



How to Reform Worker-Training and Adjustment Policies for an Era of Technological Change

BY ROBERT D. ATKINSON | FEBRUARY 2018

Rather than slow down change to protect a small number of workers at the expense of the vast majority, policymakers should focus on doing significantly more to help workers transition easily into new jobs and new occupations.

There has been growing speculation that a coming wave of innovation—indeed, a tsunami—powered by artificial intelligence (AI) and robotics, will disrupt labor markets, generate mass unemployment, and shift the few jobs that remain into the insecure “gig economy.” Kneejerk “solutions” from such technology Cassandras include ideas like taxing “robots” and implementing universal basic income for everyone, employed or not. The first would slow needed productivity growth, employed or not; the second would reduce worker opportunity.

The truth is these technologies will provide a desperately needed boost to productivity and wages, but that does not mean no one will be hurt. There are always winners and losers in major economic transitions. But rather than slow down change to protect a modest number of workers at the expense of the vast majority, policymakers should focus on doing significantly more to help those who are dislocated transition easily into new jobs and new occupations. Improving policies to help workers navigate what is likely to be a more turbulent labor market is not something that should be done just out of fairness, although it is certainly fair to help workers who are either hurt by change or at risk of being hurt. But absent better labor market transition policies, there is a real risk that public and elite sentiment will turn staunchly against technological change, seeing it as fundamentally destructive and unfair. If this happens, it will undermine support for policies that are necessary to speed automation, and it could even build support for policies that “throw a wrench” into the innovation machine. Better transition policies will have the opposite effect—they will boost GDP and help employers facing worker shortages.

When it comes to labor market adjustment policies, most nations, including the United States, can and should do better. This report first discusses the recent and current views of

technological change and employment. It then examines six issues related to technological innovation and implications for the labor market (overall number of jobs, employment relationships, income inequality, job quality, employment tenure, and worker dislocation and transition). Finally, it lays out an actionable policy agenda to ensure that workers are better positioned to navigate a potentially more turbulent, but ultimately beneficial labor market. There are four key factors that are important to reduce the costs of worker dislocation: 1) supporting full employment, nationally and regionally, not just with macro-economic stabilization policies, but also with robust regional economic development policies; 2) ensuring as many workers as possible have needed education and skills before they are laid off; 3) reducing the risk of income loss and other financial hardships when workers are laid off; and 4) providing better transition assistance to help laid off workers find new employment. Each is an area where there is more the federal government should be doing. Before turning to that discussion, it's important to articulate several key principles that should guide policymakers as they consider this issue.

Principle 1: Embrace the next technological wave. Technology-driven innovation is central to the process of increasing living standards. That is because better “tools” allow us to produce better products and services more efficiently. It is only by boosting productivity that workers can earn more and companies can lower prices, both of which increase living standards. Ensuring robust productivity growth going forward will be critical for developed economies as they face an aging population and a declining ratio of workers to non-workers. Yet some, such as Bill Gates and economist Robert Schiller, have called for governments to slow the pace of technological innovation, either with outright bans, restrictive regulations, or taxes on “robots.”¹ Policymakers need to firmly reject such proposals as anti-progress and instead support policies that enable the development and adoption of these technologies by all industries and organizations.

Principle 2: Support a full-employment economy. It is extremely likely that the pace of technologically driven employment disruption will increase somewhat over the next several decades. Affected workers will have much easier times making successful transitions if the unemployment rate is low, not just nationally but also in the geographic labor markets where they live. This means that nations need to ensure that national monetary policy tilts toward full employment; that nations have in place effective national economic competitiveness strategies; and that policies to support economic development in lagging regions are well funded and effectively implemented.

Principle 3: Focus on helping dislocated workers make speedy and successful transitions. In a natural impulse to alleviate hardship, some want to provide laid-off workers with very generous benefits extending for as long as they are unemployed. Others want to limit organizations' abilities to lay workers off in response to technological change. Still others call for universal basic income for all workers. Embracing these ideas would slow economic growth and harm the very workers they are intended to help.

Rather, America needs a comprehensive, high-quality, and flexible reemployment system, along the lines that world leaders such as Scandinavian nations and Singapore have put in place. Policymakers should embrace the concept of “flexicurity,” as Scandinavian nations have, which commits not to ensuring that workers will never get laid off or paying them for long periods to the unemployed, but to minimizing the number of workers at risk; and then, for those who are laid off, providing support so they can make successful and expeditious transitions. Policymakers also should adopt the operational models of some of the world’s best-in-class programs, particularly Singapore’s Skills Future program. The lessons from Singapore are fourfold. First, federal policy needs to make a major commitment to skill development and workforce transition. Second, such efforts need to be closely linked to employers and markets (e.g., through vouchers and credits). Third, such efforts need to be much more flexible and less bureaucratic than existing efforts and take full advantage of advanced information technology tools. Finally, incremental changes in existing institutional arrangements are not enough. If policymakers are to respond effectively to the challenges of a more turbulent labor market, they will need to drive significant institutional reform. For example, U.S. federal and state governments should work to repurpose some public four-year colleges away from being broad liberal arts institutions to becoming more mission-focused on spurring employer-based skills development. Likewise, Congress should increase the federal unemployment insurance tax rate and dedicate funding to support industry-led skills initiatives, including apprenticeships, and an expansion of the Trade Adjustment Assistance Act to include workers losing their job due to technological change.

To support these principles, this report offers the following policy recommendations in four main areas:

Ensure Full Employment, Nationally and Regionally

- Commit to running a full-employment economy.
- Expand funding for the Economic Development Administration (EDA) to support a modest number of targeted regional “growth poles.”
- Support programs focused on industry and firm competitiveness, including the National Institute of Standards and Technology’s Manufacturing Extension Partnership and the Export-Import Bank.

Ensure Workers Have Needed Competencies Before They Are Laid Off

- Push high schools to teach skills more relevant to the job market.
- Establish federal programs to help separate learning from higher-education credentialing.
- Encourage the creation of new kinds of technical colleges.
- Reduce funding inequality between four-year colleges and community colleges.
- Enable students taking short-term courses for occupational credentials to qualify for Pell grants and other federal aid.

-
- Expand the National Science Foundation’s Advanced Technological Education Program.
 - Boost information and communication technology skills, including through federal incentives for universities to expand computer science programs.
 - Establish a knowledge tax credit that would allow firms to take a tax credit for expenditures on both research and development and workforce training.
 - Expand Section 127 tax benefits for employer-provided tuition assistance.
 - Establish wider use of skills credentialing.
 - Support industry-led, sector-wide training and development plans.
 - Promote an “Investors in People” program for companies.
 - Establish a dedicated funding stream for industry-led regional skills alliances, such as through the Investments in CTE Community College to Career Fund Act.
 - Support apprenticeship programs.
 - Better target federal higher education funding to institutions that serve large numbers of low-income students in high-demand fields.

Reduce Financial Hardships for Laid-Off Workers

- Establish a stronger federal floor under state unemployment insurance systems by increasing the federal unemployment tax act (FUTA) rate.
- Institute wage insurance for workers who lose their jobs through no fault of their own.
- Expand the Trade Adjustment Assistance (TAA) program into a comprehensive Trade, Technology, and Policy Adjustment Assistance Act (TTPAA), to help all workers displaced by trade, technology, or government policy decisions.

Provide Better Transition Assistance to Help Laid-Off Workers Find New Employment

- Provide incentives for employers to pay into Job Security Councils.
- Support existing job-search assistance programs.
- Establish portable training accounts.
- Engage the private sector to run and operate online re-employment web portals.
- Better enable workers to receive unemployment insurance while they are in training by instituting stronger requirements on states.

TECHNOLOGICAL CHANGE AND THE FUTURE OF THE LABOR MARKET

It seems as if a day cannot go by without a new story warning that the “robots” are coming for our jobs. Yet such fears are not new. They are a recurring theme in American economic history, especially during periods of economic downturn in the business cycle. What is different now is that unlike the past when such claims never generated support for slowing

down the technological change, today's fears are leading far too many to suggest that we put on the technological brakes.

When factory automation took off in the late 1950s and early 1960s, increased national concerns centered on the employment effects of automation and productivity. Such concerns entered into the popular imagination of the day, with TV shows and news documentaries and reports worrying about the loss of work. One particularly telling episode of 'Twilight Zone' documented a dystopian world in which a manager replaces all his firm's workers with robots, only to find himself in the final scene being replaced by a robot.

So great was concern with automation and the rise of push-button factories, that the Congressional Joint Economic Committee held extended hearings on the matter in 1955. In the midst of an economic recession in 1961, John Kennedy created an Office of Automation and Manpower in the Department of Labor (DOL), identifying "the major domestic challenge of the Sixties—to maintain full employment at a time when automation, of course, is replacing men." In 1964, President Johnson appointed a National Commission on Technology, Automation, and Economic Progress. But soon after the economy rebounded, generating millions of jobs, low unemployment, and robust wage growth, so everyone quickly put this issue in the rearview mirror.

In the early 1980s, immediately following a severe "double-dip" recession, and when artificial intelligence was once again advancing, many warned that AI would produce mass unemployment. AI scientist Nil Nilson warned, "We must convince our leaders that they should give up the notion of full employment. The pace of technical change is accelerating." Labor economist Gail Garfield Schwartz predicted, "With AI, perhaps as much as 20 percent of the work force will be out of work in a generation." And economist Wasily Leontif predicted:

We are beginning a gradual process whereby over the next 30-40 years many people will be displaced, creating massive problems of unemployment and dislocation. In the last century, there was an analogous problem with horses. They became unnecessary with the advent of tractors, automobiles, and trucks. ... So what happened to horses will happen to people, unless the government can redistribute the fruits of the new technology.²

Today, in the wake of the Great Recession and slow labor force and GDP growth in many nations, those fears have come back, based on overzealous predictions of unprecedented technological change. Pundits use a variety of terms to refer to the supposed technological transformation, including "the Second Machine Age," "the Rise of the Robots," and "the Coming Singularity." But perhaps the most commonly referenced term is the "4th Industrial Revolution," coined by Klaus Schwab, head of the World Economic Forum. He breathlessly writes, "We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced

Today's fears are leading far too many to suggest that we put on the technological brakes.

before.”³ Such pundits tell us that powered by artificial intelligence, autonomous vehicles, robots and other breakthroughs, change will come at rates that will make the Industrial Revolution look like a period of stability.

If this were true it might be cause for concern, for it suggests that history, which has never produced high and permanent levels of technological-driven unemployment, provides no guide to the present. But, luckily, it is highly unlikely to prove true.

Before discussing why this is not true, it’s important to get the analysis of technology periods right. Despite Schwab’s insistence, the next innovation wave is not the fourth, it’s the sixth. In Schwab’s sweeping, but shallow, historical telling, the first revolution of steam power was in the late 1700s and early 1800s. Then came electric power in the early 1900s. Then a few years ago we got digital technologies. Now the fourth wave is supposedly upon us.

There will be a next wave of innovation, but it will not be an unprecedented tidal wave of transformation, but rather a moderate increase in innovation that will hopefully kick in by at least the mid-part of the next decade.

But for historians of technology such periodization makes little sense. Those who follow the work Joseph Schumpeter and study technology long-waves generally agree that there have been five waves to date: 1) the first industrial revolution of the steam engine in the 1780s and 1790s; 2) the second revolution of iron in the 1840s and 1850s; 3) the third revolution of the 1890s and 1900s based on steel and electricity; 4) the fourth revolution in the 1950s and 1960s based on electromechanical and chemical technologies; and 5) the fifth, our present era, based on information technology and communications technology.⁴ According to this periodization, a sixth wave will likely emerge, probably grounded in AI, robotics, and perhaps nanotechnology and biotechnology, but not before an intervening period of relative stagnation of perhaps as long as 20 to 25 years, a period the global economy appears to be currently suffering through. Indeed, the current fifth-wave digital technology system has reached a spot near the peak of on the “S-curve” where it is difficult for it to continue to drive productivity at a robust rate. This, more than any other factor, explains the slowdown in global productivity over the last decade.⁵

This more-accurate periodization points to several important conclusions. First, despite the talk about economies being in the midst of a fourth industrial revolution, the sixth technology wave is not here yet, and won’t likely be for at least another decade. For the history of past long waves suggests that there is an intervening period of relative stagnation between the exhaustion of one wave and the robust adoption of the next wave of innovations. This gap relates in large part to the immaturity and relatively high prices of the emerging technology system at the early stages of introduction.⁶

Second, this suggests that there is no reason to believe that this coming technology wave will be any different in pace and magnitude than past waves. Each past wave led to improved technology in a few key areas (e.g., steam engines, railroads, steel, electricity, chemical processing, information technology, etc.) and these were then used by many sectors and processes. But none completely transformed all industries or processes; within manufacturing, for example, each wave led to important improvements, but there were still many processes that required human labor.

The next wave, grounded in artificial intelligence and robotics, will be no different. While it will no doubt affect many industries, processes, and occupations, many will remain largely untouched, at least in terms of automation: think of firefighters, pre-school teachers, massage therapists, barbers, executives, legislators, athletes, and trial lawyers. Moreover, while these emerging technologies will replace some workers—that is largely how economies boost productivity and per-capita income—as all past waves have done, they will also augment others. AI, for example, won't replace doctors, but it will help them make better diagnoses and treatment decisions. Some technologies substitute for workers; others complement workers. This is why the Information Technology and Innovation Foundation (ITIF) estimated that only about 8 percent of jobs will be at high risk of automation by 2024.⁷

In response to this argument, the “4th industrialists” tell us that computer systems with powerful “artificial general intelligence” (AGI) are just around the corner. For them AGI and human-like robots will eclipse the full range of human ability—not only in routine manual or cognitive tasks, but also in more complex actions or decision-making. But there is about as much chance of AGI emerging in the next century as the earth being destroyed by an asteroid. As MIT computer science professor Rodney Brooks puts it:

The fears of runaway AI systems either conquering humans or making them irrelevant aren't even remotely well grounded. Misled by suitcase words, people are making category errors in fungibility of capabilities—category errors comparable to seeing the rise of more efficient internal combustion engines and jumping to the conclusion that warp drives are just around the corner.⁸

To be sure, there is progress in AI, including in machine learning, but these are still and will remain discrete capabilities (recognizing fraud in financial transactions, for example), not a general replication of vastly more complex human intelligence.

This relates to the second important issue: the pace of change from the technologies. If the next wave increases economy-wide productivity by 75 percent, but takes 30 years to do so, this would mean a modest annual growth rate of less than 3 percent, on par with the historical rates of growth in developed nations when labor force adjustment proceeded apace. But if this happens over 10 years, it surely would mean a much faster rate of dislocation. And here again, without evidence, the 4th industrialists assert that the coming pace of change will be unprecedented.

