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THE FOURTH AGE

Smart Robots, Conscious Computers, and the Future of Humanity

BYRON REESE

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Will Robots Take All Our Jobs?

The public discourse about robots is overwhelmingly about their impact on jobs, and therefore we will explore this topic in detail. The question at issue is this: Will automation, on net, eliminate more jobs than the economy will create, or will we remain close to full employment? An incalculable amount of analysis and opinion has been written on this question, and while it seems like a straightforward one, it is devilishly complex. That is why survey after survey of technologists, economists, and futurists show that they are almost evenly split on the answer to this "simple" question.

Why is there so little consensus? Isn't the answer just a simple calculation of jobs destroyed by technology offset by those created by it? Well, technically, yes, but that's a calculation easier described than done. The job calculation is complicated because we don't have a list of all of the jobs and the skills for each one. Even if we did, it constantly changes. We don't know what technology will be able to do over the next decade or so. We don't know the regulatory pressures and limits placed on the new

technology, what will happen to the economy, the degree to which businesses will invest in new technology, what will happen to the minimum wage, how much the new technology will cost, how good it will be, and how many jobs it, in turn, will create. What specific breakthroughs in AI will occur? What new materials will scientists invent? What advances will be made in sensor technology?

And this is just the tip of the iceberg. We don't know how quickly society will accept robots in jobs held by humans, what shifts will happen in consumer demand, what will happen to the price of labor, what new trade agreements will be signed, which technologies will get locked up in the courts. We don't know how insurers will react to some robots, or how willing banks will be to loan money for purchasing them, or how truly human independent they will be. We don't know how many jobs their lowering of costs will create, how many jobs the robot-making industry will consist of, or how many jobs will be created that our present perspective prevents us from seeing. In short, our technology now moves forward faster than our ability to comprehend its implications.

This list goes on and on, and I offer it to show why the net effect of technology on jobs is not a back-of-the-envelope calculation. The margin of error introduced by any of these variables would be enough to throw the entire calculation off. And taken together, they present an insurmountable obstacle to forecasting this way.

So if we can't calculate the net job loss from robots directly, what is our path forward? We can view the problem differently, and realize that there are just three possible outcomes, which can be sorted by the assumptions that each relies on. Each of these three outcomes is possible. There are simply too many unknowns to draw definitive conclusions about what is going to happen. What if the cost of labor falls at the rate that we saw the cost of transistors fall over the past few decades? What if that underlying assumption of economics, scarcity, is diminished by technology? Or what if robots and AI are actually not all that different in impact from steam power or electricity, which definitely changed the economy but did not cause the unemployment rate to rise?

I suggest we proceed with a mind open to a world changing in unpredictable ways. But regardless of how it all unfolds, there are only three possible outcomes:

1. Robots and AI will take *all* the jobs. "All" should be taken to mean that machines can do every single thing better than humans and the only reason people hire a person over a machine is for purely emotional or nostalgic reasons. This view says the machines will paint better paintings, write better sitcoms, be better presidents . . . the whole ball of wax. As our rule of thumb, let's say "all" here is 90 percent of the jobs.
2. Robots and AI will take *some* of the jobs. This position believes that there will be a substantial net human job loss to machines, that the machines will destroy substantially more jobs than they will create. This position assumes the machines will take over most of the jobs in retail, service, delivery, and even a good deal of "professional" jobs like bookkeepers, doctors, and paralegals. But they don't take over the jobs in the arts, for instance. Nor can they do the jobs that require emotion or social skills, or that are too complex in the breadth of requirements (think CEO or installer of aftermarket car stereos). For the "some" position, let's assume there is a 20 percent level of unemployment that persists indefinitely. This is roughly the level of unemployment during the Great Depression in the United States. In this view, there simply aren't enough jobs for all the people, but the majority of people will still work.
3. Robots and AI will take *none* of the jobs. This position states that while jobs will be eliminated by machines, roughly the same number of jobs will be created, and that *everyone* remains employable. This position says you won't have a lack of work for any portion of society, even those with few job skills. The main idea behind this view is that it doesn't matter how good machines get, they simply cannot take all the jobs because there is an infinite supply

> of them. Even if all the jobs of today were magically done by machines tomorrow, we would invent entirely new ways to make or do something that other people will pay for.

We'll examine each of these positions in detail.

One final note before we begin. Until this point, I have used the term "robot" in the sense in which most of us think of it, as a mechanical device that can operate autonomously. But from this point on, we need to broaden the term a bit. Robots, strictly speaking, don't necessarily need to be embodied or have locomotion. When considering the effects of automation on jobs, this is certainly the case. A machine replacing a beekeeper, tending hives and harvesting honey, is clearly a robot. However, a machine replacing a bookkeeper, keeping the accounting records in order, is also in this usage a robot as well. Even though that machine is a desktop computer and has no body, the end effect is the same. Both of these devices perform labor that was previously done by a human. Whether the machine is pushing around atoms or bits doesn't matter too much when we are talking about employment.

Possibility One: The Machines Take All the Jobs

Consider the foundational questions from earlier in the book. Possibility one, that the machines take all the jobs, will most likely appeal to those who believe that they themselves are machines. It will also likely resonate with those who believe that the "self" is a trick of the brain. In addition, this is a position that is most in alignment with monism, the belief that everything in the world is made of a single substance. Possibility one is based on a completely mechanistic view of the universe.

Let's start off by looking back the last couple of centuries through the lens of someone holding this position. They may describe it as such:

For 250 years, machines have been taking jobs from humans. At first, machines were able to do only the most basic, simple tasks. They took on the backbreaking work in the form of that marvel the steam engine. The things that steam could do had been such grinding toil for men and beasts that humanity welcomed the new machines with open arms. This was the start of the Industrial Revolution.

As technology improved our machines, they took on more complex, though still monotonous, tasks. Think sewing machines, cash registers, and combine harvesters. They were welcomed by the workers they freed from drudgery. And those same workers were pleased that they could now focus on higher-value work, leaving the repetitive labor to the machines.

But the march of progress never slows. The machines continued to advance, until suddenly, out of the blue, humans found themselves doing something they had never imagined: competing with machines for their own jobs. It seemed like a *Twilight Zone* episode gone bad, but Rod Serling didn't step out from behind a bush. This was real. Then came the computer.

As happened with mechanization, computers entered the scene as primitive devices. At first, they were simply glorified calculators, welcomed by scientists and mathematicians since they could do all of the tedious math problems. But they too began advancing in ability, doubling in power every two years. Before long, the bank tellers were facing off against the ATMs, while the stockbrokers battled against online trading websites. It was John Henry versus the steam drill all over again, only instead of competing with our manual labor, they were now providing cognitive labor as well.

Progress is relentless. Machines of all types will be improved upon indefinitely. You can see where this is heading: at some point soon, *technology will advance faster than the time it takes people to learn or invent new jobs.* As has happened in the past,

> the time between when a technological disruption creates a job and when another disruption destroys that job will get ever shorter, until the time will come when the machines can learn any new task better and faster than any human.
>
> This isn't a guess. It is simply math.

Or, less abstractly, the position goes like this: "When you took the person who hauled bricks with a wheelbarrow and gave him a job hauling bricks with a forklift, the training required to make that transition was economically reasonable given the value of the newly trained worker. When our machines went from being super dumb to just plain dumb, we still had no problems mastering them. But the new jobs will require such extensive skills that it will not be economically viable to retrain workers to do them. And this all repeats, ad infinitum, progressively eating away at all meaningful human employment."

