at arms to have these abominable dial telephones taken out on the Senate side … I object to being transformed into one of the employes of the telephone company without compensation.[32]

His resolution passed, and the dial phones were removed. It is hard to imagine that such a resolution would have passed if the nation had not been experiencing high unemployment. This story fed a contagious economic narrative that helped augment the atmosphere of fear associated with the contraction in aggregate demand during the Great Depression.

The loss of jobs to robots (that is, automation) became a major explanation of the Great Depression, and, hence, a perceived major cause of it. An article in the *Los Angeles Times* in 1931 was one of many that explained this idea:

> Whenever a man is replaced by a machine a consumer is lost; for the man is deprived of the means of paying for what he consumes. The greater the number of Robots employed, the less is the demand for what they produce for men cannot consume what they cannot pay for.
>
> This condition is inescapable. No political panaceas can alleviate this purely human distress.[33]

Even if the man hasn't lost his job yet, he will consume less owing to the prospect or possibility of losing his job. The US presidential candidate who lost to Herbert Hoover in 1928, Al Smith, wrote in the *Boston Globe* in 1931:

> We know now that much unemployment can be directly traced to the growing use of machinery intended to replace man power.… The human psychology of it is simple and understandable to everybody. A man who is not sure of his job will not spend his money. He will rather hoard it and it is difficult to blame him for so doing as against the day of want.[34]

Albert Einstein, the world's most celebrated physicist, believed this narrative in 1933, at the very bottom of the Great Depression, saying the Great Depression was the result of technical progress:

> According to my conviction it cannot be doubted that the severe economic depression is to be traced back for the most part to internal economic causes; the improvement in the apparatus of production through technical invention and organization has decreased the need for human labor, and thereby caused the elimination of a part of labor from the economic circuit, and thereby caused a progressive decrease in the purchasing power of the consumers.[35]

By that time, people had begun to label labor-saving inventions as "robots," even if there were no mechanical men to be seen. One article in the *Los Angeles Times* in early 1931, about a year into the Great Depression, said that robots then were already the "equivalent of 80 million hand-workers in the United States alone," while the male labor force was only 40 million.[36]

A Word Is Born: *Technocracy*

By 1932, the bottom of the stock market decline, the US stock market had lost over 80% of its 1929 value in less than three years. We have to ask: Why did people value the market at such a low level? A big part of the answer was a narrative that went viral: modern industry could now produce more goods than people would ever want to buy, leading to an inevitable and persistent surplus.

This new narrative became associated with two new words that left ordinary people out of the economic picture: *technocracy*, a society that is commanded by technicians, and *technocrat*, one of these now-powerful technicians. These words weren't new to the 1930s. They had been used occasionally in the 1920s to refer to a theory that the government should be run by scientists who could assure world peace. Thorstein Veblen had written a book, *The Engineers and the Price System*, during the previous depression, 1920–21, that envisioned a world run by a "soviet of technicians." But the words took on a new meaning with the explosion and duration of unemployment by the early 1930s. A Columbia University group with revolutionary pretensions called itself "Technocracy." Led by engineer Howard Scott, it was composed of scientists from across the United States. By 1933, Scott was as famous as movie stars of that day.

The technocracy movement created its own jargon and proposed a new kind of money, electric dollars. As explained in a 1933 book, *The A B C of Technocracy*, written under the supervision of Howard Scott and published under the pseudonym Frank Arkright, electric dollars represented units of energy. The name Arkright appears to have been inspired by the life of Richard Arkwright, the inventor of the spinning frame, a water-powered spinning machine that displaced jobs and resulted in antimachinery riots in 1779. The Arkright book and its ideas went viral, particularly with the idea that modern science would soon transform the economy, even eliminating money as we know it. The story has many similarities to the Bitcoin story, right down to the use of a pseudonym, Frank Arkright, like Satoshi Nakamoto.

According to *The A B C of Technocracy*, the US economy had an installed capacity of a billion horsepower. It also stated that one horsepower equals ten men's labor and that running the machinery for the ten laborers required only two eight-hour days a week. Thus the book gave credence to the idea that the rising unemployment of the Great Depression was the beginning of an alarming new permanent condition. The conclusions reached by one report were disturbing indeed:

> The situation we are now facing is entirely without precedent in human history, because up to less than 100 years ago the human body was the most efficient machine for energy conversion on earth. The advent of technology makes all findings based on human labor irrelevant because the rate of energy conversion of the modern machine is many thousand times that of man. Up to the year 1890 the movement of the social body in terms of energy production might be compared to the progress of an ox cart. Since 1890, by comparison, it has attained the speed of an aeroplane and is constantly accelerating.[37]

The idea that the world would now belong to the technicians who designed and ran the machinery was naturally frightening to those who did not deem themselves capable of becoming scientists—that is, most people—and it must have resulted in a hesitation to spend, invest, and hire, which worsened and prolonged the Great Depression.