But past long-wave transformations have taken at least 30 years to work their way from initial introduction to close to full “installation.” There are three reasons for this relatively measured pace. First, new technology systems don't emerge fully formed. Early versions are less advanced than later ones. We saw this with the electric motor introduced in the early 1910s. It took decades for improvements in power, price, and quality to enable electric motors to be transformative. Going forward we will likely see this pattern in many technologies, such as autonomous vehicles (AVs). The best (and quite expensive) current

Not only is the notion that productivity kills jobs rebutted by history and logic, virtually all academic studies on the topic have found that productivity increases do not decrease the number of people working or raise the unemployment rate.

autonomy technology is at what is referred to as level 3, where drivers are still necessary for many functions. Level 5 cars that are affordable—where the human can go on a long, complicated trip asleep in the backseat—are decades away. Second, even though new technologies are better than old, old technologies are usually not completely scrapped, at least until their value is significantly depreciated. This means a much slower process of change than many techno-futurists postulate. Trucking companies, for example, will not suddenly toss all their expensive semis in the junk yard even if affordable self-driving trucks emerge. Third, not all organizations are first adopters. As the literature on diffusion of innovation clearly shows, some adopt early, most adopt in a middle stage after the technology is de-risked, and some late.⁹

So, yes, there will be a next wave of innovation, but it will not be an unprecedented tidal wave of transformation, but rather a moderate increase in innovation that will hopefully kick in by at least the mid-part of the next decade and will likely take at least 20 years to diffuse through economies, leading to an increase in economy-wide labor productivity growth of, at best, 3 to 4 percent per year.

MAJOR ISSUES OF CONCERN

Notwithstanding that the next wave will not be unprecedented, there still could be negative impacts policymakers need to prepare for and mitigate. However, there will also be benefits, something 4th industrialists usually ignore. Most importantly, the next wave will raise productivity growth rates. Most developed nations' productivity rates, including the United States', have been growing anemically. Without productivity growth to create a "bigger pie" there is no way for living standards to increase, especially given that the worker-to-retiree ratio will decline over the next two decades as baby boomers retire. But this does not mean that there may not be some negative impacts from the next wave of innovation, like we have seen with every earlier wave. However, most of these fears are unwarranted and the main one, job dislocation, can and should be addressed by smart policies as detailed below.

Unemployment

Let's start with unemployment. The next wave will lead to massive job loss and elevated unemployment, 4th industrialists warn. The widely repeated narrative is that productivity growth driven by increasingly powerful ICT-enabled "machines" is the cause of today's slow employment growth, and in the future accelerating technological change will make things worse. A growing number of policymakers worry that policies that boost productivity come at the expense of needed job growth.

To start with, if technology-led productivity growth really has been the culprit behind America's anemic job growth since 2009, one would expect that America's productivity growth rate would be high. In fact, U.S. productivity growth since the end of the Great Recession has been at historic lows—about half the rate as before the Great Recession. What the pundits are attributing to anemic productivity growth has its roots in the slow recovery from the greatest financial crisis since the Great Depression.

Moreover, academic studies, historical data, and logic all suggest that increased rates of productivity growth will not lead to higher unemployment.¹⁰ Indeed, historically, there has been a negative relationship between productivity growth and unemployment rates. In other words, higher productivity meant lower unemployment. This correlation is shown in the 2011 McKinsey Global Institute report, “Growth and Renewal in the United States: Retooling America’s Economic Engine.”¹¹ McKinsey looked at annual employment and productivity change from 1929 to 2009 and found that increases in productivity are correlated with increases in subsequent employment growth, and that the majority of years since 1929 feature concurrent employment and productivity gains.

If anything, higher productivity growth in nations has been associated with lower rates of unemployment. The reason is simple and ignored by the 4th industrialists; companies invest in process innovation (innovations to boost productivity) to cut costs and because of competitive markets they pass the lion’s share of those savings onto consumers in the form of price cuts (and some to workers in the form of higher wages). This added purchasing power is not buried; it is spent and that spending creates new jobs. This dynamic is the same if productivity grows at 1 percent a year or 5 percent.

Not only is the notion that productivity kills jobs rebutted by history and logic, virtually all academic studies on the topic have found that productivity increases do not decrease the number of people working or raise the unemployment rate. If anything, the opposite is true. Trehan found that, “The empirical evidence shows that a positive technology shock leads to a reduction in the unemployment rate that persists for several years.”¹² The Organization for Economic Cooperation and Development (OECD) finds that, “Historically, the income-generating effects of new technologies have proved more powerful than the labor-displacing effects: technological progress has been accompanied not only by higher output and productivity, but also by higher overall employment.”¹³

Even if 4th industrialists acknowledge that productivity hasn’t yet killed jobs, they claim the future will be different. This is a seductive argument, of course, because their claim is not falsifiable, as there is no way to prove or disprove it. However, logic can be used to discredit it. The doomsayers tell a story about technological change accelerating so much that soon there will be “nowhere left to run.” The narrative is as follows: as automation reduced agricultural jobs, people moved to manufacturing jobs. After manufacturing jobs were automated, they moved to service-sector jobs. But as robots automate these jobs, too, there will be no new sectors to employ people.

But these 4th industrialists make three crucial mistakes. First, they wrongly assume that current technological trends will continue or even accelerate. But as a recent study found, the productivity rate of technological innovation (e.g., the number of researchers needed to produce a particular unit of innovation) has been falling for decades.¹⁴ In fact, “The average R&D worker in 1950 contributed about seven times more to U.S. total factor productivity than an equivalent worker did in 2000.”¹⁵ If anything, the pace of innovation is likely to slow, not accelerate, in the future.

Worries of machines overtaking humans are as old as machines themselves.

Second, they overstate the extent to which digital innovation is transforming occupations. Some of them believe that virtually all jobs will be disrupted by smart machines. One of the most widely cited studies on this matter, from Osborne and Frey, found that 47 percent of U.S. jobs *could* be eliminated by technology over the next twenty years.¹⁶ But they appear to significantly overstate this number by including occupations that have little chance of automation, such as fashion modeling. Osborne and Frey rank industries by the risk that their workers would be automated. While this is a speculation about the future, one would expect that there would be some positive correlation between their risk of automation score and recent productivity growth in the industry. In fact, there was a negative correlation of 0.26 between their risk of automation in an industry and industry productivity growth. In other words, industries they assessed to have a higher risk of automation actually demonstrated lower rates of productivity growth, not higher.

A more reasonable estimate is that only about 20 percent of U.S. jobs are likely to be easily automated over the next decade or two, with about 50 percent being difficult to automate, and the remaining 30 percent extremely difficult to automate.¹⁷ One reason for this difference is that, for many occupations, automation doesn't affect the occupation so much as it affects the tasks performed in an occupation. For example, the McKinsey Global Institute concludes that, "Very few occupations will be automated in their entirety in the near or medium term. Rather, certain activities are more likely to be automated, requiring entire business processes to be transformed, and jobs performed by people to be redefined."¹⁸ In other words, technology will lead much more to job redefinitions and opportunities to add more value, not to outright job destruction.

But even if Osborne and Frey are right and 47 percent of jobs are eliminated by technology over the next 20 years, this would be equivalent to an annual labor productivity rate of 3.1 percent a year, lower than the rate of productivity growth rate the U.S. economy enjoyed in the 1960s, when unemployment was at very low levels and job creation was high.¹⁹ Similarly, if a recent McKinsey Global Institute study's high-end estimate of 30 percent of jobs automated is correct, that would mean a productivity growth rate of just 2 percent per year.²⁰

The 4th industrialists' third mistake is that this "nowhere left to run" argument is absurd on its face because global productivity could increase by a factor of 50 without people running out of things to buy. Just look at what people with higher incomes spend their money on: nicer vacations, larger homes, luxury items, more restaurant meals, more entertainment like concerts and plays, and more personal services (e.g., accounting, yard work, etc.). Moreover, if the world economy ever gets 50 times richer there would be a natural evolution toward a shorter work week and more vacation days as people's material wants become more satisfied.

This gets to the core reason why we should not worry about technologically created unemployment: Say's Law. Named after 19th century French economist Jean-Baptiste Say, Say's Law holds that supply creates its own demand, and in this case, the supply of labor creates its own demand. While Say's Law does not hold in the short-run if the economy is

in a recession (where there is unemployment), in a period of full, or close to full, employment this is certainly true. In other words, what will determine the number of jobs is the size of the labor force and that is largely determined by changes in the working-age population.

Consider the following thought experiment. Imagine that a particular birth cohort is 100,000 persons larger than the cohort born in a previous year. As this larger group of workers joins the labor force they get some open jobs which leads them to increase their spending, which in turn creates demand for more jobs and so on until all 100,000 workers are employed. In this sense there can never be a worker shortage. The demand for workers is based largely on the spending by workers. Moreover, there can never, at least in the medium- to long-term, be a job shortage.

This is why any studies purporting to predict certain numbers of job creation based on expected demand for goods and services are not valid. As noted, expected demand is based on expected supply of labor. So the only valid way to predict the future number of jobs is to predict the net number of people entering the labor force: that is, the number by which jobs will change (taking into account labor-force participation rates, that some new workers are in school, some are incarcerated, some are disabled, etc.) In sum, worries of machines overtaking humans and causing unemployment are as old as machines themselves.

Job Quality

Even if unemployment rates will not rise, many ask whether the new jobs from the next wave will be good ones. But for two reasons this is not the right question. First, new jobs will be related to how people spend their increased incomes, likely on things like education, personal services, hotels and other lodging, entertainment, insurance, air travel, new cars and trucks, and more modern appliances. Some of this spending will create good jobs (e.g., education and financial services); some of it lower-wage jobs (e.g., personal services such as cosmetology). There is little policy can do about this natural evolution, short of massively taxing or subsidizing certain goods and services.

Second, rather than fret about what industries and occupations are growing or shrinking, policymakers should focus on raising productivity. A major reason some jobs pay more is because they are more productive. Cashiers are paid less than software engineers because the latter's output per hour is much higher. Therefore, the most important question regarding the mix of jobs is whether the next innovation wave will raise productivity in most or all occupations.

It will be even better if the next wave raises productivity at a faster rate in lower-wage occupations such as cashiers than in higher-wage occupations like lawyers. Indeed, this appears to be the likely outcome. To assess these potential impacts, ITIF used two different data sets on the risk of automation by U.S. occupational category: the Osborne and Frey study and a study by ITIF.²¹ The correlation between the risk of automation and the average wage of an occupation and is negative and quite large (-0.59 for Osborne and Frey, -0.52 for ITIF). In other words, this upcoming technology wave is likely to have larger

impacts on lower-skill, lower-wage occupations. When using ITIF risk assessments for each occupation, we see that the highest-risk occupations have the lowest median wage (\$32,380), the next-highest has the second-lowest median wage (\$34,990), and so on.

If this pattern actually plays out in the labor market over the next two decades, there will be relatively fewer workers employed in low-wage occupations and the wages of everyone, including the remaining low-wage workers, will increase. To see how, imagine that the next technology wave boosts productivity by 25 percent but only for the bottom 25 percent of wage earners. In the United States this would allow the tasks these workers fulfill to be performed by just 23.4 million workers, instead of the current 31.2 million. That means 7.8 million workers are freed up and as the savings from lower prices for the goods and services produced by higher-productivity industries employing low-wage earners are spent, this creates demand that would allow the 7.8 million workers to be employed doing other work, adding to overall real GDP. Because the prices of goods and services produced by low-wage workers would fall, this spending would be distributed in the same shares as it is currently, with 12.9 percent going to spend money on goods and services produced by workers in the first-wage quartile, 17.6 percent in the second, 27.2 percent in the third, and 42.3 percent in the fourth.²² This means that most of those 7.8 million workers would see a wage increase as they move to higher-wage jobs. So, too would all other workers, because the real prices of goods and services supplied by low-wage workers would now fall. And the remaining low-wage workers would see increases from either being able to earn higher wages due to their higher productivity or from having real higher incomes because the price for their expenditures on the goods and services they themselves produce would fall (again, due to their own higher productivity).

Americans today are less likely to lose their jobs than they were in the 1990s.

Labor Market Status

Even if most people will be working, 4th industrialists warn that an increasing share of workers will be contingent workers, doing work through technology platforms. To be sure, such “gig economy” work has grown in the last decade, but much of this has been a fall-out of the Great Recession where full time, permanent work was scarce. Moreover, even with the growth of Uber, Airbnb, and other work-sharing platforms, in 2015 only about 600,000 people were employed this way. Moreover, the share of the U.S. workforce that was self-employed in 2016 was at an all-time low of less than 7 percent.²³ And while Lawrence Katz and Alan Krueger found some increase in alternative-work arrangements from 2005 to 2015, that included workers in temp agencies, independent contractors, and contract workers. These are all categories where technology has not driven the growth. They find that gig economy jobs through online platforms account for around 0.5 percent of jobs in 2015.²⁴ There is no reason to believe that self-employment will grow significantly in the future as long as the economy does not fall into recession.

Inequality

Fourth industrialists warn that the next technology wave will bring massive growth in inequality. There is no doubt that income inequality has grown in the United States, although by considerably less than Thomas Piketty would have us believe.²⁵ There should

also be no doubt that this growth has had negative consequences for living standards and the overall economy. Some of this growth is due to technological change impacting middle-wage jobs more than high- and low-wage ones.²⁶ But much of this growth has stemmed from changes within occupations. As the Economic Policy Institute finds, most of the growth of inequality was not because jobs in middle-wage occupations were eliminated by productivity gains.²⁷ Rather, most of the growth of inequality was *within* occupations, with some individuals making winner-take-all incomes at the expense of other workers in the same occupation.

And this had little to do with technology-induced productivity growth and everything to do with socio-political factors. To take an example from U.S. pro basketball, income inequality in the NBA did not grow because technology eliminated middle-skilled players. It grew because of political economy factors, such as the introduction of free agency that allowed players like LeBron James and Stephen Curry to make vastly more money than the NBA stars of the 1970s. As Jonathan Rothwell showed in a study for the Brookings Institution, the one-percenters are largely professionals and financiers: 6 percent of the top 1 percent of earners are in the financial services industry, 7 percent in law, 7 percent are doctors, 7 percent work in hospitals, and 4 percent are dentists.²⁸ This growth in earnings inequality has nothing to do with technology-driven productivity.

Not convinced, 4th industrialists say the future will be different, especially if the next innovation wave impacts lower-wage occupations more than higher-wage ones. That indeed is likely to happen, as ITIF found that there was modest negative correlation (-0.38) between the risk of a U.S. job being automated and the levels of education needed for the occupation.²⁹ But this pattern of automation would reduce, not increase inequality. One reason is that from 10 to 20 percent of U.S. adult workers report they have higher skills than are required to perform their current job.³⁰ And one recent study found that over one-third of college graduates are overeducated in terms of the jobs they have.³¹ These workers are performing jobs that require fewer skills than they possess; presumably for most of them because there are not enough high-skill, higher-wage jobs to employ them. If the next technology wave has a larger impact on eliminating low-wage jobs, this would by definition mean that a greater share of jobs would be in middle- and higher-wage categories because the total number of jobs would remain constant but there would be relatively fewer lower wage jobs. And at least some of these workers now in low-wage jobs have more than enough skills to move into these more highly paid jobs.