Most of the people holding this view believe that *all* human work will eventually be done by machines, and that the only economically profitable work left will be places where humans *subjectively* prefer hiring another human, even though the machine is *objectively* better. At most, this reasoning goes, you will be left with a few ballet dancers to entertain people who don't want to watch an anatomically perfect android dance *Swan Lake*, as well as a few craftsmen to make tchotchkes for nostalgia buffs who prefer anachronistic man-made items.

To many, this narrative is a frightening scenario. What would this world be like? And if machines are better at everything than us, either we are inferior to them in every conceivable way, or we are machines ourselves, and not particularly good ones. These fears are compounded by a tendency of the media to report on automation in such a way that projects intentionality, and even malice, onto the machines in headlines like, "Is a Robot Gunning for Your Job?" or "Will a Computer Steal Your Job?" If a computer really stole your job, that would imply it snuck into the payroll system at night and deleted your name and added its own, chuckling to itself on its way out the door.

But putting aside all the emotional implications of this position, let's coolly consider the question of whether this viewpoint is true. Will we all, each of us, be replaceable by a machine at some time in the future? If possibility one is wrong, where does the logical breakdown occur? Let's look. There are nine assumptions underlying this argument.

ASSUMPTION 1: ***Humans are machines.***

ASSUMPTION 2: ***Since humans are machines, we can build a mechanical one.***

ASSUMPTION 3: ***Mechanical humans would have the full range of our mental abilities, including creativity.***

The assumptions that humans are machines, and therefore it is possible to build a mechanical human, which would then possess the entirety of human mental ability, relate to the nature of our brains, which we addressed in our foundational questions. If you don't think you are a machine, then this argument falls apart before it even gets going. The proposition that we are machines is absolutely critical here.

Many people find the idea that we are machines to be unsettling and even a bit offensive. Others, however, fully embrace it. Marvin Minsky, who was an AI researcher for over half a century and truly one of the giants in the field, often referred to humans as "meat machines." He meant it literally. Ray Kurzweil longs for the day he can back up his "mind file" onto a computer, to be restored if he has an untimely death. Stephen Hawking said it plainly: "I regard the brain as a computer which will stop working when its components fail. There is no heaven or afterlife for broken-down computers; that is a fairy story for people afraid of the dark." The list goes on and on. To many, this is the inescapable conclusion of a reductionist view of the world.

But if we are machines, can we build one? And if we did build one, would it be creative, and have a mind and a will of its own? We certainly don't know how to build one, nor do we even understand how it is that we are creative and have a mind. We don't know where ideas come from,

or how they are encoded in the brain. There is a broad range of human aptitudes that we don't understand at all. To be able to do everything a human can do, machines would need to acquire all of this. All these questions will come up again later in this book when we talk, in depth, about conscious computers.

ASSUMPTION 4: ***This conscious machine would want to do our dirty work; and,***

ASSUMPTION 5: ***Whether it is willing or not, we will compel it to, creating de facto mechanical slaves.***

Likewise, the assumptions a conscious machine would do our dirty work and that we would compel it to do so regardless of its will relate to what rights these mechanical beings may have. It could be that the minute you are able to build a robot assistant with true artificial intelligence, it might decide it would rather write poetry than iron your socks. Or maybe it would want to build *itself* a robot assistant to do the sock work.

ASSUMPTION 6: ***It would be economically practical to build such mechanical humans.***

It is not certain that it would be economically practical to build mechanical brains. The Human Brain Project, a European endeavor to build an AGI modeled on the structure of the human brain, has already spent a billion dollars toward this effort, and as of this writing, *Scientific American* reports that the project is currently "in disarray." The brain is, all agree, the most complex item we know of in the universe. A mechanical one may cost dramatically more than an iPad. Or it may not, for our experience is that prices of electronic devices fall rapidly, and that might well happen with respect to electronic brains. We just don't know. Some experts in AI believe that the computational power an AGI would need is quite small—less than what your smartphone has—if only we had the

software worked out. So a machine with AGI may not be particularly hard to build and, being mostly software, might cost just a few cents. That would sure be humbling. Or perhaps AGIs might be exceedingly expensive, but we would need to build only a few that we all share.

ASSUMPTION 7: ***Machines would become so inexpensive or efficient that they would be cheaper to deploy than human labor.***

ASSUMPTION 8: ***The programming cost to teach the machine a new skill plus the cost of running the machine will always be less than the labor costs of paying a human to do it.***

The assumptions machines will become so inexpensive or efficient that they'll be cheaper than human labor, and that the cost to program and run these machines will be less than the cost of paying a human to do the machine's job, both relate to the economic viability of using such machines to do low-cost labor. For all jobs to be lost, the costs of building, programming, and operating such machines will need to be less than the cost of employing a human in those jobs. It might be that the cost of developing machines to do obscure tasks will fall rapidly over time, or it might not. Andrew Ng, one of the industry's intellectual heavyweights, thinks this will happen:

> *There will be AI that gradually learns to do everything we do. And when a machine can do almost everything better than almost everyone, our social structure will begin to unravel. And that's something we need to prepare for.*

ASSUMPTION 9: ***Humans lack the ability to find other tasks that machines cannot do.***

The final assumption is that humans lack the ability to discover new jobs that can't be done by machines. For this to be the case, the min-

ute we invent a new job, a machine can be deployed to do it faster and cheaper than a human.

If all nine of these assumptions play out, then virtually all paid employment to humans will vanish and most institutions in society will have to be rethought. All manners of utopias and dystopias pop to mind when imagining life in such a world. If any one of these assumptions is not true, then the argument collapses. That being said, many regard all these assumptions as obvious if you begin with the idea that we are machines, that computers will continue to improve, and that the cost of building technology will continue to fall. Those three ideas taken together mean that sooner or later, the machines will surpass us in everything.

Possibility Two: The Machines Take Some of the Jobs

Possibility two is that the machines take some of the jobs, which results in long-term unemployment. If we recall our earlier foundational questions, this possibility might resonate with those who regard themselves as either animals or humans, as well as the dualists, who acknowledge that in addition to a physical world, there is a mental world or a spiritual world. It will also appeal to those who see their "self" as either an emergent property or their soul. All of these various beliefs have at their core the idea that there are substantial differences between humans and machines, and thus there are limits to what machines can do. But these beliefs also allow for a good deal of overlap between the capabilities of humans and machines.

The logic of the "some" position is straightforward, and is a narrative that will be familiar to many readers. It goes like this:

> Of course, job loss due to technology has existed in the past, but it was always offset by technologies creating new jobs. Now, however, times are different. How? First, the rate of innovation

is much faster, so jobs are eliminated much more quickly. Second, in the past, automation replaced only physical labor, but now we are dealing with the widespread automation of cognitive labor, which will destroy many previously untouched industries. And finally, the cost of automation technology is falling rapidly, meaning that a robot that cost $1 million in 2020 may cost only $1,000 in 2030.

The net of all of this is that we are about to experience job loss in a much more dramatic way than ever before. And it has been shown that the lower-paying a job is, the more prone it is to automation, generally speaking. This means that the lowest-skilled workers will lose their jobs first, and collectively, this group will be competing for fewer and fewer jobs.