The *New York Times* in 1933 described some amazement at the strength of the technocracy fad:

> The sensational nature of the technocratic case caused a mass movement that was almost hysterical. Many of those who read Scott's prediction that there would be 20,000,000 unemployed within two years unless something were done along lines set forth by him, vague as these were, looked to the imminent collapse of our industrial and economic system. Business contracts were even held up because of the fear engendered by technocracy.[38]

The technological unemployment narrative appears to have saturated the population by sometime in the 1930s. Afterward, references to it did not need to use the phrase *technological unemployment* because everyone understood the concept. For example, a long 1936 *New York Times* article deploring the tragic effects of long-term unemployment on the human spirit and on family relations did not refer to any theory of unemployment beyond stating that the unemployed people described "have been superannuated less by age than by newly invented machines."[39]

The Narrative Turns to World War II

Though the technological unemployment narrative faded after 1935 (as revealed by Google Ngrams), it did not go away completely. Instead, it continued to exert some influence in the run-up to World War II, until new narrative constellations about the war became contagious.

Many historians point to massive unemployment in Germany to explain the accession to power of the Nazi Party and Adolf Hitler in the election of 1933, the worst year of the Depression. But rarely mentioned today is the fact that a Nazi Party official promised that year to make it illegal in Germany to replace men with machines.[40]

Charlie Chaplin's 1936 movie *Modern Times* marks a narrative that was so powerful that it remains in collective memory today. The movie contained a hilarious scene[41] in which a company adopts a new technology that allows it to streamline the workers' lunch hour by having robotic hands feed the employee his lunch. When Charlie Chaplin is fed his lunch, the machine malfunctions and speeds up to such a rate that it creates a terrible mess. Not coincidentally, the story was contagious at a time of high concern with labor-saving machines.

Searching for mention of robots in the news during World War II, we find some examples. Early in the war a Yale scientist, Clark Hull, was working toward eventually developing armies of robot soldiers.[42] But the account of his efforts sounded far-off and far-fetched. The "robot bombs" and "robot planes" used by the Nazis later in the war were reported to be ineffective.[43] Instead, the news was filled with narratives of great heroism by real human soldiers.

To go viral again, the labor-saving machines narrative needed a new twist after World War II, a twist that could seem to reinforce the newly rediscovered appreciation of human intelligence, and, ultimately, of the human brain. The narrative turned to the new "electronic brains"—that is, computers. The phrase *electronic brain* has a beautiful epidemic curve peaking around 1960, which is indicative of a constellation of machines narratives then that we explore in the next chapter.

Chapter 14

Automation and Artificial Intelligence Replace Almost All Jobs

The narrative of technological unemployment as causing a problem for the indefinite future did not disappear with World War II. In fact, it repeatedly mutated and took on a different sort of virulence, often associated with the terms *automation* or *artificial intelligence*, as Figure 14.1 shows. There were at least four post–World War II narratives about artificial intelligence, peaking, respectively, in the 1960s, 1980s and 1990s, and 2010s. As of this writing, the artificial intelligence narrative of the 2010s looks to be heading even higher.

Each time, the narrative suggested that the world was only just now reaching a frightening major turning point when the machines take over. Because Rossum's Universal Robots (described in the preceding chapter) could talk, they represented a form of artificial intelligence, but there was no story regarding how such intelligence might be achieved. The robots were like the talking animals in children's stories. But the idea of automation and artificial intelligence repeatedly gained new epidemic proportions as the ideas took on new concreteness.

Fears of automation were likely associated with fears of an impending depression. A year-end 1945 *Fortune* public opinion survey conducted by Elmo Roper asked the US public:

> Do you expect we probably will have a widespread depression within ten years or so after the war is over or do you think we probably will be able to avoid it?