More fundamentally, even with robust minimum-wage levels and tax-based redistribution measures, it is extremely difficult to significantly raise the after-tax income levels of workers working in low-productivity, often low-skill-level industries for the simple reason that wages cannot exceed the output of the worker. Automating low-wage jobs will mean not only fewer low-wage jobs and more middle- and higher-wage jobs, but usually higher output per worker from the remaining workers, meaning that their wages can be more easily increased.

Universal basic income is one idea policymakers should reject. UBI would lead to the very thing its advocates warn us technology will bring: large-scale unemployment.

This positive outcome depends on relative price declines from automating low-income jobs so that demand for goods and services grows. But 4th industrialists say there will be no price reductions because all the savings will go to the increasingly few owners. In this new world, owners of capital will somehow no longer have to compete on the basis of price and will be able to make exorbitant profits, immiserating the proletariat. But this scenario of a few “robot” or AI owners making “trillions” while the rest of us are unemployed strains credibility.³² The reality is that if one robot “owner” jacked up prices and made massive profits, another robot owner would lower prices to gain market share, a process of competition that has worked since the beginning of market economies.³³

Employment Tenure Insecurity

But won't technological innovation at least make the labor market more insecure as more workers lose their jobs? This clearly seems to be what most workers think. In 1987, a solid majority of U.S. workers (59 percent) said they felt their jobs were secure; by 2014, less than half felt that way (47 percent).³⁴

Yet while people feel less secure now than in the past, employment data tell a different story. Data from the U.S. Bureau of Labor Statistics clearly disprove the idea that average American workers are trapped in a perpetual state of job insecurity, regardless of how much they may happen to earn. In fact, Americans today are less likely to lose their jobs than they were in the 1990s. Looking at the broadest measures of total job loss—defined as jobs eliminated when an establishment closes or downsizes, including from offshoring—the U.S. economy has seen fewer jobs lost as a share of total employment, with similar trends at the individual industry level. U.S. workers in 1995 had around a 7.3 percent chance that their jobs would be eliminated in any given quarter. Two decades later, that figure was down to 5.7 percent.³⁵

The same trend of greater job security holds across industries. Of 10 major sectors, all saw a lower rate of job loss (defined as the share of jobs lost in that industry through contractions or closings) in 2015 than in 1995. However, job security differs across industries. For example, in 1995, roughly 15 percent of jobs per quarter were lost in the construction industry, while the education and health services sectors eliminated about 5 percent of jobs. Nonetheless, the general trend is toward reduced losses. Consider that if the share of job losses remained unchanged from 1995 levels, the manufacturing sector would have incurred about two million additional worker displacements in 2015. In fact, while neither manufacturing output nor employment has yet to recover to 2007 levels, compared with all other economic sectors, the risk of losing one's job in manufacturing is the lowest of all major sectors.

Worker Transition and Dislocation

Of the concerns 4th industrialists raise, only one is truly valid, and that is the need to help workers adjust to the modestly higher rates of labor market churn (defined as jobs created in occupations plus jobs eliminated in other occupations) that will likely be coming and, by definition, generate increases in per-capita incomes. It's important to note however that, at least in the United States, the rate of labor market churn has been at an historic low over

the last two decades.³⁶ But as the next wave of innovation boosts productivity, that rate is sure to increase, at least somewhat.

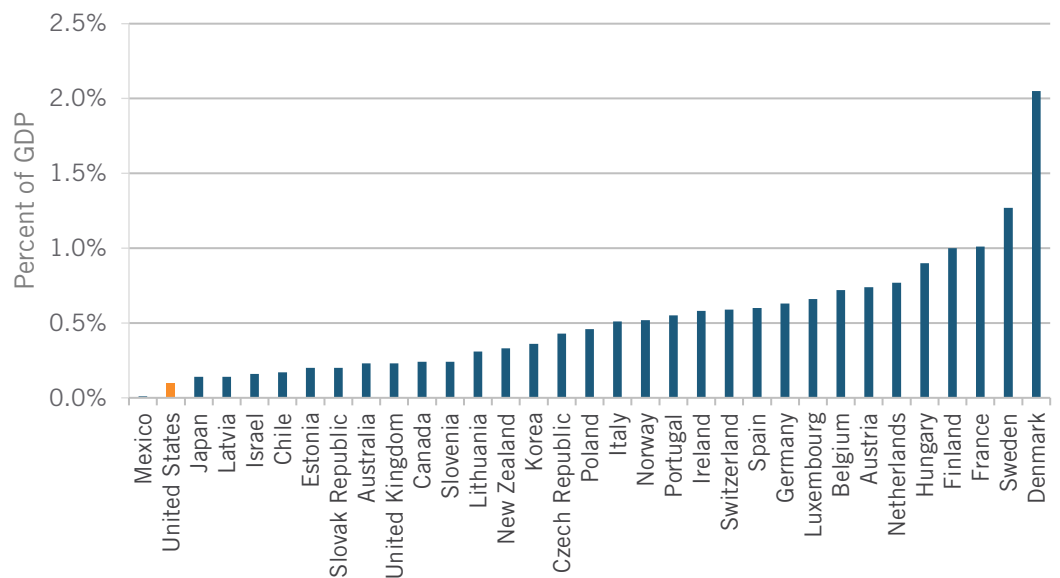
One proposal to address this is universal basic income (UBI). Under this widely touted scheme, the state would somehow take money from somewhere and write monthly checks to all adults, whether they are working or not, poor or rich. This allegedly would establish a stable floor upon which everyone would build their own brighter future. But universal basic income is one idea policymakers should reject. UBI would lead to the very thing its advocates warn us technology will bring: large-scale unemployment, as the government incentivizes workers to be idle instead of helping pave pathways for those at risk of displacement by technology to prepare for and to find success in new jobs.

To be sure, the alternative should not be a return to the Hobbesian world of the 1800s when if a worker lost his job he was on his own. Policymakers need to ensure that there is a robust and resilient system of support(s) in place for workers who lose their jobs through no fault of their own, including from technology. We turn to that agenda now.

POLICIES FOR EASING LABOR-MARKET TRANSITIONS

As noted, the key policy question related to the labor-market impacts of the next wave of innovation is how well workers are able to make transitions from one job to another in the same or a different occupation. Support for workers in the United States is inadequate. Indeed, the United States significantly underinvests in workforce training programs, dedicating just 0.1 percent of GDP in active labor market programs compared to the OECD average of 0.6 percent of GDP, meaning America's OECD peers like Austria and Germany invest six or more times more in their workforce training and support programs³⁷ (Figure 1).

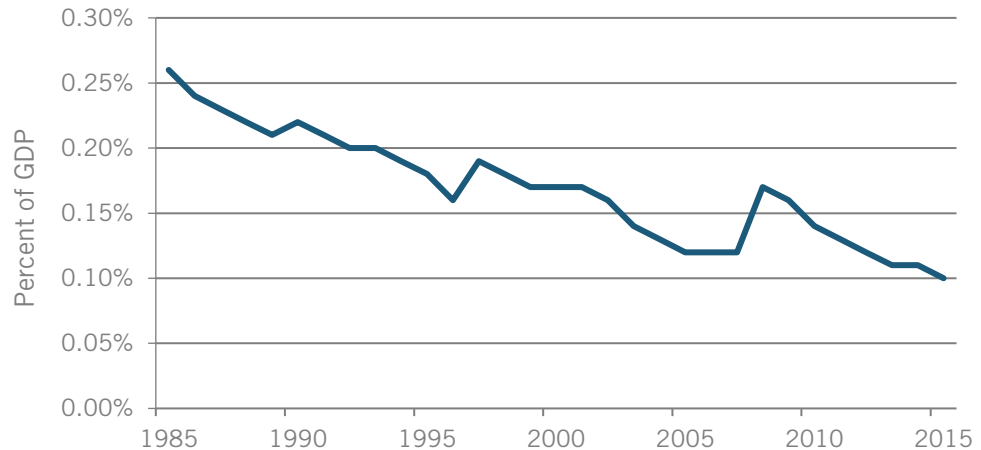
Figure 1: Public Expenditure on Active Labor Market Programs (% of GDP)³⁸



Note: Data for New Zealand and Estonia is from 2014, UK is 2011. All other countries are from 2015

Moreover, the United States now invests less than half of what it did on such programs 30 years ago, as a share of GDP (Figure 2).

Figure 2: U.S. Public Expenditure on Active Labor Market Programs as Percent of GDP³⁹



As such, the United States needs to do a much better job and for that to happen the federal government needs to play a more active role. At the broadest level, the United States should look to learn from the Nordic countries' flexicurity model, which ties benefits to proving that workers are either actively looking for work or are in a certified training program. There are five key factors that are important to reducing the costs of worker dislocation: 1) ensuring full employment, nationally and regionally; 2) ensuring as many workers as possible have needed education and skills before they are laid off; 3) reducing the risk of income loss and other financial hardships while laid off; 4) helping laid-off workers who need new skills to become reemployed gain them; and 5) helping laid-off workers find new jobs. Each is an area the federal government should do more to support. This section discusses innovative policy proposals designed to facilitate transitions. However, a core part of any program needs to be adequate funding for and appropriate reform of existing programs, including community college funding, funding for Wagner-Peyser Act for unemployment insurance systems, and funding for the Workforce Innovation and Opportunities Act (WIOA).

Ensure Full Employment, Nationally and Regionally

If there are not enough job openings available, all the approaches to help dislocated workers will be for naught. Therefore, the federal government should work to run a full-employment economy, both nationally and regionally.

Run a Full-Employment Economy

The most fundamental policy action should be to run a full-employment economy. Retraining is for naught if there are not enough jobs. This means appointing Federal Reserve governors who put more relative weight on full employment than on fighting

inflation. The other advantage of a full-employment economy is that it gives organizations, including companies, stronger incentives to boost productivity, which will support more robust wage growth. A key component of a full-employment economy, especially one that creates better jobs, is to institute a coherent and strategic national competitiveness strategy, as ITIF outlined in its report, “The Competitive Edge: A Policymaker’s Guide to Developing National Strategy.”⁴⁰

Ensure a Robust Regional Economic Development Policy to Help Sustain, Grow, and Create Jobs Where They Are Needed

It is not enough to just have enough jobs; they need to be near where workers live. This is particularly true for workers with less education and fewer skills who are often less able to transition to other jobs or move to other regions. As Bound and Holzer found, higher unemployment in metropolitan regions had a larger negative effect on less-skilled workers.⁴¹

The conventional economic view is that workers should simply move to where the jobs are and some economists favor policies, such as moving vouchers, to facilitate that movement. While better support to help workers move to work can help, many workers, particularly ones without a college degree, are loath to move away from extended families and community. This reluctance has long puzzled economists.⁴² But what is puzzling is why so many economists are puzzled. Such workers are often making a very rational assessment. Why move away from family and community support for a low-wage, low-skill job a thousand miles away? Moreover, humans are more than homo-economicus; many are connected emotionally and spiritually to place. Rather than ignore and reject that, policy should support that very natural human need for workers to be rooted in community.

There is another reason why the “workers-moving-to-jobs” approach is usually suboptimal. When workers leave communities because of lack of employment opportunities, this further devalues the investments in the communities that have been left behind, reducing house values, local tax revenues, and infrastructure utilization. In contrast, if these workers move to crowded and more-expensive metropolitan areas, they push up housing costs and traffic congestion, making life worse, not better, for existing residents. In other words, by leaving lagging communities and moving to booming ones, workers impose negative costs on both. And while some have argued that we should just have all the dislocated workers in lagging regions move to Boston, Dallas, New York, and Silicon Valley, this is fanciful.⁴³ First, the receiving communities are unlikely to adjust their zoning policies to accept more densely packed housing. And even if they did, it would lead to higher costs and more congestion in these places, reducing the competitiveness of firms in these regions. If anything, we need fewer people in Boston, Dallas, New York, and Silicon Valley, not more.

This means that any federal worker-adjustment policy has to have a significant focus on regional development. But the current approach is underfunded and too scattershot. As a share of GDP, federal investment in community and regional development fell from 0.34

Policy should support that very natural human need for workers to be rooted in community.

percent in 1978 to just 0.04 percent in 2016, a decline of 88 percent.⁴⁴ Reversing this decline is a key first step.

But while more funding is needed, so is a new approach. Current funding is too scattershot, with small grants being made to too many places, many of which have very little prospects of an economic turnaround. Any new approach should be built around the concept of “growth poles” to which people in the surrounding labor-shed would commute for work. The idea of growth poles is that these areas would have enough “critical mass,” including transportation hubs, educational institutions, a diversified labor market, and suppliers and other business, to grow and attract even more economic activity. But they would not be so large as to have significant diseconomies of scale, such as very high land costs and traffic congestion. Moreover, they would be located in regions that overall are in need of economic revitalization, with the pole serving as the key hub and driver of regional growth.⁴⁵

Federal economic development policy is likely to be much more successful if it focuses on a much smaller number of reasonably sized, lagging economies that have the potential for self-sustaining growth.

Growth poles were an idea that was developed in the 1950s and implemented in the 1960s and 1970s. For example, interest in the concept led Congress in the late 1960s and early 1970s to charge the Appalachian Regional Commission “to concentrate its investments in areas with a significant potential for future growth where the return on public dollars invested will be the greatest.”⁴⁶ But the program was poorly targeted, with help being given largely to larger cities (for example, Pittsburgh was made eligible for assistance, even though it was one of the largest metros in the nation and as such had already attained agglomeration critical mass) and in so doing it did little to help rural residents.

However, the concept still makes sense today. The reason why is that much of the 21st-century economy requires what economists call “agglomeration economies” where geographically proximate assets (firms, workers, infrastructure, educational institutions, health facilities, etc.) strengthen the overall region and lead to more growth than if these assets were distributed more widely in many small towns and hamlets. In other words, federal economic development policy is likely to be much more successful if it focuses on a much smaller number of reasonably sized, lagging economies that have the potential for self-sustaining growth. Selecting a small number of reasonably sized poles will not only lead to more growth in the growth poles, but will lead to more growth in the surrounding regions as rural residents commute to work in growth centers. Growth poles do not have to be one city, but could be broader regions of several contiguous towns, as long as they agree to work together, possibly including the development of unified management of schools, public infrastructure, and economic development planning.

For example, in Maryland such poles might include Salisbury and Easton (on the eastern shore), Hagerstown and Berkeley Springs (in West Virginia, but on the MD border) west of Washington, DC, and Cumberland in Western Maryland. In Oregon, it might include places like Medford, Coos Bay, Astoria, Hood River, Bend, and Ontario.