While it is true that technology will create some new jobs, they will be relatively few in number, and they will require extensive education and training. Sure, you may open a factory to make order-taking robot kiosks for fast-food restaurants and create a few new high-wage jobs, but that factory can manufacture many thousands of those robots, destroying untold numbers of order-taking jobs. If technology is destroying vast numbers of low-skilled jobs but is creating only a few new high-skill jobs, we will be left with a shortage of low-skill jobs and a large number of permanently unemployed low-skilled workers. Hence, we are in a permanent Great Depression.

There are jobs that computers won't be doing, or at least won't for centuries. Priest, plumber, and policeman come to mind. There are real limits to what the machines can do. However, those limits are well above the requirements of many, many existing jobs.

Once you accept the idea that automation will do more and more low-skill jobs, you cannot escape the fact that this will result in too many low-skilled workers and too few low-skill jobs.

What do we say to this line of narrative? Let's explore the five assumptions behind it.

ASSUMPTION 1: ***Machines and technology cause a net loss of jobs.***

The accusation that technology is a net job destroyer been argued for a long time. In the 1580s, William Lee invented the stocking frame knitting machine. He pulled a few strings and arranged to give a demonstration of his device to Queen Elizabeth in the hopes of obtaining a royal patent. The queen thought the device cunning but remonstrated Lee, saying, "Consider thou what the invention could do to my poor subjects. It would assuredly bring to them ruin by depriving them of employment, thus making them beggars." Lee, in fact, had to leave England because of the anger of the hosiers.

As rapid manufacturing advances swept through the world in the next few centuries, every invention was greeted with anger and hostility from labor. French textile workers resisted the automated looms by throwing their wooden shoes into the machinery. In England, participants in the Swing Riots resisted automatic threshing machines by smashing them. Boatmen destroyed the first attempts at a steam engine, which they felt would put them out of work. So overwhelming was the protest against ribbon looms in Germany that they were ordered burned by the government. When the fly shuttle was invented to make weaving easier, its creator, John Kay, was attacked by a crowd. James Hargreaves, who created another breakthrough in textiles called the spinning jenny, saw his creation burned by yet another mob in England. John Heathcoat, who created technology to make the creation of lace more efficient, saw his entire factory and its equipment torched in broad daylight.

In 1811, this hostility toward automation coalesced into the Luddite movement, which consisted of a group of people violently opposed to technology that replaced skilled laborers. Taking as its namesake Ned Ludd, a youth who is said to have smashed two stocking looms, it at-

tracted hundreds of proponents who roamed the countryside burning factories and, in some places, killing the owners of the machinery.

One story from this time may show us a path forward. It happened on November 29, 1814. It was on this date that the *Times* of London was first printed using steam-powered printing presses. The pressmen vowed vengeance on the machine's inventor and destruction to the machine itself. However, they were told that if they refrained from violence, they would all be kept on at full pay until similar jobs could be found for them elsewhere. This seemed fair to the pressmen, and the march of progress continued.

These violent and destructive reactions are understandable. Most laborers of these times lived at or below the poverty line. Men and women spent their lives mastering a trade, and then just barely eked out a living. Economic opportunities were scant. The idea of competing with machinery and losing one's livelihood in the bargain seemed too horrific to contemplate. These workers must have thought that the wealthy factory owners had such an unquenchable desire for money that they would have eliminated the job of every worker if technology had allowed it. This may even have been true.

These extreme reactions are not in response to technology in general, but to laborsaving technology in specific. You don't read about the Great Air Conditioner Riots of '49 in history class for a simple reason: people don't riot over technological inventions that don't replace human labor.

This tendency to be hesitant of the consequences of new technology lives into the modern era as well. The Kodak camera was predicted to destroy art. Electricity was so widely feared that in 1891, President Benjamin Harrison had servants turn the lights on and off in the White House, because neither he nor his family would touch the switches. When car radios became widespread in the 1930s, it was argued that people would fiddle with them while driving, or even if they didn't, they would still get distracted and get into wrecks. Present concerns about GMOs, whether merited or not, are manifestations of this innate caution.

In addition to workers' practical concerns about automation, there

are ideological ones as well. Karl Marx voiced his belief that machines were at odds with workers by saying, "The instrument of labour, when it takes the form of a machine, immediately becomes a competitor of the workman himself.... History discloses no tragedy more horrible than the gradual extinction of the English hand-loom weavers." The idea of people competing with machines at the same activity just seems wrong to some.

If indeed laborsaving technology does result in a net loss of jobs, we are in for some trouble. AI makes new breakthroughs by the day. More patents in technology are awarded each year than in the prior one. In the United States, almost a thousand are issued every day. Additionally, each of the last few years has set a new record in the number of robots sold worldwide. Costs are down a quarter over the last decade, and they are expected to fall another quarter in the next decade, and all the while, robots are getting better in quality. There is no reason to think that any of those trends will change. Amazon already has fifteen thousand robots working in warehouses, gathering products and preparing them to be shipped. The number of robots at Amazon isn't likely to decline.

There is a certain simple logic to this concern about net job loss, and it goes like this: There are only so many jobs in the world. And if you give a job to a robot, then that's one less job for a human being.

But the interesting thing about this line of thought is how obviously untrue it is. Most jobs that have ever existed have been displaced by technology. In no particular order, I offer some examples: Most stableboys lost their jobs when the car was invented. Virtually every candlemaker got laid off when the kerosene lamp was fired up. In bowling, not that long ago, there were boys who stood the fallen pins back up, but they were replaced by, get this, robots. There were elevator operators until someone came along and invented that job-eating technology the button. At one time, there were boys who delivered telegrams, and then somebody had to upset that applecart and go and invent the telephone, putting all of them out of work. At one time, you could count on streetlamp lighters to come out at dusk and do their part to battle darkness, until someone went and invented electric lighting. There once

was an entire industry of people who delivered ice, until the advent of the electric refrigerator, which sent them all to the unemployment line. There used to be people who swept the streets clean with push brooms. Then they invented a vehicle to do it.

What happened to all these people who were displaced by technology? After all, you never hear stories of roving gangs of elevator operators unable to find work. The answer is obvious. All those people who saw their jobs eliminated went on to do different things. I don't mean to minimize how difficult these transitions are, but instead I point this out to highlight how extraordinary human beings are. Animals in nature can do only one set of things. Narrow AI, as I indicated earlier, can do only one thing. But our versatility borders on the infinite. The greatest underutilized resource in all of the world is human potential. And the more technology we can employ in our pursuits, the more we can do, and thus, generally speaking, the higher our wages will be.

Certainly we have seen technology reduce the need for workers in particular sectors. In just the twentieth century, agriculture went from being 40 percent of our jobs to 2 percent. And in just the back half of the twentieth century, manufacturing jobs went from 30 percent of our economy to 10 percent. In that century, we saw entire new professions created and then destroyed. The churn of jobs almost boggles the mind. Just mentally compare the workforce of 1900 with the workforce of 2000. I calculate that the half-life of a job in a modern economy is about fifty or so years. From 1900 to 1950, probably half the jobs vanished, mostly in farming. From 1950 to 2000, another half, many of which were manufacturing. And most, if not all, of this disruption was caused by technology. To believe that technology is a net destroyer of jobs, one must explain the fact that *all* this disruption happened during a period of full employment, rising gross national product, and rising wages. (The Great Depression, a decade that defies the trend, was not caused by technology, but rather by macroeconomic forces.)