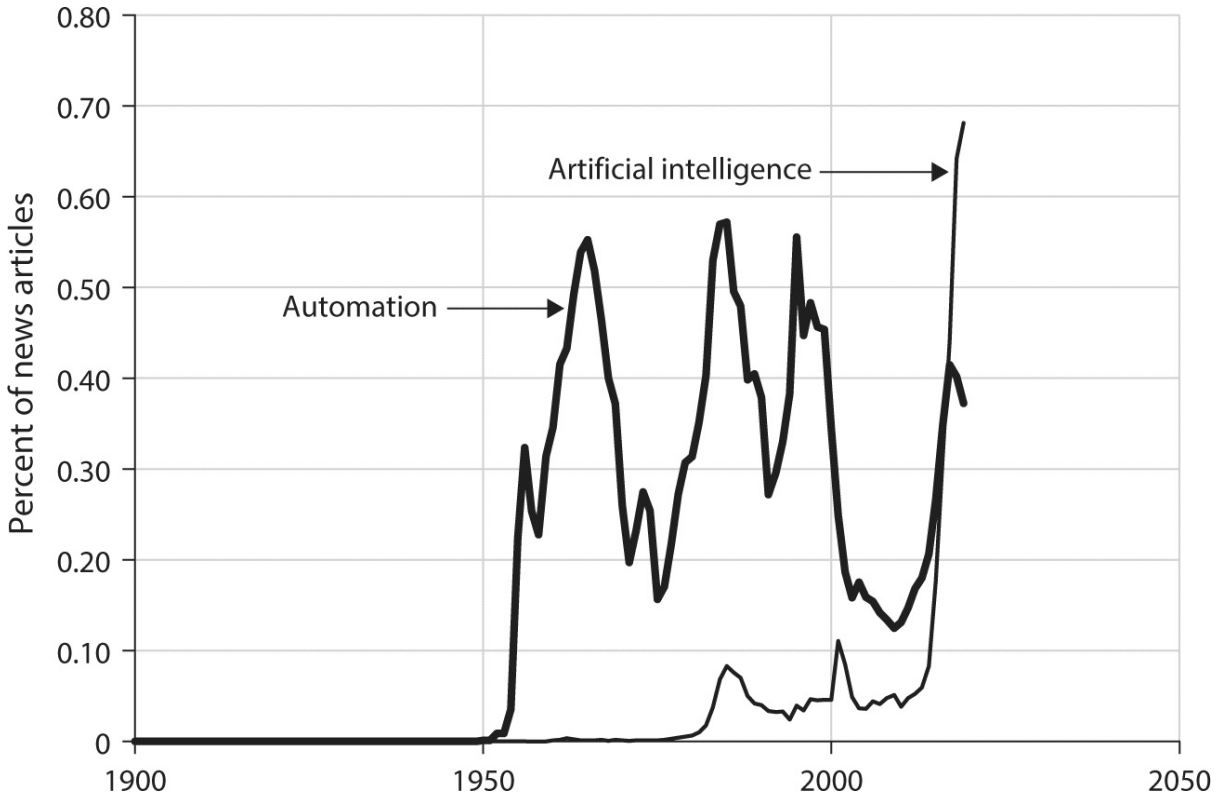


FIGURE 14.1. Percentage of Articles Containing the Words *Automation* and *Artificial Intelligence* in News and Newspapers, 1900–2019
The automation and artificial intelligence narratives have recurred several times, with variations in the story each time.
Source: Author's calculations from ProQuest News & Newspapers.

The results:

Per cent	
Have a depression	48.9
Probably avoid it	40.9
Don't know	10.2[1]

So about half the US population "expected" a depression after World War II. Most likely, their answers reflected their still-strong memories of the Great Depression and post–World War I narratives that we have discussed rather than any clear forecast.

Fortunately, these expectations were wrong; there was no recurrence of depression. Yes, there was a fatalistic fear of a returned depression, but the angry narratives of the recent depressions had faded, including the angry narrative of profiteering that contributed to the post–World War I depression. That narrative just did not restart. In addition, the idea that prices should fall to 1913 levels no longer seemed realistic. The end of World War II was also a distraction that temporarily reduced attention to technological unemployment. Instead, a constellation of economic narratives after World War II began to suggest that it was all right to spend money now that the war was over. (We discuss profiteering and the expectation of lower prices in more detail in chapter 17.)

Among these narratives was the story of the many expensive vacations that Americans were taking right after the war, which offset the frugality narratives of the Great Depression. "The greatest surge in travel in the history of the Americas" was on, and 1946, the year after the end of the war, was dubbed the "Victory Vacation Year."[2] Even a couple years before the war ended, travel agents and vacation resorts in the Western hemisphere had begun promoting the extravagant traveling victory vacation as a way for consumers to spend some of the wealth they'd socked away in government war bonds.

When the vacations actually happened in 1946, the vacationers duly recorded them on new Ready-Mounts (35mm color slides) and stored those slides in a new case that complemented last year's Christmas present, a slide projector.[3] Also, consumers used home movie cameras (which had been mostly unavailable until the years after World War I) to create extensive travelogues. These slides and movies of the vacation, as well as of the new baby (that's me, born in 1946), were shown to friends and relatives back home, spreading the sense of happy times and a patriotic feeling about the shared experience of spending extravagance.