To achieve these outcomes, Congress should significantly increase funding to the Economic Development Administration and mandate that at least 75 percent of funds go to growth-pole communities. Funding would be contingent upon state governors

identifying growth poles and targeting matching state investments in those areas. To ensure that the federal government and states do not succumb to political pressures to designate virtually every community a growth pole, no more than two to six poles could be established in any state, with smaller states (in geography and population) being able to designate two and the largest states up to six.

Another way to support these types of growth poles could be through supporting the Investing in Manufacturing Communities Partnership (IMCP) program. Initially launched during the Obama administration, the Investing in Manufacturing Communities Partnership program has already invested \$23 million to support 49 IMCP projects across 26 states. It's estimated these projects to date have saved more than 1,080 jobs and generated nearly \$855 million in private investment.⁴⁷ The Made In America Manufacturing Communities Act proposed by Senator Kirsten Gillibrand (D-NY) is bipartisan legislation that would extend the success of IMCP by establishing a program to improve the competitiveness of U.S. manufacturing by designating consortiums as manufacturing communities and authorizing federal agencies to provide them with financial and technical assistance.⁴⁸ The legislation authorizes a public-private program to enhance the way we leverage federal economic development funds to encourage American communities to focus not only on attracting individual investments one at a time, but also on transforming themselves into globally competitive manufacturing hubs.

The legislation does not propose a new funding program but rather awards a designated community preferential consideration for up to \$1.3 billion in existing federal economic development assistance across eleven federal agencies, reducing current burdens faced by communities and small manufacturers in navigating and accessing federal support. Non-designated communities nationwide could also learn from the best practices employed by these designated communities to strengthen American manufacturing.

Support Industry and Firm Competitiveness

Robust national economic competitiveness is key to ensuring a healthy and growing economy where employers are optimistic about investing. As ITIF highlighted in “The Competitive Edge: A Policymakers Guide to Developing a National Strategy,” there are a host of actions the federal government should take to restore and then maintain a competitive U.S. economy.⁴⁹ Among other steps, this includes expanding support for business assistance programs such as NIST’s Manufacturing Extension Partnership, SelectUSA, and the Ex-Im Bank. At the same time, Congress should ensure that at least some share of increased MEP funding is eligible for helping small manufacturers train their workers.

Ensure Workers Have Needed Competencies Before They Are Laid Off

Notwithstanding the fact that a modest share of American workers have more skills than they need for their current jobs, enabling workers to get “better” skills and other competencies, not necessarily more, will be an important component of ensuring easier labor-market transitions. In this case, for most workers better skills mean skills more

Enabling workers to get better skills, not necessarily more, will be an important component of ensuring easier labor market transitions.

attuned to the needs of the employers. When worker skills are more developed and attuned to workforce needs, worker adjustment from dislocation becomes easier.⁵⁰ Moreover, having a stronger base of general skills provides an important foundation if demand for a worker's specific skills dry up. There are a number of steps governments should take in this regard.

Push High Schools to Teach Skills More Relevant to the Job Market

There is increasing evidence that much of what is taught in high school has limited relevance for students as future workers. As such, workers who enter the labor market and then lose their job from technological change are less well equipped than they would be if high schools taught more relevant and long-lasting skills. Yet, high schools persist in teaching material that for the most part has little relevance to the world of work. As Bryan Caplan writes in *The Case Against Education*:

Why do [high school] English classes focus on literature and poetry instead of business and technical writing? Why do advanced math classes bother with proofs almost no student can follow? When will the typical student use history? Trigonometry? Art? Music? Physics? Physical education? Spanish? French? Latin!”⁵¹

These are all good questions that the defenders of the current system can answer in only four ways. The first is that these courses are useful for work. But the question is: compared to what? Certainly, teaching introductory engineering concepts would be more useful for future work than teaching physics. Statistics would be more useful than geometry; yet only 7.7 percent of U.S. high school students pass a stats class, compared to approximately 87 percent for geometry.⁵² Learning business writing would be more useful than literature.

The second defense is that the current array of requirements teaches students to think. But as Caplan notes, studies show that there is very little learning how to learn and transfer of learning to other areas.⁵³ Schools teach mostly what to think about topics being taught, not how to think. Moreover, the High School Survey of Student Engagement finds that 66 percent of high school students report that they bored in school every day. Thus, it's not clear that these courses, forced on students without their choice, are the best way to engage students in how to think.

The third defense is that these kinds of courses are important to educating well-rounded citizens. This defense might be more tenable if most high school students actually learned much. Yet, as Caplan shows, most American adults are woefully lacking in basic knowledge of history, civics, and science, despite being forced to “learn” these subjects in high school.

Finally, the fourth argument, and the only legitimate one of the four, is that this distribution of courses is needed for students to get into college. While true, this only pushes the question down the road. Why are these courses needed for college? The answer is that colleges perpetuate the same focus on subjects that are not very relevant to the

workplace. As Caplan writes, “youths spend years studying subjects adults rarely use on the job. Adults are amazingly ignorant about the subjects they studied since childhood.”⁵⁴

As such, much can and should be done to reform American high schools so that they not only teach skills more relevant to what the vast majority of adults will use in the workforce, but do it in a way that gives students more choice to learn what actually interests them. Thus, reforms such as high school career academies;⁵⁵ reducing the rigidity of state high school graduation course distribution and graduation requirements; and a focus on increased adoption of workforce-focused classes, such as business, statistics, and engineering, would all help future workers have a stronger base of skills with which to manage a more turbulent workforce. In addition, more should be done to encourage and support corporate partnerships with new kinds of high schools. For example, IBM has worked to develop P-TECH (Pathways in Technology, Early College High School) in New York City that runs from grade 9 to grade 14 and works to give students marketable skills in information technology.⁵⁶

Separate Learning from Higher Education Degrees

As noted, high schools are structured the way they are in part because of how higher education is structured. Any reform in high school has to pass the test of “not reducing the ability of a student to get into college.” As such, reforming high schools depends on reforming higher education. Much of what students are taught in college has little to do with the workforce. As such, this will require much more fundamental reform than simply tinkering around the edges.

As ITIF wrote in “Why It’s Time to Disrupt Higher Education by Separating Learning From Credentialing,” U.S. higher education is underperforming, especially on quality.⁵⁷ It appears that a majority of graduates are now no longer adequately educated. Moreover, the evidence is clear that most college students, especially ones not studying vocationally-related courses such as engineering, computer science, and nursing, learn and retain very little knowledge once they graduate. Indeed, less than a third of college seniors are fully literate and numerate.⁵⁸ This poor performance likewise hurts the ability of graduates to navigate turbulent labor markets.

Reforms that tinker around the edges are unlikely to achieve real progress. This is why ITIF recommended policies to separate degrees and credentialing from actual education. In other words, higher education’s job should be education; and credentialing (which is now done through degrees) should be a separate function, ideally done through some form of testing. As Caplan and others write, the main reason students with college degrees earn more than students without, is not because they learned more, but because the college degree is a signaling function to employers that these students are worth more (they are more intelligent, have more diligence and are somewhat conformist).

Separating the degree (which is a signal) from actual education not only opens up college education to a much broader array of options (including online courses, community college courses, and others), but also increases the competitive pressures on colleges to increase

teaching quality and on students to work harder. In other words, if students were to find that simply having a degree, while having learned very little in college, would not necessarily get them a good job, they would be more motivated to learn more and different things (things more relevant to employer needs). Likewise, colleges would be forced to focus much more on improving teaching quality if they knew that the sheepskin alone was not the signaling device it long has been.

There are a variety of steps the federal government can take to move the system in this direction. This can start with the Department of Education establishing a program to accredit organizations providing professional certifications, in much the same way that it provides oversight of the organizations that provide accreditation of colleges and universities. Establishing or expanding an accreditation process for these certifications will also serve as a useful indicator of quality for public and private-sector organizations that want to hire individuals who pursue non-degree learning options. Second, Congress should require federal agencies to accept alternative certifications in lieu of degree requirements. Doing so would demonstrate to the private sector the feasibility of using alternative certifications by accepting a suitable set as a substitute for a college degree when filling federal government jobs. Toward that end, the Department of Education should work with corporate partners to encourage the use of alternative certifications. At the same time, action by major companies will encourage other employers to treat such test results and related certifications and the workers who obtain them seriously. Finally, Congress should allow students to use federal aid for alternative learning options, such as massively open online courses (MOOCs) and others⁵⁹

Arguably American society would be better off if more students got an employer-focused technical degree at a two-year college than a liberal arts degree from a four-year college.

Encourage the Creation of New Kinds of Technical Colleges

If reforms are not made to separate higher education bachelor's degrees from education, one possible reform would be to foster the creation of new kinds of colleges focused much more on the teaching of skills more relevant to work. As Caplan estimates, less than one quarter of college degrees have a high level of usefulness in terms of job market, and over 40 percent have low usefulness (e.g., social sciences, philosophy, liberal arts, English).⁶⁰ Such a new kind of employer-relevant college would be focused on ensuring students learn skills employers value, such as business-oriented writing, reasoning and critical thinking skills, statistics, public speaking, computer science, and other related skills. To save students and society money, such colleges could be for three years instead of four.

One example of this model is the University of Harrisburg, in Harrisburg, PA, a new private university focused on responding to needs of employers in the region for workers educated and training in applied science and technology-related fields. The university provides degrees in areas, such as Analytics, Interactive Media, and Geospatial Technology. Another model is the Canadian system of Polytechnics, publicly-funded colleges or institutes of technology that offer four-year degrees, advanced two-year diplomas, certificates and in-class training for apprenticeships.⁶¹ The focus is on skills and technology, and hands-on learning opportunities are integral to the curriculum.

The U.S. Department of Education should work with foundations and wealthy private donors to help create new workforce-skills- focused colleges in the United States, colleges with strong connections to the regional economy and employers. At the same time state legislatures should begin to repurpose at least one public four-year institution in each state toward a technical, employer-focused model of education where faculty are rewarded more for teaching than for research and where the curriculum is focused not only on 21st century workplace skills (e.g., critical thinking, team work, communication, ICT literacy), but also on specific technical skills employers need.⁶²

Reduce Funding Inequality Between Four-Year Colleges and Community Colleges

Arguably American society would be better off if more students got an employer-focused technical degree at a two-year college than a liberal arts degree from a four-year college. One way to move in that direction would be to move toward reducing the funding gap between two-year public institutions and four-year. As Richard Kahlenberg points out in a report for the Century Foundation, the “total federal, state, and local appropriations and tax subsidies per full-time equivalent student is \$41,100 at private high-endowment institutions, \$15,300 at public flagship institutions, \$6,700 at public regional institutions, and \$5,100 at community colleges.⁶³ And direct public spending per student is almost twice as much at public research universities as at two-year community colleges. And Kahlenberg cites a Brookings Institution study that shows that “four-year institutions received nearly three times as much federal aid (\$2,600 per student, including financial aid) as community colleges (\$790).”

Some states mandate this difference as a matter of policy, with the Maryland legislature ruling “that full-time equivalent community college students should be funded at 25 percent the level of students at four-year colleges.”⁶⁴ Moreover, as Kahlenberg notes, there is more inequality in funding of two-year institutions than four, with some located in lower-income cities and counties receiving very little funding. There is some justification for greater spending on students in four-year institutions who are studying engineering and sciences, but none for greater spending for students studying liberal arts. However, both the federal government and state governments should adjust funding programs to reduce this gap.

More needs to be done to reform college education to ensure that more students graduate with the knowledge and skills needed to succeed. As Harry Holzer and Sandy Baum write in their book *Making College Work*, “Too many disadvantaged college students in America do not complete their coursework with any college credential, while others earn degrees or certificates with little labor market value.”⁶⁵ To remedy this, federal higher education funding should better target assistance to institutions that serve large numbers of low-income students in high-demand fields, and change funding to reward colleges for being more responsive by expanding their teaching capacity in high-demand fields.

Enable Students Taking Short-term Courses for Occupational Credentials to Qualify for Pell Grants and Other Federal Aid

Pell Grants help low-income students afford undergraduate education. However, increasingly many forms of education now focus on shorter-term courses leading to credentials. Congress should amend the program to enable students taking such courses to

qualify. Under current law, students taking such courses are not eligible for Pell Grants. The JOBS Act (S.206) sponsored by Senators Kaine (D-VA) and Portman (R-OH) would expand access to Pell Grants for short-term occupational credentials. Pell grants should also be expanded to cover full-time workers taking one course at a time. In addition, Congress should allow Pell grants to pay for career counseling and career-navigation assistance before a worker is enrolled in a training program. Many workers are not aware of what are the growing job fields and the kind of training they should be taking to gain access to them.

SkillsFuture—Singapore’s Experiment in Creating a Market for Skill Development as a Model for U.S. Efforts.

To tackle the challenge of existing industries becoming more technology-enabled and emerging industries requiring entirely new sets of skills, Singapore launched the SkillsFuture Singapore (SSG) agency in 2015. In its own words, “SkillsFuture is a national movement to provide Singaporeans with the opportunities to develop their fullest potential throughout life, regardless of their starting points. Through this movement, the skills, passion and contributions of every individual will drive Singapore’s next phase of development towards an advanced economy and inclusive society.”⁶⁶ Beyond this government narrative, SSG is shaping up to be a promising model for workforce development.

By forming SSG as a sub-agency of Singapore’s Department of Education-equivalent, the Singapore government has sent a clear signal that it is treating the evolving demand for skilled workers as a matter for education policy rather than labor market policy. Whereas in most countries, a person’s schooling is an educational matter while a person’s work is a labor matter, SSG turns that around by treating both these “phases” of an individual’s life as one continuum to implement and track education and skill development policy outcomes over an individual’s entire lifetime. One major push has been “empowering” Singaporeans to take greater agency over their career development.

That is evident in SSG’s MySkillsFuture platform, released in 2017—a one-stop education, training, and career guidance online portal—available to Singaporeans from grade 5 onwards. This online portal aims to provide Singaporeans career guidance before they enter the workforce, through their working years, and up to retirement by combining a number of individually tailored features for each stage of a person’s life: 1) online aptitude tests that ascertain compatible industries or occupations; 2) information on industries and what types of skills these industries require now and potentially will require in the future; 3) an online job bank to help job seekers find and apply for employment; 4) an education management system to let individuals and employers track certifications and accreditations acquired over one’s career; and most interestingly; 5) a tool to identify skill shortfalls between an individual’s profile and a selected occupation, then providing training course options and financial support to acquire those missing skills. By providing deep information, this platform will allow Singaporeans to better plan their careers in advance, switch into more suitable industries, and better equip them to meet their career aspirations.