But was the twentieth century in the United States anomalous? If we look beyond our own shores, one way to tackle the question is to

compare places with lots of robots to places without them. If robots do replace people, then we should see a decline in manufacturing jobs in places where more robots are put in use in manufacturing. But as Mark Muro and Scott Andes of the Brookings Institution write in the *Harvard Business Review*:

> *[There is] . . . no visible relationship between the use of robots and the change in manufacturing employment. Despite the installation of far more robots between 1993 and 2007, Germany lost just 19% of its manufacturing jobs between 1996 and 2012 compared to a 33% drop in the U.S.*

They then go on to point out that other countries, such as Italy, South Korea, and France, lost a smaller percentage of manufacturing jobs than did the United States even though they deployed more robots than the United States did. On the other end of the spectrum, other countries including the United Kingdom and Australia invested less than the United States in robots and had even bigger declines in manufacturing employment. The idea that robots would create manufacturing jobs and not destroy them is not as surprising as it might seem. When you can introduce efficiencies in an industry, you lower costs or increase quality. Lower costs and increased quality invite higher production, which creates jobs.

The truth is that technology mostly *augments* workers, not replaces them. The MIT economics professor David Autor argues that technology can't really do the vast majority of jobs.

> *Tasks that cannot be substituted by computerization are generally complemented by it. . . . Most work processes draw upon a multifaceted set of inputs: labor and capital; brains and brawn; creativity and rote repetition; technical mastery and intuitive judgment; perspiration and inspiration; adherence to rules and judicious application of discretion.*

He goes on to maintain that using technology to automate some part of a job almost always makes the tasks that the machine cannot do more valuable, because with technology, the value of the entire job goes up.

Lawrence Katz, a Harvard economist, echoes this view and maintains that history doesn't show any sort of net job loss due to technology. He told the *MIT Technology Review* that "we never have run out of jobs. There is no long-term trend of eliminating work for people. Over the long term, employment rates are fairly stable. People have always been able to create new jobs. People come up with new things to do."

Of course, in a few cases, new technology directly eliminates jobs. But history shows it creates offsetting ones as well. Sometimes this connection is hard to see. At the airport in Dusseldorf, robotic valet parking is now offered. You push a button and a giant machine lifts your car up and tucks it away in a vertical garage. There are new jobs—but they're not at the airport. They are at a factory making parking robots, employing people at wages presumably higher than a valet job. So this technology created new high-paying jobs.

What do we say about the kinds of jobs that the machines take, such as the valet job? Consider any job that can, in theory, be done by a machine. If you make a human being do that job, then that is literally "dehumanizing." There's nothing about that job that takes advantage of that person's being a human being. It's the worst possible work you can give anybody, to say, "You are just a stand-in until we build a machine to do this." The word "boredom" was invented only once we had factories. It was first used, in fact, in a Dickens novel, *Bleak House*. Factories are full of jobs that dehumanize people. That's why Dickens had to create a synonym for the result of unendingly repetitive and tedious work. Robots don't get bored, and frankly, humans deserve better. Clearly there are at least a billion people in the world who would love to have any job, even those jobs. The bottom billion live so close to starvation that any work is welcome. This much is obvious. But our long-term goal as a species should be to build machines to do those jobs so that people can do jobs that only people can do.

So the idea that technology is eliminating the need for workers seems a hard one to make. To get there, the "this time is different" assumption will need to be ironclad. We will get to that in a moment.

ASSUMPTION 2: ***Too many jobs will be destroyed too quickly.***

The "jobs will be destroyed too quickly" argument is an old one as well. In 1930, the economist John Maynard Keynes voiced it by saying, "We are being afflicted with a new disease . . . technological unemployment. This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour."

In 1978, *New Scientist* repeated the concern:

> *The relationship between technology and employment opportunities most commonly considered and discussed is, of course the tendency for technology to be labour-saving and thus eliminate employment opportunities—if not actual jobs.*

In 1995, the refrain was still the name. David F. Noble wrote in *Progress Without People*:

> *Computer-aided manufacturing, robotics, computer inventories, automated switchboards and tellers, telecommunication technologies—all have been used to displace and replace people, to enable employers to reduce labour costs, contract-out, relocate operations.*

But is it true now? Will new technology destroy the current jobs too quickly?

A number of studies have tried to answer this question directly. One of the very finest and certainly the most quoted was published in 2013 by Carl Benedikt Frey and Michael A. Osborne, both of Oxford University. The report, titled *The Future of Employment*, is seventy-two pages long,

but what has been referenced most frequently in the media is a single ten-word phrase: "about 47 percent of total US employment is at risk." Hey, who needs more than that? It made for juicy and salacious headlines, to be sure. It seemed as if every news source screamed a variant of "Half of US Jobs Will Be Taken by Computers in Twenty Years."

If we really are going to lose half our jobs in twenty years, well, then the *New York Times* should dust off the giant type it used back in 1969 when it printed "MEN WALK ON MOON" and report the story on the front page with equal emphasis. But that is not actually what Frey and Osborne wrote. Toward the end of the report, they provide a four-hundred-word description of some of the limitations of the study's methodology. They state that "we make no attempt to estimate how many jobs will actually be automated. The actual extent and pace of computerisation will depend on several additional factors which were left unaccounted for."

So what's with the 47 percent figure? What they said is that *some tasks* within 47 percent of jobs will be automated. Well, there is nothing terribly shocking about that at all. Pretty much every job there is has had tasks within it automated. But the job remains. It is just different.

For instance, Frey and Osborne give the following jobs a 65 percent or better chance of being computerized: social science research assistants, atmospheric and space scientists, and pharmacy aides. So what does this mean? Social science professors will no longer have research assistants? Of course they will. They will just do different things, because much of what they do today will be automated. There won't be any more space scientists? Pharmacists will no longer have anyone helping them?

Frey and Osborne say that the tasks of a barber have an 80 percent chance of being taken over by AI or robots. In their category of jobs with a 90 percent or higher chance of certain tasks being computerized are tour guides and carpenters' helpers.

The disconnect is clear: some of what a carpenter's helper does will get automated, but the carpenter helper job won't vanish; it will morph, as almost everyone else's job will, from architect to zoologist. Sure, your iPhone can be a tour guide, but that won't make tour guides vanish.

Anyone who took the time to read past the introduction to *The Future of Employment* saw this. And to be clear, Frey and Osborne were very up-front. They stated, in scholar-speak, the following:

> *We do not capture any within-occupation variation resulting from the computerisation of tasks that simply free-up time for human labour to perform other tasks.*

In response to the Frey and Osborne paper, the Organisation for Economic Co-operation and Development (OECD), an intergovernmental economic organization made up of nations committed to free markets and democracy, released a report in 2016 that directly counters it. In this report, entitled *The Risk of Automation for Jobs in OECD Countries*, the authors apply a "whole job" methodology and come up with the percent of jobs potentially lost to computerization as 9 percent. That is pretty normal churn for the economy.