People also began to see their new optimism bolstered by their perceptions of others' optimism. The baby boom, first noted in 1946, marked a big difference from the end of World War I, which was followed by a deadly influenza epidemic instead of a baby boom. The new optimistic stories after 1948 became a self-fulfilling prophecy, a term coined in 1948 by Robert K. Merton. A 1950 newspaper article asserted:

> With such an optimistic consensus as has developed at this year end, the forecasting itself can have the effect of helping to promote high activity.[4]

But the question we must ask is this: Why did so many people in 1945, at the end of World War II, expect a postwar depression? And why did the intermittent recessions in the 1950s and 1960s interrupt the overall optimism? The answer must lie in good part in a Great Depression narrative that still had intermittent power in the postwar period: the same technological unemployment narrative but in mutated form.

The Automation Recession Narrative

The same "zero hour" for the labor-saving machinery economic narrative that appeared in 1929 reappeared late in the second half of the twentieth century, but in mutated forms.

The term *singularity* began to be used after Einstein published his general theory of relativity in 1915. The word denotes a situation in which some terms in the equations became infinite, and it was used to describe the astronomical phenomenon of what came to be called the black hole: a "singularity in space-time." But later the glamorous term *singularity* came to be defined as the time when machines are finally smarter than people in all dimensions.

Such mutations in the economic narrative shifted attention from the muscles being replaced by electrical machines to the brain being replaced by artificial intelligence. The basic technological unemployment narrative is the same, but the examples have a wider scope. First, giant locomotives and electrical power equipment economized on human muscle power. After the mutation, the narrative focused on computers replacing human thinking. This mutation refreshed the narrative.

The term *automation* differs from *labor-saving* in that *automation* suggests no one is near the production process, except perhaps for a technician in a distant control room who presses buttons to start the process. Automation was then described starting in the 1950s not just as machines, but rather as "machines running machines."[5] It suggests a process that runs by itself with no one even paying attention.

Around 1955, the word *automation* suddenly launched into an epidemic. There was considerable public worry that jobs would be replaced. Notably, electronic data processing began to run whole business operations. The new narrative was of a more wholesale replacement of human involvement in production than in the technological unemployment narrative of the 1920s and 1930s. The year 1956 saw the first "automation strike … fomented by fear of the push-button age."[6] Stories were told of an unimaginable leap forward in automation. This from 1956:

> Visitors to an Eastern manufacturing plant stared in amazement recently as they viewed a new type of factory in operation. While they watched, enormous sheets of steel were fed into a conveyor system. Then the steel traveled along 27 miles of conveyors, was worked over by 2,613 machines and tools, and emerged as brand-new refrigerators—packed, crated, and ready for shipment.
>
> What amazed the visitors was the fact that no human hands touched the machines or steel while two gleaming-white refrigerators were being produced each minute.
>
> They were seeing automation in action.[7]

Automation was also seen as foretelling the imminent end of labor unions, which had stood up for workers' rights in the past. It is impossible for labor to organize the machines.[8]

Surveys of workers show a sudden shift around the time of the 1957–58 and 1960–61 twin recessions. Public opinion analyst Samuel Lubell, famous for his success at predicting election outcomes, wrote during the slow economy in 1959 between the two recessions:

> In the Spring of 1958 when I conducted a survey of how the public felt about the recession relatively few persons talked of automation, even as a cause of unemployment.
>
> Currently every third or fourth worker one interviews is likely to cite some case history, drawn from personal experience, of workers displaced by machinery.

> Often the tag line to these stories is the rueful comment, “Some men will never get back their jobs.” Some say, “It’s only the beginning.”
>
> The same gloomy prediction, “in two years a machine will be doing my job,” was voiced by an elevator operator on Staten Island, an accountant in Cleveland, a switchman in Youngstown and a railway clerk in Detroit.[9]

The twin recessions, the severest since the Great Depression, may have been caused by reduced spending attendant on public fears about the future amidst the automation scare. The 1957–58 recession was then dubbed “the automation recession.”[10]

The 1957 motion picture *The Desk Set*,[11] starring legendary actors Katharine Hepburn and Spencer Tracy, is set at a company about to acquire an IBM mainframe computer called Emerac. Hepburn plays the role of Bunny Watson, a super-knowledgeable reference librarian for the company. Tracy plays Richard Sumner, a computer engineer who is working on plans for the new computer. In the course of the movie Richard falls in love with Bunny and proposes to her, amidst tensions that he is working to destroy her livelihood. The movie notes that an earlier computer has already automated payroll and eliminated many jobs in the payroll department. Tension builds in the film when Emerac malfunctions and sends out pink slips firing not only Bunny but also everyone in the whole company. The mistake is later corrected.

The film shows the computer taking over some of the functions of the company’s reference library by answering questions typed on a console. For example, Emerac is asked, “What is the total weight of the earth?” Emerac answers, “With or without people?” (I recently asked the voice-activated Google Assistant, OK Google, the same question, and it answered matter-of-factly: 5.972×10^{24} kg.) Bunny then asks Emerac, “Should Bunny Watson marry Richard Sumner?” Emerac answers, “No,” perhaps suggesting that the computer was romantically involved with her creator. (I asked OK Google the same question, and it responded by directing me to a 2011 *New Yorker* article, “Is I-Pad the New Emerac?”)