This fifth feature of matching individuals to skill providers (e.g., public and private education institutions) within the platform is unique. SSG mediates three groups—industry, workers, and skill providers—to tackle the changing needs of the labor force. Through SSG, skill providers work with industry to identify potential skill shortfalls or future needs, and then develop training courses for these skills; industry uses SSG grants and subsidies to send their employees to skill providers for skill upgrading or retraining; and workers can make use of SSG individual training credits to seek training in skills they want to pick up. These linkages essentially reduce labor market frictions and asymmetric information costs to create a more skilled and flexible workforce.

To support this “skill marketplace,” SSG has started to “standardize” terminology used to describe skill needs. Through coordination among employers, industries, unions, and government bodies, SSG aims to create a lexicon on skill descriptions and requirements standardized across the economy. This reduces friction in the labor market in a number of ways. First, it allows training providers to “tag” their skill courses by industry. Second, individuals have an easier time identifying industries and occupations by skill (as compared to previously terse industry-specific skill terms). Third, governments can better identify skill shortfalls or emerging skill needs. Thus far, fifteen industries have been mapped, including the IT industry, retail, and early childhood education. In addition, successfully completing this skill-term standardization process will also allow more detailed data—extending beyond traditional years of schooling and levels of education data—on the skill levels and competencies of Singapore’s workforce.

Although the main aim of SSG is to treat an individual’s entire life as one long continuum of continuous learning or self-upgrading, be it through schooling or skills training, SSG boasts a host of targeted policies for Singaporeans across four-stages of life: schooling years, early career, mid-career, and “silver” years. These policies range from internships for those in their schooling years, to retraining schemes for those in their silver years. The following section highlights a few of these policies.

SkillsFuture Credit

To incentivize Singaporeans into taking a more proactive role in personal skill upgrading, SSG launched the SkillsFuture Credit in January 2016. This scheme provides all Singaporeans aged 25 and above a S\$500 (US\$370) credit that can be used toward a list of over 18,000 approved courses. This credit does not expire, receives periodic top-ups, and can be accumulated over multiple top-ups. Approximately 2.5 million Singaporeans were provided this credit when it was rolled out, and, after a year, about 126,000 had tapped into their credit, or about 5 percent of those eligible.⁶⁷ Information technology-related courses are the most popular choice, followed by engineering, then personal development courses. The most popular course searched for is basic data analytic skills, and the second most is basic skills for Microsoft Word, Excel, Access, etc.

SkillsFuture Award

To address potential skill shortfalls in emerging industries, SSG offers grants to individuals in the early- to mid-stages of their careers looking to gain skills in key emerging industries. Industries that the SSG has targeted include healthcare and precision engineering. Individuals can either apply for a grant themselves or through their company. Since its launch in 2016, approximately 700 awards of up to S\$5,000 (US\$3,700) have been provided; SSG plans on scaling the number of awards provided per year to 2,000.⁶⁸ In addition, this grant can be combined with other government-levied subsidies for skill development.

SkillsFuture Digital Workplace

To help Singaporeans adapt to an ever-more digitally enabled workplace, SSG (through various training providers) offers a two-day (18 hour) digital literacy course. SSG provides generous subsidies for this course. Any company that signs a Singaporean worker for this course can claim either a subsidy or absentee payroll from the SSF. Although the broad scope of this course is digital literacy, various training providers tailor their course toward workers in certain industries (i.e., digital literacy in the food and beverage industry, digital literacy in the office, etc.). These digital literacy courses cover the basics of technology deployed in the modern workspace, helping workers embrace rather than reject new technologies; introductions to smart devices; understanding basic data analytics; the do’s and don’ts of cybersecurity; and how to use online collaboration tools with coworkers, among other topics.

SkillsFuture Employer Schemes

While SSG pushes for Singaporeans to be more proactive in upgrading their skills, it also offers various skill-upgrading schemes for employers. In general, companies can get a 50 to 90 percent discount on SSG-approved courses when they enroll their employees, and a 95 percent discount for employees earning less than S\$1,900 (US\$

1,400) a month, and a 90 percent discount for employees aged 40 and above. In addition to these deep discounts, sponsoring companies are eligible for absentee payroll assistance.

The broad lessons from Singapore for the United States are threefold. First, federal policy needs to make a major commitment to skill development and workforce transition. Second, such efforts need to be closely linked to employers and markets (e.g., vouchers and credits). Third, such efforts need to be much more flexible and less bureaucratic than existing efforts and take deep advantage of advanced information technology tools.

Expand NSF's Advanced Technological Education Program

Federal policy needs to do a better job at ensuring that education is better linked to occupational needs, particularly for middle-skill jobs. One highly successful program designed to build technician skills is NSF's Advanced Technological Education (ATE) program, which supports community colleges working in partnership with industry, economic development agencies, workforce investment boards, and secondary and other higher education institutions. ATE projects and centers are educating technicians in a range of fields, including nanotechnologies and micro-technologies, rapid prototyping, biomanufacturing, logistics, and alternative-fuel automobiles. Notwithstanding this, ATE funding is quite small, at around \$50 million per year. Congress should expand funding for the ATE program to at least \$100 million per year and require NSF to ensure that all ATE centers are actually working closely with industry partners.

Boost ICT Skills

While a relatively small share of the workforce will be computer scientists, many jobs in the future will require what IT business expert David Moschella has termed “double deeps”: jobs that require a traditional skill (graphic design, marketing, accounting, machine operation, etc.) combined with digital skills.⁶⁹ As Ed Lazowska, the Bill and Melinda Gates Chair in Computer Science and Engineering at the University of Washington, states: “Every field is becoming an information field, and if you can program at a level beyond an intro course, it’s a huge value to you.”⁷⁰ As such, policies to ensure that more workers have digital skills will help workers make transitions going forward. One promising direction to pursue is to do a better job of ensuring that students have more ICT skills.

As ITIF laid out in its report “The Case for Improving U.S. Computer Science Education,” there are a host of steps the federal government can take to boost digital skills in the workforce. The federal government can provide incentives for states to allow computer science to count as either a math or science requirement and to establish more STEM-intensive public high schools that give students in-depth exposure to computer science and other STEM skills. In addition, Congress should establish an incentive program for universities to expand their offerings in computer science and prioritize retaining American students interested in majoring, minoring, or taking courses in computer science.

Spur the Private Sector to Invest More in Skills Training

Reforming post-secondary education is important, but national policy needs to also help incumbent workers. And one key way workers get needed skill is through on-the-job training.

Firms invest less in training than is optimal from a societal and economic perspective and it negatively impacts economic growth and innovation.

However, corporate investment in workforce training has declined significantly in the past two decades, and that is a big problem for American productivity and international competitiveness. As the *Economic Report of the President* finds, the proportion of workers that received employer-sponsored training dropped 42 percent between 1996 and 2008.⁷¹ And corporate spending on training as a share of gross domestic product declined from more than half a percent in 2000 down to one-third of a percent in 2013.⁷² These cuts have made it harder for workers to find new employment after they are laid off and have made it more difficult for firms to boost productivity and global competitiveness.

Corporations have cut their investment in workforce training for a number of reasons. Declines in employee tenure in the 1980s and 1990s meant that more and more firms sought to simply hire workers with the requisite skills instead of paying to train them. After all, why invest in human-capital development when that asset will likely walk out the door to a competitor before the investment pays off? The increasing pressure from shareholders for robust quarterly earnings profits has also driven corporations to invest less in the future, including in skills.

In short, this is a classic case of market failure. Firms invest less in training than is optimal from a societal and economic perspective and it negatively impacts economic growth and innovation. It's the same reason firms invest less in research and development than is societally optimal. To fix the latter problem, Congress created the research and experimentation (R&E) tax credit in 1983 to incentivize companies to spend more on research and development (R&D). While additional business tax reform is unlikely in the near term, when Congress again turns to the issue it should consider turning the R&E credit into a knowledge tax credit by allowing qualified expenditures on both R&D and workforce training to be taken as a credit and expanding the rate from 14 percent to at least 20 percent.

At the same time, Congress should expand Section 127 which provides tax benefits for employer-provided tuition assistance. The eligible amount has not increased since 1996. Congress should also expand Section 127 to include coverage for career counseling.

Better Align Education and Training to Labor-Market Skills Demands

Workforce training systems are more effective if they are more aligned to the needs of employers, particularly employers adopting high-performance work systems that use advanced-production technologies; give workers more say in the design of work; and invest heavily in workforce development. Federal policies need to do more to align training to these kinds of employer needs.

Establish wider use of skills credentialing

One place to start is to work to establish wider use of skills-credentialing systems. The National Skill Standards Act of 1994 created a National Skill Standards Board (NSSB) responsible for supporting voluntary partnerships in each economic sector that would establish industry-defined national standards leading to industry-recognized, nationally portable certifications. The vision was that each industry would define and validate

national standards for the skills it was seeking and credential individuals against those skills. One key reason for doing this was so that companies would have a better way to assess the skills of prospective and current workers, and workers would have a better way to identify and gain the skills they need to be successful. But while some industries stepped up to the plate to organize such a system through the Manufacturing Skill Standards Council (MSSC), the federal government failed to provide matching funding to establish this standards-based system. Moreover, in the 2000s, the national approach was abandoned in favor of a regional approach (embodied in programs such as the Department of Labor’s Employment and Training Administration’s WIRED—Workforce Innovation in Regional Economic Development—initiative). This contributed to an uncoordinated proliferation of certifications at the regional and state levels. What’s needed is a national approach, so that employers can more readily find workers with the right skills for advanced manufacturing and workers can be confident their skills will be recognized similarly by employers across the entire country. One approach is Credential Engine, a new, non-profit organization whose mission is to bring “transparency and common understanding to credentials in order to provide the information needed to make better credentialing decisions and reveal credentialing and labor trends.”⁷³ Another is Connecting Credentials, a non-profit effort focused on building learning-based credentialing systems.⁷⁴

Therefore, Congress and the Administration should work to increase credentialing by expanding the use of standards-based, nationally portable, industry-recognized certifications specifically designed for specific sectors and supporting programs like Credential Engine. In addition, where possible, government should support industry-led certificate programs. For example, Google has recently established a certificate program on the Coursera platform (online courses) to help workers with no prior IT experience to get the skills they need to get an entry level IT job.⁷⁵ However, as discussed below, these systems will not be fully effective until workers have access to a robust skills navigation system that lets them assess their own skills and gaps and growing occupational areas.

Support sector-wide training and development plans

Related to this, the Department of Labor should establish a process for developing sectoral training and development plans. Modeled after Singapore’s sectoral manpower development plans, these plans would be developed in close partnership with industry to identify both the key skills needed for the health of particular industries in the future, and the policies and programs needed to improve the skills training system for these skill areas.⁷⁶ Again, such plans should ensure that they work toward high-performance work systems that complement skills, technology and work organization.

Promote an “Investors in People” program

The Investors in People program is an internationally recognized accreditation held by 10,000 organizations across the world. Supported by the UK Commission for Employment and Skills, the standard defines what it takes to lead, support and manage people well for sustainable results.⁷⁷ Among other efforts, the program offers an annual award to employers

To really develop a robust national apprenticeship system, the federal government will need to provide funding to spur the development of these systems.

who do the best job of investing in their workforce.⁷⁸ One study by the UK government found that the program did lead participating organizations to expand workforce training to more employees. The U.S. Department of Labor should promote such a standard in the United States.

Support industry-led skills alliances

The regional Workforce Development Boards, established by the Workforce Investment Act of 1998, are an attempt to increase the influence of the private sector over the federally funded workforce investment system. But in fact, notwithstanding these boards, the system generally does a poor job of engaging deeply with employers in skill development, particularly at the operational level. All too often they are not controlled by employer demand but by service providers' interests. Moreover, often employers in the same or similar industries in a region are reluctant to invest in training their workers for fear that their competitors will attract the workers after they have trained them. As such, this is a collective action problem that government can help solve, in part by encouraging firms to establish industry-led regional skills alliances. And while there have been a number of alliances developed, they are not well-funded for sustainability, and more are needed.

To this end, there needs to be a dedicated federal funding stream to states, sub-state regions, cities, community colleges, industry associations or other entities to support industry-led or industry-union-led skills alliances. In these alliances, industry would have to play the lead role in organizing the alliance, put up matching funds, and agree to actively participate, including commitments to train their own workers and hire new workers in the program. For example, a manufacturing skills partnership established by the Virginia Manufacturers Association works with community colleges to expand credentialing for key manufacturing occupations.⁷⁹

The 2015 Workforce Innovation and Opportunities Act took some modest steps in this direction by mandating that state and local boards “promote the use of industry and sector partnerships to address the workforce needs of multiple employers within an industry” and allowing funds to be spent on incumbent worker training, registered apprenticeship, transitional jobs, on-the-job training, and customized training.⁸⁰ But this still depends on the local workforce boards being innovative and forward looking, something that is rarely the case.

One bill that moves further in the direction of more industry-led training is the industry-responsive Investments in CTE Community College to Career Fund (S. 620, H.R. 2207) sponsored by Senator Duckworth (D-IL) and Rep. Kelly (D-IL). The bill would amend the Workforce Innovation and Opportunity Act to direct the Department of Labor to award competitive grants to eligible educational institutions in partnership with employers or an employer or industry partnership representing multiple employers, to provide educational or career training programs for workers. If such a bill were to be enacted, it would need to ensure that any funded initiative is truly industry-led and not industry-led in name only.

One way to ensure that is to require cash matching by industry participants so they have “skin in the game.”

Such a program should also support industry-led employment programs. For example, McKinsey and Company, the Walmart Foundation and USAID helped create Generation, a program to train young people, aged 18 to 29 for jobs in four sectors (healthcare, technology, customer care, and retail), and help them get jobs in these areas.⁸¹

Support apprenticeship programs

At the same time, more needs to be done to expand apprenticeship programs. A number of nations, including Switzerland and Germany, have utilized system-wide apprenticeship programs to help ensure continued skill development for their economies. However, one challenge of apprenticeships is a “free rider” problem. Companies establishing or participating in apprenticeship programs are providing a public good in the sense that they are contributing to a more skilled workforce that their competitors can take advantage of. Unfortunately, U.S. firms currently invest very little in apprenticeship programs. The Trump administration took an important step forward by issuing an executive order to expand apprenticeships.⁸² However, to really develop a robust national apprenticeship system, the federal government will need to provide funding to spur the development of these systems. Such funding will need to be relatively generous at the beginning to overcome reluctance by industry but should be able to be dialed back over time as industry realizes the benefits of the programs.