At the end of 2015, McKinsey & Company published a report entitled *Four Fundamentals of Workplace Automation* that came to similar conclusions as the OECD. But again, it had a number too provocative for the media to resist sensationalizing. The report said, "The bottom line is that 45 percent of work activities could be automated using already demonstrated technology," which was predictably reported as variants of "45% of Jobs to Be Eliminated with Existing Technology." Often overlooked was the fuller explanation of the report's conclusion:

> *Our results to date suggest, first and foremost, that a focus on occupations is misleading. 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, much like the bank teller's job was redefined with the advent of ATMs.*

The "47 percent [or 45 percent] of jobs will vanish" interpretation doesn't even come close to passing the sniff test. Humans, even ones with little or no professional training, have incredible skills we hardly ever think about. Let's look closely at two of the jobs at the very top of Frey and Osborne's list: short-order cook and waiter. Both have 94 percent chance of being computerized.

Imagine you own a pizza restaurant that employs one cook and one waiter. A fast-talking door-to-door robot salesman manages to sell you two robots: one designed to make pizzas and one designed to take orders and deliver pizzas to tables. All you have to do is preload the food containers with the appropriate ingredients and head off to Bermuda. The robot waiter, who understands twenty languages, takes orders with amazing accuracy, and flawlessly handles special requests like "I want half this, half that" and "light on the sauce." The orders are sent to the pizza robot, who makes the pizza with speed and consistency.

Let's check in on these two robots on their first day of work and see how things are going:

- A patron spills his drink. The robots haven't been taught to clean up spills, since this is a surprisingly complicated task. The programmers knew this could happen, but the permutations of what could be spilled and where were too hard to deal with. They promised to include it in a future release, and in the meantime, to program the robot to show the customers where the cleaning supplies are kept.
- A little dog, one of those yip-yips, comes yipping in and the waiter robot trips and falls down. Having no mechanism to right itself, it invokes the "I have fallen and cannot get up" protocol, which repeats that phrase over and over with an escalating tone of desperation until someone helps it up. When asked about this problem, the programmers reply, snappishly, that "it's on the list."
- Maggots get in the shredded cheese. Maggoty pizza is served to the patrons. All the robot is trained to do with customers un-

happy with their orders is to remake their pizzas. More maggots. The robots don't even know what maggots are.

- A well-meaning pair of Boy Scouts pop in to ask if the pipe jutting out of the roof should be emitting smoke. They say they hadn't noticed it before. Should it be? How would the robot know?
- A not-well-meaning pair of boys come in and order a "pizza with no crust" to see if the robots would try to make it and ruin the oven. After that, they order a pizza with double crust and another one with twenty times the normal amount of sauce. Given that they are both wearing Richard Nixon masks, the usual protocol of taking photographs of troublesome patrons doesn't work and results only in a franchise-wide ban of Richard Nixon at affiliated restaurants.
- A patron begins choking on a pepperoni. Thinking he must be trying to order something, the robot keeps asking him to restate his request. The patron ends up dying right there at his table. After seeing no motion from him for half an hour, the robot repeatedly runs its "Sleeping Patron" protocol, which involves poking the customer and saying, "Excuse me, sir, please wake up" repeatedly.
- The fire marshal shows up, seeing the odd smoke from the pipe in the roof, which he hadn't noticed before. Upon discovering maggot-infested pizza and a dead patron being repeatedly poked by a robot, he shuts the whole place down. Meanwhile, you haven't even boarded your flight to Bermuda.

This scenario is, of course, just the beginning. The range of things the robot waiter and cook can't do is enough to provide sitcom material for ten seasons, with a couple of Christmas specials thrown in. The point is that those who think so-called low-skilled humans are easy targets for robot replacement haven't fully realized what a magnificently versatile thing any human being is and how our most advanced electronics are little more than glorified toaster ovens.

While it is clear that we will see ever-faster technological advances,

it is unlikely that they will be different enough in nature to buck our two-hundred-year run of plenty of jobs and rising wages. In one sense, no technology really compares to mechanization, electricity, or steam engines in impact on labor. And those were a huge win for both workers and the overall economy, even though they were incredibly disruptive.

ASSUMPTION 3: ***Not enough new jobs will be created quickly enough.***

The "we won't make new jobs fast enough" argument, you won't be surprised to hear, has been around for a while too. In 1961, *Time* magazine printed, "What worries many job experts more is that automation may prevent the economy from creating enough new jobs. . . . Today's new industries have comparatively few jobs for the unskilled or semiskilled, just the class of workers whose jobs are being eliminated by automation."

Is this a valid concern today? Will new jobs be slow in coming? I suspect not.

In 2016, the World Economic Forum in Davos, Switzerland, published a briefing paper that stated:

> *In many industries and countries, the most in-demand occupations or specialties did not exist 10 or even five years ago, and the pace of change is set to accelerate. By one popular estimate, 65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist.*

Think about that. By that estimate, two-thirds of kids entering school aren't going to exit as doctors, lawyers, architects, or *any* other profession that has a name today. They will be flummerflaves and wabberwocks and chort wranglers.

The two-thirds number may be too high. There is no way to know. But who would have ever thought that when you connected a bunch of computers together and allowed them to communicate using common protocols like http, it would create *trillions* of dollars of wealth in the

form of Google, Facebook, Twitter, Alibaba, Amazon, Baidu, eBay, Etsy, and all the rest? Who could have guessed that this seemingly simple act would transform the world and everything in it?

MIT's David Autor has this to say about those who believe we aren't going to come up with enough new jobs, thereby rendering people obsolete:

> *These self-proclaimed oracles are in effect saying, "If I can't think of what people will do for work in the future, then you, me and our kids aren't going to think of it either." I don't have the guts to take that bet against human ingenuity.*

The legendary entrepreneur and technologist Marc Andreessen agrees:

> *I do not believe robots will eat all the jobs. Here is why. For a start, robots and artificial intelligence are not nearly as powerful and sophisticated as some people fear. . . . And even when robots and artificial intelligence are far more powerful, decades from now, there will still be many things people can do that they cannot. . . . Just as most of us have jobs that were not even invented 100 years ago, the same will be true 100 years from now. We have no idea what those jobs will be, but I am certain there will be an enormous number of them.*

We have this sense that more jobs are being destroyed than created because the destruction of jobs is more obvious and easier to see. When Foxconn replaces sixty thousand human workers with robots in one factory, you can bet it makes the front page, and the editorial page as well. When Adidas builds a plant to make shoes solely with robots, the story goes viral. However, the real story is the second-order effects that these events cause. For instance, I often hear Google Translate touted as a prime example of a technology putting people out of work.

It used to be, the reasoning goes, you needed a person to translate a document. Now you don't. Case closed. However, that isn't the whole story, is it? What really happens is that this powerful technology enables cross-language business transactions to occur more seamlessly. More translators are needed because there are many more contracts and other documents that need the additional precision of a human translator. Additionally, the human translators will expand what they do, such as helping businesses understand cultural differences with the people they are dealing with. All of this is work that would simply not have existed without Google Translate. That's why by 2024, the US Bureau of Labor Statistics projects a 29 percent employment growth for interpreters and translators.

ASSUMPTION 4: ***Low-skilled workers will be the first to go.***

ASSUMPTION 5: ***There won't be enough jobs for these workers in the future.***

The assumptions that low-skilled workers will be the first to go and that there won't be enough jobs for them undoubtedly have some truth to them, but they require some qualification. Generally speaking, when scoring jobs for how likely they are to be replaced by automation, the lower the wage a job pays, the higher the chance it will be automated. The inference usually drawn from this phenomenon is that a low-wage job is a low-skill job.