Extensive concern about the dangers of automation continued into the 1960s. In 1962, the Center for the Study of Democratic Institutions issued a report on cybernation (a word that started to take off as a synonym for automation but fizzled after the 1960s). The report concluded that:

> Cybernation presages changes in the social system so vast and so different from those with which we have traditionally wrestled that it will challenge to their roots our current perceptions about the viability of our way of life. If our democratic system has a chance to survive at all, we shall need far more understanding of the consequences of cybernation.[12]

In 1963, labor leader George Meany tied a demand for a thirty-five-hour workweek to concerns about automation. In 1964, US president Lyndon Johnson signed into law during the presidential election a bill creating the National Commission on Technology, Automation, and Economic Progress. The commission’s report[13] was delayed until 1966, when the scare was mostly over.

The 1957–66 automation scare seemed to dissipate rather quickly, and for a number of years. In 1965, the *Wall Street Journal* ran a story by Alfred L. Malabre, Jr., titled “Automation Alarm Is Proving False.” The article noted that people in 1965 seemed just to have forgotten about automation. Malabre found it interesting that automation wasn’t even mentioned at a major United Auto Workers labor convention in 1965. The article concluded, “The degree to which this pessimism pervaded the leading councils of labor, the campus, the Government and even management was, to say the least, extensive.”[14]

Star Wars Stories

The automation scare came roaring back to life in the 1980s. We've seen that narratives often recur in mutated forms. Sometimes the new narratives make use of new words, but sometimes an old word comes back. Figure 14.1 shows an enormous spike of *automation* in the early 1980s. Use of the word *robot*, coined in the 1920s, also shows an enormous spike in the early 1980s. One possible explanation: the contagiousness of robot stories was encouraged by the phenomenal success of home computer manufacturers Atari and Apple, which led people to believe that technical progress was accelerating. A company called The Robot Store began manufacturing and selling humanoid robots in 1983. These robots looked like people, and the company's president predicted that between 10% and 20% of American households would own robots within two years.[15] In fact, these devices were practically useless, and the product line flopped.

Consistent with this observed spike of the word *robot* around 1980, we observe a sequence of very successful robot movies around the same time, showing how contagion can change over time and bring new viral stories with it. George Lucas's *Star Wars* trilogy, a sequence of three movies that appeared between 1977 and 1983, featured the world's most famous (to date) robots, R2-D2 and C-3PO. The American television cartoon feature *The Transformers*, which focused on the adventures of gigantic robots with the ability to transform themselves into vehicles and weaponry, aired from 1984 to 1987. Both of these series were accompanied by massive sales of children's toy figures. *Blade Runner* (1982) and *The Terminator* (1984) were other successful robot films of that time.

Of course, robots had appeared in movies long before the 1970s, and they continue to do so today. In fact, robots in movies precede even the word *robot* coined by Čapek, the Czech playwright, which started to go viral in 1922. Notably, film robots (or automatons) were called *dummies* (as in *The Dummy*, 1917) or *mechanical men* (as in *L'uomo meccanico*, 1921). Many more robots appeared in movies after 1922, notably Futura in Fritz Lang's 1927 *Metropolis*, which called a robot a Machinen-Mensch, or Machine-Man. However, most films featuring robots were B-grade horror movies with wildly implausible and juvenile themes, analogous to space-aliens-destroy-the-world films that have had relatively little impact on public thinking.[16] These mostly silly movies probably did not have much impact on economic activity except where they may have lent emotional color to fears about the automated future.

Another spike in successful robot movies preceded the automation scare, 1957–64. Film robots of that era included Ro-Man in *The Robot Monster* (1953), Tobor (robot spelled backward) in *Tobor the Great* (1954), Chani in *Devil Girl from Mars* (1954), the Venusian Robots in *Target Earth* (1954), Robby the Robot in *Forbidden Planet* (1956), Kronos in *Kronos: Destroyer of the Universe* (1957), the Colossus in *The Colossus of New York* (1957), and M.O.G.U.E.R.A. in *The Mysterians* (1957).

A significantly mutated form of the automation narrative came back with the twin recessions of 1980 and 1981–82, when the unemployment rate reached into the double digits. The unemployment encouraged the thought that automation might again be responsible for the loss of jobs, an idea that must have fed back into reduced aggregate demand and even higher unemployment. In 1982, Andrew Pollack of the *New York Times* discerned a "new automation," exemplified by the now very visible beginnings of automation of offices:

> Those affected so far by office automation have been mainly secretaries—who are still in short supply—and other clerical workers, whose tasks can be speeded by replacing typewriters with electronic word processors and filing cabinets with computerized storage systems. But new office automation systems are affecting management as well, because they give managers the ability to call up information out of the company computers and analyze it themselves, a function that once required a staff of subordinates and middle-level management.[17]

Once again, a narrative went viral that we had reached a singularity that made all past experience with labor-saving machinery irrelevant, that might just now be producing a huge army of unemployed. "I don't see where we can run to this time,"[18] Pollack says. This viral narrative may well be the real reason that these twin 1980s recessions were so damaging.