Reduce Financial Hardships for Laid-Off Workers

Policy needs to do more to help workers who lose their jobs through no fault of their own. One path not to take is that of many continental European nations that pay workers who lose their jobs relatively high compensation for relatively long periods of time. In France and Germany, unemployed workers, even ones fired for misconduct, can receive benefits for two years at relatively high levels of wage replacement.⁸³ Not only do these generous policies hurt job creation—by paying workers not to work, they reduce consumer demand from the rest of the workforce, which must pay higher taxes to support the generous unemployment insurance payments—but they also contribute to an atrophy of skills and an increased duration of unemployment.⁸⁴ This is because the longer workers are unemployed, the lower their chances of exiting unemployment and the higher their chances of receiving lower wages if they finally become reemployed.⁸⁵

At the same time, limited benefits and leaving dislocated workers largely on their own is not an answer either. In the United States, the level of unemployment insurance benefits a laid-off worker receives depends on the state in which the worker lives, with the variation in benefits being quite significant. And the Trade Adjustment Assistance program, created half a century ago to deal with dislocation from trade, ignores the fact that trade, technology, and government policy changes (e.g., defense-base closures) all contribute to job dislocation.

In addition, while it is beyond the scope of this paper, ensuring some kind of universal health insurance coverage so that when workers lose their jobs they do not lose their insurance is critical. Other ideas to reduce financial risk from job loss should be explored. For example, many workers risk losing their home if they are laid off if they can no longer make their mortgage payments on time. One possible solution would be for Congress to require mortgage lenders to allow individuals who have prepaid their mortgage to have that prepayment be drawn down without penalty to cover missed mortgage payments while they are out of work. Only then after they have drawn down their prepay would they be in arrears and at risk of default.

Establish a Stronger Federal Floor Under State Unemployment Insurance Systems

While federal law mandates that states have an unemployment insurance (UI) system, it does not prevent them from having only a minimal system. As competitive pressures for states to have a “good business climate” have increased, many states have cut benefits and restricted eligibility. One study found that without such state competition, total UI tax rates (and by extension, benefits) would be as much as 58 percent higher.⁸⁶

Raising the FUTA tax 1 percent would raise some states' minimum tax rates, thereby reducing the competitive pressure to keep their benefits and eligibility low.

Absent federal intervention, many states will continue to seek to reduce UI benefits and taxes below levels that are equitable and reasonable. There are two ways to fix this. Congress could set minimum levels of benefits and qualification requirements. However, while this has the merit of setting a national floor, doing it right would require the Department of Labor to impose complicated and bureaucratic rules. An easier solution would be for the federal government to set a national floor by increasing the UI taxes employers pay to the federal government and remitting this back to state UI trust funds. Currently, under the Federal Unemployment Tax Act (FUTA), employers are required to pay a 6 percent tax on the first \$7,000 of payroll paid annually to each employee. As long as their state has an unemployment insurance program that meets federal guidelines (all 50 states do) the employer receives an offset credit on 5.4 percent of the tax, making their effective tax rate 0.6 percent (5.4 percent plus 0.6 percent equal to 6.2 percent). These funds go to pay for program administration and payment of extended benefits. States add their own taxes on top of this. Raising the FUTA tax 1 percent (while reducing the offset tax credit by less than 1 percent, and as discussed below using the new revenues to pay for new federally supported training initiatives) would raise some states' minimum tax rates, thereby reducing the competitive pressure to keep their benefits and eligibility low. Because the floor is below the rate most states now set, states with higher payments would likely use the revenue remitted back to them to offset reductions in their state rates by a corresponding amount. Employers in approximately one-third of the states now paying less than 1.2 percent in state UI taxes would see their tax rates rise. But these states could use the increased revenues for job training; job search assistance; more generous benefits, particularly for low-wage earners (including dependent benefits and benefits for workers in training); and/or broader eligibility (e.g., allowing part-time workers to qualify, instituting alternative base periods, etc.).

Institute Wage Insurance

A recent report from the Obama White House on automation and the economy noted that “Experienced workers who lose their jobs and have to start over find themselves, on average, earning wages at least 10 percent less than what they earned in the jobs they lost, and workers with more than 20 years of experience in their prior job face wages that are nearly a quarter less than they had previously been making.”⁸⁷ Moreover, studies have found that younger workers who better handle more technical training are the ones who benefit the most from retraining, while older workers without that ability benefit the least.⁸⁸ Because of this, many labor economists have long advocated for some kind of wage insurance so that workers, particularly older ones, would be more willing to accept lower wage jobs as a way to get back into the labor market. Funded by the unemployment insurance system, a wage insurance program could be focused on workers older than 50 and earning less than \$50,000 or \$75,000. Workers would be eligible to receive half of the difference of their wages between their old and new jobs for a period of up to two years.

Transform the TAA into TTPAA

Since the 1960s, the United States has had a Trade Adjustment Assistance Act (TAA) program. The program was designed in part to help workers hurt by trade, but also to reduce opposition to trade by so doing. As President Kennedy stated in 1962 when he signed TAA legislation, “When considerations of national policy make it desirable to avoid higher tariffs, those injured by that competition should not be required to bear the full brunt of the impact. Rather, the burden of economic adjustment should be borne in part by the Federal Government.” Today it is time to adapt and expand TAA into a comprehensive Trade, Technology, and Policy Adjustment Assistance Act (TTPAA), to help all workers displaced by trade, technology, or government policy decisions (e.g., defense base closures) and to help workers adapt to changes brought by gains in productivity and automation.⁸⁹ However, the program might should reformed to provide stronger incentives for workers to take shorter-term training where appropriate, to enroll in training more quickly after a layoff, and to get back into the labor market more expeditiously. This expansion could be funded by increasing the FUTA tax and dedicating a portion of the revenues to an expanded TAA program.

Establish Job Security Councils

A key part of Sweden’s flexicurity approach is the TRR (which stands for Trygghetsrådet), a job-security council unique to Sweden that helps laid-off workers. Employers pay into these job-security councils (operated as private organizations) and if they lay employees off, those workers receive financial support and job counseling from the council to help get them back into the workforce as soon as possible.⁹⁰ The success of the program is reflected in the fact that Sweden leads OECD countries in helping displaced workers find new jobs—over 85 percent of such workers find new jobs within a year, primarily because of these arrangements between employers and social partners.⁹¹ Sweden has also found that job-security councils help make the economy more dynamic because they make it easier for companies to shed unproductive divisions without union resistance, while helping the

workers who lose their jobs as a result of these layoffs to find new work.⁹² Economists have found that the job security councils have contributed to the overall health of Sweden's labor market. As Andreas Bergh, a professor at the Research Institute for Industrial Economics, explained, "One of the better parts of the Swedish model is that we encourage adjustments by allowing people to enter into training programs, or move to other areas if that is what is needed to find a job." It's possible some sectors of the U.S. economy might benefit from experimentation with related job-security councils. Congress could provide tax incentives for companies that pay into such councils.

Provide Better Transition Assistance to Help Laid Off Workers Find New Employment

Ideally, laid-off workers would get a new job the next day. In reality, it takes time to find new employment and many workers can benefit from government assistance in this process. There are a number of steps that can be taken.

Support Existing Job Search Assistance Programs

The federal and state governments currently support a system of one-stop reemployment centers. These centers can provide valuable assistance to help workers get back to work. A number of studies have shown that such programs shorten UI durations and improve trust-fund solvency. For example, a study of Nevada's reemployment program by Impaq International for USDOL found it lowered UI duration an average of 3.1 weeks and reduced UI payments an average of \$873 per claimant. Yet funding for the Wagner-Peyser Act program has been declining and has not kept pace with growth in the labor force. Congress should reverse this funding decline. Moreover, the work of the centers should be expanded to advise the unemployed on the training and education needed for employment in growing industries. In other words, there should be a focus on re-training rather than immediate re-attachment to the labor market.

Portable Training Accounts

Giving workers more access to training through personal accounts that they can use to invest in their own skill development can help workers manage future transitions. There are several models of this, including pre-tax lifelong learning accounts and government vouchers.

Life-long learning accounts (LiLAs) are a way for employers and employees to co-finance education and training. LiLAs encourage employers and employees to contribute money pre-tax to training accounts. As with 401(k) retirement accounts, employees would contribute regularly to a LiLA and employers would match the contributions, up to an established annual cap.⁹³ To be fully effective, it is likely that governments or foundations should match employee contributions, at least for low-income workers. Funds in these accounts could be used by workers to pay for education and training activities, consistent with a learning plan developed by LiLA participants in consultation with program-sponsored career and education advisors. A number of states have established LiLA pilots but the federal government could jump start these efforts by allowing contributions to be

made pre-federal tax and by providing matching grants to help states fund accounts of low-income workers.

Other nations have established similar programs providing training vouchers. For example, France has a system of personal training accounts through which workers accrue credits based on a certain number of hours of training. They can use this to enroll in training that has been selected by industry representatives in their region, including skills assessment and common foundations for professional skills.⁹⁴ Similarly, through its “SkillsFuture Initiative,” the government of Singapore provides all Singaporeans aged 25 and above a credit of about \$370 to pay for approved work-skills related courses. More than 18,000 courses are available, and as of December 2016, more than 120,000 people had used the initiative to take courses, more than 60 percent of them over forty years of age. The United States could implement a similar skills voucher program, funding it out of FUTA taxes.

Most government online employment and training systems are poorly designed and hard to use.

Engage the Private Sector to Run and Operate a National Online Reemployment Web Portal

The Internet is transforming many industries and functions. Moreover, given that there will never be adequate funding, even with needed increases in workforce development and transition-program funding, for face-to-face help, we need more workers to rely on online systems. Yet, most government online employment and training systems are poorly designed and hard to use. For example, the U.S. Department of Labor’s Career One Stop Website’s skills profiler is clunky and poorly designed.⁹⁵ Moreover, the DOL site does not list other online skills assessments that workers might use, even though such sites exist.

There are a wide array of online courses through providers like Coursera, edX, and Udacity, these are largely courses from four-year colleges, or in some cases, short courses focused on IT (e.g., android basics, IOS development, etc.). Some organizations, such as Alison, have focused more on online technical education, giving workers the opportunity to take classes such as the fundamentals of financial accounting, retail technology and security, and plumbing. But the Career One Stop Website appears to ignore these programs. For example, when a user clicks on “find training” they are taken to a page that helps them “find local training” where one puts in their zip code to find in-person training programs, almost all at colleges and universities. For example, entering in “Retail management” pulls up over 1,000 links, with most programs being four-year degrees, with many having nothing to do with retail management (such as computer science, health care, and homeland security). Under “types of training” clicking on short-term training gives a page of suggestions such as to go to your local library. One page states “Search online for free training using ‘How to’ and the name of a skill you want to learn, or get started at SkilledUp to browse hundreds of online options.”⁹⁶ But the SkilledUp link is broken.⁹⁷ The “Data science associate” link lists 1,928 certificate programs from 480 organizations, but few are about data science. A lot are about data centers. One is about dentistry implants. Another was for a digital video engineer program, while another was for lighting design. Moreover, a search on the site for terms like “Udacity” and Alison yields no links. Clicking on “job search,” and then on “What are job banks” pulls up a page that says

online job banks are “great” but doesn’t list any.⁹⁸ And a different page on using online job banks lists Monster.com (without a URL link), but then encourages workers to post on specialty job boards, but only lists two (again, without links).

The point of these examples is to show that as a large government agency, the Department of Labor has neither the focus nor the skills to develop a world-class online system. If policymakers want to establish a robust, comprehensive, and easy-to use one-stop online portal, Congress should require DOL to competitively contract out this process to the private sector to develop and host such a system. One of their tasks would be to identify and list in an easy-to-access way all the in-person skills development programs in the United States and all the online ones from around the world that American workers could access. Such sites should be regional and sectoral in nature.

One successful example of a government agency reimagining its approach to Web-based services for worker unemployment compensation came from the Virginia Employment Commission (VEC). Under Aneesh Chopra (who would go on to become America’s First Chief Technology Officer under President Barak Obama), the VEC used a design-thinking approach that used a “Discovery-Development-Deployment” along with “customer journey mapping” to redesign and simultaneously digitalize the state’s entire approach to processing and providing unemployment insurance claims. To gain more insight into the VEC user experience, field observations were conducted to capture insights from both staff and users regarding their current interactions with the VEC system. The design thinking approach yielded journey maps of user’s experiences, noting aspects such as how often users needed to interact with the system (and for what reasons), and what roadblocks they encountered. The mapping step helped identify when information breakdowns took place, such as when users were unable to understand what documentation was required to interact with the system, usability issues in managing system access passwords, and frustration over what users identified as “wasteful procedures.” Those real-world user interactions led to a redesigned process and redesigned Website that sped processing times and increased citizen satisfaction. As Chopra would state “What we’ve learned through this process is a far clearer path from IT investment to citizen improvement. In the past, IT investments were largely back office and internal in their focus, citizen benefit often indirect and secondary. But design thinking can provide the platform on which we build a culture of continuous performance improvement throughout our organization.”⁹⁹

Improved new efforts should be modeled on existing innovative efforts to link workers with training and other supports. For example, the Markle Foundation’s Skillful Initiative, funded in part through Microsoft Philanthropies, has partnered with LinkedIn to establish an online tool to help workers in Colorado identify training for in-demand occupations.¹⁰⁰ Likewise, the Council for Adult and Experiential Learning (CAEL) has established sites to help workers understand jobs and competencies needed for those jobs, find specific jobs, and find training in the petrochemical industry and financial services industries.¹⁰¹ The goal should be to get such sites in every state, with both jobs and skills and training provider information on the sites. At the same time, efforts to help workers with career

navigation assistance, including aptitude and interest testing and career counseling, need to be improved and made more accessible. One way to improve this would be to support the development of free, high-quality online testing and counseling and career navigation services. Such an online tool might profitably consider using the latest machine-learning technologies in order to anonymously analyze large amounts of data on individuals' aptitudes, interests and labor market outcomes in order to build a more powerful and accurate tool to help individuals best assess their own skills, interests and occupational choices. Congress should allocate funding to the Department of Labor for it to competitively support third parties in building and managing such sites.

Better Enable Workers to Receive Unemployment Insurance While in Training

An ideal time for workers to obtain new skills in order to enter new occupations is when they are unemployed. However, for that to work effectively the individual should be able to collect unemployment insurance while unemployed. While federal law requires states to allow workers enrolled in certified training programs to collect unemployment insurance, few states adequately inform unemployed workers of this option and many actively limit the number of qualifying courses. They do this because state unemployment insurance offices are motivated principally by one goal: getting workers back to work as quickly as possible, in part in order to keep unemployment costs, and taxes, as low as possible.

For example, Maryland's Resource Guide for the Unemployed states: "You must be able to work and available for work each week that you are collecting benefits. You must make an active search for work unless specifically exempted under the Maryland Unemployment Insurance law."¹⁰² The guide does not say "if you are enrolled in a certified training program you can collect unemployment insurance." It goes on to say, "We work together daily to assist unemployed Marylanders in providing a broad range of services which you may be eligible to receive. Such services include Unemployment Insurance benefits, state health insurance, housing assistance, and more!" Getting training and getting income support during it through unemployment insurance appears not to be one of the services. The state Website's "frequently asked questions" page says that claimants must "be able to work, available for work and you must make an active search for full-time work."¹⁰³ Again, there is no mention that a worker could be eligible for UI benefits if they were enrolled in training.