This is not always the case. From a robot's point of view, which of these jobs requires more skill: a waiter or a highly trained radiologist who interprets CT scans? A waiter, hands down. It requires hundreds of skills, from spotting rancid meat to cleaning up baby vomit. But because we take all those things for granted, we don't think they are all that hard. To a robot, the radiologist job is by comparison a cakewalk. It is just data in, probabilities out.

This phenomenon is so well documented that it has a name, the Moravec paradox. Hans Moravec was among those who noted that it is

easier to do hard, brainy things with computers than "easy" things. It is easier to get a computer to beat a grandmaster at chess than it is to get one to tell the difference between a photo of a dog and one of a cat.

Waiters' jobs pay less than radiologists' jobs not because they require fewer skills, but because the skills needed to be a waiter are widely available, whereas comparatively few people have the uncommon ability to interpret CT scans.

What this means is that the effects of automation are not going to be overwhelmingly borne by low-wage earners. Order takers at fast-food places may be replaced by machines, but the people who clean up the restaurant at night won't be. The jobs that automation affects will be spread throughout the wage spectrum.

All that being said, there is a widespread concern that automation is destroying jobs at the "bottom" and creating new jobs at the "top." Automation, this logic goes, may be making new jobs at the top, like geneticist, but is destroying jobs at the bottom like warehouse worker. Doesn't this situation lead to a giant impoverished underclass locked out of gainful employment?

Often, the analysis you hear goes along these lines: "The new jobs are too complex for less-skilled workers. For instance, if a new robot replaces a warehouse worker, tomorrow the world will need one less warehouse worker. Even if the world also happened to need an additional geneticist, what are you doing to do? Will the warehouse worker have the time, money, and aptitude to train for the geneticist's job?"

No. The warehouse worker doesn't become the geneticist. What actually happens is this: A college biology professor becomes the new geneticist; a high-school biology teacher takes the college job; a substitute elementary teacher takes the high school job; and the unemployed warehouse worker becomes a substitute teacher. This is story of progress. When a new job is created at the top, everyone gets a promotion. The question is not "Can a warehouse worker become a geneticist" but "Can everyone do a job a little harder than the one they currently do?" If the answer to that is yes, which I emphatically believe, then we want all

new jobs to be created at the top, so that everyone gets a chance to move up a rung on the ladder of success.

Possibility Three: The Machines Take None of the Jobs

Possibility three is that the machines, on net, take none of the jobs and that we will remain at essentially full employment. Recalling our earlier foundational questions, those who identify with possibility three have many of the same assumptions as those who identify with possibility two. Dualists can readily identify with this view, as can those who see the "self" as either an emergent property or the soul, something that would be difficult to reproduce mechanically. Possibility three is based on the idea that humans are something different from animals and machines, and therefore they have skills that neither can duplicate.

The narrative of the third position goes like this:

Machines simply cannot take jobs for three reasons:

First, there exists a range of jobs that machines will not be able to do, jobs that we won't want them to do, and jobs that it isn't economical for them to do. Most jobs require dozens of skills like creativity and empathy that computers will never have, or at least not for centuries. While science fiction robots often have these skills, no one in his or her right mind looks at his or her smartphone and concludes that in a few years, it will be as intelligent as a human, and thus be able do any job a human can, from motivational speaker to ballerina. Computers have no agency, no presence. There is "no one at home." They run their ever-more-complicated programs and do wondrous things, but they are not the same type of thing as a human.

Second, for the sake of argument, let's say the first statement is wrong, and that computers can, in fact, do 80 percent of all of

the jobs out there. Even then, there still won't be any unemployment. There are an unlimited number of jobs, because any time people figure out how to sell a service they offer or a product they make, they just created a job. Therefore, technology actually empowers people to create more and better jobs.

The misconception that there is a fixed pool of jobs that the robots are going to pick off one by one has a name, the Lump of Labor Fallacy. But in reality, there will be unlimited jobs indefinitely, for they are created by the human mind, not by an outside force.

Third, even if robots did all the jobs and all the wages were distributed evenly among the population, making it so no one needed to work, most people would still choose to have a job of some kind.

Let's break the third position down and examine each of the three assumptions that support the argument:

ASSUMPTION 1: ***There are many jobs that machines will not ever be able to do.***

At this point, the assumption that there are many jobs that machines will never be able to do is just a hypothesis. All we can say with certainty right now is that presently there are jobs that machines cannot do. But what about the future? Since this question is the focus of parts three and four, we will save the discussion for then.

ASSUMPTION 2: ***There are, in effect, an infinite number of jobs.***

In 1940, only about 25 percent of women in the United States participated in the workforce. Just forty years later, that percentage was up to 50 percent. In that span of time, 33 million women entered the workforce. Where did those jobs come from? Of course, at the beginning of that period, many of these positions were wartime jobs, but women con-

tinued to pour into the labor force even after peace broke out. If you had been an economist in 1940 and you were told that 33 million women would be out looking for jobs by 1980, wouldn't you have predicted much higher unemployment and much lower wages, as many more people would be competing for the "same pool of jobs"?

As a thought experiment, imagine that in 1940 General Motors invented a robot with true artificial intelligence and that the company manufactured 33 million of them over forty years. Wouldn't there have been panic in the streets about the robots taking all the jobs?

But of course, unemployment never went up outside of the range of the normal economic ebb and flow. So what happened? Were 33 million men put out of work with the introduction of this large pool of labor? Did real wages fall as there was a race to bottom to fight for the available work? No. Employment and wages held steady.

Or imagine that in 2000, a great technological breakthrough happened and a company, Robot Inc., built an amazing AI robot that was as mentally and physically capable as a US worker. On the strength of its breakthrough, Robot Inc. raised venture capital and built 10 million of these robots and housed them in a giant robot city in the Midwest. You could hire the robots for a fraction of what it would cost to employ a US worker. Since 2000, all 10 million of these robots have been hired by US firms to save costs. Now, what effect would this have on the US economy? Well, we don't have to speculate, because the setup is identical to the practice of outsourcing jobs to other countries where wages are lower but educational levels are high. Ten million, in fact, is the lowest estimate of the number of jobs relocated offshore since 2000. And yet the unemployment rate in 2000 was 4.1 percent and in 2017 it is 4.9 percent. Real wages didn't decline over that period. Why didn't these 10 million "robots" tank wages and increase unemployment? Let's explore that question.

For the past two hundred years, the United States has had more or less full employment. Aside from the Great Depression, unemployment has moved between 3 and 10 percent that entire time. The number hasn't really trended upward or downward over time. The US unemployment

rate in 1850 was 3 percent; in 1900 it was 6.1 percent; and in 1950 it was 5.3 percent.

Now picture a giant scale, one of those old-timey ones that Justice is always depicted holding: on one side of the scale you have all the industries that get eliminated or reduced by technology. The candlemakers, the stableboys, the telegraph operators. On the other side of the scale you have all the new industries. The Web designers, the geneticists, the pet psychologists, the social media managers.

Why don't those two sides of the scale ever get way out of sync? If the number of jobs available is a thing that ebbs and flows on its own due to technological breakthroughs and offshoring and other independent factors, then why haven't we ever had periods when there were millions and millions *more* jobs than there were people to fill them? Or why haven't we had periods when there were millions and millions fewer jobs than people to fill them? In other words, how does the unemployment rate stay in such a narrow band? When it has moved to either end, it was generally because of macro factors of the economy, not an invention of something that suddenly created or destroyed 5 million jobs. Shouldn't the invention of the handheld calculator have put a whole bunch of people out of work? Or the invention of the assembly line, for that matter? Shouldn't that have capsized the job market?