As Figure 14.1 shows, there was a third spike in *automation* around 1995. Once again, narratives surged that a singularity was at hand that made all past experience with labor-saving devices obsolete. In 1995 at the very beginning of the Internet boom, there was a narrative about the advent of computer networks:

> Most economists think the ill-effects of automation are transitory, but a growing minority of their colleagues and many technologists think the current surge of technological change differs from anything seen before, for two reasons.
>
> First, tractors put only farmers out of work, and machine-tool automation only factory workers, but smart devices and computer networks can invade almost every job category involving computing, communicating or simple deduction. They can fill out and check mortgage-loan forms and transfer phone calls, and even allow cows to milk themselves without human assistance at microcontrolled milkers. No technology has ever been as protean, so unrestrained by physical limits, so capable of cutting huge swaths through unrelated industries such as banking, power utilities, insurance and telecommunications.
>
> Second, the power of devices and networks run by microprocessors and software is increasing at a rate never seen before, roughly doubling in performance every 18 months or so. Among other things, this trend leads to unprecedented reductions in the cost of microchip-based technology, allowing it to be used much more widely and rapidly.[19]

This new twist in the fear-of-automation narrative around 1995 did not immediately produce a recession. Most people were not moved to curtail spending because of it, and the world economy boomed. The dominant narratives in the 1990s seemed to be focused on the wonderful business opportunities brought by the coming new millennium. The automation narratives trailed off again in the 2000s, with the distractions of the dot-com boom, the real estate boom, and the world financial crisis of 2007–9. But the automation narratives are still with us, described by new catchphrases.

The Dot-Com or Millennium Boom in the Stock Markets

The Internet, first available to the public around 1994, launched a narrative of the amazing power of computers. Before the turn of the century, the Internet Age appeared to coincide with the coming of the new millennium in 2000, much talked about when it was an imminent future event. Dot-com stocks were the primary beneficiaries in the years leading up to 2000. During the market expansion from 1974 to 2000, stock prices rose more than twentyfold.[20] The period marked the biggest stock market expansion in US history, and descriptions of the expansion suggested exactly that. (This story is beginning to be forgotten now, as it is being replaced by the narratives surrounding the mere threefold expansion following the world financial crisis of 2007–9, which are more contagious at the time of this writing.)

Discussions of the stock market expansion in the last quarter of the twentieth century did not stress fears of being replaced by machines as a motive to buy dot-com stocks. Why? People tend to speak more of the opportunity provided by investments in information-age inventions than of their personal feelings of inadequacy in the face of technological progress. But it appears that such feelings may have driven people's motivation to be part of the dot-com phenomenon as the stockholders of tech companies.

Fears of the Singularity Gain Strength after the 2007–9 World Financial Crisis

According to Google Trends, the latest wave of automation/technology-based fears began around 2016 and continues unabated at the time of this writing.

How do we explain this recent surge in automation fears? To answer this question, we must consider the advent of Apple's Siri, the iPhone app launched in 2011 that uses automatic speech recognition (ASR) and natural language understanding (NLU) to (attempt to) answer the questions you've asked it.[21] To many, Siri's ability to talk, understand, and provide information looked like the advent of that long-awaited singularity when machines become as smart as, or smarter than, people. That same year, IBM presented its talking computer Watson as a competitor on the television quiz show *Jeopardy*, and Watson beat the human champions who played against it. Now these are followed by Amazon Echo's Alexa, Google's "OK Google," and other variations and improvements such as Alibaba's Tmall Genie, LingLong's DingDong, and Yandex's Alice. These inventions were amazing; the time prophesied by *Star Wars*, *The Transformers*, and *The Jetsons* seemed finally to have arrived.

Apple bought Siri from its creator, SRI (Stanford Research Institute) International, which had developed it with government funding from the US Defense Advanced Research Projects Agency (DARPA) between 2003 and 2008. These earlier projects did not go viral; 2011 was the year in which, suddenly, people had a device in their pockets to talk with and to show off to almost-unbelieving admirers. Siri, and its soon-to-follow competitors, seemed to start the process of eliminating the need for human conversation. We might imagine preferring Siri as a conversation partner to a human, because Siri's information is much more comprehensive and reliable. The idea that humans were ultimately replaceable was a scary thought, and it is easy to imagine a resulting loss of humanity's collective self-esteem.