Likewise, DOL's Career One Stop site under "How to pay for training" makes no mention of being able to collect UI benefits. In many cases, workers may be told that they are eligible if they are enrolled in an approved training program, but there are no links to such programs, and no information on why some people may want to do this.

Not only do states not let workers know of this option but many limit training options. States have much discretion to set particular parameters.¹⁰⁴ States establish what is "approved training" for UI purposes. During the great recession, the Obama administration asked states to expand the range of "approved training" options and some states did so.¹⁰⁵ But many did not.¹⁰⁶

Doing little to help Americans thrive in what surely will be at least a somewhat more turbulent labor market will not only mean many workers will suffer, but that the long-standing American faith in the future may wither.

To that end, policymakers should establish stronger requirements for state governments to let workers collecting unemployment insurance enroll in certified training without losing their benefits. One place to start is to require all states to actively and clearly notify workers once they apply for unemployment insurance that they qualify for unemployment insurance benefits if they are in approved training. One study found that dislocated workers who collect UI who are sent information regarding training (its potential benefits, how to enroll, and information on financial assistance) are 40 percent more likely to enroll in training.¹⁰⁷ At the same time, states should use the profiling system to predict those likely to be long-term unemployed and quickly encourage people to enroll, including advising them to meet with staff at regional “One-Stops” who can counsel them about training opportunities. In addition, Congress should require states to provide extensions to these workers’ unemployment insurance benefits (currently 26 weeks) if they need an extension to finish their training.

CONCLUSION

These and other steps to ease transitions are important if nations are going to have political economies that embrace change and innovation. Governments need to do more to reduce employment risk for workers. At the same time, if economies are going to reap the benefits of the next innovation wave, the last thing pundits and anti-technology advocates should do is to stoke people’s unwarranted fears that their jobs are on the 4th-industrial-wave chopping block and at risk due to all-powerful “Terminator-like” robots; support for completely misguided policy proposals like taxing and regulating robots will only slow economic progress. Slowing innovation runs counter to the goals of ensuring a growing standard of living for workers.

The major risk to the global economy over the next decade is not too much disruption, but too little. In other words, the risk is that productivity will grow too slowly. Therefore, it is critical that policies not hinder technology-led creative disruption.

To be sure, this is not a call for a return to the Hobbesian world of the 1800s, when, if you lost your job, you were completely on your own (hopefully with the help of your extended family). We should provide more support for firms at risk to help them adapt to market changes, new technologies, and new business practices to increase productivity. We can and should do a better job of providing temporary income support for workers who lose their jobs through no fault of their own. We should also make it easier for workers to transition into new occupations.

Improving policies for workforce training and adjustment should not be a partisan issue. One lesson from the last election is that many American voters are frustrated and do not believe that the economy is working for them. The risk with this frustration is that voters will turn their backs on sources of progress, particularly global trade and technological innovation, while at the same time becoming less tolerant of others.

This is important because if we are going to have any hope of regaining America’s historical willingness to embrace change and innovation, then government needs to reduce risk, not

by hindering innovation, but by helping those negatively affected by it. As *New York Times* columnist David Brooks writes on the issue of health insurance:

The core of the new era is this: If you want to preserve the market, you have to have a strong state that enables people to thrive in it. If you are pro-market, you have to be pro-state. You can come up with innovative ways to deliver state services, like affordable health care, but you can't just leave people on their own. The social fabric, the safety net and the human capital sources just aren't strong enough.¹⁰⁸

To paraphrase Brooks, if we want to preserve Americans' willingness to embrace, or at least accept creative destruction, then we need a state that effectively enables people to thrive. Moreover, if we are going to realize the American dream of continuing progress and increasing standards of living, then the last thing we want to do is to constantly stoke people's unwarranted and unfounded fears that their jobs are on the techno-chopping block. Certainly, the past 170 years of American history suggest these fears are misplaced. But it doesn't mean that the fears themselves are not real or that we should not do a significantly better job in helping workers make labor market transitions. Throwing sand in the gears of progress will hurt the average American. Doing little to help Americans thrive in what surely will be at least a somewhat more turbulent labor market will not only mean many workers will suffer, but that the long-standing American faith in the future may wither.

ENDNOTES

1. Kevin J. Delaney, “The robot that takes your job should pay taxes, says Bill Gates,” *Quartz*, February 17, 2017, <https://qz.com/911968/bill-gates-the-robot-that-takes-your-job-should-pay-taxes/>. See also <http://laborcenter.berkeley.edu/beyond-basic-income-claiming-our-right-to-govern-technology/>
2. Wasily Leontief and Faye Duchin, “The Impacts of Automation on Employment, 1963-2000,” *New York Institute for Economic Analysis* (April 1984), <http://eric.ed.gov/?id=ED241743>, accessed March 7, 2016.
3. Klaus Schwab, “The Fourth Industrial Revolution: what it means, how to respond,” World Economic Forum, January 14, 2016, <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>.
4. Robert D. Atkinson, *The Past and Future of America’s Economy: Long Waves of Innovation that Power Cycles of Growth* (Edward Elgar, 2006).
5. Robert D. Atkinson, “Think Like an Enterprise: Why Nations Need Comprehensive Productivity Strategies” (Information Technology and Innovation Foundation, May 2016), <https://itif.org/publications/2016/05/04/think-enterprise-why-nations-need-comprehensive-productivity-strategies>.
6. Carlota Perez, *Technological Revolutions and Financial Capital: The Dynamics of Bubble and Golden Ages* (Cheltenham: Edward Elgar, 2002).
7. Robert D. Atkinson, “Unfortunately, Technology Will Not Eliminate Many Jobs,” *Innovation Files*, August 7, 2017, <https://itif.org/publications/2017/08/07/unfortunately-technology-will-not-eliminate-many-jobs>; Michael Chui, James Manyika, and Mehdi Miremadi, “Four Fundamentals of workplace automation,” (McKinsey & Company: November 2015), <http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/four-fundamentals-of-workplace-automation>.
8. Rodney A. Brooks, “Mistaking Performance for Competence,” in *What to Think About Machines That Think*, ed. John Brockman (New York: Harper Perennial, 2015), 111.
9. Boston University School of Public Health, Behavioral Change Models, “Diffusion of Innovation Theory,” <http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories4.html>, accessed January 1, 2018.
10. Ben Miller and Robert D. Atkinson, “Are Robots Taking our Jobs, or Making Them?” (Information Technology and Innovation Foundation, September 2013), <https://itif.org/publications/2013/09/09/are-robots-taking-our-jobs-or-making-them>; Robert D. Atkinson and John Wu, “False Alarmism: Technological Disruption and the U.S. Labor Market, 1850-2015” (Information Technology and Innovation Foundation, May 2017), <https://itif.org/publications/2017/05/08/false-alarmism-technological-disruption-and-us-labor-market-1850-2015>.
11. James Manyika, David Hunt, Scott Nyquist, Jaana Remes, Vikram Malhotra, Lenny Mendonca, Byron Auguste, and Samantha Test, “Growth and Renewal in the United States: Retooling America’s Economic Engine,” (McKinsey Global Institute: February 2011), <http://www.mckinsey.com/global-themes/americas/growth-and-renewal-in-the-us>.
12. Bharat Trehan, “Productivity Shocks and the Unemployment Rate,” *Federal Reserve Bank of San Francisco Economic Review*, 2003, <http://www.frbsf.org/economic-research/files/article2.pdf>.
13. Organisation for Economic Co-operation and Development (OECD), *Technology, Productivity and Job Creation: Best Policy Practices* (Paris: OECD, 1998), 9, <http://www.oecd.org/dataoecd/39/28/2759012.pdf>.
14. Nick Bloom, John Van Reenan, Charles I. Jones, and Michael Webb, “Are Ideas Getting Harder to Find?” NBER Working Paper No. 23782, September 2017, <http://www.nber.org/papers/w23782>.

-
15. “Has the ideas machine broken down?” *The Economist*, January 12, 2013, <https://www.economist.com/news/briefing/21569381-idea-innovation-and-new-technology-have-stopped-driving-growth-getting-increasing>.
 16. Carl Benedikt Frey and Michael A. Osborne, “The Future of Employment: How Susceptible Are Jobs to Computerisation?” (Oxford Martin School, University of Oxford, Oxford, September 17, 2013), http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf.
 17. Ben Miller, “Automation Not So Automatic,” *The Innovation Files*, September 20, 2013, <http://www.innovationfiles.org/automation-not-so-automatic/>.
 18. Chu, Manyika, and Miremadi, “Four Fundamentals of Workplace Automation,” <http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/four-fundamentals-of-workplace-automation>.
 19. This is based on the assumption that all productivity growth leads to job loss in an enterprise or industry (there is no compensating increase in demand). An annual growth rate in productivity of 3.1 percent, assuming that all workers never rejoin the labor force and that the increased productivity does not lead to increased demand, leads to a loss of 47 percent of jobs over 20 years. But of course, demand grows and workers are reemployed, which is why massive increases in productivity in the past led to more income, but not fewer jobs.
 20. James Manyika, Susan Lund, Michael Chui, Jacques Bughin, Jonathan Woetzel, Parul Batra, Ryan Ko, and Saurabh Sanghvi, “Jobs Lost, Jobs Gained: Workforce Transitions in A Time Of Automation,” (McKinsey Global Institute: December 2017), <https://www.mckinsey.com/global-themes/future-of-organizations-and-work/what-the-future-of-work-will-mean-for-jobs-skills-and-wages>.
 21. Carl Benedikt Frey and Michael A. Osborne, “The Future of Employment: How Susceptible Are Jobs to Computerisation?” op. cit. Also Robert D. Atkinson, “Unfortunately Technology Won’t Replace Many Jobs,” ITIF, August 7, 2017, <https://itif.org/publications/2017/08/07/unfortunately-technology-will-not-eliminate-many-jobs>
 22. This is based on the share of wage and salary income by quartile.
 23. U.S. Bureau of Labor Statistics, Current Employment Statistics (Employment Level - All Industries Self Employed, Unincorporated, and Total Non-Farm, All Employees; accessed March 14, 2016).
 24. Lawrence F. Katz and Alan B. Krueger, “The Rise and Nature of Alternative Work Arrangements in the United States 1995-2015,” NBER Working Paper No. 22667, September 2016, <http://www.nber.org/papers/w22667.pdf>.
 25. Stephen Rose, “Does Productivity Growth Still Benefit Working Americans?” (Information Technology and Innovation Foundation, June 2007), <https://itif.org/publications/2007/06/13/does-productivity-growth-still-benefit-working-americans>.
 26. Harry Holzer, “Job Market Polarization and U.S. Worker Skills: A Tale of Two Middles,” (Brookings Economic Studies, April 2015), https://www.brookings.edu/wp-content/uploads/2016/06/polarization_jobs_policy_holzer.pdf.
 27. Josh Bivens and Lawrence Mishel, “Understanding the Historic Divergence Between Productivity and a Typical Worker’s Pay: Why It Matters and Why It’s Real” (Economic Policy Institute, September 2, 2015), <http://www.epi.org/publication/understanding-the-historic-divergencebetween-productivity-and-a-typical-workers-pay-why-it-matters-and-why-its-real/>.
 28. Jonathan Rothwell, “Why Elites Want More Competition for Everyone Except Themselves,” *Economics*, April 2, 2016, accessed April 3, 2016, <http://economics.com/why-elites-want-more-competition-for-everyone-except-themselves/>.
 29. Atkinson, “Unfortunately, Technology Will Not Eliminate Many Jobs,” <https://itif.org/publications/2017/08/07/unfortunately-technology-will-not-eliminate-many-jobs>.

-
30. European Commission, Skills Panorama, “Skills underutilization across countries in 2014,” <http://skillspanorama.cedefop.europa.eu/en/indicators/skills-under-utilisation>; Muge Adalet McGowan and Dan Andrews, “Skill Mismatch and Public Policy in OECD countries” (OECD Economics Department working papers no. 1210, April 28, 2015), <http://www.oecd.org/eco/growth/Skill-mismatch-and-public-policy-in-OECD-countries.pdf>; OECD, “Better Use of Skills in the Workplace: Why It Matters for Productivity and Local Jobs,” <http://dx.doi.org/10.1787/9789264281394-en>.
 31. Research working paper by Brian Clark and Arnaud Maurel from Duke University and Clément Joubert from University of North Carolina at Chapel Hill titled “The career prospects of overeducated Americans” uses data from the National Longitudinal Survey of Youth 1979 and Current Population Survey to look at overeducation’s effects on employment and wages over time. To analyze these effects, the researchers tracked almost 5,000 college graduates for 12 years after they entered the workforce. Their study shows that over one-third of college graduates are working in what the researchers call “overeducated employment; <https://www.bls.gov/pub/mlr/2013/article/clayton.htm>; <https://www.bls.gov/osmr/abstract/ec/ec060110.htm>.
 32. Kai-Fu Lee, “The Real Threat of Artificial Intelligence,” *The New York Times*, June 24, 2017, https://www.nytimes.com/2017/06/24/opinion/sunday/artificial-intelligence-economic-inequality.html?mwrsm=Email&_r=0.
 33. See discussion of competition and innovation in Robert D. Atkinson and Michael Lind, *Big is Beautiful: Debunking the Mythology of Small Business* (The MIT Press: Cambridge, Massachusetts and London, England, Forthcoming, March 2018).
 34. Susan Adams, “Most Americans Are Unhappy at Work,” *Forbes*, June 20, 2014, <http://www.forbes.com/sites/susanadams/2014/06/20/most-americans-are-unhappy-atwork/#5c37252d5862>.
 35. John Wu and Robert D. Atkinson, “The U.S. Labor Market Is Far More Stable Than People Think” (Information Technology and Innovation Foundation, June 2016), <https://itif.org/publications/2016/06/20/us-labor-market-far-more-stable-people-think>.
 36. Atkinson and Wu, “False Alarmism,” <https://itif.org/publications/2017/05/08/false-alarmism-technological-disruption-and-us-labor-market-1850-2015>.
 37. Executive Office of the President, “Artificial Intelligence, Automation, and the Economy,” (Executive Office of the President, December 2016), 25, <https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/Artificial-Intelligence-Automation-Economy.PDF>, accessed January 1, 2018.
 38. OECD, “Public Expenditure and Participant Stocks on LMP” (data extracted January 17, 2018 from OECD.Stat0, <http://stats.oecd.org/viewhtml.aspx?datasetcode=LMP&lang=en>).
 39. Ibid.
 40. Robert D. Atkinson, “The Competitive Edge: A Policymaker’s Guide to Developing a National Strategy” (Information Technology and Innovation Foundation, December 2017), <https://itif.org/publications/2017/12/06/competitive-edge-policymakers-guide-national-strategy>.
 41. John Bound and Harry Holzer, “Demand Shifts, Population Adjustments, and Labor Market Outcomes during the 1980s,” NBER Working Paper No. 5685, July 1996, <http://www.nber.org/papers/w5685>.
 42. Alana Semuels, “How the ‘Losers’ in America’s Trade Policies Got Left Behind,” *The Atlantic*, October 19, 2016, <https://www.theatlantic.com/business/archive/2016/10/trade-winners-losers/504584/>.
 43. Ronald Bailey, “Zoning Laws in New York, San Francisco and San Jose Cut Americans’ Wages by \$8,775” *Reason*, May 25, 2017, <http://reason.com/blog/2017/05/25/residential-zoning-in-new-york-san-franc>.
 44. The White House Office of Management and Budget, Historical Table 5.1, <https://www.whitehouse.gov/omb/budget/Historicals>, accessed December 5, 2017.