A simple thought experiment explains why unemployment stays relatively fixed: Let's say tomorrow there are five big technological breakthroughs, each of which eliminates some jobs and saves you, the consumer, some money. They are:

- A new nanotech spray comes to market that costs only a few cents and eliminates ever needing to dry-clean your clothes. This saves the average American household $550 a year. All dry cleaners are put out of business.
- A crowdfunded start-up releases a device that plugs into a normal wall outlet and converts food scraps into electricity. "Scraptricity" becomes everyone's new favorite green energy craze, saving

the average family $100 a year off their electric bill. Layoffs in the traditional energy sector soon follow.

- A Detroit start-up releases an AI computer controller for automakers that increases the fuel efficiency of cars by 10 percent. This saves the average American family $200 of the $2,000 they spend annually on gas. Job losses occur at gas stations and refineries.
- A top-secret start-up releases a smartphone attachment you breathe into. It can tell the difference between colds and flu, as well as viral and bacterial infections. Plus, it can identify strep throat. Hugely successful, this attachment saves the average American family one doctor visit a year, which, given their co-pay, saves them $75. Job losses occur at walk-in clinics around the country.
- Finally, high-quality AA and AAA batteries are released that can recharge themselves by being left in the sun for an hour. Hailed as an ecological breakthrough, the batteries instantly displace the disposable battery market. The average American family saves $75 a year that they would have spent on throwaway batteries. Job losses occur at battery factories around the world.

That is what tech disruption looks like. We have seen thousands of such events happen in just the last few years. We buy fewer DVDs and spend that money on digital streaming. The number of digital cameras we are buying is falling by double digits every year, but we spend that money on smartphones instead. The amount being spent on ads in printed phone directories is falling by $1 billion a year in the United States. Businesses are spending that money elsewhere. We purchase fewer fax machines, newspapers, GPS devices, wristwatches, wall clocks, dictionaries, and encyclopedias. When we travel, we spend less on postcards. We buy fewer photo albums and less stationery. We mail less mail and write fewer checks. When is the last time you dropped a quarter in pay phone or dialed directory assistance or paid for a long-distance phone call?

In our hypothetical case above, if you add up what our technological breakthroughs save our hypothetical family, it is $1,000 a year. But in that scenario, what happens to all those dry cleaners, coal workers, gas station operators, nurses, and battery makers? Well, sadly, they lost their jobs and must look for new work. What will fund the new jobs for these folks? Where will the money come from to pay them? Well, what do you think the average American family does with the $1,000 a year they now have? Simple: They spend it. They hire yoga instructors, have new flower beds put in, take up windsurfing, and purchase puppies, causing job growth in all those industries. Think of the power of $1,000 a year multiplied by the 100 million households in the United States. That is $100,000,000,000 ($100 billion) of new spending into the economy every year. Assuming a $50,000 wage, that is enough money to fund the yearly salaries of 2 million full-time people, including our newly unemployed dry cleaners and battery bakers. Changing careers is a rough transition for them, to be sure, and one that society could collectively do a much better job facilitating, but the story generally ends well for them.

This is how free economies work, and why we have never run out of jobs due to automation. There are not a fixed number of jobs that automation steals one by one, resulting in progressively more unemployment. That simply isn't how the economy works. There are as many jobs in the world as there are buyers and sellers of labor.

Additionally, most technological advances don't eliminate entire jobs all at once per se, but only certain parts of jobs. And they create new jobs in entirely unexpected ways. When ATMs came out, most people assumed they would eliminate the need for bank tellers. Everyone knew what the letters ATM stood for, after all. But what really happened? Well, of course, you would always need *some* tellers to deal with customers wanting more than to make a deposit or get cash. So instead of a branch having four tellers and no machines, they could have two tellers and two ATMs. Then, seeing that branches were now cheaper to operate, banks realized they could open more of them as a competitive advantage, and

guess what? They needed to hire more tellers. That's why there are more human bank tellers employed today than any other time in history. But there are now also ATM manufacturing jobs, ATM repair jobs, and ATM refilling jobs. Who would have thought that when you made a robot bank teller, you would need *more* human ones?

The problem, as stated earlier, is that the "job loss" side of the equation is the easiest to see. Watching every dry cleaner on the planet get shuttered would look like a tragedy. And to the people involved, it would be one. But, from a larger point of view, it wouldn't be one at all. Who thinks it is a bad idea to have clothes that don't get dirty? If clothes had always resisted dirt, who would lobby to pass a law that requires that all clothes could get dirty so that we could create all the dry cleaning jobs? Batteries that die and cars that run inefficiently and unnecessary trips to the doctor and wasted energy are all negative things, *even if they make jobs.* If you don't think so, then we should repeal littering laws and encourage people to throw trash out their car windows to make new highway cleanup jobs.

So this is why we have never run out of jobs, and why unemployment stays relatively constant. Every time technology saves us money, we spend the money elsewhere! But is it possible that the future will be different? Some argue that there are new economic forces at play. It goes like this: "Imagine a world with two companies: Robotco and Humanco. Robotco makes, in a factory with no employees, a popular consumer gadget that sells for $100. Meanwhile, Humanco makes a different gadget that also costs $100, but it is made in a factory full of people.

"What happens if Robotco's gadget becomes wildly successful? Robotco sees its corporate profits shoot through the roof. Meanwhile, Humanco flounders, because no one is buying its product. It is forced to lay off its human staff. Now these humans don't have any money to buy anything while Robotco sits on an ever-growing mountain of cash. The situation devolves until everyone is unemployed and Robotco has all the money in the world."

Some say this is happening in the United States right now. Corporate

profits are high and those profits are distributed to the rich, while wages are stagnant. The big new companies of today, like Facebook and Google, have huge earnings and few employees, unlike the big companies of old, like durable-goods manufacturers, which typically needed large workforces.

There is undoubtedly some truth in this view of the world. Gains in productivity created by technology don't necessarily make it into the pockets of the increasingly productive worker. Instead, they are often returned to shareholders. There are ways to mitigate this flow of capital, which we will address in the chapter about income inequality, but this should not be seen as a fatal flaw of technology or our economy, but rather something that needs addressing head-on by society at large.

Further, Robotco's immense profits probably don't just sit in some Scrooge McDuck kind of vault in which the executives have pillow fights using pillows stuffed with hundred-dollar bills. Instead, they are put to productive use and are in turn lent out to people to start businesses and build houses, creating more jobs. An economy with *no* corporate profits and everything paid out in wages is as dysfunctional as the reverse case we just explored.

ASSUMPTION 3: ***We would work anyway.***

The "we would work anyway" argument begins with a question that you have probably mulled before. It goes like this: "We have invented all kinds of productivity tools that save us time. For instance, it used to be that when you typed a memo, a single error was a pain that took several seconds to correct. Then we invented word processors and the back button. With the Internet, research tasks that used to take days now just take minutes, or even seconds. In a thousand different ways, we have made our workplaces vastly more efficient. So the question is, Why do we still work forty hours a week. Why not fifteen?"

I offer up fifteen hours in particular because of a famous prediction made by the economist John Maynard Keynes in a 1930 essay called

"Economic Possibilities for Our Grandchildren." In the essay, Keynes points out that for thousands of years, up until 1700, there was no real change in humans' standard of living. He attributed this to the lack of technical advance and the failure of capital to accumulate. He then makes the case that at the beginning of the eighteenth century, a spate of technological progress and an infusion of cash came together and created the modern economy, bringing with it the magic of compounding interest and compounding economic growth.