Around the same time, other inventions also attracted great public attention, notably driverless cars, which, despite some worries about safety, are predicted to replace many jobs. Though very few of us had actually seen a driverless car, we all knew that prototypes were already on our highways. These autonomous vehicles can already do things that we assumed were not programmable, like slowing down when the car senses children running around near the street. Human common sense can be reduced to a list of signals to a driverless car, which means that human common sense can be replaced.

Recent talk has stressed machine learning, in which computers are designed to learn for themselves rather than be programmed using human intelligence. A Google Trends search for Web searches for *machine learning* reveals a strong uptrend since 2012, with the Google search index more than quadrupling between 2004 and 2019. The narrative is propelled by recent stories. The highly successful chess computer program AlphaZero is described as working purely through machine learning—that is, without use of any human ideas about how to play chess. This narrative describes a tabula rasa program that plays vast numbers of chess games against itself, given no more information than the rules of the game, and learns from its mistakes.[22] In some ways, the machine learning narrative is more troubling than computers running human-generated programs. Historian Yuval Noah Harari describes this narrative as leading toward a "growing fear of irrelevance" of ourselves and worries about falling into a "new useless class."[23] If they grow into a sizable epidemic, such existential fears certainly have the potential to affect economic confidence and thus the economy.

Of Jobs and Steve Jobs

The story of Steve Jobs is a remarkable narrative that ties into the fear of job loss to mechanization. His story was told in many books that appeared around the time of the 2007–9 world financial crisis. Particularly notable was the 2011 book *Steve Jobs* by Walter Isaacson, which sold 379,000 copies in its first week on sale,[24] became a number-one *New York Times* best seller, and has over 6,500 reviews on Amazon with an average ranking of 4.5 stars out of 5. Isaacson specializes in biographies of geniuses (including Albert Einstein, Benjamin Franklin, and Elon Musk), but his book about Jobs was by far his most successful. Why did his book about Jobs go viral? Part of the answer was the timing: the publisher wisely dropped it into the market just weeks after Jobs's death, allowing the news media narrative of his death to interact with the talk about the book.

Interestingly, the Steve Jobs narrative makes it appear that Jobs, a real human being with quirks that no one would program into a robot, was totally indispensable for Apple Computer. Jobs's own story therefore became appealing to people who worry about their own possible obsolescence. He founded the company but was forced out, the story goes, because drab managerial types could not tolerate his eccentricities. When Apple began to fail, he was called back and breathed new life into the company, which is today one of the most successful in the world. The Steve Jobs narrative is a fantasy for people who don't quite fit into conventional society, as many people with inflated egos but modest success in life may see themselves.

Economic Consequences of the Narratives about Labor-Saving and Intelligent Machines

We have traced much popular attention over two centuries to narratives about machines that will replace jobs. These narratives certainly affected, and continue to affect, people's willingness to spend on consumption and investments, as well as their eagerness to engage in entrepreneurship and speculation. The economic hardships created by a temporary recession or depression are mistaken for the job-destroying effects of the machines, which creates pessimistic economic responses as self-fulfilling prophecies.

Henry George's solution to the labor-saving machines problem—and the defining proposal of his book *Progress and Poverty*, published during the depression of the 1870s—was to impose a single tax on land, to tax away the labor-saving inventions' benefits to landowners. George's proposal assumed that the sole purpose of the new machines was to work the land, which might be the case if the economy is purely agricultural. This proposal is analogous to the much-discussed "robot tax" that appeared in public discussion during the Great Depression and has reappeared in the last few years. Taxing companies that use robots, the argument goes, will provide revenue to help the government deal with the unemployment consequences of robotics.[25]

George proposed to distribute part of the tax proceeds as a "public benefit."[26] His proposal is essentially the same universal basic income proposal that is talked about so often today:

> In this all would share equally—the weak with the strong, young children and decrepit old men, the maimed, the halt, and the blind, as well as the vigorous.[27]

Other incarnations of the universal basic income proposal were offered by Lady Juliet Rhys-Williams in a 1943 book, *Something to Look Forward To; a Suggestion for a New Social Contract*, and by Robert Theobald in a 1963 book, *Free Men and Free Markets*. The Basic Income European Network (BIEN), an advocacy group, was founded in 1986 and later renamed the Basic Income Earth Network. The narrative that the future will be jobless for many or most people has helped sustain support for a progressive income tax and for an earned income tax credit, though in modern times it has not succeeded in producing a universal basic income in any country.