-
45. David Darwent, *Growth poles and growth centers in regional planning--a review* (Berkeley, California: University of California, 1969), 5-32.
 46. The Congressionally created Commission on Population Growth and the American Future proposed “To promote the expansion of job opportunities in urban places located within or near declining areas and having a demonstrated potential for future growth, the Commission recommends the development of a growth center strategy.” See: Lawrence E. Wood, “From theory to implementation: an analysis of the Appalachian Regional Commission’s growth center policy,” *Environment and Planning*, March 2001, http://www.academia.edu/30181773/From_theory_to_implementation_an_analysis_of_the_Appalachian_Regional_Commissions_growth_center_policy.
 47. Mayor Virg Bernero and Mayor Bill Peduto, “Viewpoint: Midwest No Longer Rust Belt, Now Production Belt,” *Lansing State Journal*, November 18, 2016, <http://www.lansingstatejournal.com/story/opinion/contributors/viewpoints/2016/11/18/viewpoint-midwest-longer-rust-belt-now-production-belt/94014430/>.
 48. Congress.gov, “S.2526 - Made in America Manufacturing Communities Act of 2016,” <https://www.congress.gov/bill/114th-congress/senate-bill/2526>, accessed January 1, 2018.
 49. Atkinson, “The Competitive Edge,” <https://itif.org/publications/2017/12/06/competitive-edge-policymakers-guide-national-strategy>.
 50. Timothy E. Zimmer, “The Importance of Education for the Unemployed,” *Indiana Business Review*, Spring 2016, <http://www.ibrc.indiana.edu/ibr/2016/spring/article2.html>.
 51. Bryan Caplan, *The Case Against Education* (Princeton University Press, 2018).
 52. Ibid, 35.
 53. Ibid, 51.
 54. Ibid, 50.
 55. Betsy Brand, “High School Career Academies: A 40-Year Proven Model for Improving College and Career Readiness” (American Youth Policy Forum, November 2009), <http://www.aypf.org/documents/092409CareerAcademiesPolicyPaper.pdf>.
 56. See <https://www.ptchnyc.org/domain/23>.
 57. Joe Kennedy, Daniel Castro, and Robert D. Atkinson, “Why It’s Time to Disrupt Higher Education by Separating Learning From Credentialing” (Information Technology and Innovation Foundation, August 2016), <https://itif.org/publications/2016/08/01/why-its-time-disrupt-higher-education-separating-learning-credentialing>.
 58. Ibid for a review of this literature.
 59. For example, see: “Straighterline: The Solution to the Cost of College,” <https://www.straighterline.com/>, accessed January 1, 2018.
 60. Caplan, *The Case Against Education*, 36.
 61. See <http://www.polytechnicscanada.ca/polytechnic-advantage/what-polytechnic>.
 62. See the Partnership for 21st Century Learning, <http://www.p21.org/>.
 63. Richard Kahlenberg, “How Higher Education Funding Shortchanges Community Colleges” (The Century Foundation, May 28, 2015), <https://tcf.org/content/report/how-higher-education-funding-shortchanges-community-colleges/>.
 64. Ibid.
 65. Harry J. Holzer and Sandy Baum, *Making College Work: Pathways to Success for Disadvantaged Students* (Brookings Institution Press, August 29, 2017).
 66. “About SkillsFuture,” <http://www.skillsfuture.sg/AboutSkillsFuture>, accessed December 12, 2017.

-
67. Loh Chuan Junn, “126,000 Singaporeans used SkillsFuture credit in 2016,” *Channel News Asia*, March 31, 2017, <https://www.channelnewsasia.com/news/singapore/126-000-singaporeans-used-skillsfuture-credit-in-2016-7546994>.
 68. “SkillsFuture 2016 Year in Review,” <http://www.skillsfuture.sg/NewsAndUpdates/DetailPage/df150d4a-411c-476b-8971-77abe4be84d1> , accessed December 17, 2016.
 69. David Moschella, “The Emerging Double-Deep Economy,” Leading Edge Forum, September 17, 2013, <https://leadingedgeforum.com/publication/the-emerging-double-deep-economy-2318/>.
 70. Tyler Soper, “Analysis: The exploding demand for computer science education, and why America needs to keep up,” *Geekwire*, June 6, 2014, <http://www.geekwire.com/2014/analysis-examining-computerscience-education-explosion/>.
 71. The White House: President Barack Obama, “The 2015 Economic Report to the President,” <https://www.whitehouse.gov/blog/2015/02/19/2015-economic-report-president>, accessed December 1, 2015.
 72. Robert D. Atkinson, “Restoring Investment in America’s Economy” (Information Technology and Innovation Foundation, June 2016), <https://itif.org/publications/2016/06/13/restoring-investment-americas-economy>.
 73. “Credential Engine,” <https://www.credentialengine.org/>, accessed January 2, 2018.
 74. Connecting Credentials, “Building Learning-Based Credentials and Systems,” www.connectingcredentials.org, accessed January 2, 2018.
 75. See <https://www.axios.com/google-starts-it-certificate-program-to-fill-empty-jobs-1516053831-ea04b5f6-eb8a-4eef-b628-43feca19effc.html>
 76. Skills Future SG, “Programmes and Initiatives,” <http://www.ssg.gov.sg/programmes-and-initiatives/manpower-lean-productivity/sectoral-manpower-plan.html>, accessed January 2, 2018.
 77. UK Commission for Employment and Skills, “Research to Support the Evaluation of Investors in People: Employer Case Studies (Year 2),” Evidence Report 70, July 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/303039/evidence-report-70-evaluation-iip-employer-case-studies-year2.pdf.
 78. Investors in People, “The Investors in People Awards 2017- Winners,” <https://www.investorsinpeople.com/investors-people-awards-2017-winners>, accessed January 3, 2018.
 79. Southside Virginia Community College, “MSI & Southside Virginia Community College Announce New Industry Skills Partnership,” <http://southside.edu/news/msi-southside-virginia-community-college-announce-new-industry-skills-partnership>, accessed January 2, 2018.
 80. United States Department of Labor, “Workforce Innovation and Opportunity Act (WIOA) Overview,” <https://www.doleta.gov/WIOA/Overview.cfm>, accessed January 10, 2018.
 81. See <https://www.generation.org/usa/>.
 82. The White House, “Presidential Executive Order Expanding Apprenticeships in America,” <https://www.whitehouse.gov/the-press-office/2017/06/15/presidential-executive-order-expanding-apprenticeships-america>, accessed June 15, 2017.
 83. The French Social Security System, “V-Unemployment Insurance,” http://www.cleiss.fr/docs/regimes/regime_france/an_5.html, accessed January 3, 2018; European Commission, “Employment, Social Affairs, & Inclusion, “Germany,” <http://ec.europa.eu/social/main.jsp?catId=1111&intPageId=2565&langId=en>, accessed January 3, 2018.
 84. Thomas Conefrey, Yvonne McCarthy, and Martina Sherman, “Re-employment Probabilities for Unemployed Workers in Ireland,” Central Bank of Ireland, November 2013, https://econpapers.repec.org/paper/cbiecolet/06_2fel_2f13.htm.

-
85. Johannes F. Schmieder, Till von Wachter, and Stefan Bender, “The Causal Effect of Unemployment Duration on Wages: Evidence from Unemployment Insurance Extensions*,” NBER Working Paper No. 19772, December 2013, Revised in October 2014, <http://www.nber.org/papers/w19772>.
 86. Laurie J. Bassi and Daniel P. McMurrer; *Essays on Interstate Competition in the –Unemployment Insurance System*, (Washington D.C: United States Department of Labor, Employment and Training Administration, 1996), p. 51, <http://wdr.doleta.gov/owsdrr/98-5/98-5.pdf>.
 87. Executive Office of the President, “Artificial Intelligence, Automation, and the Economy,” <https://www.whitehouse.gov/sites/whitehouse.gov/files/images/EMBARGOED%20AI%20Economy%20Report.pdf>, accessed December 30, 2016.
 88. Louis Jacobson, Robert J. Lalonde and Daniel Sullivan “The Impact of Community College Retraining on Older Displaced Workers: Should We Teach Old Dogs New Tricks?” *ILR Review*, Vol. 58, No. 3, https://www.jstor.org/stable/30038595?seq=1#page_scan_tab_contents.
 89. Robert D. Atkinson, “How Certain Are You That Robots Won’t Create as Many Jobs as They Displace,” *The Christian Science Monitor*, December 3, 2015, <http://www.csmonitor.com/Technology/Breakthroughs-Voices/2015/1203/How-certain-are-you-that-robots-won-t-create-as-many-jobs-as-they-displace>; United States Department of Labor, Employment and Training Administration, “What Is Trade Adjustment Assistance?” last updated June 22, 2012, <https://www.doleta.gov/tradeact/factsheet.cfm>, accessed January 2, 2018.
 90. Samuels, “What If Getting Laid Off Wasn’t Something to Be Afraid Of?” <https://www.theatlantic.com/business/archive/2017/10/how-to-lay-people-off/543948/>.
 91. OECD, “Back to Work: Sweden Improving the Re-employment Prospects of Displaced Workers,” December 16, 2015, http://www.oecd-ilibrary.org/employment/back-to-work-sweden_9789264246812-en.
 92. Samuels, “What If Getting Laid Off Wasn’t Something to Be Afraid Of?” <https://www.theatlantic.com/business/archive/2017/10/how-to-lay-people-off/543948/>.
 93. American Legislative Exchange Council, “The Lifelong Learning Accounts Act,” <https://www.alec.org/model-policy/the-lifelong-learning-accounts-act/>, accessed January 5, 2018.
 94. Ministère du Travail, Mon Compte Formation, <http://www.moncompteformation.gouv.fr/>, accessed January 5, 2018.
 95. When I put in my skills into the assessment tool, I was told that there were no occupations suitable for me. Which makes me hope that the think tank industry doesn’t collapse as I would not be able to get another job. See: Career One Stop, “Skills Profiler,” <https://www.careerinfonet.org/skills/default.aspx?nodeid=20>, accessed January 5, 2018.
 96. Career One Stop, “Short-term Training,” <https://www.careeronestop.org/FindTraining/Types/short-term.aspx>, accessed January 5, 2018.
 97. See: <http://www.skilledup.com>.
 98. Career One Stop, “What Are Job Banks?” <https://www.careeronestop.org/JobSearch/FindJobs/what-are-job-banks.aspx>, accessed January 5, 2018.
 99. Jeneanne Rae and Carl Fudge, “Design Thinking + IT-Mediated Services = Innovation Excellence,” (Motiv Strategies, August 2009), <https://www.slideshare.net/motivstrategies/design-thinking-it-services-innovation-excellence>.
 100. LinkedIn, “Training Finder, Denver Colorado” <https://www.linkedin.com/training?location=Denver-CO>, accessed January 7, 2018.
 101. “Petrochemical: Thriving Gulf Coast Industry,” <https://petrochemworks.com/>, accessed December 15, 2017, ; “Banking on My Career: Jobs in Banking, Insurance, and Wealth Management,” <https://bankingonmycareer.com/>, accessed December 15, 2017.

-
102. State of Maryland, Department of Labor, Licensing, & Regulation, “Resolve Guide for the Unemployed: Helpful Information for Unemployed Workers in Maryland,” <https://www.dllr.state.md.us/employment/wduiresourceguide.pdf>, accessed January 5, 2018.
 103. State of Maryland, Department of Labor, Licensing, & Regulation, “Claimant Most Frequently Asked Questions - Unemployment Insurance,” <https://www.dllr.state.md.us/employment/claimfaq.shtml#cert>, accessed January 5, 2018.
 104. United States Department of Labor, Employment & Training Administration, “State Law Information: Comparison of State UI Laws,” <https://workforcesecurity.doleta.gov/unemploy/statelaws.asp#sigprouilaws>, 5-24.
 105. U.S. Department of Labor, Employment and Training Administration Advisory System, “Training and Employment Guidance Letter No. 8-16,” https://wdr.doleta.gov/directives/attach/TEGL/TEGL_8-16_Acc.pdf, accessed January 7, 2018.
 106. National Association of State Workforce Agencies, “NASWA Survey on Approved Training and Pell Grants for UI Claimants,” <http://naswa.org/assets/utilities/serve.cfm?path=/sections/pdf/2010/FINALREPORTPELLGRANT.pdf>, accessed January 7, 2018.
 107. Andrew Barr and Sarah Turner, “A Letter and Encouragement: Does Information Increase Post-Secondary Enrollment of UI Recipients? NBER Working Paper No. 23374, April 2017, <http://www.nber.org/papers/w23374.pdf>.
 108. David Brooks, “The Republican Health Care Crackup,” *The New York Times*, March 10, 2017, <https://www.nytimes.com/2017/03/10/opinion/the-republican-health-care-crackup.html>.

ACKNOWLEDGMENTS

The author would like to thank Brian Bosworth, Future Works; Peter A. Creticos, Institute for Work & the Economy; Stephen Ezell, ITIF; Larry Good, Corporation for a Skilled Workforce; Harry Holzer, Georgetown University; Sam Leiken; Pam Tate, Center for Adult and Experiential Learning; Mark Troppe, the Center for Regional Economic Competitiveness for their input. Any errors or omissions are the author's alone.

ABOUT THE AUTHOR

Robert D. Atkinson is the founder and president of ITIF. Atkinson's books include *Big is Beautiful* (MIT, 2018), *Innovation Economics: The Race for Global Advantage* (Yale, 2012), and *The Past and Future of America's Economy: Long Waves of Innovation That Power Cycles of Growth* (Edward Elgar, 2005). Atkinson holds a Ph.D. in city and regional planning from the University of North Carolina, Chapel Hill, and a master's degree in urban and regional planning from the University of Oregon.

ABOUT ITIF

The Information Technology and Innovation Foundation (ITIF) is a nonprofit, nonpartisan research and educational institute focusing on the intersection of technological innovation and public policy. Recognized as the world's leading science and technology think tank, ITIF's mission is to formulate and promote policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress.

FOR MORE INFORMATION, VISIT US AT WWW.ITIF.ORG.