He goes on to say that he expects the standard of living to rise by four to eight times by 2030. On this point, he was right. We are on track to hit the upper end of his projection. Based on this assessment, Keynes makes a startling prediction: He says that while human want may be insatiable, human needs are essentially fixed. And given that we will have so much more money than we need to maintain life, he believes we will "prefer to devote our further energies to non-economic purposes."

He speculates that because solving "the economic problem" has occupied humanity for millennia, when we finally do eliminate the need for much work, we may face some problems. First, we may continue to work just out of habit. And second, because we have worked so hard for so long, we may not find happiness or meaning in leisure. He says:

> *Thus for the first time since his creation man will be faced with his real, his permanent problem [of] how to use his freedom from pressing economic cares, how to occupy the leisure, which science and compound interest will have won for him, to live wisely and agreeably and well.*

Keynes refers to the rich as "our advanced guard . . . who are spying out the promised land for the rest of us" and suggests we look at them as examples of what we might do when freed from want. He is less than impressed with the idleness of the rich.

Keynes therefore suggests that a fifteen-hour workweek might be the answer, instead of the forty-hour one Henry Ford favored. He sug-

gests that within a century, working fifteen hours a week would satisfy all our material needs and a few of our wants. He then goes on to express contempt for those who would still be workaholics in such a world:

> *Of course there will still be many people with intense, unsatisfied purposiveness who will blindly pursue wealth—unless they can find some plausible substitute. But the rest of us will no longer be under any obligation to applaud and encourage them.*

So what do we say to Keynes? Why aren't we working fifteen-hour weeks as we approach his economic Shangri-la?

Could you get by working fifteen hours a week? Let's say you currently make $60,000. Cutting your workweek by 60 percent, you might therefore make $24,000. Could you live on that? Probably, but you would have to live in a five-hundred-square foot dwelling, never eat out, make your meals at home from staples, and not run the air conditioning. In fact, that's exactly how the middle class lived in 1930: five hundred square feet, no eating out, no AC. So, yes, you could have the same standard of living as someone in 1930 by working just fifteen hours a week. Plus, being that it is modernity, you would have the advantage of having the Internet and not having rubella.

How does this look for someone a bit further down the economic totem pole? Let's say you make $30,000 now, or $15 an hour. After deciding to work a Keynesian workweek, you see your income drop to $12,000. Could you live on that? Again, if you are willing to live the life of someone in that same economic stratum in 1930: you would grow most of your own food, sew your own clothes, and live outside a city on a small plot of land.

The truth of the matter is simple: We have decided that we would rather work more hours and purchase more of the "wants" we have in life. We have opted to collectively stay late at the office instead of growing and peeling our own potatoes. We all want a higher standard of

living—and that desire is what creates most of the jobs. As long as you want more income, you will likely find a way to use your skills to add value *somewhere*, and that action is what creates a job.

Don't get me wrong. I am emphatically not saying that the working poor today are living the life of Riley and could do just fine on even less than they presently have. Not at all. Being a low-income worker in 1930 was a bitterly hard life. Forget about going to the doctor when you are sick. Forget about higher education. Forget about ever taking vacations, ever having disposable income, ever truly getting ahead. Plan on a lower life expectancy. The whole point is that since Keynes wrote, our standard of living and our expectations of a "normal" life have risen dramatically, as well they should. They should continue to rise, and we should work to make sure that this rising tide truly raises all ships.

I am saying something simple: Strictly speaking, we could, technically, survive by working less. We choose not to and instead to enjoy an ever-rising standard of living. That's where Keynes missed his mark just a bit. What were once luxuries we now consider necessities, and there is no reason to think that trend will somehow reverse.

What is the takeaway here? Even when we can all live a 1930 economic life by working five hours a week or one hour a week or no hours a week, we all will still work forty or so hours a week. You could snap your fingers and magically replace every job on the planet with a robot, pay everyone the same wage, and the next day, people would create new jobs to get more money to live a still higher standard of living.

If in 2047 we can all live a 2017 economic life by working fifteen hours a week, how many hours do you think we will work? I suspect forty or more. The economic life of 2017 is going to look pretty hard by 2047 standards. Summing up life back in 2017, someone in the future might say:

> *What, 2017? Well, that was back when people had to look at the prices of items before they bought them to see if they could afford them. Doctors would tell you the cost of medical procedures you needed because maybe you didn't have the money to buy them, or*

insurance to cover them. Almost everyone still did their own housework, drove their own car, weeded their own garden. They lived in tiny houses that sat on the ground like the dens of animals. Sometimes rats and roaches and fleas came into their homes. Their windows were clear glass, and no matter how ugly it was outside, they didn't have hologlass that could give everyone an ocean view. And the food they ate! They had no idea where it came from or what had been sprayed on it. They ate the flesh of real animals, and even the coarse bits they would grind up into a dish called "sausage" whose entire purpose was to disguise the origin of the meat. They couldn't order up custom-manufactured food to the exact taste and texture that they loved the most. They just put random food in their mouths and hoped they liked it and it didn't give them a heart attack or something called cancer. Oh, and if they had a headache, they took the same exact pill everyone else on the planet took, with no regard for their own genome. Most of time if the headache went away, it was just dumb luck. Oh, and get this: At work, they typed on . . . a keyboard! With their fingers! It was an age of stone knives and bearskins.

"No," your 2047 self will likely say, "I will stay late at the fusion reactor so I don't have to live that way."

Will we eventually have enough? Someday, will we enjoy such a high standard of living that we finally clock out of our job at noon? The economist Milton Friedman would probably have said no, for he believed human wants and needs are infinite. On the other hand, it is true that as electricity and appliances made our domestic duties much easier, we used our newfound time on leisure and hobbies, not on making more money. Because I don't have to cut the grass with a scythe or haul up water from the well, I do photography or write instead. So we aren't purely driven by the need to have ever more.

Why don't we work less? Keynes, it seems, saw a few answers. According to him, it could be that our inability to collectively chill is a

memory of poorer times, and it will take several generations for us to adapt to being part of the leisure class. Or maybe "keeping up with the Joneses" is so deeply ingrained in us that we can never rest. As long as we can see their brand-new flying car from our window as we eat our breakfast, we may never be willing to take a day off. Or perhaps permanent leisure is corrupting in some way and we thus have a deep internal abhorrence of it and its temptations. Or it could be that we haven't figured out how to get satisfaction from work when we don't have the yardstick of money to tell us how much worth to place on it. Or, most unsettling of all, maybe we are the greedy materialists whom Keynes says "love money as a possession, as distinguished from [loving it] as a means to the enjoyments . . . of life," a condition he identifies as a "semi-criminal, semi-pathological . . . mental disease."

Keynes himself died of overwork, so even he might have been a bit conflicted on the point.

To offer another interpretation, perhaps we are driven toward perpetual progress by our mild discontent with the present. No matter how good things may be, we can always picture them a little better, and the drive to relentlessly move forward and upward is our distinctive characteristic. Maybe we aren't so much *Homo sapiens*, the reasoning man, as we are *Homo dissatisfactus*.

Let's now explore the implications of these three possibilities. What does the future look like under each one?