The mutating technology/unemployment narrative tends to attract public attention when a new story creates the impression that the problems generated by technological unemployment are reaching a crisis point. A celebrated 1932 book by Charles Whiting Baker, *Pathways Back to Prosperity*, sought to explain why the public's concerns about labor-saving machines replacing jobs were wrong until *now*, the early 1930s. Baker emphasized the newness: "The widespread use of automatic machinery and economic transportation is only a thing of yesterday." He stressed that unemployment was a new long-term problem, not going away, ever. Thus Baker advocated something like a universal basic income for all:

> We have got to face the fact that there is one way, and only one, whereby we can make a market for our huge surplus of goods.… Increase the purchasing power of the 95 percent of the families of the United States who have only tiny incomes, and they will at once buy more.[28]

Recent years have seen a renewal of this great wave of concern as new redistribution

proposals are put forth and discussed. Notably, Google Trends shows a huge uptrend in searches for the term *universal basic income* starting in 2012. ProQuest News & Newspapers reveals essentially the same uptrend. Public attention to inequality has burgeoned, with much attention to the increased share of income by the top 1% or the top one-tenth of 1%. Thomas Piketty's *Capital in the Twenty-First Century*, which described this trend, was a best seller that generated intense discussion. The term "digital divide" has gone viral, describing a sort of inequality related to access to digital computers.

No one can predict the effects of labor-saving and intelligent machines on livelihoods and work in the future, but the narratives themselves have the potential to drive amplified economic booms and recessions, as well as public policy. The narratives at the time of this writing about artificial intelligence and machine learning replacing human intelligence and disintermediating skilled workers lend an instability to expenditure and entrepreneurship patterns. These and other economic narratives may show up in the speculative markets, notably the real estate markets and the stock markets, to which we turn in the next two chapters.

Chapter 13. Labor-Saving Machines Replace Many Jobs

1. Our word *automatic* goes back to the seventh century BCE, Homer's *Iliad*, bk. 18, line 376: "Him [Hephaestus] she found sweating with toil as he moved to and fro about his bellows in eager haste; for he was fashioning tripods, twenty in all, to stand around the wall of his well-builded hall, [375] and golden wheels had he set beneath the base of each that of themselves (αὐτόματοι) they might enter the gathering of the gods at his wish and again return to his house, a wonder to behold." http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.01.0133%3Abook%3D18%3Acard%3D360.

2. Aristotle, *Politics*, trans. Benjamin Jowett, bk. 1, pt. 4.

3. Argersinger and Argersinger, 1984. However, Walter Smith, in his 1879 book on the causes of the depression of the 1870s, makes no mention of labor-saving machines. The narrative did not reach everyone.

4. *Visitors' Guide to the Centennial Exhibition and Philadelphia* (Philadelphia: Lippincott, 1876), https://archive.org/details/visitorsguidetoc00phil.

5. *Visitors' Guide to the Centennial Exhibition and Philadelphia*.

6. Charles M. Depuy, "The Question of the Hour," *Philadelphia Inquirer*, February 3, 1876, p. 1.

7. "Labor-Saving Machinery," *Daily American*, December 11, 1879, p. 2.

8. "Labor-Saving Machinery."

9. George, 1886 [1879], pp. 227–28.

10. "The General Omnibus Company of Paris," *Times of India*, June 4, 1879, p. 3.

11. "Labor-Saving Machinery and Overproduction," *Los Angeles Times*, June 28, 1894, p. 4.

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14. "Stores Are Merely Labor-Saving Machines," *Chicago Daily Tribune*, March 14, 1897, p. 26.

15. "Trade Unionists' Remedy," *Boston Daily Globe*, April 24, 1899, p. 5.

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21. Chase, 1929, p. 209

22. Chase, 1929, pp. 215–16.

23. Chase, 1929, p. 323. Chase used the phrase "technological unemployment" (p. 212), but only rarely.

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27. "Topics of the Markets: Another Gloomy Day on the Stock Market," *Globe and Mail*, October 29, 1929, p. 8. "Ford Would Raise Wages, Cut Prices Down to Actual Values," *St. Louis Post-Dispatch*, November 21, 1929, p. 2a.

28. Cassel, 1935, p. 66.

29. "Text of Governor Roosevelt's Address Opening His Campaign," *New York Herald Tribune*, August 21, 1932, p. 17.

30. Chester C. Davis, "Underconsumption of Goods: A Challenge to the Nation," *New York Times*, December 9, 1934, p. XX5.

31. See Balderrama and Rodríguez, 2006.

32. "Senators Invoke Ancient Rights Declare War on Dial Phone," *Baltimore Sun*, May 23, 1930, p. 2.

33. Fred Hogue, "Robots Menace World's Wage-Earners," *Los Angeles Times*, February 1, 1931, p. 23.

34. "Fear of Losing Job Makes Worker Curtail Spending," *Boston Globe*, November 1, 1931, p. A60.

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Chapter 14. Automation and Artificial Intelligence Replace Almost All Jobs

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